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Minimal Access Surgery in Cesarean Scar Pregnancy: Challenges, Outcome and Road Ahead

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Abstract

Introduction: The incidence of cesarean scar pregnancies (CSPs) has increased worldwide due to increase in cesarean deliveries. Laparoscopic management is an effective strategy to deal with CSP resulting in immediate recovery, remediation, and repair of the cesarean scar defect. The diagnosis and management of CSP are challenging, and awareness of this condition is needed among the patients and obstetricians.

Aims and objectives: To study preventable factors, role of minimal access surgery, and outcome in CSPs over a period of 2 years.

Materials and methods: It is a retrospective cohort study in which patient's demographic characteristics, previous obstetric and surgical record, β-hCG, USG parameters, clinical presentation, contraception, etc., were studied.

Results: Eleven cases of CSPs were admitted in a tertiary care hospital from 2019 to 2021. Median maternal age was 28 years with a median parity of two. The most common presenting symptom was vaginal bleeding. Nine out of eleven cases were successfully managed by laparoscopy. Hysteroscopy and ultrasonography were found very useful intraoperatively. Two patients required exploratory laparotomy. One patient had an intrauterine pregnancy following the CSP.

Conclusion: Minimal access surgery remains the mainstay for the treatment of CSP in stable patients. Hysteroscopy and ultrasonography could be very useful during laparoscopic management of CSP. Cesarean scar pregnancy preventable factors are to be taken into consideration while performing cesarean section as the CSP incidence is increasing.

Clinical significance: This study will help in finding out risk factors to CSP. Preventive factors of CSP, if studied further in detail, can help in reducing the incidence of this dreadful pathology. Early diagnosis and timely intervention with the help of minimal access surgery can save young women from losing their fertility.

Keywords: Cesarean scar pregnancy, Hysteroscopy, Laparoscopy minimal access surgery.

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Introduction

Cesarean scar pregnancy (CSP) is a rare type of ectopic pregnancy where the embryo implants at the site of previous cesarean scar. The reported incidence of CSP is ~1:1800–1:2216.[1,2] It is of two types endogenous and exogenous. When pregnancy grows toward the uterine cavity, it is called as endogenous CSP, and when pregnancy grows toward the bladder, it is known as exogenous CSP. The risks and complications associated with this condition are severe in nature, those are ruptured uterus, massive hemorrhage, bladder involvement, etc. Continuation of pregnancy further may lead to morbidly adherent placenta and life-threatening complications.[3]

The incidence of cesarean section has increased worldwide due to various reasons, and so the incidence of CSP has increased significantly in the past decade. This is just a tip of an iceberg raising alarm worldwide. Various conservative and surgical methods have been tried till date, but the standard protocol for management of CSP is yet to be formed.[4]

Advanced minimal access surgery inclusive of laparoscopy and hysteroscopy has provided a ray of hope in the successful management of CSP with less morbidity and quick recovery. Preventable factors, early diagnosis, skills of minimal invasive surgery, and guidelines need to be formed to counter this dreadful condition on priority basis.

Currently, knowledge on the exact etiological factors for CSP is limited though multiple theories have been put forth. Wound healing due to multiple factors like infection, anemia, misalignment, etc., causes cesarean scar defect in the anterior wall of the lower uterine segment.[5–7]

Insufficient decidualization enhances the process of implantation through defective scar site causing invasion through myometrium. Quality of suture material, techniques of suturing, and surgical sterility play an important role in repair at scar site. Various other factors like total number of cesarean sections, dilatation and curettage procedures, short intervals between the present and last pregnancy, cesarean section during labor, planned elective cesarean sections, etc., have been correlated with a higher risk of CSP by different authors.[8] Various conservative and surgical modalities have been tried while managing CSP with limited success. Since the management part has not been clear among the

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treating clinician, it poses a great threat to the patient's life. This study has been planned to evaluate the laparoscopic management of CSP and its outcome with the aims and objective to study the efficacy and outcome of laparoscopic management of CSP and to study the demographic characteristics and various etiological factors leading to CSP.

Materials and Methods

This was a retrospective study. It was conducted in the Department of Obstetrics and Gynecology at a tertiary healthcare center over a period of 2 years. Patients with diagnosed CSP were included in the study after satisfying inclusion and exclusion criteria.

CSEP diagnostic criteria advocated on USG.

- Empty uterus with clearly visualized endometrium.[9]
- Empty cervical canal.[9]
- Gestational sac implanted in the lower anterior uterine segment at the presumed site of cesarean section incision site.[10]
- Thin or absent myometrium between the gestational sac and the bladder.[11]
- Doppler flow at the previous caesarean scar and negative-sliding organ sign.[12,13]

Inclusion Criteria

- Patients with a history of at least one previous CS with β-hCG >5000 IU.
- Diagnosed case of CSP on ultrasonography.
- Consented for laparoscopic management.
- Desirous of future pregnancy.
- Gestational age <12 weeks.

Exclusion Criteria

- Chronic medical disorder for which patients were not fit for the laparoscopic surgery.
- Patient willing for conservative medical management.

Routine history, including demographic characteristics, presenting complaints, etc., was recorded in an approved proforma. Routine blood investigations and serum β-hCG levels were noted. Gestational age on USG was recorded. Diagnosis inferred from the above investigations was analyzed in the study. Surgical management was carried out as per the multimodality approach, i.e., use of minimal access surgery, hysteroscopy, laparoscopy, and cystoscopy along with ultrasonography. The defective scar was excised, and the underlying uterine wall repair was done with intracorporeal suturing.

Maternal outcomes in the form of successful laparoscopic management, repair of organs like bladder, bowel, ureter, hemorrhage requiring blood transfusion, ICU management, follow-up clinical examination, onset of regular menstrual cycles, and future pregnancy outcome were recorded.

Results

All the patients enrolled in the study underwent laparoscopic management of CSP. The average age of the patients in the study was 28 years. Nine patients had undergone one cesarean section in the past. Nine patients presented with anemia with Hb <10 gm/dL. Six patients presented with gestational age less than 7 weeks, while five patients presented after 8 weeks of gestation. Nine patients presented with β-hCG >10000 IU. Patients with CSP were admitted with complaints of vaginal bleeding or pain in the abdomen, but the majority of them (54.5%) presented with no symptoms on admission. A total of seven patients provided a history of dilatation and curettage (D&C) for termination of pregnancy in the past. Five patients had undergone D&C after cesarean section (Table 1).

Table 1: Patients with history of previous cesarean section and D&C

Procedure	*Number of patients*
LSCS-1	9
LSCS-2	2
D&C before LSCS	2
D&C after LSCS	5

Table 2: Duration between previous cesarean section and current pregnancy (years)

Time elapsed since last LSCS	*Number of patients*
12—18 weeks	3
18—24 weeks	3
>24 weeks	5

Table 3: Cesarean section—emergency during labor/elective

LSCS	*Frequency*	*Percent (%)*
Emergency LSCS during labor	3	27.27
Elective LSCS (not in labor)	8	72.72

Eight patients had a history of elective cesarean section in the past. All the patients were not aware of the importance of birth spacing after cesarean section, and hence the contraceptives were not used regularly by them. Six patients conceived within 24 months of the last cesarean section (Table 2).

In our study, nine (81%) patients underwent cesarean section electively at term in the past (Table 3).

Seven patients required blood transfusion during surgery, while two patients had undergone exploratory laparotomy for bladder repair. Both these patients presented with gestational age of more than 10 weeks with higher β-hCG levels and significant-size CSP on admission. These two patients were managed in the surgical ICU for 2 days. Overall, nine patients were managed successfully through laparoscopic surgery. The average blood loss noted was 100–300 mL, and surgery duration was 90–120 minutes. Only one patient produced a discharge summary or surgical notes of the previous cesarean section, so details of the surgical procedure, the patient's recovery, and instructions on discharge could not be retrieved for rest of the patients. Overall, nine (81.8%) patients were successfully managed by minimal access surgery. One patient conceived spontaneously after 2 years of laparoscopic management of CSP.

Discussion

Mean age of the patients presented with CSP in our study was 28 years, which is comparable with the results conducted by Xiao et al. The mean age in their study was 30.7 ± 3.4 years.[14] It shows that young women were at risk of losing their fertility. Chuang et al.[15] argued that the number of previous cesarean sections does not appear to be a factor for CSP. In our study, nine patients of diagnosed CSP had a history of one cesarean section in the past.

Nine patients were found anemic on admission (Hb <10 gm/dL). Chen et al.,[16] in their study concluded that anemia and single-layer

uterine closure might contribute to the occurrence of cesarean scar defects.[17] Anemia leads to predisposition of infections and poor wound healing.

The study conducted by Xiao et al. presented data on symptoms and signs of the patients presented with CSP. About 34.50% of CSP patients experienced vaginal bleeding, 3.40% had pain in the abdomen, 11.30% had bleeding and pain, and 38.10% were asymptomatic.[14] In our study, 54.5% patients were asymptomatic on admission which also elaborates the importance of early diagnosis of CSP.

Luo et al.[18] reported that short intervals between the present and the last pregnancy were correlated with a higher risk of CSP. In our study, six patients presented with CSP had a short interval of less than 24 months from the last pregnancy. It also suggests that patients were unaware of the importance of birth spacing measures, specifically after cesarean section.

Dilatation and curettage procedure is also an additive factor for weakening of the scar, as shown by a study conducted by Shinagawa and Nagayama[19] and Luo et al.[18] In our study, seven patients of CSP had a history of dilatation and curettage procedure for termination of pregnancy.

Shi et al.[20] suggested that elective cesarean section performed before the first stage of labor in an undeveloped lower uterine segment affects wound healing. In our study, nine (81%) patients underwent cesarean section electively at term in the past.

Lin et al.[21] and Bodur et al.[22] in their studies concluded that failure rates for systemic MTX were 57% and 45%, respectively, while Lin et al.[21] concluded that laparoscopic management of CSP was associated with a high success rate (95.5–97.1%).

Drever et al.[23] concluded that patients who receive systemic MTX therapy carried 22–33% risk of future accreta, which is extremely high and raises significant concern.

In our study, nine (81%) patients were managed successfully through laparoscopy with no major complications. Laparoscopic complete excision and strengthening of the scar defect rules out the possibility of the future accreta. Patients were disease-free at the end of the surgery, so frequent follow-ups and prolonged hospitalization were not mandatory.

Conclusion

- Laparoscopic management of CSP with multimodality approach has high success rate with minimal complications.
- Early diagnosis helps to avoid serious complications.
- Women of child-bearing age should be counseled on planned pregnancies and adequate birth spacing.
- Due to limited number of cases, further research is recommended in management of CSP with minimal access surgery.

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ORIGINAL ARTICLE

Rouviere's Sulcus: Anatomy and its Clinical Significance in Laparoscopic Cholecystectomy

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Abstract

Background: Laparoscopic cholecystectomy (LC) is associated with an increased rate of bile duct injuries than open cholecystectomy (OC). Majority of the bile duct injuries result from structural misidentification. The surgeon needs some anatomical landmarks to guide him for a safe cholecystectomy. Rouviere sulcus (RVS) is one such landmark. M Henri Rouviere first described it in 1924, but it was forgotten and neglected. It is not mentioned in anatomy or surgery textbooks. Its importance was recognized only in the late 1990s with the acceptance of LC as gold standard surgery. As there is paucity of the literature on RVS, a study was conducted on RVS.

Materials and methods: A prospective study of RVS was conducted in 130 cases of LC noting the presence, morphology, and use of the RVS in safe LC.

Results: Rouviere sulcus was present in 81.5% of cases. Open type sulcus with a horizontal direction was the most common presenting type. Rouviere sulcus is an extrabiliary landmark in a solid organ, liver, which is not affected by the gallbladder disease or retraction. It is well visualized in laparoscopic surgery than the open cholecystectomy due to opening of the sulcus by CO_2 pressure and magnification of digital cameras. The cystic duct and artery lie in a safe zone ventral and anterior to the plane of RVS and the common bile duct (CBD) lies below it. Rouviere sulcus indicates a safe plane of dissection for surgeon to avoid bile duct injuries.

Conclusion: Rouviere sulcus is an important and first landmark that a surgeon must look to achieve the safe cholecystectomy and minimize bile duct injuries.

Keywords: Bile duct injury, Common bile duct, Critical view of safety, Gallbladder, Laparoscopic cholecystectomy, Open cholecystectomy, Rouviere sulcus.

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Introduction

M Henri Rouviere, a French surgeon, first described Rouviere sulcus (RVS) in 1924. He noticed a 2–5 cm long fissure running transversely between caudate process and right lobe of the liver.[1] He described it as "Silon du processus caude." Somehow RVS was forgotten and there was no mention of it in the anatomy or surgery books. Majority of the data on RVS have come from the works of Reynaud, Gans, and Couinaud on the liver anatomy.[2] In 1955, Gans in his doctoral thesis described RVS as an extension of porta hepatis but he did not elaborate on it.[3] Gans incisura, incisura hepatica dextra were other names for RVS. The present name "Rouviere's sulcus" was suggested by the French hepatobiliary surgeon Claude Couinaud. Now the name RVS is internationally accepted. With the increasing popularity of laparoscopic cholecystectomy (LC), the surgical importance of RVS is well recognized in recent times. Rouviere sulcus accurately determines the plane of the common bile duct (CBD). The cystic duct and artery lie above and ventral to it, whereas CBD lies below to it. This was confirmed by intra-operative cholangiogram. Rouviere sulcus is visible more clearly during LC than the open cholecystectomy (OC). There is a wide opening of sulcus due to CO_2 pressure and magnified view of RVS with digital cameras and lighting.[4] Hugh et al. were the first to recognize the importance of RVS in LC as it shows the correct plane of CBD.[5] They demonstrated the lowest rate of bile duct injury (BDI) by dissecting the Calot's triangle above the RVS. Peti and Moser described RVS as a lesser known but important landmark for successful completion of LC and to avoid BDI.[6] Rouviere sulcus is an extrabiliary landmark in the solid organ liver. It is not affected by diseases or retraction of the gallbladder. It is also an important landmark for right hepatectomy.

Rouviere sulcus shows wide anatomical variations. It is present in majority of cases ranging from 68 (Zubiar et al., 2009) to 82%.[2] Absent RVS is noted in 10–30% cases in the literature. Length of RVS varies from 1 to 5 cm with an average of 3 cm. Width vary from 0.5 to 2 cm averaging 1.1 cm. Depth varies from 0.5 to 2 cm with an average of 1.1 cm.[2] The position of RVS is either horizontal, oblique, or vertical. The horizontal lie is most common and vertical type is least common.[2] Dahmane et al.[7] demonstrated 97% oblique in their

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dissection of cadaveric livers. Rouviere sulcus is classified as (1) open, (2) closed, (3) slit, and (4) scar. *Open sulcus* is continuous with the porta hepatis at its medial end and has measurable dimensions of length, breadth, and depth. Branches of right hepatic pedicle are visible in it. *Closed sulcus* has a closed medial end and partly visible right hepatic pedicle. Length, breadth, and depth can be measured. *Slit sulcus* is a shallow sulcus with no visible right hepatic pedicle. Only length can be measured. The breadth and depth are barely measurable. *Scar sulcus* appears as a white scar that is completely fused. Some authors combine both open and closed sulci together as deep sulcus.[2] Rouviere sulcus contains right portal pedicle or its branches. It contains right posterior sectoral pedicle in 70% cases. The vein to segment VI, anterior sectoral pedicle, or cystic vein is seen in 25%, 5%, and 18% of cases, respectively.[8] Majority of knowledge on RVS comes from the works of Dahmane et al.[7] on cadaveric livers. The surgical importance of RVS—the cystic duct and the artery lie above the plane of RVS and the CBD lies below it, making RVS is an established anatomical landmark for a safe cholecystectomy. In LC it is easy to see the sulcus when gallbladder is pulled medially toward umbilical fissure. Hugh et al.[5] stressed that during LC, the RVS is the first landmark from where the dissection of the Calot's triangle should start. Peti and Moser[6] also stressed the same for conduct of safe cholecystectomy and to avoid BDI. The importance of RVS is also stressed in the Tokyo guidelines (2018) for management acute cholecystitis.[7] They suggest that in acute cholecystitis, the base of segment IV and the roof of RVS should be used as anatomical landmarks, and any surgical procedures during cholecystectomy should be performed above the line connecting these two landmarks.[7] This line is known as R4U line, which is drawn from the roof of RVS and the base of segment IV to the umbilical fissure. The zone above this line is a safe zone for LC and below the R4U line is unsafe. When RVS is absent, an imaginary line is drawn from umbilical fissure across base of segment IV and extended to the right across the hepatoduodenal ligament to mark a safe zone. The dissection of the hepatocystic triangle must be performed in the safe zone to achieve the critical view of safety and avoid BDI.

The *objective* of this work is to study incidence and morphology of RVS and its importance in LC.

Materials and Methods

A prospective study of RVS was conducted in the Department of General Surgery of a tertiary care hospital from March 2021 to June 2022. A total of 130 patients were included in this study. All patients with symptomatic gallstone disease were thoroughly investigated with routine hematological investigations, ultrasonogram (USG), liver function test (LFT), and other needed investigations. Laparoscopic cholecystectomy was conducted under general anesthesia. A standard 4-port LC was done. After retracting fundus of GB toward the right shoulder, the infundibulum of GB is retracted to the left of the patient to see RVS. Following data are noted: presence or absence of RVS, type, direction and measurements were made using marked feeding tube. Intraoperative difficulty in LC is graded according to the modified Nassar scale.[9] Laparoscopic cholecystectomy was completed with RVS as the landmark and keeping above it to achieve CVS. When RVS is absent imaginary R4U line is used as the landmark. In cases of difficult cholecystectomy, where CVS is not achieved, after consultation with another surgeon bail out procedures were undertaken with OC or subtotal cholecystectomy (STC) above R4U line. Drains were used only in difficult cases. Postoperative complications of bleeding and bile leak were noted

Table 1: Type of sulcus

Type of sulcus	*No. of patients*	*Percentage*
Open	77	72.6
Closed	14	13.2
Slit	11	10.4
Scar	04	03.8
Total	106	100

Table 2: Direction of sulcus

Direction	*No. of cases*	*Percentage*
Horizontal	74	69.80
Oblique	31	29.25
Vertical	01	00.95
Total	106	100

Table 3: Measurements of sulcus

Type of RVS	*Length in mm (average)*	*Breadth in mm (average)*	*Depth in mm (average)*
Open	24–42 (31)	8–15 (11)	6–12 (10)
Closed	18–28 (22)	6–11 (8)	4–9 (7)
Slit	10–16 (13)	2–4 (3)	0
Scar	42–87 (58)	0	0

Results

- Age distribution: Age in this study varied from 18 to 73 years. Mean age was 43.72 years. Maximum incidence is in 4th decade with 32% and 5th decade with 28%. The youngest was 18 years old girl and the oldest patient was a 73 years old man.
- Sex: Females (83) dominate males (47) with F:M ratio of 64:36.
- Incidence of RVS: Rouviere sulcus is seen in 106 (81.5%) cases and absent in 24 (18.5%) cases. In majority of cases (84 of 106), it is seen on retraction of infundibulum to the left. In 22 cases, RVS was visible after the separation of adhesions.
- Type of sulcus: Open type is most common with 72.6% and scar is least with 3.8% (Table 1).
- Direction of sulcus: Horizontally directed RVS is most common. Vertical directed sulcus is rarely seen (Table 2).
- Measurements of RVS: See Table 3.
- Pre-operative diagnosis: Cholelithiasis was found in 93 (71.5%) cases, cholecystitis in 23 (17.7%), choledocholithiasis in 11 (8.5%) (taken up after ERCP stone removal and stenting), and biliary pancreatitis in 3 (2.3%) cases.
- Difficulty in LC: NASSER Classification.[9] 103 (79%) cases are simple in grades 1 and 2, 27 (21%) cases are difficult Calot's in grades 3 and 4.
- Critical view of safety achieved using RVS as landmark.

In 118 cases, CVS was achieved using RVS and R4U line as a landmark. These 16 cases were with absent RVS. In 12 (9%) cases, CVS could not be achieved due to edema, dense adhesions, and fibrosis in the Calot's triangle. Eight of these cases are acute cholecystitis, four cases were with fibrosed Calot's triangle. Bailout procedures were taken up after a consultation with a second surgeon. Of the 12 cases, 4 cases were converted to OC. Eight cases were managed

with STC using RVS or R4U as landmark and completing the procedure in the safe zone. Out of eight STC, two were fenestrating type and six were reconstituting type.

Complications

Bleeding

Bleeding was seen in eight cases, resolved with medication, and blood transfusion was needed in two cases. Mostly seen in difficult GB with conversion to OC.

Bile Leak

No major BDIs were seen. Bile leak was observed in five cases. Evaluation of these five cases with ERCP revealed slipped clips from the cystic duct in one case of LC. Other four cases were a difficult GB where a bailout procedure was done: two cases of STC (fenestrating) and two cases of OC. No BDI was noted here. All cases were relieved with bile duct stenting.

Wound Infection

Wound infection seen in 12 cases, treated with drainage and dressings.

Discussion

Bile duct injury is a serious complication of LC associated with morbidity, mortality, and loss of quality of life for the patient. This one of the major causes of medicolegal litigations. The prevention of BDI is an integral aspect of LC. Misinterpretation of biliary anatomy is the major cause of BDI. Other causes are abnormal anatomy, adhesions, instrumentation, and surgeon's ability. The classical BDI occurs when the CBD is mistaken as the cystic duct and cut. The identification of anatomical structures in laparoscopic surgery is complicated by the fact that these structures exist in a 3D axis, yet the surgeon's view is fundamentally 2D.[10] Basically LC is a virtual surgery performed on an image without tactile sensation for surgeon. The best way to avoid misinterpretation of biliary anatomy is to achieve the CVS. Critical view of safety helps to minimize or eliminate the incidence of BDI. However, achieving CVS can be difficult in cases with severely inflamed and edematous GB or chronic fibrosed Calot's/hepatocystic triangle. Thus, to achieve CVS there is a need for anatomical landmarks to guide the surgeon to start a safe dissection. Even a beginner of LC needs some landmarks to orient himself to a safe dissection. Internal landmarks like cystic lymph node and elephant trunk sign, where infundibulum narrows to form the cystic duct are advocated. But these land marks are not useful in cases of acute cholecystitis with edema and inflammation or chronic cholecystitis with dense fibrosis. Rouviere sulcus is a safe but less known extrabiliary landmark for LC. Though RVS was mentioned by Henri Rouviere in 1924, its significance was not recognized till the popularization of LC in late 1990s. Reasons being it is better seen in LC than OC due to distention and illumination of digital cameras. Rouviere sulcus is an extrabiliary landmark in solid organ, liver, which is not affected by the inflammatory scarring of gallbladder. Rouviere sulcus is the first landmark the surgeon should look for safe LC.[8] Rouviere sulcus is present in majority of the cases. Dahmane et al.[7] reported an incidence of 82%, while Peti et al.[6] described an incidence of 80%. Singh and Prasad[2] and Kumar et al.[11] reported the highest incidence of RVS >90%. Zubiar et al. reported a lower incidence of 68%.[12] These variations are usually due to inclusion or exclusion of scar type in their studies.[13] In a meta-analysis of 23 anatomical or laparoscopic studies, Cheruiyot et al.[14] reported an overall incidence of 83%. Our study with 81.5% is at par with majority of reports. It is well preserved in cases of acute cholecystitis. Sometimes it is visualized after adhesiolysis. Dahmane et al.[7] studied the contents of the RVS in their autopsy liver specimens. They noted the right portal pedicle in majority of cases. Rouviere sulcus has wide morphological variations. It is described as open, closed, slit, and scar types.[2] some authors described open and close type together as deep sulcus.[2] Our series show 72% and 13% of open and closed sulcus, respectively. Direction is horizontal in majority of cases (74%). Vertical sulcus was seen in one case. The type, measurement, and the direction of the sulcus vary widely. When the fundus of GB is pulled upwards and to right shoulder the RVS points to the neck of GB where it tapers to form the cystic duct.[15] An imaginary line drawn from RVS along the base of segment IV of the liver to the umbilical fissure is known R4U line. The area cephalad to the R4U line is considered as a safe zone and caudal to it is a danger zone.[16] Dissection of the Calot's/hepatocystic triangle is confined to safe zone only, to avoid BDI. When RVS is absent, the R4U line is drawn at the base of segment IV and extended across the hepato-duodenal ligament. Hugh et al.[5] were the first to recognize the importance of RVS in LC as it shows the correct plane of CBD. They demonstrated lowest rate of BDIs by dissecting Calot's triangle above the RVS. Peti and Moser described RVS as an important landmark for successful completion of LC and to avoid BDI.[6] The importance of RVS is emphasized in the Tokyo guidelines 2018 for safe cholecystectomy.[9] They advised to use R4U line as a guideline for dissection in acute cholecystitis. In the Delphi consensus[17] on BDIs more than 80% of the Japanese surgeons agreed that RVS as an important landmark to avoid BDI. The Delphi consensus on bile duct injuries during LC also advise the use of safe zone dissection to avoid BDs.[17] The SAGES promoted safe cholecystectomy program proposed some strategies for minimizing BDIs. SAGES advises to recognize when the dissection is approaching a zone of significant risk and halt the dissection before entering the zone. This is a part of adopting a universal culture of safety in cholecystectomy (COSIC). The zone of significant risk is below R4U line. Brittany Greene et al. proposed an anatomical landmark, inferior boundary of dissection to prevent dangerous dissection in the porta hepatis when a CVS may not be immediately achievable. The boundary extends from RVS to the peritoneum and fat overlying cystic and hilar plates, near the base of segment IV.[18] Another approach advised is B-SAFE landmarks. B-SAFE stands for the bile duct, the sulcus of Rouviere, the left hepatic artery pulsations, the umbilical fissure, and the duodenum (enteric).[19] In our series, we did not have any major BDI. Bile leaks were seen mainly in difficult bailout cases. Conversion to OC was done early in the study. Only two of four open conversions could be completed and other two were operated with open STC. Open cholecystectomy does not guarantee the completion of cholecystectomy without BDI. There is additional morbidity and complications of open surgery. The advantage of laparoscopic surgery is lost. So, we started doing laparoscopic STC above R4U line. Fenestrating type showed bile leak (2 of 3) for which ERCP was done. Later reconstitution STC was taken up with no bile leaks post-operatively. In 16 of 24 cases without RVS we could complete LC using imaginary R4U line as a guide. In difficult cases RVS guide us to do a bailout procedure of STC above R4U line. It is suggested to remember mnemonic "RANGERS" sign during LC.[15] Rouviere's at neck of gallbladder eases recognition of structures. This allows the

operating surgeon to recall the presence of the sulcus, and then to start safe dissection of Calot's triangle medial to and above the sulcus, and always keeping the view laterally all the times, thereby ensuring the CBD is well below the plane of dissection.

Conclusion

Rouviere sulcus is an important extrabiliary landmark for safe cholecystectomy. It is present in majority of cases and provide an easy referral point to achieve the CVS and minimize bile duct injuries. It is the first landmark to seek in an LC and start dissection of Calot's triangle above and medial to it. We strongly suggest to use RVS as guide to minimize BDIs.

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ORIGINAL ARTICLE

A Study to Evaluate Clinical Outcome of Laparoscopic Nissen Fundoplication in Patients with Hiatus Hernia

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Received on: 09 March 2023; *Accepted on*: 04 June 2023; *Published on*: 05 September 2023

Abstract

Introduction: Laparoscopic fundoplication is also important after medical management failure of gastroesophageal reflux disease. Nissen's fundoplication effectiveness is widely regarded as safe and effective, with a mortality rate of less than 1%. The purpose of this study is to assess clinical outcomes after laparoscopic Nissen's fundoplication in a patient with hiatus hernia and evaluate postoperative symptom relief, to evaluate postoperative complications, and to evaluate postoperative improvement in patients' lifestyles.

Materials and methodology: This retrospective observational study was conducted in civil hospital Ahmedabad for 30 patients admitted to Civil Hospital, Ahmedabad from May 2019 to October 2021. The selection criteria for cases were based on the physical findings, clinical history, radiological findings, and endoscopic findings. Patient information was collected from the medical record office. Sociodemographic variables include age at diagnosis, marital status, religion, level of education, occupation, and socioeconomic status.

Results: In this study, the 51–60 years of age-group is affected mostly and the mean age is 56 years. Females are affected by around 53% as compared with 47% of males. The most common presenting complaint is upper abdominal discomfort followed by heartburn, bloating, and regurgitation. The usual day of discharge is day 3 or 4.

Conclusion: Laparoscopic Nissen fundoplication is the better surgery in patients with hiatus hernia with good clinical outcomes. Laparoscopic Nissen fundoplication is an effective surgery for hiatus hernia with minimal complications in expert hands.

Keywords: Heartburn, Hiatus hernia, Nissen fundoplication.

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Introduction

In this era of laparoscopy, a variety of surgeries are being done for a large number of abdominal pathologies, out of those, laparoscopic repair of hiatus hernia is one of the meticulous procedures that needs expertise. Laparoscopic fundoplication is also important after the failure of medical management of gastroesophageal reflux disease. Nissen's fundoplication effectiveness is widely regarded as safe and effective, with a mortality rate of less than 1%.

In fundoplication, the stomach's gastric fundus is wrapped around the lower end of the esophagus and sutured in place; therefore enhancing the closing function of the lower esophageal sphincter. In order to prevent and cure a concurrent hiatal hernia, in cases in which the fundus protrudes through an enlarged esophageal hiatus of the diaphragm, the esophageal hiatus is constricted further with sutures. There are many types of fundoplication. Commoners are Nissen (posterior 360 degrees), Dor (anterior 90–180 degrees), and Toupet (posterior 270 degrees).

The fundus is completely wrapped around the esophagus in a Nissen fundoplication, which is also referred to as "complete fundoplication." This procedure is now routinely performed laparoscopically. The mechanism of comfort is that anytime the stomach contracts, the esophagus likewise closes up, preventing stomach acid from entering it. Laparoscopic hiatal hernia repair procedure has been shown to give good short- and long-term outcomes in gastroesophageal reflux disease.[1,2]

Complications include dysphagia, gas bloat syndrome, excessive scarring, dumping syndrome, rare achalasia, and vagus nerve injury, Postoperatively irritable bowel syndrome that lasts roughly 2 weeks. A good outcome following Nissen fundoplication may be expected in approximately 90% of the patients at 10 years follow-up. The failure is caused equally by recurring reflux and prolonged adverse effects.

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Source of support: Nil

Conflict of interest: None

Materials and Methodology

The materials for the study of the outcome of laparoscopic Nissen fundoplication were collected from cases admitted in Civil Hospital, Ahmedabad from May 2019 to October 2021 clinically, 30 cases have been studied. The criteria for the case selection were based on physical findings, clinical history, endoscopic findings, and radiological findings.

Study Design

Study type: Retrospective Observational study

Study site: Department of Surgery, Civil Hospital, Ahmedabad

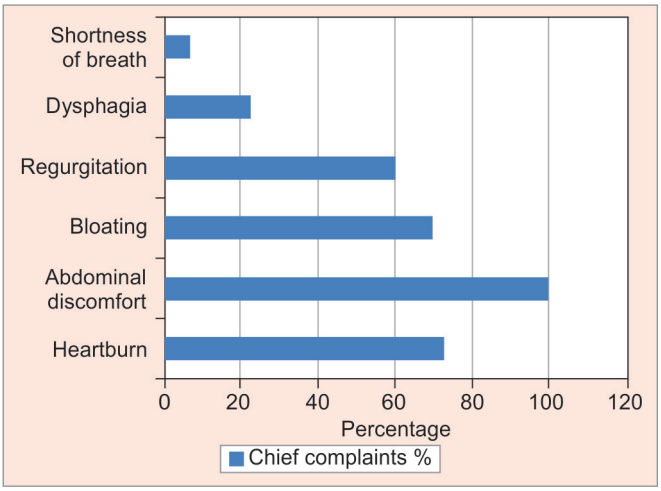

Fig. 1: Chief complaints

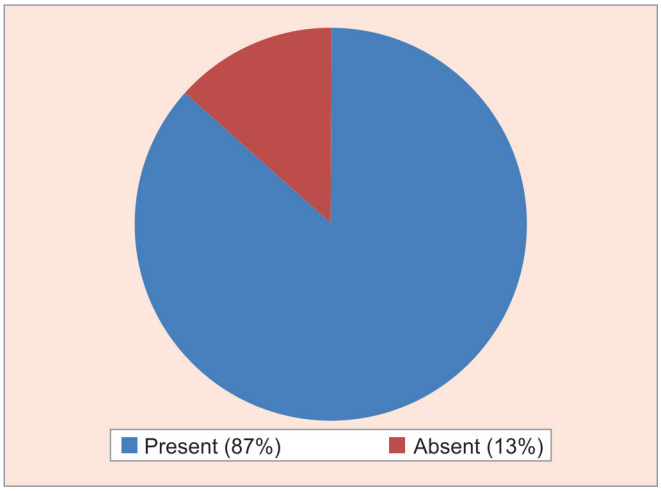

Fig. 2: History of prolonged proton pump inhibitors

Study duration: May 2019 to October 2021

Subject selection:

Inclusion Criteria

- Patients who are undergoing laparoscopic Nissen fundoplication for hiatus hernia.
- Patient willing to participate in the research and give informed and written consent.
- Patients fit for general anesthesia.

Exclusion Criteria

- Patient undergoing another type of fundoplication.
- Patient undergoing fundoplication for a cause other than hiatus hernia.
- Patient was operated on by another method of fundoplication.
- Patient presented with gastric volvulus.

Patient information was collected from the medical record office. Sociodemographic variables include age at diagnosis, marital status, religion, level of education, occupation, and socioeconomic status.

Results

This study comprised 30 patients who met the inclusion criteria during the study period. In this study, participants of 51–60 years age-group are affected mostly and the mean age is 56 years, but commonly affected age-group is 50 years and older.[3] This study shows the females' preponderance over males. Females are affected by around 53% as compared with 47% of males in this study.

The most common presenting complaint is the upper abdominal (Fig. 1) discomfort, followed by heartburn, bloating, and regurgitation. Dysphagia and shortness of breath are also present in 23% and 7%, respectively while in the study of Herron et al., dysphagia is up to 24% which is almost equal to our study.[4] Late postoperative dysphagia was observed in 5.5% of the patients in the study of Perdikis et al.[5]

Smoking, overweight, and obesity are important risk factors. In the present analysis, 40% of the patients are smokers and 83% are either overweight or obese. Age is another important individual risk factor. In our study, the majority of the patients are older than 50 years of age.

History of prolonged proton pump inhibitors usage is present in 87% of the cases in this study (Fig. 2).

Table 1: Complications

Complication	*No. of patients*	*Percentage (%)*
Intraop		
Gastrotomy	0	0
Esophagotomy	0	0
Major intraop bleeding	0	0
Pneumothorax	1	3
Postop		
Empyema	0	0
Severe postop nausea and vomiting	0	0
Wrap migration	0	0
Intra-abdominal abscess	0	0

Complications of laparoscopic Nissen fundoplication of 30 patients, certain problems are compared as follows:

In the study of Singhal et al., the pneumothorax incidence is 0.67%, whereas the pneumothorax incidence is 3% in this study.

Intraop bleeding, severe post-op nausea and vomiting, and wrap migration are 0%, 0%, and 0% as compared with 0.33%, 0.33%, and 0.66% in the study of Singhal et al.[6] (Table 1).

The usual day of discharge from the hospital after laparoscopic Nissen fundoplication is on day 2 or 3[7] but in this study, the usual day of discharge is on day 3 or 4. One of the patients in this study was discharged on post-op day 10 due to a complication of pneumothorax was managed by an intercostal drainage tube and chest physiotherapy (Fig. 3).

Reoperation rate in this study is 0% in 6 months as compared with 5% that was observed in the study by S.S. Castelijns et al. after 3.7 years of median follow-up.[8] we followed up with 30 patients for 6 months and checked for symptom relief and complications. K Sato et al. reported that transient dysphagia after the operation was seen in 40–70% of patients but it is relieved after 2–3 months.[9] In this study, dysphagia persists in one patient after 6 months.

Discussion

Laparoscopic Nissen fundoplication routinely performed surgery for hiatus hernia. Age, overweight, obesity, and smoking are some important risk factors for hiatus hernia. In this study, most of the

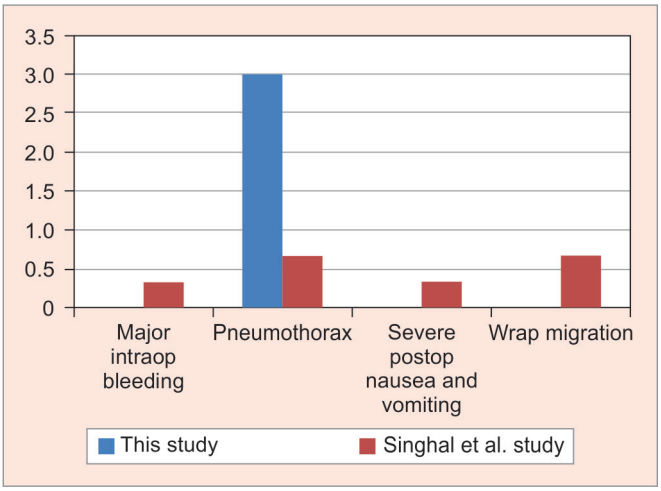

Fig. 3: Comparison of complications with other studies

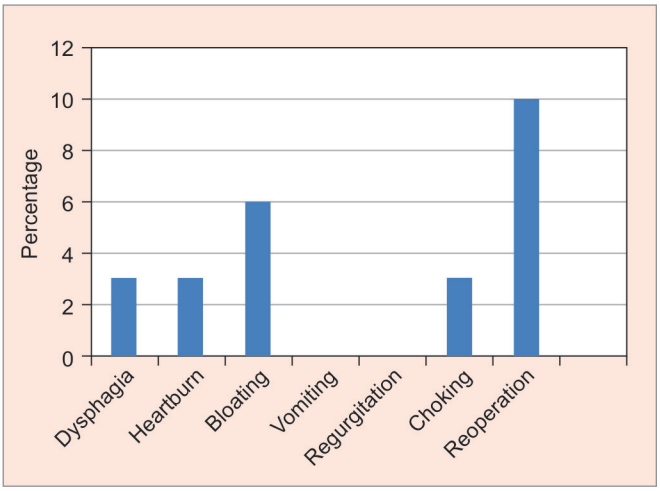

Fig. 4: Follow-up (after 6 months)

patients are older than 50 years and all 30 patients are above the age of 40 years. In this study of 30 patients, more than 80% of patients are either overweight or obese, so we can conclude that overweight and obesity are important risk factors.

Heartburn and upper abdominal discomfort are some common preoperative symptoms. In this study, upper abdominal discomfort was seen in almost all patients and heartburn was seen in more than 70% of patients. Proton pump inhibitors were being used by more than 85% of the patients preoperatively.

Intraoperative and postoperative complications are uncommon, but in this study of 30 patients, 1 patient developed pneumothorax and was managed conservatively and discharged but had complaints of chest pain in follow-up. A few of them developed dysphagia in early follow-up but most of them got rid of these symptoms, which may be due to lower esophageal edema, but persists in 1 patient after 6 months. In the follow-up, regurgitation is present in none of the patients. No patients are re-operated in 6 months (Fig. 4).

Conclusion

Although this study shows comparatively good outcomes, long-term follow-up is required to know the outcome of this operation. Laparoscopic Nissen fundoplication is better surgery in patients with hiatus hernia having good clinical outcomes. Laparoscopic Nissen fundoplication is an effective surgery for hiatus hernia with minimal complications in expert hands.

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ORIGINAL ARTICLE

Total Laparoscopic Hysterectomies at Tertiary Care Center: A Retrospective Analysis

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Abstract

Background: After cesarean section, hysterectomy is the second most common procedure performed in the OBGY department. In this study, we analyzed the safety and complications of total laparoscopic hysterectomy (TLH) at our tertiary care center. Total laparoscopic hysterectomy is the preferred procedure over the laparotomy because of higher feasibility and lower postoperative complications.

Materials and methods: This is a retrospective cohort study conducted on 200 patients who underwent TLH due to various benign gynecological conditions from January 1, 2017 to July 31, 2022. The statistical analysis was done using EPIINFO software.

Results: The mean age of the women undergoing TLH at our center was 42 years. About 52% of the women were having parity 2, 43% were having a uterine size between 6 and 12 weeks. The most common symptom and indication for TLH were heavy menstrual bleeding (75.5%) and AUB L (leiomyoma) is about 49%, respectively. The average blood loss in the study was 150 mL. The mean duration of surgery was 50 minutes. The mean duration of hospital stay was 3 days. And 4% of the patients had intraoperative complications, 9% had postoperative complications which were identified and managed successfully.

Conclusion: Laparoscopic gynecological surgeries are safe procedures in terms of feasibility in obese patients, minimal blood loss, and postoperative complications in patients with benign uterine etiology. Greater technical challenges and advanced equipment with long learning curve make it difficult for all surgeons to practice it.

Keywords: Hysterectomy, Laparoscopy, Minimally invasive surgey, Retrospective.

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Introduction

Hysterectomy is mainly an age-old surgery practiced from ages undergoing multiple modification in the technique, routes, etc. Hysterectomy can be done through these routes abdominal, vaginal, or laparoscopic. After cesarean section, hysterectomy is the second most common procedure performed in the OBGY department.[1] Recently, increasing number of surgeries done by minimally invasive approaches, that is., total laparoscopic hysterectomy (TLH) and laparoscopic-assisted vaginal hysterectomy (LAVH). Total laparoscopic hysterectomy is the preferred approach over other modalities due to fewer complications and faster patient recovery.[1,2] Most of the laparotomies for hysterectomies can be avoided by using the laparoscopic approach in cases of adhesions and extensive endometriosis. Most surgeons do not prefer the vaginal approach because of the inaccessibility to adnexal masses and difficulty in patients with narrow introitus and uterine sizes of more than 12 weeks.[3] Laparoscopic approach has its own advantages and pitfall.[2,4–7]

The advantages are smaller wound, shorter hospital stays, speedy recovery, decreased surgical site infection. The disadvantages are a long learning curve, high cost, and longer operative time.[2,4–7] The aim of the study is to analyze the pros and cons of laparoscopic approach for benign uterine pathology at rural setup.

Materials and Methods

This is a retrospective cohort study reviewed for 200 patients who underwent TLH at our institute from January 1, 2017 to July 31, 2022.

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Ethical approval: Yes. (Reference No.-110/2022)

Source of support: Nil

Conflict of interest: None

Inclusion criteria: All cases of benign gynecological condition, uterine size less than 18 weeks, patients fit to undergo laparoscopic surgeries.

Exclusion criteria: Suspected or confirmed malignant gynecological cases, uterine size more than 18 weeks, patients unfit to undergo laparoscopic surgeries.

Patient's demographic details, complete patient's profile were accessed after ethical committee and institution's head approval.

The type of anesthesia decided is based on the patient profile. The team consists of anesthetist, two main surgeons, one assistant for holding camera, and one assistant for uterine manipulation, staff nurse, and OT staff for assistance. Patient was placed in modified Lloyd-Davis position. Primary 10 mm port insertion was done by direct trocar entry; port was always inserted in supraumbilical site 1 inch above the umbilicus. After the creation of pneumoperitoneum, three 5 mm accessories port were introduced. (Two lateral trocar

were inserted 2 inches above and medial to anterior superior iliac spine and one central trocar at midpoint of a line between pubic symphysis and umbilicus, Trocar was inserted one inch lateral toward left side) After inserting the 10 mm, 30° laparoscope, the uterus and adnexal pathologies were identified. Energy source for the surgery consisted of Harmonic scalpel (J & J Ethicon ultrasonic device) and bipolar cautery/shearer/vessel sealer (Alan Indian make). Electro surgical unit (ESU) used was from Alan with bipolar, monopolar, and vessel sealing function. Vaginal manipulation was done by a patented specialized Sukhadia manipulator. The main advantage of this manipulator was that it allows anteversion, retroversion, and side to side movements of uterus and allowed ease of access to bilateral uterine arteries; also the vaginal tube made the vault cutting safe and secure by pushing the bladder downward and ureters laterally. During difficult dissection for bladder and rectum, the dictum followed was fat in the dissecting plane always belongs to rectum and bladder.

Surgical Steps

Right round ligament, ovarian ligament and fallopian tube were coagulated and cut if ovaries are to be conserved. Infundibulopelvic ligament were coagulated and cut in cases of associated ovarian pathologies. Similar procedure repeated on the left side. Separation of the bladder was done with the help of harmonic scalpel and uterovesical fold and bladder were pushed down. Posterior peritoneum was dissected down and ureters were identified. In cases with advanced bladder or bladder adhesion [in cases of previous 1 or more lower segment caesarean section (LSCS)] sharp dissection was done and bladder dissection is done through the lateral window technique. The vaginal manipulation helped and facilitated the bladder dissection by traction and counter traction technique. In difficult cases where cervix is pulled up due to previous multiple caesarean surgeries/cervical fibroid/pelvic surgeries/advanced endometriosis, myoma screw was used for uterine manipulation. Bilateral uterine arteries were identified at the level of isthmus, coagulated, and cut. Hemostasis was confirmed. Bilateral uterosacral ligament was coagulated and cut using harmonics. Vault was cut by giving circumferential incision over the vaginal manipulator. Specimen was delivered out by vaginal route. Wherever necessary, the manual morcellation was carried out vaginally. Vaginal vault was sutured by vicryl round body no 1 by continuous interlocking intracorporeal suturing technique. Bladder, bowel, and hemostasis were checked. All accessories port were removed under vision. Carbon dioxide (CO_2) desufflation was done. Main port was removed. Port sites were sutured with ethilon 2-0/stainless steel clip. Sterile dressing was done. Patient's postoperative course was monitored. Patient catheter was removed on day 2, oral started after 8 hours. Patient discharged on day 3 and follow-up on day 7 and day 21.

Results

The demographic characteristics of the patients who underwent TLH at our study center include (1) the mean age of the patient in the study was 42 years; (2) parity in the majority (56%) was 2, while 59% of the patients had a history of previous 1 surgery. (Tables 1 and 2)

About 70% of the cases were operated under regional spinal anesthesia, while 30% of the patients underwent surgery under general anesthesia. Majority of the patients had fibroids as an indication for the surgery (49%), (Fig. 1) operative time declined throughout the study progressively with a mean operative time of 50 minutes. The mean duration of the hospital stay was 3 days. About 10 cases required blood transfusion, while 5.5% had blood loss more than the mean blood loss in the study, that is, more than 150 mL (Table 3).

Table 1: General characteristics of patients

Characteristics	*Numbers (%)*
Age-group	
30–40	10 (5%)
41–50	182 (91%)
51–60	08 (4%)
Parity	
1	13 (6.5%)
2	112 (56%)
More than 2	75 (37.5%)
History of previous surgeries	
0	53 (26.5%)
1	118 (59%)
2	21 (10.5%)
More than 2	8 (4%)

Table 2: Clinical characteristics of patients

Characteristics	*Numbers (%)*
Presenting symptoms	
Heavy menstrual bleeding	151 (75.5%)*
Pain in the abdomen	131 (65.5%)*
White discharge per vaginum	43 (21.5%)
Lump in the abdomen	10 (5%)
Inter-menstrual bleeding	12 (6%)
Uterine size	
Normal	09 (4.5%)
Bulky	81 (40.5%)
6–12 weeks	88 (44%)
12–16 weeks	22 (11%)

*Since the patients had multiple complaints, thus the aggregate is more than 100%

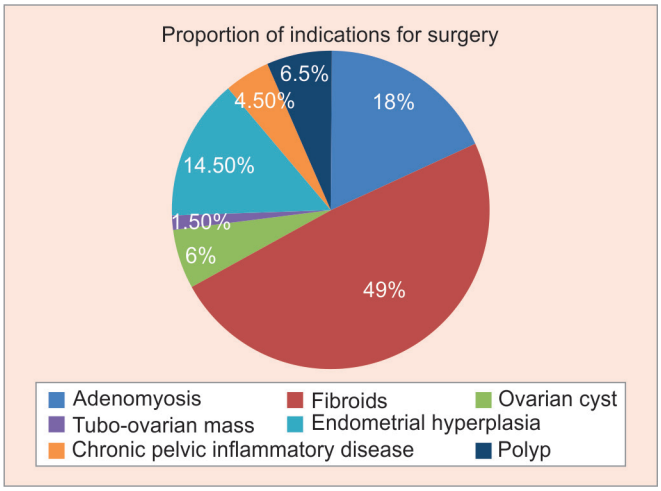


Fig. 1: Indications for surgery

Discussion

The proportion of laparoscopic hysterectomies has been increasing compared with hysterectomies performed through laparotomy. Despite the fact that hysterectomy is the most frequently performed major gynecological surgery, there are still controversies regarding the optimal route for hysterectomies.[7–9] According to the study done by Garry et al., a surgeon needed to perform 25 cases to complete the learning curve and gain adequate experience.[10] The mean age of women undergoing TLH in the present study was 42 years (Table 1) which was comparable with the findings of the study done by Mani et al.,[11] Shin et al.,[12] Bastidas-Guarín et al.,[13] and Dojki and Bano colleagues.[14]

About 59% of the patients had a history of prior abdominal surgery in the present study which was higher as compared with the findings of the study by Dojki and Bano colleagues.[14] Only 33% of patients had prior abdominopelvic surgery.

Patients had multiple symptoms on admission and were presented with the most common symptom as heavy menstrual bleeding (75.5%), followed by pain in the abdomen (65.5%). These findings were similar to the findings in the study by Bastidas-Guarín et al.,[13] Dojki and Bano colleagues,[14] and Suisted and Chittenden.[15]

In the present study, majority of the patients (70%) underwent TLH under regional spinal anesthesia, while only 30% required general anesthesia. These findings were comparable with the study findings Chilkund JN and colleague.[16]

Table 3: Intra- and postoperative events

Characteristics	*Numbers (%)*
Intraoperative blood loss (in mL)	
Less than 100 mL	73 (36.5%)
100–150 mL	116 (58%)
150–200 mL	11 (5.5%)
Duration of surgery (hours)	
Less than 1 hour	69 (34.5%)
1–1.5 hours	118 (59%)
1.5–2 hours	13 (6.5%)
Duration of hospital stay (days)	
3	190 (95%)
4–5	10 (5%)

The average surgical time in the present study was 50 minutes. The operative time in the study done was Bettaiah et al.[17] ranged from a minimum of 20 minutes to a maximum of 2 hours. About 10 patients required blood transfusion in the present study.

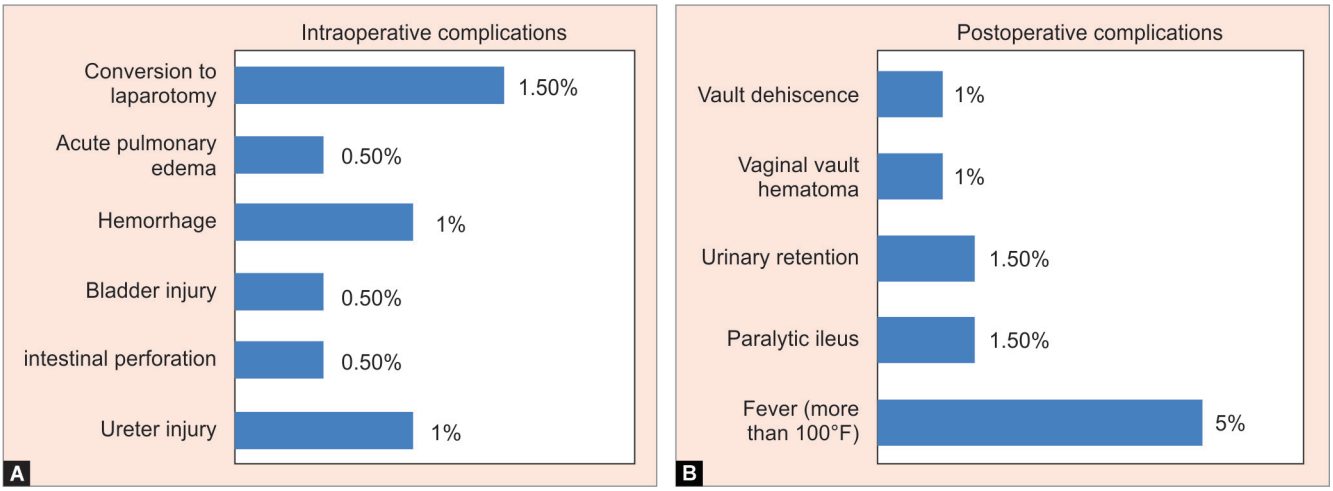
The most common indication for hysterectomy in the present study is fibroids which contribute to 49%. These findings were similar to the study findings of Rentiya FM and colleagues[18] and Shin et al.[12] The mean blood loss in our study was 150 mL. The mean blood loss in the study done by Mani K and coworkers,[11] Suisted and Chittenden[15] were 163 mL and 153 ± 116.1 mL, respectively.

Complications noted in the present study (Fig. 2) were bladder injury (0.5%) over the dome of the bladder, one case of thermal ureteric injury (0.5%) followed by ureterovaginal fistula on day 10. In the case of bladder injury over dome – the central portion diagnosed intraoperatively during the dissection of uterovesical fold in the case of previous 2 LSCS with fibroids was managed by suturing the bladder in two layers with vicryl 3-0 and omental interposition followed by keeping the Foley for 14 days. While in another case of thermal ureteric injury followed by ureterovaginal fistula on postoperative day, 10 patients complained of leaking per vaginum and they immediately underwent contrast CT. On examination using contrast enhanced computed tomography (CECT), the ureterovaginal fistula was confirmed. Bladder integrity was maintained. It was found that the patient had double ureters on the side of the injury with upper and lower moiety drained separately by two ureters. The opinion of the urologist was taken followed by DJ stenting. Urine leakage from the vagina stopped after 3 weeks and DJ stenting was removed after 6 weeks. Thus, all intraoperative and postoperative complications were recognized and managed successfully as per standard protocols. These findings were similar to single-center study done by Puntambekar et al.[19] The number of cases converted was 3 (1.5%), which was comparable to the study conducted by Bettaiah et al.[17] (0.9%) Out of the 3 cases, 2 cases were having large cervical fibroids while in the other case, it was severe endometriosis making it difficult to proceed for TLH (Fig. 2).

None of the cases needed re-exploration in the present study.

Conclusion

Total laparoscopic hysterectomy is an effective and safe procedure with minimal blood loss, minimal pain with shorter duration



Figs 2A and B: Complications among the study population – intraoperative and postoperative

of hospital stay when performed by an expert surgeon. With improvement in surgical skills, TLH is being considered the day care surgery. Standard operating procedure (SOP) and high case volume are milestones for safe surgery.

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ORIGINAL ARTICLE

Study of Selection of Method of Laparoscopic Inguinal Hernia Repair by Comparison of Totally Extraperitoneal with Transabdominal Preperitoneal

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Abstract

Aim: Selection of type of laparoscopic inguinal hernia repair procedure for patients. To observe the comparison of the outcome of laparoscopic totally extraperitoneal (TEP) with transabdominal preperitoneal (TAPP) inguinal hernia repair. Explore the safety and feasibility of laparoscopic TEP and TAPP inguinal hernia repair. Advantages and Disadvantages of laparoscopic TEP with TAPP inguinal hernia repair.

Materials and methods: In this study, 100 cases of inguinal hernia were admitted to the Department of General Surgery, L.G. Hospital, Maninagar, Ahmedabad, Gujarat, India in during the study period of 2019–2021 and operated for either of the laparoscopic methods randomly and equal in number.

Results: All of our laparoscopic inguinal hernia repair patients selected for TEP and TAPP and all of them have good outcomes in the form of no recurrence. Both TEP and TAPP are found to have safe procedures and our institute has all the facilities required to perform inguinal hernia repair so it is feasible as well. Both procedures have their advantages and disadvantages, but both were found to be equally effective.

Conclusion: From our study, we concluded that any of the inguinal hernia patients can be treated with either of the laparoscopic methods with equal results. There is no recurrence in both TEP and TAPP procedures. However, there are some concerns regarding the feasibility of both the procedure in the form of laparoscopic setup it requires and higher cost. Laparoscopic TEP repair is marginally better than TAPP in the form of the duration of surgical time, port site infection, and seroma while TAPP is marginally better at fewer chances of subcutaneous emphysema, the technicality of the procedure and diagnosis of opposite site hernia. However, both techniques are comparable and commendable if performed with precision and expertise.

Keywords: Inguinal hernia, Transabdominal preperitoneal, Totally extraperitoneal.

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Introduction

Laparoscopic surgeries have made inguinal hernia surgery a most interesting endeavor that demands renewed discipline and dedication, and therefore hernia repairs have been studied repeatedly.[1] Both totally extraperitoneal (TEP) approach and transabdominal preperitoneal (TAPP) approach are performed, none can be termed as a superior procedure as each one is accompanied by varied advantages, disadvantages and early or late complications.

The objective of this article is to systematically study the selection of method, comparison of advantages, disadvantages, outcome, safety, and feasibility of laparoscopic inguinal hernia repairs.

Materials and Methods

In this study, 100 cases of inguinal hernia were admitted to the Department of General Surgery, L.G. Hospital, Maninagar, Ahmedabad, Gujarat, India during the study period between 2019 and 2021. The sample size of the study was 100.

Inclusion Criteria

- Patients having uncomplicated reducible and nonobstructive unilateral and bilateral inguinal hernias.
- Patients with primary and recurrent hernias.
- Patients should be operated under general anesthesia.

Exclusion Criteria

- Patients presented with irreducible/strangulated/obstructed inguinal hernia who required emergency exploration.
- Pediatric age group (<12 years) patients are not included.
- High-risk patients (ASA grade >3) who are not fit for general anesthesia.

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Table 1A: Age distribution

Age range (years)	*Number of patients*
13–20	3
21–30	5
31–40	10
41–50	10
51–60	15
61–70	7
	50

Table 1B: Mean age distribution

	N	*Minimum*	*Maximum*	*Mean*
Age (year)	100	16	68	45.40

Table 2: Type of surgeries in different types of hernias

Type of hernia	*Total*
Direct	58
Indirect	42
Laparoscopic TEP	50
Laparoscopic TAPP	50

- Patients who were not willing to follow-up.
- History of any previous pelvic surgery or irradiation for malignancy.
- Recurrent laparoscopic hernia.

Visual analog scale (VAS) was used to assess the severity of pain. The patient was asked to describe the pain on a scale of 0–10; 0 denoted "no pain," 1 denoted "mild pain," and 10 denoted "worst pain."

Pain Score

- P0, VAS score 0: No pain
- P1, VAS score 1–3: Mild
- P2, VAS score 4–6: Moderate
- P3: VAS score 7–10: Severe

Results

In this study of laparoscopic inguinal hernia repair, 100 cases were taken for study from 2019 to 2021. Operative and postoperative details were collected and confirmed by asking questions and systemic examination was done during the follow-up. The follow-up duration was 1 year.

- *Age distribution*: The maximum age at the time of operation was 68 years and the minimum age was 16 years. The highest age group was between 51–60 years (Tables 1A and B).
- *Gender distribution:* All the patients were male.
- *Type of surgeries in different types of hernias:* We have performed 50 TAPP and 50 TEP surgeries. Out of 50 TAPP surgeries, 28 were direct hernias and 22 were indirect hernias and in TEP surgeries out of 50 patients, 30 were direct hernias and 20 were indirect hernias (Table 2).
- *Duration of surgery:* The mean duration of TEP was 1 hour and 20 minutes and the mean duration of TAPP surgeries was 1 hour and 40 minutes (Table 3).
- *Pain incidence:* The incidence of mild pain (P1) was 26% at the 1-week follow-up in both TEP and TAPP. The incidence of mild pain was 2% at 3-months follow-up in TAPP cases while in TEP cases there were 0% mild pain cases. Thus, the incidence of chronic pain was 2% at 3-months follow-up in TAPP only (Tables 4 and 5). Moderate or severe pain was not present at 3 months follow-up.
- *Hematoma:* No incidence of hematoma was reported in laparoscopic inguinal hernia repair.
- *Seroma formation:* The incidence of seroma formation was reported in 4% cases more in TAPP (three cases) as compared to TEP (one case) (Table 6).
- *Wound infection:* Incidence of wound infection in the form of port-side mild infection was reported in 2% of cases both in TAPP cases most probably due to missed intraperitoneal infection (Table 7).

Table 3: Duration of surgery

Surgery done	*N*	*Mean (average) (minutes)*
Laparoscopic hernia repair	100	90
TEP	50	80
TAPP	50	100

Table 4: Incidence of pain at 1 week

	LAP hernia repair (both TEP and TAPP)	
Grade of pain	*Total*	*Percentage*
P0 (No pain)	74	74
P1 (Mild)	26	26
P2 (Moderate)	0	0
P3 (Severe)	0	0

Table 5: Incidence of pain at 3 months

	LAP hernia repair (both TEP and TAPP)	
Grade of pain	*Total*	*Percentage*
P0 (No pain)	98	98
P1 (Mild)	2 (in TAPP only)	2
P2 (Moderate)	0	0
P3 (Severe)	0	0

Table 6: Seroma formation

LAP hernia repair	*Seroma formation*
TEP	1
TAPP	3

Table 7: Wound infection

LAP hernia repair	*Wound infection (%)*
TAPP	2
TEP	0

Table 8: Surgical emphysema

LAP hernia repair	*Surgical emphysema (out of 50)*
TEP	12 (24%)
TAPP	0 (0%)

Table 9: Scrotal edema

LAP hernia repair	*Scrotal edema (%)*
TAPP	2
TEP	0

Table 10: Shoulder pain

	Shoulder pain	
LAP hernia repair	*Total*	*Percentage*
TEP	0 of 50	0
TAPP	2 of 50	4

Table 11: Duration of hospital stay

	Hospital stay (days)			
LAP hernia repair	*1*	*2*	*3*	*4*
TEP	0	45	5	0
TAPP	0	40	8	2

Table 12: Age of the patients at presentation

Age (years)	*Present study (100 cases)*	*Rutkow and Robbins study*
<15	–	18 (18%)
15–44	44 (44%)	26 (26%)
45–64	52 (52%)	30 (30%)
>65	4 (4%)	26 (26%)

- *Surgical emphysema:* Incidence of surgical emphysema was reported in 24% of cases of TEP repair and 0 in TAPP (Table 8).
- *Scrotal edema:* Incidence of surgical scrotal edema was reported in 2% of cases in TAPP in an indirect hernia. Reason being we are able to dissect the indirect hernial sac easily in TEP as compared to TAPP according to our experience (Table 9).
- *Shoulder pain:* Incidence of shoulder pain was reported in 4% of cases in TAPP due to abdominal distention by the creation of pneumoperitoneum while in TEP, there was no shoulder pain reported as there was no need for pneumoperitoneum creation (Table 10).
- *Urinary retention:* No incidence of urinary retention was reported as all cases were catheterized preoperatively.
- *Recurrence:* Incidence of recurrence was not reported in laparoscopic inguinal hernia repair cases.
- *Duration of hospital stay*: The mean duration of the hospital stay was found to be 2.17 days for the laparoscopic inguinal hernia repair. Since ours is a teaching institution the minimum time taken from admission to surgery is 1 day hence making the duration of the hospital stay apparently longer (Table 11).

Discussion

Age

In our study, the maximum age of the patients at the time of operation was 68 years and the minimum age was 16 years. The highest age group was between 45 and 64 years. In a study by Rutkow and Robbins,[2] the age at presentation is discussed as follows. It is compared with this study (Table 12).

In the study of Rutkow and Robbins, the highest incidence was in the age group 45–64 years, which was in 30 cases. In our study, 26 cases in the 45–64 age group were the highest cases. The age incidence of our study matches the above study. In our study, the average mean age is 45.40. The mean average age 55.98 ± 12.71 was found in the study by Choi et al.[3]

Laparoscopic inguinal hernia repair is done under general anesthesia whereas open inguinal hernia repair is usually done under local or spinal anesthesia. So, in elderly patients who are usually comorbid, the laparoscopic procedure becomes riskier, making it a disadvantage of the laparoscopic procedure. Laparoscopic hernia repair is an ideal procedure in young and in non-comorbid elderly patients. In TEP, there is the formation of pneumo-preperitoneal space creation is done while in TAPP pneumoperitoneum is created so in conditions in which pneumoperitonem is contraindicated we can still go for TEP.

Table 13: Types of hernia

Type of hernia	*Total*	*Present study (%)*	*Rutkow and Robbins (%)*
Direct	70	70	68
Indirect	30	30	32

Table 14: Types of surgery

Type of surgery	*Present study*
TEP	50
TAPP	50

Types of Hernia

In our study, the average percentage of incidence of direct hernia was 58% while for indirect hernia it was 42%, and the mean age group in our study was 45.40 years. That is because older patients have more chance to develop direct hernia rather than indirect hernia. The incidence of different types of hernia in our study is consistent with the analysis of the hernia centers 8-year series of 2,861 primary hernias (Table 13).

Types of Surgery

In this study, 50 cases underwent TEP repair and 50 cases underwent TAPP (Table 14). The patients were randomly chosen for the different surgeries.

Laparoscopic TEP repair is technically more difficult than laparoscopic TAPP repair. In TAPP pneumoperitoneum is created and later peritoneal flap dissection is done. It is the lucid procedure as compared to the dissection of preperitoneal space by balloon inflation in TEP. According to the basic principles of laparoscopic surgery, in the TEP procedure, there is no triangulation of ports, which makes it a challenging procedure.

It is advisable to repair a recurrent hernia previously operated by open repair, by the laparoscopic method as a smaller number of adhesions are encountered and a smaller number of additional defects are missed. One of our patients, who was operated by an open Lichtenstein repair method 3 years ago, developed recurrence. He was easily managed for recurrent hernia by TAPP procedure.

Duration of Surgery

In our study, the time for laparoscopic inguinal hernia repair (TEP/TAPP) was 90 minutes compared to the Udwadia Tehemton study which was taking around 67.5 minutes.[4] In the medical research council (MRC) trial, the operating time was 58.4 minutes for the laparoscopic inguinal hernia repair group (Table 15).

Table 15: Duration of surgery

Type of surgery	*N*	*Mean (time in minutes)*	*Udwadia Tehemton*	*MRC trial*
Laparoscopic hernia repair	30	90	67.5	58.4

Table 16: Intraoperative complications

Complication	*Present study (%)*	*MRC trial (%)*
Bladder injury	0	2
Common iliac artery injury	0	1
Lateral femoral cut; nerve injury	0	1

This may be due to the difficult initial learning curve in laparoscopic hernia repair. The time taken to perform laparoscopic repair also depends on the type of hernia (direct/indirect) and size of the defect. Encircling the cord in laparoscopic indirect inguinal hernia repair is challenging as compared to direct inguinal hernia repair, therefore requiring more time in indirect hernias. In laparoscopic TEP repair, there is the possibility of an accidental tear in the peritoneum. It can cause seepage of carbon dioxide into the abdominal cavity. This decreases the working preperitoneal space. Also, repair of the peritoneal tear has to be done. This can increase the operative time for TEP repair in such cases.

In our study, there were 12 cases of bilateral direct inguinal hernia repair done laparoscopically. For bilateral inguinal hernias repair, TEP is simple because there is the creation of common preperitoneal space for repair on both sides by balloon. Whereas in TAPP, different peritoneal flaps have to be made. This is proven by our study, as the average time taken for bilateral TEP was 100 minutes, and for TAPP was 140 minutes.

Intraoperative Complications

Laparoscopic hernia repair can be faced with serious intraoperative complications (Table 16). When laparoscopic hernia was newly developed these complications were encountered more often, but it was due to the lack of the number of surgeries performed with this method and hence experience was minimal. Few studies and trials showed common injuries during laparoscopic surgeries; according to the MRC trial,[5] three complications were common during TAPP surgeries, which were bladder injury, lateral femoral cutaneous nerve injury, and common iliac artery injury. About 15 visceral and vascular injuries were reported in TAPP repair by the laparoscopic group of the European Union Hernia Trialists Collaboration. Two bladder injuries were reported while performing TAPP during the clinical study (SCUR).[6] Vascular injuries of 0.42% and visceral injuries of 0.11% were reported in the study of Brittner et al. 2011. As mentioned previously, due to lack of exposure to such surgeries, herniation of small bowel loops through incomplete sheath closure at the port site causing obstruction that occurred more often, but they were gradually recognized and with sheath closure compulsorily performed their incidence has decreased.

In our study, there were no major complications such as major vascular injury, or visceral injury in laparoscopic inguinal hernia repair. These major complications are not usually witnessed in open inguinal hernia repair surgeries as there is no dissection in deeper planes in open inguinal hernia repair surgeries.

Table 17: Postoperative complications

Complication	*%*	*TEP (%)*	*TAPP (%)*
Hematoma	0	0	0
Seroma	4	3	1
Wound infection	2	0	2
Scrotal edema	2	0	2
Urinary retention	0	0	0
Shoulder pain	4	0	4

Other unique complications of laparoscopic surgeries are port site hernias, hemorrhage due to injury to epigastric and gonadal vessels, hypotension, hypercapnia, and subcutaneous emphysema.

Minor intraoperative complications such as subcutaneous emphysema were encountered in 24% of cases of TEP, and it was never found in TAPP repair. Surgical emphysema was noted in 48% patients of bilateral TEP repair and 56% patients of pneumoperitoneum due to peritoneal breach encountered in a study by Philips et al. Pneumoperitoneum was easily managed by insertion of Veres needle at Palmer's point or repair of the peritoneal rent. No active management is required for subcutaneous emphysema. It usually resolves with time.

Postoperative Complications

In our study, the postoperative complications such as hematoma, seroma, wound infection, scrotal edema, urinary retention, and shoulder pain were reported in 0, 4, 2, 2, 0, and 4% cases in the laparoscopic hernia repair group (Table 17).

In the study done by Tehemton et al. wound infection rates were significantly lower after laparoscopic techniques (1%). Also, a surgical site infection (SSI) of 0.6–1.5% was observed by McCormack et al.[7] and Schmedt et al. in the laparoscopic method. Our study has comparable results with the above study regarding wound infection. Wound infection at the port site is managed with regular cleaning and dressing. One of the advantages of laparoscopic hernia repair is decreased incidence of SSI. A single shot of preoperative antibiotic can drastically lower the chances of postoperative SSI. Probable causes of SSI were high volume centers, not maintaining proper aseptic and antiseptic protocols, local site skin infections, lack of hygiene, and lack of usage of postoperative antibiotics. in our study, 2% of cases operated by TAPP developed port site infection most probably due to missed intraperitoneal infection. It is less in TEP as we remain outside the peritoneum while performing surgery and the peritoneum act as a barrier for infection to reach the port side.

In our study, no incidence of hematoma was recorded. In the study done by Tehemton et al., the incidence of inguinal hematoma was found to be significantly lower after the laparoscopic repairs (13.1%). McCormack et al. encountered 8.7% hematoma; Schmedt et al. found hematoma in 13.1%. Contrary to this, Phillips et al. had 0% hematoma in their patients. The incidence of hematoma formation in laparoscopic repair is comparatively low.

In our study, 4% of laparoscopic hernia repair patients develop seroma. In a study done by Tehemton et al., seroma formation was observed in (10%) by laparoscopic techniques. This shows that there is an increased incidence of seroma in laparoscopic repair, making it a disadvantage. The reason is, increase dissection is required in laparoscopic repair either to make preperitoneal space or to make

the peritoneal flap. In our observation low incidence is mainly due to meticulous dissection during surgery, packing with gauze pieces at the hernial defect site, and strapping with dynaplast to decrease the potential space for seroma collection. We can also prevent seroma formation by tucking pseudosac to the posterior abdominal wall with tacker and decreasing the potential space for seroma formation. We observed more seroma formation in TAPP which is about 3% out of the 4% of indirect hernia patients in our study mainly because of excessive dissection and pulling of the indirect hernial sac from the deep ring making it difficult to do hemostasis beyond deep ring which may be the cause. No active management is required for seroma. The seroma usually subsides within a month. We advise never to aspirate the seroma as it may introduce infection from outside into the seroma.

A total of 2% of our patients developed scrotal edema postoperatively in TAPP, and none of our TEP patients had developed scrotal edema. Mainly observed in patients with large complete indirect hernial defects; as such defects require excessive dissection and mobilization and the indirect sac can be dissected more meticulously by TEP as compared to TAPP according to our experience. No active management is required. The edema usually subsides within a month. We have prescribed chymotrypsin–trypsinogen and serratiopeptidase combination for oedema treatment.

In our study, 4% of the cases experienced shoulder pain in TAPP, which may be due to diaphragmatic irritation caused by carbon dioxide insufflation to create pneumoperitoneum, and this minor complication is never faced in TEP as pneumo preperitoneum is created rather than pneumoperitoneum.

Mesh infection is also a troublesome complication that requires the removal of the mesh. Mycobacterium other than tuberculosis (MOTT) can be cultured from infected mesh. Luckily, we did not encounter this kind of complication in our study because the mesh and mesh fixation devices used were sterilized by ethyline oxide sterilisation (ETO), and we usually take laparoscopic hernia as the first operation in our operative list to prevent infection.

Postoperative Pain

In our study, postoperative pain at 1 week of surgery was 26% which was of mild grade that is P1 according to VAS score in both TEP and TAPP laparoscopic repair method. No significant difference was found according to the SCUR trial for graded pain scores on the 7-day postoperative visit. During this visit, 72% of patients in the laparoscopic group, reported no pain. The veterans affairs (VA) trial found significantly less pain on the day of the operation and at 2 weeks in both TEP and TAPP methods by using a VAS.

Chronic pain is sometimes a debilitating complication for the patient and a more difficult problem for the surgeon to treat than perioperative pain and also the spectrum of severity is wide. Hence, this makes it more important for successful inguinal hernia repair.

In our study, postoperative pain at 3 months of surgery was found in only two patients (2%) in TAPP cases for which we could not find any reasons. None of our TEP patients had postoperative pain post 3-months follow-up. The laparoscopic group in the MRC trial, at 1 year after the operation, had a significantly lower rate of persistent groin pain. In the VA trial, incidence of neuralgia or other pain post 1 year after the operation was 9.8% in the laparoscopic group. Significantly a smaller number of cases of pain persisting post 1 year of either surgery was found according to The European Union meta-analysis.[8]

Table 18: Recurrence

Recurrence	*Current study (%)*	*MRC trial (%)*
Laparoscopic repair	0	1.9

Hence, there is evidence as per our study that laparoscopic surgeries show significant differences in both postoperative and persistent pain.

Recurrence

In our study, we found 0% recurrence in laparoscopic hernia repair cases. MRC laparoscopic hernia trial group found a 1.9% recurrence rate in the laparoscopic group. Results of recurrence are comparable for both TEP and TAPP in our study (Table 18). The most common reason for recurrence is improper dissection and separation of the hernial sac which might cause its inadequate reduction or other additional defects or hernias may be missed.[9] Incomplete mesh placement as in not covering the defect completely, the small size of mesh or not taking into account the contraction of mesh is another major reason for recurrence. It is now generally believed that the mesh size should be at least 10 cm × 14 cm[10] to cover all of the potential hernia sites, to provide at least 4-cm overlap with the hernia, and to avoid problems with mesh migration, shrinkage, and rolling. We kept 12 cm × 15-cm-sized mesh in both TEP and TAPP.

Duration of Hospital Stay

The mean duration of the hospital was found to be 2.17 days for the laparoscopic inguinal hernia repair. Since ours is a teaching institution the minimum time taken from admission to surgery is around 1 day hence making the duration of stay apparently longer. Choi et al.[3] had a mean hospital stay of 1.4 days for the laparoscopic method. Similarly, Phillips et al. in their study found a mean stay of 1.91 days for the laparoscopic method. This shows, there is decreased hospital stay in laparoscopic surgery. The mean duration of hospital stay in our study for TEP was 2.1 and for TAPP was 2.24. it is showing no major difference in hospital stay for TEP vs TAPP.

Cost of Surgery

The increased cost of surgery is a major drawback of laparoscopic hernia repair, and this increased cost is due to more expensive equipment, longer operative time, and more operative charges claimed by surgeons. Accurate evaluation of operative cost based on the type of procedure (TEP/TAPP), type and length of anesthesia, and the number of tackers used to fix the mesh. Laparoscopic instruments require a special sterilization technique (ETO), which also increases the cost. In the case of TAPP if the peritoneum flap is closed by the tackers, then as compared to TEP cost of surgery increases, and if the peritoneum flap is closed by intracorporeal suturing then the length of surgery will increase so in this domain TEP is better compared to TAPP.

Conclusion

The TAPP repair is useful in special circumstances like when there is diagnostic uncertainty if a hernia is present or not in a patient whose history and physical examination are unclear also in uncomplicated irreducible hernias or large-sized hernias. We can also look for the undiagnosed opposite-site hernia in TAPP as compared to TEP. Also, TAPP is preferred over TEP in patients with a hernia who have

had previous lower abdominal and pelvic surgery in the space of Retzius as it provides a wider approach to groin anatomy. Hernial sac contents can be easily seen with TAPP while it is not possible to see the content in the case of TEP. In this domain, TAPP is better than TEP. In the case of unilateral inguinal hernia if we perform TEP and if the patient develops a hernia on the opposite side later on in his/her life span then TAPP will be the surgery of choice because due to previous TEP repair preperitoneal space creation again by TEP method will become troublesome.

The patient selected for TEP repair is a unilateral as well as bilateral inguinal hernia but more useful for bilateral direct inguinal hernias, as it allows common preperitoneal space dissection.

Chances of potentially serious intraoperative complications like bladder injury, bowel perforation, and vascular injury are not commonly witnessed with both TEP and TAPP.

Fewer chances of scrotal edema in TEP compared to TAPP in our study and hematoma formation is usually not found in either, laparoscopic method.

Chances of hernial repair site seroma are more in laparoscopic repair as there is wide preperitoneal space dissection. In our study, seroma is more common in TAPP as compared to TEP reason behind it is balloon dissection in the right preperitoneal plane and hemostasis achieved more efficiently by letting the balloon inflate for 2–3 minutes. Which decreases the chances of seroma in TEP. We also used to pack the hernia defect site (potential space for the seroma formation) with a piece of thick gauze piece and strapped it with the dynaplast for an initial 3–4 days of postoperative dressing.

According to our comparison, the major advantage of TEP is decreased incidence of acute and chronic postoperative pain compared to TAPP in indirect hernia. The reason is, there are few chances due to meticulous dissection, particularly in the indirect sac.

Narrow working space and lack of triangulation of instruments make the TEP procedure more difficult than TAPP and is the reason behind the longer learning curve in TEP. However, once mastered TEP is less time-consuming and comparable with TAPP.

In both TEP and TAPP, early resumption of normal activity and days of disability are equal in our study as mean hospital stay is less and chronic pain is insignificant.

Fewer chances of mesh infection as the mesh is placed in preperitoneal space. However, chances of port site infection may be there in TAPP due to exposure to the intraabdominal cavity which might be already infected and missed in preop evaluation.

It is advisable to repair a recurrent hernia previously operated by open repair, by the laparoscopic method as a smaller number of adhesions are encountered and a smaller number of additional defects are missed. Both TEP and TAPP have equal benefits in such cases.

In both techniques of TAPP and TEP learning curve is more compared to open surgery while among both the laparoscopic methods of hernia repair learning curve in TEP is technically longer than TAPP.

Both TEP and TAPP have a steep learning curve and fearsome complications but once mastered, it is the safest and most efficacious technique. Because of the advantages and disadvantage of both techniques one should learn both of them.

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ORIGINAL ARTICLE

Clinical Profile and Laparoscopic Management of Hiatus Hernia: In a Tertiary Care Center

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Abstract

Aim: This study will be useful in evaluating the clinical profile of patients and to assess the outcome of laparoscopic and medical management of gastroesophageal reflux disease (GERD) with hiatus hernia.

Materials and methods: We retrospectively analyzed patients who were diagnosed with GERD and hiatus hernia over a period of 4 years and looked for outcomes of laparoscopic fundoplication.

Results: A total number of 30 cases between January 2018 and December 2021 were included in this retrospective study with male-to-female ratio of 2:1. Most patients with GERD present with abdominal pain which is localized to the epigastric region. About 72.1% (p-value = < 0.005) of patients had mainly reflux symptoms such as epigastric pain, heartburn, or regurgitation, of which, epigastric pain was the most common (68%). In our study, the most common investigation performed was upper gastrointestinal endoscopy which was able to highlight an underlying pathology in terms of hiatal hernia in 38.5% (p-value = 0.019) patients. Proton pump inhibitors were used more frequently in patients and outcome of medical management varied. Laparoscopic fundoplication is the standard surgical treatment for GERD and has very low complication rates. On routine follow-up of all patients treated surgically for GERD, 67% (p-value = 0.007) had complete symptomatic relief in contrast to medical management, wherein only 22% of patients had long-term symptomatic relief.

Conclusion: Laparoscopic total fundoplication is fast being adopted as the surgical gold standard for the treatment of GERD after appropriate trial of medical management among the population presenting in an Indian tertiary care hospital.

Clinical significance: The study results would improve treatment outcomes in patients with hiatus hernia.

Keywords: Gastroesophageal reflux disease, Hiatus hernia, Laparoscopic fundoplication, Proton pump inhibitors, Retrospective comparative study, Upper gastrointestinal endoscopy.

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Introduction

Hiatal hernia refers to the displacement of abdominal organs, most commonly the stomach, through the esophageal hiatus of the diaphragm into the mediastinum. The prevalence of hiatal hernia increases with age and is present in over 50% of the aged population.[1] Gastroesophageal reflux disease (GERD) is a motility disorder characterized primarily by heartburn and caused by the reflux of gastric contents into the esophagus. Most cases can be diagnosed on the basis of clinical history; diagnosis can generally be made with reasonable certainty if the patient complains of heartburn and regurgitation of gastric contents.[2] Clinicians should develop a care plan for the investigation of symptoms suggestive of GERD, selection of therapy (with an explanation of potential risks and benefits), and long-term management, including possible de-escalation, in a shared decision-making model with the patient.[3] Total fundoplication (TF) is an effective treatment for patients with GERD symptoms, particularly in those with persistent regurgitation despite proton pump inhibitor (PPI) therapy, based on evaluation 6 months after the procedure.[4]

Objectives

This study will be immensely useful in evaluating further the outcome of laparoscopic surgery in tertiary care centers. In this context, our goal is to:

- Evaluate the clinical profile of patients with GERD with hiatus hernia.
- Assess the outcome of laparoscopic management of GERD with hiatus hernia.
- Know the outcome of medical management of GERD with hiatus hernia.

Materials and Methods

This study was a hospital-based retrospective study wherein we compiled data from all the patients who were diagnosed with GERD and hiatus hernia between January 1, 2018 and December 31, 2021. The data consisted of the patient demographics, their clinical symptoms, investigations for diagnosis, treatment, and follow-up records until 6 months after their surgical/medical management. These data entries were obtained from the patient records using electronic medical record and collected using Microsoft Excel.

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Conflict of interest: None

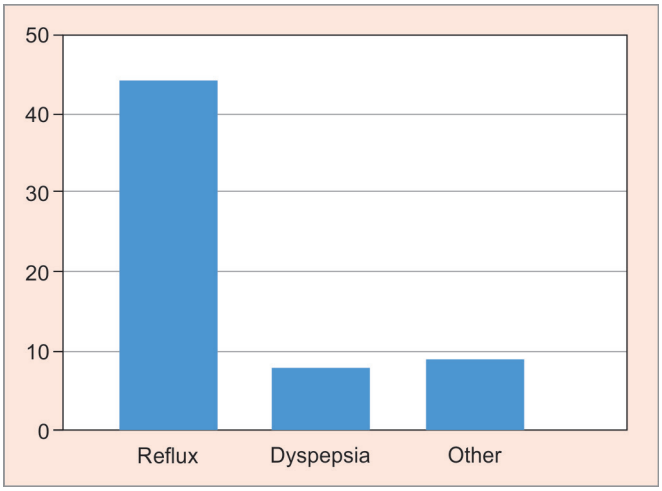

Fig. 1: Distribution of symptoms

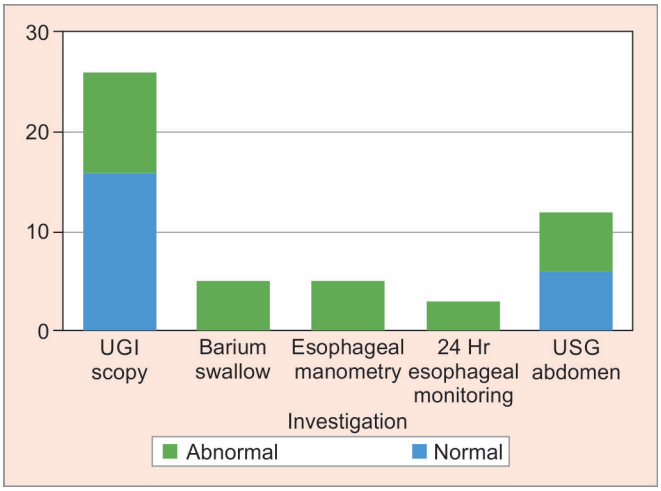

Fig. 2: Diagnostic investigations

The entries were analyzed using IBM SPSS 23.0 for Windows. All categorical and quantitative variables were presented as frequencies and percentages and were compared by Chi-squared test for trend. All statistical analyses were carried out for two-tailed significance, and $p < 0.05$ was considered significant.

Results

A total number of 30 cases between January 2018 to December 2021 were included in this retrospective study. The maximum and minimum age was 19 and 74 years, respectively. The most common age-group with symptoms of GERD was observed to be 51–60 years. There was a total of 20 male patients and 10 female patients giving a male-to-female ratio as 2:1.

Most patients with GERD present with abdominal pain which is localized to the epigastric region. In our study, all 30 patients had this common presentation. We divided the symptom presentation broadly into reflux symptoms, dyspepsia symptoms, and other symptoms such as vomiting, dysphagia, and early satiety. A graphic presentation of the same is shown in Figure 1. According to our study, 72.1% (p-value = < 0.005) of patients had mainly reflux symptoms such as epigastric pain, heartburn, or regurgitation, of which, epigastric pain was the most common (68%). Loss of appetite was also a common complaint in 13.3% of cases whereas dyspepsia symptoms including bloating and belching in total accounted for 13.1% of cases. The graphic distribution of all symptoms observed is shown in Figures 1 and 2.

Few patients ($n = 5$) presented with gastric complaints such as diarrhea, constipation, or alternating diarrhea and constipation. Cholelithiasis was also an incidental finding in four patients.

Underlying comorbidities also have a significant bearing on the treatment outcome. Among the cases collected, 26.6% of patients ($n = 8$) had underlying hypertension, 13.3% of patients had diabetes mellitus, and 10% of patients had a history of previous ischemic heart disease. About 50% of cases ($n = 5$) who underwent laparoscopic fundoplication had an underlying comorbidity.

Diagnosis of GERD requires various investigation modalities such as upper gastrointestinal (GI) scope, barium swallow, esophageal manometry, and 24-hour esophageal monitoring. In our study, the most common investigation performed was upper GI endoscopy in 26 patients. The scopy was able to highlight an underlying pathology in terms of hiatal hernia in 38.5%

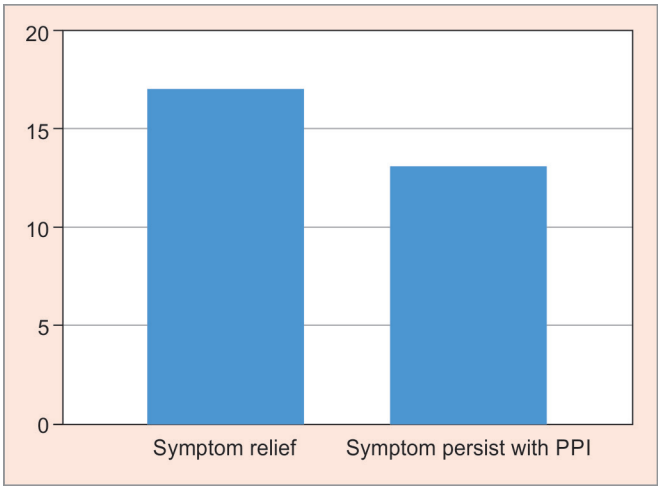

Fig. 3: Outcomes of medical management

(p-value = 0.019) of patients. Esophageal manometry and 24-hour esophageal monitoring were the most accurate investigations that gave a better visualization of gastric reflux into the esophagus. All the patients who underwent these investigations were taken up for laparoscopic fundoplication later (Fig. 3). Other investigations such as ultrasound (USG) abdomen were able to provide an inconclusive diagnosis in only 6% of cases ($n = 2$).

Initial management for all patients was medical using PPIs, H2-receptor antagonists (H2RAs), or prokinetic agents. Proton pump inhibitors were used more frequently in patients treated empirically, with Pantoprazole being the most commonly given medicine, followed by esomeprazole and rabeprazole. Antacids were also added in a few patients. The outcome of medical management varied as some patients (56.7%, $n = 17$) had symptom relief by solely medical management, while others (43.3%, $n = 13$) had persistent symptoms (Fig. 4). This ratio was statistically significant ($p = 0.0014$) and highlights the importance of PPI and H2RA on short-term treatment of GERD.

The need for a surgical correction was observed in patients in whom symptoms were persistent even with the use of PPI (50%, $n = 6$), in patients where symptoms recurred after stopping of PPI (33%, $n = 4$), or in patients who were dependent on PPI

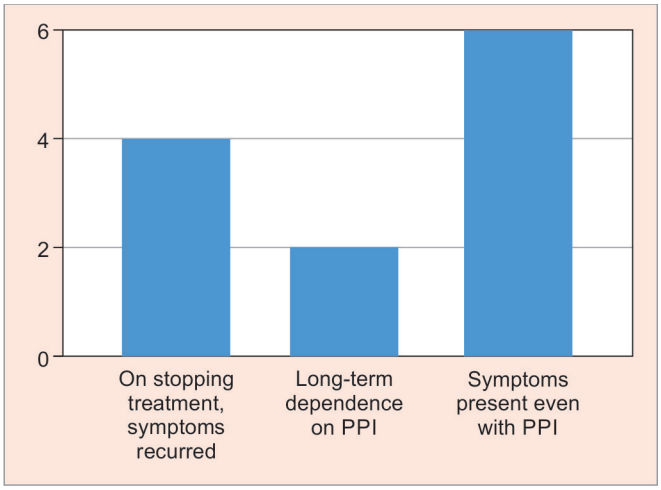

Fig. 4: Reasons for surgical management

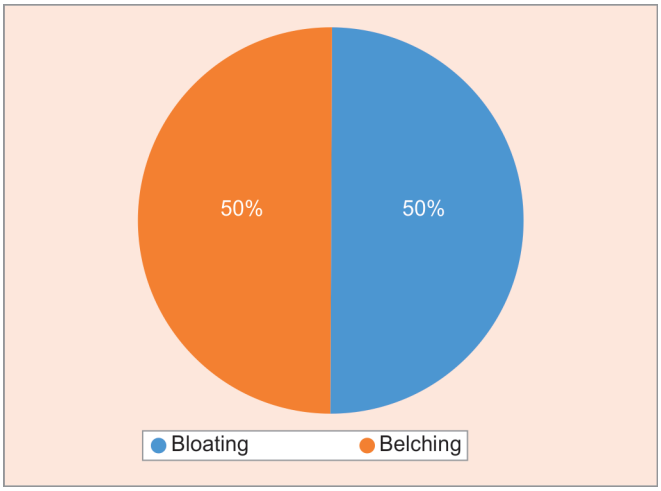

Fig. 5: Dyspepsia symptoms

for long term (17%, $n = 2$; Fig. 5). Laparoscopic fundoplication is the standard surgical treatment for GERD and has very low complication rates. In our study, 40% of patients ($n = 12$) underwent laparoscopic fundoplication. We observed that only 1 out of these 12 patients who underwent surgery had immediate postoperative complications of subcutaneous emphysema and postoperative urinary retention. Two other patients had remote postoperative complications with loose stools and tightness or symptoms relapse with reflux symptoms (p-value < 0.05) (Fig. 6).

On routine follow-up of all patients treated surgically for GERD, 67% (p-value $= 0.007$) had complete symptomatic relief even up to 6 months of treatment. This was in contrast to medical management, wherein only 22% of patients had long-term symptomatic relief.

Discussion

According to the Montreal Classification and Description, Global Consensus Group, GERD is a disorder that develops when stomach acid refluxes into the esophagus and creates bothersome symptoms and/or issues. There are two types of GERD: erosive and nonerosive reflux disease (NERD). The class of symptoms known as

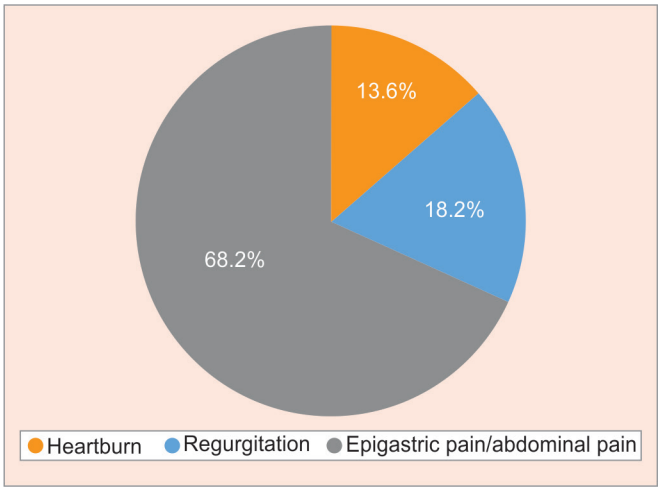

Fig. 6: Reflux symptoms

"erosive" includes those that show esophageal mucosal injury. The NERD group includes signs of esophageal mucosal injury but no endoscopic proof of it. In NERD, PPIs have a low symptom response rate.[5] Women report heartburn and regurgitation symptoms more frequently than men do.[4] In the adult population of the US, the incidence of GERD is 5 per 1,000 person-years. Our study, however, saw a ratio of 2:1 for men and women, respectively, mostly in the 51–60 years age-group.

According to a retrospective study by the Stanford University School of Medicine, heartburn and acid regurgitation were the most prevalent symptoms in the cohort, and they were all resistant to PPI medication.[6] Dysphagia and chest discomfort were not the most common complaints. In our study, 72% had reflux symptoms of which epigastric discomfort was the most prevalent. While loss of appetite was observed in 13.3% cases and other dyspeptic symptoms were far less common.

The AGA clinical practice update states that if persistent heartburn, regurgitation, and/or noncardiac chest pain do not respond sufficiently to a PPI trial, or if warning symptoms exist, doctors should perform an endoscopy. Thereafter, in the absence of erosive reflux disease (Los Angeles B or greater) or long-segment (3 cm) Barrett's esophagus, it is recommended to perform prolonged wireless pH monitoring off medication (96 hours recommended if feasible) to confirm and characterize GERD.[3] We concluded that while upper GI endoscopy was the most basic investigation showing an underlying abnormality for the reflux in 38.5% of cases, other investigations were more specific to demonstrate the reflux *per se*. In individuals treated empirically and in those with endoscopy-negative reflux disease, PPIs are more efficient than H2RAs, but H2RAs are also beneficial.[7]

Refractory symptoms (symptoms that may or may not be related to GERD), refractory GERD symptoms (symptoms that persist in individuals with established GERD regardless of relation to continuous reflux), and refractory GERD should all be distinguished from one another.[8] About 56.7% of patients had symptomatic relief with medical management, but others presented later with symptom persistent and were taken for further evaluation. An initial management strategy that places a strong emphasis on the proper use of PPIs will result in a complete response in about 80% of patients.[2]

A recent open-label randomized controlled trial comparing PPI treatment with TF found that TF was superior to PPI in controlling problematic GERD symptoms, with 54% of patients reaching normalization of intraesophageal pH after TF.[4] Our routine follow-up proved 67% success rates for patients treated surgically.

A retrospective analysis of 50 surgical cases of GERD in Japan revealed that just four patients (8%) had postoperative problems, which is very comparable to our study (8.3%). They also determined in their study utilizing the frequency scale for the symptoms of GERD—that there was a considerable improvement in postoperative symptoms, which accounted for a 90% overall efficacy rate.[9]

Dallemagne et al. summarized that laparoscopic fundoplication can be used as a "gold standard" treatment of GERD among appropriately investigated and selected individuals.[10] Our study is limited by a small sample size and the population is limited to one tertiary care center. However, the results obtained contrast the reasons for outcomes observed in surgical as well as medical management of GERD.

Conclusion

Laparoscopic TF is fast being adopted as the surgical gold standard for treatment of GERD after appropriate trial of medical management, and our study reaffirms this concept among the population presenting in an Indian tertiary care hospital. This study sheds light on the high efficacy of PPI regimens and the utility of laparoscopic fundoplication in necessitated patients toward providing adequate relief from GERD symptoms.

Clinical Significance

The study results would improve treatment outcomes in patients with hiatus hernia.

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ORIGINAL ARTICLE

Laparoscopic Cholecystectomy in Gangrenous Cholecystitis

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Abstract

Introduction: Gangrenous cholecystitis (GC) is difficult to diagnose preoperatively. A delay in diagnosis leads to increased complications. A high index of suspicion followed by early surgery leads to increased chances of laparoscopic cholecystectomy with decreased morbidity and early discharge. The aim of the study was to study the demographics, contrast-enhanced computerized tomography (CECT) and magnetic resonance imaging (MRI) findings, type of procedure (laparoscopic/open), and the outcome of the patients.

Materials and methods: A retrospective study was undertaken on GC patients. Patients were divided into three groups depending upon the type of surgery (LC, OC, LC-OC). Patient demographics, comorbidities, preoperative biochemical, CECT, MRI findings, time taken from admission to surgery, type of surgery, post-op complications, and length of stay were compared.

Results: During a 5-year period, a total of 55 patients were diagnosed with GC. Of these cases, 47.27% underwent laparoscopic cholecystectomy (LC), 41.82% were treated with OC, and the remaining 10.91% had a combination of LC and OC. The median age of the patients was 58.12 ± 16.66 years, 65.65 ± 11.13, 58.16 ± 12.79 years in LC, OC, LC-OC groups respectively. The male to female ratio was 1.4:1. Approximately 45.45% of the individuals had hypertension, while 41.81% were diagnosed with diabetes. Additionally, 16.36% of the patients were found to have coronary artery disease (CAD), and 14.54% were undergoing antiplatelet therapy. Moreover, leukocytosis was observed in 40% of the patient cases. The conversion rate from laparoscopic procedure to open procedure was 18.75%. Postoperative morbidity was seen in 18.18% of patients. Average hospital and ICU stay in the LC group was the shortest (3.76 ± 1.94 days, 0.53 ± 1.38 days respectively). Hospital and ICU stay in the OC group was 10.8 ± 5.76 and 2.43 ± 5.35 days respectively. The average stay of the LC-OC group in the hospital and ICU was 9 ± 6.75 and 3.5 ± CECT 68 days. The *p*-value for hospital and ICU stay was 0.0001 and 0.0179 respectively.

Conclusion: A high index of suspicion, and increased use of CECT and MRI in suspected cases followed by early LC leads to favorable outcomes in GC.

Keywords: Cholecystitis, Gangrenous, Laparoscopic.

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Introduction

Gangrenous cholecystitis (GC) is a severe form of acute cholecystitis (AC).[1] It results from increasing vascular insufficiency resulting in mural infarction, necrosis, and perforation of the gall bladder (GB).[2,3] Treatment of GC is challenging due to difficulty in preoperative diagnosis, increased intraoperative complications, and more morbidity and mortality postoperatively.[1,4,5] Early preoperative diagnosis of GC is essential to reduce delays in surgery. Preoperative evaluation of GC requires cross-sectional imaging techniques like computed tomography and magnetic resonance.[6] Management of GC is similar to AC, i.e., laparoscopic cholecystectomy (LC).[7] Early LC in GC can decrease the incidence of complications.[8,9] The threshold for conversion to open surgery should be kept low in patients with GC.[10] Conversion rates in GC are higher varying from 14 to 35% compared to non-GC AC (3.4–7%).[4,11,12] In our study, we reviewed the records of patients with GC. Demographics, radiological and histopathological findings, and postoperative complications of the patients with GC were noted. The time taken from admission to surgery and hospital and intensive care unit (ICU) stay of patients who underwent LC, OC, and LC-OC were compared.

Materials and Methods

This retrospective observational study was conducted in Fortis Hospital, Mohali from 2010 to 2015 after necessary approvals from the Institutional Ethics Committee. We reviewed data of patients who underwent cholecystectomy for cholecystitis in the above period. Patients who were diagnosed with GC on histopathology examination were included. The study was approved by the institutional ethics committee. The study population was divided into three groups based on the type of surgical procedure, i.e., laparoscopic cholecystectomy (LC), open cholecystectomy (OC), and laparoscopic cholecystectomy converted to open cholecystectomy (LC-OC). For each patient medical record was analyzed for the demographics (age, gender), preexisting comorbidities [hypertension (HT), diabetes mellitus (DM), coronary artery disease (CAD)], etc., preoperative manifestations (upper abdomen pain, vomiting, and fever), preoperative laboratory

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examination [leukocytosis, total serum bilirubin (TSB), aspartate transaminase (AST), alanine transaminase (APT) and serum creatinine]. Preoperative radiological findings on contrast-enhanced computerized tomography (CECT) of the abdomen and magnetic resonance imaging (MRI) of the abdomen were also analyzed. Intraoperative findings, histopathology examination features, postoperative morbidity, and length of hospital and ICU stay were compared for the three groups.

Results

In the study period, 55 cases of GC were identified. About 26 (47.27%) patients underwent LC, OC was performed in 23 (41.82%) and LC was converted to OC (LC-OC) in 6 (10.91%) patients. In the LC group 13 patients were male and 13 were female (50% each), in the OC group 14 (60.87%) were males and 9 (39.13%) were females, while in the OC-LC group 5 (83.33%) were males and 1 (16.66%) was female. The median age of the patients in the LC, OC, and LC-OC groups was 58.12 ± 16.66 years, 65.65 ± 11.13 years, and 58.16 ± 12.79 years respectively. Patients with hypertension accounted for 45.45% (25 patients), while 41.81% (23 patients) were diagnosed with diabetes. Moreover, 16.36% (9 patients) had CAD, and 14.54% (8 patients) were on antiplatelet therapy. Preoperatively leukocytosis was seen in 22 (40%) patients, raised bilirubin in 13 (23.63%) patients, impaired AST/ALT in 7 (12.72%) and raised alkaline phosphatase in 6 (10.90%) patients. Creatinine was raised in 8 (14.54%) patients. CECT abdomen was done preoperatively in 15 patients. GB distension (60%), gall stones (53.3%), wall thickening (53.3%), irregular or absent wall (40%), and a pericholecystic fluid (40%) were the common findings. Few patients had pericholecystic abscess (20%), adjacent liver changes (13.34%), and mural striations (6.67%) on the CECT abdomen. Magnetic resonance imaging abdomen was done in 23 patients. Distended GB with the edematous wall was the commonest finding (78.26%) on MRI, followed by irregular mucosal surface (47.82%) and absence of enhancement of wall (43.78%). Time taken from admission to surgery was 0.84 ± 1.54, 3 ± 4.75, 0.66 ± 0.55 days in LC, OC, LC-OC groups respectively with *p*-value = 0.0008.

During cholecystectomy adhesions were the commonest finding (80%), distended GB was seen in 50.9% and thick GB wall was present in 30.9%. Gall bladder was perforated in 29.09%, and bile or pus in the abdomen was seen in 9.09%. Histopathological examination findings of resected specimens were mucosal ulceration (98.18%), diffuse edema (74.55%), prominent thickening of the wall (60%), and necrosis (52.72%). Postoperative morbidity was seen in 10 (18.18%) patients. four patients had wound infection, delirium, and atrial fibrillation was seen in two patients each, and one patient each developed myocardial infarction and bronchospasm. Average hospital and ICU stay in the LC group were the shortest (3.76 ± 1.94 days, and 0.53 ± 1.38 days respectively). Hospital and ICU stay in the OC group was 10.8 ± 5.76 and 2.43 ± 5.35 days respectively. The average stay of the LC-OC group in the hospital and ICU was 9 ± 6.75 and 3.5 ± 6.8 days. The *p*-value for hospital and ICU stay was 0.0001 and 0.0179 respectively.

Discussion

We performed a retrospective study to analyze the demographics, radiological findings, time from diagnosis to surgery, safety of laparoscopic surgery, postoperative complications, and a hospital stay of patients with GC.

Gangrenous cholecystitis is a rare but serious complication of AC. The pathophysiology is GB distension resulting in increased tension and pressure on the GB wall. The distension leads to ischemic changes and necrosis of the GB wall. Inflammation and ischemia of the GB wall show progressive worsening with age due to deteriorating venous insufficiency with age, resulting in more necrosis and perforation.[13,14] Various studies have shown that the risk of developing GC is higher in males as compared to females.[2,15] Our study showed a male:female ratio of 1.4:1, which is similar to a study by Saber et al.[16] With increasing age the incidence of GC rises, Yacoub et al. reported age >45 years as a risk factor for GC.[17] Fang and Yerkovich reported in their studies the median age of patients of GC was 65 years, this is also similar to the study of Hunt and Chu.[2,18] Fang et al. also demonstrated an independent association of age with GC, and each 5-year increase in age was associated with an 18% increase in the likelihood of GC.[2] Our study also showed similar findings with a median age of patients in LC, OC, and LC-OC groups as 58.12 ± 16.66, 65.65 ± 11.13, and 58.16 ± 12.79 years respectively.

The majority of the patients had one or more comorbidities in this study. In the patient cohort, there was a prevalence of hypertension in 45.45% of cases, diabetes in 41.81% of cases, and a prior history of CAD in 16.36% of cases. Various other studies have also documented similar findings.[2,3,18] The theory purported in literature is that atherosclerosis of cystic artery may contribute to vascular insufficiency which leads to the development of GC.[19] Fang and Yerkovich reported a novel association between antiplatelet medication and GC.[2] Our study also showed that 14.54% of patients were on antiplatelet medications with the number being more in OC (26.08%) and LC-OC group (16.6%). This finding is also consistent with the pathophysiological theory that proposes vascular insufficiency due to atherosclerosis leads to the development of GC.[19]

Leukocytosis was present in 22 (40%) patients. Leukocytosis as an independent predictor of GC has been shown in many studies.[2,17] Findings in preoperative CECT abdomen were GB distension (60%), GB wall thickening (53.3%), gallstones (53.3%), irregular or absent wall (40%), and pericholecystic fluid (40%). Other findings were pericholecystic abscess (20%), liver changes (13.34%), and mural striations (6.67%). Various studies have reported similar findings in CT in patients of GC.[20,21] Magnetic resonance imaging abdomen showed distended GB with the edematous wall (78.26%), irregular mucosal surface (47.82%), and absence of wall enhancement (34.78%). Similar findings have been reported in other studies as well.[20,21]

We also studied the time taken from admission to surgery for the patient. This was found to be significantly less (*p*-0.00080) in LC patients (0.84 ± 1.54 days) as compared to the OC group (3 ± 4.75 days). Thus, validating the theory that early surgery leads to better results and increased chances of laparoscopic surgery. Delayed surgery due to delay in diagnosis can lead to more chances of open surgery and prolonged stay in the hospital. The conversion rate of LC to OC was 18.75% in our study. Various studies have reported conversion rates varying from 14 to 35% for GC.[4,11,12] Dense adhesions, insufficient anatomic exploration, bleeding, and injury to the bile duct are the main causes of conversion to open.[19] In our study also adhesions, GB perforation, and thick GB walls were found in patients who underwent LC-OC.

Postoperative hospital stay of patients was significantly shorter in patients undergoing LC as compared to patients with open

Table 1: Demographic characteristics of Patients with GC

Characteristics	*LC*	*OC*	*LC-OC*
Number	26 (47.27%)	23 (41.82%)	6 (10.91%)
Male	13 (50%)	14 (60.87%)	5 (83.33%)
Female	13 (50%)	9 (39.13%)	1 (16.66%)
Median age (years)	58.12 ± 16.66	65.65 ± 11.13	58.16 ± 12.79
Hypertension	9 (34.62%)	11 (47.83%)	5 (83.33%)
Diabetes	10 (41.67%)	10 (52.63%)	3 (50%)
CAD	2 (7.69%)	5 (21.74%)	2 (33.33%)
Antiplatelet therapy	1 (3.8%)	6 (26.08%)	1 (16.6%)

Table 2: Clinical parameters

Parameter	LC *n = 26*	OC *n = 23*	*LC-OC n = 6*	*Lap to open n = 6*
Vomiting	9	11		6
Fever	1	6	0	1
Leukocytosis	7	12	3	0
LFT impairment	5	6	3	3 (50%)
Time from admission to surgery $p = 0.0008$	0.84 ± 1.54	3.0 ± 4.75	0.66 ± 0.51	0.66 ± 0.51

Table 3: CT findings ($N = 15$)

Findings	*n*	*%*
Irregular or absent wall	6	40
Pericholecystic abscess	3	20
Mural striations	1	6.67
Pericholecystic fluid	6	40
Gall stone	8	53.3
Adjacent liver changes	2	13.34
Distension	9	60
Wall thickening	8	53.3

procedure ($p = 0.0001$). Similarly, ICU stay was also short in the LC group when compared to OC patients (0.0179). Postoperative morbidity was 18.18% in this study. While no postoperative morbidity was observed in the LC group; OC and LC-OC groups reported wound infection, bronchospasm, myocardial infection, and atrial fibrillation in the postoperative period. Previous studies have reported reduced postoperative morbidity and mortality in patients of GC who underwent LC.[18,22] Girgin et al. reported that the type of surgery does not have any effect on morbidity, and mortality of patients so LC can be safely attempted in patients with GC (Tables 1 to 6).[23]

Conclusion

A high index of suspicion and early surgical intervention in GC patients helps in achieving optimum results. Increased and early use of imaging modalities like CECT and MRI abdomen in AC patients can help in the early diagnosis of GC. Laparoscopic cholecystectomy in GC patients is the appropriate surgical approach. Laparoscopic cholecystectomy reduces postoperative morbidity, but OC should be used where required to ensure patient safety.

Table 4: MRI findings

Findings	*n*	*%*
Absence of enhancement of wall	8	34.78
Irregular mucosal surface	11	47.82
Distended GB with edematous wall	18	78.26

Table 5: Post OP morbidity

	LC	*OC*	*LC-OC*
MI	0	1	0
Bronchospasm	0	1	0
Wound infection	0	3	1
Delirium	0	1	1
Atrial fibrillation	0	1	1
Total	0	7 (30.4%)	3 (50%)

Table 6: Hospital stay

	LC	*OC*	*LC-OC*
Hospital stay (days) $p = 0.0001$	3.76 ± 1.74	10.08 ± 5.76	9 ± 6.75
ICU stay (days) $p = 0.0179$	0.53 ± 1.58	2.43 ± 5.35	3.5 ± 6.8

Clinical Significance

Elderly patients of cholecystitis with leukocytosis should be investigated for GC with CECT and MRI and early surgery should be planned for them for optimum results.

Author Contributions

Dr Preetinder Brar: Research design, writing of paper, performance of research, data analysis.
Dr Iqbal Singh: Performance of research, review and editing.
Dr Hemant Yadav: Research, review and editing.
Dr Saraansh Bansal: Writing of paper, research and data analysis.
Dr JD Wig: Research design, writing of paper, performance of research, data analysis, review and editing.

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ORIGINAL ARTICLE

The Assessment of Perioperative Outcome and Cost-effectiveness of Laparoscopy versus Open Surgery in the Management of Periappendiceal Abscess: A Comparative Multicentric Study

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Abstract

Aim: To investigate the perioperative outcomes and cost-effectiveness of the laparoscopic approach for patients with periappendiceal abscess (PA) in comparison with the open approach. The controversy is still evolving as regards laparoscopic surgery in cases with complicated appendicitis in general.

Materials and methods: Three-center analysis of the records' data of candidates >14 years of age with PA operated from January 2017 until October 2020 by either laparoscopic or open approach. Demographic and clinical data, perioperative outcomes, and cost-effectiveness were recorded and analyzed.

Results: Within the study period, 399 eligible cases with PA were identified by clinical evaluation conjoined with the US and/or CT, of which 143 patients underwent laparoscopic appendectomy (LA) and 256 patients had an open appendectomy (OA). The average operating time was 78 minutes for the LA group and 62 minutes for the OA group ($p < 0.001$). The mean hospital stay was 6.3 days for LA and 7.4 days for the OA group ($p < 0.001$). There were 18 cases in the LA group who had surgical site infections, and there were 27 ones in the OA group ($p = 0.001$). There were six patients who suffered from a recurrent intra-abdominal collection in the LA group and four cases in the other group ($p = 0.37$). Laparoscopic appendectomy had a lower odds for the development of any specific surgical complication in the multivariate analysis (OR, 0.381, $p = 0.008$). The total expenses of management were marginally higher by about $300 in the LA group.

Conclusions: Laparoscopic appendectomy is an efficient and safe operative approach in the management of PA, and it exhibits clinically beneficial merits over OA against marginally longer operating time and higher management expenses.

Clinical significance: Laparoscopic surgery for appendicitis complicated with an abscess is feasible and safe. It offers beneficial merits over the open approach.

Keywords: Appendicitis, Appendectomy, Laparoscopy, Open surgery, Periappendiceal abscess.

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Introduction

The surgery of open appendectomy (OA) has become the gold standard for the management of acute appendicitis (AP). However, the operation of appendectomy itself has remained unchanged for more than a century, and the treatment of periappendiceal abscess (PA) is controversial.[1–3] Open surgery for PA is technically difficult and may be associated with surgical complications (SCs). Moreover, persistent complaints, recurrent intra-abdominal abscesses, and multiple healthcare visits can complicate drainage techniques followed by interval appendectomy (IA).[4,5]

Till now, there is no standard universal treatment policy among various physicians. The literature comparing urgent operative intervention and nonoperative management has increased nowadays investigating the nonoperative issue or the IA. Although the nonoperative strategy was advised by many reviews and meta-analysis, because it was accompanied by a lower rate of complication and morbidity,[6,7] one prospective research[6] concluded that urgent surgical treatment was superior

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to the nonoperative approach. Other publications did not show any clinically important differences between the two strategies.[8]

The postoperative complications are a significant issue for urgently operated cases, with surgical site events being in up to 17% of cases; additionally, operative intervention may result in ileocecal resection or right hemicolectomy.[9] Laparoscopic appendectomy has acquired the favorability of many hospitals worldwide. It was recommended by various researchers and meta-analysis,[10–12] to be an amenable and efficient approach, with many clinical merits, like the reduced incidence of surgical site infection (SSI), less postoperative ileus, less postoperative pain, reduced length of hospital stay, and early return to daily activities. As LA was accompanied by a lowered risk of postoperative complications, it may represent a considerable alternative for urgent treatment of PA than IA and an urgent open approach. But there are still limited studies that compare LA with OA and the development of SCs. The objective of this comparative activity was to perform a comparison of the perioperative outcomes (length of hospital stay, operative time, SCs, start to oral feeding, and return to daily work) and cost-effectiveness in LA vs OA in these cases with PA.

Materials and Methods

Study Design and Patient Population

A three-center observational study had been conducted, after securing ethical approval from our local institutional research board, for the analysis of the records' data of candidates diagnosed with PA and they had been operated on within the period from January 2017 until October 2020 either by laparoscopic or open approach. Out of 4,133 patients with AP who underwent operations in our institutions, 399 eligible cases with PA were identified by clinical evaluation conjoined with the US and/or CT. These patients were divided into the LA group (143 patients) if they had LA, and the OA group (256 patients) if they had an OA, solely based on the surgeon's approach and patient criteria. The study was ethically conducted in accordance with the Declaration of Helsinki.

Inclusion Criteria

All patients >14 years of age with a postoperative diagnosis of a well-defined PA, which was identified by clinical evaluation conjoined with the US and/or CT, were recruited. PA was defined if the localized abscess was present exclusively in the right lower quadrant or extended to the pelvic region. All cases with percutaneous interventional drainage, generalized peritonitis. History of major open abdominal surgery, pregnancy, and severe medical comorbidities that preclude pneumoperitoneum were excluded from the research.

Surgical Technique

All patients of both groups received preoperative intravenous third-generation cephalosporins and metronidazole. A Foley catheter and nasogastric tubes were inserted as needed.

All surgeries were performed by an attending senior member (Staff or Fellow) of the general surgery department of our three centers. The operative technique was decided according to the operator's preference. LA was performed using open or closed methods for pneumoperitoneum and the approach of three ports was performed. According to the surgeon's preference, an additional 5-mm port might be needed. Cautious dissection of periappendiceal adhesions was done. Suction drainage of PA was completed after taking swabs. Control of the mesoappendix was secured with vessel sealing devices or clips before cutting it. Amputation of the appendix was done after intracorporeal or extracorporeal ligature of the base and extraction using endobag was done. Copious irrigation with warm saline solution and lavage was done based on the operator's preference. A suction drain was left as needed. Open appendectomy was performed by making an Mc Burney's incision with or without extension. Postoperative assessment of pain was achieved using the visual analog scale (VAS) on the first postoperative day (POD1) and analgesia was given accordingly. Analgesics in the form of NSAIDs were administered as required by patients. Intravenous fluids were administered to all patients until the return of bowel function when oral intake of clear fluids was started.

Consent for publication: Available
Availability of data and materials: Available

The Variables of Patients' Follow-up Evaluation

Data of all patients were recorded including demographic data, clinical manifestations, intraoperative events, postoperative monitoring pieces of information, and postoperative complications (early or late).

Any deviation of the expected known postoperative course was defined as a primary SC. Surgical site infection, recurrent abscess formation, and ileus were recorded as being specific SC. Readmission and 30-day mortality were the secondary ones. Also, readmissions and reoperations were recorded. Incisional hernia and attacks of mechanical bowel obstruction were followed up as a long-term specific SC.

Statistical Analysis

The data were collected, revised, tabulated, coded, and fed into a PC using the SPSS 26 (IBM Corp., Armonk, N.Y., USA) software. Data were presented and suitable analyses were carried out based on the data type gained for each parameter. Frequencies and percentages were used for representations of categorical data and their comparison was accomplished using the Chi-square test. The mean and standard deviation were used to represent parametric and nonparametric continuous data which were evaluated by the student's *t*-test, and Mann–Whitney *U* test respectively was done for using the variables mentioned before and was analyzed using Logistic regression to identify the presence of SC and their risk factors. An intention-to-treat basis was the cornerstone of this comparative analysis between the two groups. Thus, the cases in the laparoscopic-assisted group that were converted to OA were not excluded, but they were transferred to cases of an open one. If the p-value was ≤ 0.05, it was considered statistically significant.

Results

Demographic Data and Clinical Characteristics

The demographic and clinical features of the recruited patients according to LA or OA approach are presented in Table 1. Among the 399 cases eligible for this study, 149 patients (37.4%) had LA. About 6 cases were converted from LA to the OA approach and were added to the OA group. In this observational study, the demographic and clinical features of the study sample were very similar with no significant differences between the two groups in the gender distribution, body mass index, comorbidities, and ASA assessment.

Table 1: The demographic and preoperative clinical data of the eligible cases

The demographic features	*LA group (143) N (%)*	*OA group (256) N (%)*	*p-values*
Age, y (mean ± SD)	36.3 ± 3.7	38.12 ± 2.6	0.341
Male: female	80:63	154:102	0.382
Body mass index	23.9 ± 3.4	25.8 ± 3.5	0.546
Co-morbidities	33 (23.0%)	45 (17.6%)	
CAD	5 (3.5%)	6 (2.3%)	
Hypertension	15 (10.4%)	18 (7%)	
COPD	8 (5.6%)	9 (3.5%)	
DM	5 (3.5%)	12 (4.7%)	
ASA I, *N* (%)	101 (70.6%)	190 (74.2%)	
II	42 (29.4%)	51 (19.9%)	
III	0	15 (5.8%)	
IV, V	00	00	
The preoperative clinical data			
Abdominal pain	136 (95)	238 (92.9)	0.471
Vomiting	76 (53.1)	135 (52.7)	0.303
Fever	91 (63.6)	157 (61.3)	0.339
Duration of presentation in days (mean ± SD)	4.3 ± 2.6	5.9 ± 3.6	0.238
Heart rate (beat /min)	91.5 ± 22.8	88.6 ± 19.4	0.64
WBC, $\times 10^9$/L	16.7 ± 3.2	17.2 ± 3.6	0.144
Size of abscess (cm)	4.1 ± 1.6	4.7 ± 2.8	0.31

Table 2: The perioperative data and events of both groups

The intraoperative variables	*LA group (n = 143), N (%)*	*OA group (n = 256), N (%)*	*p-values*	*RR (95% CI)*
Operative time, min (mean ± SD)	78.9 ± 28.4	62.1 ± 23.6	0.016	1.79 (0.55–1.42)
Blood loss, mL (mean ± SD)	19.6 ± 5.2	24.9 ± 7.8	0.351	1.82 (0.69–1.78)
Use of drains, *N* (%)	127 (88.8)	241 (94.1)	0.220	1.75 (0.41–1.38)
Failed appendectomy, *N* (%)	7(4.9)	8(3.1)	0.340	1.62 (0.43–1.12)
The postoperative variables and outcome				
Bowel movements (POD1)	133 (93)	214 (83.6)	0.021	1.52 (0.44–0.69)
Start of diet (POD1) *N*	128 (89.5)	156 (60.9)	0.031	1.57 (0.54–0.79)
Postoperative pain (M ± SD)	3.12 ± 0.41	3.84 ± 0.61	0.145	1.51(0.34–0.59)
Parenteral analgesics (doses/day)	1.9 ± 0.5	2.8 ± 0.6	0.024	1.42 (0.49–0.67)
Oral analgesics (doses/day)	1.86 ± 1.14	2.40 ± 2.26	0.035	1.43 (0.34–0.89)
Postoperative LOS/days	6.4 ± 2.3	7.3 ± 2.6	0.032	1.53 (0.41–0.76)
Return to normal activity/day	13.5 ± 3.1	17.1 ± 3.3	0.015	1.57 (0.48–0.87)

Preoperative Assessment and Clinical Data of PA

As depicted in Table 1, the categorical and numerical variables were comparable and nearly similar between the cases of both groups, including duration of symptoms, clinical manifestations like abdominal pain, fever, and vomiting, and laboratory tests like WBC.

Intraoperative Data and Complications

The magnitude difference in the operative theater between both groups was assessed by the operating time measurement, intraoperative estimation of blood loss, and the need for blood transfusion within the perioperative period. These variables showed no statistical difference between the two groups. The intraoperative data are given in Table 2, where the average operating time was higher in the cases of the LA group ($p = 0.016$). The variable of blood loss in failed appendectomy trials and the use of the drains was similar in both groups. Conversion to open surgery was decided in six cases due to dense adhesions mostly and they have been added already to the OA group.

Postoperative Variables and Outcome

The patients (143) with LA were comparable with those (256) with OA in Table 2 as many variables were comparable and statistically significant. Postoperative assessment of gastrointestinal function was done by the first bowel movement (the passage of the first flatus or the first audible intestinal sounds) and the start of oral intake within the POD1. In the matched groups, the first bowel

Table 3: The distribution of short- and long-term postoperative complications between the two groups

	LA group (n = 143), N (%)	*OA group (n = 256), N (%)*	*p-values*	*RR (95% CI)*
Short-term primary complications				
Surgical Complications	38 (26.6)	62(24.2)	0.017	1.61 (0.34–1.10)
Surgical site infection	18 (12.6)	27 (10.5)	0.008	1.88 (0.18–0.81)
Peritonitis or recurrent abscess	6 (4.2)	4 (1.6)	0.370	1.59 (0.44–1.10)
Ileus	12 (8.4)	21 (8.2)	0.029	1.48 (0.24–0.97)
Hemoperitoneum	1 (0.7)	1 (0.4)	0.339	1.52 (0.39–1.10)
Incision dehiscence	1 (0.7)	9 (3.5)	<0.001	1.66 (0.01–0.45)
Short-term secondary complications				
30-day mortality	00	00	00	00
Readmissions	7 (4.9)	9 (3.5)	0.390	1.47 (0.39–1.10)
Long-term complications				
Incisional hernia	2 (1.4)	12 (4.7)	0.046	1.45 (0.44–1.10)
Mechanical bowel obstruction	1 (0.7)	4 (1.6)	0.280	1.44 (0.54–1.10)

movements reported within the POD1 were in 133 (93%) cases of the OA group and 214 (83.6%) cases after surgery in the OA group ($p = 0.021$; OR, 1.52; 95% CI, 0.44–0.69), so the start of oral intake within POD1 was in 128 (89.5%) patients in the LA group vs 156 (60.9%) ($p = 0.031$; OR, 1.57; 95% CI, 0.54–0.79). Assessment of pain postoperatively was achieved using the VAS in POD1 and analgesia was given accordingly. Significant differences were found in the postoperative administration of analgesia for both groups ($p = 0.024$), as less postoperative pain was experienced by patients of LA. The average postoperative hospital stay was 6.4 ± 2.3 days in the cases of the LA group, which was significantly < that of patients of the OA group (7.3 ± 2.6 days) ($p = .032$; OR, 1.53; 95% CI, 0.41–0.76). Earlier return to work was noticed in LA with a significant difference ($p = 0.015$).

Distribution of Postoperative Complications between the Two Groups

As given in Table 3, specific salient SCs were summarized. Mild and recoverable early gastrointestinal manifestations were noticed postoperatively. Surgical complications reported in cases undergoing the LA approach were fewer than in cases undergoing the OA approach ($p = 0.017$; OR, 1.61; 95% CI, 0.34–1.10). The diminished rate of SSI ($p = 0.008$; OR, 1.38; 95% CI, 0.18–0.81) and dehiscence of the incision ($p < 0.001$; OR, 1.08; 95% CI, 0.01–0.45) was reported in cases receiving LA compared with cases receiving OA. About 12 of 143 cases (8.4%) with LA had experienced ileus, which was obviously < the 21 of 256 cases (8.2%) of the OA group ($p = 0.029$; OR, 1.48; CI, 0.24–0.97). About 7 cases in the LA group had readmissions against 9 cases in the OA group ($p = 0.392$). Reoperations of the cases of the recurrent intra-abdominal collection were conducted by open approach and cases of ileus were treated conservatively. Significant differences were found in the variable of the incisional hernia incidence, and the difference was higher in cases with OA than in cases with LA. Mechanical bowel obstruction was noticed to be lower in cases of the LA group compared with the cases of the OA group, but this comparison was statistically insignificant ($p = 0.283$). No cases of mortality were recorded in the follow-up of the cases of the study.

Table 4: The analysis of hospital cost/case of each group

	LA group	*OA group*	*p-value*
Equipment cost	$300	$30	0.001
Theater cost	$250	$250	–
Ward cost/night	$650	$650	–
Cost of Anesthesia	$290	$230	0.232
The mean cost of the in-patient	$1490	$1160	0.041

Analysis of Hospital Cost of the Case of Each Procedure

Marginally higher hospital costs were observed in LA ($1490) than the costs of OA ($1160) as given in Table 4.

Discussion

Laparoscopic appendectomy has been broadly accepted and performed by various surgeons for uncomplicated AP in several hospitals worldwide. The feasibility and safety of the LA were proved in many articles and meta-by analysis[10–12] offering plenty of clinical merits, such as rapidly recoverable ileus, less postoperative pain, less incidence of SSI, reduced length of stay (LOS), and fast return to normal daily activity. Surgeons have recommended the use of laparoscopy for appendectomy; however, the benefit of its use in complicated appendectomy is still controversial.[13–16]

There has been a lack of adequate evidence supporting the use of laparoscopy for the management of complicated appendicitis.[17] Some studies have shown almost equivalent results of the two approaches with respect to morbidity and mortality;[18] many studies clarified significant benefits of the laparoscopic technique, such as less postoperative pain, shorter LOS,[19–21] the chance of exploration of the peritoneal cavity, ease of suction irrigation under vision, and better cosmetic results.[22]

The current prospective observational study addressed the surgical issue of whether the laparoscopic approach efficiently does the improvement of various types of surgical recovery and diminishes the incidence of specific SCs in cases of PA in comparison with traditional open surgery.

In this study, the population was divided into two groups according to the operative approach. The laparoscopic group (LA) included 143 patients. The open group (OA) included 256 patients. No statistical significance was observed between the patients of the two groups regarding the sex difference, age, BMI, ASA grading, or associated comorbidities.

The clinical characteristics of the study population, including major symptoms, duration of symptoms prior to admission, body temperature at the time of admission, and the number of leukocytes showed no statistical significance between cases of the two groups.

As regards the operative findings, with a *p*-value of more than 0.05 in the operative blood loss, the need for drain application, and failed appendectomy, they were statistically insignificant. During the clinical follow-up period, 12 out of 15 cases of failed appendectomy in the study population were passed with no further experience of recurrent attacks; hence, they did not have an interval appendectomy. About three cases had interval OA following the recent attack after variable periods of 6–12 months.

The role of routine IA is currently debatable. Even in cases with localized PA formation, IA is not mandated after successful conservative treatment. The incidence of recurrent attacks of AP is low and at that time, removal of the appendix can be safely performed.[23,24]

The open group involved lesser operative time than did the laparoscopic group, as the average operating time for the LA group was 78.9 ± 28.4 minutes (range: 65–160 minutes), whereas, for the open group, it was 62.1 ± 23.6 minutes (range: 45–145 minutes) with a *p*-value of less than 0.016 by *t*-test, which was statistically significant. Nearly similar findings were obtained by Quezada et al.[25] with longer operative time for the LA group. This may be attributed to the time taken for the peritoneal irrigation, suction, lavage, and securing of the appendicular stump.[26,27]

The rate of conversion was 6 out of 149 patients of LA and they were transferred to the other group (OA), reaching 4.7%, which was within the range compared with other studies.[25,28] In this research, the mean operative time was in favor of the OA group with a significant difference of 16 minutes, which was observed to be of statistical significance. As in the case of PA, the meticulous dissection and safe appendectomy were practically challenging and time-consuming. The average rate of the switch to open approach was due to dense adhesions, mainly severe inflammatory reaction, and even more challenging difficult dissection.

The key point that directly affects the general status of the case and the economic issue is lowered hospital stay, which stemmed from the earlier start of oral feeding, diminished SCs, and so a faster return to daily activity.[29] The characteristic pros of the laparoscopically managed patients of PA over the traditional open surgery contain the aforementioned merits, which were proved by late meta-analysis, which concluded that cases with LA return quicker to daily activities.[30,31]

Our findings included closely recorded variables, with ongoing monitoring of gastrointestinal motility and close assessment by nurse staff, which could be performed continuously in our hospital settings. So, any postoperative gastrointestinal complaints would be recorded in the eligible cases.

Patients in the laparoscopic group needed less analgesia[32,33] as the *p*-value was 0.024, with the early return of bowel habits and the early start of oral feeding. They also had a shorter hospital stay[34] (6.3 vs 7.4 days) and early return to normal activities (13.5 vs. 17.1 days, $p = 0.015$) compared with the cases in the OA group. Also, we reported that the LOS at the hospital was shorter in cases with the LA group with a statistically significant difference ($p = 0.032$) with a superior conjoined early recovery of gastrointestinal function and intestinal motility, which subsequently led to an earlier start of oral intake and return to home.

Despite the recruited candidates being different, our results are coping with various research that reported a statistical significance of short LOS for the LA group.[35–37] The applicable reasons for these results might result from the minimal surgical trauma of laparoscopy and little manipulation of the ileocecal area by an experienced skillful physician during laparoscopy, and less postoperative pain owing to the limited extension of the surgical wounds.

In the surgical field, despite the aforementioned merits, open surgery is still widely accepted because of the issues of possible longer operating duration, higher expenses, and in some hospital settings, the absence of equipment and expert surgeons for the LA approach. In general, the long operative time is mostly due to insufficient skills of surgeons, such as handling of the instruments, pneumoperitoneum, and careful monitoring of ports under vision during the operative time.[38,39]

Our institutions have a satisfactory experience with the LA approach for the cases of PA. For the last 6 years, laparoscopy was mostly preferred for the management of cases of PA. Our rate of the switch to OA was only 4.7%; this result pointed to the well-gained experience of the laparoscopic approaches in our institutes. Moreover, advanced training in laparoscopic techniques was spread worldwide, leading to a noticeable reduction in the difference in the operative time.

The present research concluded a noticeably reduced incidence of specific surgical events after the laparoscopic approach for cases of PA. We observed a decreasing rate of salient SCs with 24.2% (62/256) and 26.6% (38/143) for open approach and laparoscopic approach, respectively. This finding agrees with the net results of a recent scientific meta-analysis,[27] which points to AP in the adult population. SSI is frequent in complicated AP; however, it is not a serious event but has a considerable effect on the early postoperative period of recovery and the quality of life.

The significant reduction of SSI rate becomes a major advantage of laparoscopy techniques.[2] In the LA group, 18 (12.6%) patients had SSI, whereas in the open group, 27 (10.5%) patients had SSI; similar results have been reported in other series.[27]

In the laparoscopic group, 2 (1.4%) patients had an incisional hernia, whereas in the open group, 12 (4.7%) patients had an incisional hernia. This emphasizes the advantage of the laparoscopic approach in preventing SSI[40] and incisional hernia in septic operations as in complicated appendicitis. Despite, the definite reason is hard to touch in the clinical setting of contaminated surgery, the lower rate of SSI in LA may result from the tiny incisions of the laparoscopic approach, and specimen retrieval inside the plastic endopouch lowers the probability of SSI. Since this method clarifies the surgical site issues frequently incurred from the conventional approach, it is highly beneficial that skillful physicians can do the highest percentage of these surgeries via a laparoscopic approach despite the abscess.

The recurrence of a postappendectomy intraperitoneal collection is a terrible life-threatening specific SC. We reported recurrent intra-abdominal collection in 6 (4.2%) cases and 4 (1.6%) cases in the LA group and OA group, respectively ($p = 0.37$). there was a significant risk of recurrent intra-abdominal collection after LA, which was published in a recent meta-analysis.[11] But our results agreed with other publications and the most updated research that proved a reduced incidence of intraperitoneal collections,

with no statistically significant difference between the LA and the OA groups. The recurrence of the postoperative intraperitoneal collection has been attributed to the absence of skillful surgeons, improper manipulation, and techniques like an excessive residual of the fluids of lavage in the peritoneal cavity, which in turn causes considerable contamination. An uncontrollable manipulation of complicated appendicitis, especially the ruptured one; moreover, CO_2 insufflation can facilitate the intraperitoneal spread of bacteria. In the current research, the rate of intra-abdominal collection recurrence of the LA group had no significant difference from that of the OA group. We consider that the skillful laparoscopic surgeon is the key part of this finding, which was supported before by some authors.[38,39] The antibiotics therapy was administered regularly per and postoperative in LA in our cases. Despite the high incidence of recurrent formation of the intra-abdominal collection being a little higher after LA, greater improvements in our technique may eradicate this serious event.

One (0.7) patient in the LA group had intestinal obstruction, whereas in the OA group, 2 (.8) patients had an intestinal obstruction in the early postoperative period due to fibrinous adhesions, and 2 (.8%) patients had adhesive intestinal obstruction after 17 and 19 weeks, respectively. This can be attributed to the fact that the laparoscopic approach was more exploratory than the open approach and it could dissect adhesions made by inflammatory processes compared with the open approach, and to the fact that the absence of the large abdominal wall wounds prevents the intestine from adhering to the wound scar, which occurred with the open approach.[41] LA was associated with lower odds for developing any SC in the multivariate analysis.

The laparoscopic equipment was costly ($300 in our institutions) compared with the traditional open approach ($30 in our hospital settings) and they did not represent an obstacle to their valuable utilization. This higher cost of instruments was little compensated by the shorter LOS, so the total expenses of management were a little higher by $300 in the LA. Also from a social perspective, it was noticed by Moore et al. that LA gained a significant economic concern as a quicker return to normal activities and work is so beneficial, especially for the productive young population in life.[42]

The limitation of this research included its limited centers design, the small sample size, and the choice of the technique as it was a surgeon's decision and patient criteria. The selection of patients for the laparoscopic approach was biased by presentation duration, age of the patients, and surgeon preference. It is still controversial to perform LA with inexperienced hands with respect to the severe inflammatory reaction present.

In brief, the clinical support gained from this research gives the upper hand for LA in the management of cases with PA in terms of early recovery of gastrointestinal functions, SCs, and hospital stay.

We suggest that the utilization of this finding should be generalizable if the institution has laparoscopically skillful surgeons and sufficient laparoscopic resources.

Conclusions

Laparoscopic surgery for appendicitis complicated with an abscess is feasible and safe. It offers clinically beneficial merits over the open approach (including shorter LOS, less postoperative analgesia, early start of oral feeding, faster return to normal daily work, and lower incidence of postoperative complications) against marginally longer operative time and higher hospital costs.

Clinical Significance

Laparoscopic surgery for appendicitis complicated with an abscess is feasible and safe. It offers beneficial merits over the open approach including the perioperative and financial outcome.

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REVIEW ARTICLE

Review of Ergonomics in Minimally Invasive Surgery

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Abstract

Musculoskeletal occupational injury is prevalent within the surgical community. This is a multi-factorial issue but is contributed to by physical posture, environmental hazards, and administrative deficiency. There is growing awareness of this issue, with several behavioral, educational, and administrative techniques being employed. The literature on this topic is, however, sporadic and difficult to access by healthcare practitioners.

The aim of this review was to evaluate the literature on the current interventions used to minimize musculoskeletal occupational injury in surgeons and interventionalists. This review will focus on engineering interventions, administrative interventions, and personal protective equipment.

Keywords: Ergonomics, Laparoscopic, Minimal invasive surgery.

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Introduction

Surgeons generally concentrate on procedural improvement and strive toward perfection. One of the crucial factors which will enhance the abilities and ensure smooth conduct of the surgical procedures is ergonomics. Even though ergonomics is learned during training, it is commonly ignored or not strictly adhered to. This might impede and rather increase the learning curve.

The synchronicity of the surgeon and his workplace, and the operating room is one of the important elements that surely influences the whole experience of the surgeon. The topic of ergonomics has not been of priority among researchers. Sporadic research has been trying to establish some recommendations but has not been quite successful in ensuring the strict adaptation of ergonomic principles.

Surgeons with their routine of performing complex and technically demanding surgeries are highly prone to occupational hazards.[1] Surgeons during the procedures tend to be positioned in very awkward or non-neutral positions and often for long durations which will lead to musculoskeletal problems. Specialty surgeons of plastic operate wearing coupes and they have to bend sharply at the neck region which causes cervical region strain;[2] the other good example is the orthopedics who wear heavy lead aprons which cause muscular fatigue.[3,4] A heavy lead apron can even injure the vertebral disc prolapse.[5–8]

The evolution of open surgery into minimal access surgery has hugely benefitted the patients but unfortunately made the surgeon's life more demanding. The technical challenge of minimal access surgery pushes the risk of musculoskeletal injuries.[5,9–26] The surgeon's freedom of movement and odd positions for long hours increase the risk by many folds.

The ergonomic peril has been addressed in the recent decade. Many randomized controlled trials (RCTs) have shown the risk among surgeons as high as 68% in form of pain.[27] Surgeons performing minimal access surgery face this occupational injury, and to an extent of 87% of surgeons reporting it as per the study by Park et al.,[28] the injury to the back and the incidence of disc prolapse has been reported around 15%.[29] The areas involved were commonly the back in which ~50% the upper body is involved including the shoulders, and arms were average around 45%.

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The work injury not just affected the professional life at the operating but surprising impacted the social life also. A study revealed that 41% of the participants agreed that this pain due to the work injury negatively affected their relationships. The other major concern was sleep which was disturbed and possibly reduced cognitive abilities subsequently leading to unwarranted errors during the procedures.[13] As a result of the multi-facet influence of occupational hazard, the long-term career would be clearly affected and even end in burnout.

The necessity for intervention in form of medications was noted in 29%, and most of the others felt that the pain increased only during performing the procedure.[27] Few (31%) even had to undergo surgery due to the pain.

Another major impact was seen in form of sick leave. A survey showed as many as 26% took sick leave and 40% had to make some mechanical adjustment in the operating room.[30] All these significant effects show the glaring need for attention.

These occupational injuries have a wide range of consequences, ranging from physical pains to psychological bearing. A survey revealed that many 47% of the surgeons feared that this injury will surely reduce their career span.[31] This concern is not just an assumption, but rather a survey among the ophthalmic plastic surgeons reported to have stopped operating due to either pain or fear of spinal injury.[32]

The wellbeing of the healthcare workers and here the surgeon is of utmost importance. This will undoubtedly matter in patient care. A total of 30% of surgeons admitted that their symptoms

influenced either directly or indirectly even in decision making for the patients and even affected the surgical planning.

The next big concern is the interest of the future medical students on whether this will influence the career option to choose to be a surgeon. A study showed that many students did not prefer surgery as their subject of choice due to the lingering fear of musculoskeletal injuries.[33]

A solution to handle this situation is the immediate need for ergonomic corrections. This can be conveniently divided into the following three groups:

1. Engineering controls
2. Administrative controls
3. Personal protective equipment

Engineering controls are mainly focused on physical structural changes in the operating room, such as manipulating the table height, and equipment changes, such as changes in instrument handles design, using 3D/high definition (HD) monitor, proper monitor position, and exact camera position.

Administrative controls are mainly the workforce or human factors. These include maintaining a neutral body posture such as altering wrist posture during surgery, reducing neck rotation during surgery and balancing the load on dominant or non-dominant shoulder.

Personal protective equipment are the tools individual surgeons might use, such as customized surgical exosuits or body support equipment.

These three categories of control intertwine and each plays a role in potential improvement. In this study, we aim to perform a review of the literature on Engineering interventions, administrative interventions and personal protective equipment used to reduce musculoskeletal occupational injury in surgeons. This is because these interventions are internationally available and require a relatively small amount of resources to incorporate into practice.

The term administrative controls mean the external control or regulator which here is the surgeon's hand movement holding the instruments.

The surgeon may use an additional supportive measure such as the exosuit to enhance his ability which becomes the personal gear or the personal protective equipment. These are additionally used to reduce any health or occupational injuries. Few of such equipment are available across the world and with such easy access, the utilization in everyday practice is highly likely.

Methods

Information Sources and Search

Literature was searched in free access search engines such as the Google Scholar, PubMed, and journal websites such as Springer. The technical terms were used to filter the right and relevant articles. The duplicate articles were excluded. The abstracts along with the title was used as the key search factor.

Inclusion Criteria

- Studies on ergonomics of the operative room.
- Studies involving ergonomics of the operating surgeons and the instrumentation.
- Studies on innovation in a surgical instrument for reducing the ergonomic errors.

Exclusion Criteria

- Studies on ergonomic research in labs other than the operating room.
- Non-surgeon participants
- Studies on custom-made equipment.

Intervention(s)

- Engineering intervention is the modification that makes structural changes in the operating room such as the operating table and laparoscopic instruments such as changes in instrument handle design, using 3D/HD monitor, proper monitor position, and exact camera position.
- The term administrative controls mean the external control or regulator which here is the surgeon's hand movement holding the instruments, neck rotation during surgery, and load on the dominant or non-dominant shoulder, shoulder position during surgery, neck stiffness, back stiffness, and back pain during surgery, musculoskeletal disorders during surgery, and need of ergonomic training programs.

The surgeon may use an additional supportive measure such as the exosuit to enhance his ability which becomes the personal gear or the personal protective equipment.

Results

With the filtering using the criteria, only 12 studies qualified. A total of six of them studied on specialized instruments.[12,34–43] (Flowchart 1). Of these, six studies investigated the use of engineering interventions.[22,34–37] Five studies investigated the use of administrative interventions.[39–44] One study investigated the use of personal protective equipment.[12] Table 1 provides a description of the engineering intervention studies; Table 2 provides a description of the administrative intervention studies; Table 3 provides a description of the study of intervention by personal protective equipment.

Participants

The participants of the studies were from various branches of surgery and specialties such as general, urology, gynecology, surgeons.[12,22,34–43]

Outcome Measures and Results

Since there is methodological diversity and can instill bias the outcome along with the results will be separately discussed.

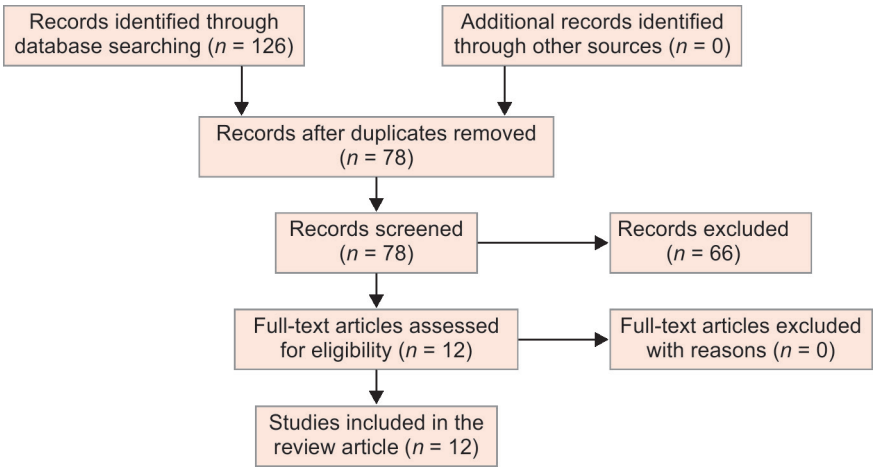
Engineering Interventions

Matern et al. arrived at a conclusion with the electromyography (EMG) data that the monitor positioned at the level of the eye is recommended. Based on the individual surgeon's choice and skill, it is definitely an advantage with two monitors situated, one at position A for complex tasks or procedures and the lowest muscular fatigue at the position B. Either way, the position of the monitor lateral to the surgeon is not recommended.[34]

Gallagher et al. concluded that the camera has to be steady and any movement which is unwarranted would result in complications or risk safety.[35]

Manasnayakorn et al. opined that for the hand-assisted laparoscopic procedures the operating table height should be 5 cm above the elbow or the surface of the hand instruments used.[22]

Flowchart 1: Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) flow diagram for the selection of studies



Sancibrian et al. arrived at the conclusion that the specifically designed significantly improved the efficiency of the surgeon in completing the asks and were better than the conventional RH instruments.[36]

Tung et al. concluded that the pistol grip was found to be far better than the regular grip and it was noted to have reduced the task–peg transfer and cutting time. The results also suggested reduced pain but with the data, and the possibility of having bias of subjective variability it was not possible to arrive at a definitive conclusion on the effect of tool design.[37]

Harada et al. concluded that even though the 3D/HD monitor might provide an advantage over the 2D/4K monitor for the operating expert surgeon in most cases, the 2D/4K monitors might score over these in narrow or finer working areas over the 3D/HD with their high-resolution images.[38]

Administrative Interventions

Stomberg et al. concluded that the incidence of musculoskeletal injuries and problems is higher in surgeons performing minimal access surgeries. This is due to the long hours of static posture or non-neutral positions of the body during the procedures. The general surgeons and gynecologists were found prone to such injuries.[39]

Miller et al. concluded that occupational injury in the form of musculoskeletal problems is common among surgeons. These could be due to non-ergonomic body postures. They added that with better awareness, knowledge, and following the right rubrics these can be reduced.[40]

Tjiam et al. concluded that urologists particularly endourologists experience a high rate of musculoskeletal injuries. The insufficient knowledge among the urologist about ergonomics was highlighted by this study. They recommended the introduction of ergonomic principles in the surgical curriculum in the early phase of the career to gather knowledge. Hoping that this move will reduce occupational injuries.[41]

Aitchison et al. identified four crucial areas which are putting the surgeons at risk of having injuries. (1) The asymmetrical movement between the dominant shoulder and the non-dominant one; (2) The constant awkward positions of the neck; (3) The repetitive in and outward instrument movement through the ports; (4) The long duration of odd positions.[42]

Bartnicka et al. concluded that there exists an inverse relationship between the benefit to the patient and surgeon wrist strain.[43]

Personal Protective Equipment

Liu et al. concluded that the operative procedure interference would not happen with the exosuit, which rather will be a minimal gear device that can be worn by the surgeon. This can drastically decrease fatigue and pain.[12]

Discussion

Ergonomics is an interplay between the human here the surgeon and the environment which in this case is the operative room and the surgical instruments. Surgical devices and instruments which are designed following ergonomic principles will hugely benefit the surgeon and ensure the smooth conduct of the intended procedure. This field of ergonomics is still in the infancy stage as compared to other sectors such as aerospace, car design, etc. This study attempted to study the overall role of the application of ergonomic principles in the operative room. This is much-needed study as the application is comparatively minimal among the surgical fraternity.

Engineering Interventions

The most important aspect of any surgical intervention is the minimal complication rate and faster recovery rate. This can be achieved with precision which demands some strain on the surgeon musculoskeletal system. The relation between the duration of the procedure and the strain appears to be directly proportional to each other.

None of the surgeons felt the side position of the monitor would be ideal; subject preferred the monitor at the side position.[34]

The study conducted by Gallagher et al. provided results that in study 1, the outcome among the resident's performance came down ($p = 0.00001$) due to the movement of the camera. Further, the error rate was significantly high ($p = 0.00001$). In study 2, the task of intracorporeal knotting was prolonged and it was due to the camera movement again ($p = 0.00001$), hence it is advisable that the unwarranted movement of the camera should be avoided and steadiness would reduce the errors.[35]

Table 1: Engineering interventions studies

S. No.	Title of abstract	First author	Year	Conclusion
1.	Monitor position in laparoscopic surgery	Matern et al.[34]	2005	Regarding EMG data, the monitor positioned frontal at eye level is preferable. Reflecting on personal preferences of subjects and task performance, it should be of advantage to place two monitors in front of the surgeon: one in position A for lowest neck strain and the other in position B for difficult tasks with optimal task performance. The monitor position at the side is not advisable
2.	An ergonomic analysis of the effects of camera rotation on laparoscopic performance	Gallagher et al.[35]	2009	Unintentional camera rotation during surgery should be avoided to eliminate one potential source of errors
3.	Ergonomic assessment of optimum operating table height for hand-assisted laparoscopic surgery	Manasnayakorn et al.[22]	2009	The optimum table height for hand-assisted laparoscopic surgery allows the working surface of the extracorporal instrument handle to be at or 5 cm above the elbow level
4.	Design and evaluation of a new ergonomic handle for instruments in minimally invasive surgery	Sancibrian et al.[36]	2014	The new ergonomic handle not only provides important ergonomic advantages but also improves efficiency when completing tasks. Compared with ring handle (RH) instruments, the new prototype reduced the high-pressure areas and the extreme motions of the wrist
5.	The effect of ergonomic laparoscopic tool handle design on performance and efficiency	Tung et al.[37]	2015	There was a significant preference for as well as lower pain experienced during the use of the pistol grip tool as seen from the survey feedback. Both evaluation tasks (cutting and peg transfer) were also completed significantly faster with the pistol grip tool. Finally, due to the high degree of variability in the error data, it was not possible to draw any meaningful conclusions about the effect of tool design on the number or degree of errors made
6.	The effect on surgical skills of expert surgeons using 3D/HD and 2D/4K resolution monitors in laparoscopic phantom tasks	Harada et al.[38]	2018	Compared to a 2D/HD monitor, a 3D/HD monitor improved the laparoscopic surgical technique of expert surgeons more than a 2D/4K monitor. However, the advantage of 2D/4K high-resolution images may be comparable to a 3D/HD monitor especially in narrow spaces

EMG, electromyography

Table 2: Administrative interventions studies

S. No.	Title of abstract	First author	Year	Conclusion
1.	Work-related musculoskeletal disorders when performing laparoscopic surgery	Stomberg et al.[39]	2010	This study revealed musculoskeletal disorders in a majority of laparoscopists. The laparoscopic technique often requires static and tiring work positions, sometimes extreme, which can explain musculoskeletal disorders among general surgeons and gynecologist
2.	Ergonomics principles associated with laparoscopic surgeon injury/illness	Miller et al.[40]	2012	Results suggest that awareness, knowledge, and utilization of ergonomic principles could protect surgeons against symptoms that lead to occupational injury
3.	Ergonomics in endourology and laparoscopy: An overview of musculoskeletal problems in urology	Tjiam et al.[41]	2014	We recommend integration of ergonomics in hands-on training programs early in the residency curriculum to gain knowledge and awareness and hopefully to offer possibilities to prevent these complaints in the future
4.	The ergonomics of laparoscopic surgery: A quantitative study of the time and motion of laparoscopic surgeons in live surgical environments	Aitchison et al.[42]	2016	The following four primary areas have been identified where surgeons are consistently demonstrating movements that increase their risk of harm: (1) Extended periods of neck rotation (2) Asymmetrical loading between the dominant and non-dominant shoulders (3) Power morcellation and frequent insertions/removals of laparoscopic instruments resulting in repetitions of the most extreme shoulder positions (4) A negative correlation between height and percentage of time spent in more extreme positions
5.	An ergonomics study on wrist posture when using laparoscopic tools in four techniques in minimally invasive surgery	Bartnicka et al.[43]	2018	The outcomes proved that the surgical technique which is best for the patient imposes the greatest strain on the surgeon's wrist

Table 3: Interventions by personal protective equipment studies

S. No.	*Title of abstract*	*First author*	*Year*	*Conclusion*
1.	Solving the surgeon ergonomic crisis with surgical exosuit	Liu et al.[12]	2018	The progressive arm support exosuit can be a minimally intrusive device that laparoscopic surgeons wear to reduce pain and fatigue of surgery without significantly interfering with operative skills or manual dexterity

The influence of ergonomics on the performance of the surgeon is quite evident. This particularly is more in the surgeons performing minimally invasive surgeries which reduce the freedom of movement and the instruments push the surgeons toward an unfavorable and uncomfortable position.[44]

This very important factor can be understood from a study by Manasnayakorn et al.[22] The experiment assessed three different positions of the elbow above the table. First 10 cm revealed a long time to do tasks such as the intracorporeal suturing. Even the second position, that is, 15 cm also showed a negative impact on the outcome. This laid heavy strain, particularly on the deltoid, trapezius, and the paraspinal muscles. and lastly, the strain was observed on the flexor muscles of the arm in the final position of 5 cm.[22]

Sancibrian et al. evaluated the ergonomics of newer and innovative handpiece of laparoscopic instruments. This was compared with that of the conventional ring handle. and the results were encouraging for the newly designed device. Majority of the participants (64%) liked the new device as it reduced pain and fatigue. the key to the new instrument was less need for the hyperflexion at the wrist.[36]

Tung et al. studied the comparison between the pistol grip and the pinch grip. Volunteers who participated preferred the pistol grip which is ergonomic friendly whereas the other group suffered from pain and discomfort., further the duration in completing the tasks was shorter with the pistol grip ($p < 0.05$). They did not find any correlation between the tool and the type of error[37] and the study by Harada et al. noted the advantage the 2D/4K monitors have over the 3D/HD in visualizing target organs in very narrow spaces due to the high resolution.[38]

Administrative Interventions

Not many studies have been conducted on the role of administrative interventions. In the study by Stomberg et al.,[39] they recorded that most of the surgeons who conduct these minimally invasive surgeries suffered from some form of musculoskeletal problems. Discomfort if not pain was found to be very high among them. At least around 70% of surgeons admitted to behaving some injuries. joint stiffness was quite a common issue apart from headaches and problems with vision.

Gender played a significant role with lady surgeons expressing more discomforts ($p < 0.01$). The time was a vital factor in determining the possibility of developing the injuries. The longer the duration of surgery more injuries were noted ($p < 0.01$).

The non-neutral position when held for a long time contributes to these injuries. It is not uncommon among surgeons and gynecologists who have these long-duration procedures.[39]

Miller et al. found that those who gave the option of undecided in the questionnaire were more likely be suffering from this occupational hazard as compared to those who were well aware of the ergonomic principles. A few of the common symptoms were stiffness in neck and back.[40]

Tjiam et al.[41] had a total of 285 responses. Among these, almost 86% of urologist had suffered from some form of musculoskeletal issues in the last 1 year, and the majority were work-related common sites of these were in the neck and shoulder.

About one-third of the participating urologist accepted to have poor or minimal knowledge about the ergonomic principles and the influence of these on the outcome. Half of them were quite agreeable to the special training on ergonomics to be included along with the training in their urology skills. This led to the recommendation of including the module in the surgical curriculum. This will be the first step in preventing the health hazard to come down in the future.[41]

The study by Aitchison et al. found that BMI had no influence on ergonomics and so was the experience which did not contribute to this.[42]

The study by Bartnicka et al. arrived at a conclusion that task specification was important including the pattern of movement and dynamics.[43]

Personal Protective Equipment

In the study conducted by Liu et al., they gave attention to the influence of any additional devices which can be used to enhance ergonomics or provide support to the body posture, but at the same time not hamper the movement or dexterity of the surgeon. A total of 20 surgeons were part of this study which used an exosuit and assessed its influence of it. They found that these suits do not interfere with the performance of the surgeon ($p = 0.15–0.84$). They did a comparative study between a group that used and a control group that did not use the exosuit. The task was holding the camera for 15 minutes. It was found that the group without the suit experienced more pain and discomfort as compared to the ones who were wearing the suit (3.11 vs 5.88; $p = 0.019$). Most of the surgeons (~85%), who used the suit were more comfortable at the end of the day.[12]

It is becoming clearer about the necessity of a structured training program in the curriculum. A small study showed that more than half of the participants (53.2%; $n = 5,125$) accepted about the lack of formal training and were keen on getting the training.[45]

It was observed that many of the surgeons who are facing the work-related musculoskeletal problems were the ones who lacked the training programs in ergonomics. A total of 21% sought for right suggestions and modifications to reduce the non-neutral position themselves and follow the right postures during the procedure, and many (69.9%) after practicing ergonomics observed improvement in their health and were free of pain or discomfort.

However, it appears that we are far from achieving a complete application of the right ergonomics in the operating table. The lack of time for the surgeon sort of pushes the importance of ergonomic settings to be made in the operating room. More research is now begun in this highly vital area.

Regulations on the design of instruments do not usually consider ergonomics and might be contributing the non-ergonomic instruments in to the hands of the surgeons, more regulations are needed to end this practice.[46] A recent meta-analysis showed something glaring, that is, the lack of knowledge among

the surgeons and 55–90% of the surgeons had not got any formal training in ergonomics, even though some tried to adopt the recommendations.[27]

Conclusion

Ergonomics appears to be a neglected facet, with 68% experiencing some or the other form of work-related musculoskeletal problems. This review attempted to highlight the importance of these good practices. Further, this study highly recommend a structured formal training program for all surgeons and even includes it in the curriculum. Engineering interventions, administrative interventions, and personal protective equipment are the three most important parts. Improvement must be ensured in these three groups to get the optimal operating environment. The field of ergonomics must be given priority and relevant attention. Ergonomic guidelines should be periodically evaluated and corrected. Further work is suggested to refine the ergonomic practices.

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CASE SERIES

Laparoscopy in Three Cases of Unusual Abdominal Emergencies: Report and Literature Review

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Abstract

Common abdominal emergencies like acute appendicitis, acute pancreatitis, hollow viscus perforation, and diverticulitis are being managed with laparoscopy.

We here present three cases of unusual abdominal emergencies which were managed successfully by laparoscopy at a tertiary care center.

These cases are of anaphylactic shock due to hepatic hydatid cyst with free peritoneal rupture, upper GI bleeds due to early gastric volvulus in a patient with a posttraumatic left-sided diaphragmatic hernia and the last case was a patient of blunt abdominal trauma with splenic laceration with hypotension. The postoperative course was very satisfying and possibly laparotomy was avoided in all cases.

We reviewed the literature on the role of laparoscopy in acute abdominal conditions.

Keywords: Acute abdomen, Blunt and penetrating trauma, Laparoscopy in emergency, Ruptured hydatid, Splenic laceration.

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Introduction

With expanding surgical experience and skills application of laparoscopy in the emergency setting has proved its role.[1] This approach allows both the evaluation in case of a diagnostic dilemma as well as the accomplishment of procedure in a wide variety of abdominal surgeries, such as acute appendicitis, blunt and penetrating trauma, perforated peptic ulcer disease, and a variety of conditions that seem set to expand further.[2–4] Initially, laparoscopy was limited to elective surgery, however with accumulated surgical experience and skills over the past decades the application of laparoscopy into the emergency setting has stepped in. It also has a significant impact on the reduction of wound complications, postoperative pain, hospital stay and overall costs, and high patient satisfaction.[5] Our aim is to present three cases of relatively uncommon abdominal emergencies managed with a laparoscopic approach with a positive outcome.

Case Reports

Case 1: Anaphylactic Shock

A 40-year-old male presented with sudden onset epigastric pain associated with profuse sweating, giddiness, and brief loss of consciousness of 3 hours duration. There was no history of fever, chills, and seizure.

On examination, he was drowsy his vital parameters were as pulse rate 110/minute, BP 84/58 mm Hg, RR 22/minute, and was afebrile. Systemic examination was essential within normal limits except for having urticarial rashes all over the body.

He was started on inotropic support, injection of hydrocortisone 100-mg stat, and intravenous (i.v.) fluids.

On further evaluation by contrast-enhanced computed tomography (CECT) abdomen was found to have a liver cystic lesion in segment IV/V of the liver with an impression of ruptured hydatid cyst (Fig. 1).

With this, he was referred to our center and was taken up for emergency diagnostic laparoscopy and found to have around 300 mL peritoneal clear fluid with ruptured hydatid cyst right lobe of the liver (segment IVB with 3 cm × 3 cm rent) (Fig. 2).

He underwent deroofing of the cyst and peritoneal lavage with normal saline and placement of two drains 28 Fr size. Cyst wall submitted to histopathological examination and which confirmed hydatid in nature. In postoperative period, he recovered well and was started on tab albendazole 400 mg twice a day for 6 months, and on follow-up at 3 and 6 months was asymptomatic.

Case 2: Hematemesis with Left Diaphragmatic Hernia

A 41-year-old male had a history of a road traffic accident 10 years back which was without any immediate clinical consequences as he remained asymptomatic till now. He now presented with acute onset pain epigastrium with three episodes of hematemesis

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Patient consent statement: The author(s) have obtained written informed consent from the patients (for case 1, 2 and 3) for publication of the case report details and related images.

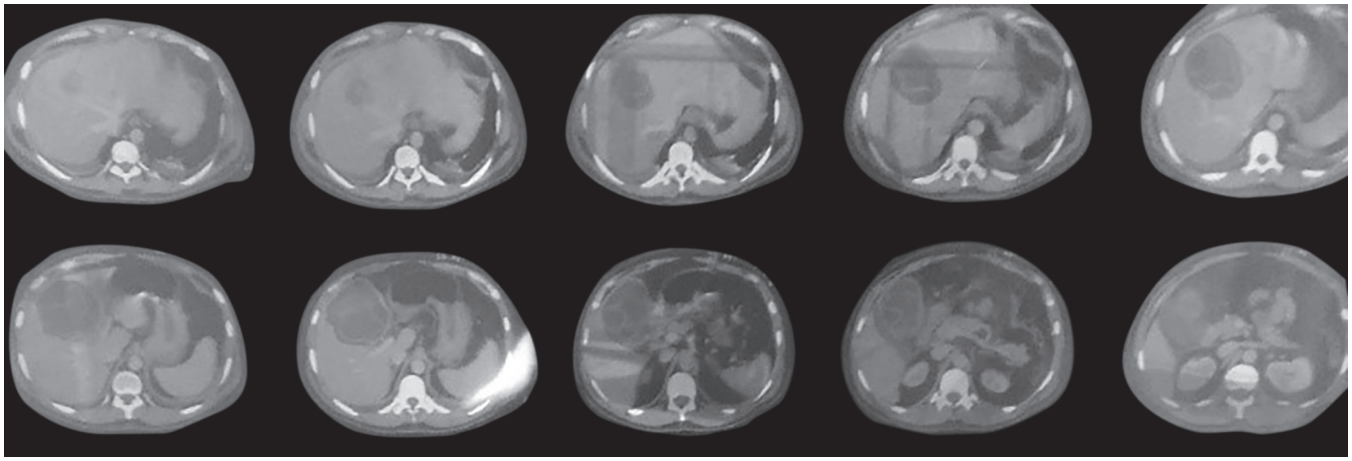


Fig 1: The CECT abdomen shows a hepatic hydatid cyst in segment IV/V (ruptured)

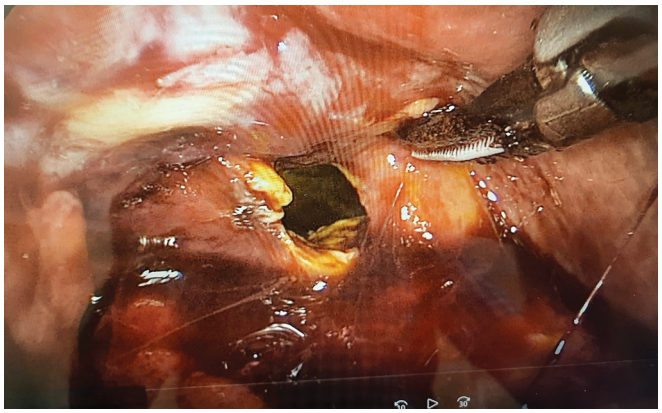


Fig. 2: Ruptured hydatid cyst right lobe of the liver

of 1-day duration. He presented outside our hospital and was resuscitated with iv fluids and two units of packed red blood cells. His CECT chest and abdomen revealed features of a left diaphragmatic hernia with stomach herniating into chest – volvulus (Fig. 3).

He presented to our center and on arrival, his vitals parameters were within normal limits, on systemic examination he had reduced breath sounds on the left side, and the rest of the systemic examination was essentially normal.

We took him for emergency laparoscopy and intraoperative findings were a large left diaphragmatic hernia with stomach as content (Fig. 4A). Gastric viability was preserved and underwent reduction of content, mesh repair of defect with the placement of left side 28 Fr intercostal drainage (ICD) (Fig. 4B).

He recovered well, started orally on the second postoperative day, and was discharged on postoperative day 5.

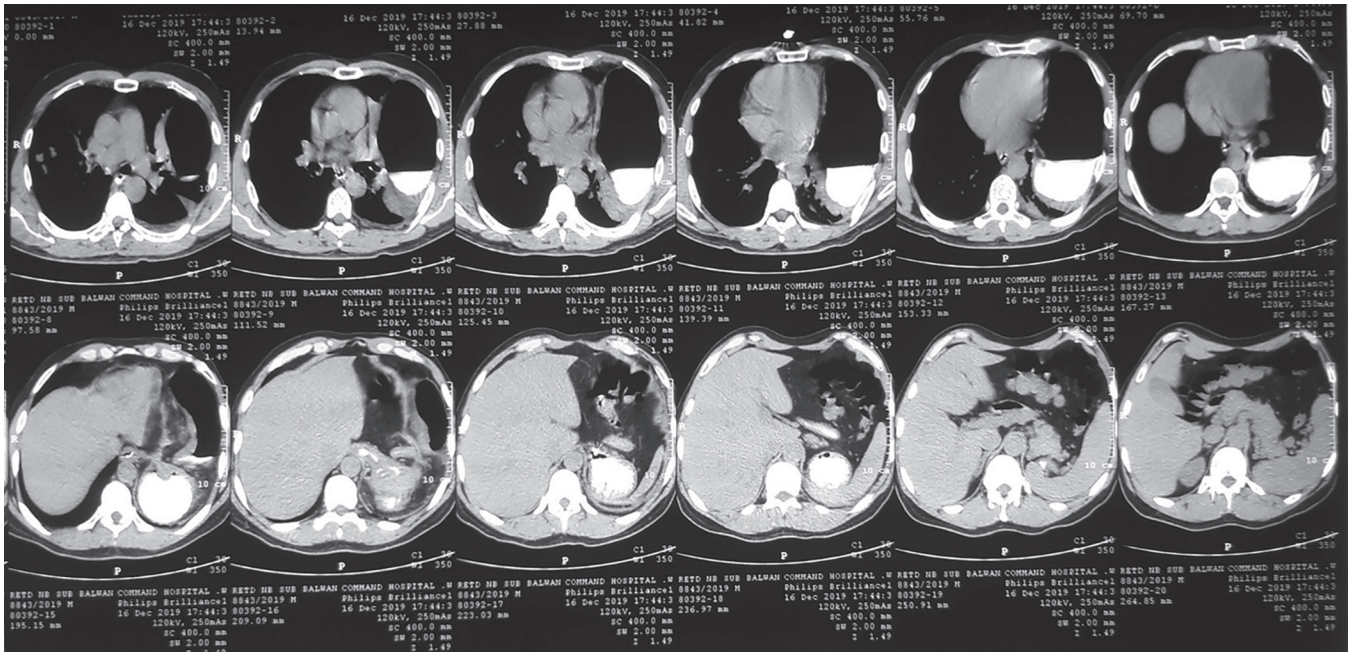
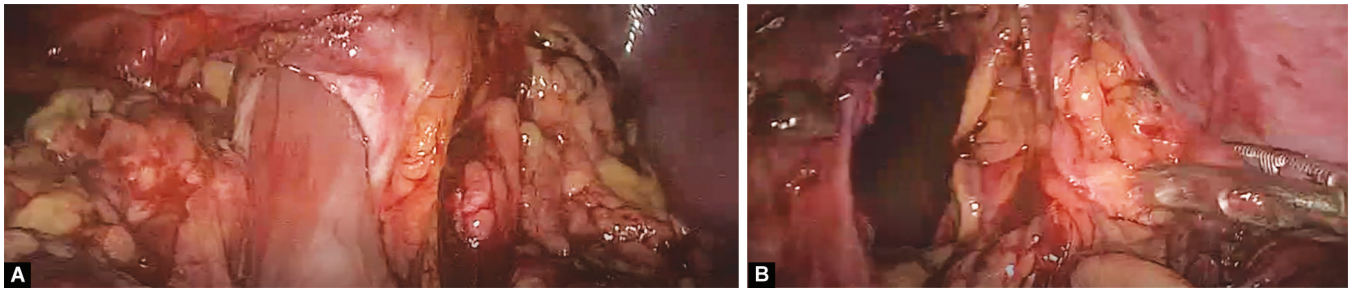
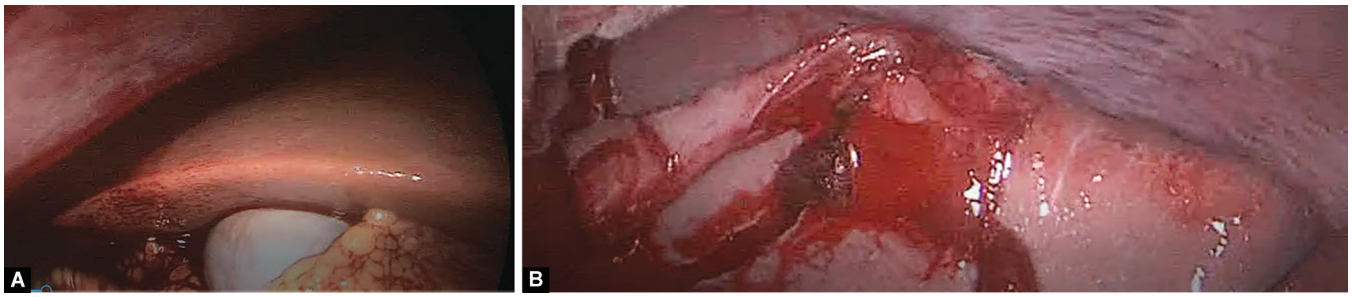


Fig. 3: The CECT chest and abdomen showed a left diaphragmatic hernia with stomach herniating to the chest



Figs 4A and B: (A) Stomach herniating through defect 4; (B) Defect after reduction of content



Figs 5A and B: Intraoperative findings. (A) Hemoperitoneum 5; (B) Splenic laceration with ongoing bleed

Fig 6: Application of hemostatic agent to control bleed

Case 3: Blunt Abdominal Trauma with Splenic Laceration

A 24-year-old male presented with a history of blunt injury abdomen following a road traffic accident in the emergency department.

On examination, he was anxious, with hypotension (BP 90/60 mm Hg) and the pulse rate was 120 per minute. Resuscitation started as per standard protocol and bedside ultrasound revealed a large hemoperitoneum with a splenic laceration. His blood pressure (BP) was persistently low and was taken for emergency laparoscopy and intraoperative findings were splenic laceration (Fig. 5A) and hemoperitoneum (about 1-L blood) (Fig. 5B).

Bleeding was controlled laparoscopically, and peritoneal wash was given with normal saline. He recovered well and was discharged after 2 weeks of observation (Fig. 6).

He recovered well in postoperative period and was discharged from the hospital after 2 weeks.

Discussion

Laparoscopic surgery has grown its age as more and more elective and emergency abdominal surgeries are being performed with the advantage of less postoperative pain, faster recovery, and early return to work. With increasing experience and skills horizon also expanded to unusual conditions apart from acute appendicitis, hollow viscus perforation, and obstruction.

Over the last three decades, a number of studies have reported its role in diagnosis with accuracy rates of between 86–100%,[6–8] and with accumulated surgical experience and skills a large number of patients managed exclusively with a laparoscopic approach.[9,10] Its role has come a big way in selected patients with penetrating abdominal trauma who are hemodynamically stable as in a large number of cases, there is no peritoneal breach, and the need for emergency laparotomy is safely negated on the basis of laparoscopic findings.[11–13] In literature, most of the studies on the role of laparoscopy are for common emergencies such as acute appendicitis, hollow viscus perforation, and acute diverticulitis.

Our first case, who presented with anaphylactic shock, was subsequently diagnosed with a case of ruptured hepatic hydatid cyst was safely managed by emergency approach. In the second case, laparoscopy has helped to assess the viability of the gastric wall and subsequent reduction and repair of diaphragmatic rent. In the last patient of blunt abdominal trauma, splenic laceration was safely managed by avoiding the need for laparotomy and with splenic preservation.

To conclude with available expertise and skills a myriad of abdominal emergencies can be managed successfully with a laparoscopic approach with minimal postoperative morbidities and high patient satisfaction as the benefits of laparoscopy in the emergency setting are compatible with those of elective surgery (less requirement of pain killer, shorter hospital stay, less abdominal wall complications, and early return to work). Laparoscopy is only a means of surgical approach and should not alter the procedure itself. Conversion to open should not be considered a failure but a technical option whenever required. It is emphasized that role of a laparoscopic approach is only valid where experienced and sufficient expertise in minimal-access surgery available.

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CASE REPORT

An Early Presentation of Stump Appendicitis Following Laparoscopic Appendectomy: A Rare Diegesis

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Abstract

Laparoscopic appendectomy is now the standard surgery of choice for acute and recurrent appendicitis. Development of stump appendicitis after 3 days of laparoscopic appendectomy is a very rare incidence.

Presenting a case report of a 19-year-old male who underwent laparoscopic appendectomy for acute appendicitis, and on postoperative day 4, developed sudden onset of high-grade fever, pain over the right iliac fossa, vomiting, localized features of peritonitis, and raised total leukocyte count (TLC). On contrast-enhanced computed tomography (CECT), abdomen and pelvis revealed stump appendicitis with minimal pelvic collection. The patient underwent exploratory laparotomy, and a stump of size 1.5 cm was found with features of inflammation and surrounding minimal adhesion. A stump appendectomy was done.

Stump appendicitis presentation immediately after appendectomy is very uncommon. Though the incidence of stump appendicitis is rare but should be kept as a differential diagnosis in a previously operated appendectomy patient. Awareness of such cases initiates early diagnosis and advocates proper intervention at the right time to prevent unnecessary morbidity and mortality.

Keywords: Appendectomy, Appendicitis, Case report, Laparoscopic, Stump appendicitis.

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Introduction

Acute appendicitis is one of the common surgical emergencies encountered, incidence being the highest in the 2nd and 3rd decade of life.[1] Laparoscopic appendectomy is the standard treatment of choice now. Stump appendicitis is an uncommon complication post appendectomy, usually present lately and thought to be due to interval-repeated inflammation of the incompletely excised stump of the appendix (<0.5-cm stump length).[2,3] Only very few cases are being reported in the literature.[4]

We report a case of early presentation of stump appendicitis, diagnosed in the postoperative period, which is very unusual.

Case Description

A 19-year-old male presented to the Emergency Department with pain in the right iliac fossa and fever since 2 days. Fever subsided after taking antipyretics. On examination, the patient was febrile, tachycardic, BP – 118/82 mm Hg, the abdomen was soft, tenderness in the right iliac fossa (RIF) was present, and rebound tenderness was also present. Total leukocyte count was 13.2 × 10^3/μL. Alvarado score was 6. On ultrasonography (USG), abdomen and pelvis revealed a blind-ended tubular structure with 7 mm diameter, and probe tenderness was there. Compiling clinical, radiological, and biochemical reports, acute appendicitis was diagnosed. The patient underwent laparoscopic appendicectomy for the same.

Postoperative days 1, 2, and 3 were uneventful.

On postoperative day 4, the patient developed pain in the lower abdomen followed by high-grade fever (102.3°F), and multiple bouts of vomiting, despite of being on antibiotics and paracetamol infusion. On postoperative day 5, he had four episodes of watery diarrhea. Physical examination of the abdomen showed tenderness in the lower abdomen with rebound tenderness in the RIF and localized guarding. Total leukocyte count was 18.6 × 10^3/μL. Contrast-enhanced computed tomography revealed inflamed appendicular stump of caliber 6 mm noted in RIF suggestive of acute appendicular stumpitis with pelvic collection (Fig. 1). The patient did not improve with expectant management.

On postoperative day 7, he was planned for exploration with lower midline incision. Intraoperatively, the stump of the appendix was found, of length 1.5 cm, which was inflamed with pelvic collection of pus (Fig. 2). After thorough toileting with warm saline, stump appendectomy was done (Fig. 3), and the abdomen was closed by putting an ADK drain. Postoperatively fever subsided, TLC was in the declining trend. The drain was removed after 48 hours. The postoperative period was uneventful. Histopathology showed a remnant appendix with neutrophilic transmural infiltration. On follow-up, the patient has no complaints till now.

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Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

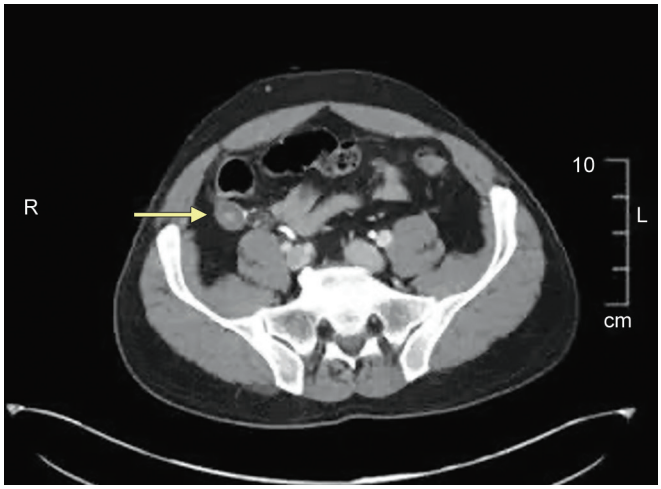

Fig. 1: CECT showing the stump of the appendix

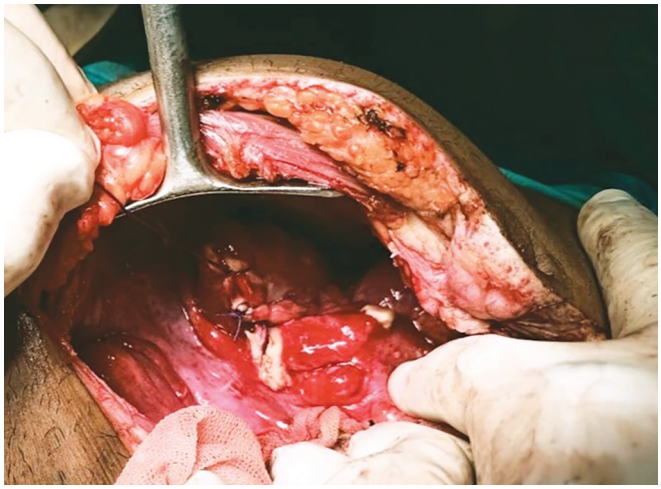

Fig. 2: Appendicular stump with the surrounding slough

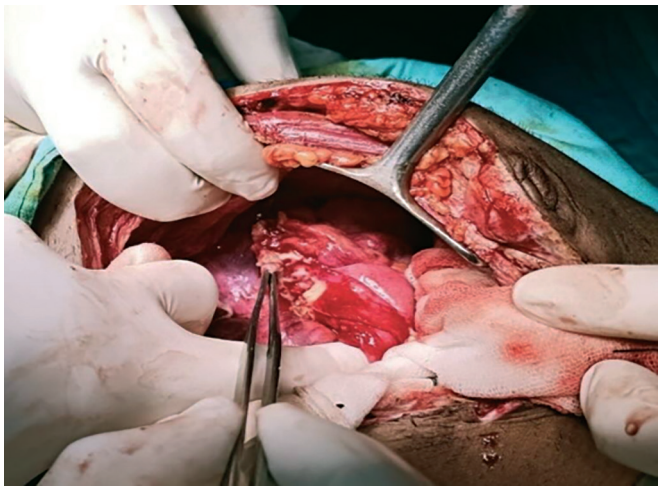

Fig. 3: Post stump appendectomy

Discussion

The stump appendicitis is reported as early as 2 months and as late as 50 years from the day of appendectomy.[5] The cause of stumpitis is the re-inflammation of the residual appendix in the initial procedure. It has been found following open appendectomy with ligation of stump, inversion of stump,[2] and laparoscopic appendectomy.[5] The prevalence is more with laparoscopic procedure[6] due to small field of vision, absence of tactile, and three-dimensional perception.

The other factors for stump appendicitis include inflammation causing inadequate exposure of base, a subserosal or retrocecal appendix, lighting the appendix without stump invagination, long stump left in the fear of injuring the cecum, and local ulceration by fecolith.[4] To minimize diagnostic dilemma, USG and CECT are the investigations of choice for diagnosing preoperatively. A CT also excludes other etiologies.[7] To avoid stump appendicitis, it is better to prevent. "Appendicular critical view", i.e., appendix at 10 o'clock, taenia coil/libera at 3 o'clock, and terminal ileum at 6 o'clock position is to be used. Identification of the merging point of three taeniae is paramount in identification and ligation of the base of the appendix. The remnant stump should not be >5 mm, as longer than this size is associated with stump appendicitis as per the literature. [3]

It can be treated by open or laparoscopic intervention.[4] In our case, as there was pelvic collection, a lower midline exploration was done with removal of the residual stump.

Conclusion

In patients with prior appendectomy, mild index of suspicion is required to rule out stump appendicitis that will prevent late diagnosis and its aftermath. It can present at any point of time post appendectomy.

Depending upon presentation, clinical and radiological evaluation, the patient may undergo conventional or laparoscopic stump appendectomy.

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CASE REPORT

Wandering Dermoid Cyst of Ovary: A Case Report

Rajneet N Bhatia,[1] Nozer K Sheriar,[2] Sachin K Dhaduk[3]

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Abstract

Background: Mature cystic teratomas (dermoid cysts) are most frequently seen in the reproductive age-group. Torsion is the most common complication of dermoid cysts, with detachment from the adnexa in rare circumstances.

Case description: A 38-year-old patient presented with dull pain in right lower abdominal region. Tenderness was elicited in the right iliac fossa with right forniceal fullness on per vaginal examination. The ultrasound diagnosis of a mature cystic teratoma was confirmed on computerized tomography. Laparoscopy showed torsion of the right adnexa, with the dermoid cyst seen detached and within the pouch of Douglas. The wandering dermoid cyst was removed laparoscopically, en masse using an endobag without spillage.

Conclusion: The rare possibility of detachment of the dermoid cyst with or without the entire ovary exists in cases of torsion necessitating recognition and appropriate surgical removal.

Keywords: Case report, Cystic teratomas, Dermoid cysts, Pouch of Douglas, Torsion of adnexa.

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Background

Mature cystic teratomas also known as dermoid cysts, are the most common germ cell neoplasia of the ovary. They are derived from one or more of the three germ cell layers.[1] Their incidence ranges from 5 to 25% of all ovarian tumors.[2] Torsion of the pedicle is the most frequent complication of dermoid cysts and is seen in 16.1% of all cases.[2] Torsion interferes with the blood supply and may thus result in venous congestion and aseptic inflammation of the tumor wall. In acute torsion, the ovary or the entire adnexa may undergo necrosis due to ischemia, whereas in subacute or chronic torsion the dermoid cyst or ovary could adhere to adjacent structures and develop a new collateral circulation.[2] In rare situations, the cyst or the entire ovary along with the cyst may completely detach from its primary pedicle and form a parasitic dermoid or ovary. The reported incidence of this entity is as low as 0.4% of all ovarian teratomas.[2] We describe one such case of a wandering dermoid diagnosed and managed laparoscopically.

Case Description

A 38-year-old woman, with previous three cesarean deliveries, presented with a complaint of pain in the right lower abdomen since a month. The pain was described to be dull in nature with radiation to the back and thigh. Menstrual history was unremarkable with no significant medical history. There were no urinary- or bowel-related complaints.

On examination, her abdomen was soft with minimal tenderness in right iliac region with no rebound tenderness. Per vaginal examination revealed bulky, mobile, anteverted uterus with right forniceal fullness.

Pelvic ultrasound revealed a large adnexal mass lesion with the right ovary not separately visualized from the lesion. The lesion had solid and cystic components with thick walls showing internal debris and marginal echogenic focus. The routine hematological and biochemical markers were within normal limits. CA-125 concentration was found to be 79.1 U/mL (normal values 0–35 U/mL) with other tumor markers including CEA (0.35), beta hCG (<0.1), and AFP (1.01) within normal limits.

Magnetic resonance imaging was suggested for further evaluation but patient who suffered claustrophobia, opted to avoid it. Instead a detailed evaluation of the abdomen and pelvis was undertaken using contrast-enhanced computerized tomography (CECT). The scan revealed a solid cystic mass lesion in the pouch of Douglas with the right ovary lying anterosuperior to the lesion. The lesion showed well-defined margins with minimal enhancement of the solid component along with fat tissue and calcific foci within it. The fat planes with adjacent pelvic organs were maintained with no obvious pelvic or abdominal lymphadenopathy. These features were consistent with mature cystic teratoma (Figs 1 and 2).

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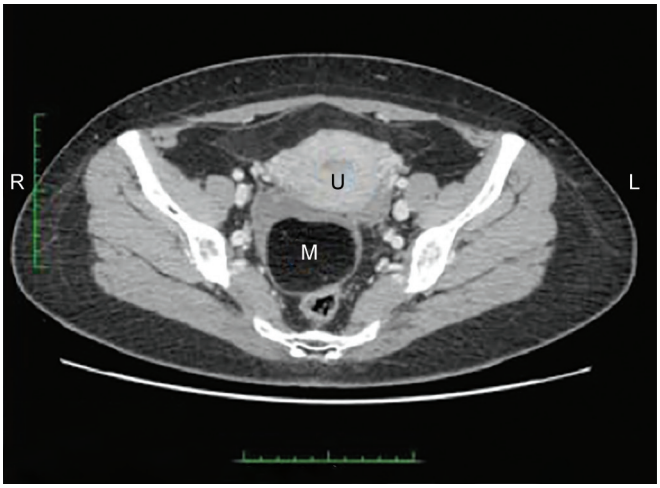

Fig. 1: CECT showing a mass lesion between the uterus and the rectum maintaining the fat planes with the adjoining tissues

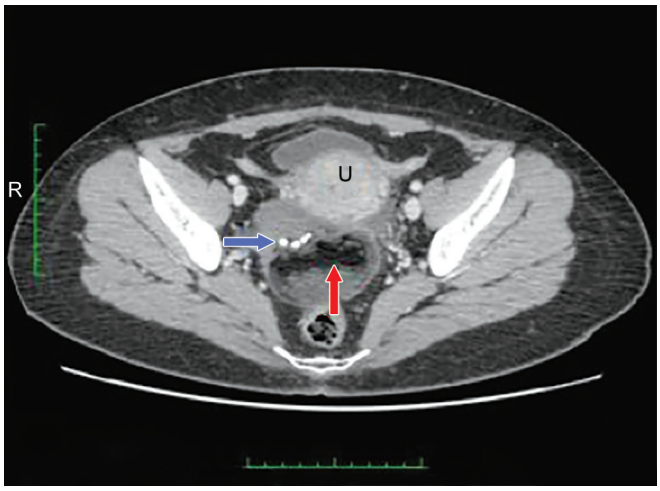

Fig. 2: CECT showing the calcification and fat tissue in the mass lesion classically seen in the dermoid cyst

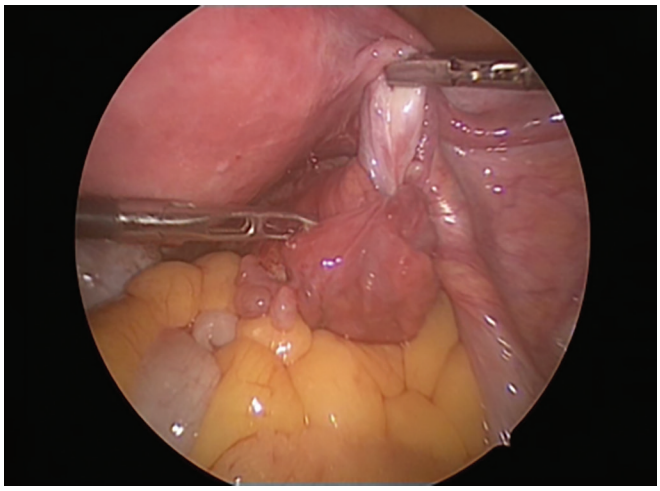

Fig. 3: Torsion of the right adnexa

The procedure of laparoscopic ovarian cystectomy was planned and undertaken following an informed consent and a discussion regarding possible findings and treatment.

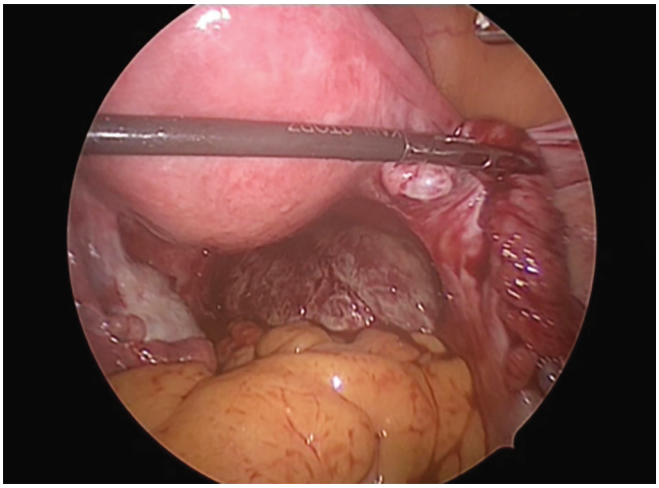

Fig. 4: Adhesiolysis with detorsion of the right adnexa with dermoid cyst in the pouch of Douglas

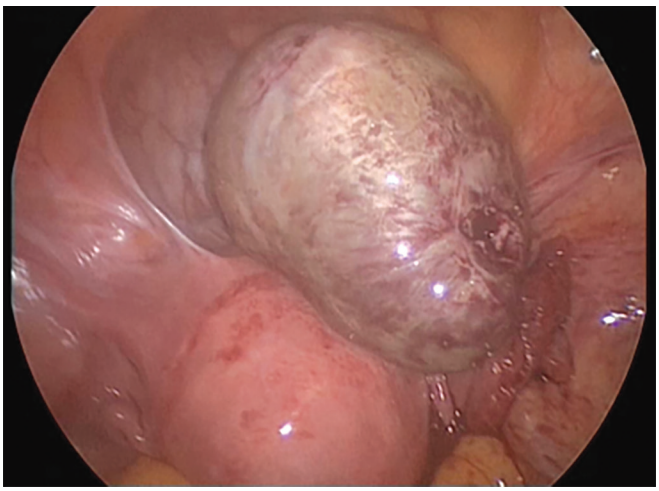

Fig. 5: Wandering dermoid cyst

Four-port laparoscopy revealed bulky uterus with torsion of right ovary and fallopian tube having flimsy adhesions to the pouch of Douglas (Fig. 3). The left ovary and the fallopian tube appeared normal with flimsy adhesion to the posterior wall of the uterus. Careful adhesiolysis with detorsion of right ovary and fallopian tube was undertaken (Fig. 4). A dermoid cyst measuring 10 x 8 cm was found to be located in the pouch of Douglas without any attachment to right ovary (Fig. 5). The dermoid cyst was retrieved using an endobag, avoiding any spillage of its contents (Fig. 6). The procedure was uneventful and the patient was discharged within 36 hours of surgery. The histopathologic diagnosis confirmed it to be a benign mature cystic teratoma with diffuse hemorrhagic infarction and areas of necrosis with features considered consistent with torsion.

Discussion

Lefkowitch et al.[3] reported the first such case in 1978, in which a woman had presented with urinary retention. Under the impression of a fibroid uterus, laparotomy was performed and a benign cystic teratoma of the retrouterine pouch of Douglas was found.

Dermoid cysts arise from germ cells that originate in the mature gonads. In embryonic life, migration of the germ cells occurs along

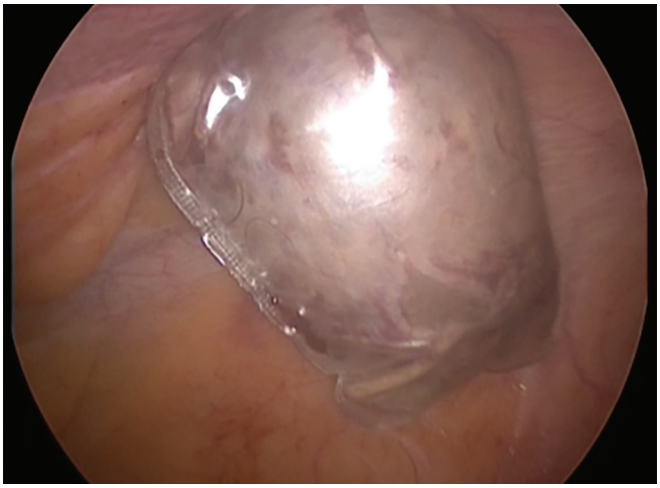

Fig. 6: Dermoid cyst retrieved enmasse in endobag

the route of the mesentery toward the primitive gonads. These cells in future life might give rise to spectrum of tissues originating from the three primitive embryonic layers, including the dermoid cysts.[2] Torsion of the pedicle, rarely, may lead to autoamputation and reimplantation of the ovarian dermoid or even the ovary forming the parasitic tumor.[2]

In this index case, CT scan and pelvic sonography revealed the cyst being in close contact with the right ovary without obvious evidence of torsion. However, laparoscopy findings included no demonstrable attachment of the tumor to the right ovary as the adnexal torsion was unwound. The lesion was seen lying free in the pouch of Douglas showing a hemorrhagic pedicle suggesting recent detachment and auto amputation. Ovarian torsion was confirmed on laparoscopy and histopathology.

Review of literature suggests most common location of parasitic dermoids is the omentum (32 reported cases) followed by the pouch of Douglas (12 reported cases) signifying the rarity of this condition.[4] Few other ectopic sites reported are the urinary bladder[5] and fimbrial end of the fallopian tube.[6] One case of parasitic dermoid in median umbilical fold was reported where a non-pregnant women presented with perception of something moving in her abdomen.[7]

Dermoid cysts are generally seen in the reproductive age-group but a few cases of parasitic dermoids have been reported in extremes of age. A 9-year-old girl presented with dull aching huge lump in right flank since 3 months. X-ray of abdomen and contrast-enhanced CT scan revealed large intraperitoneal mass with variable density and solid, cystic, and fatty components.

At laparotomy, huge nodular, highly vascular mass that was attached to omentum with a vascular pedicle but free from the other surrounding tissues was found and confirmed to be benign cystic teratoma on histopathology.[8] Other patient was 61 years who presented with lower abdominal pain and ultrasound diagnosed two adnexal cysts. On laparoscopy, one was a right adnexal simple cyst and the second was a dermoid cyst found in cul-de-sac with flimsy adhesions to the peritoneum of the pouch of Douglas.[9]

In three cases, parasitic dermoids were found during cesarean section in women who presented with obstructed labor. One patient had an auto amputated ovary with vascular pedicle connecting dermoid cyst to the omentum and the intestine without any ligamentous connection with the pelvic organs.[10] Another patient had an impending uterine rupture with a large dermoid cyst impacted in the pouch of Douglas separate from the adnexa.[11]

The third patient presented with obstructed labor and intra-uterine fetal demise. Exploration revealed a dermoid cyst adherent to the urinary bladder.[5]

One case of parasitic dermoid has been reported whose etiology has been attributed to previous dermoid cystectomy where there was spillage of contents in the abdomen.[9]

Intraoperatively, dermoid cyst spill may result in chemical peritonitis or a recurrence of similar lesion in future.[1] Utmost care should be taken to prevent this or else generous suction irrigation will help to avoid future complications.

In our case, the whole cystic mass was retrieved in an endobag without any spillage of contents onto the surrounding structures. Three-year follow-up of the patient has not shown any recurrence of the lesion.

Clinical Significance

However, uncommon the parasitic dermoids are, the surgeon should always have this as a differential diagnosis while dealing with large dermoid cysts. Laparoscopy is the preferred modality to deal with this condition but the technique and skills are required to retrieve it en masse to prevent the complications of spillage. Few case reports have reported the auto amputation of the ovary along with these teratomas, hence a timely action may help to save the ovarian function of these women.

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CASE REPORT

Pulmonary Thromboembolism While Receiving Tranexamic Acid after Laparotomy Myomectomy: A Case Report

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Abstract

Aim: We aimed to review a case with pulmonary thromboembolism while using tranexamic acid after laparotomy myomectomy.

Background: Pulmonary embolism (PE) is life-threatening and early diagnosis and proper treatment are crucial.

Case description: This case was a middle-aged healthy and active woman that referred to our gynecology clinic due to menometrorrhagia and dysmenorrhea. According to an ultrasound report, she had an enlarged myxomatosis uterus. Medical treatment did not work therefore she chose the surgery. During surgery due to massive blood loss, 1 gram of tranexamic acid was infused two packed cells were transfused. After 48 hours of the surgery, the patient complained of shortness of breath. More evaluations showed PE. The patient had no thromboembolism risk factors. It seemed that tranexamic acid caused thrombosis in this patient. After proper treatment measures such as anticoagulant medicines, she was discharged from the hospital.

Clinical significance: Considering the risk of thrombosis in each case as prescribed tranexamic acid.

Keywords: Case report, Pulmonary embolism, Thromboembolism, Tranexamic acid.

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Background

Pulmonary embolism (PE) which more commonly results from deep vein thrombosis of the legs, might be asymptomatic, diagnosed accidentally, or in some cases, it can lead to sudden death.[1] It is a life-threatening condition and approximately occurs 23 to 69 in 1,00,000 patients. Proper treatment measures are usually effective.[2] Predisposing factors include coagulation factors deficiency, sedentary lifestyle, hypercoagulation due to cancers, pregnancy, trauma, oral contraception pills, and major surgeries.[1] The homeostatic system helps the integration of blood circulation following severe vascular damage through surgery.[3] A perturbation happens following major surgeries due to massive blood loss. A part of the body's response in this condition is fibrinolysis, which can be pathologic in some cases and leads to hyperfibrinolysis.[3] Teranexamic acid is a fibrinolytic medicine used mostly in major surgeries in order to prevent fibrinolysis and reduce blood loss.

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Patient consent statement: The author(s) have obtained written informed consent from the patient for publication of the case report details and related images.

Case Description

This case report is written to increase the healthcare providers' awareness, which tranexamic acid can cause pulmonary thromboembolism even in low-risk patients.

This case is an Iranian 39 years old, nulligravida woman who complained of menometrorrhagia and dysmenorrhea and was referred to a gynecology clinic. The patient mentioned using Ferinject months ago and she had been using mefenamic acid and Transid due to menorrhagia. The patient scored her dysmenorrhea 7 out of 10 based on the pain scale. Her mensuration pattern was 9 days of menorrhagia and clot and 4 days of spotting. Based on an ultrasound report in 2021 she had multiple myomas in her uterus, which caused menometrorrhagia. Ultrasound report showed an enlarged uterus with intramural myomas 24 mm, 14 m, and a subserosal-intramural myoma sized 100 × 78 mm in the anterior fundus. Both ovaries were reported with normal appearance and no pelvic mass nor any fluid. The patient was healthy physically with BMI in the normal range, never smoked cigarettes or drank alcohol, and had no previous history of deep venous thrombosis (DVT) or PE. She also denied using any form of contraceptive pills, had a recent long flight journey, and had no significant family history of clotting disorders or cancer. She only mentioned that she is allergic to penicillin. She had no history of surgeries. She only mentioned hypothyroidism, which was under control, based on her laboratory result. The vital signs were in the normal range. A day before the operation the patient's laboratory results included hemoglobin of 11 g/dL, and all coagulation factors were in normal range. The surgery was performed by an open method and took an hour. The exact mass location under direct

supervision was superior to the cervix. During the operation, two packed cells were transfused due to massive bleeding, and then 1 gram of tranexamic acid was infused intravenously. Due to massive hemorrhage during surgery and the patient`s normal BMI, we refused to prescribe heparin. A day after surgery hemoglobin was 9.3 g/dL. After 48 hours, the patient complained of shortness of breath. Blood oxygen saturation was 87% and the temperature was 38.7°C. Spiral-CT scan showed a right lower lobule embolism. Some degrees of atelectasis changes were detected in the right lower lung lobule and right middle lobe (RML). The patient was referred to ICU by a cardiologist and pulmonologist order. Echocardiography was normal. D-dimer was 3.67 (normal range was 0–0.5). Color Doppler ultrasound showed normal lower limb vessels. Enoxaparin 60 mg was prescribed subcutaneously two times a day in addition to that serum therapy and oxygen saturation monitoring were performed. After a week in ICU, the patient was discharged in good general condition and was prescribed apixaban 2.5 mg every day and a cardiopulmonary check weekly.

Discussion

Uterine myoma is usually a benign tumor in reproductive women and more commonly in women above 35 years old.[4] Most women with myoma are asymptomatic.[5] Symptomatic myomas are usually the ones, which make vessel changes in the endometrium.[6] Patients of reproductive ages are usually suggested myomectomy instead of hysterectomy.[7] Menstrual abnormality especially menorrhagia, which often leads to iron-deficiency anemia is the most common complication of uterine leiomyoma.[8] Tranexamic acid is an effective safe medicine using commonly to prevent and treatment of menorrhagia caused by medical, surgical, or even after surgeries as an anti-fibrinolytic treatment.[9] It directly blocks the formation of plasmin and the binding of plasminogen to fibrin and prevents the blood to be clotted.[10] Potential risk in thrombosis has been discussed since this medicine was introduced. Pulmonary thromboembolism is caused by venous thromboembolism, which moves through the circulation system and blocks the pulmonary arteries and it is life-threatening. Early diagnosis and proper treatment can reduce mortality and morbidity.[11] Although the correlation between tranexamic acid and thromboembolism has been reported, there are some studies, which claimed this medicine does not increase the risk of developing venous thromboembolism in the general population.[12–14] In addition to that, CRASH-2 showed using this medicine reduces the risk of myocardial infarction significantly and there is no effect on developing venous thromboembolism. However, some studies showed no relationship in using this medicine with thromboembolism.[15–17] What is more important is considering prothrombin time, and activated partial thromboplastin time.[18] It seems that there is a need for more studies with more statistical power. Although some studies suggest using anticoagulation as prophylaxis, thromboembolism, and hemorrhagic risk should be considered.[19]

Clinical Significance

In our case, it seems that tranexamic acid caused thromboembolism as we did not find any other risk factor. It seems that considering the risk of thrombosis in each individual case as prescribed tranexamic acid can be beneficial.

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CASE REPORT

Post-transabdominal Preperitoneal Mesh Hernioplasty Seroma Formation and Its Management: A Case Report

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Abstract

Repair of inguinal hernia is one of the commonest surgical procedures performed worldwide. Starting from Bassini's repair proposed in 1887, numerous methods and their modifications have overwhelmed the field of inguinal hernia surgery and after the introduction of laparoscopy there has been a procedural revolution for the same. Ger documented the first laparoscopic hernia repair in 1982 by approximating the internal ring with stainless clips. Since then, transabdominal preperitoneal and total extraperitoneal hernia repair have become increasingly popular with lesser postoperative pain, postoperative complications, early return to work, and less recurrence. However, when we talk about hernia repair, there is tissue handling and this tissue manipulation gives rise to seroma formation which is one of the most common postoperative complications.

Keywords: Case report, Laparoscopic hernia repair, Open mesh repair (open), Polypropylene mesh, Scrotal mass, Seroma, Surgery, Transabdominal preperitoneal, Total extraperitoneal, Unilateral inguinoscrotal hernia.

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Introduction

Seroma is a mass or a lump caused by a build-up of clear fluid in a tissue, organ, or body cavity. It is often naturally resolving but in certain cases, it persists which is misinterpreted as a recurrence of hernia by the patient leading to repeated visits of the patient to outpatient as well as anxiety. Seroma usually occurs in large inguinoscrotal hernias.[1–4] A remaining hernial sac during transabdominal preperitoneal (TAPP) most often than not results in seroma formation.

Also, the dissection of two layers of fascia transversalis in the initial step of TAPP may result in local inflammation, which on a later stage forms a seroma. The occurrence of seromas is common after large hernia and direct hernia repair.[5] In the early phases of a learning curve in surgery, the chances of formation of a seroma is very high, but with an increasing acquaintance with the procedure, in experienced hands, the chances go significantly lower.

Case Description

A 43-year-old man presented to the surgery outpatient department (OPD) with a left-sided indirect complete inguinoscrotal hernia for which TAPP was done. In the process of laparoscopic surgery, we had left the distal sac intact. The patient again presented to surgery outpatient department (SOPD) 15 days postoperative with a left-sided scrotal swelling which was globular in shape, with well-defined margins, size of approximately 6 cm × 5 cm, soft in consistency, fluctuant, and irreducible in nature. There was no pain or tenderness associated with the swelling. Getting above the swelling was positive. Testis and chord structures were palpated separately. The transillumination test was positive.

The patient was sent for ultrasonography of the bilateral inguinoscrotal region, and the report suggested of cystic swelling on the left side. All other routine serum investigations and blood parameters were within normal limits.

He was initially subjected to observation and oral antibiotics for 2 months. The swelling persisted even after 2 months postoperative. So aspiration of seromal fluid was planned and approximately 50 mL of straw-colored fluid aspirated out. After aspiration, the swelling reduced in size greatly. The patient again presented with recurrent swelling 15 days later. Repeat aspiration done for the second time. A subsequent visit after 15 days revealed a similar fluctuant, globular, discrete swelling, which was palpated separately from chord structures. Finally, putting the patient's comfort and desire in the forefront excision of an entire sac of seroma along with its fluid content was planned, and the patient was admitted to the general surgery ward.

A left scrotal incision was given to open skin subcutaneous tissue and fascial layers.

The seroma sac was identified and separated from the left testis and cod structures (Fig. 1).

The sac was excised in toto (Fig. 2).

The testis and cord structures were repositioned back in the scrotum and all the layers along with the skin closed. The sac was then opened in a kidney tray and approximately 80 mL of hemorrhagic fluid came out. The sac was sent for histopathological study (Fig. 3).

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Fig. 1: Seroma sac *in vivo*

Fig. 2: Seroma sac with contents after excision

Fig. 3: Hernial sac after opening

Discussion

Seroma happens to be the frequent complexity of TAPP and TEP and can easily orchestrate a dreaded mesh infection.[6] Mesh infection displaces the mesh. As a result, the hernia may recur. Studies have shown that occurrence of seroma after TAPP is 7.7–17%. Susmalian et al. believed in using ultrasonography for the detection of seroma.[7] However, they are mostly asymptomatic and are not clinically meaningful.

Applying pressure bandage, the application of fibrin sealant in the preperitoneal space, and placing a negative-suction or vacuum suction drain in the plain of dissection are a few of the procedures described in the literature to prevent seroma formation.[8] But the drain can only be placed for a short period or else it will lead to iatrogenic infections. In the inguinoscrotal region, putting on a compression dressing is not an easy job. Some studies have also favored the complete dissection of the sac to prevent seroma formation. But with concomitantly running cord structures, most importantly the vas deference and the vessels, complete dissection can lead to unwanted complications like bleeding or transection of cord structures.

Post-dissection, the fascia transversalis becomes lax. Hence, after mesh placement in between both layers of fascia, a potential space is created which may extend into the scrotum and plays a significant role in seroma formation. Reddy et al. suggested that inversion of this lax fascia transversalis and fixing it on the pubic ramus can decrease the incidence of seroma formation during medial hernia rectification yet, these procedural approaches are not applicable for lateral hernias as there is no fascia transversalis in these hernias.[9] Interestingly, Daes reported a method of pulling up the distal hernial sac out of the scrotum and fixing it to the posterior abdominal wall, which resulted in a low incidence of seroma in indirect inguinoscrotal hernia repair.[10]

In the case of huge inguinoscrotal hernias and sac extending deep into the scrotum, reduction and fixation of distal sac high and lateral to posterior abdominal wall are also beneficial. Certain studies also suggest cauterization of the hernia sac to avoid seromas and reduce recurrence. This is done by disrupting the serosal surface that exudes serum when infected, and second, by creating adhesion.

Conclusion

Repairing an inguinal hernia through a technically demanding laparoscopic procedure like TAPP only for the patient's benefit and then making the patient suffer through mental agony and anxiety because of a mere seroma makes no sense. In our method of excision of the seroma sac with its content after 2 months of TAPP provides a lifelong solution for this complication along with patient satisfaction.

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CLINICAL TECHNIQUE

Is Laparoscopy Valuable for Detection of Distal Fallopian Tubal Peristalsis?

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Abstract

Objectives: To evaluate the usefulness of employing laparoscopy to observe distal fallopian tube (FT) peristalsis and to compare its efficacy to the hysteroscopic viewing of proximal FT peristalsis in normal and hydrosalpingeal FT.

Design: A prospective comparative cohort study.

Patients and methods: One hundred and fifteen infertile women undergoing concomitant diagnostic or operative laparoscopy and hysteroscopy were divided into two groups. Group A comprised 59 cases with apparently normal FTs while group B comprised 56 cases with hydrosalpingies.

Setting: Endoscopy unit of a tertiary university hospital.

Methods: Fallopian tube status was assessed during diagnostic or therapeutic laparoscopy, including whether morphologically normal and patent or not. Whenever possible, monitoring of the distal ends of both FTs was performed to detect any potential peristalsis. The proximal portions of each FT were then subjected to hysteroscopy to assess proximal tubal peristalsis. The effectiveness of laparoscopy in assessing distal FT peristalsis and comparing its findings to the hysteroscopic assessment of proximal FT peristalsis in normal and pathologic FT were the primary outcomes.

Results: Laparoscopic detection of distal tubal peristalsis either in normal or hydrosalpingeal FT was low [5 (4.2%) and 5 (4.4%)] in both groups, respectively. After the exclusion of cases with unilateral patent FT from group B, the percentage dropped to 3.2% (only three FT). Hysteroscopic detection of proximal tubal peristalsis was significantly higher in group A [80 (67.8%) vs 40 (35.7%)] in total group B.

Conclusions: Laparoscopic evaluation of distal FT peristalsis, whether for healthy or pathologic FT, is of limited utility and is not advised. Its effectiveness is significantly lower than the hysteroscopic evaluation of proximal FT peristalsis.

Keywords: Anatomy, Hysteroscopy, Hydrosalpinx, Laparoscopy, Peristalsis, Physiology.

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Introduction

Peristalsis, or the contractility of the fallopian tube (FT), is a recognized physiological phenomenon. For the proximal, middle, and distal sections, respectively, it may be continuous tonic contractions, brief periodic contractions, or a series of oscillating movements. It provides proper mixing of tubal secretions necessary for the gametes and embryo, acts as a functional gate at the utero-tubal junction and ampullary–isthmic junction, and aids in the oocyte pick-up process in the three parts, respectively.[1,2] It has been proven for a very long period in several animals,[3] experimental or *in vitro* human research.[4–6] Right now, it is accepted that FT patency testing is considered a tubal function test that includes peristalsis.[7] Numerous cases of infertility have been satisfactorily explained by gynecologic endoscopy in contemporary clinical practice.[8] Endoscopic visualization of proximal FT peristalsis is achievable utilizing office hysteroscopy.[9] The purpose of this study was to evaluate the utility of laparoscopy for distal FT peristalsis visibility in normal and hydrosalpingeal FT, and to compare outcomes to hysteroscopic detection of proximal FT peristalsis.

Patients and Methods

This is a prospective comparative cohort study done at the Endoscopy Unit of the Woman's Health Hospital, Assiut, Egypt, between December 10, 2019 and August 20, 2020. It was approved by the Assiut Medical School Ethical Review Board (#17101059) and was registered at ClinicalTrials.gov (ID: NCT03953586). It included infertile women in the reproductive age group subjected to combined laparoscopy and hysteroscopy to be done under general anesthesia due to different indications as previously recommended.[10] After proper counseling, informed written consent was taken from every case. Detailed clinical, sonographic, and radiologic assessments of all cases were similar to a previous study on the same cases.[11] Intraoperatively, patients were divided into two groups according to the laparoscopic appearance of the FT. If the FT was patent after a chromopertubation test, of normal size, length, integrity, external surface, and fimbriae; the patient was allocated in group A regardless of the existence, extent, and

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type of pelvic adhesions. On the other hand, if one or both FTs were distended with the dye and showed a characteristic increased tubal size with distal occlusion (hydrosalpinx), the patient was allocated in group B. Sustained observation of any rhythmic contractions and relaxation of the distal end for 1 minute was done to assess distal FT peristalsis. If FT was inaccessible, it would be grasped by atraumatic forceps and kept in place by elevation of the mesosalpinx of its middle part against the lateral pelvic wall while observing its distal end. At the end of the laparoscopic assessment, diagnostic hysteroscopy was done as previously described.[10] To properly visualize the proximal part of the FT by hysteroscopy, all procedures were done in the follicular phase. The corneal ends were meticulously evaluated to comment on Darwish hysteroscopic triad.[12] Darwish hysteroscopic triad is formed of a conical part of the FT seen by hysteroscopy. Its base is the ostium, its walls are converging first millimeters of the intramural part, and its summit is a distal pinhole dark spot representing the narrowest part of the FT. Darwish hysteroscopic triad was assessed for any anatomic abnormality and simultaneous visualization of rhythmic opening and closing (peristalsis) on maintained intrauterine pressure. The primary outcome was to estimate distal and proximal FT. The Statistical Program for Social Science version 24 was used to analyze the data. Quantitative data were expressed as mean ± SD. Qualitative data were expressed as frequency and percentage. The independent-sample *t*-test (T) and Mann–Whitney *U* tests were used to compare two means of normally and abnormally distributed data, respectively. The Chi-square test was used when comparing nonparametric data. Probability (*p*-value) < 0.05 was considered significant (S), < 0.001 was considered highly significant and > 0.05 was considered nonsignificant. All the STrengthening the Reporting of OBservational studies in Epidemiology (STROBE) guidelines were followed during the preparation of the manuscript.

Results

According to the laparoscopic status of the FT, two groups of infertile women who underwent concurrent laparoscopic and hysteroscopic evaluations of infertility were studied. Group A included 59 patients with apparently healthy FTs, while group B included 56 cases with unilateral or bilateral hydrosalpingies (swollen and distally obstructed FT). Sociodemographic information for both groups is shown in Table 1. Laparoscopic appearance and chromopertubation tests in both groups are seen in Table 2. Laparoscopic detection of distal tubal peristalsis either in normal or hydrosalpingeal FT was low [5 (4.2%) and 5 (4.4%)] in both groups, respectively, as demonstrated in Table 3. After the exclusion of cases with unilateral patent FT from group B, the percentage dropped to 3.2% (only three FT). Moreover, hysteroscopic detection of proximal tubal peristalsis was significantly higher in group A [80 (67.8%) vs 40 (35.7%)] in total group B. Table 4 shows diagnostic indices of hysteroscopic detection of proximal FT peristalsis in both groups.

Table 1: Basic preoperative data

Variables	*Group A (n = 59)*	*Group B (n = 56)*	*p-value*
Age (years) (mean ± SD)	25.90 ± 5.08	25.96 ± 4.81	0.943
Parity			
Nullipara	21 (35.6%)	19 (33.9%)	0.851
Para	38 (64.4%)	37 (66.1%)	
BMI (kg/m^2) (mean ± SD)	25.32 ± 4.64	25.59 ± 4.50	0.755
History of PID	5 (8.5%)	27 (48.2%)	0.000*
History of operation	18 (30.5%)	26 (46.4%)	0.079
Infertility			
Primary	22 (37.3%)	20 (35.7%)	0.861
Secondary	37 (62.7%)	36 (64.3%)	
Residence			
Urban	32 (54.2%)	30 (53.6%)	0.943
Rural	27 (45.8%)	26 (46.4%)	

*Highly significant

Discussion

The FT is a dynamic, paired organ[13] that responds to steroid hormones and has a sensitive anatomical, physiological, neurological, and histologic makeup. To aid in ovum pick-up and fertilization, a functional FT should be anatomically patent and physiologically active. It is interesting to note that there are two paradoxical peristalses of proximal and distal FTs that move in opposite directions to draw sperm and oocyte to the ampulla, respectively.[5,14] Intensifying the interface between hormones and nutrients and the eggs or embryos[15] is another role of FT peristalsis, which helps with proper fertilization as well as early embryo development and transportation.[16]

Tubal function assessment in clinical practice is entirely based on FT patency by various diagnostic techniques.[7] Additionally, some studies justified this by pointing out the limited technical accessibility and ethical constraints of invasive tests of tubal physiology.[17] Under the influence of several reproductive hormones, the contractility of circular and longitudinal strips from excised FT was evaluated *in vitro*.[18] However, there were not enough data to compare oviduct ciliary activity to muscle contraction in transit.[19] Trials of FT peristalsis *in vivo* measurements are rare. For example, it was done in some patients who underwent laparotomy or tubal occlusion repair. Throughout the whole menstrual cycle, they inserted two to three fluid-filled FT catheters to measure the peristaltic waves.[5] Utilizing straightforward, relevant, and useful technologies, more research on FT peristalsis is urgently required.[20] To the best of our knowledge, this work is the first to employ laparoscopy to visualize distal tubal peristalsis *in vivo*. Due to direct and simple access, laparoscopy is supposed to be suitable for this goal. Unfortunately, this study revealed a low rate of peristalsis in the FT that appeared to be normal and a very low rate in the FT that was pathological. This may be attributed to the detrimental effects of CO_2 gas on tubal physiology, which may result in the deterioration of the peritoneal (serosal) integrity[21] or a general anesthetic impact, including muscle relaxants, which is counteracted by regional anesthesia in other studies.[22] Another possibility is the postmenstrual period timing of all cases, which was suitable for proper hysteroscopic visualization of the proximal FT but not ideal for the observation of the distal section. To determine the precise percentage of distal peristalsis induced by progesterone, another study in the periovulatory period is needed. Without scientific support, there is a consensus that distal FT peristalsis would be evident at ovulation to help oocyte pickup. Additionally,

Table 2: Laparoscopic findings

	Group A (n = 59)		*Group B (n = 56)*		
	Right	*Left*	*Right*	*Left*	*p-value*
FT length					
Right					
Normal	45 (76.3%)	45 (76.3%)	10 (17.9%)	8 (14.3%)	0.000
Shortened but patent	14 (23.7%)	14 (23.7%)	2 (3.6%)	1 (1.8%)	
Hydrosalpinx	0 (0.0%)	0 (0.0%)	44 (78.6%)	47 (83.9%)	
FT width					
Right					
Normal	45 (76.3%)	45 (76.3%)	12 (21.4%)	9 (16.1%)	0.000
Distended	14 (23.7%)	14 (23.7%)	0 (0.0%)	0 (0.0%)	
Hydrosalpinx	0 (0.0%)	0 (0.0%)	44 (78.6%)	47 (83.9%)	
Peritubal adhesions					
Right					
No	35 (59.3%)	32 (57.1%)	32 (57.1%)	16 (27.1%)	0.972
Fine	16 (27.1%)	16 (28.6%)	16 (28.6%)	37 (62.7%)	
Extensive	8 (13.6%)	8 (14.3%)	8 (14.3%)	6 (10.2%)	
Positive perchromation test					
Right	59 (100.0%)	59 (100.0%)	11 (19.6%)	9 (16.1%)	0.000

Table 3: Laparoscopic and hysteroscopic peristalses

	Group A (118 FT)		*Group B (112 FT)*		*Group B (91 FT)*[a]		*Total positive test*		
	Right (59 FT)	*Left (59 FT)*	*Right (56 FT)*	*Left (56 FT)*	*Right (44 FT)*	*Left (47 FT)*	*Group A (118 FT)*	*Group B (112 FT)*	*Group B (91 FT)*[a]
Laparoscopic distal peristalsis test									
Positive	3 (0.05%)	2 (0.03%)	4 (0.07%)	1 (0.17%)	2 (0.04%)	1 (0.02%)	10 (8.4%)	2 (1.7%)	0 (0%)
Negative	56 (94.9%)	57 (96.6%)	52 (46.4%)	55 (98.2%)	42 (46%)	46 (50.5%)			
Hysteroscopic proximal peristalsis test									
Positive	42 (71.2%)	38 (64.4%)	24 (42.9%)	18 (32.1%)	6 (13.6%)	7 (14.9%)	80 (67.8%)	42 (37.5%)	13 (14%)
Negative	17 (28.8%)	21 (35.6%)	32 (57%)	38 (67.8%)	38 (86.3%)	40 (85%)			

[a]After exclusion of unilateral normal FT

Table 4: Diagnostic indices of different hysteroscopic tests in relation to laparoscopy

	True positive		*True negative*		*False positive*		*False negative*	
	Right	*Left*	*Right*	*Left*	*Right*	*Left*	*Right*	*Left*
Peristalsis (*n* = 115)	43 37.4%	39 33.9%	32 27.8%	38 33.04%	24 20.9%	18 15.7%	16 13.9%	20 17.4%

	Sensitivity		*Specificity*		*PPV*		*NPV*		*Accuracy*	
	Right	*Left*	*Right*	*Left*	*Right*	*Left*	*Right*	*Left*	*Right*	*Left*
Peristalsis	72.9% (59.7–83.6)	66.1% (52.6–77.9)	57.1% (43.2–70.3)	67.9% (54–79.7)	64.2% (56.1–60.7)	68.4% (58.7–76.8)	66.7% (55.4–76.3)	65.5% (56–73.9)	65.2% (55.8–73.9)	66.9% (57.6–75.4)

NPV, negative predictive value; PPV, positive predictive value

group B failed to visualize peristalsis due to the negative effects of hydrosalpingeal fluid.[23]

This study's limitations include its relatively small sample size (because of the rarity of cases of hydrosalpinx), use of general anesthesia, and selection of the postmenstrual phase for hysteroscopic optimal imaging of the proximal region of the FT. This study's findings support the conclusion that laparoscopic evaluation of distal FT peristalsis, whether for healthy or pathologic FT, is of limited utility and is not advised. Its effectiveness is significantly lower than the hysteroscopic evaluation of proximal FT peristalsis.

Author Contributions

Atef Darwish conceptualized this study, performed all operations, wrote and revised the study. Dina Darwish collected data and revised the study.

Data Availability Statement

All data generated or analyzed during this study are included in this article. Further enquiries can be directed to the corresponding author.

Ethical Approval

The author(s) have obtained written informed consent from the patients for publication of the case details. The Assiut Medical School Ethical Review Board approved the study protocol (#17101059).

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Laparoscopic Cholecystectomy: Tricks Learned over a Decade and How We Do It

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Abstract

Cholelithiasis is one of common health issues and about 10–20% population harboring the calculi without any clinical features. Only one-fifth of these asymptomatic individuals progress to develop clinical symptoms at a rate of around 5% per year. Laparoscopic cholecystectomy is indicated for symptomatic patients and considered to be a "Gold Standard" treatment for the last three decades. It is the commonest abdominal procedure performed globally in an elective setting. Myriad techniques have been evaluated with increasing experience, skills, need, and availability of laparoscopic instruments. We have witnessed lots of modifications in creating pneumoperitoneum, dissection of Calot's triangle, division and securing cystic duct and artery, dissection of gallbladder (GB) from liver bed, retrieval of specimen, and port closure.

Here we are presenting our experience and modifications used over the last one and a half decades.

Keywords: Bile duct injury, Cirrhosis, Fundus first Approach, Gallbladder extraction, Laparoscopic cholecystectomy, Pneumoperitoneum.

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Materials and Methods

The surgical procedure was performed by an experienced surgeon at various tertiary care teaching centers. We have retrieved patient's medical records including intra-operative pictures and videos. We also search for any difficulties, complications, any modifications used during the procedure, from available patient records in both digital and manual forms.[1,2]

Tricks Used during Laparoscopic Cholecystectomy

Patient Position and Perioperative Antibiotics: The Patient was placed in a supine position and a single dose of third-generation IV cephalosporin was used selectively just prior to intubation. Another position like Davis Lloyd was used when this procedure was done with other surgery like sleeve gastrectomy, cystogastrostomy, and splenectomy.

Creation of Pneumoperitoneum

Usually, pneumoperitoneum is created by the open method through a horizontal incision just above the umbilicus. In patients with mid-line scar from previous surgery may lead to bowel injury to avoid this we used optic trocar through the epigastric area which is vergin.

By using this we could place port safely without any bowel and vascular injury.

Vertical Incision on Linea Alba to Retrieve Large Calculus

In the case of large gallbladder calculus (>20 mm) retrieval of calculus is difficult.

Anticipating this difficulty we make a vertical incision at the umbilicus during the placement of the first port. At the time of retrieval, this incision enlarged cranially which facilitates retrieval. This incision is easily closed with Vicryl 2-0 suture material.

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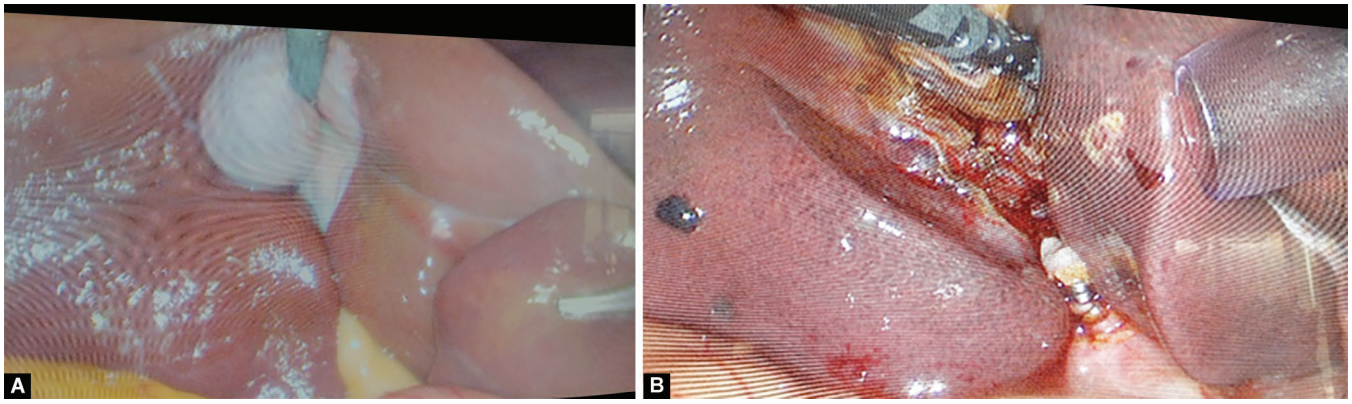
Extra Ports Placement in Difficult Cholecystectomy

Globally most of the modifications that have been invented are related to the number of ports placed. A three-port modification is common among these. We have used three port techniques in which the port used for fundus retraction is not placed. In our experience, it is only feasible in selected patients in whom adhesions at port are minimal or not present.

Extra Port

We have put an extra port in three cases where the left lobe of the liver was enlarged obscuring the Calot's anatomy, precluding the



Figs 1A and B: (A) Enlarged left liver lobe; (B) Shuttering Calot's triangle and post-dissection view

Fig. 2: Incidentally detected hepatic SOL white

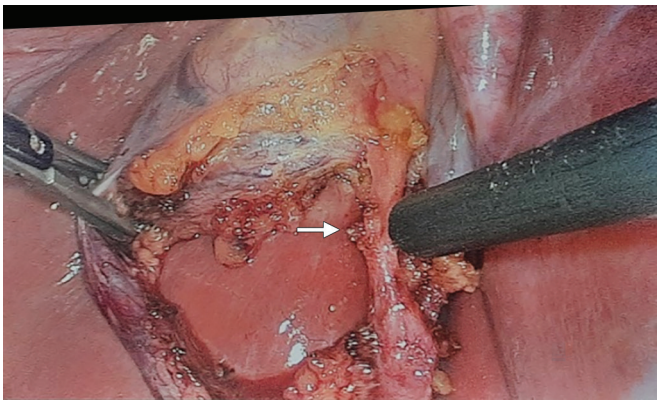


Fig. 3: Initial dissection completed with hook; Arrowhead

safe dissection and rendering Shuttering effect (Fig. 1). In all these three patients we put a 5 mm extra port in the right hypochondrium to push the enlarged left lobe.

Inspection of Peritoneal Cavity

A thorough inspection of the peritoneal cavity using a 30° telescope is made as the glance of the cavity before commencing may yield some incidental findings (IFs). We have noted hepatic micro/macro nodules, hepatic SOLs, growth from gastric, small bowel wall, and Meckel's diverticulum (Fig. 2). One patient was finally diagnosed to have hepatic tuberculosis on histopathological examination of the incidentally detected hepatic lesion. Other entities like cirrhosis and adenocarcinoma of GB with hepatic metastasis were also detected. One patient each of gastric/bowel wall lesion was diagnosed to have gastrointestinal stromal tumor (GIST).

Dissection at Calot's Triangle

In patients with minimal or no adhesions and normal Calot's anatomy, we do dissection in standard fashion, posterior to anterior with a demonstration of a critical view of safety. Here we dissect part of the infundibulum from the liver bed which is an extra step towards safety to avoid bile duct injury.

Maryland dissecting forceps is traditionally used for dissection however due to its bulky nature of jaws, there is the risk of touching nearby structures which may lead to thermal injury.

A hook dissector is a good alternative for dissection in this area as it allows the dissection of thin fibers and poses minimal risk for transferring energy to neighboring structures (Fig. 3).

The harmonic scalpel is used particularly in patients having thick-walled gallbladders or in patients with portal hypertension where numerous pericholecystic collateral are present (Fig. 4). It also facilitates the division of cystic artery without applying a clip towards the specimen side of the artery.

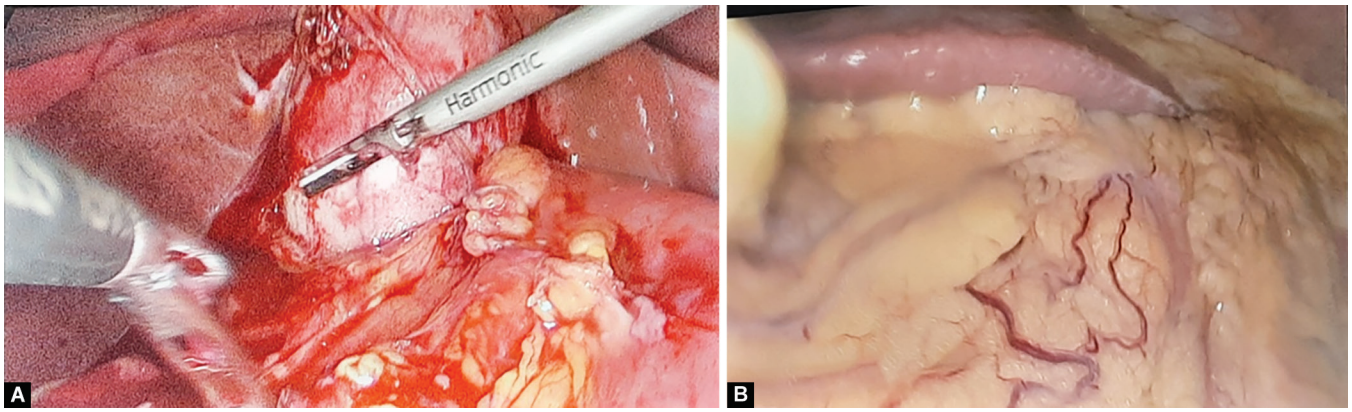
Dissection of thick and sclerotic tissue by high-pressure water stream (Hydro-Jet) using a laparoscopic irrigation system is also done when initially no lead with other dissecting devices is made (Fig. 5). Tissue planes are opened and become thin which allows identification and further dissection.

Fundus First Approach

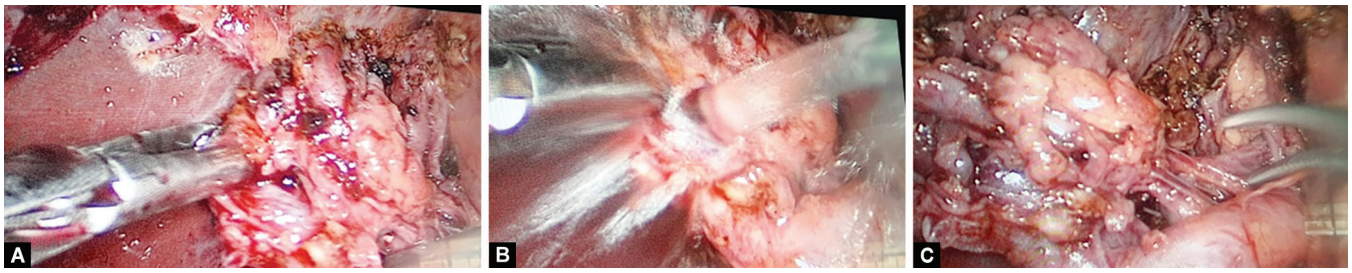
This approach is popular in open cholecystectomy (OC) in patients having distorted anatomy at Calot's triangle due to extensive adhesions. We use this technique during the laparoscopic approach when a frozen Calots is encountered which renders identification and safe dissection. Once GB is dissected from the fossa, we usually divided the cystic duct using an endo GI linear stapler (usually 45 mm blue reload) (Fig. 6).

Dissection of GB from Fossa

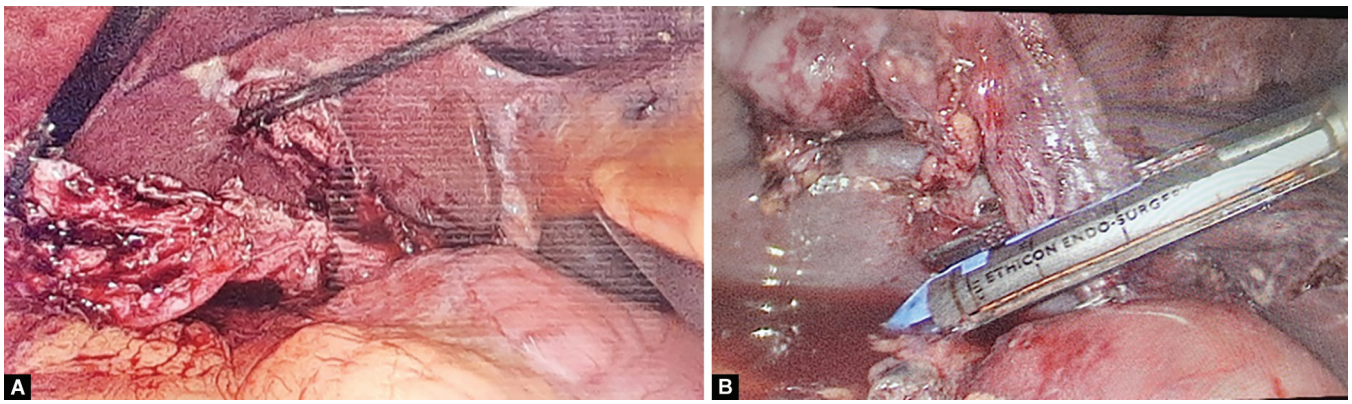
We take extra precautions in patients with thick-walled GB where no definitive plane occurs between the GB wall and fossa as exposure and inadvertent injury to segmental branches of the Right portal



Figs 4A and B: (A) Harmonic scalpel in thick-walled GB; (B) Numerous pericholecystic collaterals



Figs 5A to C: Hydro-Jet dissection: (A) No progress made initially; (B) Dissection by irrigation system; (C) Post-dissection; small cystic duct and artery visible



Figs 6A and B: Fundus first approach: (A) GB dissected off fossa; (B) Division of cystic duct using endo GI linear stapler

vein and/or hepatic artery can lead to torrential bleeding at the point of time. A portion of the posterior wall is left in such cases as well as in patients with known cases of cirrhosis or incidentally detected during surgery where high risk of bleeding from GB fossa (Fig. 7).

Liver Biopsy

Both trucut and incisional biopsy are taken in cases of cirrhosis and liver SOL respectively and tissue is submitted for frozen section when suspicion of malignancy is high based upon clinical and radiological background.

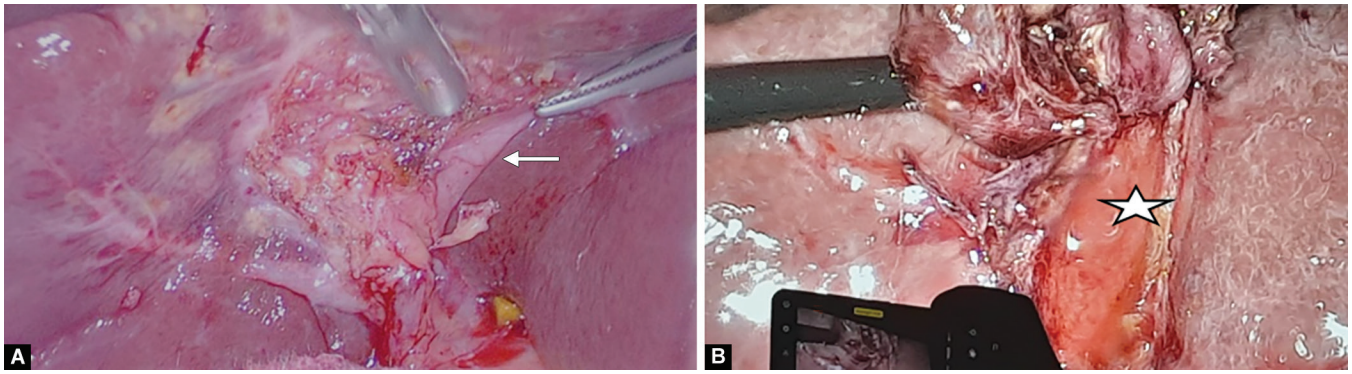
Specimen Retrieval

We often retrieve the specimen without placing them in the endobag through the epigastric port site and also ensured the single clip placed over the cystic duct toward the specimen side is also present with the specimen. Accidentally leaving this clip behind may lead to infection of the port site and subsequently formation of the sinus as it will act as a foreign body. The port track was also irrigated to clear if there is any calculus stuck during specimen retrieval. Use of endobag is done in cases GB full of calculi, ruptured during dissection, empyema GB, and risk of malignancy.

There used to be a lot of struggle during retrieval in endo bag as GB specimen positioned in horizontal lie to the port site once kept inside. In this grip, extractor holds both leaves of endo bag without holding the part of the specimen (Fig. 8).

We use a different technique in which part of the GB specimen near the clip is held along with both leaves of the endo bag. This manoeuver maintains the lie of the specimen vertically and facilitates smooth passage through the port site (Fig. 9).

As it was mentioned above incise the linea alba vertically as the incision can be further extended in cases of retrieval done through



Figs 7A and B: (A) Exposure of segmental vessels arrow; (B) Posterior wall of GB left *in situ*

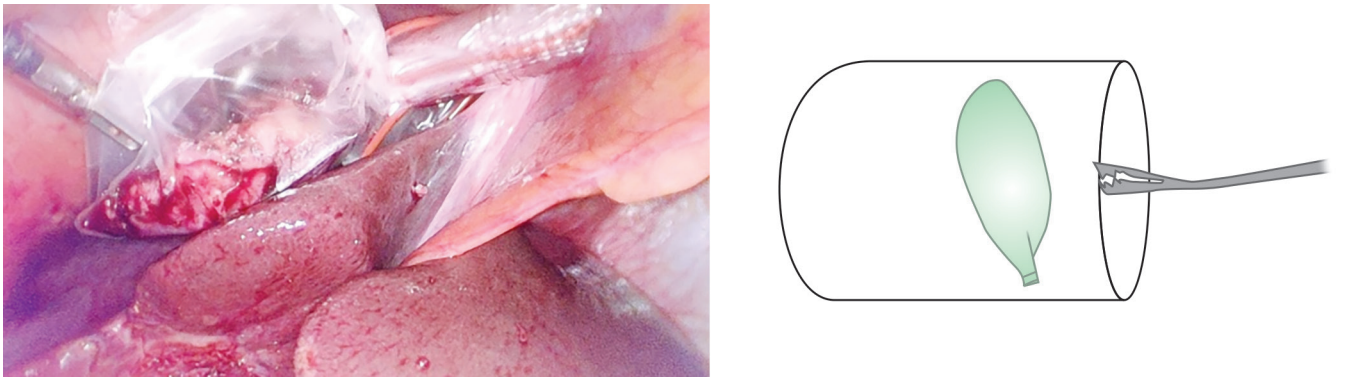


Fig. 8: Gallbladder specimen horizontal lie

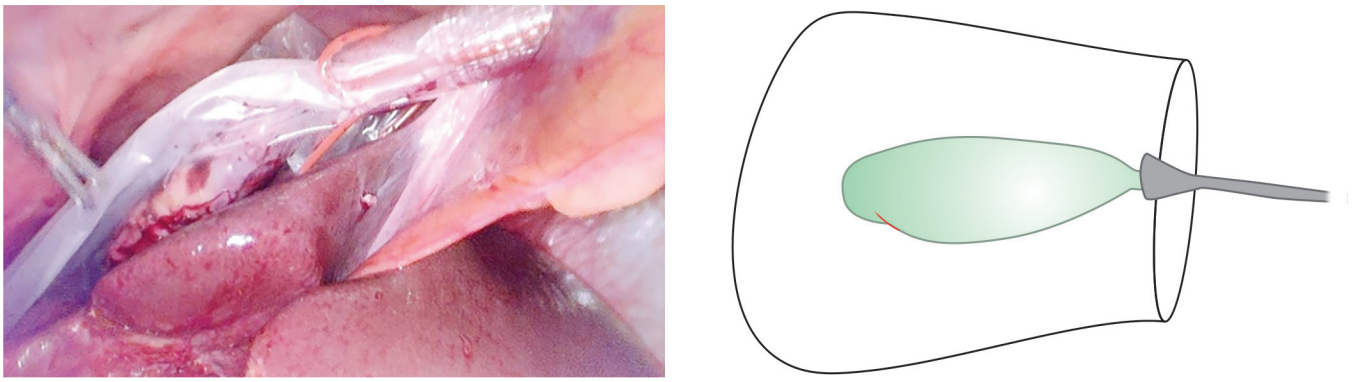


Fig. 9: Gallbladder specimen vertical lie

this site. We use this port for retrieval in cases of large stones (Size on preop ultrasound abdomen > 20 mm) and close it with Vicryl 2–0 at the end of the procedure (Fig. 10).

Inspecting port sites we inspect all port sites and ensure hemostasis before terminating pneumoperitoneum.

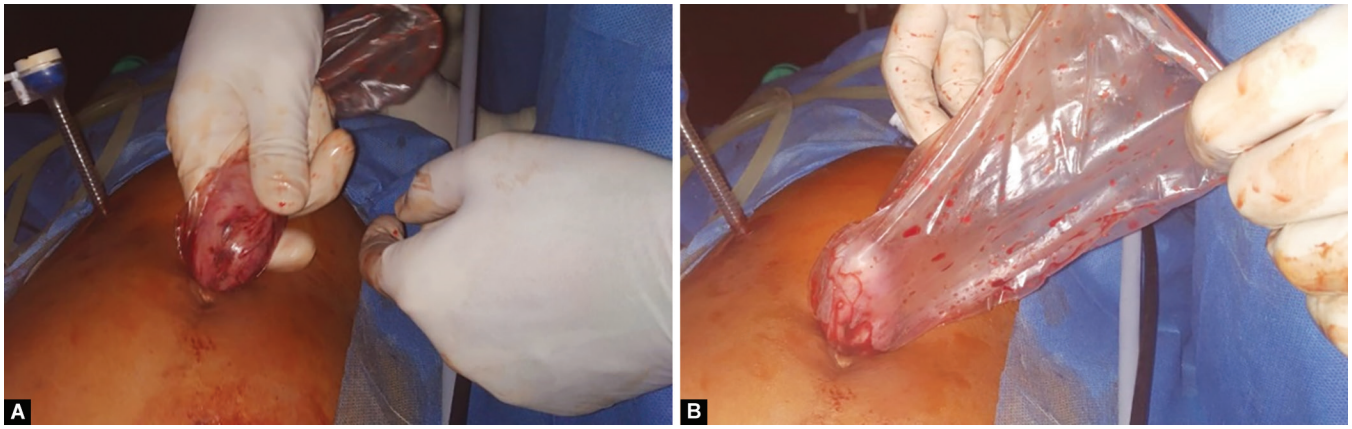
Results

In our series, there was no single case of CBD injury, major bleeding, or bile leak.

Port site infections were seen in three patients and all patients presented after 6 weeks of the procedure. These patients responded to culture-based oral antibiotics for 6 weeks duration. None of these three patients had an infection caused by non-*mycobacterium* tubercular (Non-MTB).

Discussion

About 10–20 % of the population harboring cholelithiasis and the majority (about two-third of them) remain asymptomatic at 20 years follow-up.[3] Laparoscopic gallbladder removal First performed, and by Mouret in France in 1987. It was a big leap in the realm of biliary surgery as it reformed the landscape. It gained widespread popularity at a fast pace and replaced conventional OC globally.[4] There are myriad modifications that have been made to strive for better cosmetic results and overall outcome. Most of the modifications were related to number and port size. However, the standard technique has to be kept in mind and not to be violated at the cost of patient safety. In this study, we have incorporated tips and tricks which are acquired over decades and seem to be very useful at each and every step during the procedure particularly



Figs 10A and B: Specimen retrieval through umbilical port site

for surgery residents and budding surgeons to accomplish the procedure with the desired outcome as procedure-related complication rate in young hands continued to be static.

Prophylactic antibiotic is not used and more and more study support this policy. A RC by Anil Mehta et al. concluded that routine prophylactic antibiotics can be omitted safely.[5] There are two ways of achieving pneumoperitoneum, the closed technique, and open technique. Although the superiority of one over another is not yet established. However few **s**mall study favors the open technique requires less time and has a better safety profile.[6] Conventional procedures done using four ports (2 mm × 10 mm, 2 mm × 5 mm) worldwide and yet enjoy the preferred technique despite a maximum number of modifications that have been evaluated. We found 3 port procedure avoiding placement of 5 mm port for fundal retraction only useful in selective patients where thin-walled GB with normal Calot's ids present. Adding forth port is often required in patients having intraoperative mucocele, pyocele, frozen Calot's etc. Need of additional 5th port is seldom required to control intraoperative excessive bleeding or excessive adhesion in the case of frozen calots triangle.[7] We used an additional 5 mm port in three cases at the right upper abdomen to push the enlarged left hepatic lobe. An additional port in difficult laparoscopic cholecystectomy for surgical safety As soon as we enter the peritoneal cavity we should inspect the abdominal cavity for bleeding or any pathology to abdominal organs. In our study, we found hepatic micro/macro nodules, hepatic SOLs, growth from gastric, small bowel wall, and Meckel's diverticulum. One patient was finally diagnosed to have hepatic tuberculosis on histopathological examination of the incidentally detected hepatic lesion. Other entities like Cirrhosis, and adenocarcinoma of GB with hepatic metastasis were also detected. One patient each of gastric/bowel wall lesion was diagnosed to have gastrointestinal stromal tumor (GIST). There are few interesting case reports of concurrent appendicectomy for subhepatic inflamed appendix that have been described. We have made this inspection an indispensable part of our surgical practice. In a cross-section study by Baraa Shebli 534 patients underwent laparotomy/laparoscopy while most of the procedures done for cholelithiasis (66%) incidental finding (IF) were present in six patients (1.1%).[8]

A Maryland forceps connected to diathermy is conventionally used by the majority of surgeons for initial dissection at Calot's triangle. A major drawback with Maryland forceps is bulky jaws possess a risk of accidentally touching surrounding vital structures and causing thermal injury.

However, we found the hook dissector more feasible for this purpose as less bulky and smoothly negotiable when inflamed thick tissue is encountered. We also started selective use of the hormonic scalpel in patients with thick-walled GB and in patients with cirrhosis having pericholecystic collateral and found it a very useful viable alternative tool in our armamentarium for this procedure which is safe and reduces procedure time.

Current literature also illustrates its usefulness as the study reports it reduces the duration of duration of surgery and overall procedure-related complications.[9]

Hydro-Jet (High-pressure water stream) is also an effective way for dissection at the calots triangle in grossly thickened tissue which may be amenable to bleeding or injury of neighboring vital structures by using conventional cautery. It is a great savior when no progress of dissection is being made and requires lots of patience.

It is first used by Hodjat Shekarriz et al. for cholecystectomy in the porcine model and reported as an excellent alternative to the conventional technique. This is also replicated by the same study group in a prospective randomized clinical study.[10]

Fundus first approach is popular in OC, however, remained underutilized in laparoscopic surgery. We found it a good alternative technique in cases where anatomy at the calots triangle is completely obscured. The harmonic scalpel is used to mobilize the fundus from the GB fossa and dissection should be done till the junction of the cystic duct with the common bile duct (CBD). In such cases cystic duct is invariably found dilated therefore endo GI liner stapler is useful for safer division. Beginners and budding surgeons can practice this approach in simple cases also. In such cases, cystic duct and artery can be divided using liga clips or end loop.

In a systemic review by Michael El Boghdady et al., they found a feasible technique resulting in shorter operative time and less post-op pain, nausea and vomiting.[11]

Retrieval of the specimen at the end of the procedure is the last but not least important step. We use epigastric or umbilical ports for retrieval of specimens depending upon the character of the specimen and the size of the calculus. Thin-walled GB with small calculi can be easily retrieved through an epigastric port without using an endobag.

The umbilical port site is often used with thick-walled GB, i.e., mucocele, pyocele, and stone >20 mm. Improvised polythene bag (locally available bag which is sterilized before use) is usually used for specimen retrieval. Using this type of bag reduces the overall cost.

Once the specimen is retrieved we check for the presence of ligaclips applied to specimens. This clip sometimes dislodged from a specimen and can lead to sinus formation by acting as a foreign body. In most of the study reports endo bag is used selectively when the risk of port site infection and deposition of the malignant cells is high.

Conclusion

Laparoscopic cholecystectomy is one of the most commonly performed elective abdominal procedures globally. Despite a giant leap in experience complication in the form of bile duct injury is still Achilles's heel. Keeping all the small tricks in mind during surgery may be the great saviour to avoid major ductal injury and other complications.

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