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EDITORIAL

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World Journal of Laparoscopic Surgery: Advancing the Frontiers of Minimally Invasive Surgery

The current issue of the *World Journal of Laparoscopic Surgery* encapsulates a dynamic spectrum of topics, reflecting the progress and versatility of minimally invasive surgical techniques in addressing complex medical challenges. With contributions spanning clinical studies, innovative techniques, and robust reviews, this issue provides invaluable insights for surgeons, researchers, and educators alike.

Pioneering Research in Minimally Invasive Techniques

This issue presents a comparative study on closed versus open methods for creating pneumoperitoneum during laparoscopic cholecystectomy, a procedure fundamental to safe and effective laparoscopic practice. Additionally, the observational study on Rouviere's sulcus highlights the significance of anatomical nuances in enhancing surgical safety during cholecystectomy—a critical reminder of the interplay between anatomy and operative strategy.

The article addressing gastropexy-omentopexy in laparoscopic sleeve gastrectomy is particularly compelling, shedding light on how nuanced procedural modifications can improve postoperative outcomes. Similarly, the findings on laparoscopic repair of congenital diaphragmatic hernia in adults represent an exciting frontier for surgeons managing complex thoracoabdominal conditions.

Addressing Challenges in the Surgical Community

This issue also delves into challenges faced by surgeons. The survey on the prevalence of musculoskeletal symptoms among laparoscopic surgeons underscores the need for ergonomic awareness and interventions to sustain long-term surgical practice. Moreover, the exploration of simulation-based training among surgical residents underscores the value of modern educational tools in fostering competency.

Innovations and Future Directions

The review article titled *"Robotic Surgery from Earth to Space!"* is an outstanding contribution, offering an inspiring perspective on how robotics and artificial intelligence are revolutionizing surgery. Such advancements not only enhance precision but also pave the way for extraterrestrial applications, marking a bold stride toward the future.

The inclusion of novel techniques, such as the use of a rigid laparoscope for intraoperative bowel endoscopy, exemplifies how creativity and innovation continue to redefine surgical possibilities. Equally intriguing is the case series on nonsurgical approaches to weight loss using the swallowable balloon, a testament to the multidisciplinary efforts in addressing metabolic disorders.

Strengthening Surgical Education and Collaboration

The case reports in this issue serve as a reminder of the importance of tailored solutions for complex scenarios. From ovarian inguinal hernias to concurrent femoral and inguinal hernia recurrences, these reports provide practical insights and foster collaboration within the global surgical community.

Lastly, the short communication on hemocoagulative considerations during laparoscopic cholecystectomy in cirrhotic patients offers timely guidance for managing high-risk cases. Such contributions highlight the need for meticulous planning and adaptability in surgical practice.

Conclusion

As we step into 2025, this issue of the *World Journal of Laparoscopic Surgery* stands as a testament to the relentless pursuit of excellence in minimally invasive surgery. It is our hope that the research, reviews, and innovations featured herein will inspire further advancements and foster a collaborative spirit within the global surgical community.

We extend our heartfelt gratitude to the contributors, reviewers, and editorial team who have made this issue possible. Together, let us continue to push the boundaries of what is achievable in minimally invasive surgery.

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ORIGINAL ARTICLE

Comparing Closed and Open Methods for Creation of Pneumoperitoneum in Laparoscopic Cholecystectomy

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Abstract

Background: This study is based on the access technique for the creation of pneumoperitoneum in the operative procedure of laparoscopic cholecystectomy. This technique is a crucial step in this operative procedure.

Aim: The specific aim is to study the efficacy of closed and open methods for creating pneumoperitoneum in laparoscopic cholecystectomy by comparing their outcomes and complications.

Materials and methods: Our study is a prospective observational study for 2 years January 2021 to January 2023 of cases done in our facility at central and southern Ondo, Nigeria. Consecutive patients with cholelithiasis who consented to laparoscopic cholecystectomy were recruited into the study using a purposive sampling method after applying the exclusion criteria. The patients demographics and comparative variables were imputed into a proforma which was analyzed using SPSS version 26 (IBM incorporated Chicago, Illinois).

Results: Of the 50 patients under study there were 4 males (8%) and 46 females (92%). The mean age was 45.74 ± 6.2 years. About 28 underwent the closed method of access while 22 underwent the open method. Minor complications like gas leaks during the procedure were observed more in the open method group. Other complications such as visceral and vascular injury and conversion to open surgery after the initial access were not observed in both groups. However umbilical port-site hematoma, umbilical port-site infection, and incisional hernia were observed in the open access method during follow-up period. The time taken to close abdominal ports wound was almost the same in both groups. However, the mean operating time was significantly less in the closed-access method. In general, the length of hospital stay in both groups was not significantly different.

Conclusion: Even though both access methods are safe, the closed method is more efficacious than the open method.

Keywords: Access, Cholecystectomy, Closed, Laparoscopic, Open.

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Introduction

This study was conducted on the background of the access technique which is the initial step in the operative procedure of laparoscopic cholecystectomy and intraoperative cholangiogram

Laparoscopic surgical outcome may not be satisfactory all the time as a result of associated complications.[1,2]

The most crucial step in laparoscopy is the creation of pneumoperitoneum.[3,4]

The majority of these complications result from the initial process of creation of pneumoperitoneum at the umbilicus.[5]

The incidence of vascular injuries is 2 in 10,000 procedures. These are life-threatening major vascular injuries visceral injuries have also been reported and is up to 3 in 10,000 operations of laparoscopic cholecystectomy.[6,7]

The two most common access techniques are[8–10]

1. Closed—where Veress needle is used.
2. Open—where Hasson's cannular is used.[8–10]

Pneumoperitoneum is activated by a blind puncture at the umbilicus using the Veress needle followed by insertion of trocar at the same point. Whereas in the open method, dissection at the navel and identification of the peritoneum are first performed before the introduction of the cannular. However, it still remains controversial which of the techniques is optimal in the operative procedure of laparoscopic cholecystectomy.

We aim to evaluate the two access techniques and determine the difference in terms of outcome and complications at the operative procedure of laparoscopic cholecystectomy which remains the gold standard in the management of gall bladder disease.

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Conflict of interest: Dr Rajneesh Kumar Mishra is associated as the Editor-in-Chief of this journal and this manuscript was subjected to this journal's standard review procedures, with this peer review handled independently of the Editor-in-Chief and his research group.

Materials and Methods

This was a 2-years prospective observational study conducted at the University of Medical Science Teaching Hospital, Ondo, and the

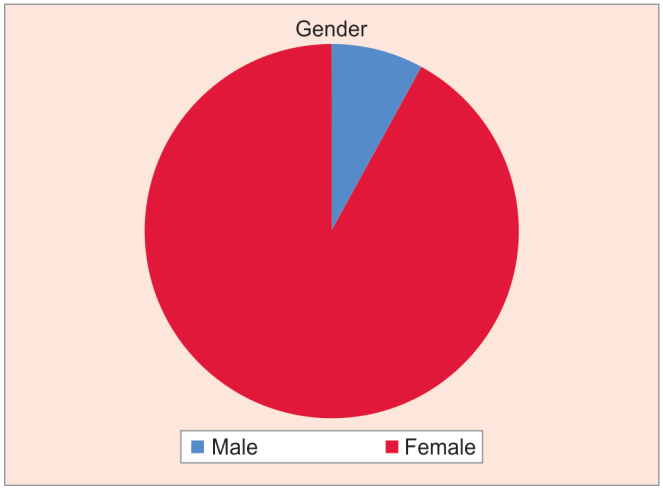

Fig. 1: Gender distribution

George and Martin Specialist Laparoscopy Center Ore Ondo state Nigeria, between January 2021 to January 2023.

Consecutive patients who presented with cholelithiasis were recruited into the study. After obtaining informed consent, the patient was asked to choose either of the closed or open methods of creating pneumoperitoneum. By this purposive random sampling, participants are chosen based on the purpose or method agreed with the surgeon.

Exclusion criteria included patients with uncontrolled pre-morbid disease others with a visceral hernia at or close to the umbilicus and also those with previous surgery at the upper abdomen. Laparoscopic cholecystectomy was done and the variables studied where demographics of the patients, access group, gas leak, intraoperative complications, postoperative complications, wound closure time, operating time, and the period spent in the hospital.

Access Time: Timing from the Knife on the Skin to Installation of the Telescope into the Abdomen

Operating time: Time taken from knife on skin to closure of all ports.

Vascular injury: We concentrated on major vascular injuries.

Visceral injury: Injury of the intra-abdominal viscera.

Postoperative vomiting: Vomiting within 48 hours of surgery.

Postoperative urinary retention: Not being able in half of a day postoperatively.

Port-site hematoma: Presence of a hemorrhagic discharge or clot from the port-site wound within 7 days of surgery or beyond.

Port-site hernia: Presence of a hernia at the umbilicus at and beyond 30 days postoperatively.

Statistical analysis was performed through the use of SPSS version 26 (IBM, Chicago, USA).

Student's *t*-test was applied to compare the two groups, *p*-value < 0.05 was considered statistically significant.

Chi-squared nonparametric test was applied to categorical variables at 95% confidence interval.

Results

The overall 28 patients had the closed method while 22 had the open access method of creation of pneumoperitoneum. Figure 1 shows that in the study, 96% were females while 8% were males (Table 1). Figure 2 shows a bell-shaped normal age distribution irrespective of two outliers at the extreme and Table 2 presents the mean age overall to be 45.72 ± 6.2 years. Table 3 presents of access time in the two groups and Table 4 the mean access time of 12.8 ± 1.2 minutes in the closed and 18.55 ± 5.4 minutes in the open which is of significant difference.

Table 5 depicts gas leak, with no gas leak in the closed group and a significant difference of 81.8% of gas leak in the open method. Table 6 displays the postoperative complications with no hematoma at the port site, absence of infection, and no incisional hernia in the closed group. Table 7 displays the time taken to close port-site wounds of 7.36 ± 3.3 minutes in the closed group and 7.59 ± 2.6 minutes in the open group with no significant difference in the two groups. Table 8 presents the mean operating time of 135.54 ± 14.8 minutes in the closed group and 161.05 ± 44.4 minutes in the open group with a significant difference in the two groups.

Table 1: Showing gender distribution of patients

	Gender			
	Frequency	*Percent*	*Valid percent*	*Cumulative percent*
Valid				
Male	4	8.0	8.0	8.0
Female	46	92.0	92.0	100.0
Total	50	100.0	100.0	

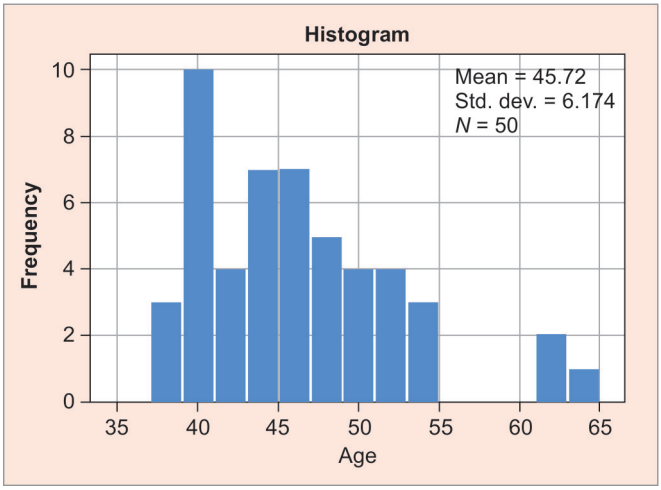

Fig. 2: Showing age distribution and the mean age

Table 2: Showing age distribution and the mean age

	N	*Mean*	*Std. deviation*
Age (years)	50	45.72	6.174
Valid *N*	50		

Table 3: Showing access time in the two groups

	Access time			
	5–15 minutes	*16–25 minutes*	*More than 25 minutes*	
Access group				
Open	8	12	2	22
Closed	11	17	0	28
Total	19	29	2	50

Table 4: Showing mean access time in the two groups

Access group	*N*	*Mean*	*Std. deviation*	*Std. Error mean*
Access time (minutes)				
Open	22	18.55	5.387	1.149
Closed	28	12.18	1.786	0.337
p-value = 0.000				

Table 5: Showing gas leak in the two groups

	p = 0.000 Gas leak		
	No gas leak	*There is gas leak*	*Total*
Access group			
Open	4	18	22
Closed	28	0	28
Total	32	18	50

Table 6: Showing postoperative complications

	Access group		
	Open	*Close*	*Total*
Postoperative complications			
No complication	9	25	34
Postoperative vomiting	2	2	4
Postoperative urinary retention	1	1	2
Port-site hematoma	5	0	5
Port-site infection	2	0	2
Incisional hernia	3	0	3
Total			
p-value = 0.004	22	28	50

Table 7: Showing time taken to close the wound

	Group statistics				
p-value = 0.787	*Access group*	*N*	*Mean*	*Std. deviation*	*Std. error mean*
Time taken to close the wound of the ports (minutes)	Open	22	7.59	2.594	0.553
	Closed	28	7.36	3.302	0.624

Table 8: Showing operating time

	Group statistics				
p-value = 0.000	*Access group*	*N*	*Mean*	*Std. deviation*	*Std. error mean*
Operating time (minutes)	Open	22	161.05	44.387	9.463
	Closed	28	135.54	14.844	2.805

Table 9: Showing hospital stay

	Group statistics				
p-value = 0.926	*Access group*	*N*	*Mean*	*Std. deviation*	*Std. error mean*
Hospital stay (days)	Open	22	3.55	1.262	0.269
	Closed	28	3.57	0.690	0.130

Table 9 illustrates the length of hospital stay of 3.57 days ± 0.69 in the closed group and 3.55 ± 1.3 days in the open method group with no significant difference in the two groups.

Discussion

The most important step in laparoscopy is the creation of pneumoperitoneum. The great majority of complications arising from laparoscopy occurs at the beginning of the main surgery at creation of pneumoperitoneum.[8–10]

We have thus compared Harrith Hasson open method and Veress blind puncture techniques of creating pneumoperitoneum, which are the most commonly used methods.[11–14]

A study was done in which the mean time needed to create pneumoperitoneum with the closed techniques was 4.1 ± 1 minutes and open method was 5 ± 1 minutes, respectively (*p*-value = 0.000).[3,15]

Another study noted that the average time of access in the closed method was 7 ± 2 minutes, and in the alternate method 5.1 ± 2 minutes. For us, the access time in closed techniques came to be 12 ± 2 minutes and in the open technique 18 ± 5 minutes (*p*-value 0.000). Our study thus varies with then for mentioned studies in not only a longer general access time but also in the fact that there is a significant differences in mean access time in the two groups.[16]

In our study there was no gas leak in the closed method whereas 18 (81.8%) patients had leakage of gas out of 22 cases. Our findings correspond to other studies in which the incidence of gas leakage was higher in the open technique of creating pneumoperitoneum.

In our study, no vascular or visceral injuries was seen and conversation to open cholecystectomy was also not seen. However, Bonjer et al. reported 0.08% of visceral injury and 0.07% of vascular injury in the closed technique, and their frequency of visceral injury was 0.05% and blood vessel injury of 0% in the open technique of pneumoperitoneum (*p* = 0.002).[17–19]

Our study observed more postoperative complications like postoperative vomiting, urinary retention, hematoma at the port-site, infection at the port site and incisional hernia in the open method than in the closed method and a marked difference between the techniques (*p* = 0.004). Other studies were in keeping with thin finding.

A study noted infection at the umbilical site as 5.31%. Another noted 6.3% and also another noted below 20%.[20–23]

The mean time taken to close the wound was 7.36 in the closed group and 7.59 in the open group (*p* = 787) showing no significant difference.

The operating time was however shorter in the closed group. This was probably due to the less time taken to create pneumoperitoneum at the start (*p* = 0.000). The mean hospital stay in days was 3.57 in the closed group and 3.55 in the open group *p* = 926 showing no significant difference in the length or duration of hospital stay in the two groups.

Conclusion

The closed method of access is more efficacious in shortening the time of access and overall operative time, saving hospital resources by the reduction in gas usage and also having lower postoperative complications rate. However, there is no significant difference in the length of hospital stay between the two access techniques.

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ORIGINAL ARTICLE

Prevalence of Musculoskeletal Symptoms in Laparoscopic Surgeons

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Abstract

Aim: Work-related musculoskeletal disorders consist of group of symptoms caused by occupational risk factors. These symptoms are the main cause of loss of productive working time and increase in labor costs. This study aims at estimating the prevalence and identifying risk factors for developing work-related musculoskeletal symptoms in surgeons performing laparoscopic surgery.

Materials and methods: This cross-sectional study was conducted on 50 surgeons in a tertiary care hospital of Ahmedabad. In this study, the prevalence and severity of musculoskeletal symptoms was evaluated using the Nordic Pain questionnaire and Workplace Ergonomic Risk Assessment (WERA) method in surgeons performing laparoscopic surgery.

Results and conclusion: The results revealed that there's development of significant pain during laparoscopic surgeries due to various reasons like neck posture and shoulder abduction posture; various ergonomics of laparoscopy. Workplace Ergonomic Risk Assessment scoring was very effective in identifying group of surgeons having high risk of developing musculoskeletal symptoms. This study concluded that surgeons maintained a more extended posture during laparoscopic surgery that led to musculoskeletal symptoms.

Keywords: Ergonomics of laparoscopy, Musculoskeletal symptoms, Posture, Surgeons.

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Introduction

Musculoskeletal disorders are one of the prevalent reasons of occupational trauma and disability.[1] The risk factors responsible for the occurrence of these symptoms can be divided by physical factors, organizational, psychological, and individual factors. Physical factors include improper posture, poor ergonomics, carrying heavy loads and working with repetitive movements. These disorders mainly occur in upper extremities, such as hands, wrists, arms, shoulders, neck, and waist. These disorders occur due to repetitive movements that lead to injury of nerves, tendons, joints, cartilage, and intervertebral disks. Factors responsible for the above symptoms are improper posture and repetitive movements.

When we discuss incidence of such musculoskeletal symptoms in white collar jobs like doctors, on first thought, everyone tends to shrug it off. But in streams like laparoscopic surgeons, the incidence of such symptoms is high in number. Such musculoskeletal symptoms include limb pain, uneasiness, tingling sensation, tenderness, restricted range of motion and loss of precision. Laparoscopic surgeons are at danger of developing these manifestations. The position of surgeons during laparoscopic surgery is upright position and their hands are generally moving. Many a time, surgery gets prolonged for hours and continuous high tone applied by muscles is too high.[2,3] As surgery is often subtle, sensitive and time-consuming, ergonomics helps surgeons to work without any pain or stress and with fewer errors.

The laparoscopic procedures are currently performed in large volumes over the last few years. Laparoscopic surgery is restricted by the fulcrum effect, lack of properly functioning instruments and adaptation of limited body movement. During laparoscopic procedures, body movement of surgeon is very limited, resulting in more static upright body posture.

There are multifaceted reasons for development of these symptoms among surgeons. With help of this study, we will try to quantify the incidence and prevalence of musculoskeletal symptoms among surgeons doing laparoscopic surgery and to discuss a few causes of such symptoms.

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Aims

The goal of this research project was to estimate the prevalence and detect the causes for developing work-related musculoskeletal symptoms in surgeons performing laparoscopic surgery.

Another aim of the study was to assess the effectiveness of Workplace Ergonomic Risk Assessment (WERA) scoring in predicting the risk status for development of musculoskeletal symptoms.

Materials and Methods

In this cross-sectional study, 50 surgeons in the age-group of 25–60 years who were working actively in tertiary healthcare

Table 1: Age distribution and incidence of musculoskeletal symptoms in sampled surgeons

Age-group (in years)	*Total no. of surgeons*	*Incidence of musculoskeletal symptoms*
25–35	26	01
35–45	14	04
45–60	10	06

Table 2: Total number of average surgeries performed in a single day

Total no. of surgeries performed in single day	*Development of symptoms in such surgeons*
1–3	04
>3	07

center of Ahmedabad and performing both open and laparoscopic surgeries were selected as participants with informed consent taken from them.

Those having any previous injury of any musculoskeletal system, such as shoulder, neck, wrists, back, those having history of spine injury and having any medical conditions, such as diabetes, vitamin deficiency related to musculoskeletal disorders were excluded from the study.

To determine the prevalence of musculoskeletal symptoms in these participants, the Nordic questionnaire (Appendix 1) was used.[4,5] Various types of information, such as age, height, weight, nature of regular operative work, number of operations hours per week, total duration of individual laparoscopic procedures, involuntary change in weight bearing foot during surgery, usage of foot operated energy device during laparoscopic surgery were added to the questionnaire.

To evaluate the risk factors in laparoscopic types of surgery, WERA (Appendices 2 and 3) method was used.[6] The WERA covers an extensive range of physical risk factors including posture, repetition, forceful vibration, contact-stress, and task duration.

It helps to assess the five main body regions, that is, shoulder, wrists, back, neck, and legs in participants performing laparoscopic procedures. Laparoscopic procedures were observed and data were collected for assessment over a period of 12 months. Ethical committee approval was taken to conduct the study.

Below are the Nordic questionnaire and WERA questionnaire.

Results

The results observed are given below. The results state that about 22% incidence of musculoskeletal symptoms was observed among surgeons.

There were 26 young surgeons who participated in the study. About 14 surgeons were in the 35–45 years age-group, whereas about 10 surgeons were in the 45–60 years age-group. A total of 11 surgeons developed musculoskeletal symptoms, out of which, 6 surgeons were of more than 45 years old as given in Table 1.

There was an increased incidence in surgeons' group which were performing an average of more than three surgeries or more than 4 hours of laparoscopy per day as given in Table 2.

As per our study, the chances of development of musculoskeletal symptoms are increased when total duration of surgery increased as given in Table 3.

Table 3: Correlation of duration of surgery with incidence of musculoskeletal symptoms

Average duration of laparoscopic surgery per day	*Incidence of musculoskeletal symptoms*
<2 hours	2
2–4 hours	2
>4 hours	7

Table 4: WERA scoring and its correlation to development of musculoskeletal symptoms.

WERA score	*Total no. of surgeons*	*Development of musculoskeletal symptoms*
Low risk	31	1
Medium risk	13	4
High risk	6	6

Table 5: Symptom distribution according to Nordic questionnaire

Regions under inquiry under Nordic questionnaire	*Development of musculoskeletal symptoms in laparoscopic surgeons*
Neck	5
Shoulders	3
Upper back	2
Elbows	0
Wrist	0
Lower back	0
Hips/thighs	0
Knees	0
Ankles/feet	1

Surgeons having medium and high-risk level according to WERA findings, have higher chances of development of musculoskeletal symptoms as presented in Table 4.

In laparoscopic surgeons there is more involvement of neck and shoulder regions as shown in Table 5.

Conclusion

The goal of research project is to measure prevalence and detect the causes for developing laparoscopic procedure-related body aches in surgeons performing laparoscopic surgery. Many research articles have shown that immobile and ergonomically poor body position, female gender, table height, and device pattern, age, unawareness regarding proper ergonomics in laparoscopic procedures.

According to our study, with increasing age or increased work-load, surgeons are more prone for developing musculoskeletal symptoms (Table 1). So, laparoscopic surgeons should be more aware of such parameters to prevent developing such problems. However, our sample size is very small to draw any definitive conclusion.

According to our study, WERA scoring system is very helpful in predicting the high risk of occurrence of musculoskeletal symptoms among surgeons (Table 4). So, by following this scoring system, surgeons can prevent occupational hazards and wear and tears

to the body. By doing so, one can increase the efficiency as well as improve the quality of life.[7,8]

The surgeons, while performing laparoscopic procedures, should be aware of simple ergonomic practices like adopting acceptable postures during surgery and adequate breaks in between the procedures. Spinal postures with greater than 20° of flexion, lateral flexion or rotation and more than 5° of extension pose a risk for spinal pain if adopted for longer periods.[1,3]

The monitors should be mounted in a manner that viewing angle is in surgeon's line of vision. The proper screen distance should be at 1 m from surgeon's eyesight and at a declining angle from surgeon's neutral gaze that ranges from 0 to 15°. Among the most important tools used in laparoscopic surgery, is the grasper/loop, which causes poor posture of the body. Minimal invasive surgeries show a trend for prolonged timespan in immobile position of neck, while open procedures showed trends for higher frequency of movements.[1]

The problem of high prevalence of musculoskeletal symptoms among surgeons can be solved by using appropriate ergonomic tools, management solutions and suitable design of surgical instruments. For example, a standing-sitting ergonomic chair could be used to prevent back pain during surgery and using a suitable chair can improve postures.[6] Surgical tools with ergonomic design and soft rubber handle can be used easily to raise hands while working.

This study concluded that there is more prevalence of musculoskeletal symptoms among both surgeons. Surgeon who maintained body position in flexion during open surgery and in full extension of back with forward protruded neck and abducted shoulder position while minimal invasive procedure leads to muscular symptoms. The knowledge of proper ergonomic set up of operation table and monitor and properly articulated instruments with timely plan break interval can lower down symptoms. Laparoscopic procedures showed a trend for longer duration in static posture in the neck.

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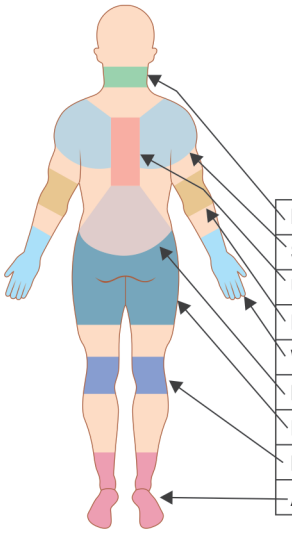
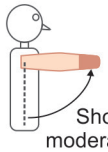
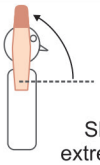
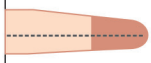
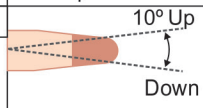
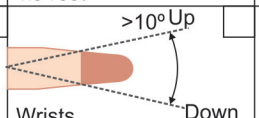
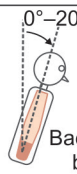
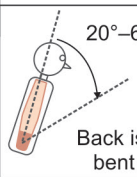
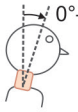
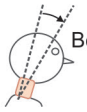
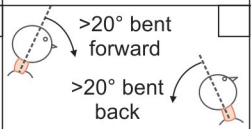
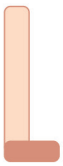
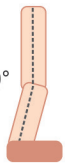
Appendix 1



	Have you at any time during the last 12 months had trouble (such as ache, pain, discomfort, numbness) in:	During the last 12 months have you been prevented from carrying out normal activities (e.g., job, housework, hobbies) because of this trouble in:	During the last 12 months, have you seen a physician for this condition:	During the last 7 days, have you had trouble in:
Neck	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Shoulders	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Upper back	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Elbows	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Wrists/Hands	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Lower back	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Hips/Thighs	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Knees	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes
Ankles/Feet	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes	☐ No ☐ Yes

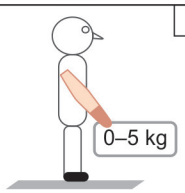
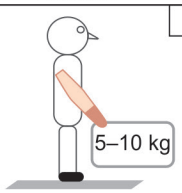
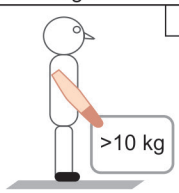
A1: Nordic musculoskeletal questionnaire[4,5]

Appendix 2

Physical risk factor		Risk level			Scoring system
		Low	Medium	High	
1. Shoulder	1a. Posture	 Hands at about the waist level. Shoulders in neutral position	 Hands at above the chest level. Shoulder is moderate bent up	 Hands at above the chest level. Shoulder is extreme bent up	1a. Posture / 1b. Repetition: Risk level — Low: Low 2, Medium 3, High 4; Medium: Low 3, Medium 4, High 5; High: Low 4, Medium 5, High 6. Score 1
	1b. Repetition	Light movement with more pauses	Moderate movement with some pauses	Heavy movement with no rest	
2. Wrist	2a. Posture	 0°. Wrists in a neutral position	 10° Up. Down. Wrists are moderate bent up or bent down	 >10° Up. Down. Wrists are extreme bent up or bent down with twisting	2a. Posture / 2b. Repetition: Risk level — Low: Low 2, Medium 3, High 4; Medium: Low 3, Medium 4, High 5; High: Low 4, Medium 5, High 6. Score 2
	2b. Repetition	0–10 times per minute	11–20 times per minute	Over 20 times per minute	
3. Back	3a. Posture	 0°. Back in neutral position	 0°–20°. Back is moderate bent forward	 20°–60°. Back is extreme bent forward	3a. Posture / 3b. Repetition: Risk level — Low: Low 2, Medium 3, High 4; Medium: Low 3, Medium 4, High 5; High: Low 4, Medium 5, High 6. Score 3
	3b. Repetition	0–3 times per minute	4–8 times per minute	9–12 times per minute	
4. Neck	4a. Posture	 0°–10°. Neck in neutral position with little bent forward	 10°–20° Bent forward. Neck is moderate bent forward	 >20° bent forward. >20° bent back. Neck is extreme bent forward or bent back	4a. Posture / 4b. Repetition: Risk level — Low: Low 2, Medium 3, High 4; Medium: Low 3, Medium 4, High 5; High: Low 4, Medium 5, High 6. Score 4
	4b. Repetition	Light movement with more pauses	Moderate movement with some pauses	Heavy movement with no rest	
5. Leg	5a. Posture	 Legs in neutral position OR sitting with feet are flat on floor/foot rest	 30°–60°. Legs are moderate bent forward OR sitting with feet are bent on floor	 >60°. Legs are extreme bent forward OR sitting with feet do not touch floor	5a. Posture / 9. Duration: Risk level — Low: Low 2, Medium 3, High 4; Medium: Low 3, Medium 4, High 5; High: Low 4, Medium 5, High 6. Score 5

A2: Workplace ergonomic risk assessment part A[6]

Appendix 3

Physical risk factor		Risk level			Scoring system
		Low	Medium	High	
6. Forceful	Lifting the load	 Lifting the load 0–5 kg	 Lifting the load 5–10 kg	 Lifting the load more than 10 kg	6. Forceful 3a. Posture: Low/Low=2, Low/Medium=3, Low/High=4, Medium/Low=3, Medium/Medium=4, Medium/High=5, High/Low=4, High/Medium=5, High/High=6 Score 6
7. Vibration	Using of vibration tool	 Never used of vibration tool OR Used vibration tool <1 hour per day	 Occasional used of vibration tool WITH 1–4 hours per day	 Constant used of vibration tool with >4 hours per day	7. Vibration 2a. Posture: Low/Low=2, Low/Medium=3, Low/High=4, Medium/Low=3, Medium/Medium=4, Medium/High=5, High/Low=4, High/Medium=5, High/High=6 Score 7
8. Contact stress	Using of tool handle OR wearing hand gloves	 Soft/Round shape of tool handle OR Using a full cover of hand gloves	 Hard/Sharp shape of tool handle OR Using a half cover of hand gloves	 No/Without of tool handle OR Never used hand gloves	8. Contact stress 2a. Posture: Low/Low=2, Low/Medium=3, Low/High=4, Medium/Low=3, Medium/Medium=4, Medium/High=5, High/Low=4, High/Medium=5, High/High=6 Score 8
9. Task duration	Task—hour/day	 <2 hours per day	 2–4 hours per day	 >4 hours per day	9. Task duration 6. Forceful: Low/Low=2, Low/Medium=3, Low/High=4, Medium/Low=3, Medium/Medium=4, Medium/High=5, High/Low=4, High/Medium=5, High/High=6 Score 9
					Final score

Job/Task : _____

Date : _____

Observer : _____

Action level

Risk level	Final score	Action	Tick (✓)
Low	18–27	Task is acceptable	☐
Medium	28–44	Task is needed to further investigate and required change	☐
High	45–54	Task is not accepted, immediately change	☐

A3: Workplace ergonomic risk assessment part B[6]

ORIGINAL ARTICLE

A Study on Perspective of Surgical Residents Toward Simulation-based Training in a Teaching Hospital: A Prospective Observational Study

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Abstract

Aims and background: Simulation-based training is an innovative approach to medical education that is rapidly being adopted in many medical specialties, including surgery. Simulation-based training has several advantages over traditional methods of surgical training as it provides a safe and controlled environment for the repeated practice of surgical skills, which allows residents to gain confidence and competence in a particular skill before applying it to real patients. The objective of this study is to assess the perspective of a surgical residents toward simulation-based training in polytrauma scenario.

Materials and methods: A prospective observational study was conducted over a period of 1 month in September 2022 at the BMCRI Simulation and Skill Centre located at Victoria Hospital in Bengaluru. About 26 surgery residents participated in the study and at the end of the study; all residents completed a short survey to obtain their perspective about the qualities of the simulator as well as usage of the system.

Results: Based on the responses from the participants, it can be inferred that the majority of them agree (38.5%) or strongly agree (38.5%) with the effectiveness of the simulation training in polytrauma scenario briefing, the superiority of simulation-based education techniques (53.8%), the use of hands-on techniques (61.5%), and the appropriateness of the polytrauma scenario and equipment choices (38.5%). Additionally, the majority of the participants (76.9%) agree that the course met their needs regarding orientation to polytrauma assessment and management and that they would highly recommend the course to their peers. Regarding debriefing, the majority disagree (46.2%) which indicates a need for further detailed debriefing regarding the scenario.

Conclusion: Simulation-based training is an effective method for training surgical residents in the management of polytrauma scenarios.

Clinical significance: With the rapidly evolving surgical education simulation-based education is highly appreciated by surgical residents and they would benefit from more exposure to simulation in their learning process.

Keywords: Simulation, Surgical education, Surgical training, Surgical skills.

World Journal of Laparoscopic Surgery (2025): 10.5005/jp-journals-10033-1634

Introduction

Simulation-based training is an innovative approach to medical education that is rapidly being adopted in many medical specialties, including surgery. It provides a safe and realistic learning environment for repeated practice, underpinned by feedback and objective metrics of performance.[1] Simulation has been used in high-risk industries, such as aviation, for teaching both technical and nontechnical skills, and has shown to be an effective tool.[2] The use of simulation in healthcare is increasingly being recognized as a valuable tool for training healthcare professionals.[3]

Surgical residents are required to acquire a broad range of technical and nontechnical skills to become competent surgeons. The traditional approach to surgical training involves hands-on experience in the operating room under the guidance of an experienced surgeon. However, this approach has several limitations, including the risk of patient harm and the potential for errors to occur.[4] Simulation-based training has coherence with adult learning principles and is particularly valuable in training subjects to deal with emergencies without causing harm to patients.[5] It has been shown to be effective in measuring and maintaining trainee skills in various medical specialties, including laparoscopy, endoscopy, advanced cardiac life support, airway management, and trauma resuscitation.[6] The use of polytrauma simulator in medical education has grown as simulators have progressed from simple, passive models, to high-fidelity manikins that combine passive, active, and interactive elements.[7] There is also evidence to show that skills learned in the simulated environment are transferable to the operating room with real patients.[8]

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Conflict of interest: None

Polytrauma refers to the simultaneous occurrence of multiple traumatic injuries in one patient. Polytrauma is a common scenario in trauma centers, and the management of such cases requires the coordination of multiple medical specialties.[9]

Simulation-based training has several advantages over traditional methods of surgical training. It provides a safe and controlled environment for the repeated practice of surgical skills, which allows residents to gain confidence and competence in a particular skill before applying it to real patients.[10] Additionally, simulation-based training can be used to teach nontechnical skills, such as teamwork, communication, and leadership, which are essential for the effective delivery of healthcare.[11]

Objective

- To assess the perspective of a surgical residents toward simulation-based training in polytrauma scenario.

Materials and Methods

Study Design

A prospective observational study.

Study Period

The study was conducted over a period of 1 month in September 2022.

Study Setting

The study was conducted at the BMCRI Simulation and Skill Centre located at Victoria Hospital in Bengaluru.

Participants

A total of 26 surgery residents participated in the study.

BMCRI Simulation Center

The BMCRI Simulation and Skill Centre is a 9000-square-foot educational facility and state-of-the-art technology center that simulates real patient care settings to complement traditional clinical training for medical professionals.[12] The center has large team training rooms simulating the following environments: emergency department, operating room, endoscopy room and intensive care patient room. Each room has both a corresponding debriefing and control room. The system enables us to deliver simulation-based educational opportunities by presenting specific clinical changes or crises demanding specific interventions.

Procedure

The steps involved briefing the participants on the polytrauma scenario, allowing them to participate in the simulation, and debriefing them after the simulation (Fig. 1). At the end of the study, all residents completed a short survey to obtain their perspective about the qualities of the simulator as well as usage of the system. The survey consisted of six questions that evaluated the residents' satisfaction with the training program, the effectiveness of the simulation-based education techniques, and the usefulness of the hands-on techniques. The survey also evaluated the residents' perceptions of the polytrauma scenario and the equipment used in the training program. The study procedure included the following steps:

1. **Briefing of a scenario:** The participants were provided with a briefing regarding the polytrauma scenario (Fig. 2).

Fig. 1: Emergency room with mannequin for polytrauma scenario

Fig. 2: Briefing of a scenario

Fig. 3: Performing task on simulator

2. **Participation:** The participants were allowed to participate in the simulation-based training using the simulator (Fig. 3).
3. **Debriefing:** After the simulation training, the participants were debriefed on their performance and given feedback (Fig. 4).
4. **Survey:** At the end of the study, all participants were asked to complete a short survey to obtain their perspective about the qualities of the simulator and the usage of the system. The survey consisted of the following questions:
   - Was the briefing regarding the polytrauma scenario sufficient for the simulation training?
   - Do you believe that simulation-based education techniques are superior to classroom-lecture and clinic-based education techniques?
   - Did the use of hands-on techniques enhance your learning experience?
   - Did the choice of polytrauma scenario and equipment meet your educational needs?

Fig. 4: Debriefing

- Overall, do you believe that the course met your needs regarding orientation to polytrauma assessment and management?
- Would you highly recommend this course to your peers?

Results

The results of the prospective, observational study conducted at the BMCRI Simulation and Skill Centre to assess the perspective of 26 surgical residents toward simulation-based training in polytrauma scenario are presented in the following table (Table 1).

The briefing regarding polytrauma scenario—simulation training was found to be sufficient by 38.5% of the participants who strongly agreed and 38.5% who agreed. Only 15.4% of the residents disagreed, while 7.7% strongly disagreed, with a statistically significant *p*-value of 0.001.

Regarding the superiority of simulation-based education techniques over classroom-lecture and clinic-based education techniques, 53.8% of the participants strongly agreed, and 46.2% agreed. The *p*-value was 0.073, which is not statistically significant.

In terms of the use of hands-on techniques enhancing the learning experience, 30.8% of the participants strongly agreed, 61.5% agreed, and 7.7% strongly disagreed. No one disagreed, with a statistically significant *p*-value of 0.001.

Regarding the choice of polytrauma scenario and equipment meeting the educational needs, 38.5% of the participants strongly agreed, and 38.5% agreed. However, 23.1% of the residents disagreed, with a statistically significant *p*-value of 0.001.

Overall, the course was found to have met the needs of the participants regarding orientation to polytrauma assessment and management by 15.4% of the residents who strongly agreed, and 61.5% who agreed. However, 23.1% disagreed, with a statistically significant *p*-value of 0.037.

Regarding the recommendation of the course to peers, 61.5% of the participants strongly agreed, 30.8% agreed, and 7.7% disagreed, with a statistically significant *p*-value of 0.001.

Lastly, debriefing was found to be sufficient by 23.1% of the residents who strongly agreed, 30.8% who agreed, and 46.2% who disagreed. The *p*-value was 0.062, which is not statistically significant.

Based on the responses from the participants (Table 2), it can be inferred that the majority of them agree or strongly agree with the effectiveness of the simulation training in polytrauma scenario briefing, the superiority of simulation-based education techniques, the use of hands-on techniques, and the appropriateness of the polytrauma scenario and equipment choices. Additionally, the majority agree that the course met their needs regarding orientation to polytrauma assessment and management and that they would highly recommend the course to their peers. Regarding debriefing, the majority disagree which needs further detailed debriefing regarding the scenario.

Discussion

Based on the responses from the participants, it can be inferred that the majority of them agree or strongly agree with the effectiveness of the simulation training in polytrauma scenario briefing, the superiority of simulation-based education techniques, the use of hands-on techniques, and the appropriateness of the polytrauma scenario and equipment choices. These findings are consistent with previous studies that have also reported the benefits of simulation-based training for surgical residents. For example, a systematic review by Zendejas et al. found that simulation-based training is superior to traditional training methods in terms of knowledge acquisition and skill retention, with an effect size of 1.07. Additionally, a meta-analysis by McGaghie et al. reported that simulation-based medical education resulted in better clinical outcomes than traditional clinical education, with an effect size of 0.45.

The present study found that the course met the needs of the participants regarding orientation to polytrauma assessment and management, with the majority agreeing or strongly agreeing. However, a significant proportion of the residents disagreed with this statement. This is in contrast to a study by Maconochie et al., which found that simulation-based training improved clinical performance and increased knowledge retention among pediatric emergency medicine trainees.[13] Similarly, a study by Arora et al. reported that simulation-based training resulted in improved patient safety and reduced medical errors.[14]

Regarding the recommendation of the course to peers, the majority of the participants agreed or strongly agreed. This is consistent with a study by Al-Jundi et al., which found that simulation-based training was highly valued by surgical residents and resulted in improved confidence and performance.[15]

Table 1: Responses to survey questions

	Frequency	*Percentage*	*p-value*
Briefing regarding polytrauma scenario—simulation training was sufficient?			
Strongly agree	10	38.5	0.001
Agree	10	38.5	
Disagree	4	15.4	
Strongly disagree	2	7.7	
Simulation-based education techniques are superior to classroom-lecture and clinic-based education techniques			
Strongly agree	14	53.8	0.073
Agree	12	46.2	
The use of hands-on techniques enhanced my learning experience			
Strongly agree	8	30.8	0.001
Agree	16	61.5	
Strongly disagree	2	7.7	
The choice of polytrauma scenario and equipment met my educational needs			
Strongly agree	10	38.5	0.001
Agree	10	38.5	
Disagree	6	23.1	
Overall, I believe the course met my needs regarding orientation to polytrauma assessment and management			
Strongly agree	4	15.4	0.037
Agree	16	61.5	
Disagree	6	23.1	
I would highly recommend this course to my peers			
Strongly agree	16	61.5	0.001
Agree	8	30.8	
Disagree	2	7.7	
Debriefing was sufficient?			
Strongly agree	6	23.1	0.062
Agree	8	30.8	
Disagree	12	46.2	

Table 2: Participant feedback on polytrauma scenario—simulation training

	N	*Median*	*IQR*	*Inference*
Briefing regarding polytrauma scenario—simulation training was sufficient?	26	2	1–2.5	Majority agree
Simulation-based education techniques are superior to classroom-lecture and clinic-based education techniques	26	1	1–2	Majority strongly agree
The use of hands-on techniques enhanced my learning experience	26	2	1–2	Majority agrees
The choice of polytrauma scenario and equipment met my educational needs	26	2	1–2.5	Majority strongly agree
Overall, I believe the course met my needs regarding orientation to polytrauma assessment and management	26	2	2–2.5	Majority agrees
I would highly recommend this course to my peers	26	1	1–2	Majority strongly agree
Debriefing was sufficient?	26	2	1.5–3	Majority Disagree

Additionally, a study by Seymour et al. reported that simulation-based training improved surgical skills and decreased errors in the operating room.[16]

In terms of debriefing, the majority of the participants found it to be sufficient, but a significant proportion disagreed. This is in contrast to a study by Rudolph et al., which found that debriefing is critical for learning in simulation-based training and should be carefully structured to facilitate learning.[17] Similarly, a study by Kolbe et al. reported that debriefing is an essential component of simulation-based training and can improve team performance and patient outcomes.[18]

Conclusion

Overall, the findings of this study suggest that simulation-based training is an effective method for training surgical residents in the management of polytrauma scenarios. However, there is still a need for careful structuring of the training program and debriefing

sessions to ensure that they meet the needs of the participants and facilitate learning.

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ORIGINAL ARTICLE

Effect of Gastropexy-omentopexy on Early Postoperative Outcome of Laparoscopic Sleeve Gastrectomy: A Prospective Comparative Study

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Abstract

Background: The laparoscopic sleeve gastrectomy (LSG) is a pure restrictive bariatric operation. Gastropexy-omentopexy was proposed to alleviate complications, such as leakage, twist, and vomiting that may occur after sleeve gastrectomy This study was aimed to compare the effect of gastropexy-omentopexy on the early postoperative complications of LSG.

Methodology: This is a prospective comparative study conducted between August 2021 and January 2024. It included 376 patients who had LSG at Asyut University Hospital. They were randomly divided in two groups, group A (No = 200) with gastropexy-omentopexy and group B (176) without gastropexy-omentopexy.

Results: There was no statistically significant difference in terms of age, sex, and preoperative body mass index. The overall postoperative complications of group B are higher than those of group A ($p = 0.001$). There was no significant difference in postoperative leak, bleeding, stricture, and twist between the two groups. Nausea and vomiting were higher in group B than in group A ($p = 0.001$) gastropexy-omentopexy.

Conclusion: Laparoscopic sleeve gastrectomy with omentopexy had a significant effect on the overall early complications and readmission rates after LSG. More studies are required to provide a strong recommendation of omentopexy as a standard step in LSG.

Keywords: Gastric twist, Laparoscopic sleeve gastrectomy, Omentopexy.

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Introduction

The laparoscopic sleeve gastrectomy (LSG) is a pure restrictive bariatric operation. It involved constructing a uniformly long gastric tube by removing about two-thirds of the stomach.[1] The consequence is an overall reduction in stomach volume, hormonal capacity, and accelerated duodenal emptying.[2,3] Although it is a straightforward, one-step procedure, there may be some unfavorable adverse events, such as nausea, vomiting, gastric sleeve twist, leaks, or reflux symptoms.[4,5] Since its inception in the late 1990s and early 2000s, it has been subjected to several modifications to enhance the outcome and eliminate associated complications as well.[6,7] Gastropexy-omentopexy was proposed to alleviate these complications.[8–10]

Our study aimed to compare the effect of gastropexy-omentopexy on the early postoperative complications of LSG.

Methodology

Between August 2021 and January 2024, 376 patients had LSG as a single treatment to treat morbid obesity at Asyut University Hospital. The study group was randomly divided into two groups: group (A) with gastropexy-omentopexy and group (B) without it. Patients with a BMI of 40 kg/m^2 or more, patients with a BMI of 35 kg/m^2 or higher and co-morbidities, and those aged 18–65 were all included. We excluded patients with symptomatic reflux or who had undergone prior bariatric surgery. All patients provided informed consents and followed the preoperative assessment process set by the bariatric team. The study was authorized by the local ethics committee. Pre- and postoperative patient care, as well as scheduled follow-up, were provided as previously stated.[11]

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Source of support: Nil

Conflict of interest: None

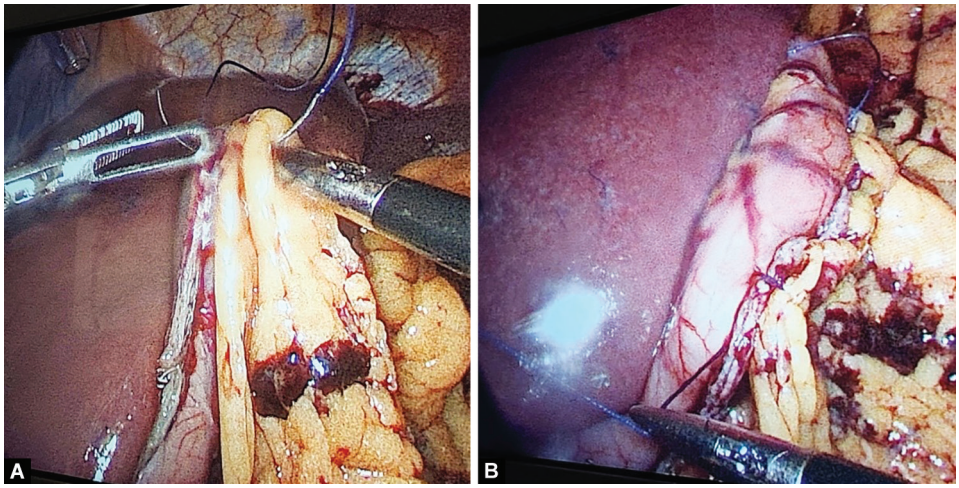
Technique

The same bariatric surgeons conducted all procedures, which followed the same protocol. Our technique for performing LSG has previously been published.[11] The additional step in omentopexy was composed of approximating and fixing the previously detached greater omentum to the evolved staple line by a continuous suture, 5–10 cm from the incisura angularis downward toward the pylorus with Vicryl 2-0 (Fig. 1).

Results

Demographic Data

There was no significant difference between the two study groups in terms of age, sex, and mean BMI (Table 1).



Figs 1A and B: Omentopexy by 2-0 Vicryl

Table 1: Demographic data

	Group A (omentopexy) No = 200	*Group B (without omentopexy) No = 176*	*p-value*
Mean age (range) years	36 ± 10 (range, 24–61)	35 ± 12 (range, 19–65)	0.3788
F:M	111:89	99:77	0.8917
Mean BMI	44 ± 8	43 ± 9	0.2547

Table 2: Postoperative outcome

	Group A (omentopexy) No = 200	*Group B (without omentopexy) No = 176*	*p-value*
Leakage (%)	0	1 (0.56)	0.3174
Stricture	1 (0.5)	2 (1.1)	0.5101
Gastric twist	0	1 (0.56)	0.3174
GERD	4 (2)	6 (3.4)	0.4001
Nausea and vomiting	4 (2)	12 (6.8)	0.0214
Bleeding	1 (0.5)	2 (1.1)	0.5101
Readmission	4 (2)	15 (8.5)	0.0041
Overall complications	10 (5)	24 (13.6)	0.0037

Perioperative Outcome

The mean operative time was 53 ± 9.5 minutes in group A and 68 ± 11.2 minutes in group B ($p = 0.02$). Groups A and B had a mean hospital stay of 24 ± 8 and 28 ± 9 hours, respectively ($p = 0.06$). No mortality was reported in both groups.

Postoperative Surgical Outcome

Within the first 2 weeks, postoperative leakage was detected in one patient (0.5%) in group B. He was treated with an endoscopic stent for 4 months and had satisfactory outcomes. While no leakage was noted in group A. Similarly, within the first 2 weeks, 4 patients in group A and 12 in group B had nausea and vomiting ($p < 0.001$). Nausea and vomiting were severe in group B, prompting readmission, and requiring antiemetics and proton pump inhibitors, but they were mild in group A and treated as outpatients. In group B, one patient experienced epigastric pain and frequent vomiting. He was readmitted, and an upper endoscopy identified a gastric twist. They responded satisfactorily to endoscopic dilatation within 6 months of surgery. In group A, there was no definitive diagnosis of gastric twist (Table 2).

Discussion

Laparoscopic sleeve gastrectomy is a well-established and successful bariatric treatment among surgeons worldwide.[12–14] Bleeding, leakage, gastric twist, and vomiting are among the most frequent surgical complications that prolong stay and impair quality of life.[15,16] Gastropexy-omentopexy was supposed to reduce early postoperative adverse event by staple line reinforcement, fixing the gastric tube, and straightening of the gastric sleeve.[17–19]

The effect of gastropexy on the early outcome of LSG is controversial. Several studies reported a significant lower incidence of overall complications and readmission among sleeve gastrectomy

with omentopexy patients.[9,20,21] While others found no significant difference in readmission and postoperative complications rate.[22–24] Our study indicated that gastropexy-omentopexy patients had fewer overall early postoperative complications than those who did not have gastropexy-omentopexy. This finding is consistent with the preceding data.[10,17,25] The additional step of gastropexy-omentopexy resulted in a statistically significant increase in the operational time of group A, which is consistent with previous study results.[21,26] As with previous data, we reported a leakage in one patient (0.5%) in group B and zero leakage in group A,[24] with no statistical significance. Furthermore, there was no statistical significance in bleeding, stomach twist, or stricture in the two groups; these findings were consistent with prior studies.[27–29] In similar manner with earlier findings, we noted that nausea, vomiting, and GERD symptoms were more in group B than group A, but the result was not significant.[8,23,24,30] Although we provide a randomized control trial, it has several limitations, such as a limited sample size and single center experience; thus a multicentered study with a large population size is required. Based on our results, we concluded that LSG with omentopexy had a significant effect on overall early complications and readmission rates after LSG. More studies are required to provide a strong recommendation of omentopexy as a standard step in LSG.

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ORIGINAL ARTICLE

Laparoscopic Repair of Congenital Diaphragmatic Hernia in Adults: A Tertiary Care Center Two-year Experience with Literature Review

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Abstract

Aims and background: Surgical repair of diaphragmatic hernia (DH) is indicated in all diagnosed cases. It can be done by various approaches. Traditionally, laparotomy has been preferred, but with increasing experience in laparoscopic techniques advanced laparoscopic procedures are being carried out as well.

Materials and methods: We retrospectively reviewed the clinical records of confirmed cases of DH treated in our institute from April 2016 to March 2018 with a minimum follow-up of 3 years. Cases of hiatus hernias have been excluded. The diagnosis was confirmed in all cases radiologically. Surgical repair was done in all cases by laparoscopic approach.

Results: Laparoscopic repair was completed successfully in all patients with none requiring conversion. All patients except one were male (Male:Female – 6:1). Median age in our series of patients was 42 years. Predominant symptoms were abdominal discomfort with one patient being asymptomatic. Eventration was present in two of the patients, both being on the left side, while Bochdalek's hernia was noted in two patients. Three patients had anterior parasternal hernia with one being Morgagni and Larry's hernia each and in one patient bilateral anterior hernia was present. Diagnosis made in all preoperatively except Larry's hernia that was detected intraoperatively. Content comprised of stomach, part of small and large bowel, omentum, appendix, spleen, tail of pancreas and left kidney. Mesh repair was done in all cases except Larry's hernia where anatomical repair of defect was done. Operative time ranged from 50 to 90 minutes. Postoperative recovery was smooth in all. Hospital stay was 2–4 days. Follow-up has ranged from 45 to 68 months that has been uneventful till date without any recurrence reported.

Conclusion: Surgical repair of DH should be done in all diagnosed patients irrespective of symptoms. The laparoscopic approach is recommended, keeping in view better vision, lesser postoperative pain, shorter hospital stay, and quicker recovery with the equivalent outcome.

Clinical significance: Congenital diaphragmatic hernias (CDH) are mainly present in the neonatal period and are associated with high mortality. Rarely, these hernias are present later in life in adulthood. Late-presenting CDH is often difficult to diagnose and delays in treatment are common. In this article, we share our experience of diagnosing and managing CDH in adult patients.

Keywords: Bochdalek hernia, Congenital diaphragmatic hernias, Diaphragmatic hernia, Morgagni hernia, Tertiary care center.

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Introduction

Diaphragmatic hernia (DH) occurs when the continuity of the diaphragm is disrupted or attenuated, resulting in the migration of intra-abdominal contents into the thoracic cavity. It can be congenital as well as acquired. Congenital diaphragmatic hernia (CDH) typically presents in childhood with its presentation in adults being rare.

The diaphragm is a dome-shaped musculo-tendinous organ that develops from various embryological structures; septum transversum, pleuroperitoneal membrane, mediastinum, and body wall muscles.[1] Its development is completed by 8–10 weeks of gestation.[2] Diaphragmatic hernia can occur possibly due to incomplete closure of the pleuroperitoneal membrane, early return of mid-gut, i.e., prior to closure of the pleuroperitoneal canal, primary herniation of mid-gut into the chest, or secondary to trauma. A most common cause of DH in adults is trauma.

Various types of CDH are posterolateral Bochdalek hernia (BH), parasternal hernia of Morgagni–Larrey, eventration of diaphragm, peritoneopericardial hernia, and central tendon hernias.[1–3] Out of these, most common is BH, which occurs due to the failure of closure of the pleuroperitoneal membrane and is predominantly seen on the left side.[4]

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Conflict of interest: None

Herniation through the anterior parasternal space is quite uncommon, representing only about 1–6% of all surgically repaired DH.[5] It is considered to occur due to failure of fusion of the diaphragm's septum transversum with costal arches.[6]

Table 1: Demographic data

Case	*Age*	*Gender*	*Chief complaints*	*Investigation*
1	56	Male	Pain lower chest and upper abdomen discomfort on and off	Chest X-ray, CT scan, USG
2	55	Male	Occasional dyspnea on exertion	Chest X-ray, 2D echo, PFT, CT scan
3	24	Male	Abdominal discomfort and occasional vomiting	USG, chest X-ray, CT scan
4	27	Male	Postprandial pain in abdomen	USG, chest X-ray, CT scan
5	25	Male	Occasional dyspnea on exertion and lower chest pain	Chest X-ray, PFT, CT scan
6	62	Female	Chest discomfort and DOE	Chest X-ray, CT scan
7	51	Male	Incidental finding	

Table 2: Operative data

Case	*Defect type*	*Defect size (cm)*	*Content*	*Type of repair*	*Discharge, postoperative day (POD)*	*Complication*
1	Anterior hernia	9 × 6	Transverse colon	Primary repair	POD4	Nil
2	Eventration left side		Spleen stomach omentum and bowel loops	Plication + mesh repair	POD3	Nil
3	Hernia of Bochdalek, left side	8 × 7	Spleen and bowel loops	Primary repair + mesh repair	POD2	Nil
4	Eventration left side		Stomach and splenic flexure	Plication + mesh repair	POD3	Nil
5	Morgagni hernia right side	4 × 3	Terminal ileum caecum, appendix, ascending colon and omentum	Primary repair + mesh repair	POD2	Nil
6	Hernia of Bochdalek, left side	5 × 4	Omentum and Jejunal loops	Primary repair + mesh repair	POD3	Nil
7	Larrey's hernia	3 × 2	No contents	Anatomical repair	POD2	Nil

A hernia through the right sternocostal hiatus is referred to as the Morgagni hernia whereas on left hiatus is named as Larrey hernia.[7] Eventration of diaphragm is abnormal elevation of the diaphragm that can be caused by muscular aplasia/hypoplasia or paralysis of the diaphragm secondary to phrenic nerve injury. It is also more common on the left side.[3]

Surgery is indicated in all cases irrespective of symptoms as it can present later as bowel obstruction/strangulation.[8,9] Diaphragmatic hernia repair can be done by open (laparotomy/thoracotomy) or minimal access (laparoscopy/thoracoscopy) approach. With increasing experience in the field of advanced laparoscopy, laparoscopic repair of DH has become the standard of care. We present our experience with laparoscopic repair of DH.

Materials and Methods

We retrospectively reviewed the clinical records of confirmed cases of DH treated in our institute from April 2016 to March 2020 with a minimum follow-up of 3 years. Ethical Committee approval was taken prior to the study. All the cases of hiatus hernias were excluded. Demographic data relevant to patients included in the study was collected (Table 1).

All the patients presented to us electively with pain in the abdomen and respiratory complaints being their predominant symptom. Routine hematological investigations were done. Radiological investigations comprised chest X-ray, ultrasonography (USG) abdomen, and computed tomography (CT) scan. Upper gastrointestinal endoscopy, and pulmonary function test and 2D ECHO were done in a few as per symptoms. A CT scan was used to confirm the diagnosis. The laparoscopic approach was used for surgical repair in all patients. Operative details including type of hernia, size of the defect, content, status of content, type of repair, duration of surgery, postoperative complications if any, and follow were noted (Table 2).

Surgery was performed under general anesthesia after informed written consent. Patients were placed in modified lithotomy/Llyod Davis position and adequately strapped to the table prior to port insertion. Appropriate Trendelenburg tilt was given as and when required. The abdominal cavity was accessed through the supraumbilical port with the open Hasson technique. A 45-degree 10 mm telescope was used for diagnostic laparoscopy thereby confirming our diagnosis. A 5 mm port was placed in the subxiphoid, right midclavicular line, and left anterior axillary line each, and one 10 mm port in the left midclavicular line. This was our port position in the majority though we were flexible with our port position as the aim should be to maintain triangulation depending upon the site of the hernia. In laparoscopy, it is imperative to use ergonomics to one's advantage by changing the port position and position of the operation table as per individual case demands and is advisable not to have fixed ideas regarding port and patient position. Contents were reduced from the sac using atraumatic bowel graspers. In a couple of cases with narrow necks or dense adhesions, widening of the hernia defect was required which was accomplished by lateral incisions. Adhesions encountered within the sac were taken down using sharp and blunt dissections. Reduced contents were examined for any iatrogenic injury. Hernia defect was approximated using non-absorbable sutures in a transverse fashion. Eventration of the diaphragm was plicated with non-absorbable barbed sutures in a continuous fashion without causing undue tension. The composite mesh was used with an adequate overlap of 4–5 cm in cases requiring mesh repair. Mesh fixation was done with non-absorbable sutures and tackers. All ports greater than or equal to 10 mm were closed.

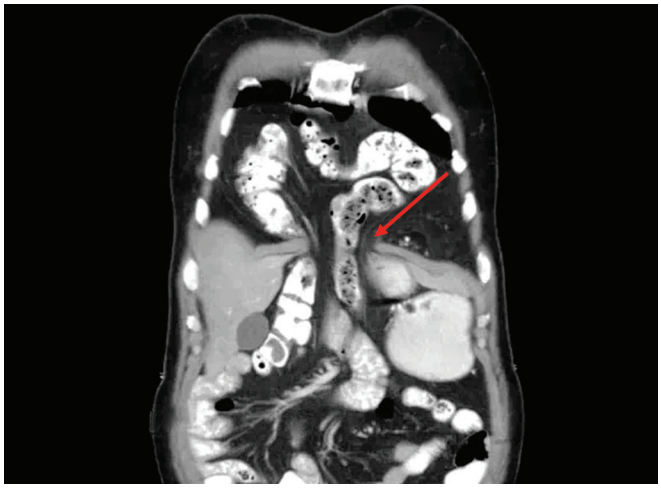

Fig. 1: Case I: CT image showing anterior diaphragmatic hernia with its contents

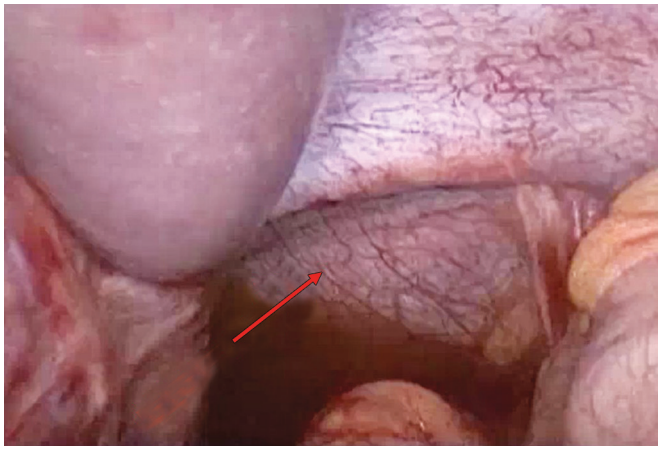

Fig. 2: Case II: Operative image of eventration of diaphragm

Results

A total 7 patients of DH were identified. Laparoscopic repair was completed successfully in all patients with none requiring conversion. All patients except one were male (Male:Female – 6:1). Median age in our series of patients was 42 years. Diagnostic laparoscopy was performed in all the patients after placement of the camera port and the finding was noted (Table 2).

Patient 1 (Fig. 1) of anterior hernia has transverse colon as a content of hernia with the size of defect around 9 × 6 cm and presented with pain in lower chest and upper abdomen discomfort on and off. After the reduction of content primary repair was done without mesh. Postoperative period uneventful and patient discharge by postoperative day (POD) 4.

Patient 2 (Fig. 2) of Eventration left side has a spleen, stomach, omentum, and bowel loops as content of hernia and presented with occasional dyspnea on exertion. After the reduction of content plication with mesh repair done. Postoperative period uneventful and patient discharge by POD 3.

Patient 3 (Fig. 3) of BH has spleen and bowel loops as a content of hernia, size of defect around 8 × 7 cm, and presented with abdominal discomfort and occasional vomiting. After reduction of content primary repair with mesh repair was done. Postoperative period uneventful and patient discharge by POD 2.

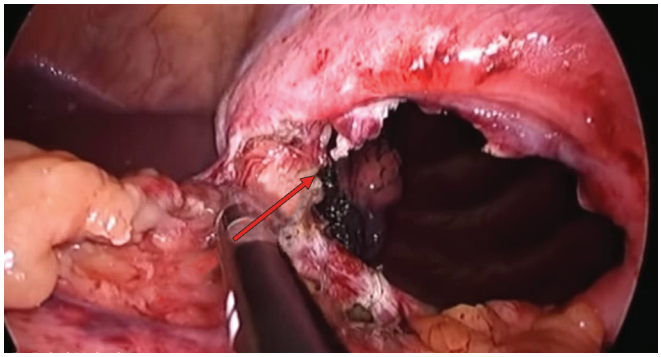

Fig. 3: Case III: Operative image of case 3 of Bochdalek hernia showing diaphragm defect

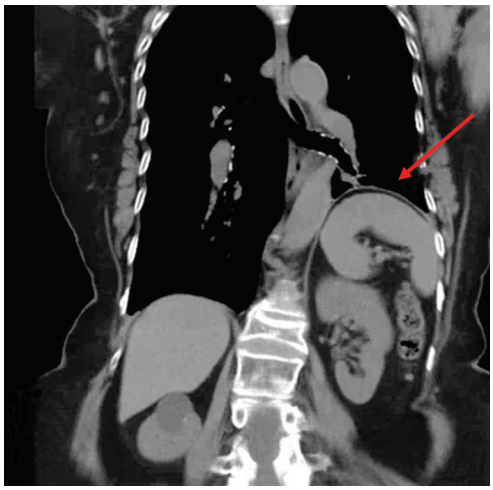

Fig. 4: Case IV: CT image showing eventration of diaphragm

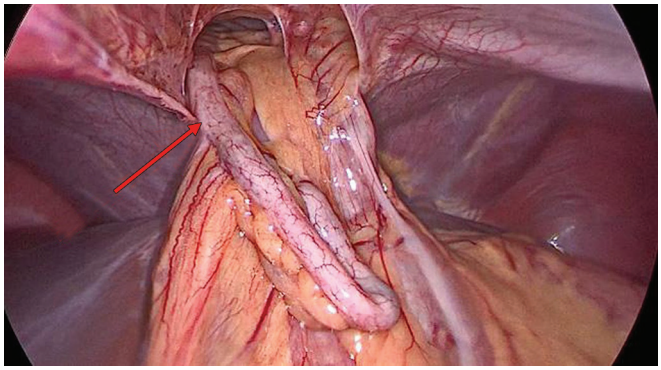

Fig. 5: Case V: Operative picture of Morgagni hernia showing defect with its contents

Patient 4 (Fig. 4) of eventrations left side have stomach and splenic flexure as content of hernia and presented with post-prandial pain in the abdomen. After the reduction of content plication with mesh repair done. Postoperative period uneventful and patient discharge by POD 3.

Patient 5 (Fig. 5) of Morgagi hernia right side has terminal ileum, caecum, appendix, ascending colon, and omentum as content of hernia, size of defect around 4 × 3 cm and presented with occasional dyspnea on exertion and lower chest pain. After the reduction of content primary repair with mesh repair was done. Postoperative period uneventful and the patient discharged by POD 2.

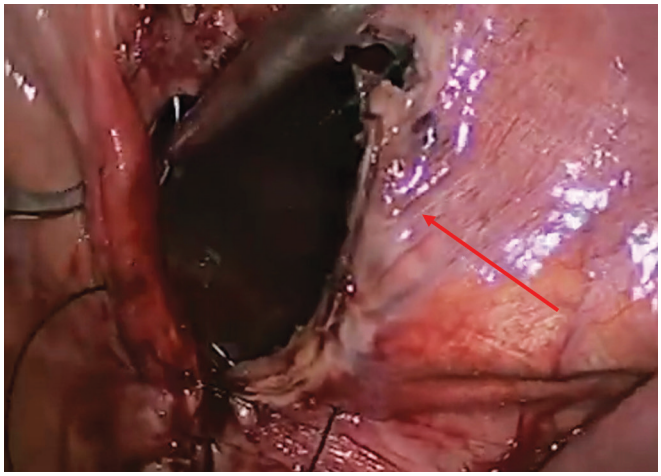

Fig. 6: Case VI: Operative image of case 6 of Bochdalek hernia showing diaphragm defect

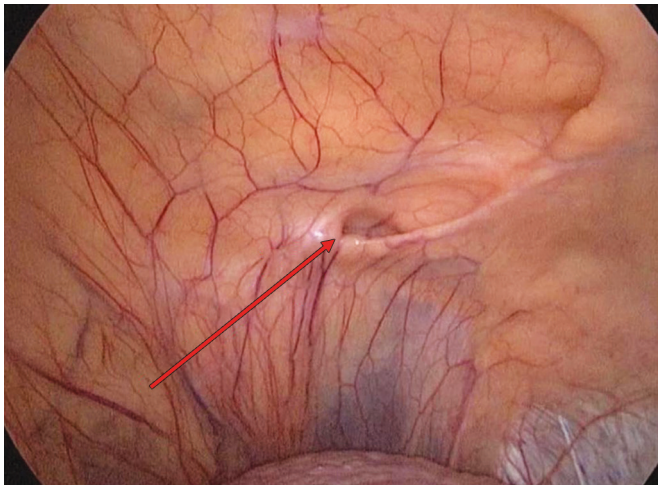

Fig. 7: Case VII: Operative picture of Larrey hernia

Patient 6 (Fig. 6) of BH has omentum and jejunal loops as a content of hernia, size of the defect is around 5 × 4 cm Presented with chest discomfort and dyspnea on exertion. After the reduction of content primary repair with mesh repair was done. Postoperative period uneventful and patient discharge by POD 3.

Patient 7 (Fig. 7) Larreys hernia is empty without any content, the size of defect around 3 × 2 cm and it's an incidental finding, patient does not have any symptoms due to the hernia, it was repaired primarily without mesh. Postoperative period uneventful and the patient discharge by POD 2.

Diagnosis was made in all preoperatively except Larry's hernia (Fig. 7) which was detected intraoperatively in a patient undergoing incisional hernia repair. Approximation of defect was possible in all cases. Mesh repair was done in all cases except Larry's hernia where anatomical repair of the defect was done. None of the patients required intercoastal drain placement. Intraoperative period was uneventful in all. The operative time ranged from 50 to 90 minutes. Postoperative recovery was smooth in all with no major/minor postoperative complications. Hospital stay ranged from 2 to 4 days. Follow-up has ranged from 45 to 68 months with no reported recurrence.

Discussion

Congenital diaphragmatic hernia presents differently in the pediatric and adult populations. Neonates usually present with respiratory distress while vague abdominal symptoms and respiratory complaints predominate in adults. The most common type DH of is BH. It was first reported by Bochdalek in 1848, that 5–10% of BH remain undetected in childhood and later present in adults, the majority of DH are symptomatic.[10] Two-thirds of asymptomatic cases are on the right side and it is mainly because of the liver which prevents herniation of other organs.[11]

Presentation can be delayed or absent due to omental or intra-abdominal viscous plugging of the defect. Anterior parasternal hernia is more commonly diagnosed in adults. It accounts for up to 3–5% of DH in the adult population and is usually associated with increased intra-abdominal pressure.[12,13] Associated precipitating factors are chronic constipation, obesity, pregnancy, childbirth, chronic obstructive pulmonary disease (COPD), heavy meals, and vigorous physical activity.[9,14]

In adults, the most common cause of DH is trauma. Usually seen in patients of polytrauma, with the majority associated with penetrating trauma. In patients with trauma to the lower chest or upper abdomen, it is pertinent to rule out diaphragmatic injury as many times it may not be apparent at the time of presentation and DH can be missed.[15] Patients can have delayed presentation with vague complaints that may not point towards diaphragmatic injury and at times can be fatal. Mortality as high as 25–60% has been reported in patients with strangulation of incarcerated viscera if left untreated.[16,17]

Congenital diaphragmatic hernia can be associated with a number of congenital anomalies like Down syndrome, pentalogy of Cantrell, Noonan syndrome, Prader-Willi syndrome, turner syndrome, Marfan syndrome, mitral/tricuspid valve prolapse, patent ductus arteriosus, pulmonary sequestration, accessory lung lobe. Commonly herniating organs are omentum, loops of small and large bowel, uncommon contents may include the liver, spleen, tail of pancreas, and the kidney. It can be misdiagnosed in a significant number of patients due to the rarity of the presentation of CDH in adults and its varied presentation. Common misdiagnoses include hemothorax, hydropneumothorax, pleural effusion, pneumonia, empyema, Lung cyst, etc.[18] It can lead to inappropriate intervention like chest tube placement which can be further disastrous or can delay treatment thereby presenting with obstruction or strangulation of hernia.

Normal chest X-ray does not rule out DH as herniation of contents can be intermittent. Ultrasonography has also shown to be a useful tool in the initial workup of DH, however, diagnosis can be confirmed by CT, MRI, contrast studies, or laparoscopy. Typical findings on a CT scan would be the abutment off at or soft tissue along the upper surface of the diaphragm, diaphragmatic discontinuity adjacent to the mass, and continuous density above and below the diaphragm through the defect.[19]

Surgical management of CDH can be performed by open, minimal access means or using a hybrid approach. Historically, open trans-abdominal and trans-thoracic approaches were used for the repair of DH. With increasing expertise in the field of minimal-access surgery, laparoscopy has emerged as the preferred option. Campos and Sipes did the first laparoscopic repair of DH in 1991.[20] It can be performed by placing the patient in a supine, reverse Trendelenburg, or lateral decubitus position. Lateral decubitus is particularly helpful in pregnant females. An angled, 30- or 45-degrees telescope is

preferred. Laparoscopic repair is recommended for routine cases and is usually avoided in emergency procedures. Excision of the sac is an area of controversy, while some are of the opinion that it should be excised, the majority still feel that it should be left intact as it is associated with a high risk of pleural injury, pneumomediastinum, and other cardiovascular complications that may arise because of dissection of the mediastinum.[21] Seroma formation is considered to be a potential complication when the sac is left intact. However, studies show the complete disappearance of remnant sac thirty days post-surgery.[22]

Pneumothorax can occur in a proportion of patients. In the majority, it is minimal and can be easily dealt with by lowering the insufflation pressure and increasing positive end-expiratory pressure towards the end of procedure. In patients with persistent/significant pneumothorax, insertion of an intercoastal drain is indicated. In cases where a large hernia is reduced, it is crucial to monitor the patient in the postoperative period for Abdominal compartment syndrome.[23]

There is no data favoring non-absorbable over absorbable or interrupted over continuous sutures, closure of the defect is important from the point of view of the restoration of normal anatomy.[24,25] The use of Teflon sheets has been described during the closure of diaphragmatic defects where some tension during defects closure is anticipated. However, closure of defects is not mandatory if it causes undue tension.

The advantages of the laparoscopic approach are an excellent and magnified vision of the operative field, visualization of both domes of the diaphragm, better and easier instrumentation and reduction of contents, identification of iatrogenic injury if any and concomitant evaluation and treatment of any other intra-abdominal injury/pathology. Patient experiences lesser postoperative pain and duration of hospital stay. The drawbacks of laparoscopic repair are that reduced content tends to fall back due to positive intra-abdominal pressure caused by pneumoperitoneum. However, it can be easily overcome by lowering the intra-abdominal pressure and holding back the content into the abdomen with atraumatic graspers if at all it tends to fall back.

Thoracoscopic repair is considered to be more useful in patients with large hernia contents and dense adhesions between herniated viscera and thoraco-mediastinal structures as it allows the release of adhesions under direct vision prior to the reduction of contents into the abdominal cavity. It is especially more useful in the repair of the right DH as vision is these cases is usually obscured by the liver. Drawbacks associated with it are that only one hemi diaphragm can be evaluated and it may be difficult to manipulate herniated contents back into the abdomen. It is not possible to repair any iatrogenic injury after reduction of contents intra-abdominally and to take care of any other concomitant intra-abdominal injury/pathology.[26]

A variety of mesh are available and have been used for the repair of DH. Intraperitoneal use of polypropylene mesh has been associated with dense intraabdominal adhesions, wound sepsis, erosions into intraabdominal organs, and bowel fistula.[27,28] Bowel fistula has been reported with polypropylene mesh as long as 15–20 years post-surgery. On the other hand, several authors have reported none of these complications after the application of polypropylene mesh in an intraperitoneal position.[27] To be noted in these studies is a short follow-up of approximately 36 months. Decreasing the tendency to form adhesions with composite meshes makes them more desirable. Though sufficient data favoring any particular type of mesh is lacking, the use of composite mesh is advocated.[27,28]

Fixation of prosthesis can be done by intracorporeal suturing or mechanical fixating devices. Great care is to be taken with fixation devices at places where the diaphragm is relatively thin and is in close proximity to the pericardium.[24]

Conclusion

Surgical repair of DH should be done in all diagnosed patients given the high complication rate. A minimal access approach is recommended, keeping in view excellent magnified vision, lesser postoperative pain, shorter hospital stay, and quicker recovery with equivalent outcome.

Clinical Significance

Congenital diaphragmatic hernias are mainly present in the neonatal period and are associated with high mortality. Rarely are these hernias present later in life in adulthood. Late-presenting CDH are often difficult to diagnose and delays in treatment are common. In this article, we share our experience of diagnosing and managing CDH in adult patients.

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ORIGINAL ARTICLE

Advanced Hysteroscopy: Can It Be Safe and Effective Alternative to Hysterectomy in Perimenopausal AUB?

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Abstract

Background: Abnormal uterine bleeding (AUB) is one of the most common indications for hysterectomy in perimenopausal age-group patients. Due to inadequate and varied response to medical management, fear of malignancy and lack of awareness, patients prefer to opt for hysterectomy. The incidence of unwanted hysterectomies is increasing particularly in rural and tribal populations in our country. Hysteroscopy is considered the gold standard technique for diagnosing and managing pathological conditions affecting the uterine cavity. Immediate treatment of endocervical, endometrial, or submucosal pathologies is possible with advanced operative hysteroscopy and it is associated with high patient satisfaction. Major surgery like hysterectomy can be avoided in case of benign uterine pathologies.

Aims and objectives: To evaluate the role of advanced hysteroscopy in perimenopausal age-group patients with chronic AUB and to study the effect of operative hysteroscopy on improvement in the quality of life of perimenopausal AUB patients.

Materials and methods: It was a retrospective study conducted over a period of one and a half year. 128 patients of age-group 35–50 years with AUB who had undergone hysteroscopy were included. Any demonstrable pelvic pathologies like pelvic malignancies and active pelvic inflammatory diseases were set as an exclusion criteria. Institutional standard operating protocol for hysteroscopic surgeries was followed. As per the protocol experienced senior faculties were the operating surgeons for all the cases. Demographic characteristics, hysteroscopic findings, and histopathology reports were correlated. All the patients were followed up for 6 months after hysteroscopic surgery.

Results: A significant number of patients were diagnosed with intracavitatory lesions and they were managed successfully through operative hysteroscopy. Patients were satisfied with their quality of life after hysteroscopic surgeries.

Conclusion: Operative hysteroscopic surgeries have been shown to be effective in treating AUB and possibly avoiding or delaying hysterectomy in perimenopausal women.

Keywords: Hysteroscopy, Hysterectomy, Perimenopausal abnormal uterine bleeding.

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Background

Abnormal uterine bleeding (AUB) is very commonly seen in perimenopausal age-group patients and it is also seen with a significant number of patients attending Gynec OPD.[1] Patients present with both heavy and irregular menstrual bleeding for the last couple of months. Chronic AUB is defined as "bleeding from the uterine corpus that is abnormal in volume, regularity and/or timing that has been present for the majority of the last six months.[2] It affects the quality of life in women significantly and it is also associated with loss of productivity and major health care costs.

Perimenopausal age-group that is 35–50 years is the most vulnerable age-group, as these patients suffer from several perimenopausal symptoms such as irregular menses, vaginal dryness, mood swings, hot flushes, etc. More than 90% of women experience at least one episode of AUB and 78% of them experience at least three episodes of AUB during their transition to menopause.[3] Due to inadequate and varied responses to medical management, fear of malignancy and lack of awareness, patients prefer to opt for hysterectomy. Sometimes due to an increase in the severity of symptoms and failure of medical management, a hysterectomy is advised for chronic AUB patients by a treating clinician. Abnormal uterine bleeding is one of the most common indications for hysterectomy in perimenopausal age-group patients. The incidence is increasing in rural and tribal populations in our country. Hysteroscopy is considered the standard technique for diagnosing and managing pathological conditions affecting the uterine cavity. Immediate treatment of endocervical, endometrial, or submucosal pathologies is possible with advanced operative hysteroscopy and it is associated with high patient satisfaction.[4]

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Aims and Objectives

To evaluate the role of advanced hysteroscopy in perimenopausal age-group patients with chronic AUB and to study its effect on improvement in their quality of life.

Table 1: Hysteroscopic findings

Hysteroscopic findings	*Number of patients*
Submucous fibroid (42.1%)	54 – Grade 0 – (31), Gr.1 – (21), Gr.2 – (2)
Polyp (32%)	41 Sessile – 14: Pedunculated – 27
Adenomyosis with hypervascularization (12.5%)	16
Hyperplastic endometrium (10.9%)	14
Suspected endometrial neoplastic lesions (3.9%)	5
Endometritis (4.6%)	6
Intra-uterine adhesions (17.9%)	23
Isthmocele (3.9%)	5
Missing cut (3.1%)	4
Old RPOC (2.3%)	3

Materials and Methods

It is a retrospective study conducted over a period of one and a half year from June 2022 to December 2023 in a tertiary care institute. A total of 128 patients of age-group 35–50 years with chronic AUB who underwent hysteroscopic surgeries were included in the study. Any demonstrable pelvic abnormalities like pelvic malignancies and active pelvic inflammatory diseases were set as an exclusion criteria. Department has a standard operating protocol for operative hysteroscopy procedures. This study was conducted in accordance with the ethical standards and approved by the institutional Ethics Committee (IEC 109/2023-24). Senior Gynec endoscopic surgeons were the operating faculty for all the cases. All the diagnostic and operative hysteroscopy cases were analyzed. Hysteroscopic findings and histopathology reports were correlated. Their follow-up clinical records up to 6 months were collected. Data were analyzed on the basis of demographic characteristics, surgical findings, histopathological reports and follow-up records.

Results

Most of the patients with chronic AUB who had undergone hysteroscopy were in the age-group of 40–45 years. The average age of the patients was 43 years. Patients with a higher parity of three or more than three were commonly seen with AUB. Commonly performed hysteroscopic procedures were submucous fibroid resection, polypectomy, adhesiolysis, endometrial biopsy, TCRE, missing copper T removal, isthmocele resection, cervical biopsy, therapeutic curettage, mirena insertion, etc. The most common finding on hysteroscopy was a submucous fibroid (42.1%) followed by polyps (32%) commonly seen in the age-group of 40–45 years (Table 1). Histopathology reports revealed simple hyperplasia without atypia as the most common finding followed by disordered proliferative phase and cystic glandular hyperplasia. Four patients were diagnosed with endometrial carcinoma. The average time taken for the hysteroscopic surgeries was 16 minutes. Fluid deficit calculated during procedure varied from 150 to 900 mL. Six months follow-up after hysteroscopy procedure revealed that 91 patients responded well to hysteroscopic surgeries and further major surgery like hysterectomy was not required in these patients. Patients who had a recurrence of symptoms were treated conservatively. A total of 26 patients had undergone hysterectomy within 6 months of hysteroscopic procedures (Table 2). The most common indication for hysterectomy was adenomyosis followed by multiple uterine fibroids, adnexal masses and endometrial carcinoma (Table 3). Maximum patients who had undergone hysterectomy were in the age-group of 41–44 years. Minor hysteroscopic complications such as vaginal bleeding, headache, fever, transient hypotension were seen in a few patients. One patient with the coagulation disorder and the other with mild pulmonary edema required ICU admission for a day. Blood transfusion was required in three anemic patients. Follow-up patients at the end of 6 months of hysteroscopic procedure were interrogated and found to have a better quality of life in 71% of patients.

Table 2: Post-hysteroscopy follow-up results (up to 6 months)

Follow-up results	*Number of patients*
Recurrence of symptoms pain/bleeding/both	28 (21.8%)
Symptoms subsided with hormonal/ analgesics/antibiotics therapy	9 (7%)
Patient underwent hysterectomy	26 (20.3%)
Patients diagnosed CA endometrium on histopathology	4 (3.1%)
Loss to follow-up at 6 months	11 (8.5%)
Patients responded well to hysteroscopic surgery	91 (71%)

Table 3: Indications for hysterectomy (total 26)

Indications for hysterectomy	*Number of patients*
Adenomyosis (7.03%)	9
Multiple uterine fibroids (4.6%)	6
Large adnexal masses (3.1%)	4
CA endometrium (3.1%)	4
CIN progressed to higher grade (1.5%)	2
Coagulation disorder (0.78%)	1

Discussion

Almost one-third of the patients in perimenopausal age-group visiting Gynec OPD's are diagnosed to have AUB.[3] FIGO classified AUB into the structural and non-structural causes popularly known by the acronym PALM COIEN.[2] Structural causes like endometrial polyps and submucous fibroids can be managed through hysteroscopy. Endometrial pathologies can be diagnosed effectively through hysteroscopy-guided biopsy with the help of histopathological examination. Many patients are reluctant for conservative uterine preserving approach due to various reasons such as chronic symptoms, prolonged course of medications and its cost, fear of recurrence of disease, and malignancy. As a result, patients who have already completed their family, demand hysterectomy without understanding its implications on their health. Hysterectomy is a major surgical procedure and apart from surgical risk, it is also associated with many health-related complications especially when done in reproductive age. Salpingo-oophorectomy along with hysterectomy renders women to various side effects like reduction in bone mineral density and early menopause. Hysterectomy is a major surgery and it predisposes to surgical or postoperative complications, such as hemorrhage, injury to vital organs, septicemia, and vesicovaginal fistulas. Fatal complications though are rare but can be seen in low-resource setting healthcare facilities.

The Ministry of Health and Family Welfare—Government of India released guidelines to prevent unnecessary hysterectomies on 4th October 2022.[5] The National Family Health Survey-4 (2015–2016) data estimate hysterectomy prevalence to be 9.2% among women 40–49 years. The median age at hysterectomy was 37 years. Heavy menstrual bleeding or pain was self-reported as the leading indication for hysterectomy.[5] These government guidelines address the seriousness of the issue and elaborates on the need for preserving the uterus and treating benign pathologies conservatively.[6] Hysteroscopy has a significant diagnostic value and it is safe and cost-effective. It can be performed in the office setting as well. Transvaginal sonography (TVS) though considered as an initial investigation of choice, it may miss a few endometrial pathologies, such as small polyps, submucous fibroids, and rarely CA endometrium.[7,8]

Traditionally done D&C procedures are replaced by hysteroscopy due to the see and treat approach.[9] In this study, AUB was found to be more common in 41–45 (35%) years of age-group patients. Anupma Kumari and Kumar R studied and found AUB was most common with the age-group of 40–45 years (65.55%), and 46–50 years (27.77%) respectively.[10]

The incidence of structural causes of AUB increases with age. In our study, we found 70% of the patients diagnosed to have polyp and submucous fibroids.[11] Parity increases the incidence of AUB, in our study, 74 (57.8%) patients were found to have parity more than three whereas Sreeja PA found AUB with parity 2 (42.04%) followed by parity 3 (18.1%), respectively.[12] Tinelli et al. in their study shown that few patients with atrophic endometrium on TVS were diagnosed as a cases of CA endometrium on histopathological examination obtained through hysteroscopy. In our study, two patients of CA endometrium had endometrial thickness of less than 5 mm on TVS.[13] Soja M et al. found polyps and submucous fibroids as the most common cause for the structural defect in AUB. In our study, polyps and submucous fibroids were the most common hysteroscopy findings.[14]

Study shows that apart from structural causes, the most common diagnosis on endometrial histopathology was simple endometrial hyperplasia without atypia. These patients responded well to the conservative medicine line of management after hysteroscopy. Wortman et al. confirmed that major operative hysteroscopic surgery resulting in a 98.8% rate of satisfied patients.[15] In our study, follow-up cases were interrogated about the quality of life through questionnaire and clinical examination. About 71% of the patients were found to have a better quality of life after 6 months of hysteroscopic procedure.

Vilà Famada et al. described hysteroscopic procedures as safe surgical procedures with minimal complications. In our study, all the hysteroscopic procedures were uneventful except for two known cases of medical disorder that required ICU admission for a day.[16]

A total of 128 patients who had either come demanding hysterectomy or were referred for further management after failed medical treatment were diagnosed correctly and treated with standard management protocols through hysteroscopy. Ninety one patients responded well to hysteroscopic procedures and revealed improvement in their quality of life. Hysteroscopy helped in formulating further lines of management for AUB patients. Patients who had recurrence of symptoms were treated conservatively and few patients had undergone hysterectomy as a last resort when it was actually indicated. On interrogating patients after hysteroscopic procedure we perceived that hysteroscopic examination, its see and treat approach and histopathology report played a crucial role in allaying the anxiety of the patients regarding their endometrial diseases and helped us in the productive counseling and further management.

Conclusion

Hysteroscopy as a daycare procedure can effectively diagnose and treat endometrial causes of AUB in the same setting with high patient and surgeon's satisfaction.

This low-cost minimal invasive procedure can effectively prevent unwanted hysterectomies in a perimenopausal age-group patients. Long-term prospective studies are required to see the overall impact on the quality of life of perimenopausal age-group patients.

Clinical Significance

Recently due to the alarming increase in the incidence of hysterectomy in rural and tribal areas, there has been growing concern about its impact on women's health and overall quality of life. In our view, inspite of being a daycare procedure, hysteroscopy is still not effectively utilized to diagnose and treat endometrial causes of AUB. Modern hysteroscopy facilities if made available in rural health centers can definitely prove a great milestone in the management of AUB and can effectively prevent unnecessary hysterectomies. Additionally, it will also provide an opportunity for effective screening of cervical premalignant and malignant lesions, PID, and sexually transmitted diseases.

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ORIGINAL ARTICLE

Revealing Rouviere's Sulcus: An Observational Study on Anatomy Presence and Clinical Significance in Laparoscopic Cholecystectomy at a Tertiary Care Center in Tamil Nadu

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Abstract

Purpose: In the realm of laparoscopic cholecystectomy, the significance of Rouviere's Sulcus as a pivotal physiological landmark cannot be overstated. Its identification plays a crucial role in facilitating the meticulous dissection of Calot's triangle, ensuring the secure ligation of the cystic artery and duct, and ultimately preventing common bile duct injuries. Understanding the anatomical variations of Rouviere's Sulcus is paramount for surgeons aiming to enhance the precision and safety of this common surgical procedure.

Materials and methods: This observational study was designed to meticulously examine 49 patients presenting with confirmed gallstones, identified through ultrasound of the abdomen, in the general surgery outpatient department. The individuals included in the study were aged 19 years and above, representing both genders. The study methodology involved a comprehensive observation during laparoscopic cholecystectomy procedures.

Results: Among the 49 patients subjected to laparoscopic cholecystectomy, the visualization of Rouviere's Sulcus was achieved in 46 cases (93.9%). The observed variations in Rouviere's Sulcus were diverse, revealing distinct anatomical configurations: Open type: 23 cases (46.9%), closed type: 7 cases (14.3%), slit type: 9 cases (18.4%), scar type (oblique): 4 cases (8.2%), scar type (transverse): 3 cases (6.1%) and absent: 3 cases (6.1%).

Conclusion: These findings underscore not only the high prevalence of Rouviere's Sulcus but also the diverse nature of its anatomical presentations. The recognition of such variations emphasizes the need for a nuanced and individualized surgical approach, ensuring the utmost safety and efficacy in laparoscopic cholecystectomy.

Keywords: Bile duct injuries, Laparoscopic cholecystectomy, Rouviere's sulcus.

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Introduction

To ensure effective and safe dissection in surgical procedures, a profound understanding of surgical anatomy is paramount. The advent of laparoscopy, while revolutionizing surgical approaches, has brought about challenges, particularly an increased risk of bile duct damage during laparoscopic cholecystectomy now considered the "Gold Standard" treatment for symptomatic gall stones.[1] The limitations of laparoscopy, with its inherent 2-D perspective on anatomical structures existing in a 3-D axis, pose difficulties for surgeons in identifying these structures accurately. Various factors contribute to the heightened risk of bile duct damage during laparoscopic cholecystectomy, including hemorrhage, aberrant anatomy, inflammation or infection in cases of acute cholecystitis, and the experience level of the surgeon.[2] The complex interplay of these factors necessitates innovative approaches to mitigate iatrogenic damage to the biliary system and prevent complications associated with this commonly performed procedure.

In recent years, research efforts have been dedicated to exploring diverse methods aimed at reducing the incidence of iatrogenic biliary system injuries during laparoscopic cholecystectomy. These endeavors encompass advancements in imaging technologies, refining surgical techniques, and developing guidelines to enhance the overall safety and efficacy of the procedure. By addressing the multifactorial nature of bile duct injuries in laparoscopic cholecystectomy, these research initiatives strive to elevate the standard of care, ultimately minimizing the risks associated with this widely adopted surgical intervention.

In laparoscopic cholecystectomy, bile duct injuries are rare, occurring 0.5% or less frequently. Bile duct injuries still occur and the rates of injury have not significantly decreased despite improvements in laparoscopic surgery.[3] In the past ten years, with an increased focus on patient safety, it has been advised to recognize and adhere to some significant landmarks as reference points. Doing so may help the surgeons determine where to start

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the dissection by helping them recognize the plane of the common bile duct even before the dissection begins.

The Rouviere's sulcus is a significant landmark that has been discussed in more recent papers. The fissure that exhibits a person's name was initially labeled in 1924 by French surgeon MH Rouviere. The posterior bed dissection in the laparoscopic cholecystectomy procedure at the beginning itself will disclose Rouviere's sulcus, a 2–5 cm fissure located between the right lobe and caudate process in the liver which provides an easier way for dissection calot's triangle.[4,5] It has either its branches or the appropriate entrance toad. Accurately locating the common bile duct plane is the function of the sulcus.

Rouviere's sulcus is prominently visualized when the abdomen is inflated with CO_2 at the beginning of the procedure due to the widening of the fissure, and the enhanced illumination and image quality of the digital laparoscopy triple chip high-definition cameras both make it conceivable easier to see the anatomy of Rouviere's sulcus during laparoscopic cholecystectomy effectively. This is in contrast to the open surgery era when it was difficult to see and describe this anatomy purely based on the tactile perception of the gallbladder and cystic duct.

Rouviere, Gans, and Chouinard's seminal work on liver anatomy was where we learned what little we do know about the sulcus. These investigations reported that the sulcus was present in most specimens but did not go into detail about its function. Its significance in advancing hepatectomy procedures was emphasized by Reynaud.[6] Hugh et al. were the first to emphasize the significance of it during laparoscopic cholecystectomy since it correctly identified the plane of the CBD. Hence, a safer and more efficient, less traumatic laparoscopic cholecystectomy can be performed by a surgeon with the help of viewing the Rouviere's sulcus. The significance of viewing the Rouviere's sulcus during the procedure is performed for the safe dissection of Calot's triangle in all the patients requiring laparoscopic cholecystectomy, the purpose of the study was to determine the incidence of routine sulcus frequency with its types while performing laparoscopic cholecystectomy.[7]

Materials and Methods

This observational study was conducted on 49 patients who presented with Symptomatic Cholecystitis and underwent laparoscopic cholecystectomy from November 2022 to October 2023 in the Department of General Surgery, Karpaga Vinayaga Institute of Medical Sciences & Research Center, Chengalpattu, Tamil Nadu. The types of Rouviere's sulcus and the operation time were documented. All the data were entered into a Microsoft Excel sheet and verified before analysis using SPSS version 25.0. It shows that the observed data were not normally distributed. The experimental values were tabulated using frequency and percentage. The student *t*-test was used to examine the mean difference between operation time for minutes with Rouviere's groups and without Rouviere's groups. Consider the 5% level of significance.

Sample Size Calculation

The proportion of Rouviere's Sulcus was reported as 76% by Dr Hitesh Bhatia et al.[2] in the recent edition of the Journal of Medical Science and Clinical Research. With this reference and assuming a 95% confidence interval, a 5% absolute precision value, and with the available population size of 48. The minimum required sample size will be 41~ 45.

$$n = \frac{Z^2_{1-\frac{\alpha}{2}} p(1-p)}{d^2}$$

Inclusion Criteria

All patients of age ≥19 years with acute cholecystitis, calculous cholecystitis, cholelithiasis, gall bladder polyp, and gall bladder wall rupture disease who are undergoing laparoscopic cholecystectomy.

Exclusion Criteria

Patients with complicated gallstone disease, patients willing to undergo open cholecystectomy, and not fit for general anesthesia. coagulopathy, severe cardiopulmonary disease, abdominal wall infection, pregnancy generalized peritonitis and massive ascites.

Results

Out of 49 patients on whom the study was conducted, the majority were 40–50 years of age, and among both male and female patients, female patients had a higher prevalence of cholelithiasis (Table 1).

Out of 49 persons who underwent laparoscopic cholecystectomy. About 46 (93.9%) patients Rouviere's sulcus was visualized. In that open type was observed in 23 (46.9%), closed type was observed in 7 (14.3%), slit type was observed in 9 (18.4%), scar type oblique in 4 (8.2%) and transverse in 3 (6.1%). Absent in 3 (6.1%) patients (Fig. 1). In this Rouviere's sulcus was identified first and dissection was started from there the procedure was completed without any injury to the common bile duct. One case had been converted from lap to open cholecystectomy and the operation time was more than 55 minutes in a patient with absent Rouviere's sulcus (Table 2).

None of these patients had any intraoperative complications, while only 3 of them had a port-site infection as a major postoperative complication. Of all these individuals, only one had undergone surgery in such a way that laparoscopic cholecystectomy had been converted to open cholecystectomy.

Table 1: Descriptive statistics for demographical variables

	Frequency (n = 49)	
Characteristics	*n*	*%*
Age-group (years)		
20–30	3	6.1
30–40	12	24.5
40–50	24	49
50–60	8	16.3
Above 60	2	4.1
Sex		
Male	24	49
Female	25	51
Age		
Mean ± SD	45.18 ± 10	

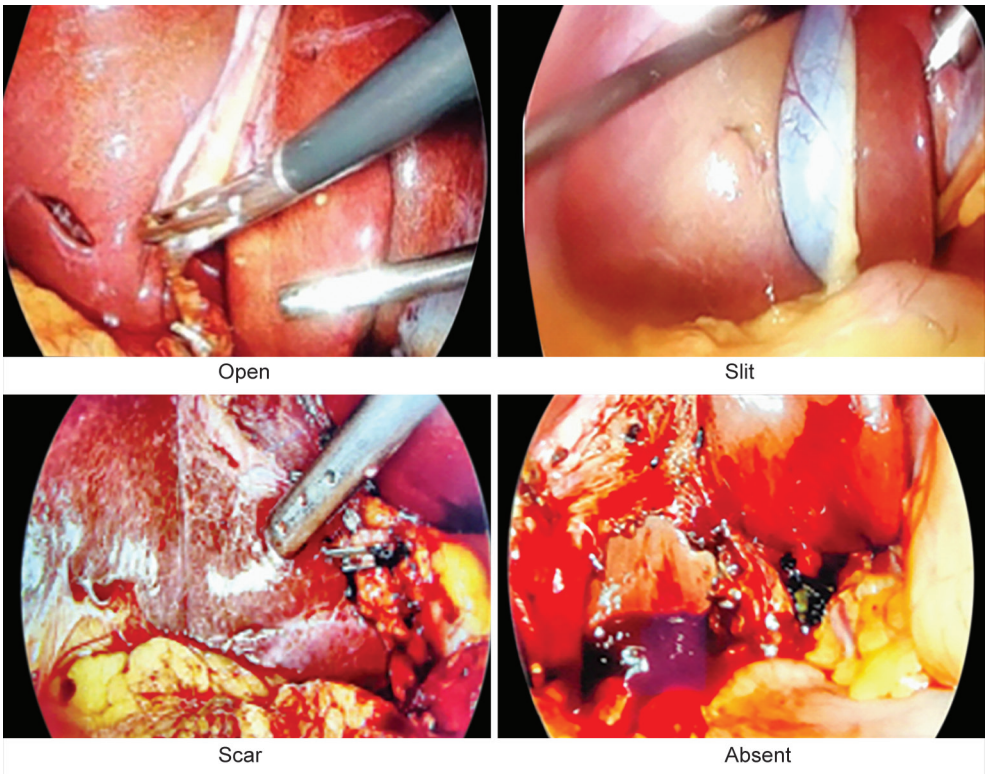

Fig. 1: Intraoperative images

Table 2: Descriptive statistics for study parameters

	Frequency (n = 49)	
Study parameters	*n*	*%*
Diagnosis		
Acute cholecystitis	1	2
Calculous cholecystitis	3	6.1
Cholelithiasis	42	85.7
Gall bladder polyp	2	4.1
Gall bladder wall rupture	1	2
Rouviere's sulcus		
Present	46	93.9
Absent	3	6.1
Types of Rouviere's sulcus		
Nil	3	6.1
Open	23	46.9
Slit	9	18.4
Scar	7	14.3
Closed	7	14.3
Scar		
Oblique	4	8.2
Transverse	3	6.1
Intraoperation complication		
Yes	0	0
No	49	100
Postoperative complication		
No	46	93.8
Yes	3	6.1
Conversion to open		
No	48	98
Yes	1	2
Operation time for minutes		
Mean ± SD	57.76 ± 11.27	

A student test shows that the probability value is less than 0.05, indicating a significant difference between the mean operation time for patients in minutes and Rouviere's sulcus ($t = 3.291$, $p = 0.002$). The result reveals that the absence of Rouviere's sulcus was influencing the operation time of surgery in minutes. The Rouviere's sulcus was prominent for 46 subjects, and the surgery time was shortened (mean = 56.52) compared to the rest of the 3 subjects, for whom the Rouviere's sulcus was absent, so the surgery time was prolonged (mean = 76.67) (Table 3).

Discussion

Laparoscopic cholecystectomy is the most commonly followed gold standard procedure for cholelithiasis, and cholecystitis even though it is very challenging for the surgeons to do a safe laparoscopic cholecystectomy due to anatomical variations in the biliary tract

Table 3: The mean difference between operation time for minutes and Rouviere's sulcus

	N	*Mean*	*SD*	*p-value*
Operation time for minutes	46	56.52	10.481	< 0.002*
	3	76.67	2.887	

p-value considered as less than 0.05 is significant. *Highly significant

and gallbladder. The most common difficulty is dissection near the cystic artery and cystic duct. Improper dissection may lead to bile duct injury and cystic artery injury. Improper ligation of the cystic duct can cause biliary leakage and also in some patients more dreadful complications like complete transection of the common bile duct or thermal injury causing necrosis of the common bile duct.[8,9]

In this study, the identification and visualization of Rouviere's sulcus is an important landmark while performing laparoscopic cholecystectomy for safer dissection of Calot's triangle. We identified the Rouviere's sulcus in 94% of the patients, among visualized Rouviere's sulcus most common type, and least common type in this study. The operation time was increased from 30 minutes to 1 hour in patients where there is absence of Rouviere's sulcus.[10] Rouviere's sulcus can be used as a particular landmark to identify the structures within Calot's triangle and safer dissection to avoid bile duct injuries and complications.

Conclusion

Out of 49 persons who underwent laparoscopic cholecystectomy 46 (93.9%) patients Rouviere's sulcus is visualized that open type observed in 23 (46.9%), closed type observed in 7 (14.3%), slit type observed in 9 (18.4%), scar type oblique in 4 (8.2%) and transverse in 3 (6.1%). Absent in 3 (6.1%) patients (Table 2 and Fig. 1). The Rouviere's sulcus was identified first, dissection started from there, and the procedure was completed to prevent accidental injury to the common bile duct. One case had been converted from lap to open cholecystectomy and the operation time was more than 55 minutes in a patient with absent Rouviere's sulcus.

In summary, identifying Rouviere's sulcus at the outset of surgery is a prudent step that strengthens surgical confidence, facilitates safe dissection, reduces operative time, and ultimately minimizes the risk of complications such as bile duct injury. Surgeons often rely on such anatomical landmarks to navigate complex procedures with precision and safety.

Ethical Committee Approval

The Institutional Ethics Committee of Karpaga Vinayaga Institute of Medical Sciences & Research Center, Maduranthagam, reviewed and discussed the application for approval for the above study, and the proposal is approved. My approval number IEC Ref. No: KIMS/PG/2022/39.

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ORIGINAL ARTICLE

Nonsurgical Approaches to Weight Loss and Diabetes Remission: A Comprehensive Study of the Swallowable Balloon Intervention

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Abstract

Introduction: Obesity and type 2 diabetes mellitus (T2DM) pose significant health challenges, necessitating innovative interventions. This study aims to explore the efficacy of a novel swallowable balloon process in addressing these dual burdens.

Methodology: To evaluate weight loss, diabetes remission, and adverse events (AEs) in 150 patients with a body mass index of 30–40 kg/m^2. The swallow balloon was inserted, and outcomes were assessed over a 6-month follow-up period.

Results: The swallowable balloon process demonstrated consistent and significant ($p < 0.001$) weight loss, with mean percentage total weight loss (%TWL) ranging from 6.8 to 14.6% and mean percentage excess weight loss (% EWL) ranging from 15.5 to 32.8% over the 6-month follow-up period. Remarkably, diabetes remission rates were notable at 30% in 3 months and an impressive 67% in 6 months post-balloon insertion. However, AEs, particularly nausea and vomiting extending beyond one week, occurred in 12% of participants, leading to hospital admission, highlighting the importance of careful monitoring and management. Additionally, nausea and vomiting occurred in 46.6% and 40.6% of participants, respectively, without major complications.

Conclusion: The swallowable balloon process demonstrates promising outcomes in weight loss and diabetes remission over the end of period. AEs require careful consideration, emphasizing the need for ongoing research to optimize safety and efficacy. This intervention offers a nonsurgical approach for individuals with obesity and T2DM, marking a significant step toward addressing these interconnected health challenges.

Keywords: Obesity, Nonsurgical process, Swallow balloon, Type 2 diabetes mellitus, Weight-loss.

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Introduction

Obesity stands as a critical global health concern, intricately linked to the rising prevalence of type 2 diabetes mellitus (T2DM) and various metabolic disorders.[1] This complex interplay contributes not only to increased morbidity and mortality but also places a substantial financial burden on healthcare systems worldwide.[2,3] While population-based interventions targeting lifestyle modifications are paramount in preventing and addressing the dual epidemics of obesity and T2DM, a considerable challenge persists in achieving long-term weight loss and glycemic control for those who have already developed these conditions.[4] Current therapeutic approaches encompass a combination of diet, exercise, and medications, aiming to manage both obesity and T2DM. However, the long-term success rates of lifestyle modifications can be disheartening, and achieving optimal glycemic control remains elusive despite the growing pharmacotherapeutic arsenal. Furthermore, many diabetes medications inadvertently contribute to weight gain, and aggressive glycemic control with these medications heightens the risk of hypoglycemia.[5–7]

In cases where conventional interventions prove insufficient in promoting substantial weight loss and glycemic control, an innovative and nonsurgical method has recently emerged: The swallowable balloon process. This novel approach presents a potential breakthrough in the management of obesity and T2DM by leveraging the gastrointestinal tract's role in metabolic regulation. The elipse swallow (ES) balloon, developed by Allurion Technologies in Natick, MA, USA, represents a pioneering advancement in weight loss interventions that requires no surgery, endoscopy, or anesthesia. Remarkably, patients can undergo the procedure while remaining conscious throughout. The swallow balloon self-empties and passes naturally approximately 16 weeks after placement, adding to its appeal as a minimally invasive intervention.[8,9] Previous proof-of-concept studies conducted on a prototype version of the swallowable balloon in a small cohort of patients reported encouraging results with no serious adverse events (AEs). All participants successfully swallowed and excreted the balloon, providing initial evidence of its safety and

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feasibility.[8] The introduction of this swallowable balloon process holds promise in addressing the intertwined challenges of obesity and T2DM. Despite these initial positive findings, real-world data on the performance of the swallowable gastric balloon approach in a larger cohort, adhering to standard follow-up protocols outlined in current guidelines, are limited.[8–11] Hence, there is a critical need to investigate the effectiveness and safety of the swallowable balloon process in a more extensive and diverse patient population. In response to this gap in knowledge, our study aims to evaluate the impact of the swallowable balloon on patients with both obesity and T2DM. Our study assesses the postoperative changes in key parameters, including body weight loss, fasting plasma glucose (FPG), hemoglobin A1c (HbA1c), and diabetes medication requirements. Additionally, we meticulously document any AE associated with the swallowable balloon process. The objective is to determine whether the swallowable balloon can safely and effectively improve glycemic control, potentially leading to the remission or improvement of diabetes and its associated comorbidities in obese individuals. This study contributes to the growing body of evidence on the swallowable balloon process, offering insights into its real-world performance and its role in managing the intricate relationship between obesity and T2DM. The outcomes of this research hold the potential to inform clinical practice, guide treatment strategies, and contribute to the ongoing dialogue surrounding innovative interventions in the field of metabolic health.

Materials and Methods

Study Design

The study design and data collection methods were implemented with ethical considerations and adherence to relevant guidelines. Institutional review board approval was obtained prior to the commencement of the study. This prospective observational study aimed to assess the impact of the swallowable balloon process on 150 patients with a body mass index (BMI) ranging from 30 to 40 kg/m^2. The study spanned from April 2023 to November 2023, encompassing a comprehensive evaluation of primary data, including demographic information and various postoperative outcomes.

Participant Selection

A total of 150 patients meeting the BMI criteria were recruited for the study. All participants underwent the swallowable balloon process as part of their weight-loss intervention. Informed consent was obtained from each participant prior to inclusion in the study.

Data Collection

Data were collected through electronic healthcare records, capturing a range of parameters to comprehensively evaluate the outcomes of the swallowable balloon process. Primary data, including demographic information age, gender, and baseline comorbidities, were recorded. Postoperative outcome measures—changes in body weight, T2DM remission, early patient-reported concerns, or complications related to the swallowable balloon—were recorded.

Follow-up Assessments

The study incorporated a structured follow-up schedule to track the trajectory of weight loss and diabetes outcomes.

Table 1: Demographic and baseline characteristics

Characteristics	*Mean/Percentage*
Age (years)	42 ± 2.12
Height (cm)	166.23 ± 21.32
Weight (kg)	112.23 ± 18.34
BMI (kg/m^2)	39.23 ± 11.23
Gender (Male/Female)	45 (30%)/105 (70%)
T2DM	72 (48%)
HTN	108 (72%)
OSA	99 (66%)

HTN, hypertension; OSA, obstructive sleep apnea

Weight-loss Outcome

Follow-up assessments were conducted at 1, 2, 3, 4, 5, and 6 months postoperatively to monitor changes in both percentage total weight loss (%TWL) and percentage excess weight loss (%EWL).

T2DM Remission

Diabetes-related parameters, including glycemic control and potential remission, were specifically assessed at the 3- and 6-month follow-up. The American Diabetes Association's FPG ≥ 126 mg/dL or HbA1c ≥6.5% criteria were used to diagnose T2DM.[12]

AE Monitoring

The occurrence of adverse events was closely monitored throughout the study period. AEs of interest included nausea, vomiting, prolonged nausea and vomiting beyond one week, abdominal pain, constipation, and Gastroesophageal Reflux Disease. These events were documented and analyzed to evaluate the safety profile of the swallowable balloon process.

Statistical Analyses

Statistical analyses were performed to assess the significance of the observed outcomes. Descriptive statistics, including means, standard deviations, and percentages, were calculated for demographic variables and primary outcome measures. Inferential statistical methods, such as *t*-tests and Chi-square tests, were employed to determine the significance of changes in weight, diabetes outcomes, and the occurrence of AEs over the study period.

Results

Demographic and Baseline Characteristics

Table 1 summarizes the demographic and baseline characteristics of the study population. The study included a diverse cohort of participants (n = 150) with a mean age of 42 years (±2.12) and a balanced gender distribution of 30% males and 70% females. Anthropometric measurements revealed an average height of 166.23 cm (± 21.32), a mean weight of 112.23 kg (±18.34), and a mean BMI of 39.23 kg/m^2 (±11.23). The baseline characteristics highlighted a significant prevalence of comorbidities among the participants, with 48% diagnosed with T2DM, 72% with hypertension (HTN) and 66% with obstructive sleep apnea (OSA), respectively. These findings underscore the complexity of the study population, reflective of the multifaceted health challenges associated with obesity.

Weight Loss Outcome

We have calculated the mean %TWL and %EWL at regular follow-up intervals post-insertion of the swallowable balloon. It was seen that their mean %TWL were 6.8, 10.5, 12.9, 15.7, 15.1, and 14.6% at 1, 2, 3, 4, 5, and 6 months, respectively. The mean %EWL was 15.5, 24.3, 29.1, 34.6, 33.9, and 32.8% at each follow-up visit postoperatively (Table 2 and Fig. 1). Statistical significance ($p < 0.001$) was observed for both %TWL and %EWL at each follow-up interval, indicating substantial improvements in weight loss post-balloon insertion.

Diabetes Remission Outcome

Table 3 outlines the diabetes remission outcomes at different follow-up intervals. Notably, 30% of patients experienced diabetes remission at 3-month post-balloon insertion, with a substantial increase to 67% at the 6-month mark. Statistically significant improvements in diabetes remission rates were observed at both 3 and 6 months post-balloon insertion.

Adverse Events

Adverse events were carefully documented, revealing nuanced insights into the safety profile of the swallowable balloon process. Notably, 12% of participants experienced nausea and vomiting extending beyond one week, leading to hospital admission in 2% of cases. Additionally, nausea and vomiting occurred in 46.6 and 40.6% of participants, respectively, without major complications (Table 4). These findings underscore the importance of vigilant monitoring and management of AEs, particularly those leading to hospitalization, and highlight areas for potential optimization in patient care.

Discussion

In this study, we investigated the impact of a swallowable balloon process on weight loss, diabetes remission, and associated outcomes in a cohort of patients with obesity and T2DM. Our results demonstrate significant and sustained improvements in weight loss, both in terms of %TWL and %EWL, at various follow-up intervals. The progressive increase in mean %TWL and %EWL from months 1 to 6 suggests the effectiveness of the swallowable balloon process over an extended period. These findings align with existing literature on the benefits of bariatric interventions in achieving substantial weight reduction and improving metabolic health.[8–11] The mean %TWL values ranging from 6.8 at month 1 to 14.6% at month 6 indicate a gradual and consistent weight loss trajectory. Similarly, the mean %EWL values, ranging from 15.5 at month 1 to 32.8% at month 6, reflect the substantial reduction in excess weight over the study duration. The significance of these improvements ($p < 0.001$) underscores the clinical relevance of the swallowable balloon process in the context of managing obesity. These findings resonate with studies that have explored the efficacy of various bariatric interventions. The observed weight loss not only contributes to improvements in body composition but may also alleviate obesity-related comorbidities, including T2DM. The sustained %EWL at 6 months suggests the potential for long-term metabolic benefits, although continued follow-up is essential to ascertain the durability of these outcomes.

A noteworthy outcome of our study is the substantial rate of diabetes remission observed at 3 months (30%) and 6 months (67%) post-balloon insertion. These findings suggest a rapid and sustained positive impact on glycemic control, reinforcing the notion that interventions addressing obesity can play a pivotal role in the management of T2DM. The observed remission rates align with studies investigating the metabolic effects of weight-loss interventions. Weight loss, particularly through bariatric procedures, has been associated with improvements in insulin sensitivity and glucose metabolism. The mechanisms behind the observed diabetes remission may involve changes in hormonal signaling, inflammatory modulation, and improvements in beta-cell function. The rapid onset of remission at 3 months suggests that the swallowable balloon process may exert prompt effects on metabolic parameters. Moreover, the comprehensive evaluation of diabetes-related conditions is crucial for understanding the holistic impact of the intervention. While specific details on these effects were not provided in the current study, further investigations into changes in insulin resistance, HbA1c levels, and other relevant markers would enhance our understanding of the metabolic benefits associated with the swallowable balloon process.

Table 2: Weight loss outcome

Follow-up (months)	*Mean %TWL*	*Mean %EWL*	*p-value (vs Baseline)*
1	6.8%	15.5%	<0.001
2	10.5%	24.3%	<0.001
3	12.9%	29.1%	<0.001
4	15.7%	34.6%	<0.001
5	15.1%	33.9%	<0.001
6	14.6%	32.8%	<0.001

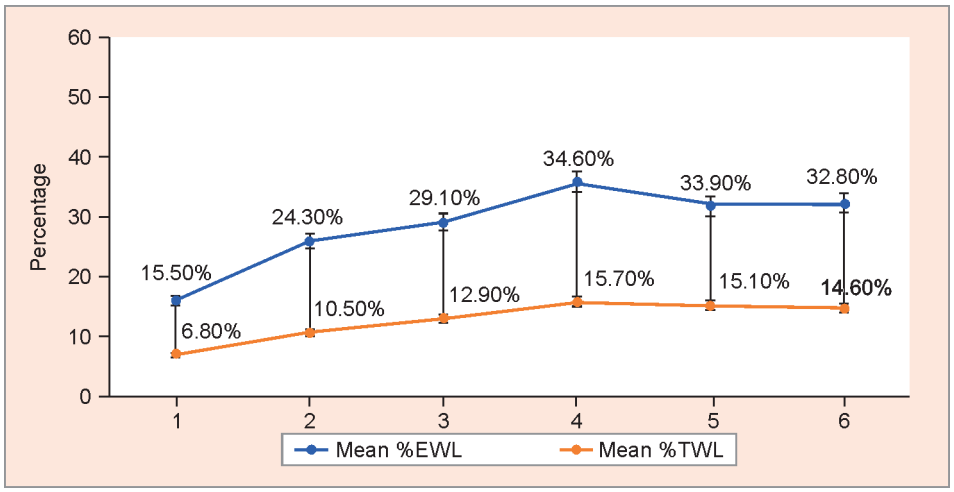

Fig. 1: Weight loss outcome

Table 3: Diabetes remission outcome

Follow-up (months)	*Remission (%)*	*p-value (vs Baseline)*
3	30%	<0.001
6	67%	<0.001

Table 4: Adverse events

Adverse events	*Incidence (%)*	*Outcome*
Nausea and vomiting extending beyond 1 week	18 (12%)	2% hospital admission, 2 days post-balloon insertion, due to vomiting and dehydration
Nausea	70 (46.6%)	No major complications observed
Vomiting	61 (40.6%)	No major complications observed
Abdominal pain	–	–
Constipation	–	–
Gastroesophageal reflux disease	–	–

Despite the promising metabolic outcomes, the study highlights the importance of monitoring AEs associated with the swallowable balloon process. Notably, 12% of patients developed nausea and vomiting extending beyond one week, leading to hospital admission in a subset of cases. These AEs, while not uncommon in bariatric interventions, underscore the need for vigilant patient monitoring and appropriate management strategies. The incidence of AEs, particularly gastrointestinal symptoms, raises questions about the tolerability and acceptance of the swallowable balloon process. Nausea and vomiting, common side effects associated with intragastric devices, can significantly impact patient experience and adherence. Identifying strategies to mitigate these AEs, such as optimized patient selection, tailored dietary counseling, and proactive symptom management, could enhance the overall safety and acceptability of the intervention. While the study reports no major complications, the focus on AEs reinforces the importance of balancing the potential benefits of the swallowable balloon process with its safety profile. Understanding the factors contributing to AEs can inform future modifications in the intervention protocol to optimize patient outcomes.

Despite the valuable insights provided by this study, certain limitations should be acknowledged. The relatively short follow-up period of 6 months limits our understanding of the long-term sustainability of weight loss and metabolic improvements. Future studies with extended follow-up durations are warranted to assess the durability of outcomes and potential late complications. Additionally, the absence of a control group in this study limits our ability to attribute the observed changes solely to the swallowable balloon process. Comparative studies, preferably randomized controlled trials, would strengthen the evidence base and provide a clearer understanding of the intervention's efficacy.

Conclusion

Our study contributes to the evolving landscape of nonsurgical interventions for obesity and T2DM. The swallowable balloon process demonstrates significant and sustained weight loss, rapid diabetes remission, and an acceptable safety profile. These findings, while promising, necessitate further exploration in larger, controlled trials with longer follow-up periods. The potential of the swallowable balloon process as a viable and minimally invasive option in the management of obesity and T2DM warrants continued investigation and optimization. As the field of metabolic interventions advances, ongoing research efforts will refine our understanding of these interventions, providing meaningful options for individuals struggling with the dual burden of obesity and metabolic disorders.

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RESEARCH ARTICLE

A Case Series of Laparoscopic Cholecystectomy for Giant Gallbladder Stones

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Abstract

Gallbladder (GB) stones are a very common scenario in surgical cases operated worldwide. However, large GB stones are rarely reported and operated on due to the fact of high risk of complications and technical difficulties during surgery with few successful outcomes or postoperative complications.

Here we report a case series of successful laparoscopic cholecystectomies done for large GB stones, the largest measuring 7 × 6 cm with no complications and positive outcomes with no mortality or postoperative complications in the Indian and Asian subcontinent.

Case presentation:

Case 1: A 77-year-old female with complaints of right hypochondriac pain. Ultrasound report suggestive of contracted GB filled with echogenic shadow. Elective laparoscopic cholecystectomy was performed with the removal of 7 × 6 cm large solitary GB stone through an extended umbilical port.

Case 2: A 45-year-old female presented in emergency with a complain of colicky pain in her abdomen. Radiological findings are suggestive of a large GB stone measuring 6 × 5 cm. Laparoscopic cholecystectomy was performed safely.

Case 3: A 51-year-old male presented with a history of cholelithiasis and cholecystitis with pain and vomiting. Ultrasound findings reveal multiple large gall stones largest measuring 4 × 3 cm and smallest 1.5 × 1 cm with a total 5 GB stones operated laparoscopically.

Case 4: A 40-year-old female with history of acute cholecystitis with intermittent right upper quadrant pain and vomiting. Ultrasound suggestive of large GB stone of size measuring 5 × 4 cm.

Conclusions: Large gallstones >5 cm are rare, with a greater incidence of complications during surgical and postoperative management. It is advocated to operate even in asymptomatic cases as they have higher risks of GB cancer, biliary enteric fistula, and ileus. Laparoscopic management poses risks and challenges including grasping GB wall, calots triangle exposure, and extraction of large stones from 10 mm size ports. In cases of large GB stones, there are likelihood of conversion from laparoscopic to open cholecystectomy. However laparoscopic management is the gold standard procedure in the hands of experienced surgeons and is the procedure of choice as a laparoscopic approach has higher benefits than the traditional open method.

Keywords: Case report, Giant gallstones, Laparoscopic cholecystectomy, Large gallstones, Open cholecystectomy.

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Introduction

Cholelithiasis with cholecystitis is a very common phenomenon in current surgical scenarios worldwide with more prevalence in females than males with a higher prevalence in 5th decade of life.[1,2]

The etiology of gallstones is likely due to defects in lipid metabolism and supersaturation of bile contents, especially cholesterol. Gallstones size carries a greater significance as large/giant stones carry a higher risk of complications and technical difficulties during laparoscopic cholecystectomy.[3,4]

Gallstones >3 cm have a higher incidence of gallbladder (GB) cancer. Stones >5 cm are rare in occurrence with very few cases reported. Gallstones cause biliary colic or acute cholecystitis in the biliary tree cause biliary obstruction or in the gastrointestinal tract causing gallstone ileus or gastric outlet obstruction in cases of large stones.[4–9]

In this retrospective case series of 4 cases at a Tertiary Healthcare Center in Southern Rajasthan, we review 4 cases of giant gallstones of size largest measuring 7–4 cm in diameter operated via laparoscopic approach.

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

In these case series patients were included with inclusion criteria where the patients age was more than 18 years, and gallstones size was more than 4 cm.

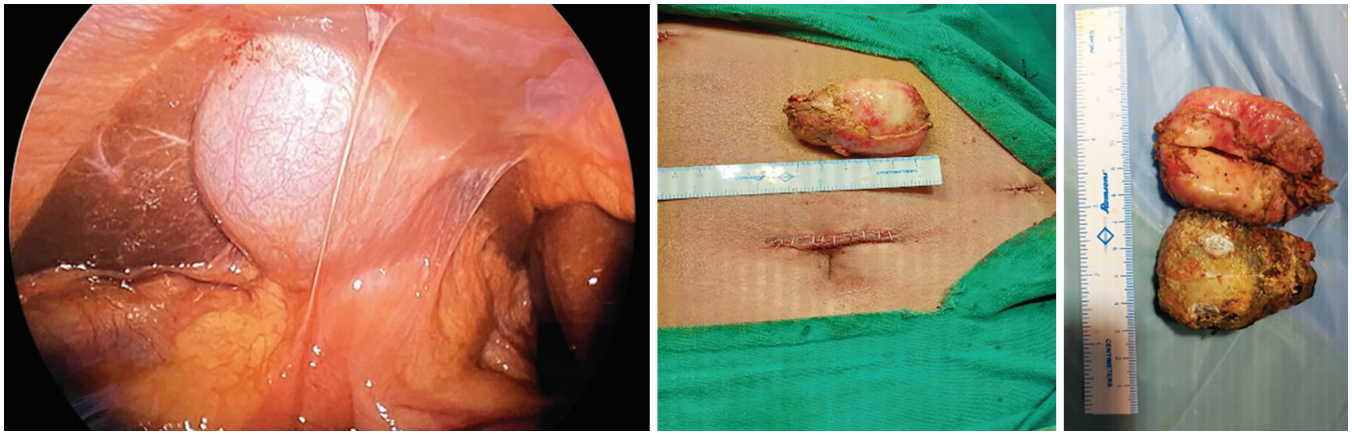

Fig. 1: Case 1: Intraop finding and giant gallstone extraction of size 7 × 6 cm

To the best of our knowledge, this is the largest case series well documented with the largest gallstone size of 7 × 6 cm reported in the Indian subcontinent.

Case Presentation

Case 1

A 77-year-old female presented in surgical OPD with complain of right hypochondriac pain with prior 6 months history of intermittent pain with vomiting. No associated history or complain of fever, jaundice. No past history of any co morbidities with normal liver enzymes levels. Ultrasound investigation suggestive of contracted GB filled with echogenic shadow of approximately 7 × 6 cm size. Elective laparoscopic cholecystectomy was performed with the removal of 7 × 6 cm large solitary GB stone through the supraumbilical port. A standard four ports approach was followed with the supraumbilical port as 10 mm camera port, 10 mm epigastric port, and two 5 mm ports as the right subcoastal and right lumbar port placement. Intraoperative findings reveal adhesions of GB fundus to the liver bed. The giant gallstone with GB was retrieved in an endo bag via supraumbilical port after extending the incision to 2 cm without spillage of bile contents. The 10 mm port site was closed with a port closure needle and skin staples for wound closure (Fig. 1).

Case 2

A 45-year-old female presented in the emergency with complains of colicky pain in the abdomen. Ultrasound findings are suggestive of a large GB stone measuring 6 × 5 cm. Liver function tests reveal enzymes in normal parameters. Elective laparoscopic cholecystectomy was performed with a four-port standard approach and GB with giant GB stones was retrieved through the umbilical camera port. There was no intraoperative complication and the hospital stay was uneventfully followed by discharge on the 5th day (Fig. 2).

Case 3

A 51-year-old male presented with a history of pain right hypochondriac pain and vomiting. ultrasound findings revealed multiple large gallstones, the largest measuring 4 × 3 cm and the smallest 1.5 × 1 cm with a total 5 GB stones. Liver enzymes were within normal limits. An elective laparoscopic four-port approach was followed with the GB retrieved in to from the epigastric port.

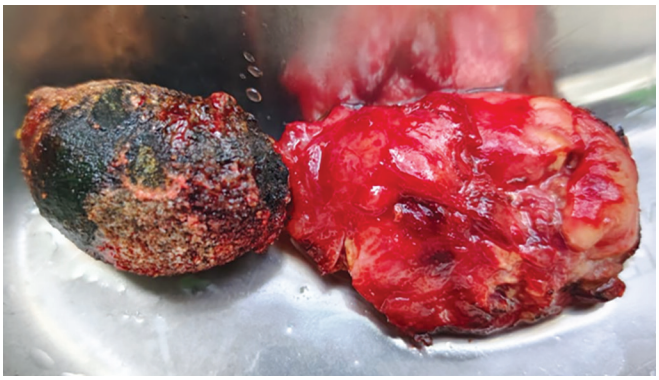

Fig. 2: Case 2: Giant stone measuring 6 × 5 cm

There were no intraoperative or post-op complications and the patient was discharged on 4th day with the advice of follow-up (Fig. 3).

Case 4

A 40-year-old female presented with a history of acute cholecystitis with intermittent right upper quadrant pain and vomiting. Ultrasound is suggestive of two large GB stone of size measuring 4 × 3 cm and 2 × 1 cm. Through a laparoscopic approach, a single giant stone with GB was retrieved. Both intraoperative and post-op periods was uneventful and the patient was discharged with regular follow-up advice (Fig. 4).

Discussion

In this case series of four patients with giant gallstones largest measuring 7 × 6 cm, we have managed all cases laparoscopically with no intraoperative adverse events, short postoperative stay, and no postoperative complications with early recovery in regular follows-ups.

To the best of our knowledge, this is the largest case series of giant gallstones with a size of more than 7 cm ever reported in the literature. In this case series, we have noticed a traditional predominance of more female patients affected than men with a ratio of 3:1 with almost all patients belonging to late decades of life with the eldest patient aged 77 year as the prevalence of gallstones increases with advancing age.[1,2,10] As there are associated comorbidities reported as risk factors for the development of

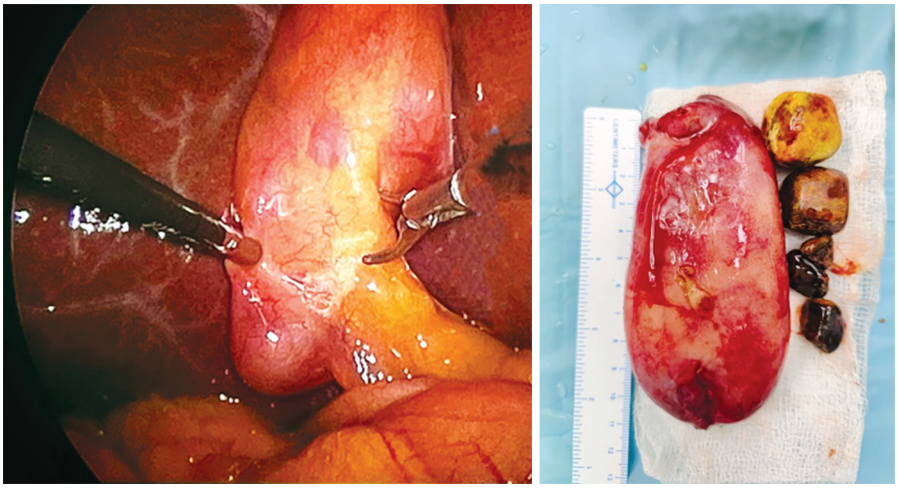

Fig. 3: Case 3: Intraop finding with no adhesions, extraction of 5 giant stones

Fig. 4: Case 4: Two gallstones one measuring 4 × 3 cm and 2 × 1 cm

gallstones in our case series only one patient has been reported with a history of diabetes mellitus.

In clinical presentation 60–80% of patients are asymptomatic and are reported as accidental or routine radiological investigations. However symptomatic patients often present with biliary colic pain, cholecystitis, and biliary obstruction depending on the location and duration of the disease.[11] As in our cases mostly present as biliary colic, acute and chronic cholecystitis. Gallstones can present as gallstone ileus which can be seen in large stones by migrating through a fistula between the GB and duodenum/small or large intestines.[3] In our cases none of the patients exhibits migration.

With the advancement of radiological investigations as preoperative assessment which often detects cholelithiasis and cholecystitis with almost 90–95% specificity and sensitivity.[1,12] These preoperative assessments alert surgeons of potential intraoperative challenges and complications with the likelihood of conversion of lap to open approach.

In our cases in spite of large gallstones which warrant conversions from laparoscopic to open method as advocated by authors and literatures[4] there were no conversion observed in our cases which mandates in the hands of skillful and experienced surgeons laparoscopic approach is the management of choice.

The risks of conversion also depend on equipment factors, previous abdominal surgeries, acute cholecystitis, thickened GB, and adhesions. Also, difficulty in grasping the GB with laparoscopic instruments and exposing the anatomy of the frozen calot's triangle.[13,14]

In three cases the giant stones were retrieved via the supra umbilical camera port with the widening of port size to 7 cm for retrieval of the largest stone of 7 × 6 cm in 1st case and in 3rd case, the GB with large stones was extracted via epigastric port. Even after the extension of the incision of the supra umbilical retrieval approach, it results in better cosmetics outcomes with respect to wound scar.[6] A recent review of umbilical vs epigastric port retrieval reveals umbilical port retrieval method has less postoperative pain with shorter GB retrieval time.[15] Intraoperatively only in case 1 having the largest stone encountered peri GB adhesions, also no bile spillage was observed in any of the cases.

To the best of our knowledge, in the laparoscopic approach for large gallstones without conversion to open, most retrievals were done through the epigastric port.[5,6] Only one published case reported retrieval through the umbilical port.[6]

As in our case series 3 giant stones are retrieved via epigastric port and 1 giant stone by supraumbilical port using endo bag to prevent bile spillage or wound infection. In a recent meta-analysis wound infection of the port site was reported less when compared to using an endo bag vs without an endo bag (4.2 vs 5.9%) in retrieval of the GB.[16]

In histopathological investigation no features of malignancy were reported in all four cases as it regards to potential risk of development of GB carcinoma in gallstones size >3 cm.[17,18] Hence such patients who are considered to be at high risk of development of cancer can be benefited for early detection and elective cholecystectomies.[17,18]

With the best of our knowledge and thorough searching of research articles on popular literature and case report journals and platforms this is the largest case series with the largest giant gallstones of size 7 cm retrieved laparoscopically ever and supported by thorough review literature of cases provided as references.

Results

Large gallstones are rare in terms of occurrence with high chances of intraoperative complication and technical difficulty. Also warrants for high chance of conversion from laparoscopic to open method. However, in the hands of experienced surgeons laparoscopic approach is still advised as the primary method even in giant gallstones whether symptomatic or asymptomatic patients.

Conclusions

Large gallstones >5 cm are rare, with a greater incidence of complications during surgical and postoperative management. It is advocated to operate even in asymptomatic cases as they have higher risks of GB cancer, biliary enteric fistula, and ileus. Laparoscopic management poses risks and challenges including grasping GB wall, calots triangle exposure, and extraction of large stones from 10 mm size ports. In cases of large GB stones there are likelihood of conversion from laparoscopic to open cholecystectomy. However laparoscopic management is the gold standard procedure in the hands of experienced surgeons and is the procedure of choice as a laparoscopic approach has higher benefits than the traditional open method.

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REVIEW ARTICLE

Robotic Surgery from Earth to Space!

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Abstract

Robotic surgery is an innovation that has yielded a multitude of applications within the realm of surgery. This approach has allowed for the performance of more complex procedures with the promise of improved outcomes. Although the availability of this surgical operating system depends on market and financial elements within healthcare organizations, it has shown its value in clinical practice. This ranges from reduced complication rates resulting in decreased hospital stay and return to baseline activity. The ability to operate this system remotely is fascinating and can allow the involvement of experts from around the world. We aim to shed light on the value of robotic surgery, particularly when it comes to the surgical management of patients participating in missions in outer space.

Keywords: Da Vinci robotic surgery, Emergency surgery, Robotic.

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Introduction

Minimal access surgery has become the standard of most elective surgical procedures and recently the use of robotic surgery and artificial intelligence assistance is recommended. This paper is a collaborative work assemblage of a literature review on the usage of robotic surgery in future space missions.

Discussion and Review

In 1921, the term robot was first used in a theatrical play, and since then, people have moved from the concept of the robot being an inanimate slave to its human master to a more intellectual creation capable of artificial intelligence.[1]

Robots were initially invented to assist humanity with basic activities such as manufacturing until they eventually found their way to the medical field. Interest was compounded following the evolution and popularity of laparoscopic procedures where they showed improvements in length of the stay, postoperative pain, improved cosmesis, and earlier return to normal work and activities of daily living.[2]

The first robotic surgery was performed in the field of Neurosurgery by obtaining accurate biopsies, done in 1985 using the Puma 560 robot.[3] Using this robotic innovation helped in creating another robotic system (ROBODOC) to perform urological procedures including transurethral prostatectomy, which at the time, was the first robotic system to be approved by the Food and Drug Administration (FDA).

Intensive research was done to improve this new technique, and the new concept of tele-surgery became a reality. This was proven when surgeons began performing procedures remotely with the aim of assisting with injured military personnel during the conflict. This allowed for further innovations and improvements in robotic design, culminating in the Da Vinci surgical system.[1]

The Da Vinci robot is fully based on telepresence surgery. Robotic arms are operating remotely from the console with enhanced 3-D visualization, thus giving the surgeon a sense of augmented reality.[4]

The advantages of robotic surgery are not yet fully established in all surgical fields as it continues to find applications for use. The primary difficulty faced by healthcare providers has been the associated cost of running the system, along with maintenance and replenishment of required system components.[5] Nevertheless, numerous applications have allowed for drastic improvements in the management of many pathologies that have traditionally been performed through the open and laparoscopic surgical technique.

Astronauts are highly trained, healthy individuals. They undergo numerous tests and rigorous training before being sent into space. The near future, however, will see people traveling to space as part of commercial activities or tourism. Therefore, space travel may no longer be monopolized by healthy astronauts, and thus medical emergencies may occur at any time despite the relatively low incidence.[6] This can be extrapolated from missions to the Antarctic continent at research stations, where we occasionally have patients completely isolated from advanced medical facilities. Tremendous resources are required to bring in such patients at times of emergency to undergo testing and surgical procedures.[7]

It may be prudent to predict medical emergencies rather than risking the astronauts' life, or jeopardizing the mission through early abortion and return to earth, especially since sending a rescue team might not be feasible. Some studies suggest astronauts undergo prophylactic surgeries like appendectomies and cholecystectomies prior to their long space travel, particularly since the effect of

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prolonged space travel on human physiology, wound healing, and the immune system has not been fully explored yet. Therefore, the risk of developing appendicitis or other surgical emergencies during the mission might be higher than the normal population on planet earth.[8]

Other studies have suggested that performing prophylactic surgery might result in the development of other potential complications such as small bowel obstruction implying that prophylactic surgery may not be worth the associated risk.[9]

Other surgical emergencies that may arise in outer space include blunt and penetrating trauma. In zero gravity situations, objects may appear light but can still cause significant physical injury particularly, at high speed.[10]

An alteration in physiological response may occur due to the prolonged loss of gravity to the injured individual. Such changes may include a decrease in circulating blood volume and circulating red cell mass, reduced cardiac output, alterations in neuroendocrine function, and others.[11,12]

Applying the advanced trauma life support (ATLS) protocol in space can save the lives of injured personnel.[13] Nevertheless, the challenge would be controlling intra-abdominal or intra-thoracic bleeding. This was studied in 1998 on rats during the STS-90 Neurolab Shuttle mission, where they were able to perform a thoracotomy, laparotomy, craniotomy, and lower extremity dissection. Findings noted in this study include the prolonged length of time required in the manipulation of instruments, however, it did conclude the feasibility of performing these procedures in space.[14]

In concept, applying damage control principles, such as intra-abdominal packing, re-alignment of fractured limbs and others can help in saving time and saving the life or limb of the injured person. In selected patients, penetrating or blunt abdominal injuries can be managed using minimally invasive techniques in both diagnosing and managing certain injuries.[15]

Others have suggested the utility of a medical team present as a part of the team of astronauts heading to space. This may help in recognizing signs and symptoms at an earlier stage and begin early treatment. This is particularly true since many inflammatory conditions such as appendicitis or cholecystitis have been treated conservatively with considerable success utilizing broad-spectrum antibiotics. While this might be considered the safest, medical personnel would still not have the necessary diagnostic tools needed to confirm the diagnosis. Nevertheless, it is still feasible to operate in space with the appropriate instruments as has been shown in studies involving microgravity situations within underwater laboratories.[6,16]

Since surgery in outer space has been shown to be technically feasible, further studies involving the performance of emergency operations at the international space station using tele-surgery such as robotic surgery should be considered. We hypothesize that it is a matter of time before this becomes a reality as more space missions are being launched by numerous nations around the world. This is particularly true as the commercial aspect of space tourism becomes a reality. The development of improved technology such as higher speed, improved resolution, and faster connection systems can help astronauts and their companions get the treatment they may eventually require.

The largest space corporation, NASA, has always been aware of the importance of providing better healthcare for space travelers to ensure their ability to endure long duration flights and missions. This led to the development of the NASA Extreme Environment Mission Operations (NEEMO) missions. NASA is utilizing an underwater laboratory for astronauts to live and acclimate to low gravity conditions.[17] NASA extreme environment mission operations missions are conducted with the sole target of studying telemedicine. Several robots were studied like the AESOP robot (ZEUS), M7 Robot, and the RAVEN Robot. All of these studies were completed utilizing crews with minimal surgical training, mimicking the latency in connection speeds between Earth and the moon, and even experimenting on real-time procedures like suturing while the surgeons are in a remote location. All of the experiments have shown the possibility and the importance of using telemedicine in the near future.[17–20] In fact, MIRA will be the first surgical robot to be sent to the international space station by NASA in 2024.[21] This is considered a significant leap forward in furthering surgical robotics in outer space.

Conclusion

Robotic surgery might be an asset in the future of space surgery, regardless of mission duration. Procedures that may be performed include management of acute abdominal pathologies or even blunt or penetrating trauma. More studies and investment in robotic surgery will be required—and as we know, the sky is not the limit. Reaching the moon once again, and the establishment of the human presence will be the first step in the space adventure. We advocate the need to continue researching the role of surgical robotics in space. We believe that surgeons will continue to have a role to play in these endeavors.

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CASE REPORT

Laparoscopic Repair of Ovarian Inguinal Hernia: A Case Report

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Abstract

The documentation of this case report about ovarian inguinal hernia is to create awareness about this rare entity.

A 40-year-old female was referred to the Department of Surgery from the Department of Obstetrics and Gynaecology with complaints of pain and swelling in the left groin region and a history of secondary infertility. Physical examination revealed an inguinal hernia with irreducible contents and no features of obstruction or strangulation. Sonography confirmed the left inguinal hernia with the ovary as the content. The patient was taken up for laparoscopic repair.

Ovarian inguinal hernias are commonly present in the pediatric population and are associated with congenital anomalies of the female genital tract and are rarely present in women of reproductive age-group.

This study aims to create awareness of the possibility of ovarian inguinal hernia which should be kept in mind when a female patient presents with an irreducible groin swelling. Uncomplicated hernias are amenable to laparoscopic repair.

Keywords: Case report, Laparoscopic repair, Ovarian inguinal hernia.

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Background

Inguinal hernias are more common in males than females (male:female ratio, 9:1).[1] The common contents are omentum or small bowel. Inguinal hernias in females containing ovary and fallopian tubes are mostly associated with congenital anomalies of the female genital tract.[2] Hence, they are more common in children than in adults.

Inguinal hernias containing gonadal structures such as ovary, fallopian tubes, and/or uterus are rare. In a retrograde study of female inguinal hernias, comprising 1,950 cases, the ovaries and fallopian tubes were found in only 2.9% of the cases.[3]

Case Description

A 40-year-old female was referred to the Department of General Surgery of Bharatratna Dr Babasaheb Ambedkar Hospital, Mumbai, Maharashtra, India from the Department of Obstetrics and Gynaecology and was under treatment for secondary infertility. She had a history of an ectopic pregnancy in the right fallopian tube 10 years ago for which a right salpingectomy was done (details of previous surgery were not available) after which she was unable to conceive. For 3 months, she had complained of pain in the abdomen and had noticed a swelling in the left groin region. No other significant past medical/surgical history.

On examination, per abdomen (P/A) was soft and nontender; local examination (L/E) revealed a firm cystic swelling in the left inguinal region. The swelling was irreducible and minimally tender to touch. There was no evidence of (e/o) any cough impulse.

Ultrasound examination of the inguinal region revealed a left inguinal hernia with an ovary as the content with preserved vascularity; concomitantly, the absence of a left ovary and fallopian tube in the pelvis was noted. Magnetic resonance imaging (MRI) pelvis was done and confirmed the same. All other routine investigations were within normal limits.

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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.

The patient was taken up for laparoscopic surgery—transabdominal preperitoneal (TAPP) repair.

Findings

Unicornuate uterus with a right dominant horn and left rudimentary horn were seen. There was evidence of partial right salpingectomy and the right ovary was normal. The left ovary and fallopian tube could not be visualized in the pelvis (Fig. 1).

The peritoneal flap was raised from the left anterior superior iliac spine (ASIS) to the midline and showed a left inguinal hernia with the ovary as the contents (Figs 2 and 3). The sac was opened and the contents were reduced. The ovary looked atrophied and

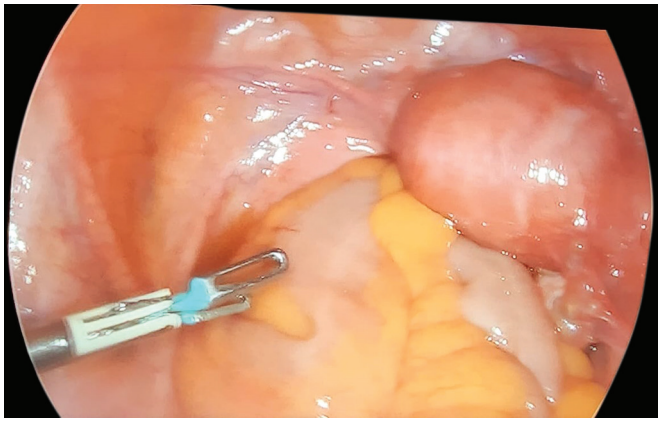

Fig. 1: Intraoperative findings

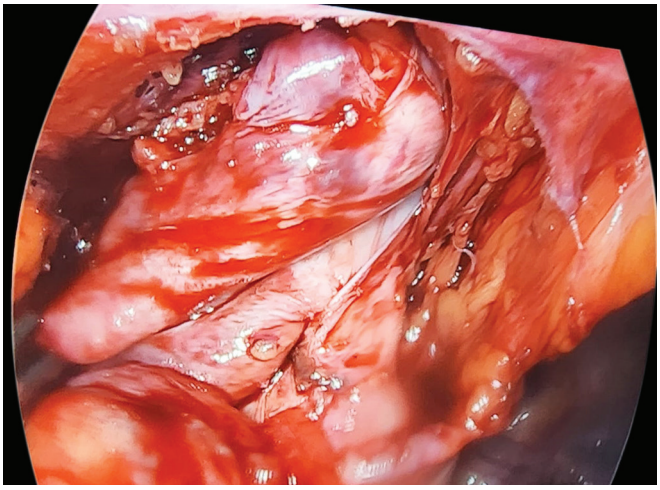

Fig. 2: Hernial sac in the canal of nuck

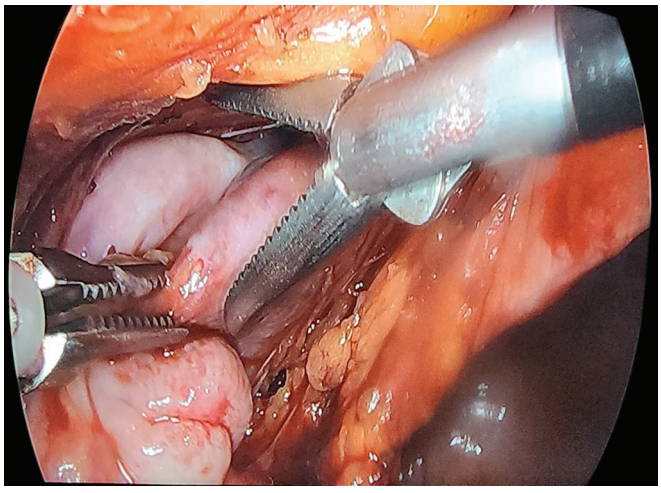

Fig. 3: Opened sac with ovary as content

fibrosis and the left fallopian tube were absent, hence the decision was taken to do an oophorectomy. Prolene mesh was placed over the defect (Fig. 4) and the peritoneum was reposited (Fig. 5).

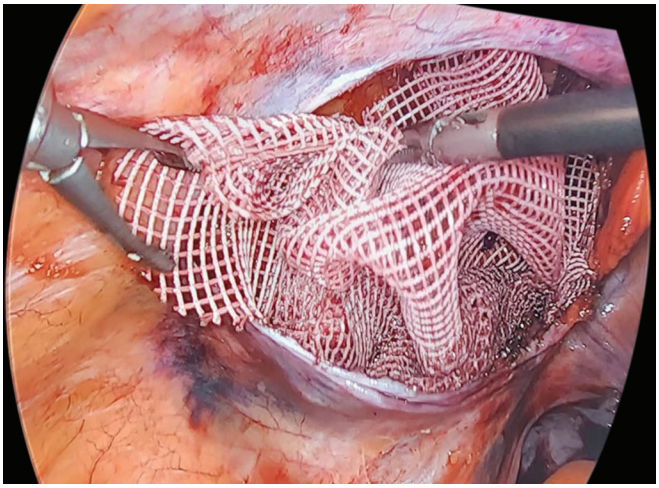

Fig. 4: Defect being covered by Prolene mesh after reducing the hernial sac

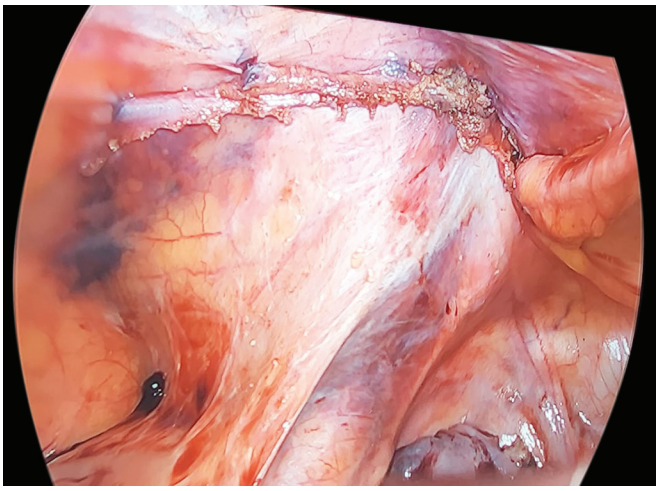

Fig. 5: Reposited peritoneum

The postoperative recovery of the patient was uneventful. The histopathology report confirmed an atrophic ovary.

Discussion

Most of the female inguinal hernias with gonadal contents are associated with anomalies of the genital tract; hence, they are commonly present in the pediatric age-group and rarely present in women of reproductive age-group.[3] Incidence in children under 5 years of age is 70% and in adolescent women is 30%.[4]

During 8–12th week of intrauterine life in a female fetus, the gubernaculum develops and it attaches to the uterus at the corneal level. The cranial portion forms the ovarian ligament and the caudal part forms the round ligament.[5] A small evagination of the parietal peritoneum called the canal of Nuck, accompanies the round ligament into the inguinal canal. This canal of Nuck obliterates shortly before birth.[6] The abnormal embryological development of the gubernaculum, the round ligament, and the persistence of a patent canal of Nuck are responsible for the formation of female inguinal hernia with ovary as the contents.[7]

Apart from embryology, it was also hypothesized by Thomson that a failure of fusion of the Mullerian ducts, may lead to excessive mobility of the ovaries and this may be a causative factor in the herniation of the gonadal structures into the inguinal canal.[4] According to Fowler's theory, the elongated ovarian suspensory ligaments are the cause of ovaries being found in the groin hernias.[7] Another theory by Okada et al. suggests that the weakness in the ovarian suspensory ligaments or the broad ligaments is a causative factor.[8]

To conclude some developmental anomalies result in the persistence of the ovarian pedicle in the inguinal canal and is responsible for the hernia with gonadal structures as the contents.

The clinical diagnosis of inguinal hernia can be confirmed by high-resolution ultrasound.[9] Ultrasonography is an optimal diagnostic tool for differentiating the contents of the hernia.[6] The unique morphological characters of the ovary allow easy diagnosis on ultrasound and its absence in the abdomen confirms the same. Color Doppler evaluation helps to assess the blood flow and rule out strangulation.

Hernias with ovary as the content are less likely to regress spontaneously than simple Inguinal hernias. They are at a greater risk of incarceration, due to the large size of the ovary as compared to its narrow vascular pedicle.[10] The incidence of incarceration in an ovarian inguinal hernia is as high as 43%.[5] Hence, it is necessary to treat all cases even when asymptomatic.

When detected in the uncomplicated state, they can be dealt with effectively by laparoscopy and a concomitant mesh repair can be done (TAPP approach). Groin hernias can be approached laparoscopically either transabdominally or extra peritoneally. In our case we chose the transabdominal approach as it also helped us to document all the congenital anomalies in the patient's genital organs. When diagnosed with gangrenous contents it warrants an open anatomical repair.

Clinical Significance

This is a study of a rare entity—ovarian inguinal hernia—one must keep in mind when a female patient presents with an irreducible swelling in the groin. It can be treated effectively by laparoscopy if diagnosed early as in our case.

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CASE REPORT

Minimally Invasive Inside-out Plug and Mesh Placement in an Ipsilateral Concurrent Femoral and Inguinal Hernia Recurrence: A Case Report of Tailored Solution

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Abstract

Aim: This case report aims to highlight a tailored solution in the management of femoral and inguinal concurrent recurrence by laparoscopic approach.

Background: Hernia recurrence is one of the problems in this kind of surgery. Recurrence rates following primary hernia repair range from 0.5 to 15%. Hernia recurrence is more common after primary femoral hernia repair due to higher rates of emergency treatment than inguinal hernia. We present a case of complicated femoral hernia recurrence with concomitant re-recurrence of inguinal hernia that required a tailored solution to restore both hernia recurrences.

Case description: A 66-year-old woman with a medical history of previous treatment for a right groin hernia, its subsequent recurrence, and an open repair for a right femoral hernia. A description of challenge in the diagnosis and treatment of coexisting inguinal and femoral ipsilateral recurrence with a tailored solution.

Conclusion: Laparoscopy is widely recommended in women with a hernia in the groin area because it often presents an unsuspected femoral hernia that was not diagnosed by preoperative examination.

Clinical significance: The presented case report highlights how tailored solutions can be used in complicated anatomical presentations. In particular, an unusual solution was presented to correct the recurrent double defect with the placement of plugs and mesh in a non-standard way.

Keywords: Advanced laparoscopic surgery, Case report, Femoral hernia, Transabdominal preperitoneal meshplasty.

World Journal of Laparoscopic Surgery (2025): 10.5005/jp-journals-10033-1643

Background

Femoral hernias, although less common than inguinal hernias, remain clinically significant due to their potential for acute complications such as occlusion or strangulation. These hernias predominantly affect women, occurring approximately four times more frequently in this population.[1–3] Several surgical approaches exist for femoral hernia repair. These include both mesh and non-mesh techniques. Mesh repairs, whether performed open or laparoscopically [using techniques such as laparoscopic totally extra-peritoneal (TEP), transabdominal preperitoneal (TAPP), and enhanced view totally extraperitoneal approach (eTEP)], have gained prominence. While both open and laparoscopic methods have their proponents, elective laparoscopic repair demonstrates favorable outcomes. Cumulative reoperation rates are significantly lower with laparoscopic repairs (0.62 vs 3.4%).[2,3] The laparoscopic approach, with preperitoneal mesh placement, has emerged as the standard for primary femoral hernia repair.[4] International Hernia guidelines, as proposed by the HerniaSurge Group, recommend this technique.[5] However, it is crucial that only experienced abdominal wall reconstruction surgeons undertake re-repair of inguinal hernias following failed anterior and posterior approaches. We present a case of recurrent right femoral hernia with synchronous ipsilateral groin hernia re-recurrence.

Case Description

We present a case study involving a 66-year-old woman who experienced concurrent right inguinal and femoral hernia recurrence. Her medical history included previous treatment for a right groin hernia, its subsequent recurrence, and an open repair for a right femoral hernia. The inguinal hernia recurrence was addressed through laparoscopic TAPP repair. Six months after the primary open femoral hernia treatment, the patient presented with swelling in the right inguinal area. A laparoscopic TAPP repair was planned. During the laparoscopic evaluation, the following hernias were observed: Re-recurrence inguinal hernia with lateral mesh sliding and recurrence of femoral hernia which contains a loop of ileus. Briefly, the operation consisted of laparoscopic examination, ileus reduction, and TAPP repair of either femoral or inguinal hernia recurrences by plug and mesh (Fig. 1).

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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.

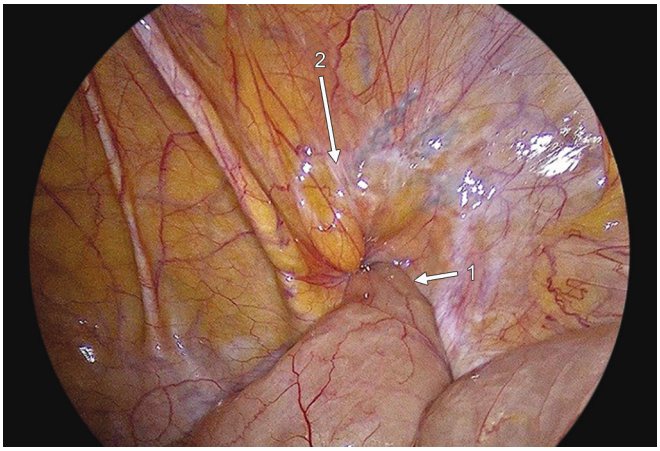

Fig. 1: Right inguinal area intraperitoneal inspection. (1) Recurrent femoral hernia with small bowel sliding and (2) Previous flat mesh slipped

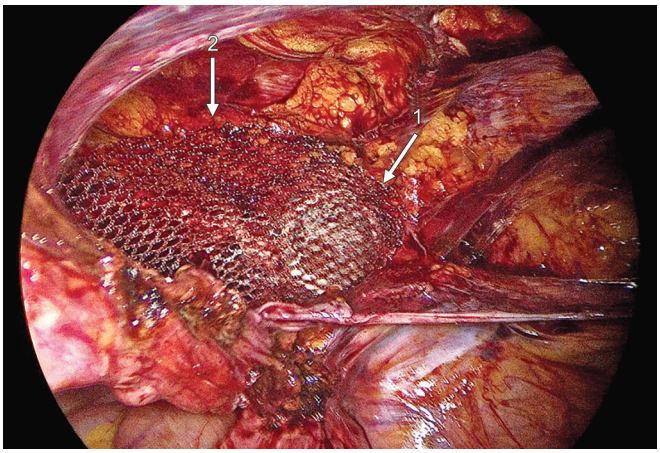

Fig. 2: Right extraperitoneal view after treatment. (1) Medial hernia recurrence covered by flat mesh and (2) Femoral hernia recurrence treated by plug behind the flat mesh

Repairing with a large mesh to cover both defects was not possible due to the impossibility of performing a complete dissection of the peritoneum from the mesh. Then we decide to repair the femoral hernia with the partially semi-absorbable plug (87% poly-L-lactic acid, resorbable and 87% poly-L-lactic acid non-resorbable, 4D Dome® Cousin biotech) without removing the previous mesh and plug. We employed a bridge to approach inguinal hernia recurrence. A semi-absorbable mesh (75% poly-L-lactic acid resorbable, 25% polypropylene, 4D Dome® Cousin biotech) was fixed with glue 3 cm over the edge of the previous mesh to bridge the gap (Fig. 2). The peritoneum was closed with absorbable barbed suture.

The patient's recovery was uneventful, and she was discharged the day after surgery. No recurrence was observed 15 months postoperatively.

Discussion

Femoral and inguinal hernias are grouped together as groin hernias. Although femoral hernia is relatively rare, accounting for 2–4% of all groin hernias, its significance lies in the high incidence of complications such as incarceration, occlusion, and strangulation.[6,7] This pathology is commonly observed in patients older than 40 years and is rare in younger individuals. Untreated femoral hernias may lead to complications that often require emergency surgery. Therefore, a watch-and-wait approach is not suitable; femoral hernias should be operated upon electively as soon as possible. Primary femoral hernias may be repaired using various methods, including direct suture or different types of mesh repair with either open or minimally invasive techniques. The choice of procedure depends on local availability, surgeons' expertise, and patient preferences.[3,8–12] Advantages of the anterior open approach include ease of treatment, the option to use local or spinal anesthesia, and a lower frequency of visceral mesh-related complications. Currently, recent HerniaSurge Group International guidelines for hernia repair recommend using a laparoscopic approach for femoral hernia repair due to its numerous benefits over conventional techniques, such as less pain, a lower recurrence rate, and reduced nerve damage risk. Additionally, direct visualization of all hernial orifices allows for concurrent corrections of groin hernias through the same access. Early and late complications of hernia surgeries include recurrence, which in cases of femoral hernia surgery appears within the first 6 years in 67% of cases. A recent study within a large US-based integrated healthcare system found that the rate of reoperation for femoral hernias was 17 times higher for females compared to males.[11] Interestingly, 38.1% of women operated on for recurrent inguinal hernia presented with an unsuspected concurrent femoral hernia during surgery.

Minimally invasive surgery has been reported to be superior to the anterior approach in treating recurrent hernias when performed by experienced surgeons using standard techniques. Evaluating the femoral canal becomes complex in cases of hernia recurrences, especially if a minimally invasive procedure has been previously performed.

Certainly, the TAPP approach for recurrent hernias provides an overview of the myo-pectineal area and allows for appropriate identification and repair of the type of recurrence. Unfortunately, it is not always that simple. In our case, part of the peritoneum was inseparable from the mesh. The surgical management in difficult cases may be a more intricate operation. We therefore had to devise a tailored solution to correct the defects. Placing a plug and completing the cover with a mesh with adequate overlap could help in such difficult cases. This approach required certainly high laparoscopic surgical expertise but a glue fixation of both plug and mesh may be a good alternative in this potentially dangerous area.

Conclusion

This is the first reported case of laparoscopic mesh and plug repair of concurrent femoral and inguinal ipsilateral hernia recurrence. The decision to perform a mesh and plug placement will depend on the intraoperative findings.

Laparoscopy is widely recommended in women with a hernia in the groin area because often presents an unsuspected femoral hernia that was not diagnosed by preoperative examination.

Clinical Significance

The presented case report highlights how tailored solutions can be used in complicated anatomical presentation. In particular, an unusual solution was presented to correct the recurrent double defect with the placement of plugs and mesh in a non-standard way.

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SHORT COMMUNICATION

Hemocoagulative Considerations on Laparoscopic Cholecystectomy in Patients with Liver Cirrhosis

Veronica Vecchio[1], Eva Intagliata[2], Rossella Rosaria Cacciola[3], Emma Cacciola[4], Rosario Vecchio[5]

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Abstract

A still debated issue is how to treat gallbladder diseases in patients with advanced stages of liver cirrhosis. Laparoscopic cholecystectomy has specific advantages in patients with liver cirrhosis. Complications of the wound, incisional hernia rate, operating time, and hospitalization time are significantly reduced due to the less invasiveness of laparoscopic cholecystectomy. The risk of contamination of the ascitic fluid and the exposure of the surgical team to fluids infected by hepatitis C virus (HCV) or hepatitis B virus (HBV) are reduced. The risk of bleeding is also reduced, either because of the less invasiveness of the procedure or the pneumoperitoneum pressure, which induces vascular compression. There is another important reason that can help reduce bleeding during laparoscopic cholecystectomy in cirrhotic patients. Laparoscopic surgery induces activation of coagulation and fibrinolytic pathways. This prothrombotic tendency may be a further advantage for cirrhotic patients who tend to have alterations of coagulation in a prohemorrhagic sense.

Keywords: Hemocoagulation, Liver cirrhosis, Subtotal laparoscopic cholecystectomy.

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Short Communication

A problematic still debated issue is how to treat patients with advanced stage of liver cirrhosis when they get affected by symptomatic gallbladder stones. It is preferable to avoid cholecystectomy in favor of a less invasive percutaneous cholecystectomy in the presence of Child–Pugh C patients.[1] In fact, in a cirrhotic liver with portal hypertension, it is common to find dilated and tortuous vessels even on the bed of the gallbladder, which can be damaged during the dissection, with consequent bleeding difficult to control. In such patients, another option could be to perform a laparoscopic subtotal cholecystectomy, called subtotal type I cholecystectomy, which leaves intact the posterior wall of the gallbladder attached to the liver.

In patients with liver cirrhosis, laparoscopic cholecystectomy has some advantages. Complications of the wound, incisional hernia rate, operating time, and hospitalization time are significantly reduced due to the less invasiveness of laparoscopic cholecystectomy.[2] The risk of contamination of the ascitic fluid, with bacterial dissemination, and the exposure of the surgical team to fluids potentially infected with hepatitis C virus (HCV) or hepatitis B virus (HBV) are reduced. Furthermore, the laparoscopic approach reduces the adhesion formation that would make a possible transplant more difficult in patients candidate for liver transplantation.

Advantages referring to the risk of bleeding during laparoscopic cholecystectomy in cirrhotic patients can also be found. The smaller size of the trocar incisions reduces the blood loss from the muscular wall and the risk of interrupting of important collateral vessels due to portal hypertension.[3] The magnification of the visual field by the camera and the positive pressure caused by the pneumoperitoneum, which involves vascular compression, guarantee a better hemostasis. According to some Authors, laparoscopic cholecystectomy appears to be a safe procedure in patients classified as Child–Pugh A and Child–Pugh B stage, because of acceptable complication rates, need for conversion, morbidity, and mortality, with a bit greater demand for transfusion.[4]

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For patients belonging to the Child–Pugh C class, higher complication rates and mortality were found, such as hemorrhages and liver failure.[2,4] We would like to point out another important issue. Our previous study comparing pre- and postoperative values of prothrombin time, fibrinogen, β-thromboglobulin, and D-Dimer, which were statistically higher in the first postoperative day, suggested that laparoscopic surgery induces activation of coagulation and fibrinolytic pathways. β-thromboglobulin elevation might account for postoperative platelet activation with a greater risk of thrombogenicity.[5,6] This prothrombotic tendency, which leads to the recommendation of routine thromboembolic prophylaxis in patients undergoing laparoscopic surgery, may be a further advantage for cirrhotic patients that tend to have alterations of coagulation in a prohemorrhagic sense.

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CLINICAL TECHNIQUE

Use of Rigid Laparoscope for Intraoperative Bowel Endoscopy: An Easy and Novel Technique

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Abstract

Aim: The aim of reporting this technique is to demonstrate the new surgical method and its feasibility.

Background: Intraoperative bowel endoscopy (IOBE) is a salvage technique when conventional and advanced endoscopic techniques, video capsule endoscopy (VCE), and radiological imaging fail. Conventional IOBE requires the use of a flexible endoscope and the need for a skilled endoscopist, leading to the requirement of extra manpower and costs. Hence, there is a need for alternative easy-to-perform techniques.

Technique: An intestinal clamp is applied distally. The bowel is opened, and a 30-degree 10 mm rigid laparoscope is inserted along with 10 French infant feeding tubes for air insufflation and irrigation. The laparoscope is maneuvered as required.

Conclusion: Intraoperative bowel endoscopy by rigid laparoscope can be easily done by most surgeons due to its easy availability and easy learning curve. It plays an important role in the evaluation of the bowel for various indications.

Clinical significance: Here, we have described an easy-to-do and novel technique that can be done by the operating surgeon with basic laparoscopic skills.

Keywords: Laparoscopy, Obscure bleeding, Peroperative enteroscopy.

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Background

Richter et al. first described intraoperative colon endoscopy in 1973.[1] Intraoperative bowel endoscopy (IOBE) is a salvage technique when conventional endoscopic techniques, namely upper gastrointestinal (UGI) endoscopy and colonoscopy, and advanced endoscopic techniques like deep enteroscopy and video capsule endoscopy (VCE) fail due to various reason/s like continuous bleeding leading to poor visibility, intermittent and/or low-volume bleeding leading to the inability of identification of the bleeding source, bowel obstruction causing the inability to evaluate nonaccessible bowel proximally or distally as applicable in cases of polyps or malignancy, poorly prepared bowel, instability of the patient, nonavailability of enteroscopy/flexible endoscope or skilled endoscopist, etc. to name a few. It also plays a role when radiological investigations are unable to localize the lesion/s and/or evaluate the bowel. Conventional IOBE requires the use of a flexible endoscope and the need for a skilled endoscopist as most surgeons are not well-versed in flexible endoscopy. This leads to the requirement of extra manpower and costs. Hence, there is an unmet need for alternative easy-to-perform techniques. We are here under describing a novel technique that can easily be adopted by the operating surgeon.

Technique

The following steps describe our novel easy-to-do technique:

- First, an intestinal clamp is applied distal to the area of interest being evaluated to allow the gas to inflate the bowel.
- Once the bowel is opened (in the middle of purse-string suture), preferably a 30-degree 10 mm rigid laparoscope is inserted along with 1 or more 10 French infant feeding tube/s for air insufflation and/or irrigation (by insufflator or 50 mL syringe with a three-way stop cock connector) (Figs 1 and 2 and Video 1).
- Then, the laparoscope is maneuvered as required to evaluate the bowel circumferentially from distal to proximal end (Fig. 3).
- The laparoscope and the infant feeding tube/s are withdrawn followed by intestinal clamp release after the procedure.
- Thermal injury can be avoided by avoiding contact with the tip of the laparoscope with the mucosa and also by saline irrigation.
- Once the source and/or lesion/s is/are either identified or not, definitive management is done as deemed necessary.

Discussion

Complete bowel assessment cannot be done in all patients, especially when evaluating the small bowel due to its length and/or due

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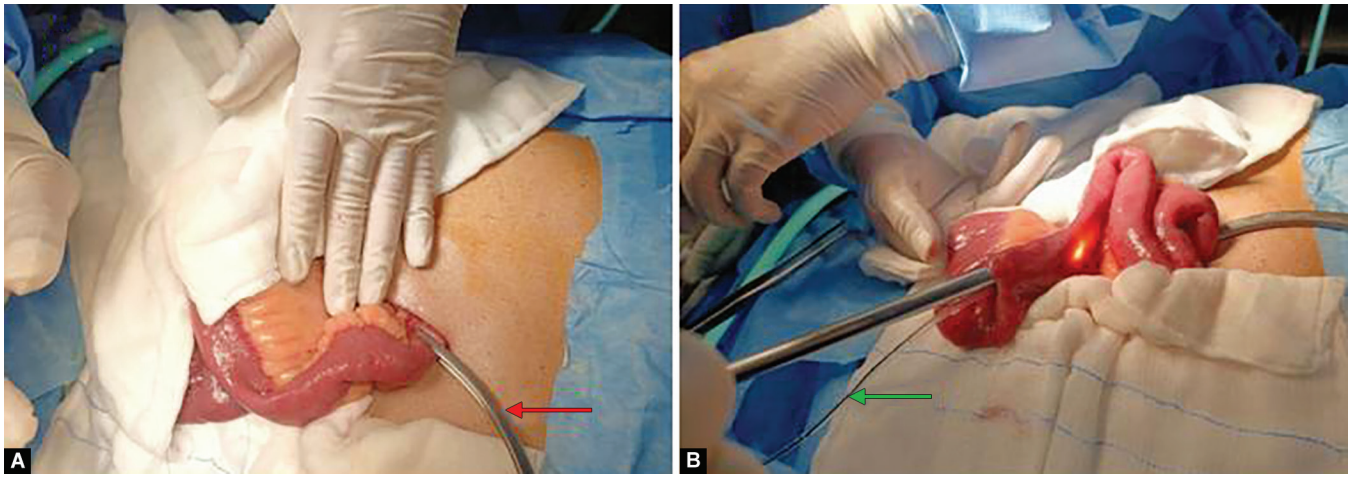
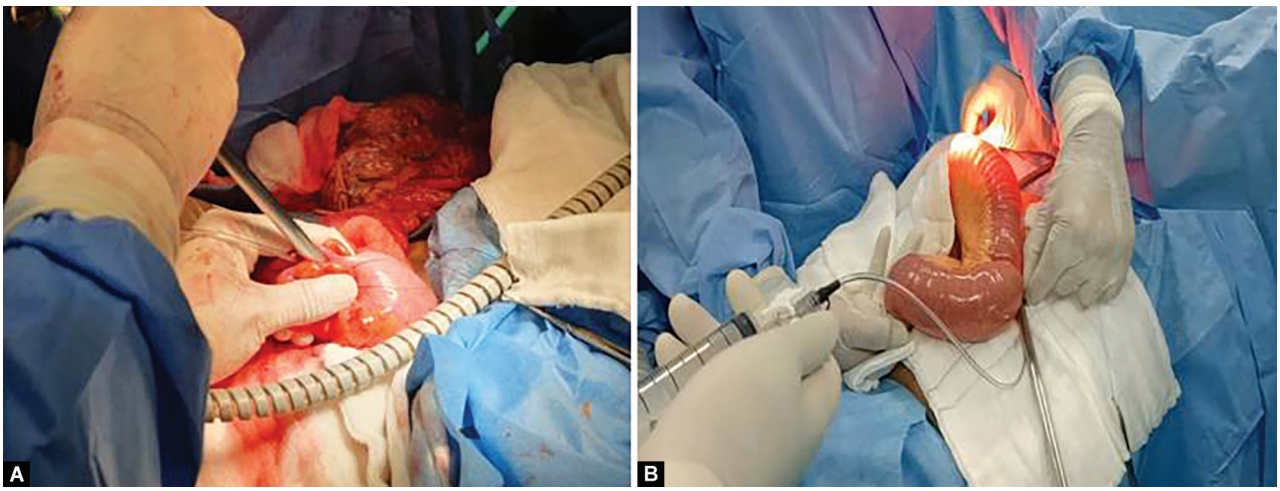
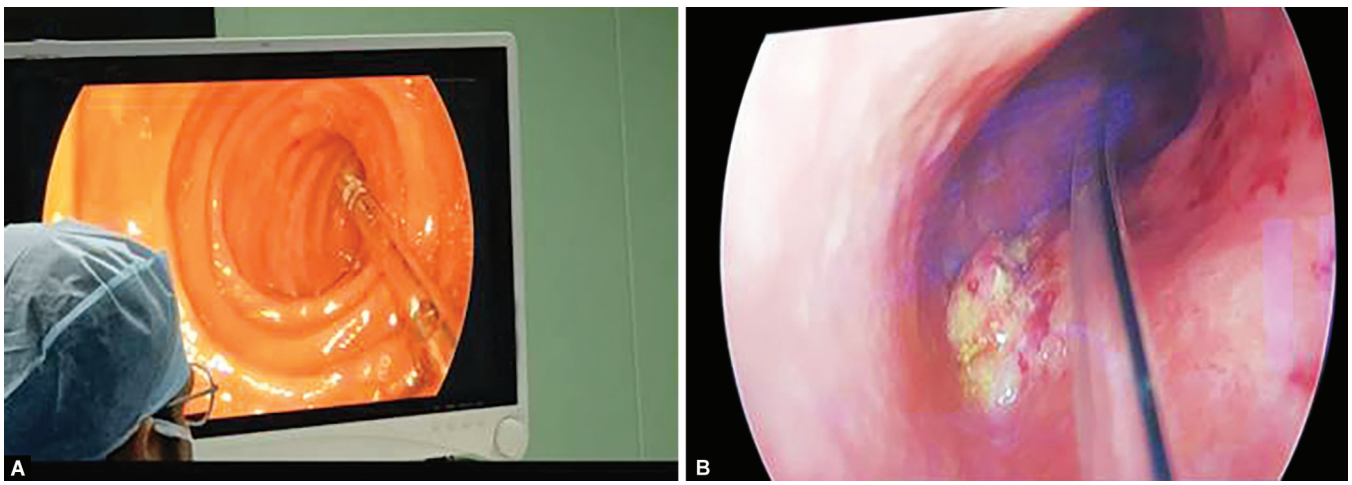


Figs 1A and B: (A) An intestinal clamp is applied distal to the area of interest; (B) A 30-degree laparoscope is inserted along with a 10 French infant feeding tube



Figs 2A and B: (A) Insufflation of CO_2 gas through insulator; (B) Insufflation of air through 50 mL syringe with three-way stop cock



Figs 3A and B: (A) Laproendoscopic view showing a high definition view of the small intestine; (B) Laproendoscopic view showing lesion in the sigmoid colon

to obstruction, large bowel due to an obstructing growth, or due to other factors as mentioned earlier. Though VCE plays a role in patients without intestinal obstruction, a successful study can be conducted in 79–90% of patients, with a diagnostic yield of 38–83% in patients with suspected small bowel bleeding.[2] According to the American College of Gastroenterology, the term "obscure GI bleeding" should be reserved for patients not found to have a source of bleeding after performance of standard upper and lower endoscopic examinations, small-bowel evaluation with VCE and/or enteroscopy, and radiographic testing" and then recommends IOBE when the above fails.[3] Intraoperative bowel endoscopy also has a role in evaluating the large bowel inaccessible by colonoscopy. The integrity of an anastomosis can very well be visualized by IOBE.[4] The rigid 30° laparoscope scope due to its angulation allows better high-definition (HD) visualization of bowel lumen when compared with flexible endoscopes that are conventionally end-on view scopes. We have described an easy-to-do and novel technique that can be done by the operating surgeon with basic laparoscopic skills which is part of the surgical training curriculum. Others have described a laparoscope insertion along with a port.[5] Here, we have described the technique without a port and use of infant feeding tubes instead. So, it is easy to maneuver and is less cumbersome. Our technique is cost-effective as there is no need for extra medical personnel or flexible endoscopes and we are using rigid laparoscopes, which are easily available in most operating rooms (ORs). There are certain limitations wherein if the length of the bowel to be evaluated is not accessible by a rigid laparoscope or when negotiating tight turns, especially if fixed like splenic or hepatic flexures of the colon, then conventional flexible endoscopy is required.

Clinical Significance

This article describes our innovative intraoperative technique which is feasible and effective to localize the site of bleeding or the lesion. This may play an important role in the evaluation of the bowel for various indications.

Supplementary Materials

The supplementary video 1 is available online on the website of https://www.wjols.com/journalDetails/WJOLS.

Video 1: Novel technique of laparo-endoscopy.

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