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Research Article

Pelvic sepsis following laparoscopic appendicectomy versus open appendicectomy: a retrospective study of 648 cases

Hannah L. Adams[1]*, Sheik S. Jaunoo[2]

[1]Warwickshire Surgical Research Group, Coventry, CV2 2DX, United Kingdom
[2]Oxford University Hospitals, Oxford, OX3 7LE, Uniter Kingdom

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***Correspondence:**
Dr. Hannah L. Adams,
E-mail: h.l.adams@doctors.org.uk

ABSTRACT

Background: The purpose of this retrospective study was to evaluate the development of postoperative pelvic collections following Laparoscopic Appendicectomy (LA) and Open Appendicectomy (OA).
Methods: A retrospective analysis of all patients undergoing emergency appendicectomy between February 2010 and January 2012 at a single UK tertiary care referral centre were considered for inclusion in this study. Data collection was undertaken and analysed using descriptive statistics.
Results: Of the 648 appendicectomies (361 male, 287 female), 177 were performed laparoscopically. Histology confirmed appendicitis in 484 patients. There were 19 cases of pelvic sepsis (LA n=2, OA n=17), not statistically significant (p=0.1184).
Conclusions: Laparoscopic appendicectomy is a safe operative procedure and is not associated with an increased risk of pelvic sepsis.

Keywords: Laparoscopic appendicectomy, Open appendicectomy, Pelvic sepsis, Appendicitis

INTRODUCTION

Appendicitis is the most common cause of an acute surgical abdomen in all age groups.[1,2] Between 7-10% of the general population will develop acute appendicitis during their lifetime with the highest incidence being in the second and third decades of life.[3-5]

The surgical technique of Open Appendicectomy (OA) was first described in 1894 by McBurney and has remained relatively unchanged over the last century.[6] However, advances in surgical science have continually developed and improved outcome, leading to a substantial reduction in the mortality associated with appendicitis.[7,8]

Laparoscopic surgery was introduced by Semm in 1983 and its evolution has allowed appendicectomies to be optimised using this technique.[9] Since that time the advantages of the laparoscopic technique have been well demonstrated and Laparoscopic Appendicectomy (LA) has become the preferred procedure over OA in hospitals worldwide.[10-15] Advantages of LA include reduced post-operative pain and cosmesis.[8,12,14-21] Despite the popularity of LA, it is still a controversial subject and some studies demonstrate a preference towards OA.[18,22] When making a comparison between the two techniques, the disadvantages of laparoscopic surgery include a longer and more expensive procedure.[8,11,16,17,20,23] Studies have also suggested that there is an increased risk of pelvic sepsis when LA is performed; this particularly applies in patients with perforated appendix.[13,14,18,22] However there is conflicting evidence and not all studies

are in agreement.[8,10-12,16,19,21] A study by Sleem et al. suggests that LA is safe to use in cases of perforated appendicitis with no evidence of increased rate of postoperative pelvic collection when compared with OA.[12]

Another study reports that LA should decrease the incidence of pelvic sepsis as the procedure allows better visualisation of the abdominal cavity and a thorough washout of all abdominal quadrants.[10] However this is contradicted by a study reporting that extensive irrigation carried out during LA and the handling of a perforated appendix within the abdomen leads to contamination of the abdominal cavity.[13]

The majority of studies demonstrating a statistically significant difference between LA and OA were performed in the late 1990s through to the early 2000s including a randomised trial by Pedersen et al.[8,16,19,21] It is possible that in the last decade laparoscopic appendicectomy has developed enough to demonstrate a decrease in the rates of pelvic sepsis. This gap in recent literature and the overall uncertainty surrounding the development of pelvic collections provides a research opportunity and will form the endpoint of this study.

Aim

The endpoint of this retrospective study is to determine whether patients have an increased risk of pelvic collections following laparoscopic surgery when compared with the open approach.

METHODS

Study population

A retrospective analysis of 648 patients undergoing emergency appendicectomy between February 2010 and January 2012 at a single UK tertiary care institution were considered for inclusion in this study. A clinical diagnosis of acute appendicitis was made using a history and physical examination alongside supporting laboratory results. In patients where a clinical diagnosis could not be established radiological imaging was performed in the form of abdominal ultrasound or Computed Tomography (CT) scans.

Data collection

A comprehensive range of data was collected for analysis including patient demographics (gender, ethnicity, age), pre-operative laboratory investigations, time from A&E admission to theatre, operative procedure (LA, OA), grade of surgeon and histological diagnosis. Histology reports were used to determine complicated and uncomplicated appendicitis. Complicated appendicitis was defined as an appendix which had become gangrenous or perforated. Insertion of operative drain, length of hospital stay and development of postoperative pelvic sepsis were also recorded.

Patients were excluded if they underwent a laparotomy or conversion to a laparotomy, were pregnant and had a history of multiple abdominal operations or previous abdominal surgery. Those patients undergoing concurrent bowel resection were also excluded. Patients with intraoperatively diagnosed appendicitis whose appendix was normal on histology were not excluded.

Pelvic sepsis

Post-operative pelvic/intra-abdominal abscess was defined by evidence of a fluid collection shown on a CT scan or Ultrasound Scan (USS) within one week of operative procedure. If radiological and clinical findings were more suggestive of a haematoma or seroma and the patient did not receive treatment, the pelvic/intra-abdominal collection was not counted as pelvic sepsis.

Operative procedures

OA was performed through a standard McBurney muscle splitting incision in the right lower quadrant. Peritoneum was accessed and opened to allow inspection of the mesoappendix. The appendix was crushed at the base, ligated with vicryl and then removed from the abdomen. Haemostasis was achieved and the appendiceal stump was buried into the caecum using a purse-string suture. The abdominal cavity was irrigated with a warm saline wash and evacuated before closing the peritoneum, muscle and skin.

LA was completed via the standard laparoscopic technique using three trochar. A small infraumbilical incision was made, and a 10mm trochar was placed at this incision site. Pneumoperitoneum was achieved to a pressure of 10-12 mmHg carbon dioxide and a 10mm camera was inserted via this port. Under direct vision two 5 mm trochar were placed in the midsuprapubic and left iliac fossa regions. After identification of the appendix the appendicular artery was dissected and divided between haemostatic clips. The appendix was secured at the base with 2-3 endoloops and divided between the ligatures. Endodiathermy was used to achieve adequate haemostasis. The appendix was delivered through the 10 mm trochar or in an endoscopic bag. The abdomen was irrigated with warm saline solution. Some variances may have occurred owing to the demand of each individual case. The use of operative drains and postoperative antibiotics was at the discretion of the surgeon.

Laparoscopy was converted to open appendicectomy if uncertain anatomy, technical difficulties and bleeding were encountered. An LA converted to an OA was considered an OA and not on an intention to treat analysis.

Macroscopically normal appendices were removed as part of the standard procedure at our single institution.

Statistical analysis

Continuous data are presented as median (IQR) unless indicated otherwise. Differences in qualitative variables were assessed using Fisher's exact test and quantitative variables were analysed using an unpaired T-test. Relative risk was described by the estimated Odds Ratio (OR) with 95 per cent confidence interval. Two-sided P values were computed and P ≤0.05 was considered statistically significant. All statistical analyses were performed using GraphPad Prism® software (GraphPad Software, Inc, San Diego, CA 92130 USA).

RESULTS

648 emergency appendicectomies were performed over a two year period. Median age of patients undergoing appendicectomy was 24 years of age with a range of 6-86 years, 361 were male and 287 female (Table 1). A laparoscopic approach was used in 177 cases (27.3%) and a laparoscopic converted to open procedure in 7 patients (the latter have been treated as OA). A histological diagnosis of appendicitis was found in 484 patients (74.7%), other histological diagnoses included; normal appendix, benign hyperplastic polyp, carcinoid tumour and mucinous neoplasm. 325 patients had a simple appendicitis and 165 had complicated appendicitis i.e. gangrenous n = 49 and perforated n = 116 (Figure 1).

Table 1: Characteristics of the patients included in this study (n=648).

Characteristic	Number
Age [median (range)]	24 (6-86)
Male:Female	361:287
Total appendicectomies	648
Laparoscopic procedure	177 (27.3%)
Open procedure	471 (72.7%)
Cases of pelvic sepsis	19

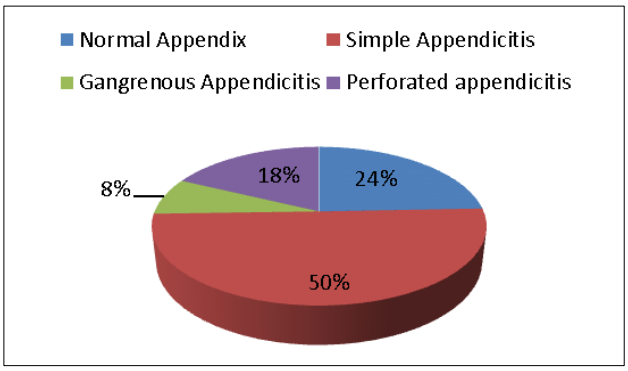

Figure 1: The distribution of complicated and uncomplicated appendicitis examined in this series of 648 patients.

Pelvic sepsis

There were 19 cases of pelvic sepsis, 2 after LA and 17 following OA. LA was associated with a decreased risk of pelvic sepsis compared with OA, but this difference was not statistically significant (p=0.1184), (Table 2). Of the 19 patients with pelvic sepsis 3 had histologically normal appendices, 7 had acute appendicitis and 9 had complicated appendicitis (gangrenous n = 4, perforated n = 5). Our study reported the removal of histologically normal appendices 24.4% (17.4% OA and 42.9% LA) of the time.

Table 2: Rates of pelvic sepsis in laparoscopic and open appendicectomy.

	Pelvic sepsis	Non-pelvic sepsis
Laparoscopic appendicectomy	2	175
Open appendicectomy	17	454
Odds Ratio (95% CI)		0.3018 (0.069-1.320)
P value		0.118

The majority of collections were found in the Right Iliac Fossa (RIF) (n = 9), pelvis (n = 2) and right paracolic gutter (n = 2). The remaining collections were located in the sub-hepatic region (n = 1) and pre-sacral region (n = 1), with an unspecified location for two collections and two having multiple collections throughout the abdomen.

DISCUSSION

Laparoscopic surgery has recently advanced and improved surgical procedures, enabled surgeons to decrease infection and improve complication rates that are often associated with the equivalent open procedure. This has been demonstrated for appendicectomies in a number of studies.[8,12,14-21]

The development of pelvic sepsis following appendicectomy is an infrequent but serious complication and can be associated with significant morbidity as well as a second operative procedure, as reported by Krukowski et al.[24] Jan et al.[20] reports the development of pelvic collections within a week of operative procedure,[20] this is consistent with the timeframe employed in this study. The current literature demonstrates conflicting evidence with some studies suggesting that LA is associated with a higher risk of developing pelvic sepsis,[13,14,18,22] and other studies concluding that this is not significant.[8,10-12,16,19,21] Our study reports 19 patients with pelvic sepsis (laparoscopic n = 2, open n = 17) demonstrating no statistically significant difference in pelvic sepsis between the two operative groups (p = 0.1184). Although there was no significant difference, LA was associated with a decreased risk of pelvic sepsis.

This is inconsistent with current literature which suggests that rates of pelvic sepsis are higher following LA. Reasons for this increased risk include; the infected contents spreading throughout the abdomen during abdominal lavage and pneumoperitoneum.[13,14,18] One study suggested that the use of carbon dioxide for peritoneal insufflation may promote the growth of anaerobic organisms; however this has not been confirmed by further studies.[18] Other reasons for decreased rates of pelvic sepsis during OA include; the division of the appendix outside the abdominal cavity and the inversion of the appendiceal stump,[13,14,18,22] but in our series this was not demonstrated.

It has been recommended in previous studies that irrigation is a likely cause of pelvic sepsis as it leads to contamination of the entire abdominal cavity which can be difficult to aspirate and should therefore be avoided.[25] These findings are inconsistent with our study, in which we experienced a lower rate of pelvic sepsis in patients who had undergone LA. Our laparoscopic procedure employed irrigation, especially in cases with complicated appendicitis, which if consistent with the current literature should have allowed demonstration of a higher rate of pelvic sepsis in LA. A previous study by Hussain et al.[15] also demonstrated a decreased rate of pelvic sepsis following copious washout of all four abdominal quadrants using a 3L saline wash.[15]

An interesting finding of note in our study is the anatomical distribution of the collections. The majority of collections were found in the RIF, pelvis and right paracolic gutter, this does not support the mechanism of possible diffusion that has been mentioned in the literature to date.[10,13,18]

Further studies have evaluated the rates of pelvic sepsis in complicated appendicitis and have concluded that there is a statistically significant increase in pelvic sepsis rates in patients with complicated appendicitis.[10,13,18,22] Frazee and Bohannon[14] published a retrospective analysis in which 19 patients with perforated appendicitis and 15 patients with gangrenous appendicitis underwent LA. They found a 26% and 7% rate of pelvic sepsis in each group respectively, however a statistical analysis was not completed.[14] Another study by Tang et al.[22] was in agreement with a pelvic sepsis rate of 11% for perforated appendicitis following LA compared with a 3% rate for patients who underwent OA resulting in $p = 0.054$, just missing out on statistical significance. Their study also found no statistically significant difference in pelvic sepsis rates between LA and OA in gangrenous appendicitis.[22] Further studies such as that by Krisher et al.[13] are in agreement with the aforementioned results demonstrating that rates of pelvic sepsis were much higher in the laparoscopic group than the open group in cases of perforated appendicitis (24% vs. 4.2% respectively).[13] Our study demonstrated inconsistency with previous findings in the literature. Pelvic sepsis following perforated appendicitis was much higher in OA (4.3%) when compared with LA (0%). However, this was not statistically analysed. It is not known why our results demonstrate different findings from that in the literature, although it is assumed our low rates of pelvic sepsis overall, especially following LA are the likely explanation. A study by Jan et al.[20] found low rates of both pelvic sepsis and wound infections in both procedures and concluded that the use of antibiotics were the likely reason for this finding.[20] Perioperative antibiotic prophylaxis has been demonstrated to significantly reduce the risk of all postoperative infections in a Cochrane Review by Andersen et al.[26] Our study did not evaluate the use of antibiotics in the reduction of pelvic sepsis and therefore we are unable to comment further.

The rate of removal of normal appendices has been reported as high as 22-30% in a number of studies.[27-33] Our study is consistent with findings in the current literature as we report removal of normal appendices at 24.4%. We believe that negative appendicectomy rates depend on several factors including the institution's and surgeon's policy regarding removal of a normal looking appendix and the decreased use of laparoscopy as a tool to settle any diagnostic inconsistencies. Evidence such as that reported in a recent international study by Jaunoo et al.[34] provides the consensus that a macroscopically normal appearing appendix should be removed at the time of surgery.[34] Another study reports that as many as 19% of macroscopically normal appearing appendices demonstrate histological pathologies, this indicates the importance of removing macroscopically normal appendices.[33] The decision still remains at the discretion of the surgeon undertaking the procedure and the guidance given by the institution.

Unfortunately, the size of this study sample of patients with pelvic sepsis was insufficient to definitively resolve the inconsistency regarding the development of pelvic sepsis in LA and OA. Our data was further analysed to determine the number of patients needed to demonstrate a statistically significant difference between the two procedures. Had it been possible to increase the number of patients with pelvic sepsis to 31cases, assuming the same ratio of sepsis to non-sepsis (1042 patients in total), the results would have derived a significant confidence interval.

This study had several limitations. First, it is a retrospective and uncontrolled study. Second, the laparoscopic and open groups contained varying numbers of patients due to the retrospective nature of this study. We recommend that a prospective randomised blinded study should be completed with computer generated allocations. Patients should be matched by gender, age and Body Mass Index (BMI). This would enable an equal number of patients in both groups (open and laparoscopic) and provide further evidence surrounding the development of pelvic sepsis.

The conversion from LA to OA were analysed with the open cases and not on an intention to treat analysis. We acknowledge that some studies would treat these converted cases on an intention to treat basis, however had the data been compared using the procedure starting the case, our findings of pelvic sepsis and length of hospital stay would remain valid.

We recommend that further studies should be undertaken regarding the use of operative drains and the use of pre and postoperative antibiotics in the development of pelvic sepsis. The low number of patients with pelvic sepsis included in this study warrants further studies over a longer time period to help validate our results.

In conclusion, appendicitis remains a sometimes difficult diagnosis. This study demonstrated no statistically significant difference in the incidence of pelvic sepsis when comparing LA and OA. The risk of pelvic sepsis development appears not to be based on the operative procedure performed, but more likely to be related to the presence of a perforated or gangrenous appendix.

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