ORIGINAL ARTICLE

Laparoscopic vs Open Appendectomy: Surgical Outcomes with Early Recovery and Length of Hospital Stay - A Comparative Study in Rawalpindi, Pakistan

Naeem Yousaf[1*], Nadeem Abbas[2], Wajiha Mehmood[1], Fazal Ur Rehman[3], Rohail Ahmed Abbasi[1]

ABSTRACT

Objective: To compare the surgical outcomes in terms of recovery and complications of laparoscopic versus open appendectomy in patients presenting to tertiary care hospitals in Rawalpindi.

Study Design: Prospective comparative study.

Place and Duration of Study: The study was conducted at the Department of Surgery at Combined Military Hospital (CMH) Rawalpindi, Pakistan from 1st July 2022 to 31st December 2022.

Methods: Seventy patients with clinically and radiologically confirmed acute appendicitis were segregated by lottery method into two equal groups of 35 each. Patients undergoing open appendectomy (OA) were placed in Group A, those planned for laparoscopic appendectomy (LA) were placed in Group B. Pre and postoperative outcomes, including Alvarado score, operating time, postoperative pain, and hospital stay documented and compared between the groups.

Results: A mean age of 28.40 ± 6.73 years in the open appendectomy group and 29.06 ± 9.84 years in the laparoscopic appendectomy group was noted (*P*=0.745). The mean Alvarado score was 7.29 ± 0.95 in Group A and 6.86 ± 1.16 in Group B (*P*=0.098). A statistically significant difference was noted in the mean operation time of 67.29 ± 9.67 minutes for open appendectomy versus 38.77 ± 8.67 minutes for laparoscopic appendectomy (*P* < 0.05). The mean hospital stay was shorter for laparoscopic appendectomy, with 1.51 ± 0.61 days compared to 2.00 ± 0.54 days for open appendectomy (*P* < 0.001).

Conclusion: Laparoscopic appendectomy offered intra- and post-operative advantages like less operating time, shorter hospital stays, and quicker resumption of normal activities.

Keywords: *Alvarado Score, Appendicitis, Appendectomy, Laparoscopy, Length of Stay, Operating Time.*

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Introduction

Acute appendicitis is the acute inflammation of the appendix, often due to blockage of its patency by fecolith, stool, infective agents, or lymphoid hyperplasia.[1] Hospital emergency departments are always receiving patients with various acute life-threatening conditions. Among patients presenting to a surgical emergency, the most commonly reported non-traumatic emergency worldwide is acute appendicitis.[2] In developed countries, the incidence of acute appendicitis peaked during the mid-twentieth century, after which it has steadied. In contrast, newly industrialized countries, like those in Asia, have seen a rise in cases.[3] Researches have pointed out appendicitis being caused by an array of environmental activators, in relation to the industrial development of the society.[3]

The management of appendicitis commences with

[1]*Department of General Surgery*
PNS Shifa Hospital Karachi, Pakistan
[2]*Department of General Surgery*
Islamabad Medical Complex (IMC) Islamabad, Pakistan
[3]*Department of General Surgery*
Combined Military Hospital (CMH) Lahore, Pakistan

Correspondence:
Dr. Naeem Yousaf
Department of General Surgery
PNS Shifa Hospital Karachi, Pakistan
E-mail: naeem3524@yahoo.com

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non-operative care, such as analgesics and antibiotics.[4] Operative treatment involves the surgical removal of the appendix, in the form of appendectomy. Two methods have been advocated to remove the appendix. This includes a more conventional open appendectomy (OA), and a newer, lesser invasive procedure of laparoscopic appendectomy (LA).[5]

Different laparoscopic procedures have been introduced among which, LA has rapidly gained popularity and has become the gold standard for acute as well as chronic appendicitis.[5] LA is favored due to reduced postoperative pain, better more appealing cosmesis after surgical procedure, and improved likelihood of earlier discharge from the hospital.[6]However, it still remains elusive whether LA or OA is the best procedure for patients suffering from acute appendicitis, and is a topic of interest all over the world.[7]

The purpose of this study was to analyze post-surgical outcomes of open and laparoscopic appendectomy procedures amongst the local population of Rawalpindi. This study aims to fill a research gap, as no previous study in Rawalpindi has comprehensively compared these four parameters including Alvarado score, operating time, post-operative pain, and hospital stay duration. Moreover, minimal studies have been conducted in developing countries, where minimally invasive surgery is less popular and where cost and available resources are an important consideration as well. This study will provide additional insight to surgeons in these regions regarding helping them consider laparoscopic options to reduce complications associated with open procedures.

Methods

The study was conducted as a prospective comparative study over a period of 6 months, from 1st July 2022 to 31st Dec 2022 at the Department of Surgery, Combined Military Hospital (CMH) Rawalpindi, Pakistan after taking approval from the Institutional Ethical Committee of the hospital on dated: 10th August 2021 vide letter no: IEC:374/dte10/08/21. The sample size calculated by the online WHO sample size calculator was 62 while taking a confidence level of 95%, a margin of error of 5%, and a prevalence and lifetime appendicitis risk of 5% with the targeted population of Rawalpindi. A total 70 patients fulfilling inclusion criteria were enrolled in the study after taking informed consent. All patients were selected after scrutiny and only those were enrolled in the study who fulfilled the inclusion criteria of clinical and radiological diagnosis of appendicitis.

Inclusion Criteria: Patients of either gender, aged 12-60 years, with clinical and radiological diagnosis of acute appendicitis, planned for open or laparoscopic appendectomy with an Alvarado score of more than 6 were included in the study.

Exclusion Criteria: Patients of age > 60 years, pregnant females, morbid obesity, associated co-morbidities, chronic appendicitis, appendicular mass or ruptured appendix, malignancy, immunocompromised, patients whose surgery was converted from laparoscopic to open appendectomy and those unwilling for inclusion were excluded from the study.

The clinical diagnosis of appendicitis was confirmed after taking a complete history from the patient, relevant clinical examination, calculation of Alvarado score and considering baseline investigations, ultrasonography of abdomen and pelvis, or Contrast Enhanced Computed Tomography of abdomen and pelvis. After confirmation of diagnosis, all patients fulfilling inclusion criteria were divided by lottery method into two groups of 35 each for two interventions being studied comprising: Group A (open appendectomy) and Group B (laparoscopic appendectomy). Baseline investigations including CBC, coagulation profile, LFTs, RFTs, HbA1c, and Hepatitis B & C serology were done in all patients. Pre-anesthesia assessment was sought in all patients.

Group A patient had an open appendectomy under general anesthesia using a classical gridiron incision at McBurney's point and the appendix was removed. Group B patients had Laparoscopic appendectomy under general anesthesia. After creating a pneumoperitoneum using a Veress needle at the umbilicus, a 10mm port and endoscope were placed through the incision, and the diagnosis was confirmed. We used two 5mm ports, one in the right iliac fossa and another in the left iliac fossa, however, port placement may slightly vary according to the position of the appendix. Any local adhesions were gently divided, and the tip of the appendix was

grasped and drawn into the port in the right iliac fossa. The appendix mesentery was occluded with bipolar diathermy and then divided. The base of the appendix is secured with a Roeder knot, occluded, and divided with diathermy. After achieving complete hemostasis, the appendix was removed through the right iliac fossa port. All patients were shifted back to the surgical ward after complete recovery from anesthesia for further observation.

The factors kept under consideration included patients' pre-operative variables such as age, gender, and Alvarado score. Intra-operative variables such as duration of anesthesia, and total operative time were recorded in minutes. Post-operative variables included pain during recovery and pain after 24 hours using the Visual Analogue Scale (VAS), reintroduction of solid and liquid diets, time in days of first activity, and full activity. Patient's hospital stay in days was also documented.

The patients in the two groups were compared considering age, gender, anesthesia duration, operation time, complications that occurred intra-operatively, postoperative visual analogue pain score at day 1, duration of hospital stay, complications in the postoperative period, and the period of reintroduction of solid diet, time of returning to normal and full activity and Alvarado score under consideration. Data was scrutinized statistically using the Statistical Package for Social Sciences version 23.0 (SPSS v23). For quantitative variables the independent sample t test was used, while for qualitative variables, the Chi square test was used to compare the two groups. The p-value for statistical significance and association between categorical variables was calculated using the paired t-test and a *P*-value of ≤ 0.05 was taken as statistically significant.

Results

No statistically significant difference was noted in the age of patients in both groups, with a mean age of 28.40 ± 6.73 years in group A (OA) and 29.06 ± 9.84 years in group B (LA) (*P* = 0.745) which ranged from 12 years as the youngest patient to 58 years as the oldest patient. There were 21 (60.0%) males and 14 (40.0%) females in group A whereas, 20 (57.1%) males and 15 (42.9%) females were in group B (*P* = 0.812). The mean Alvarado score of 7.29 ± 0.95 and 6.86 ± 1.16 was noted in group A and group B respectively (*P*=0.098). (Table-1) (n=70).

The anesthesia time and operating time were also observed per-operatively in both groups which were less in the LA group as compared to the OA group (*P*<0.05). There was a statistically significant difference in the mean operation duration, which was 67.29 ± 9.67 min for OA and 38.77 ± 8.67 min for LA (*P*<0.05). (Figure.1)

Post-operative parameters were also studied and compared between both groups. The postoperative pain quantified using a visual analogue score (VAS) was far less in the LA group than in the OA group. Post-operative return of bowel function, observed by the time of first stool was noted with a mean of 1.54 ± 0.50 days and 1.23 ± 0.42 days in the OA group and LA group respectively (*P*=0.001). There was a statistically significant difference noted in the time of

Table-1: Comparison of Pre-Operative Variables in studied Cohorts

Variables		Group A (OA) (n=35)	Group B (LA) (n=35)	*P*-value
Age (mean years ± S.D)		28.40 ± 6.73	29.06 ± 9.84	0.745
Gender	Male, n (%)	21 (60.0%)	20 (57.1%)	0.812
	Female, n (%)	14 (40.0%)	15 (42.9%)	
Alvarado Score (mean ± S.D)		7.29 ± 0.95	6.86 ± 1.16	0.098

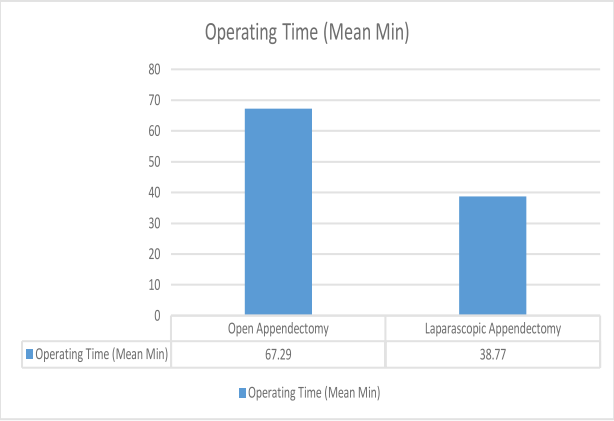

Fig.1: Comparison of Intra-Operative Variables in Studied Cohorts (n=70)

initiation of oral fluids and solids as well as the time required for normal activity and back to work. The mean hospital stays of patients undergoing LA was reduced, as compared to the OA group, with a mean of 1.51 ± 0.61 days in LA, while the mean was 2.00 ± 0.54 days in OA patients (*P*<0.001). (Table 2).

Table-2: Comparison of Post-Operative Variables in Studied Cohorts (n=70)

Variable	Group A (OA) (n=35)	Group B (LA) (n=35)	*P*-value
Post-op Pain in recovery (mean VAS ± S.D)	4.97 ± 0.78	4.40 ± 0.73	0.002
Post-op Pain Day-1 (mean VAS ± S.D)	3.51 ± 0.74	1.91 ± 0.56	< 0.05
Time of first stool (mean days ± S.D)	1.54 ± 0.50	1.23 ± 0.42	0.001
Time of reintroduction of liquids (mean hours ± S.D)	7.26 ± 1.03	6.49 ± 1.19	0.002
Time of reintroduction of solid diet (mean days ± S.D)	1.86 ± 0.55	1.40 ± 0.49	0.001
Time of normal activity (mean days ± S.D)	4.49 ± 0.50	3.03 ± 0.78	< 0.05
Time of full activity (mean days ± S.D)	7.77 ± 1.00	4.80 ± 1.07	< 0.05
Hospital Stay (mean days ± S.D)	2.00 ± 0.54	1.51 ± 0.61	0.001

Discussion

Since its introduction and initial popularity in the 1990s, laparoscopic procedures have been adopted by a majority of surgeons in the surgeries of appendix, gallbladder, and some bariatric procedures. The use of laparoscopy to remove the appendix in acute appendicitis is referred to as laparoscopic appendectomy. Laparoscopic appendectomy is being widely preferred all over the world, as well as nationally, as a better procedure than open appendectomy. It has become known to be less invasive, with shorter hospital stays and cosmetically more appealing results.[6-9] Open appendectomies, though being performed traditionally, lacks such results. However open appendectomy is still widely used in different surgical departments and has shown promising results as well.

Our study showed that a majority of patients who presented with right iliac fossa discomfort and subsequently underwent appendectomy were males 41 (58.6%), which is similar to other studies including a demographic study by Akbulut et al. This may be attributed either to particular etiological factors more prevalent in males and also to misdiagnoses in female patients, as reported by Mahajan p et al. in a retrospective cohort study.[10,11]

For the diagnosis and inclusion criteria, the Alvarado score was used. Our study showed a mean score of 7.29 ± 0.95 in the OA Group A and 6.86 ± 1.16 in the LA Group B respectively, which was in accordance with other studies. Bhuayan el at. concluded in his observational study that the mean Alvarado score was 7.39 ± 0.77 in the Open appendectomy group as compared to 7.52 ± 0.65 in the Laparoscopic group.[12]

Total anesthesia time and operating time were also studied and compared between both groups. The findings indicating lower anesthesia time as well as operating time in LA as compared to OA, and this finding was in agreement with other studies as shown by Khan MS et in a comparative observational study.[13] However, extra stages in the laparoscopic approach, like arrangement of gadgets and devices, insufflation process, insertion of ports, and diagnostic laparoscopy before beginning the actual procedure may prolong the duration of surgery as well.[6]

Post-operative pain was quantified using VAS (Visual Analogue scale), with pain severity measured on a linear scale from 0 to 10 (0 being none and 10 excruciating pain). The study depicting reduced post-op pain in recovery as well as after 24 hours in the laparoscopic group (Figure.2) is similar to the results of a randomized trial conducted by Trejo-Avila ME et al.[14]

The patients may have a bias due to their enthusiasm for a new technique and in order to prevent them from being influenced, only the number of analgesics doses (oral and parenteral) required by individual patients have also been considered in this trial.[14] Similarly post-operative pain especially after twenty-four hours was lesser in the laparoscopic

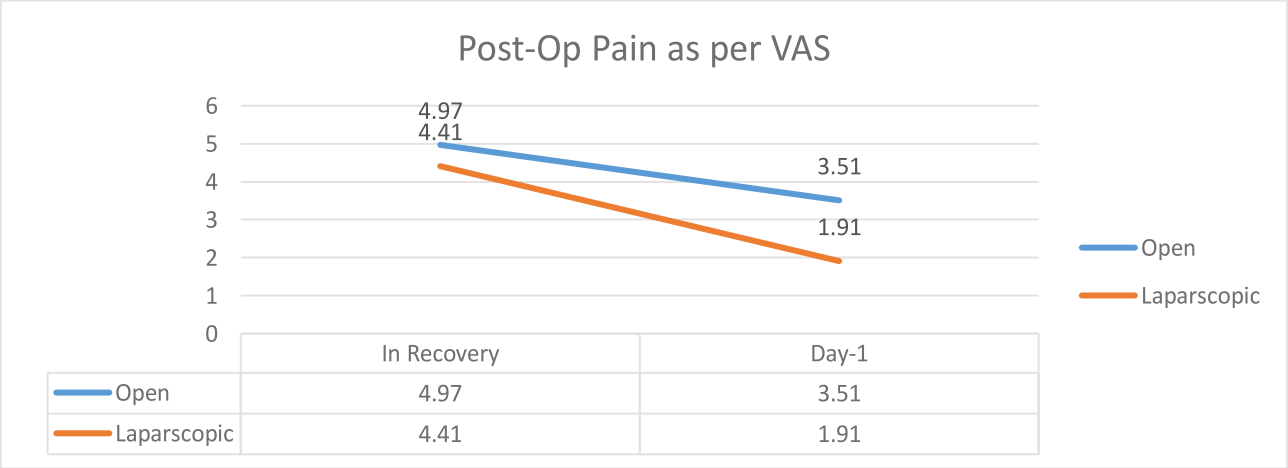

Fig.2: Comparison of Post-Operative Pain in studied groups

appendectomy as opposed to the open appendectomy procedure group as shown in a retrospective study by Rao et al (3.60 vs 4.14; *P*=0.068).[15] Similarly, in another randomized trial by Talha et al. statistically significant difference was observed in post-op pain, lesser requirement of analgesics, duration of hospital stay and return to work time.[16]

The most important post-operative factor is the length of hospital stay, as it has a great impact on economy and the well-being of the patient. It is an important determinant of the effectiveness of any surgical procedure. The total number of days of hospital stay was mean 1.51 ± 0.61 days in laparoscopic appendectomy and mean 2.00 ± 0.54 days in open appendectomy in our study (*P*=0.001). These findings were also demonstrated in a meta-analysis and systemic review by Wand D et al. showing shorter hospital stay post-operatively in laparoscopic appendectomy when compared with open appendectomy surgery.[17] However, Milewczyk et al. demonstrated longer hospital stay in laparoscopic appendectomy for complicated appendectomy, as compared to open appendectomy group.[18]

Our study stated that in OA the return of patient to full activity was around 7.77 ± 1.00 days, while in LA it was 4.80 ± 1.07 days ($P < 0.05$). Also, in a retrospective study by Srinivasalu YP et al. it was observed that there was less time taken to return to ordinary activities and daily routine in laparoscopic appendectomy patients 11.5 ± 3.1 days as compared to a mean 16.1 ± 3.3 days in patients who had undergone conventional open appendectomy.[19]

The laparoscopic surgical technique has an advantage in terms of better post-op cosmetic outcome and patient satisfaction which was observed in this study once patients were inquired post-operatively. It was also demonstrated in an observational study by Ibrahim et al. in which he concluded that Laparoscopic appendectomy was safer, had less operating and recovery time with shorter hospital stay, lower risk of wound infections, early return to work, and had better cosmetic scar and patient satisfaction.[20]

It is reassuring to note that our conclusions are in accordance with many other recent studies on the subject, where surgery was performed on patients belonging to different regions, in different hospital locations, and with different resources.

The limitations of the study are the single-center study and limited sample size. Lack of information regarding body mass index (BMI) of the patients, therefore not studying the role of laparoscopic surgery in obese patients. Furthermore, the patients were monitored till two weeks after discharge from the hospital, and no long-term follow-up of the patients was done; and, in addition, this study was not blinded for treatment outcome and clinical assessment. Hence, further studies including control trials with a larger sample set need to be conducted before implementing results on the general population.

Conclusion

Laparoscopic appendectomy is noted to be an effective surgical technique that provides intra and

post-operative advantages. There was short operating time, short length of hospital stays, less requirement for analgesia during post-op recovery, and earlier return of bowel habits with the early start of oral diets. Also quicker resumption of full normal activity, better cosmetic outcome, and patients satisfaction was observed with Laparoscopic intervention. These findings suggest that laparoscopic appendectomy is a preferable surgical method for treating acute appendicitis where available.

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REFERENCES

1. Guan L, Liu Z, Pan G, Zhang B, Wu Y, Gan T, et al. The global, regional, and national burden of appendicitis in 204 countries and territories, 1990-2019: A systematic analysis from the Global Burden of Disease Study 2019. Bio Medical Central Gastroenterology. 2023; 23: 44-6. doi: 10.1186/s12876-023-02678-7
2. Téoule P, de Laffolie J, Rolle U, Reissfelder C. Acute Appendicitis in Childhood and Adulthood. Deutsches Ärzteblatt International. 2020; 117: 764-4. doi: 10.3238/arztebl.2020.0764
3. Danwang C, Bigna JJ, Tochie JN, Mbonda A, Mbanga CM, Nzalie RN, et al. Global incidence of surgical site infection after appendectomy: a systematic review and meta-analysis. British Medical Journal Open. 2020; 10: e034266. doi: 10.1136/bmjopen-2019-034266
4. Talan DA, Di Saverio S. Treatment of Acute Uncomplicated Appendicitis. New England Journal of Medicine. 2021; 385: 1116-23. doi:10.1056/NEJMcp2107675
5. Bessoff KE, Choi J, Wolff CJ, Kashikar A, Carlos GM, Caddell L, et al. Evidence-based surgery for laparoscopic appendectomy: A stepwise systematic review. Surgery Open Science. 2021; 6: 29-39. doi: 10.1016/j.sopen. 2021. 08.001
6. Kleif J, Thygesen LC, Gögenur I. Moving from an era of open appendectomy to an era of laparoscopic appendectomy: a nationwide cohort study of adult patients undergoing surgery for appendicitis. Scandinavian Journal of Surgery. 2021; 110: 512-9. doi: 10.1177/1457496921992615
7. Taweerutchana V, Suwatthanarak T, Methasate A, Akaraviputh T, Swangsri J, Phalanusitthepha C, et al. Laparoscopic surgery produced less surgical smoke and contamination comparing with open surgery: the pilot study in fresh cadaveric experiment in COVID-19 pandemic. Bio Medical Central Surgery. 2021; 21: 422. doi: 10.1186/s12893-021-01432-8
8. Nikolovski A, Tahir S, Mladenovikj D. Complications after Laparoscopic Appendectomy for Complicated Appendicitis. Lietuvos Chirurgija. 2020; 19: 34-41. doi: 10.15388/Liet Chirur.2020.19.23
9. Moris D, Paulson EK, Pappas TN. Diagnosis and Management of Acute Appendicitis in Adults: A Review. The Journal of American Medical Association. 2021; 326: 2299-311. doi: 10.1001/jama.2021.20502
10. Akbulut S, Bahçe ZŞ, Öztaş T, Gümüş S, Söğütçü N, Sakarya H, et al. Assessment of demographic, clinical and histopathological features of patients who underwent appendectomy due to a presumed diagnosis of acute appendicitis. Turkish Journal of Trauma & Emergency Surgery. 2021; 27: 315-34. doi: 10.14744/tjtes.2020.73537
11. Mahajan P, Basu T, Pai CW, Singh H, Petersen N, Bellolio MF, Gadepalli SK, Kamdar NS. Factors associated with potentially missed diagnosis of appendicitis in the emergency department. The Journal of American Medical Association Network Open. 2020; 3: e200612. doi: 10.1001/jamanetworkopen.2020.0612
12. Bhuiyan MA, Azad MA, Islam MZ. A comparison between laparoscopic and open appendectomy: a study in a tertiary care hospital. Journal of Dental and Medical Sciences. 2020; 19: 37-40. doi: 10.9790/0853-1902183740
13. Khan MS, Khattak IA, Jamil T, Saqib M, Hussain SA, Younis S. Comparison of Laparoscopic Appendectomy with Open Appendectomy with Respect to Surgical Site Infection. Pakistan Journal of Medical & Health Sciences. 2022; 16: 695-7. doi: 10.53350/pjmhs22168695
14. Trejo-Ávila ME, Romero-Loera S, Cárdenas-Lailson E, Blas-Franco M, Delano-Alonso R, Valenzuela-Salazar C, et al. Enhanced recovery after surgery protocol allows ambulatory laparoscopic appendectomy in uncomplicated acute appendicitis: a prospective, randomized trial. Surgical endoscopy. 2019; 33: 429-36. doi: 10.1007/s00464-018-6315-9
15. Rao AD, Tan CBD, Singaporewalla, MD RM. Laparoscopic Appendectomy Translates into Less Analgesics and Faster Return to Work in Asia. Journal of the Society of

Laparoscopic and Robotic Surgeons. 2022; 26: e2022.00006. doi: 10.4293/JSLS.2022.00006

16. Talha A, El-Haddad H, Ghazal AE, Shehata G. Laparoscopic versus open appendectomy for perforated appendicitis in adults: randomized clinical trial. Surgical Endoscopy. 2020; 34: 907–14. doi: 10.1007/s00464-019-06847-2
17. Wang D, Dong T, Shao Y, Gu T, Xu Y, Jiang Y. Laparoscopy versus open appendectomy for elderly patients, a meta-analysis and systematic review. Bio Medical Central Surgery. 2019; 19: 54. doi: 10.1186/s12893-019-0515-7
18. Miyo M, Urabe S, Hyuga S, Nakagawa T, Michiura T, Hayashi N, Yamabe K. Clinical outcomes of single-site laparoscopic interval appendectomy for severe complicated appendicitis: Comparison to conventional emergency appendectomy. Annals of Gastroenterological Surgery. 2019; 3: 561-7. doi: 10.1002/ags3.12277
19. YP S. Comparison between Laparoscopic and open appendectomy: a population-based study. International Journal of Medical Arts. 2022; 4: 2333-8. doi: 10.21608/IJMA.2022.131815.1446
20. Ibraheem M, Sayed AA, Raafat I. A comparative study of laparoscopic and open appendectomy. The Medical Journal of Cairo University. 2021; 89: 155-61. doi: 10.21608/MJCU.2021.153782

Authors Contribution

NY: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proofreading

NA: Study designing, data collection, data analysis, results and interpretation

WM: Idea conception, study designing, data collection, data analysis, results and interpretation, manuscript writing and proofreading

FR: Study designing, data collection

RA: Data analysis, results and interpretation, manuscript writing and proofreading