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Original Article

Evaluation of Laparoscopic Appendectomy in Response to Anatomical Variation of Appendix

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ABSTRACT

Laparoscopic appendectomy also known as minimally invasive surgery has revolutionized the field of surgery by offering patients less invasive alternatives to traditional open procedure. However, anatomical variations in the location of appendix can prove challenging for laparoscopic surgeons. **Objective:** To evaluate the effectiveness and challenges of laparoscopic appendectomy in patients with anatomical variations in the location of the appendix. **Methods:** It was a cross-sectional study conducted at Jinnah international hospital Abbottabad KPK Pakistan from January 2023 to December 2023. After screening through the selected criteria 91 patients were included in this study. Data were entered and analyzed using SPSS version 24.0. P-values of ≤0.05 will be considered statistically significant. **Results:** The mean age of the study population was 49.2 ± 5.4years. Among the 91 patients analyzed, the anterior position was observed in 54 individuals, pelvic position observed in 10 patients, the retrocecal position observed in 19 patients, and the subhepatic position observed in 8 patients. Among patients with a retrocecal appendiceal position 19 (13.6%) experienced appendiceal rupture, while 2.9% had appendiceal bleeding. A notable proportion (11.11%) required conversion to open surgery. Among patients with a subhepatic appendiceal position 8 (17.1%) experienced appendiceal rupture, while 1.9% had appendiceal bleeding. A considerable proportion (12.5%) required conversion to open surgery. **Conclusions:** In conclusion, laparoscopic appendectomy, while advantageous over open surgery in many aspects, presents specific challenges when dealing with anatomical variations of the appendix, particularly in the retrocecal and subhepatic positions. The study found that these variations are associated with higher rates of intraoperative complications and conversion to open surgery.

INTRODUCTION

Laparoscopic surgery, sometimes referred to as minimally invasive surgery, has transformed the field of surgery for patients by offering them less intrusive options that are used instead of conventional open procedures. By using a laparoscope, a small video camera, inserted through a small incision in the patient's skin, that capture a high-quality magnified image of organs within the abdominal cavity enabling them to make precise cuts or other necessary medical manipulations using a screen [1]. Laparoscopic appendectomy is ranked among top emergency surgical procedures globally. Traditionally, appendectomy was performed using an open surgical approach, which involves a larger incision in the abdomen [2]. Laparoscopic appendectomy has grown in popularity since early 2000s due to its significant advantages including smaller incisions than the open method, better cosmetic outcomes, shorter hospital stay durations and lower risks of wound infections [3]. Typically, the appendix is found in the right lower quadrant (RLQ) of the abdomen. It is typically located about one third of the distance between the anterior superior iliac spine (ASIS) and the umbilicus which is also known as McBurney's point [4]. It is the place

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where three bands of longitudinal muscles called taeniae coli converge at the cecum, which is the approximate location. The appendix differs in size and position; some appendices are about 20 cm long, being one of the longest ever recorded [5]. 33% are in retrocecal position but others like pelvic appendix are seen among 28.5% patients as well as ileal which is also present in 14.5% [6, 7]. Appendices are usually fixed in 32% of normal cases and 22.6% of pathological appendices but this position is linked to fixity and complications [8]. Atypical presentations of appendicitis due to anatomical variations can make it difficult to diagnose the ailment. Apparent but mild right lower quadrant pain and tenderness can manifest in retrocecal appendicitis and may easily be confused with renal colic or diverticulitis among other conditions. Moreover, if the appendix is located within the pelvis, typical signs may only arise from the lower parts hence creating confusion when trying to distinguish it from gynecologic or urological problems [9]. A thorough knowledge of their locations is necessary for efficient surgical interventions especially because the anatomical variations in the caecum and appendix can pose diagnostic and surgical challenges [10]. When laparoscopy is used for appendectomy, anatomical variations in the appendix make it a challenge but an understanding of these variations is important in positioning the ports safely and for optimal performance [11]. Studies have shown that laparoscopic appendectomy is safe and suitable for various anatomical positions of the inflamed appendix, with a conversion rate of 4.7% due to other pathologies [12]. The existing literature has scarce information on the effect of anatomical variations to surgical outcomes and complications after doing laparoscopic appendectomy. Moreover, there is little information on best surgical practices in cases of anatomical variations of the appendix during laparoscopy [13]. Long-term follow-up data on patients that have undergone laparoscopic appendectomy for appendicitis with anatomical variations are scarce [14]. Filling these voids in literature will add value by aiding in understanding the difficulties and considerations in lap appendectomy due to anatomical variations of the appendix hence leading to better treatment and operative results.

This research aimed to determine how anatomical variations of the appendix (e.g., retrocecal, pelvic, and subcecal positions) influence surgical parameters such as operative time, intraoperative complications, frequency of conversion to open surgery, hospital stay length, and postoperative complications. The study seeks to provide evidence-based guidelines for managing appendicitis in various anatomical settings, focusing on preoperative imaging, surgical planning, intraoperative techniques, and postoperative care to improve treatment outcomes in complex cases.

METHODS

A cross-sectional study was performed at Jinnah International Hospital Abbottabad, KPK, Pakistan from January 2023 till December 2023 after the approval of Institutional review board (IRB), Jinnah International Hospital, Abbottabad (JIHA/QMS/7611). All patients admitted to surgical ward of Jinnah International Hospital Abbottabad KPK Pakistan within the chosen period were screened for inclusion in this research. Patients of all ages with clinical signs of acute appendicitis (abdominal pain, tenderness, systemic inflammation) who underwent laparoscopic appendectomy were included. Excluded were patients with non-appendicitis diagnoses (e.g., appendiceal tumor, inflammatory bowel disease), incomplete records, missing preoperative imaging, contraindications to laparoscopic surgery (e.g., severe cardiopulmonary disease, coagulopathy, hemodynamic instability), prior abdominal surgery, or complications requiring immediate open surgery. A total of 132 patients were admitted for laparoscopic appendectomy in surgery department and after screening through the selected criteria 91 patients were included in this study. The sample size was calculated by using population proportion 26.3%. The confidence interval of 95% and error margin of 6.5%. The selected sample was provided detailed information about the steps and procedure involved in this study and informed consent was taken. Patients were divided into four groups according to the appendiceal positions (anterior, retrocecal, pelvic and sub-hepatic). All the selected participants were evaluated for demographic variables such as age and gender, clinical variables including BMI, duration of symptoms, vomiting, diarrhea, urinary symptoms, fever, and abdominal pain. Anatomical positions of the appendix (anterior, pelvic, retrocecal, subhepatic) was considered. Intraoperative variables include appendiceal rupture, appendiceal bleeding, conversion to open surgery, and operative time. Postoperative variables were assessed for the duration of analgesia therapy, hospital stay, oral refeeding time, and postoperative complications like bowel obstruction. Descriptive statistics summarized age, operative time, anatomical positions, and complications. Chi-square tests compared intraoperative complications, conversion to open surgery, and postoperative complications among different anatomical positions. One-way ANOVA analyzed differences in operative time and hospital stay length, with Tukey's test for post-hoc comparisons. P-values ≤0.05 were statistically significant, and confidence intervals provided estimate precision. Data were entered and analyzed using SPSS (Statistical Package for the Social Sciences) version 24.0. It was presented as mean, standard deviation, and percentages. P-values of ≤0.05 will be considered statistically significant.

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RESULTS

The result of the study has shown that the mean age of the study population was 49.2 ± 5.4years. In terms of gender distribution, 55 patients (60.44%) were male, while 36 patients (39.56%) were female. The BMI of the study cohort was 28.3 ± 5.6kg/m. Among the included patients, 34 individuals (37.36%) had a documented history of diabetes, while 31 patients (34.07%) had hypertension. Among the 91 patients analyzed, the anterior position was observed in 54 individuals, pelvic position observed in 10 patients, the retrocecal position observed in 19 patients, and the subhepatic position observed in 8 patients (Table 1).

Table 1: Demographic Characteristics of Study Sample (n=91)

Variables	(Mean ± SD) / N (%)
Age (Years)	49.2 ± 5.4
Male	55 (60.44 %)
Female	36 (39.56 %)
BMI	28.3 ± 5.6

This study has examined the symptoms and signs presented by patients with different appendiceal positions. Among patients with the anterior position (n=54), the mean duration of symptoms was 1.4 days. Vomiting was reported in 57% of cases, followed by diarrhea in 15.2% of cases. Urinary symptoms were less common, occurring in 7.6% of patients. Fever, defined as a temperature of ≥38ºC, was observed in 37.6% of patients with an anterior appendiceal position. Abdominal pain was predominantly localized to the right iliac fossa in 81.9% of cases, with a smaller proportion reporting widespread (14.0%) or other locations (4.1%) (P=0.29). In patients with a pelvic appendiceal position (n=10), the mean duration of symptoms was slightly longer at 1.7 days. Vomiting occurred in 67% of cases, while diarrhea was reported in 19.2% of cases. Urinary symptoms were less frequent, occurring in 4.7% of patients The anatomical variations of the appendix observed in the study were as follows: anterior (n=54), pelvic (n=10), retrocecal (n=19), and subhepatic (n=8) (Table 2).

Table 2: Comparison of Clinical Signs and Symptoms

Symptoms and Signs	Anterior (Mean ± SD) /N (%)	Pelvic (Mean± SD) /N (%)	Retrocecal (Mean ± SD) /N (%)	Sub hepatic (Mean ± SD) /N (%)	P-Value
Duration of Symptoms (Days)	1.4 ± 0.01	1.7 ± 0.034	1.2 ± 0.031	1.2 ± 0.04	0.29
Vomiting	57%	67%	59%	72%	0.14
Diarrhea	15.2%	19.2%	9.3%	8.4%	0.07
Urinary symptoms	7.6%	4.7%	3.9%	1.1%	0.01
Fever (≥38ºC)	37.6%	49%	29.6%	52.3%	0.06
Abdominal Pain					
Right iliac fossa	81.9%	71.4%	88.8%	81.4%	0.22
Widespread	14.0%	22.2%	7.4%	14.8%	
Other locations	4.1%	6.4%	3.8%	3.8%	

The intraoperative and postoperative findings among patients with different appendiceal positions were as follows. Among patients with an anterior appendiceal position (n=54), intraoperative findings revealed that 7% experienced appendiceal rupture, while 2.1% had appendiceal bleeding. A small proportion (1.9%) required conversion to open surgery. The mean operative time for laparoscopic appendectomy in this group was 55.7 minutes. Postoperatively, patients received analgesia therapy for an average of 3.4 days, with a hospital stay averaging 2.7 days. The duration of oral refeeding was relatively short, with an average of 1.3 days. Additionally, 2.1% of patients experienced postoperative bowel obstruction. Statistical analysis revealed significant differences between groups in terms of intraoperative appendiceal rupture (P = 0.02), appendiceal bleeding (P = 0.03), conversion to open surgery (P = 0.005), operative time (P = 0.006), analgesia therapy duration (P = 0.001), and oral refeeding duration (P = 0.009). In patients with a pelvic appendiceal position (n=10), intraoperative findings showed a slightly higher incidence of appendiceal rupture (11%) and appendiceal bleeding (3%), with no conversions to open surgery. The mean operative time for laparoscopic appendectomy in this group was 56.9 minutes. Postoperatively, patients received analgesia therapy for an average of 5.3 days, with a hospital stay averaging 3.5 days. The duration of oral refeeding was slightly longer, with an average of 1.5 days. Postoperative bowel obstruction was observed in 7.7% of patients. Statistical analysis revealed significant differences between groups in terms of operative time (P = 0.006), analgesia therapy duration (P = 0.001), and oral refeeding duration (P = 0.009). Among patients with a retrocecal appendiceal position (n=19), 13.6% experienced appendiceal rupture, while 2.9% had appendiceal bleeding. A notable proportion (11.11%) required conversion to open surgery. The mean operative time for laparoscopic appendectomy in this group was 64.8 minutes. Postoperatively, patients received analgesia therapy for an average of 2.8 days, with a hospital stay averaging 2.8 days. The duration of oral refeeding was relatively short, with an average of 1.1 days. No cases of postoperative bowel obstruction were reported. Statistical analysis revealed significant differences between groups in terms of intraoperative appendiceal rupture (P = 0.02), conversion to open surgery (P = 0.005), operative time (P = 0.006), and oral refeeding duration (P = 0.009). Among patients with a subhepatic appendiceal position (n=8), 17.1% experienced appendiceal rupture, while 1.9% had appendiceal bleeding. A considerable proportion (12.5%) required conversion to open surgery. The mean operative time for laparoscopic appendectomy in this group was 79.2 minutes. Postoperatively, patients received analgesia therapy for an average of 2.1 days, with a hospital stay averaging 3.1 days. The anatomical variations of the appendix observed in the study were as follows: anterior (n=54), pelvic (n=10), retrocecal (n=19), and subhepatic (n=8) (Table 3).

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Table 3: Intra Operative and Post-Operative Findings of the Study

Symptoms and Signs	Anterior (Mean ± SD) /N (%)	Pelvic (Mean± SD) /N (%)	Retrocecal (Mean ± SD) /N (%)	Sub hepatic (Mean ± SD) /N (%)	P-Value
Intra Operative Findings					
Appendiceal Rupture	7%	11%	13.6%	17.1%	0.02
Appendiceal Bleeding	2.1%	3%	2.9%	1.9%	0.03
Conversion to Open Surgery	1.9%	0	11.11%	12.5%	0.005
Mean Operative Time (Minutes)	55.7 ± 5.14	56.9 ± 4.32	64.8 ± 7.31	79.2 ± 6.32	0.006
Post-Operative Findings					
Analgesia Therapy (Days)	3.4 ± 0.14	5.3 ± 0.84	2.8 ± 0.15	2.1 ± 0.05	0.001
Hospital Stay (Days)	2.7 ± 0.07	3.5 ± 0.09	2.8 ± 0.074	3.1 ± 0.031	0.05
Oral Refeeding (Days)	1.3 ± 0.02	1.5 ± 0.1	1.1 ± 0.01	1.5± 0.047	0.009
Bowel Obstruction	2.1%	7.7%	0	0	0.083

DISCUSSION

Laparoscopic appendectomy has become the preferred approach for many cases of appendicitis due to its minimally invasive nature and associated benefits such as reduced postoperative pain and faster recovery times. However, anatomical variations in the position of the appendix, particularly in pelvic and retrocecal locations, can present unique challenges during laparoscopic surgery. In cases where the appendix is located in the pelvic region, visualization and access may be hindered by surrounding pelvic structures such as the bladder, uterus, and rectum which has been reported by literature as well [15]. It can be hard for the surgeon to handle tools and successfully expose the operating region because there is just not enough room in this part of abdomen. In addition, this area is very small because it is crowded with organs like blood vessels, nerves and intestinal organs. It likely that some harm will occur accidentally when dissecting/mobilizing appendicitis. This contributed to prolonged operation time, increased complexity and an increased chance of intraoperative complications like appendiceal rupture [16]. Similarly, a retrocecal appendix also presents problems for its direct view and during laparoscopic surgery access. The surgeon could hardly see a retrocecal appendix based in the retroperitoneal region and it could limit his laparoscopic motions. Great care must be taken when dissecting any structure inside the retroperitoneal space to prevent the ileocecal vessels and ureter from getting damaged [17]. Furthermore, the angle of approach in retrocecal area is not favorable for the dissection of appendix leading to possible difficulties in getting enough exposure and dissecting it well. To overcome with these issues, surgeons that perform laparoscopic appendectomy on pelvic or retrocecal appendix must carefully handle the anatomical intricacies in the pelvis and retroperitoneal [18]. By positioning the patient cautiously, choosing the best place for ports and disassembling the appendix with careful direct visualization, can increase the reliability of useful safety profile of laparoscopic appendectomy. Furthermore, the laparoscopic ultrasonography can be use for localization and imaging the appendix when usual landmarks are invisible [19]. The need for additional research on how anatomical differences affect outcomes of laparoscopic appendectomy requires more extensive studies using larger and diverse patient pools from future prospective research [20].

CONCLUSIONS

In conclusion, laparoscopic appendectomy has many advantages compared to open surgery but challenges brought about by anatomical variation involving pelvic-retrocecal position of appendices ought to be recognized and addressed. Surgeons can navigate these challenges and improve results for patients who undergo laparoscopic appendectomy by understanding anatomical complications and using proper surgical methods.

Authors Contribution

Conceptualization: AI
Methodology: FJ, ANA, AH, I
Formal analysis: MZ
Writing, review and editing: FJ, ANA

All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflict of interest.

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REFERENCES

[1] Lee SL, Ku YM, Choi BG, Byun JY. In vivo location of the vermiform appendix in multidetector CT. Journal of the Korean Society of Radiology. 2014 Apr; 70(4): 283-9. doi: 10.3348/jksr.2014.70.4.283.

[2] Siraj F, Hassan B, Iqbal Z, Shamim R, Azhar F, Faruqui MU. Assessment of length, external outer diameter and positional variations in normal and inflamed appendix. InMedical Forum Monthly 2020 Nov; 31(11).

[3] Alraddadi A. Literature review of anatomical variations: clinical significance, identification approach, and teaching strategies. Cureus. 2021 Apr; 13(4): e14451. doi: 10.7759/cureus.14451.

[4] Salih M, Mehdi AJ, Abdullah S. Human Vermiform Appendix of Different Age Groups. Egyptian Academic Journal of Biological Sciences, D. Histology & Histochemistry. 2020 Jun; 12(1): 15-20. doi: 10.21608/eajbsd.2020.69071.

DOI: https://doi.org/10.54393/pjhs.v5i07.1662

[5] Queiroz MR, Francisco MJ, Rahal A, Jabour VA, Andrade GN, Silva PS *et al*. Ultrasonographic evaluation of cecal appendix diameter in pediatric population. Einstein (São Paulo). 2022 Jul; 20: eAO6935. doi: 10.31744/einstein_journal/2022AO6935

[6] Azhagiri R, Anitha M, Hemapriya J. Prevalence of anatomical variations of the position of appendix in acute appendicitis by CT scan. International Journal of Anatomy and Research. 2019 Sep; 7(4.1): 7051-5. doi: 10.16965/ijar.2019.304.

[7] Kacprzyk A, DroŚ J, Stefura T, Krzysztofik M, JasiŃska K, PĘdziwiatr M *et al*. Variations and morphometric features of the vermiform appendix: A systematic review and meta-analysis of 114,080 subjects with clinical implications. Clinical Anatomy. 2020 Jan; 33(1): 85-98. doi: 10.1002/ca.23474.

[8] GAjAPriyA P, SivArAj S, PrASAnnA MB. Luminal and Extraluminal Factors in Normal and Pathological Appendix-A Cadaveric Study from Central Kerala, India. International Journal of Anatomy, Radiology and Surgery. 2023 Jan, 12(1): 01-06.

[9] Botteri E, Ortenzi M, Alemanno G, Giordano A, Travaglio E, Turolo C, Castiglioni S, Treppiedi E, Rosso E, Gattolin A, Caracino V. Laparoscopic Appendectomy Performed by junior SUrgeonS: impact of 3D visualization on surgical outcome. Randomized multicentre clinical trial. (LAPSUS TRIAL). Surgical Endoscopy. 2021 Feb; 35: 710-7. doi: 10.1007/s00464-020-07436-4.

[10] Santos BMVD, Garcia DFDA, Illias EJ. Appendix positions and their clinical implications: literature review. International Journal of Science and Research. 2021 Aug; 10(8): 677-80. doi: 10.21275/SR21816014054.

[11] Chakraborty J, Kong JC, Su WK, Gourlas P, Gillespie C, Slack T *et al*. Safety of laparoscopic appendicectomy during pregnancy: a systematic review and meta-analysis. ANZ Journal of Surgery. 2019 Nov; 89(11): 1373-8. doi: 10.1111/ans.14963.

[12] Najjar SM, Aumer JT, Muhamad PJ. Evaluation of laparoscopic appendectomy proficiency in the management of acute appendicitis based on anatomy and pathologies. Zanco Journal of Medical Sciences. 2021 Aug; 25(2): 551-9. doi: 10.15218/zjms.2021.019.

[13] Patra A, Kaur H, Chhabra U, Sghar A, Balawender K, Pasternak A *et al*. Reappraisal of the variational anatomy of the vermiform appendix and their possible clinical applicability: a cadaveric analysis. Folia Morphologica. 2023 Sep. doi: 10.5603/fm.96443.

[14] Mucilli F, Barone M, Capone S, Peccianti MA, Guetti L, Prioletta M *et al*. Laparoscopic appendectomy in adult patients: locoregional or general anesthesia? A meta-analysis. Laparoscopic Surgery. 2020 Jul; 4. doi: 10.21037/ls.2020.03.02.

[15] Nikolovski A, Tahir S, Mladenovikj D. Complications after Laparoscopic Appendectomy for Complicated Appendicitis. Lietuvos chirurgija. 2020; 19(1-2): 345-41. doi: 10.15388/LietChirur.2020.19.23.

[16] Shames HN, Amr WM, Abdel Moneim HM, Yassin MA. Efficacy of Laparoscopy versus Open Surgical Appendectomy in Complicated Appendicitis. Zagazig University Medical Journal. 2023 Mar; 29(2.1): 185-91. doi: 10.21608/zumj.2021.51901.2033.

[17] Ussia A, Vaccari S, Gallo G, Grossi U, Ussia R, Sartarelli L *et al*. Laparoscopic appendectomy as an index procedure for surgical trainees: clinical outcomes and learning curve. Updates in Surgery. 2021 Feb; 73: 187-95. doi: 10.1007/s13304-020-00950-z.

[18] Birindelli A, Dester SE, Compagnoni B, Carrara B, Taglietti L. Retrograde technique with intra-corporeal tie in difficult laparoscopic appendectomy-a video vignette. Colorectal Disease. 2020 Jul; 22(7). doi: 10.1111/codi.14990.

[19] Monrabal Lezama M, Casas MA, Angeramo CA, Bras Harriott C, Schlottmann F. Conversion from laparoscopic to open appendectomy: trends, risk factors and outcomes. A 15-year single-center analysis of 2193 adult patients. World Journal of Surgery. 2022 Nov; 46(11): 2642-7. doi: 10.1007/s00268-022-06670-2.

[20] Almas T, Nagarajan VR, Ahmed D, Ullah M, Ashary MA, Oruk M *et al*. Recurrent appendicitis of vermiform appendix after a prior appendectomy: a case report and review of the literature. Annals of Medicine and Surgery. 2022 May; 77: 103603. doi: 10.1016/j.amsu.2022.103603.