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Original article

Laparoscopic appendicectomy: safe and useful for training

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Debate exists about the benefits of laparoscopic appendicectomy when compared to a conventional open procedure. The majority of appendices are removed by the open route in the UK. We report a series of 132 cases of suspected appendicitis managed laparoscopically: 112 (85%) of the patients had acute appendicitis, the remaining 20 (15%) had non-appendiceal pathology. The median operative time was 30 min and there were no conversions to an open operative procedure. The median postoperative stay was two days. Complications were seen in two patients.

The published evidence comparing laparoscopic and open appendicectomy is contradictory. Our series shows that laparoscopic appendicectomy is a safe procedure with low morbidity; it is also an excellent training tool in laparoscopic technique and, with sufficient experience, takes no longer than an open procedure. Negative appendicectomies are most common in women of fertile age and can be associated with significant morbidity; therefore, laparoscopy should be used to make the diagnosis and, if appendicitis is the cause, the appendix could safely be removed laparoscopically. However, the choice between open and laparoscopic procedure is a subjective decision for the patient and their surgeon. Laparoscopic appendicectomy cannot be regarded as the gold standard.

Key words: Appendicectomy – Laparoscopy – Laparoscopic appendicectomy – Appendectomy – Laparoscopic appendectomy

Appendicitis is common and appendicectomy is one of the most common surgical procedures performed. However, the diagnosis of appendicitis is not always straightforward and, in most published series, the rate of negative appendicectomies varies between 5–25%;[1], this rate is higher in women of fertile age.[2,3] In the continuing debate about laparoscopic versus open appendicectomy, proponents of laparoscopy propose that this approach reduces the rate of negative appendicectomy. Although laparoscopic appendicectomy is relat-

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ively simple, fewer than 1.5% of patients with appendicitis in the UK were treated by a laparoscopic procedure in 1992.[4] This relates to a number of factors, including the absence of trained laparoscopic surgeons outside normal working hours when acute appendicitis is often diagnosed and treated. We report a series of 132 cases of suspected appendicitis managed laparoscopically.

Patients and Methods

A retrospective review of patients undergoing laparoscopic appendicectomy admitted under the care of the senior author (ARD) was performed over a 54-month period up to September 1998. Patients were reviewed by the senior author and were those thought likely to have appendicitis on the basis of clinical examination and the results of investigations. Data were collected on consecutive patients. End-points noted were the age and sex of the patients, the status of the operating surgeon, diagnosis at laparoscopy, operative time, conversion rate, postoperative analgesic requirement, ability to tolerate diet at 24 h, length of postoperative stay, postoperative complications, time to normal activities and time to return to full-time employment.

Laparoscopic appendicectomy was performed under general anaesthetic in a supine position. The umbilicus was everted using toothed grasping forceps and the umbilical tube incised longitudinally to access the peritoneum under direct vision. A 30° laparoscope was introduced through a 10 mm umbilical port; 5 mm ports were inserted 2 cm above each pubic tubercle under direct vision, the right side for manipulation of the appendix and the left side for tissue dissection. The abdominal viscera and small bowel were examined and any free fluid or pus aspirated.

If the appendix appeared to be macroscopically normal, it was not removed. Appendicectomy began with diathermy coagulation and dissection of the mesoappendix, as near as possible to the appendix down to its base. In the case of an inflammatory phlegmon, dissection was performed carefully using a combination of blunt forceps and irrigation to reveal the appendix. Retrocaecal appendices required mobilization of the caecum by medial retraction and division of the peritoneum laterally, as at open operation. Once cleared to the caecum, the appendix base was doubly ligated using endoloop ligatures of either 1 chromic catgut or polydioxanone. The appendix was divided between ligatures and the mucosa cauterised. A 5 mm laparoscope allowed extraction of the appendix via the umbilical port. All specimens that were perforated or gangrenous were removed using a retrieval bag. The operative field and pelvis were irrigated with saline. A single absorbable suture was used to close the umbilical tube. The laparoscopic wounds were infiltrated with 0.5% bupivacaine.

All the patients received peri-operative antibiotics, continuing for 56 h if the appendix was perforated. All patients were reviewed at four weeks.

Table 1 Degree of inflammation of the appendix

	Number of cases (%)
Normal appendix	7 (5%)
Inflamed appendix	74 (56%)
Gangrenous appendix	26 (20%)
Perforated appendix	12 (9%)
Non-appendiceal pathology	13 (10%)
Total	132 (100%)

Results

A total of 132 patients underwent laparoscopy with the symptoms and signs of acute appendicitis. The median age of the patients was 33 years (range, 17–71 years); 72 patients were male (55%) and 60 were female (45%).

In all cases the senior author performed or supervised the procedure; 23 (17%) cases were performed by the senior author, 82 (62%) by a higher surgical trainee and 27 (20%) by a basic surgical trainee.

In all, 112 (85%) patients had acute appendicitis and, of these, 24 had an inflammatory phlegmon, 26 were gangrenous, 12 were perforated, and 36 were retrocaecal (Table 1). Of the inflamed appendices, 44 were removed using a retrieval bag. Other diagnoses encountered in the 20 non-appendiceal pathology patients are shown in Table 2.

The median operative time was 30 min (range, 14–75

Table 2 Operative findings

Diagnosis	Number of cases (%)
Acute appendicitis	112 (85%)
Salpingitis	2
Ovarian pathology	5
Mesenterial lymphadenitis	2
Diverticulitis	2
Incisional hernia	1
Adhesions	1
Normal	7 (2.3%)
Total	132

min) and there were no conversions to an open operative procedure.

Thirty-two patients (24%) required no additional postoperative analgesia other than the intra-operative analgesia that was given by the anaesthetist.

Of the 112 cases with acute appendicitis, 92 patients (82%) were tolerating diet at 24 h.

The median postoperative stay was two days (range, 1–15 days): 28 patients were discharged home within 24 h following their surgery.

Few complications were encountered; one patient (case 35) developed bruised genitalia at 48 h. He was re-admitted on day six with bruising over the pubis and into the right flank and a haemoglobin concentration of 8.6 g/dl. He underwent a laparotomy, at which a sterile clot was found; it was not clear if the secondary bleed had occurred from a port site or from the mesoappendix. He made an uncomplicated recovery following the laparotomy. An additional patient (71 years old) developed pneumonia in the postoperative period. A further patient was re-admitted with pain and pyrexia which subsequently settled with conservative treatment; ultrasound, CT scan and double contrast barium enema investigations showed no abnormality.

The median time back to normal physical activity was 10 days (range, 6–26 days).

Of the 79 patients in full-time employment, the median time to return to work was 16 days (range, 6–28 days); 49 of these 79 patients (62%) returned within 16 days.

Discussion

Unlike laparoscopic cholecystectomy, many surgeons continue to have doubts about the benefits of laparoscopic appendicectomy. Those not in favour of laparoscopic surgery argue that an open appendicectomy has low morbidity, is simple to perform, can be done by junior surgeons requiring little supervision, is associated with a quick recovery period and good cosmesis such that the benefits of minimal access surgery are not significant. Laparoscopic surgery, by contrast, has a longer operating time, requires experienced and more senior staff, is more expensive and needs more equipment. Our experience does not support the assumption that laparoscopic appendicectomy is more expensive than the open procedure. Apart from the two endoloop sutures, all procedures were performed using non-disposable equipment and the operative time was comparable to that of an open procedure.

Laparoscopy and laparoscopic appendicectomy allow a diagnosis to be made in the majority of cases,[3] 97.7% in this series, hence avoiding unnecessary appendectomies. Macroscopically normal appendices were not removed. Potential exists for a clinically normal appearing appendix to be microscopically inflamed;[5] the seven patients who had macroscopically normal appendices left *in situ*, all settled with conservative treatment, none went on to require appendicectomy or further surgery. In this series, 13 patients had non-appendiceal pathology seen at laparoscopy which may have been missed at an open operation (Table 2). Although this series was weighted in favour of advanced pathology, no patients developed wound infections or intra-abdominal sepsis. Although phlegmon formation increased the technical difficulty of laparoscopic appendicectomy, we do not consider it a contra-indication to a trial dissection.

Published studies about the role and benefits of laparoscopic appendicectomy are contradictory. Outcome measures that have been studied include the length of time to recovery, the amount of postoperative pain, the operative time, the length of in-patient stay, the rate of complications and the conversion rate. Prospective randomised studies have shown significant shortening of the recovery time and time to return to normal activities in patients undergoing laparoscopic appendicectomy compared with those undergoing an open procedure,[3,6–9] but other similar studies have shown no significant difference.[10] Likewise, studies suggest that postoperative pain is less with a laparoscopic procedure,[7–12] the in-patient stay is shorter,[6,10,12,13] and the complication rate is less.[6,8,12] Conversely, there are studies to contradict these findings and show that there is no difference in postoperative pain in laparoscopic procedures compared with open appendicectomies,[14] and there is no difference in in-patient stay or complication rate.[3,7,9,13,14] The one point that the majority of studies agree upon is that laparoscopic procedures take longer than open appendicectomies;[3,7–11,13,14] however, with increasing experience, the operative time is reduced greatly.[15,16] The reported conversion rates vary from 2% to 22%,[11,15,16] with the lowest conversion rates being seen at centres with large amounts of experience in laparoscopic appendicectomy.

In our review of 132 patients treated with laparoscopy and laparoscopic appendicectomy, the rate of acute appendicitis of 85% compares well with other studies[11,14] and is higher than that usually found at open appendicectomy;[3] 20 unnecessary appendicectomies were avoided due to the finding of non-appendiceal pathology or a normal appendix. The median operation time of 30 min is quicker than that reported in most of the prospective studies comparing laparoscopic approaches with open procedures and

reflects the learning curve as experience in laparoscopic surgery is acquired. The conversion rate was zero. Our other postoperative outcome measures compare well with published studies.

In most hospitals, daytime emergency operating is still difficult to arrange and most higher surgical trainees are not experienced laparoscopists; this may explain the slow uptake of this procedure. As part of the commitment to the recommendations of National CEPOD, the majority of patients in this series were operated on during daytime and emergency lists under consultant supervision. Although this delay may have weighted the series in favour of more advanced pathology, laparoscopic appendicectomy proved to be a good teaching tool, in that 82% of operations were successfully performed without complications by trainees. Pier also emphasises, on the basis of a large number of cases, that laparoscopic appendicectomy is a good training procedure in laparoscopy.[15,16] Apart from a slight increase in infective complications, similar results have been reported in a series performed by residents with limited experience in laparoscopic surgery.[17] Open appendicectomy is currently regarded as a training operation for basic surgical trainees. If laparoscopic appendicectomy became widely adopted for the treatment of appendicitis, this training opportunity could be lost (as has occurred to a large extent for laparoscopic and open cholecystectomy). Until laparoscopic appendicectomy is shown to be clearly of benefit to the patient, the laparoscopic approach should not become routine and, consequently, junior surgical trainees will still have access to these cases. However, of those patients in whom laparoscopy is indicated, a supervised laparoscopic appendicectomy provides a useful and safe training tool for the basic and higher surgical trainee.

Conclusions

We conclude that laparoscopy and laparoscopic appendicectomy have the potential to increase the rate of positive diagnoses and avoid unnecessary appendicectomies. This is important as negative appendicectomies are associated with significant morbidity.[1] This benefit is likely to be greatest in those in whom the rate of negative appendicectomy has traditionally been high, in particular, fertile age women. Whilst few would refute the value of laparoscopy in the diagnosis of appendicitis, particularly in young women, the above series demonstrates that if appendicectomy is suggested by diagnostic laparoscopy, it can be safely performed by the laparoscopic approach.

From a clinical point of view and on review of the literature, neither the open nor laparoscopic technique is superior to the other. The preferred method is, therefore, a subjective decision for the surgeon and patient together.[8,14] Therefore, laparoscopic appendicectomy cannot currently be regarded as the gold standard.

References

1. Lau W, Fan S, Yiu T, Chu K, Wong S. Negative findings at appendectomy. *Am J Surg* 1984; **148**: 375–8.
2. Berry J, Malt R. Appendicitis near its centenary. *Ann Surg* 1984; **200**: 567–75.
3. Laine S, Rantala A, Gullichsen R, Ovaska J. Laparoscopic appendectomy – is it worthwhile? A prospective, randomized study in young women. *Surg Endosc* 1997; **11**: 95–7.
4. Baigrie RJ, Dehn TCB, Fowler SM, Dunn DC. Analysis of 8651 appendicectomies in England and Wales during 1992. *Br J Surg* 1995; **82**: 933.
5. Grabham JA, Sutton C, Nicholson ML. A case for the removal of the 'normal' appendix at laparoscopy for suspected acute appendicitis. *Ann R Coll Surg Engl* 1999; **81**: 279–80.
6. Attwood SEA, Hill ADK, Murphy PG, Thornton J, Stephens RB. A prospective randomized trial of laparoscopic versus open appendectomy. *Surgery* 1992; **112**: 497–501.
7. Frazee RC, Roberts JW, Symmonds RE, Snyder SK, Hendricks JC, Smith RW *et al.* A prospective randomised trial comparing open versus laparoscopic appendectomy. *Ann Surg* 1994; **219**: 725–31.
8. Hansen JB, Smithers BM, Schache D, Wall DR, Miller BJ, Menzies BL. Laparoscopic versus open appendectomy: prospective randomized trial. *World J Surg* 1996; **20**: 17–21.
9. Hellberg A, Rudberg C, Kullman E, Enochsson L, Fenyo G, Graffner H *et al.* Prospective randomized multicentre study of laparoscopic versus open appendicectomy. *Br J Surg* 1999; **86**: 48–53.
10. Vallina VL, Velasco JM, McCulloch CS. Laparoscopic versus conventional appendectomy. *Ann Surg* 1993; **218**: 685–92.
11. Moberg A, Montgomery A. Appendicitis: laparoscopic versus conventional operation. A study and review of the literature. *Surg Laparosc Endosc* 1997; **7**: 459–63.
12. McAnena OJ, Austin O, O'Connell PR, Hedennan WP, Gorey TF, Fitzpatrick J. Laparoscopic versus open appendicectomy: a prospective evaluation. *Br J Surg* 1992; **79**: 818–20.
13. Heinzelmann M, Simmen HP, Cummins AS, Largiader F. Is laparoscopic appendectomy the new 'gold standard'? *Arch Surg* 1995; **130**: 782–5.
14. Tate JJT, Dawson JW, Chung SCS, Lau WY, Li AKC. Laparoscopic versus open appendicectomy: prospective randomised trial. *Lancet* 1993; **342**: 633–7.
15. Pier A, Gotz F, Bacher C. Laparoscopic appendectomy in 625 cases: from innovation to routine. *Surg Laparosc Endosc* 1991; **1**: 8–13.
16. Pier A, Gotz F, Bacher C, Ibald R. Laparoscopic appendectomy. *World J Surg* 1993; **17**: 29–33.
17. Klinger A, Henle KP, Beller S, Rechner J, Zerz A. Laparoscopic appendicectomy does not change the incidence of postoperative infective complications. *Am J Surg* 1998; **175**: 232–5.