Is Laparoscopic Appendicectomy a Safe Procedure for Trainees in the Peripheral Hospital Setting?

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Abstract
Laparoscopic appendicectomy has become standard in the treatment of acute appendicitis in most hospitals in Ireland. Studies have shown that it is a safe procedure for trainees to perform. However, these studies were conducted in university teaching hospitals whereas a significant proportion of training in Ireland takes place in peripheral hospitals which provide a different training environment. The aim of this study was to determine whether laparoscopic appendicectomy is a safe procedure for surgical trainees to perform in a peripheral hospital setting. A retrospective analysis was performed of appendicectomies carried out at a peripheral hospital over a 12 month period. Comparisons were made between consultant surgeons and trainees for a variety of outcomes. Of 155 appendicectomies, 129(83.2%) were performed laparoscopically, of which 10(7.75%) were converted to open. Consultants performed 99(77 %) laparoscopic appendicectomies. There were no statistically significant differences between consultants and trainees in complication rates (19(19.2%) vs. 4(13.3%), p=0.46), mean length of hospital stay (4.7 +/- 4.0 vs. 3.4 +/- 3.3 days, p=0.13), or rate of conversion to open operation (9(9.1%) vs. 1(3.3%), p=0.45). For cases of complicated appendicitis there were no significant differences between consultants and trainees in complication rates (12 vs 2, p=0.40) or length of hospital stay (6.4 +/- 3.9 vs. 4.7 +/- 5.6 days, p=0.27). We conclude that laparoscopic appendicectomy is a safe procedure for trainees to perform in the peripheral hospital setting and should be incorporated into surgical training programs at an early stage of training.

Introduction
Laparoscopic appendicectomy has become standard in the treatment of acute appendicitis in most hospitals in Ireland. It has been shown to be safe with comparable overall complication rates to open appendicectomy. In addition, laparoscopic appendicectomy is associated with fewer wound infections, less post-operative pain, better cosmesis, a shorter hospital stay and an earlier return to normal activity [1]. Traditionally, open appendicectomy was considered an ideal procedure for surgical trainees to perform. There are concerns that the advent of laparoscopic surgery has resulted in less opportunities for junior trainees to perform appendicectomies [2]. Since the introduction of laparoscopic appendicectomies in Ireland, there has been a 50% reduction in the number of appendicectomies performed by basic surgical trainees [3]. This may be because of perceptions that laparoscopic appendicectomy carries a higher morbidity rate and is therefore not as safe for trainees to perform [4-7].

Several studies have shown that trainees safely perform laparoscopic appendicectomy with similar conversion rates, complication rates, and length of hospital stay to consultant surgeons [8-10]. However, all of these studies were carried out in university or teaching hospitals, whereas much of the surgical training in Ireland, and elsewhere, takes place in peripheral hospitals. This study aimed to determine whether laparoscopic appendicectomy is a safe procedure for surgical trainees to perform in a peripheral hospital setting.

Methods
The study took place at St Lukeâ s Hospital, Kilkenny, a peripheral hospital with 228 acute beds. A retrospective analysis was performed of all appendicectomies performed from August 2008 to July 2009. Patients were identified using the Lothian surgical audit system. Data was collected from patient charts and operative records and included the type of surgery, grade of operating surgeon, intra-operative findings, post-operative complications, the need for a repeat operation, the need for ICU admission, total length of the patientâ s hospital stay and any re-admissions. Operating surgeons were graded as either consultant or trainee. Data on duration of surgery was not collected as this was not routinely recorded in the operative record and total length of anaesthesia was considered a poor proxy for duration of surgery.
Laparoscopic appendicectomies were performed using a standard three port technique.

Pneumoperitoneum was created using the Hasson technique at the umbilicus and two further ports placed suprapubically and in the left iliac fossa. The mesoappendix was divided between clips or controlled using diathermy. The appendix base was ligated with loop ligatures and divided. The appendix was retrieved using a retrieval bag system. Patients received a prophylactic dose of broad spectrum antibiotic at induction of anaesthesia, usually co-amoxiclavulinic acid 1.2g. The decision to continue antibiotics post-operatively was made by the operating surgeon based on the intra-operative findings. There were no protocols in place dictating which grade of surgeon would operate on any particular patient, nor were there any guidelines in place to decide which patients would receive a laparoscopic or open appendicectomy, which was a decision made by trainees and their supervising consultant at the time the patient was assessed. Trainees were not routinely supervised by a consultant, with a junior colleague assisting in the majority, although in some instances a consultant may have been present unscrubbed in the operating theatre.

Comparisons were made between consultants and trainees for rate of conversion to open operation, post-operative complication rates, mean total length of hospital stay, and number of ICU admissions, re-admissions within 30 days and repeat operations. To ensure that consultants and trainees were performing similar numbers of difficult appendicectomies, the proportions of appendicectomies with complicated findings (perforated or gangrenous appendix or an appendix mass or abscess) performed by each group were also compared. Statistical analysis was performed using Epi-info version 6.0. Categorical data was analyzed using the chi-squared test. Mean total length of hospital stay was compared using one-way ANOVA. P values less than 0.05 were considered significant.

Results
164 appendicectomies were performed during the study period. Complete data were available for 155. 129 (83.2%) appendicectomies were performed laparoscopically, of which 10 (7.75%) were converted to open. Of the 26 open appendicectomies, 12 were performed by trainees. Appendicitis was confirmed histologically in 81% of specimens. 65 (50.4%) patients were female. The mean age of the patients was 28 +/- 14 years (median 24 years). 13 operators were involved, 5 consultants and 8 trainees. A consultant was the principal operating surgeon in 99 (77%) cases and a trainee in 30 (23%) cases. All trainees who performed laparoscopic appendicectomies were registrars on training programs in their first to third years at this level [Table 1].

*p=0.27
p=0.07

!p=0.55

Table 2 shows the outcomes for laparoscopic appendicectomies performed by consultants and trainees. 23 patients experienced post-operative complications. The overall post-operative complication rate for procedures begun as laparoscopic appendicectomies was 17.8%. There were no statistically significant differences between consultants and trainees in post-operative complication rates (19.2% vs. 13.3%, p=0.46) or in mean total length of hospital stay (4.7 +/- 4.0 vs. 3.4 +/- 3.3, p=0.13). 9.1% of operations performed by consultants were converted to open operation versus 3.3% of those performed by trainees, but this difference was not significant (p=0.45). There were no significant differences between consultants and trainees for a variety of other outcomes including proportions of ICU admissions, re-admissions or the need for a repeat operation.

49 patients had complicated findings at operation. There was no difference in the proportion of appendicectomies with complicated findings performed by consultants or trainees (39.4% vs. 33.3%, p=0.55). Although overall for complicated appendicitis at surgery post-operative complications were greater (28.6% vs. 11.3%, OR 3.16, p=0.01) and mean LOS longer (6.0 +/- 4.3 vs. 3.5 +/- 3.5, p<0.001), there were no significant differences between consultants and trainees.

Discussion

Laparoscopic appendicectomy has become standard in the treatment of acute appendicitis in most hospitals in Ireland. Although it has been shown to have advantages over open appendicectomy, concerns still remain amongst some surgeons about a potential increase in the risk of intra-abdominal abscesses, greater operative risks, longer operative times and the greater technical demand of laparoscopic surgery [4-7]. As a result, there is often reluctance to allow trainees, especially junior trainees, to perform laparoscopic appendicectomies.

Several studies have demonstrated that trainees perform laparoscopic appendicectomies with similar complication rates, rates of conversion to open operation and patientsâ length of hospital stay to consultants [8-10]. However, these studies were performed in large university or teaching hospitals where the training environment differs significantly from peripheral hospitals due to different staffing levels, levels of expertise, on-call duties, staff to patient ratios, levels of supervision, access to special investigations, access to theatre and availability of other specialities. A significant proportion of surgical training in Ireland takes place outside of these settings in peripheral hospitals, with most trainees working at some point during their training in a peripheral hospital. This study demonstrates that trainees can safely perform laparoscopic appendicectomies in a peripheral hospital setting with no significant difference in complication rates, rates of conversion to open operation and length of patientsâ hospital stay to consultant surgeons. The fact that consultants and trainees performed similar proportions of appendicectomies with complicated findings indicates there was no significant difference in the type of patient or complexity of the surgery between the two groups. Furthermore, trainees have similar outcomes to consultants when performing appendicectomies with complicated findings.

The overall complication rate in this study of 17.8% was high. This was because of the broad definition of post-operative complications used. For example, recurrent or persistent abdominal pain was included as a complication so as not to inadvertently exclude patients with potential complications, such as small intraabdominal collections or abscesses, who would not have received imaging and may not be diagnosed but would likely be included in this group. If these patients were excluded, the overall complication rate following laparoscopic appendicectomy would be 10.8%, which is in keeping with that quoted in other studies [4,7,11-13]. Similarly, the mean length of total hospital stay was relatively long. This was because the definition of total hospital stay included not only the hospital stay relating to the original admission but also any future re-admission within 30 days. This was felt to be necessary in case patients whose appendicectomies were performed by any particular grade of surgeon were discharged earlier than others, only to return later, particularly as laparoscopic appendicectomy may be associated with more re-admissions than open appendicectomy [14].

Many trainees are only performing laparoscopic appendicectomies later rather than earlier in their training [2,15], with an Irish study showing a 50% reduction in the number of appendicectomies of any type performed by basic surgical trainees since the introduction of laparoscopic techniques3. Some trainees feel that they may not have mastered even basic laparoscopic techniques such as laparoscopic appendicectomy by the end of their training [16].

Assessment of laparoscopic skills using Hidden Markov Models shows that significant laparoscopic capability develops between the first and third year of surgical training [17]. The learning curve for laparoscopic appendicectomy may be even shorter, with some suggesting proficiency after 20 procedures [18-20]. The European Association for Endoscopic Surgeons (EAES) recommends a minimum of 20 laparoscopic appendicectomies are performed before accreditation [21]. Increasingly enforced restrictions on working time and the trend toward more streamlined, shorter training programs mean that trainees should learn common techniques such as laparoscopic appendicectomy early in their training. The more experience gained in laparoscopic appendicectomy the better the outcome under various degrees of difficulty of the appendicectomy. For example, the rate of post-operative intraabdominal abscess is significantly reduced with laparoscopic appendicectomy performed by surgeons more experienced in this technique working in dedicated laparoscopic

units [22]. Alvarez and Voitk found in a series of 151 laparoscopic appendicectomies that Alvarez was comfortable to perform laparoscopic appendicectomy as standard treatment for perforated appendicitis after performing 20 such procedures [23], which emphasises the value of allowing trainees to begin performing laparoscopic appendicectomies early in their training. It would be ideal for trainees to perform laparoscopic appendicectomy as principal operator within their first year of training9. Furthermore, mastery of more basic laparoscopic techniques early in a traineeâ s career will mean better opportunities to perform more advanced minimal access techniques, which many feel they will be unlikely to master by the end of their training [16,24,25].

Laparoscopic appendicectomy performed by trainees has been shown to be safe in university teaching hospitals, and this study shows it can be performed safely by trainees in a peripheral hospital setting. Laparoscopic appendicectomy should therefore be incorporated into surgical training programs at an early stage of training, allowing trainees to gain experience and a solid grounding in laparoscopic surgery.

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References

1. Sauerland S, Lefering R, Neugebauer EAM. Laparoscopic versus open surgery for suspected appendicitis (Cochrane Review). Cochrane Database of Systematic Reviews 2004, Issue 4. Art. No.: CD001546. DOI: 10.1002/14651858.CD001546.pub2.
2. Hedrick T, Turrentine F, Sanfey H, Schirmer B, Friel C. Implications of laparoscopy on surgery residency training. Am J Surg 2009;197:73-5.
3. McCormick P, Tanner W, Keane F, Tierney S. Minimally Invasive Techniques in Common Surgical Procedures: Implications for Training. Irish J Med Sci 2003;172:27-29.
4. Pederson A, Petersen O, Wara P, Ronning H, Qvist N. Randomized clinical trial of laparoscopic versus open appendicectomy. Br J Surg 2001; 88:200-205.
5. Katkhouda N, Mason RJ, Towfigh S, Gevorgyan A, Essani R. Laparoscopic versus open appendectomy: a prospective randomized double-blind study. Ann Surg 2005 Sep;242:439-48; discussion 448-50.
6. Sporn E, Petroski GF, Mancini GJ, Astudillo JA, Miedema BW, Thaler K. Laparoscopic appendectomy - is it worth the cost? Trend analysis in the US from 2000 to 2005. J Am Coll Surg. 2009 Feb;208:179-185.
7. Kehagias I, Karamanakos SN, Panagiotopoulos S, Panagopoulos K, Kalfarentzos F. Laparoscopic versus open appendectomy: Which way to go? World J Gastroenterol 2008;14:4909-4914.
8. Bencini L, Bernini M, Martini F, Rossi M, Tommassi C, Miranda E, Sanchez LJ, Naspetti R, Manetti R, Ferrara A, Nesi S, Boffi B, Farsi M, Moretti R. Laparoscopic Appendectomy Performed by Residents and Experienced Surgeons. JSLS 2009;13:391-397
9. Sweeney K, Dillon M, Johnston S, Keane F, Conlon K. Training in Laparoscopic Appendectomy. World J Surg 2006;30:358-363.
10. Wong K, Duncan T, Pearson A. Unsupervised Laparoscopic Appendicectomy by Surgical Trainees is Safe and Time-effective. Asian J Surg 2007;30:161â 6.
11. Milewczyk M, Michalik M, Ciesielski M. A prospective, randomized, unicenter study comparing laparoscopic and open treatments of acute appendicitis. Surg Endosc 2003;17:1023â 1028.
12. Moberg AC, Berndsen F, Palmquist I, Petersson U, Resch T, Montgomery A. Randomized clinical trial of laparoscopic versus open appendicectomy for confirmed appendicitis. Br J Surg 2005;92:298-304.
13. Hellberg A, Rudberg C, Kullman E, Enochsson L, Fenyˆ¶ G, Graffner H, Hallerbˇck B, Johansson B, Anderberg B, Wenner J, Ringqvist I, Sˆ¶rensen S. Prospective randomized multicentre study of laparoscopic versus open appendicectomy. Br J Surg 1999;86:48-53.
14. Faiz O, Clark J, Brown T, Bottle A, Antoniou A, Farrands P, Darzi A, Aylin P. Traditional and Laparoscopic Appendectomy in Adults: Outcomes in English NHS Hospitals between 1996 and 2006. Ann Surg 2008;248:800-806.
15. Noble H, Gallagher P, Campbell WB. Who is doing laparoscopic appendicectomies and who taught them? Ann R Coll Surg Engl 2003;85: 331-333.
16. Schijven M, Berlage J, Jakimowicz J. Minimal-access surgery training in the Netherlands. Surg Endosc 2004;18:1805-1814.
17. Rosen J, Solazzo M, Hannaford B, Sinanan M. Objective laparoscopic skills assessments of surgical residents using Hidden Markov Models based on haptic information and tool/tissue interactions. Stud Health Technol Inform 2001;81:417-423.
18. Lin Y, Shabbir, A, So J. Laparoscopic appendectomy by residents: evaluating outcomes and learning curve. Surg Endos 2010;24:125-130.
19. Jaffer U, Cameron A. Laparoscopic Appendectomy: A Junior Traineeâ s Learning Curve. JSLS 2008;12:288-291.
20. Meinke AK, Kossuth T. What is the learning curve for laparoscopic appendicectomy? Surg Endosc 1994;8:371â 5.
21. Neugebauer E, Troidl H, Kum C, Eypasch E, Miserez M, Paul A. The EAES Consensus Development Conferences on laparoscopic cholecystectomy, appendectomy, and hernia repair. Consensus statements â September 1994. The Educational Committee of the European Association for Endoscopic Surgery. Surg Endosc 1995;9:550-563.
22. Hatkhouda N, Friedlander MH, Grant SW, Achanta KK, Essani R, Paik P, Velmahos G, Campos G, Mason R, Mavor E. Intraabdominal Abscess Rate After Laparoscopic Appendectomy. Am J Surg 2000;180:456-461
23. Alvarez C, Voitk, A. The Road to Ambulatory Laparoscopic Management of Perforated Appendicitis. Am J Surg 2000;179:63-66
24. Chiasson PM, Pace DE, Schlata CM, Mamazza J, Poulin EC. Minimally Invasive Surgery Training in Canada. Surg Endosc 2003;17:371-377.
25. Rattner D, Apelgren K, Eubanks W. The need for training opportunities in Minimal Access Surgery. Surg Endosc 2001;15:1066-1070.