The Egyptian Journal of Hospital Medicine (January 2023) Vol. 90, Page 768-774

Management of Complicated Acute Appendicitis in Adults: Laparoscopic versus Open Appendectomy

Yasser Baz[1], Yasser A. Orban*[2], Ibrahim A. Heggy[2]
[1]Department of Surgery, Faculty of Medicine Helwan University, Egypt
[2]Department of Surgery, Faculty of Medicine, Zagazig University, Egypt
***Corresponding author:** Yasser A. Orban, **Mobile:** (+20)01002428734, **Email:** yasser_ali_orban@yahoo.com

ABSTRACT

Background: Nowadays laparoscopic appendectomy (LA) is the management of choice for acute appendicitis (AA) in simple, uncomplicated cases. For complicated acute appendicitis (CAA), laparoscopic or conventional open appendectomy (OA) is still in debate.

Objective: This study aimed to compare minimally invasive LA and traditional OA in CAA cases.

Methods: In this study, 44 patients with CAA (22 for LA and 22 for OA) with 18 years of age or older were enrolled. It was conducted in General Surgery Department, Helwan University Hospital.

Results: The operative time difference between the LA and OA groups was statistically significant (18.5 minutes shorter in the OA group, ($p<0.001$). The median length of hospital stay, return to normal activity, and patient satisfaction were significantly better in the LA group (p-values of 0.001, 0.00, and 0.14 respectively). The need for analgesics in the LA group was significantly lower than in the OA group. There were no detectable statistically significant findings concerning the occurrence of surgical findings, postoperative vomiting, postoperative ileus, wound infection, wound dehiscence, or postoperative intra-abdominal collection.

Conclusions: Laparoscopic appendectomy management of CAA is feasible, safe, and has numerous advantages over the traditional open procedure in terms of reducing postoperative pain, requiring fewer analgesics, shortening the postoperative hospital stay, having a low incidence of postoperative infectious complications, and allowing a rapid return to daily activities with improved comfort and satisfaction.

Keywords: Laparoscopic appendectomy, Complicated appendicitis, Open appendectomy.

INTRODUCTION

Acute appendicitis (AA) is among the most prevalent abdominal surgery emergencies worldwide **(1).** It is most often seen in patients between 10 and 30 years old **(2).** If neglected, AA ultimately complicates (20–30%), leading to gangrene, perforation, local peritonitis, or diffuse peritonitis, among other potentially serious problems **(3-7).** The diagnosis of complicated acute appendicitis (CAA) is primarily built on a combination of clinical suspicion of AA progression of severity, inflammatory laboratory blood markers, and pelvi-abdominal imaging such as ultrasonography (US) and computed tomography (CT) **(6-9).**

The optimal treatment of CAA remains indeterminate **(10)**. CAA is associated with more risk of postoperative morbidity and mortality and has been delineated as a relative contraindication for LA. Nevertheless, this conception has been faced by some authors. There is a lack of good evidence-based support for the LA approach for CAA **(11-13).** On review of the literature, most research studies were retrospective and involved heterogeneous groups of cases **(7)**. We assumed that laparoscopy is superior to traditional OA in the management of CAA, and our purpose of this investigation was to compare the outcomes of LA versus OA in cases with CAA in terms of the operative time, perioperative morbidity, hospital stay, time to return to daily activities, and patients' satisfaction.

PATIENTS AND METHODS

Between January 2021 and March 2022, 44 participants were involved in this prospective, randomized-controlled study comparing laparoscopic and open appendectomy in adults (18 and older). Using the closed-envelope randomization approach, the patients were divided randomly into 2 groups, with 22 participants in the LA group and 22 in the OA group. It took place at General Surgery Department, Helwan University Hospitals.

Criteria for inclusion: The study included adult patients with CAA, defined as perforated AA, gangrenous AA, and a walled-off abscess of localised peritonitis or diffuse peritonitis, by either preoperative or intraoperative diagnosis. Preoperative diagnosis was built on history, thorough clinical examination, participants' laboratory findings, and abdominal US, whereas an abdominal CT scan was saved only for selected cases. However, the intraoperative gross appearance was the basis for the intraoperative diagnosis.

Criteria for exclusion: Non-CAA patients, patients with CAA aged less than 18 years, pregnant females and patients with prior abdominal surgeries. Patients who are unfit or unwilling to participate in the study, or who had their LA converted to open.

Preoperative evaluation: All participants were exposed to complete history taking, general and local clinical examinations, required laboratory tests, and imaging investigations, including abdominal US and CT. Preoperatively, all participants received 1 gram of third-generation cephalosporin and 0.5 gram of Metronidazole intravenously**.**

Received: 01/09/2022
Accepted: 02/11/2022

Operative Technique: All participants who operated with LA had general anesthesia, but those who underwent OA had either spinal or general anesthesia. Preparation and draping of the skin were done.

I - Technique of OA: Abdominal incision was done (lower infra-umbilical midline abdominal or extended McBurney's [14] the splitting of abdominal wall muscles was done in the direction of their fibers.

The peritoneum was incised and entered. Aspiration was done if the peritoneal fluid was found. Wise, gentle finger identification and dissection of the appendix (Figure 1: A, B, and C), and to release any fibrous adhesions and inter-loop adhesions as well as drainage of the pus cavity.

The mesoappendix was divided and ligated. The appendix was double-ligated and divided. Retrograde appendectomy was an option for difficult cases of dissection. An adequate amount of warm saline was used for suction irrigation. Through a separate stab incision, drains were inserted into the pelvic cavity. Absorbable sutures were used to stitch the wound in layers. Non-absorbable sutures were used to close the skin, and a subcutaneous suction drain was used if indicated.

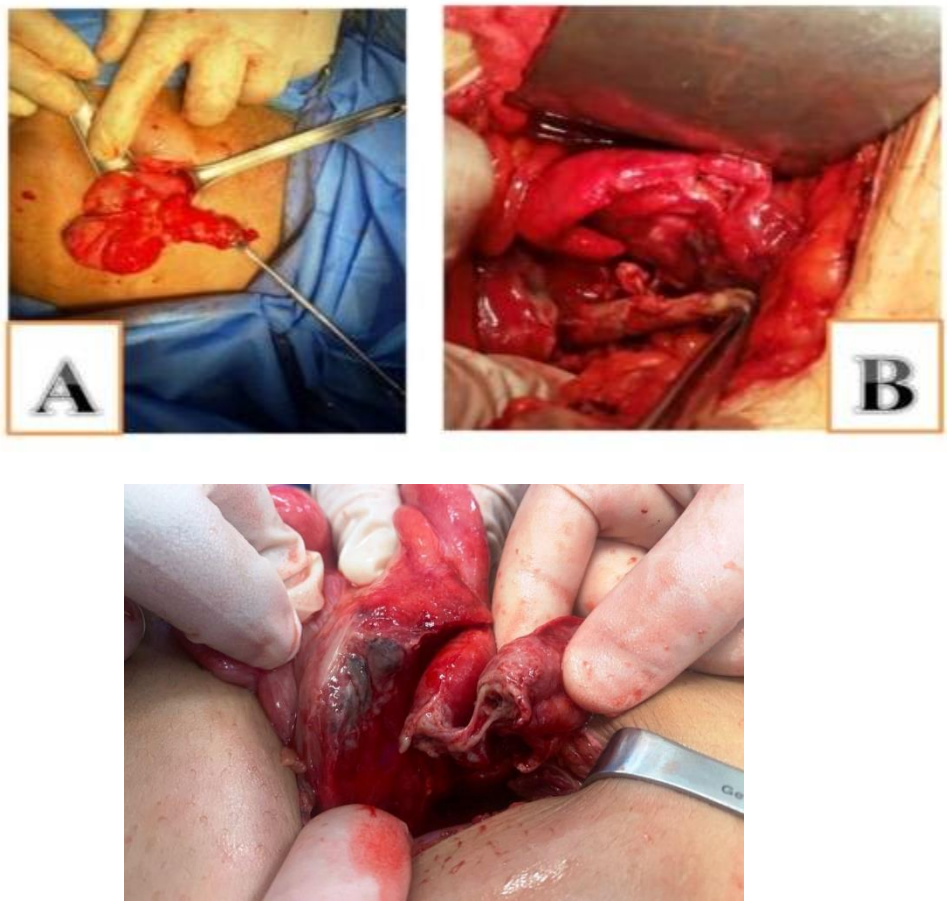

Fig. (1): Dissection of CAA (A, B & C) in OA.

II- Technique of LA: The participant was in supine position with his arms at his side, and the operator stood on the participant's left side with the cameraman assistant (Figure 2).

Fig. (2): Patient and operating team positioning

The operation was done via the three-port technique, with a fourth trocar used if necessary. After pneumoperitoneum creation, insertion of a 10-mm camera port at the umbilicus. Abdominal and pelvic cavity inspections were done. The other two ports were inserted under visualization: one port to the right upper quadrant region (5 mm) and the other third port to the lower left abdominal quadrant at the suprapubic region (10 mm). If purulent fluid was discovered, aspiration was performed (Figure 3 A), as well as appendix retraction towards the abdominal wall (figure 3 B).

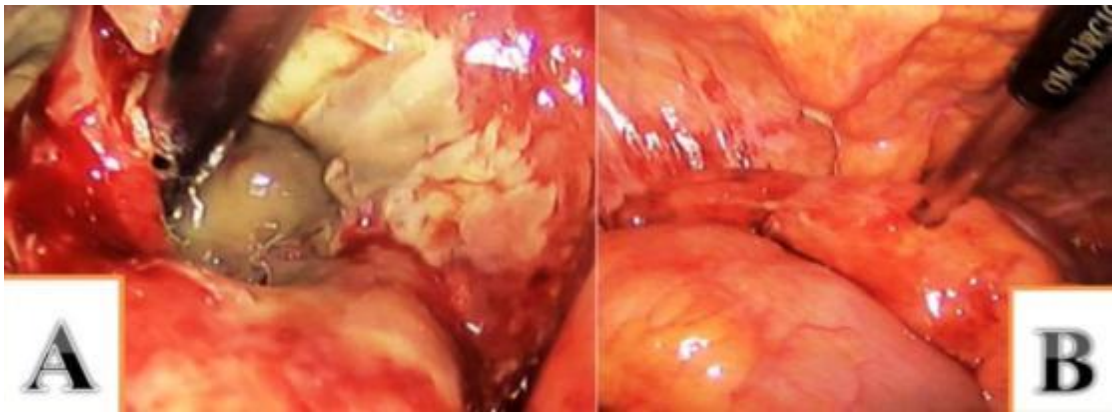

Figure (3): Aspiration of purulent fluid (A) & retraction of appendix (B) in LA for CAA

The mesoappendix was wisely divided from the distal to the base of the appendix using a bipolar, harmonic, or monopolar hook and scissors. The appendix's base will be ligated via intra-corporeal knotting, followed by scissor amputation. The appendix was ejected through the cannula. Inter-loop adhesions were divided, and when they were found, the pus cavity was drained. Suction and irrigation were performed as needed, using adequate worm normal saline. Drains will be left in dependent spaces. The operative field was checked for bowel injuries and hemostasis. Trocars were taken out after the abdomen was deflated. Sutures were used to close the skin.

Postoperative care: Post-operative antibiotics consist of 1 gram of third-generation cephalosporins (Cefotaxime) every 12 hours and 500 mg of Metronidazole every 8 hours, depending on the need. Pain is assessed 24 hours a day using a visual analogue score for pain (VAS), and analgesics (Diclofenac potassium 75 mg I.M. or 50 mg oral) will be given accordingly. Vital signs regular checking started immediately postoperatively. Regular insulin was given to diabetics according to their blood glucose that was checked every 6 hours. Early ambulation was encouraged. Begin oral intake as soon as possible, if it is tolerated, and when intestinal motility regains without signs of leaking stump of the appendix. Every 24 hours, wound care was planned. The amount drained and its color was recorded every 24 hours with bag changes, and when the drained amount was less than 30 ml per 24 hours, the drain could be removed.

Hospital stay and patient discharge:

We discharged the patient when oral feeding and ambulation had sufficiently improved, the participant's temperature, WBC count, and serum CRP started to decrease, and there was no further patient complaint. Pelvi-abdominal ultrasonography had been done with an accepted report. The patient was instructed to connect with us if there were any problems.

Follow-up:

- Weekly for one month for all participants after discharge.
- Follow-up visits were made in the outpatient clinic to assess participant satisfaction and to detect any postoperative complications.

Ethical consent: An approval of the study was obtained from Helwan University Academic and Ethical Committee. After explaining our research objectives, written informed consent was obtained from each study participant. This study was conducted in compliance with the code of ethics of the world medical association (Declaration of Helsinki) for human subjects.

Statistical analysis:

The collected data were analyzed utilizing version 25 of the Statistical Package for Social Services (SPSS). Tables were used to present the data. When the significant probability was equal or less than 0.05 ($P \leq 0.05$), the results were considered statistically significant, but when the P value was greater than 0.05, the results were ruled statistically insignificant.

RESULTS

Age was distributed as 28.73 ± 7.592 for the OA group and 25.32 ± 4.110 years for the LA group, with non-significant differences for age, sex, co-morbidities, surgical findings, postoperative vomiting, postoperative ileus, wound infection, wound dehiscence, and postoperative intra-abdominal collection (Table 1). However, operative time was highly significant (p 0.001), with the OA group being 18.5 minutes shorter than the LA group. Although, the demand for analgesics was significantly lower in the LA group compared to the OA group. The VAS 24-hour pain score was not significantly lower in the LA group (p = 0.005) (Table 2).

Table (1): Clinicopathological characteristics of patients undergoing appendectomy for complicated appendicitis

Characteristics		Open appendectomy (n = 22 (50%))	Laparoscopic appendectomy (*n* =22(50%))	P-value
Sex	Male	15	14	0.500
	Female	7	8	
Co-morbidities	No comorbidity	13	14	0.857
	Smoking	6	4	
	Diabetes	2	2	
	Hypertension	1	2	
Surgical findings	Abscess formation	12	12	0.833
	Gangrenous	5	7	
	Peritonitis	2	1	
	perforation	3	2	
Post-operative vomiting	No	19	20	.500
	Yes	3	2	
Post-operative ileus	No	19	21	.303
	Yes	3	1	
Wound infection	No	17	21	.093
	Yes	5	1	
Wound dehiscence	No	19	22	.116
	Yes	3	0	
Post-operative IAA	No	20	18	0.332
	Yes	2	4	

Table (2): Clinicopathological characteristics of complicated appendicitis in the OA and the LA group

Characteristics	Type of procedure	Mean ± Std. Deviation	
Age	Open	28.73 ± 7.592	.071
	Laparoscopic	25.32 ± 4.110	
Operative time (min)	Open	61.73 ± 6.311	.000
	Laparoscopic	80.23 ± 7.825	
Pain score VAS 24 H	Open	6.59 ± 1.436	.005
	Laparoscopic	5.41 ± 1.182	
Parenteral analgesics (doses/day)	Open	2.23 ± 0.752	.001
	Laparoscopic	1.45 ± 0.671	
Oral analgesics (doses/day)	Open	2.55 ± 0.510	.011
	Laparoscopic	2.18 ± 0.395	
Hospital Stay (day)	Open	3.14 ± 0.990	.001
	Laparoscopic	2.09 ± 0.868	
Return to normal activity (day)	Open	15.91 ± 2.759	.000
	Laparoscopic	12.18 ± 1.918	

Hospital stay period, resuming normal daily activity, and satisfaction of patients were significantly better in the LA group (with corresponding p-values of 0.001, 0.00, and 0.14, respectively) (Tables 2 and 3).

Table (3): Participants' satisfaction in the LA and OA groups post-CAA appendectomy

Participants' satisfaction		Type of appendectomy		p-value
		Open	Laparoscopic	
Satisfaction	Very unsatisfied	5	1	0.014
	Unsatisfied	3	2	
	Neutral	9	7	
	Satisfied	5	10	
	Very satisfied	0	2	

DISCUSSION

One of the utmost common surgical procedures performed worldwide is appendectomy. According to **McBurney's** [14] initial description from 1849, this procedure is often carried out through an open incision. Following **Semm's** [15] initial description in the early 1900s, a laparoscopic technique was presented. Today, LA is widely accepted as a standard treatment for AA, while laparoscopy in complicated appendicitis is still debatable. Numerous studies have compared LA to OA with conflicting results [16-18].

Regarding operative time, the current study revealed that LA necessitated 18.5 minutes more than OA method (P < 0.001), probably as CAA frequently presented with challenging peritonitis and risky intestinal adhesions, which all increased difficulties in laparoscopy non-hand touching manipulation. This is in accordance with **Wang *et al.*** [19] meta-analyses where the time of the LA was 15 minutes longer than for the OA. Similarly, **Yoshiro *et al.*** [20] published that time required for LA was significantly 21 minutes longer than OA. In contrast to an earlier study by **Horvath *et al.*** [21] reported that the operative time required for LA was 4.5 minutes shorter than OA. This is in line with the published finding by **Refaat *et al.*** [22] that the operative time required for LA was 27.38 seconds less than OA. **Galli** [23] data and **Yu *et al.*** [24] investigation reported that OA required more operative time than LA (With a p-value of 0.338).

Some studies found that LA had a longer operative time than OA, while others found that there was a shorter or even no difference [22]. These heterogeneous results might be due to varied operating time criteria and LA experience requirements. However, the operating time was in fact reduced by the enhanced laparoscopic equipment technology and the greater operating staff experience [24, 25].

This study confirms previous findings of many studies: fewer analgesic demands and less postoperative pain with LA, which was confirmed in our study, where the analgesic requirements were significantly lesser in LA than in OA. This is in accordance with **Aziz *et al.*** [26] report where LA cases presented with less pain and less narcotic use postoperatively. Similarly, **Mohamed and his colleagues** [13] published that fewer analgesics were used in LA than OA (P< 0.0001).

Our research investigated post-operative complications of CAA surgery. Regarding postoperative vomiting, postoperative ileus, wound infection, wound dehiscence, postoperative intra-abdominal collection, overall complications were significantly lower in the laparoscopic patients and conservatively managed with nil mortality in both groups of the study. This study didn't show a significant difference between both groups, but it did substantiate less post-operative complication in the LA group except for postoperative intra-abdominal abscess (IAA) formation and that could be clarified on the basis that in LA pneumoperitoneum creation may lead to spread of intraperitoneal infection via opening of spaces [18]. This is consistent with the findings of **Biondi *et al.*** [27] who reported that IAA is more prevalent in LA (9%) paralleled with the OA (4.5%). Similarly, **Horvath *et al.*** [21], described the occurrence of IAA in 2 participants in the OA group while 10 cases develop IAA in the LA group with (p=0.002). In our study, 2 (9%) participants presented with IAA in OA, and 4 cases (18 %) in the LA group had IAA. The incidence of IAA was less in both groups in our study, and there was no statistically significant variance between them. The use of standardized surgical techniques, adequate peri-operative antibiotics, and adequate pre-operative resuscitation may be responsible for this lower incidence. In current everyday practice, IAA development post-CCA appendectomy is a common complication with comparable incidence in LA and OA [17, 18].

In our study, 5 participants experienced postoperative vomiting: 2 (9% of cases) in the LA group and 3 (14% of cases) in the OA group, with the OA group having more cases but no statistically significant difference between the two groups. Similarly, **Aziz and his colleagues** [26] published that there was no statistically significant variance between their study groups regarding vomiting postoperatively, which was less in the LA group (10%) paralleled to the OA group (15%).

The reduction in the occurrence of wound infections is a main benefit of LA. In our work, the LA participants had fewer wound infections postoperatively (4.5%). This could be because the appendix was ejected out inside a disposable retrieval bag and a thorough suction and irrigation of infected turbid fluid via laparoscopy, avoiding direct contact with the port wounds. OA, however, has a higher infection rate (22.7%). This could be due to the incapability to save incision from contamination to avoid contact with both the infected fluid and the appendix. Similarly, outcomes are verified with the **Yu *et al.*** [24] study where LA for CAA had the great benefit of reducing the incidence of surgical wound infections.

According to this study, which supports earlier findings; the postoperative hospital stay was reduced significantly in the LA group, with a mean of 2.090 ± 0.868 days compared to 3.14 ± 0.990 days in the OA group. Return to normal daily practice was quicker in the LA patients, with a mean of 12.18 ± 1.918 days compared to 15.91 ± 2.759 days in the OA group. According to **Horvath *et al.* [21],** (with a p-value of 0.001), the mean number of days for hospital stay in OA patients was 4 days and one day less in LA. Similarly, **Mohamed and his colleagues [13]** found that the mean hospital stay length was 5.3± 2.1 days and 7.2±3.2 days for the LA and OA groups, respectively (p < 0.001**). Yau *et al.* [28]** discovered that the average hospital stay of participants in LA cases was 5 days and 6 days in OA cases (p 0.001). **Yu *et al.* [24]** results disclosed that the hospital stay length period was longer in the OA group than in the LA group (P < 0.0002).

Laparoscopy can therefore be both a therapeutic and diagnostic tool in the event of a challenged CAA diagnosis where it offers a better evaluation of other pelvic and abdominal pathologies, especially in women of reproductive age, and makes assessment of gynecologic pathologies easier and less morbid [2, 29, 30].

Considering those with CAA, the abundant advantages of the laparoscopic approach are shorter operative time, less post-operative pain, low incidence of infectious complications, rapid recovery, shorter hospital stay length and time to start oral feeding, can offer fewer postoperative complications, and better cosmoses [24, 28, 30, 31, 32]**.** But because of the lack of laparoscopic equipment sets in some peripheral hospitals, LA is not widely practiced [30].

Treatment of CAA laparoscopically is safe and feasible [13]**,** with a desirable post-operative course even in high-risk surgical patients and elderly patients [13, 30, 33].

CONCLUSION

Laparoscopic appendectomy management of complicated acute appendicitis is feasible, safe and has numerous advantages over traditional open surgery in terms of reducing postoperative pain, requiring less analgesia, shortening the post-operative stay, having a little incidence of infectious complications, and allowing a rapid return to daily activities with improved comfort and satisfaction.

RECOMENDATION

We recommend LA as the initial management of choice for all patients with CAA, with local irrigation carefully performed to minimize the development of intra-abdominal abscesses. Further investigation would be necessary to clarify the efficiency of LA in the management of CAA.

Financial support and sponsorship: Nil.
Conflict of interest: Nil.

REFERENCES

1. **Ullah S, ALi F, Shi M *et al.* (2022):** Is it time for global adoption endoscopic retrograde appendicitis therapy of acute appendicitis?. Clinics and Research in Hepatology and Gastroenterology, 13: 102049. **doi: 10.1016/j.clinre.2022.102049.**
2. **Katkhouda N (2009)**: Laparoscopic Surgery of the Appendix: In Mastery of Endoscopic and Laparoscopic Surgery 3rd Edition edited by Soper N, Swanstrom L, Eubanks W. Lippincott Williams & Wilkins, Pp: 462-467. https://www.pdfdrive.com/mastery-of-endoscopic-and-laparoscopic-surgery-e158196347.html
3. **Wu Z, Zhao L, Liu Y *et al.* (2022):** Fibrinogen as a Marker of Overall and Complicated Acute Appendicitis: A Systematic Review and Meta-Analysis. Journal of Surgical Research, 280: 19-26.
4. **Sullins V, Lee S (2014):** Appendicitis: In Holcomb G, Murphy J, Ostlie D (eds). Ashcrafts Pediatric Surgery, 6th Ed. Elsevier; Pp: 568–579**.** https://www.academia.edu/50986816/ Pediatric_surgery_Ashcraft_and_Holcomb_7_ed_2020
5. **John M, Kimberly S, Basil A *et al.* (2007):** The appendix.Sabiston Textbook of Surgery, 18th edn. Philadelphia, Pp: 149-163. https://epage.pub/doc/sabiston-textbook-of-surgery-2012-xyl91oj4jy
6. **Dunn J (2012)**: Appendicitis. In: Coran A (ed.) Pediatric Surgery. 7th ed. Elsevier Inc., Pp: 1255–1263. https://www.sciencedirect.com/book/9780323072557/pediatric-surgery
7. **Talha A, El-Haddad H, Ghazal A *et al.* (2020):** Laparoscopic versus open appendectomy for perforated appendicitis in adults: randomized clinical trial. Surgical Endoscopy, 34 (2): 907-14.
8. **Brown R (2014)**: Appendicitis. In Ziegler M, Azizkhan R, von Allmen D (eds). Operative Pediatric Surgery. 2nd ed., McGraw Hill, Pp: 613–631. https://accesssurgery.mhmedical.com/book.aspx?bookID=959
9. **Lloyd A, Abd Elwahab S, Boland M *et al.* (2022):** Acute complicated appendicitis caused by an ingested toothpick–A case report. International Journal of Surgery Case Reports, 25: 106872. doi: 10.1016/j.ijscr.2022.106872.
10. **de Almeida Leite R, de Souza A, Bay C *et al.* (2022):** Delayed Operative Management in Complicated Acute Appendicitis—Is Avoiding Extended Resection Worth the Wait? Results from a Global Cohort Study. Journal of Gastrointestinal Surgery, 21: 1-8.
11. **Arakawa S, Kato H, Asano Y *et al.* (2022):** Emergency appendectomy versus elective appendectomy following conservative treatment for acute appendicitis: a multicenter retrospective clinical study by the Japanese Society for Abdominal Emergency Medicine. Surgery Today, 52 (11): 1607-19.
12. **Martínez-Pérez A, Payá-Llorente C, Santarrufina-Martínez S *et al.* (2021):** Predictors for prolonged length of stay after laparoscopic appendectomy for complicated acute appendicitis in adults. Surgical Endoscopy, 35 (7): 3628-35.
13. **Mohamed A, Mahran K (2013):** Laparoscopic appendectomy in complicated appendicitis: Is it safe? J Minim Access Surg., 9 (2): 55-8.

14. **McBurney C (1894):** The incision made in the abdominal wall in cases of appendicitis, with a description of a new method of operating. Annals of Surgery, 20 (1): 38-43.
15. **Semm K (1983):** Endoscopic appendectomy. Endoscopy, 15 (02): 59-64.
16. **Svensson J, Patkova B, Almström M (2016)**: Outcome after introduction of laparoscopic appendectomy in children: A cohort study. Journal of Pediatric Surgery, 51 (3): 449–453.
17. **Zamaray B, de Boer M, Popal Z *et al.* (2022):** AbcApp: incidence of intra-abdominal ABsCesses following laparoscopic vs. open APP endectomy in complicated appendicitis. Surgical Endoscopy, 6: 1-6**.**
18. **Fadl E, Amer A, Abdelrahim H (2022):** Is Abdominal Drain Necessary after Laparoscopic Appendectomy for Complicated Appendicitis?. Surg Gastroenterol Oncol., 27 (2): 130-137.
19. **Wang D, Dong T, Shao Y *et al.* (2019):** Laparoscopy versus open appendectomy for elderly patients: A meta-analysis and systematic review. BMC Surgery, 19: 1-11.
20. **Yoshiro T, Shunichiro K, Eiji S *et al.* (2016):** Laparoscopic versus open surgery for complicated appendicitis in adults: a randomized controlled trial. Surg Endosc., 30: 1705- 12.
21. **Horvath P, Lange J, Bachmann R *et al.* (2017):** Comparison of clinical outcome of laparoscopic versus open appendectomy for complicated appendicitis. Surgical Endoscopy, 31 (1): 199-205.
22. **Refaat D, El-Shewail A, Heggy I *et al.* (2021):** Laparoscopic versus Open Appendectomy for Complicated Cases of Acute Appendicitis in Adults. European Journal of Molecular & Clinical Medicine, 8 (04): 2980-2993.
23. **Galli R, Banz V, Fenner H *et al.* (2013):** Laparoscopic approach in perforated appendicitis: increased incidence of surgical site infection? Surgical Endoscopy, 27 (8): 2928-33.
24. **Yu M, Feng Y, Wang W *et al.* (2017):** is laparoscopic appendectomy feasible for complicated appendicitis? A systematic review and meta-analysis. International Journal of Surgery, 40: 187-97.
25. **Botteri E, Ortenzi M, Alemanno G *et al.* (2021):** Laparoscopic Appendectomy Performed by junior SUrgeonS: impact of 3D visualization on surgical outcome. Randomized multicentre clinical trial.(LAPSUS TRIAL). Surgical Endoscopy, 35 (2): 710-7.
26. **Aziz O, Athanasiou T, Tekkis P *et al.* (2006):** Laparoscopic versus open appendectomy in children: A meta-analysis. Annals of Surgery, 243 (1): 17-27.
27. **Biondi A, Di Stefano C, Ferrara F *et al.* (2016):** Laparoscopic versus open appendectomy: a retrospective cohort study assessing outcomes and cost-effectiveness. World Journal of Emergency Surgery, 11: 1-6.
28. **Yau K, Siu W, Tang C *et al.* (2007):** Laparoscopic versus open appendectomy for complicated appendicitis. Journal of the American College of Surgeons, 205 (1): 60-5.
29. **Oravsky M, Bank V and Schnorrer M (2014):** Laparoscopic versus open appendectomy in treatment of acute appendicitis. Bratisl Lek Listy., 115: 660-662.
30. **Werkgartner G, Cerwenka H, El Shabrawi A *et al.* (2015):** Laparoscopic versus open appendectomy for complicated appendicitis in high risk patients. International Journal of Colorectal Disease, 30 (3): 397-401.
31. **Shogilev D, Duus N, Odom S *et al.* (2014):** Diagnosing appendicitis: evidence-based review of the diagnosing approach. The Western Journal of Emergency Medicine, 15 (7): 859-71.
32. **Ball C, Kortbeek J, Kirkpatrick A *et al.* (2004):** Laparoscopic appendectomy for complicated appendicitis: an evaluation of postoperative factors. Surgical Endoscopy, 18 (6): 969-73.
33. **Yang J, Yu K, Li W *et al.* (2017):** Laparoscopic appendectomy for complicated acute appendicitis in the elderly: a single-center experience. Surgical Laparoscopy, Endoscopy & Percutaneous Techniques, 27 (5): 366-8.