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ORIGINAL RESEARCH

Should an Interval Appendicectomy Be Performed by a Minimally Invasive Gynaecologist?

Yael Yagur[1–3], Sarah Choi[1,2], Jessica A Robertson[1,2], Orla Donohoe[1,2], Mohammed Almoqren[1,2], Danny Chou[1,2], David MB Rosen[1,2]

[1]Sydney Women's Endosurgery Centre (SWEC), St George Hospital, Sydney, NSW, Australia; [2]University of New South Wales, Sydney, NSW, Australia; [3]School of Medicine, Faculty of Medical and Health Sciences, Tel Aviv University, Tel Aviv, Israel

Correspondence: Yael Yagur, Sydney Women's Endosurgery Centre (SWEC), Suite 10b, Level 3, St George Private Hospital, 1 South St Kogarah, Sydney, NSW, 2217, Australia, Tel +610434174885, Email yaelyagur@gmail.com

Objective: We aimed to explore the abnormal pathology findings in appendix specimens removed based on intraoperative abnormal appearance during elective surgery for benign gynaecological conditions by a minimally invasive gynaecologist, as well as the associated complication rate.

Materials and Methods: This retrospective cohort study was conducted in a tertiary referral surgical centre for benign gynaecological conditions between the years 2004–2023. It included patients who underwent appendicectomy by a trained minimally invasive gynaecologist based on observations during surgery for benign gynaecological conditions. Data included demographic, clinical, surgical and pathological information followed by postoperative complication data obtained from electronic medical records and direct communication with surgical colleagues. The primary outcome was the evaluation of the abnormal pathological findings in the appendix. The secondary outcome was the complication rate associated with appendicectomy in these cases.

Results: The study cohort included 34 women who met inclusion criteria and underwent a laparoscopic surgery for endometriosis, chronic pelvic pain or a benign ovarian mass. Indications for appendicectomy included twelve cases (38.2%) with apparent appendiceal immobility (stiffness), fourteen cases (41.2%) with an appendix adherent to ovaries or the pelvic side walls, and seven cases (20.6%) with an abnormal appearance (large, wide, long, coiled, or curved). Pathological findings revealed six cases (17.6%) of acute or chronic appendicitis, four cases (11.8%) of endometriosis, five cases (14.7%) of abnormal pathological conditions, and three cases (8.8%) of cancer (two cases of well-differentiated adenocarcinoma and one case of low-grade appendiceal mucinous cystadenoma). Postoperative complication rate was 5.8% (two cases).

Conclusion: This study supports incorporating appendicectomy by trained gynaecological specialists during gynaecological elective surgery when abnormal findings are encountered. Further research and guidelines in this area can provide even greater clarity and direction for the future of gynaecological surgical practice.

Keywords: appendicectomy, cancer, minimally invasive gynaecology surgery, training

Introduction

Gynaecological surgery has been profoundly reshaped by the application and maturation of minimally invasive techniques. Minimally Invasive Surgery has also benefited our patients with reduced invasiveness and inpatient stay, diminished complication rates, and faster postoperative recovery.[1,2]

With the passage of time and wide experience as well as collaboration with our urological and colo-rectal colleagues in combined cases, minimally invasive gynaecological surgeons have transcended the stereotype of years past and brought gynaecologists into the conversation along with their surgical colleagues, pushing the boundaries of what is possible for minimally invasive pelvic surgery.[3] In endometriosis cases, shared decision-making plays a role in determining the surgical approach, considering the size and depth of lesions, as well as patient priorities, while aiming

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to minimize postoperative morbidity.[4,5] For example, the development of laparoscopic disc resection for bowel endometriosis has been achieved via collaboration between gynaecologists and colorectal surgeons.[6]

Laparoscopic appendicectomy is one of the most minimally invasive procedures performed traditionally by general surgeons, usually in the scenario of acute appendicitis.[7–9]

Gynaecological surgeries, within the pelvis as they are, commonly involve the "other pelvic organs" – the bladder, small and large intestine including the appendix. Consequently, patients undergoing laparoscopy for gynaecological concerns such as endometriosis, ovarian cystectomy, pelvic pain or adhesions may present with incidental abnormal findings necessitating appendicectomy.[10,11]

The role of prophylactic appendicectomy remains a subject of ongoing debate in cases of ovarian neoplasm[12] and endometriosis.[13] A link has been drawn between chronic pelvic pain, severe endometriosis, and an elevated risk of appendiceal endometriosis, with reported rates of up to 15% based on a retrospective large series involving 609 patients.[14,15]

Appendicectomy however, is not without risk. A retrospective study of elective concomitant appendicectomy included a population cohort of 246,987 patients. Of these 1,760 patients who underwent laparoscopic surgery for benign indications reveal an 8% complications rate (all complications). Control patients (no appendicectomy) reveal a complications rate of 5.5%.[16] Case series targeting patients who stand to benefit from concurrent appendicectomy during gynaecologic procedures have yielded reassuring results, reporting no complications directly attributed to the appendicectomy itself.[11]

Our study deals with the rate and significant appendiceal pathology that can coexist in gynaecological patients found during laparoscopic surgery for benign gynaecological causes performed by an experienced minimally invasive gynaecological surgeon particularly focusing on significant appendiceal pathology beyond endometriosis. Additionally, we aim to explore the role of minimally invasive gynaecological surgeons performing appendicectomies during primary surgeries, presenting the advantages of surgeons addressing abnormal appendiceal findings during the same procedure whilst also examining complication rates and outcomes.

Materials and Methods

Patients

This retrospective observational study included women who were admitted for an elective laparoscopic surgery for benign indication to the Sydney Women's Endosurgery Center during the years 2004–2023.

Patient ages ranged from 18 to 65 years old. Indications for Laparoscopic gynaecology surgery included Endometriosis, chronic pelvic pain, ovarian cysts and uterine leiomyoma. Laparoscopic surgeries included laparoscopic hysterectomy, laparoscopic ovarian cystectomy and laparoscopic endometriosis for excision of adhesions and peritoneal lesions. Surgical indications were determined based on clinical data, physical examinations, and sonographic findings. Appendicectomy was discussed and consented to as a possibility prior to all of the endometriosis surgeries based on the copresence of endometriosis in the appendix. No additional imaging of the appendix was performed prior to surgery.[11] Although no pathology was identified preoperatively, these cases were referred to as "planned" appendicectomies based on the consent obtained before surgery.

Appendicectomy was indicated under specific circumstances as an incidental findings during the gynaecological procedure, such as abnormal appearance of appendix, stiff texture or adhesions to pelvic side walls or to gynaecological tissue while explicitly excluding cases of acute appendicitis.

Appendicectomy was performed by the same surgeon with a consistent technique of surgical isolation of the appendiceal artery with bipolar ligation followed by triple-loop PDS suture to the base of the appendix – two loops proximal and one distal to minimize content spillage after transection of the appendix. The surgical technique was formulated by the primary surgeon after observing general surgical colleagues performing the procedure and adapting it to align with his personal surgical skills and preferences. This approach has remained consistent over the entire study duration, ensuring uniformity.

Exclusion criteria comprised women undergoing emergency surgeries, endometriosis surgeries involving rectal shaving or resection, cases of ovarian malignancy, those lacking data regarding surgical indications or surgical reports, and patients diagnosed with acute or chronic infections or acute appendicitis before surgery.

All study participants received prophylactic intravenous antibiotics prior to surgery. The antibiotic regimen was cefazolin-based, with a dosage of 2 grams for individuals weighing up to 80 kg and 3 grams for those weighing above 80 kg, in accordance with established protocols, In cases of appendicectomy a dose of intra venous metronidazole 500 mg was admitted.

Outcomes

The primary outcome was the evaluation of the abnormal pathological findings in the appendix and defined as histopathological diagnosis other than normal appendix tissue. These included specific conditions such as acute or chronic appendicitis, endometriosis, neoplasms (benign or malignant), and other significant inflammatory or pathological changes - hyperplastic polyp of appendix, follicular hyperplasia and low grade dysplasia. The secondary outcome was the short term (30 days) complication rate associated with appendicectomy in these cases, categorized using the Clavien-Dindo Classification system.

Data

Data collected from electronic medical records included patient demographics and medical history including age, marital status, smoking status, medical history, pharmacological treatments, use of hormonal therapy, surgical history, parity, and cervical test history. Additionally, data related to patient symptoms, physical examinations, sonographic scans, indications for surgery, surgical findings, pathology diagnoses, and postoperative complications were collected.

Ethics

The study was approved by the South Eastern Sydney Local Health District Human Research Ethics Committee (HREC) under protocol number 2024/ETH00922. The ethics application was reviewed as a Low or Negligible Risk pathway.

The project was determined to meet the requirements of the National Statement on Ethical Conduct in Human Research (2023) and was granted approval. As the data in this study is permanently de-identified, a waiver of consent was not required, in accordance with the NSW Information and Privacy Commission Statutory Guidelines for Research. The study adhered to strict patient data confidentiality standards, and all research activities were conducted in compliance with the ethical principles outlined in the Declaration of Helsinki.

Statistical Analysis

Descriptive statistics was performed to describe the parameters.

Categorical variables were summarized as numbers and percentages. For reader ease, all continuous variables were reported as mean and standard deviation, unless mentioned otherwise.

Results

During the study period, out of 1800 patients 34 patients met the inclusion criteria and underwent laparoscopic appendicectomy during surgery for gynaecological causes.

Table 1 presents the demographic data for the entire cohort. The mean maternal age at the time of surgery was 30 (±12) years. Women in the study cohort were generally in good health with no vascular or bowel comorbidities. Thirteen women (38.2%) used hormonal therapy before surgery, all of whom used combined oral contraception. Only five (14.7%) women had a history of previous laparoscopic surgeries, mostly for endometriosis. Nineteen (55.9%) women reported dysmenorrhea, 11 (32.3%) reported dyspareunia, 9 (26.5%) reported dyschezia, 10 (29.4%) reported bowel symptoms such as constipation or diarrhea, and 10 (30.3%) experienced menorrhagia.

The primary indication for surgery was endometriosis, with stages 1–4 accounting for 19 cases (55.8%).

Table 2 presents operative data and pathological findings for the study cohort. Operative data encompassed surgical findings and pathological results. Among the entire cohort, five appendectomies (14.7%) were planned prior to surgery.

Table 1 Study Cohort Characteristics

Demographic data	Study Cohort N=34
Age	30 (±12)
Marital Status	
Single	16 (47%)
Married	18 (53%)
Smoker	6 (17.6%)
Contraception use	13 (38.2%)
Previous surgeries	12 (35.3%)
Primiparous	27 (79.5%)
Abnormal PAP status	2 (5.9%)
Dysmenorrhea	19 (55.9.6%)
Dyspareunia	11 (32.3%)
Dyschezia	9 (26.5%)
Bowel symptoms	10 (29.4%)
Urine symptoms	2 (5.9%)
Menorrhagia	10 (30.3%)
Indication for surgery	
Endometriosis	20 (58.8%)
Pelvic pain	9 (26.5%)
Ovarian Cyst	3 (8.8%)
Fibroid	2 (5.9%)

Note: Data are shown as number (%), mean ± standard deviation, as appropriate.

Table 2 Presents Operative Data and Pathological Report of Study Cohort

Parameter	Study Cohort N=34
Surgical findings of appendix	
Adherent to ovary of pelvic sidewall appendix	14 (41.2%)
Stiff appendix	13 (38.2%)
Abnormal appendix appearance (large, wide, long, coiled or curved)	7 (20.6%)
Pathology result	
Normal pathology	16 (47.1%)
Appendiceal Endometriosis	4 (11.8%)
Acute or chronic appendicitis	6 (17.6%)
Abnormal pathological conditions*	5 (14.7%)
Malignancy of appendix	3 (8.8%)

Note: Data are shown as number (%). * Including hyperplastic polyp of appx, follicular hyperplasia and low grade dysplasia.

Indications for planned or unplanned appendix removal included twelve cases (38.2%) with a stiff appearing appendix, fourteen cases (41.2%) with an appendix adherent to ovaries or the pelvic side walls, and seven cases (20.6%) with an abnormal appearance (large, wide, long, coiled, or curved).

Pathological findings revealed six cases (17.6%) of acute or chronic appendicitis, four cases (11.8%) of endometriosis, five cases (14.7%) of other abnormal pathological conditions (including hyperplastic polyp of appendix, follicular hyperplasia and low grade dysplasia) and three cases (8.8%) of cancer (two cases of well-differentiated adenocarcinoma and one case of low-grade appendiceal mucinous cystadenoma). An additional 16 cases (47.1%) were diagnosed with normal pathology. The patients with appendiceal malignancy were referred for ongoing surveillance by our colo-rectal colleagues. No disease progression has been noted in these patients.

Postoperative complications were monitored over both short (30 days) and long term, up until the date of data collection (6 month – 10 years). There were two cases (5.8%) of complications within the study group with no long-term complications reported. The first case involved a patient who presented with abdominal pain, was observed overnight with a normal abdominal CT scan and blood tests and was discharged the next day on oral antibiotics. The second case involved stump necrosis, with the patient readmitted on Day 5 postoperatively under the care of general surgeons. A diagnostic laparoscopy was performed, and no further treatment was required.

Discussion

This study aims to highlight the benefit to our patients when expert minimally invasive gynaecologists conduct appendicectomies concurrently with elective gynaecological procedures. Our research revealed that 52.9% of cases of appendicectomy based on abnormal findings during gynaecological surgeries yielded abnormal pathological findings in the appendix. Among these cases, 14.7% were diagnosed with abnormal pathological conditions and 8.8% with cancer, all within a remarkably young population, with a mean age of 30 years. These procedures alone were potentially life-saving surgeries.

A significant observation from our study is the relatively low postoperative complication rate, standing at 5.8%. Only one case was classified as a major complication, necessitating repeat laparoscopy due to stump necrosis without significant sequelae.

Among the cases of appendicectomy based on clinical judgment, we included reasons for appendicectomy such as a stiff appendix, adhesions, and abnormal appearance. Previous studies of appendicectomy based on intra-operative appearance presented low percentages of patients with macroscopic abnormalities in the appendix, ranging from 1–6% in cases of borderline mucinous ovarian tumors[17] up to 12% in mucinous ovarian cancer[18] but these gross abnormalities often correlated with a high rate of positive pathology findings for abnormal appendiceal conditions, up to 70%.

The observed 8.8% incidence of appendiceal cancer is high, particularly given the young mean age of the population, These cancers were incidental, as no preoperative evaluations indicated malignancy, emphasizing the importance of performing appendicectomy based on surgeon suspicion during surgery. Patients with appendiceal cancer require further oncological evaluation and treatment and were all referred to a colo-rectal colleague for ongoing management. To date, no ongoing sequelae have been recorded. This finding suggests the need for heightened awareness among gynaecologists regarding the possibility of occult malignancies during gynaecological surgery.

In patients having surgery for endometriosis and chronic pelvic pain, data demonstrates gross abnormalities of the appendix in 2.6% of cases, with an 98% of these women having positive pathology.[19] These statistics provide confidence in the decision to resect when encountering an abnormal appearing appendix. Furthermore, studies focusing on a specific population with stage 4 endometriosis who underwent appendicectomy during endometriosis surgery reported even higher percentages of patients with abnormal endometriotic appendices, with rates reaching up to 35%,[20] whilst there is a known 2.4% risk for malignancy in endometriosis patients.[21]

Additionally, the observed low rate of complications associated with appendicectomy within this context underscores the safety and viability of this combined procedure. Our data only identified two cases reporting any short- or long-term complications (5.8%), and just one was recognized as a major complication. In comparison, studies involving specialized general surgeons reported overall complication rates ranging from 8% to 30%, with wound infection rates of 3–10% and pelvic abscess rates of 9%.[22] However, it is important to note that the cases in this study were elective appendectomies

performed in conjunction with gynaecological surgeries for benign indications, which are inherently less complex compared to cases of acute appendicitis cases commonly managed in general surgery. This difference in case complexity likely contributes to the lower complication rates observed in our study. Studies focusing on appendiceal resection due to endometriosis reported post-operative complications such as port-site infections, colitis, urinary tract infections, and ureteric injuries, but none were purely related to appendicectomy alone but were seen to be related to the excision of complex endometriosis.[20] In some instances where gynaecologists performed the operation, no complications were reported.[11] Notably, there is existing data suggesting no significant advantage for any particular surgical method in laparoscopic appendicectomy, further indicating that complications are not method-dependent.[23]

One confounding factor that may influence the uptake of gynaecologists performing concurrent appendicectomy is medico-legal. If the procedure does not form part of standard gynaecological training, will the gynaecologist be supported by their peers if a complication occurs, regardless of the indication? Of course, a surgical colleague can be asked to attend every time a suspicious appendix is encountered to perform the surgery, however this is time-consuming and as we have shown, may not guarantee a better outcome.

Solutions include developing guidelines by professional bodies, implementing mandatory training, and establishing collaborative protocols with general surgeons for complex cases to address medico-legal issues. Proper documentation and informed consent detailing the potential for appendicectomy and its associated risks can assist in mitigating medico-legal risks. Furthermore, institutional policies that support the conditions under which gynaecologists can perform appendicectomies provide an additional layer of legal protection and peer support.

There are several strengths to the current study. Firstly, it is one of the few studies exploring the correlation between appendicectomy based on surgical observations and performed by trained minimally invasive gynaecologists during gynaecological surgery and pathology results, and the long-term complication rate. Secondly, the study population involved a single-center and was consistently managed by the same surgeon (DR) throughout the study period. The relatively narrow age range of the patients aids in understanding the characteristics relevant to this particular population.

Nonetheless, this study has its limitations, most notably its small sample size. Drawing from a single institution may limit the diversity of the population studied and as for all appendicectomies performed were done by a single surgeon can limit the generalizability of the study results. Additionally, it can introduce potential bias related to subjective judgment in decision-making and reliance on one surgeon's expertise. As well the retrospective nature of the study restricted our control over all potential confounding factors, and some information may have been missing from patients' medical records. The study population encompassed a wide range of surgical indications, which could introduce variability into our conclusions. In the preoperative preparation there is no standard of appendix imaging. Further studies should consider imaging of the appendix for known pathologies that can involve abnormal pathology of the appendix such as endometriosis and ovarian cysts. Lastly, despite our conclusion of the low complication rate, we cannot compare this rate to other groups where the underlying pathology is different.

In conclusion, this study illuminates a compelling argument in favor of incorporating appendicectomy by highly trained gynaecological specialists during gynaecological elective surgery when abnormal findings are encountered. The relatively high incidence of cancer (and other significant pathology) within this young patient population, coupled with the observed low complication rates and relative ease of learning of the procedure for a skilled laparoscopic surgeon, underscores the importance of incorporating appendicectomy into the training curriculum of minimally invasive gynaecologists. A focused approach on recognizing abnormal appendiceal pathologies and practicing appendicectomy during training is essential to ensure comprehensive surgical care.

The findings of this study could influence gynaecological surgical practice globally, especially in resource-limited settings. Training gynaecologists to perform appendicectomy during elective procedures may reduce the need for additional surgeries and improve access to comprehensive care, particularly where specialist availability is limited.

Further research and guidelines in this area can provide even greater clarity and direction for the future of gynaecological surgical practice.

Data Sharing Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request. Data will be shared after careful consideration and in accordance with ethical guidelines and data protection regulations.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

We declare no competing interests.

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