ISSN (Print): 2663-9491 ISSN (Online): 2789-6897

Original Article

Evaluation of Security of Roeder's Knot in Laparoscopic Appendicectomy and Cholecystectomy

DOI: dx.doi.org

Md Shahinur Rahman[1*], Khalid Hassan[2], Md Saifullah Kabir[3], Md Shaha Alam Sarker[4], Md Abul Kalam Azad[5]

Received: 21 November 2023
Accepted: 26 November 2023
Published: 28 November 2023

Published by:
Sheikh Sayera Khatun Medical College (SSKMC), Gopalganj, Bangladesh

*Corresponding Author

ABSTRACT

Introduction: *Laparoscopic surgery has gained significant attention in recent years due to its suitability for the treatment of appendix and gallbladder diseases, offering a less invasive surgical approach. The practical application of laparoscopic appendicectomy and cholecystectomy presents several advantages.* ***Aim of the study:*** *This study aimed to evaluate the security of Roeder's knot in laparoscopic appendicectomy and cholecystectomy.* ***Methods and materials:*** *This was an experimental study that was conducted at the Department of Surgery in Jahurul Islam Medical College & Hospital, Kishorgonj, Bangladesh from Jan 2020 to Dec 2021. A total of 100 patients undergoing laparoscopic appendicectomy and cholecystectomy admitted in the Surgery ward of the mentioned hospital were enrolled in this study as the study subjects purposively. For data analysis, MS Office tools and SPSS Version 23.0 were applied.* ***Results:*** *Among the total patients who underwent laparoscopic appendicectomy, 94.3% had a smooth recovery without complications, while 5.7% experienced complications. On the other hand, among the total patients who underwent laparoscopic cholecystectomy, 90% had an uneventful recovery, and 10% experienced complications. Regarding the time required to perform Roeder's knot, the mean duration for laparoscopic appendicectomy was 50±3.40 seconds, while for laparoscopic cholecystectomy, it was 125±7.90 seconds.* ***Conclusion:*** *The security of Roeder's knot in stump closure in laparoscopic appendicectomy and cholecystectomy is sufficient which is evident by the lower*

(The Insight 2023; 6(1): 178-186)

1. *Assistant Professor, Department of Surgery, Sheikh Hasina Medical College, Jamalpur, Bangladesh*
2. *Assistant Registrar, Department of Surgery, Mymensingh Medical College Hospital, Dhaka, Bangladesh*
3. *Assistant Professor, Department of Surgery, Sheikh Hasina Medical College, Jamalpur, Bangladesh*
4. *Assistant Professor, Department of Surgery, Jahurul Islam Medical College, Kishoregonj, Bangladesh*
5. *Assistant Professor, Department of Surgery, Dhaka Medical College, Dhaka, Bangladesh*

rate of stump leakage and complication rate.

Keywords: *Security, Roeder's knot, Laparoscopic appendicectomy, Cholecystectomy, Stump leakage*

INTRODUCTION

Laparoscopic surgery has gained significant attention, particularly for treating conditions like appendix and gallbladder diseases, as it offers a less invasive approach to surgery. The practical application of laparoscopic appendicectomy and cholecystectomy provides numerous benefits, including: a) Significant reduction in postoperative pain, reduced need for analgesia, and decreased risk of wound infections. b) Faster return to normal activities and shorter hospital stays. c) Quicker overall recovery [1]. In laparoscopic surgery, tying knots within the abdominal cavity is a critical concern because knots represent the weakest and most sensitive point in surgical sutures. Closing the base of the appendix and the stump of the cystic duct is crucial to prevent postoperative intra-abdominal infections, fecal fistulas, biliary peritonitis, and surgical site infections, both in open and laparoscopic procedures [2]. In the face of the challenges and difficulties associated with intra-corporeal knot tying during laparoscopic surgery, surgeons often opt to avoid suturing within the body and instead utilize GIA staplers, metallic endoclips, and extracorporeal sliding knots. While stapling devices and endoclips can be effective, they may not always be suitable for ligating a broad base of the appendix or a dilated cystic duct, making traditional knot-tying techniques necessary [3]. Laparoscopic surgery has emerged as the gold standard in various medical fields, particularly in reproductive (especially gynecological) and digestive procedures like cholecystectomy and appendicectomy. Significant advancements in surgical training, along with improvements in instruments, imaging, and surgical techniques, have made laparoscopic surgery a safe and feasible approach for a wide range of medical procedures [4]. Laparoscopic surgery, particularly laparoscopic appendicectomy, has seen a surge in popularity since the 1990s, and in recent years, the number of laparoscopic appendicectomies performed worldwide has significantly increased. However, the debate regarding whether open or laparoscopic appendicectomy is the preferred surgical approach for acute appendicitis continues [5]. The historical timeline of laparoscopic surgery is noteworthy. Carl Langebuch of Germany performed the first cholecystectomy in 1882, and it took over a century for Prof Dr Erich Mühe, also in Germany, to perform the first laparoscopic cholecystectomy in 1985. The development of high-quality video imaging systems has played a pivotal role in enabling the advancement of these new procedures [6,7]. Laparoscopic procedures, including laparoscopic appendicectomy, have been a topic of debate, partly due to their impact on healthcare expenditure. The introduction of novel base closure techniques has added to the overall cost of these procedures. For this reason, experienced surgeons often prefer intra-corporeal or extra-corporeal knotting to

secure the base, as they are considered safer, especially in cases involving friable and inflamed bases [8]. There are various techniques employed for securing the base during laparoscopic surgery, each with its advantages and limitations. Some techniques, like the use of endoscopic linear cutting staplers (Endo-GIA), can be expensive, while others, such as preformed suture loops (endoloops), may not be available in all hospitals. One challenge with the use of metallic clips is that not all surgeons may feel equally confident in their safety [9]. In a study conducted by Sahm and his colleagues, they confirmed that intra-corporeal ligation is a safe and viable alternative to the costly linear stapler or the more affordable end loop technique [10]. Their research found no significant differences in safety and efficacy between these methods. The objective of this current study was to evaluate the security of Roeder's knot in laparoscopic appendicectomy and cholecystectomy.

METHODS AND MATERIALS

This experimental study was conducted at the Department of Surgery at Jahurul Islam Medical College & Hospital in Kishorgonj, Bangladesh, from January 2020 to December 2021. The study included 100 patients who underwent laparoscopic appendicectomy and cholecystectomy and were admitted to the Surgery ward of the hospital. Sample selection was done using a purposive sampling technique. The study received approval from the hospital's ethical committee, and all participants provided written consent before data collection. The inclusion criteria for this study encompassed patients who underwent laparoscopic appendicectomy and cholecystectomy and had Roeder's knot used to secure the stump. Exclusion criteria included patients who did not have Roeder's knot used, as well as patients with acute appendicitis with peritonitis and those with empyema gall bladder. Demographic and clinical information of the participants was meticulously recorded, and data analysis was carried out using MS Excel and SPSS version 23.0 as required.

RESULTS

In this study of 100 patients, 70% underwent laparoscopic appendicectomy, while the remaining 30% underwent laparoscopic cholecystectomy. The diagnoses among these patients were distributed as follows: 60% were diagnosed with acute appendicitis, 30% with cholelithiasis (gallstones), and 10% with recurrent appendicitis. The mean age of all the patients in the study was 34.42 years with a standard deviation of 13.80 years. The ages of the patients ranged from a minimum of 18 years to a maximum of 60 years. In this study, it was observed that among all the patients, 55% were male, and 45% were female. When broken down by surgical procedure, in the laparoscopic appendicectomy group, males constituted 65.7%, while females made up 34.3%. In the laparoscopic cholecystectomy group, 30% were male, and 70% were female. Regarding clinical findings, abdominal pain and rebound tenderness were found in 100% of patients in the laparoscopic appendicectomy group, followed by nausea in 94.3% of cases. Dyspepsia was present in 100% of patients in the laparoscopic cholecystectomy group, followed by nausea in 60% and abdominal

pain in 10%. Among the 70 patients who underwent laparoscopic appendicectomy, 94.3% had a smooth recovery without complications, while 5.7% experienced complications. Among the 30 patients who underwent laparoscopic cholecystectomy, 90% had an uneventful recovery and 10% experienced complications. This difference in complication rates between the two procedures was statistically significant ($p<0.05$). In our current study, it was noted that the most common complication in both surgical groups was wound infection. The distribution of other complications was similar between the two types of operations. Regarding the time required to perform Roeder's knot, the mean duration for laparoscopic appendicectomy was 50±3.40 seconds, while for laparoscopic cholecystectomy, it was 125±7.90 seconds. In terms of the investigation profile, the mean hemoglobin levels (g/dl) were 13.09±1.40 for laparoscopic appendicectomy and 12.95±0.92 for laparoscopic cholecystectomy. The mean white blood cell (WBC) count ($\times 10^9$/L) for laparoscopic appendicectomy was 10,704.28 ±2,415.43, and for laparoscopic cholecystectomy, it was 7,630±806.07.

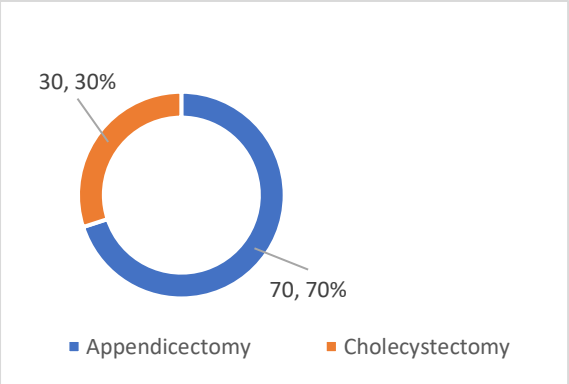

Figure 1: Distribution of patients according to operation done (N=100)

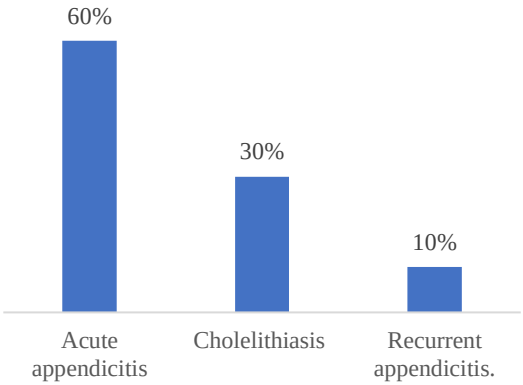

Figure 2: Distribution of patients according to diagnosis

Table I: Distribution of patients according to gender

Gender	Appendicectomy (n=70)		Cholecystectomy (n=30)		Total
	n	%	n	%	
Male	46	66%	9	30%	55
Female	24	34%	21	70%	45

Table II: Clinical findings of the patients

Clinical findings	Appendicectomy (n=70)		Cholecystectomy (n-30)	
	n	%	n	%
Abdominal pain	70	100%	3	10%
Vomiting	56	80%	0	0%
Nausea	66	94.30%	18	60%
Dyspepsia	0	0%	30	100%
Fever	60	85.70%	0	0%
Tachycardia	60	85.70%	0	0%
Rebound tenderness	70	100%	0	0%
Raised temperature	60	85.70%	0	0%

Table III: Distribution of outcome in relation to operation done

Outcome	Appendicectomy n=70		Cholecystectomy n=30		p-value
	n	%	n	%	
Recovery	66	94.30%	27	90%	<0.001
Complication	4	5.70%	3	10%	

Table IV: Distribution of complications in relation to operation done

Complications	Appendicectomy (n=70)		Cholecystectomy (n=30)		p-value
	n	%	n	%	
Wound infection	4	5.71%	3	10%	0.287
Postoperative ileus	0	0%	1	3.33%	0.27
Stump leakage	1	1.42%	2	6.66%	0.175
Peritonitis	1	1.42%	1	3.33%	0.27
Fecal fistula	1	1.42%	0	0%	0.27
Basal atelectasis	2	2.85	2	6.66%	0.19
Sepsis	3	4.28%	1	3.33%	0.34
Pneumonia	2	2.85%	2	6.66%	0.19

Table V: Time required to perform the knot

Appendicectomy	Cholecystectomy
(n=70)	(n=30)
Mean± SD tine (Sec.)	
50±3.40	125±7.90

Table VI: Distribution of patients according to investigation profile

Diagnostic profile	Appendicectomy (n=70) Mean± SD	Cholecystectomy (n=30) Mean± SD
Hemoglobin (g/dl)	13.09±1.40	12.95±0.92
WBC count ($\times 10^9$/L)	10704.28±2415.43	7630±806.07
Neutrophil (%)	75.95±4.06	65.5±3.31
Serum creatinine (mg/dl)	0.96±0.16	0.98±0.10
Blood urea (mg/dl)	16.50±2.04	17.70±1.82

DISCUSSION

This study aimed to evaluate the security of Roeder's knot in laparoscopic appendicectomy and cholecystectomy. In this study, 100 patients were analyzed, with 60% diagnosed with acute appendicitis, 30% with cholelithiasis, and 10% with recurrent appendicitis. Among the patients, 70% underwent laparoscopic appendicectomy, and 30% underwent laparoscopic cholecystectomy. This distribution may be attributed to the higher incidence of appendicitis in the Bangladeshi population compared to cholecystitis, as reported in a study by Bhasin et al., which found a prevalence of 0.95% for appendicectomy and 0.92% for cholecystectomy in an urban population of East Delhi [11]. In this study, 65.7% of patients in laparoscopic appendicectomy were male, and 34.3% were female. In laparoscopic cholecystectomy, 30% were male, and 70% were female. These gender distributions align with existing research, such as Nshuti et al. reporting a male-to-female ratio of 1.6:1 for appendicitis, and Elizabeth et al. noting that acute cholecystitis is 1.5 times more common in women than in men [12, 13]. Thus, these findings support the observed gender predominance in patients undergoing laparoscopic appendicectomy and laparoscopic cholecystectomy. In the laparoscopic appendicectomy group, 100% of patients experienced abdominal pain and rebound tenderness, followed by nausea (94.3%), fever (85.7%), tachycardia (85.7%), vomiting (80%), and elevated temperature (85.7%). In contrast, the laparoscopic cholecystectomy group primarily presented with dyspepsia (100%), with nausea (60%) and abdominal pain (10%) as secondary symptoms. This aligns with Nshuti et al.'s findings in their study, where the main symptoms in acute appendicitis included right iliac fossa pain (95%), nausea (80%), and vomiting (73%). Only 31% of patients provided a typical history of vague peri-umbilical pain at the onset of symptoms, and fever was present in 15% of cases [12]. Another study suggested that initial pain in patients may arise as a referred symptom due to the visceral innervation of the midgut, and localized pain occurs as the inflammatory process progresses and involves the parietal peritoneum [14]. The study by Knab et al. corroborated the findings of this study. Knab et al. reported that the majority of patients presenting with acute cholecystitis experience symptoms such as right upper quadrant or epigastric abdominal pain, nausea, vomiting, and anorexia [15]. Additionally, they found that only 32% to 53% of patients have a fever

at the time of presentation, which aligns with the observations in this study. In our study, 94.3% of the 70 patients who underwent laparoscopic appendicectomy recovered without any complications, while 5.7% developed complications. Similarly, among the 30 patients who underwent laparoscopic cholecystectomy, 90% had a complication-free recovery, and 10% experienced complications. The difference in complication rates between the two procedures was statistically significant ($p<0.05$). Ashraf et al. conducted a study and reported that laparoscopic appendicectomy had excellent outcomes with 0% mortality, minimal blood loss, and a low wound infection rate of 8.3%. They also reported an intraabdominal abscess rate of 6.8% in laparoscopic appendicectomy [16]. On the other hand, Al-Mulhim et al. studied 968 patients who underwent laparoscopic cholecystectomy and found that most patients recovered well, with a complication rate of 4.03% [17]. These findings differ somewhat from our study, possibly due to variations in surgical facilities, sterilization procedures, and maintenance protocols. Among the 100 patients in our study, wound infection was the most common postoperative infection. In the laparoscopic appendectomy group, 5.71% of patients had wound infections, while stump leakage, peritonitis, fecal fistula, basal atelectasis, and pneumonia each had lower occurrence rates ranging from 1.42% to 2.85%. Among those who underwent laparoscopic cholecystectomy, 10% developed wound infections, while postoperative ileus, stump leakage, peritonitis, basal atelectasis, and pneumonia had rates of 3.3% to 6.66%. Other complications were distributed similarly in both types of operations. Gupta et al. conducted a study with 175 patients and found that only three patients had significant postoperative infectious complications, which included one wound infection and two cases of intra-abdominal abscesses [18]. In a study conducted by Al-Mulhim et al., which included 968 patients who underwent laparoscopic cholecystectomy, complications were reported at a low rate, such as wound hematoma in 0.31% of cases, atelectasis in 0.41% of cases, wound infection in 1.7% of cases, epigastric port site hernia in 0.31% of cases, bile leak in 0.31% of cases, and collection in the pouch of Morrison in 1.9% of cases. These findings differ from the results of our study [16]. In our study of 100 patients, we found that the type of operation was significantly associated with the length of hospital stay. Although the median hospital stay was the same in both types of operations, patients undergoing laparoscopic cholecystectomy stayed in the hospital significantly longer than patients undergoing laparoscopic appendicectomy ($p<0.05$). Another study by Kassem et al. reported that the mean length of hospital stay was 5.3 ± 2.1 days for laparoscopic appendicectomy patients [19]. In our study, we used 1.0 RB Vicryl sutures, which cost 220 Taka and are cheaper and more cost-effective than titanium endoclips. Laparoscopy is widely regarded as the preferred method for treating cholecystitis and appendicitis worldwide [20]. The clinical experience has validated the safety and ease of execution of Roeder's knot. This technique offers distinct advantages, including execution through a 5.5mm cannula and precise knot placement. It also requires less mobilization of the base of the appendix,

meso appendix, cystic duct, and cystic artery, making it a practical choice for patients with recurrent appendicitis, chronic cholecystitis, and a shortened cystic duct. Laparoscopic Roeder's knot can be safely used to treat acute complicated appendicitis, even in the presence of a large purulent abscess or diffuse peritonitis. It is also a viable option for managing gangrenous or perforated cholecystitis.

Limitation of the study:

The study conducted at a single center with a small sample size and over a short period of time may have limitations in terms of its representativeness for the entire population or country. These findings may not provide a comprehensive view of the broader situation.

CONCLUSION & RECOMMENDATION

The study suggests that Roeder's knot is a secure method for stump closure in laparoscopic appendicectomy and cholecystectomy, as evidenced by lower rates of stump leakage and complications. It indicates that Roeder's knot might be a relatively safer option for laparoscopic appendicectomy compared to cholecystectomy. However, further research is needed to draw a definitive conclusion.

Funding: No funding sources
Conflict of interest: None declared

REFERENCES

1. *Champault A, Polliand C, da Costa PM, Champault G. Laparoscopic appendectomies: retrospective study of 2074 cases. Surgical Laparoscopy Endoscopy & Percutaneous Techniques. 2008 Apr 1;18(2):168-72.*
2. *Kiudelis M, Ignatavicius P, Zviniene K, Grizas S. Analysis of intracorporeal knotting with invaginating suture versus endoloops in appendiceal stump closure. Videosurgery and Other Miniinvasive Techniques. 2013 Mar 1;8(1):69-73.*
3. *Abou-Sheishaa MS, Negm A, Abdelhalim M, Abbas A, Ibrahim M, Elghadban H. Ligation versus clipping of the appendicular stump in laparoscopic appendectomy: a randomized controlled trial. Ann Emerg Surg. 2018;3(1):1029.*
4. *Buia A, Stockhausen F, Hanisch E. Laparoscopic surgery: A qualified systematic review. World journal of methodology. 2015 Dec 12;5(4):238.*
5. *Piccinni G, Sciusco A, Gurrado A, Lissidini G, Testini M. The "BASE-FIRST" technique in laparoscopic appendectomy. Journal of Minimal Access Surgery. 2012 Jan;8(1):6.*
6. *Reynolds Jr W. The first laparoscopic cholecystectomy. JSLS: Journal of the Society of Laparoendoscopic Surgeons. 2001 Jan;5(1):89.*
7. *Monson JR. Advanced techniques in abdominal surgery. British Medical Journal. 1993 Nov 20;307(6915):1346-50.*
8. *Nadeem M, Khan SM, Ali S, Shafiq M, Elahi MW, Abdullah F, Hussain I. Comparison of extra-corporeal knot-tying suture and metallic endo-clips in laparoscopic appendiceal stump closure in uncomplicated acute appendicitis. International Journal of Surgery Open. 2016 Jan 1;2:11-4.*
9. *Abou-Sheishaa MS, Negm A, Abdelhalim M, Abbas A, Ibrahim M, Elghadban H. Ligation versus clipping of the appendicular stump in laparoscopic appendectomy: a randomized controlled trial. Ann Emerg Surg. 2018;3(1):1029.*
10. *Sahm M, Kube R, Schmidt S, Ritter C, Pross M, Lippert H. Current analysis of endoloops in appendiceal stump closure. Surgical endoscopy. 2011 Jan;25:124-9.*
11. *Bhasin SK, Roy R, Agrawal S, Sharma R. An epidemiological study of major surgical procedures in an urban*

population of East Delhi. Indian Journal of Surgery. 2011 Apr;73:131-5.

12. *Nshuti R, Kruger D, Luvhengo TE. Clinical presentation of acute appendicitis in adults at the Chris Hani Baragwanath academic hospital. International journal of emergency medicine. 2014 Dec;7:1-6.*
13. *Fialkowski E, Halpin V, Whitney RR. Acute Cholecystitis.2008;2008*
14. *Petroianu A. Diagnosis of acute appendicitis. International Journal of Surgery. 2012 Jan 1;10(3):115-9.*
15. *Knab LM, Boller A-M, Mahvi DM. Cholecystitis. Surg Clin North Am; 94 (2):455–70.*
16. *Mohamed AA, Mahran KM. Laparoscopic appendectomy in complicated appendicitis: Is it safe?. Journal of minimal access surgery. 2013 Apr;9(2):55.*
17. *Al-Mulhim AS, Amin TT. Outcome of laparoscopic cholecystectomy at a secondary level of care in Saudi Arabia. Saudi journal of gastroenterology: official journal of the Saudi Gastroenterology Association. 2011 Jan;17(1):47.*
18. *Gupta R, Sample C, Bamehriz F, Birch DW. Infectious complications following laparoscopic appendectomy. Canadian journal of surgery. 2006 Dec;49(6):397.*
19. *Kassem R, Shreef K, Khalifa M. Effects and clinical outcomes of laparoscopic appendectomy in young children with complicated appendicitis: a case series. The Egyptian Journal of Surgery. 2017 Apr 1;36(2):152-5.*
20. *Mandrioli M, Inaba K, Piccinini A, Biscardi A, Sartelli M, Agresta F, Catena F, Cirocchi R, Jovine E, Tugnoli G, Di Saverio S. Advances in laparoscopy for acute care surgery and trauma. World journal of gastroenterology. 2016 Jan 1;22(2):668.*