

## DAY-CARE LAPAROSCOPIC APPENDECTOMIES

Daniel T. Brosseuk, MD; Oliver F. Bathe, MD, MSc

**OBJECTIVE:** To demonstrate the safety of laparoscopic appendectomy in a day-care setting and to compare patients selected for laparoscopic versus open appendectomy.

**DESIGN:** A retrospective, nonrandomized study.

**SETTING:** A community hospital in a small town in British Columbia.

**PATIENTS:** Ninety-four consecutive patients with a clinical diagnosis of acute appendicitis.

**INTERVENTIONS:** Each patient underwent laparoscopic or open appendectomy as selected by the operating surgeon.

**OUTCOME MEASURES:** Duration of operation and of hospital stay, morbidity and mortality.

**RESULTS:** The average operating time was 32 minutes for open appendectomy and 36 minutes for laparoscopic appendectomy. Two (4%) of the 52 patients who had a laparoscopic appendectomy had significant complications; 1 of them required reoperation for intra-abdominal abscess. Thirty-nine (75%) of the laparoscopic appendectomies were done as day-care procedures. The average length of stay for the remaining patients was 2.1 days. The overall complication rate for patients who underwent open appendectomy was 20%. The average length of stay for these patients was 3.2 days; no patient was discharged within 24 hours.

**CONCLUSIONS:** Laparoscopic appendectomy can be safely performed as a day-care procedure, even for selected patients with gangrenous or perforated appendices. Patients typically selected for open appendectomy include children and those with more advanced infection.

**OBJECTIF :** Démontrer la sécurité de l'appendicectomie par laparoscopie dans un contexte de soins de jour et comparer des patients qui ont subi une laparoscopie à d'autres qui ont subi une appendicectomie ouverte.

**CONCEPTION :** Étude rétrospective non randomisée.

**CONTEXTE :** Petite ville de la Colombie-Britannique.

**PATIENTS :** Quatre-vingt-quatorze patients consécutifs chez lesquels on a posé un diagnostic clinique d'appendicite aigüe.

**INTERVENTIONS :** Chaque patient a subi une appendicectomie par laparoscopie ou une appendicectomie ouverte, au choix du chirurgien.

**MESURES DE RÉSULTATS :** Durée de l'intervention et du séjour à l'hôpital, morbidité et mortalité.

**RÉSULTATS :** L'appendicectomie ouverte a duré en moyenne 32 minutes et l'appendicectomie par laparoscopie, 36 minutes. Deux (4 %) des 52 patients qui ont subi une appendicectomie par laparoscopie ont eu des complications importantes : il a fallu en réopérer un pour un abcès intra-abdominal. Trente-neuf (75 %) des appendicectomies par laparoscopie ont été réalisées en soins de jour. Le séjour des autres patients a duré en moyenne 2,1 jours. Le taux global de complication chez les patients qui ont subi une appendicectomie ouverte a atteint 20 %. Le séjour de ces patients a duré en moyenne 3,2 jours. Aucun n'a reçu son congé dans les 24 heures.

**CONCLUSIONS :** Il est possible de procéder à une appendicectomie par laparoscopie en toute sécurité en contexte de soins de jour, même chez certains patients qui ont un appendice gangrené ou perforé. Les patients chez lesquels on pratique habituellement une appendicectomie ouverte comprennent les enfants et ceux dont l'infection est plus avancée.

*From the Cariboo Memorial Hospital, Williams Lake, BC*

*Presented at the 50th annual meeting of the British Columbia Surgical Society, Victoria, BC, May 1997.*

*Accepted for publication May 29, 1998.*

**Correspondence to:** Dr. Daniel T. Brosseuk, Suite 401, 517 North 6th Ave., Williams Lake BC V2G 2G8; fax 250 398-8287, dbrosseuk@stardate.bc.ca

© 1999 Canadian Medical Association (text and abstract/résumé)

Laparoscopic appendectomy is a safe procedure, but the advantages of the laparoscopic technique over the open technique have been debated.<sup>1-3</sup> Theoretically, the avoidance of a muscle splitting incision, as in the open technique, would spare the patient considerable discomfort and potentially minimize the duration of hospitalization. However, many studies demonstrate only minor advantages with respect to the duration of hospitalization.<sup>4,5</sup> This may represent reluctance on the part of the surgeon to discharge early those patients with acute inflammatory conditions such as appendicitis.

Most surgeons would be particularly reluctant to discharge prematurely patients who had a perforated appendix or diffuse peritonitis. Under these conditions, a prolonged course of parenteral antibiotics is normally recommended. In recent years more powerful antibiotics have been developed in which adequate tissue levels can be achieved by oral administration. For example, the bioavailability after oral administration of metronidazole and the fluoroquinolone ciprofloxacin approaches that after parenteral administration.<sup>6</sup> Further, these antibiotics have a broad spectrum of coverage including gram-negative organisms. In light of the potential advantages for minimally invasive laparoscopic appendectomies and the availability of new powerful antimicrobials it may be feasible to perform laparoscopic appendectomies as day-care procedures, even in selected cases of gangrenous appendicitis or after perforation. Our experience with laparoscopic appendectomies, particularly those performed as day-care procedures, is the subject of this review.

## PATIENTS AND METHODS

The Cariboo Memorial Hospital is

a community hospital serving Williams Lake, BC, and surrounding areas, a total patient population of approximately 40 000. All the appendectomies performed between July 1, 1996, and Feb. 15, 1997, were identified and reviewed. Particular attention was paid to the indications for operation, the type of operation, the operative findings, the postoperative pathological findings, the antibiotics administered, the length of procedure, the duration of hospitalization and the complications. Pathologically the appendix was classified as normal, inflamed, gangrenous or perforated. When there was disagreement between an intraoperative diagnosis and a postoperative pathological diagnosis, the pathological diagnosis was recorded.

Generally, the following principles we adhered to: a clinical presentation suggestive of appendicitis in an adult warranted a diagnostic laparoscopy. Children up to 13 years of age usually underwent immediate laparotomy through an incision centred over McBurney's point, because their small size makes laparoscopic appendectomy more difficult and the size of their (open) incision approximated the size of the incisions that would be required for a laparoscopic procedure. At the time of laparoscopy, it was decided whether appendectomy was indicated and, if indicated, whether it would be feasible to perform the procedure laparoscopically. Antibiotics were administered intravenously as a single dose preoperatively; if much inflammation was encountered, 1 to 2 postoperative doses were given. Patients were discharged within 24 hours if they had satisfactory home arrangements, were considered reliable for follow-up and had no prohibitive comorbid conditions. Patients with a gangrenous appendix or perforation who were admitted to hospital

were given a full 7-day course of antibiotics intravenously. Patients with a gangrenous appendix or perforation who were selected for discharge within 24 hours were prescribed oral ciprofloxacin and metronidazole to complete a 7-day course of antibiotics. Patients with contraindications to these antibiotics (e.g., children and patients with allergies) were not discharged so early.

Laparoscopic appendectomies were performed by a 3-trocar technique. We use the following port placements: an infraumbilical 10-mm port for the 30° laparoscope; a right lateral 5-mm port and a left suprapubic 10-mm port. Some procedures initially were performed using an endogastrointestinal anastomotic stapling device to divide the mesoappendix and base of the appendix. This technique has since been abandoned as it is more expensive and not significantly faster than that using Vicryl endoloop ligatures. The appendix was removed through the 10-mm port in the left lower quadrant. If it was too bulky to pull into the port with ease, it was removed after intra-abdominal placement in a sterile plastic bag introduced into the abdomen through the 10-mm port.

## FINDINGS

During the study period, 94 appendectomies were performed: 35 were open appendectomies, 52 were laparoscopic appendectomies, and 7 were laparoscopic procedures converted to an open procedure. The clinical characteristics of patients are summarized in Table I.

Eight (23%) patients who underwent an open appendectomy had significant concomitant illnesses including leukemia, malignant hypertension, hemochromatosis, anemia, diabetes, seizure disorder, gastric leiomyoma and medically controlled hyperthy-

roidism. Most of the patients who underwent an immediate open procedure were younger than 14 years. Three had open procedures for different reasons: one had a large periappendiceal mass, another presented with complete bowel obstruction and the third had a history of numerous lower abdominal operations. The average length of operation was 32 minutes (range from 15 to 100 minutes); the longest operation consisted of a right hemicolectomy for complicated periappendiceal abscess. None of these patients was discharged within 24 hours.

Four (8%) of the 52 patients who underwent laparoscopic appendectomy had significant comorbidity including diet-controlled diabetes mellitus, hypothyroidism, ulcerative colitis treated with steroids, and pregnancy (18 weeks' gestation); only the diabetic was managed by day care. The average length of operation was 36 minutes (range from 15 to 65 minutes). The longest operation consisted of removal of a normal appendix followed by laparoscopic repair of an incarcerated in-

guinal hernia (suture technique — no mesh used). Thirty-nine of the patients who underwent laparoscopic appendectomy were discharged within 24 hours, most within 8 hours. The average length of stay for the 13 patients who were admitted after laparoscopic appendectomy was 2.2 days.

Of the 39 patients who underwent a laparoscopic appendectomy as a day-care procedure, the average age was 29 years (range from 11 to 55 years). Only 1 patient had a significant concomitant illness: diet-controlled diabetes. All had easy access to a medical facility and family support in the event of any complication. Of these 39 patients, 12 (31%) had normal appendices, 16 (41%) had inflamed appendices and 11 (28%) had perforated or gangrenous appendices. The clinical characteristics of patients who underwent laparoscopic appendectomy as a day-care procedure are summarized in Table II.

Of the 7 patients who underwent a laparoscopic appendectomy converted to an open procedure, 2 had significant comorbidity: 1 was an insulin-

dependent diabetic, the other had concomitant acute cholecystitis (with the distal one-third of the appendix adherent to the gallbladder). One patient had numerous pelvic abscesses. In 1 patient the laparoscopic procedure was converted to an open procedure owing to equipment failure. The average time of operation was 42 minutes (range from 26 to 60 minutes). No patient in this group was discharged within 24 hours.

Of all the patients who had an open appendectomy, the total complication rate was 20%, and most of these complications were minor. There were 2 wound hematomas. One patient had an extended admission for severe postoperative nausea. One patient had pneumonia on the third postoperative day and 2 patients presented with wound infections on postoperative days 5 and 6. Finally, 1 patient returned 2 weeks after the procedure with fever, leukocytosis and a decreased hemoglobin level. Ultrasonography was done but no abnormality was found. This postoperative inflammatory condition resolved spontaneously.

The complication rate was 3.8% for all those who had laparoscopic appendectomy and was 2.6% for the subgroup who had day-care laparoscopic

**Table I**

**Clinical Characteristics of Patients Who Underwent Laparoscopic, Open and Laparoscopic Converted to Open Appendectomy**

Characteristic	Laparoscopic (n = 52)	Open (n = 35)	Converted (n = 7)
Age, yr			
Mean (and SD)	29 (13)	20 (19)	38 (16)
Range	11–65	7–70	11–53
Significant comorbidity, no. (and %)	4 (8)	8 (23)	2 (28)
Pathological findings, no. (and %)			
Normal	18 (35)	9 (26)	0 (0)
Inflamed	19 (36)	14 (40)	2 (28)
Gangrenous/perforated	15 (29)	12 (35)	5 (71)
Complications, no. (and %)	2 (4)	7 (20)	3 (43)
Length of operation, mean (and SD), min	36 (10)	32 (19)	42 (14)
Duration of hospitalization, mean (and SD), d*	2.2 (0.8)	3.3 (2.2)	5.3 (2.4)

\*Excludes 39 day-care procedures.  
SD = standard deviation.

**Table II**

**Characteristics of 39 Patients Who Underwent Laparoscopic Appendectomy as a Day-Care Procedure**

Characteristic	No.	%
Age, yr*	29	11
Significant comorbidity	1	2.6
Pathological findings		
Normal	12	31
Inflamed	16	41
Gangrenous/perforated	11	28
Complications	1	2.6

\*Mean and standard deviation

appendectomy: 1 patient who had laparoscopic appendectomy but was admitted had pneumonia on postoperative day 7, and 1 of the day-care patients presented on postoperative day 3 with an intra-abdominal abscess, which was drained at a subsequent laparotomy. Two day-care patients returned to the emergency department but were not included in this complication rate. One returned 24 hours after discharge with nausea and vomiting and another was assessed in the emergency department 24 hours after her procedure for weakness and fatigue. Both were discharged with no further interventions. Finally, of those patients who had laparoscopic appendectomy converted to open appendectomy, 1 had a wound infection, 1 had a prolonged postoperative ileus and 1 was reassessed 20 days after his procedure because of wound pain for which no cause could be identified, for a complication rate of 43% in this group.

## DISCUSSION

The major theoretic advantage of laparoscopic surgery is reduced morbidity related to the surgical wound and faster recovery in the postoperative period. In the case of laparoscopic appendectomy, however, many studies have not demonstrated a significant advantage over the open procedure. We believe that this mainly represents a reluctance on the surgeon's part to discharge patients early after successful treatment of acute appendicitis. Our series demonstrates that properly selected adults can be discharged safely within 24 hours of laparoscopic appendectomy.

Our general approach to adult patients with signs and symptoms suggestive of appendicitis includes early laparoscopy and in most cases laparoscopic appendectomy. In Williams Lake, BC, ultrasonography is another

diagnostic modality that is available, but it is not always available at night and is not as accurate as direct inspection by laparoscopy, which is a relatively low-risk procedure. On the other hand, the consequences of missed appendicitis and perforation are potentially fatal and frequently associated with long-term morbidity. For this reason, we advocate a relatively liberal use of diagnostic laparoscopy, particularly in young females.

Our liberal use of diagnostic laparoscopy results in removal of a relatively high number of normal appendices. In the literature on open appendectomy, most authors take a less aggressive approach; typically, normal appendices are encountered in 10% to 20% of open appendectomies.<sup>7</sup> But, as in our series, other investigators reporting series of laparoscopic appendectomies have found higher proportions of patients with normal appendices.<sup>2,8</sup> It appears, therefore, that other groups are taking a similar approach to the diagnosis of intra-abdominal disorders.

Appendectomy adds little to the morbidity associated with diagnostic laparoscopy, especially since we have been treating these patients on a day-care basis. So far, we have not encountered any complication of appendectomy done in this *en passant* fashion. Very little extra operating-room time is required to remove a noninflamed appendix. The potential benefit to the patient is that appendicitis is eliminated as a diagnostic consideration if similar symptoms occur in the future. Further, we have encountered a few cases in which the appendix appears normal on laparoscopic inspection, and histopathologic examination reveals appendicitis. Although the natural history of such cases is unknown, some of these cases probably progress to more severe forms of appendicitis. Therefore, we believe that incidental

appendectomy is the safest course in patients with suspicious clinical findings and a negative diagnostic laparoscopy.

Our complication rate for patients who underwent laparoscopic appendectomy was quite low (4%), far less than that encountered with open appendectomy. This is because patients who had open appendectomy or who had converted appendectomy tended to have more severe disease. The low complication rate for the laparoscopic procedure could also be partially attributable to the fact that laparoscopy affords an excellent opportunity for high-volume peritoneal toilet in the face of a perforated appendix.

Patients with an uncomplicated laparoscopic appendectomy and no systemic signs of sepsis and with minimal comorbidity are prime candidates for early postoperative discharge. To make this approach work, however, it is crucial that adequate follow-up is provided. Complications such as the development of intra-abdominal abscesses and wound infections are likely to become apparent in 3 to 10 days. We do not believe that keeping patients hospitalized for any longer than 24 hours will prevent these complications. In our series, most complications would have occurred after discharge even if the patients had been admitted, since our average length of stay in the open appendectomy group was 3.2 days. Clearly, for patients with systemic signs of sepsis, a prolonged course of parenterally administered antibiotics is required. In contrast, for those with a perforation or with gangrenous appendicitis in the absence of frank sepsis, ciprofloxacin and metronidazole taken orally should suffice. With the availability of such powerful antibiotics and with good follow-up there is no reason why the majority of laparoscopic appendectomies cannot be done as day-care procedures.

One of the main arguments against performing laparoscopic appendectomy has been increased cost. We did not do a cost analysis on our patients, but a few points can be made in this regard. We do not use any disposable instrumentation in our laparoscopic procedures, so instrument costs should not be significantly higher. The average length of operation in our laparoscopic appendectomy group was 36 minutes. Although we cannot directly compare this to the 32 minutes operating time in our open appendectomy group because of the obvious differences between the 2 patient populations, when compared with reported operating times of 40 minutes,<sup>9</sup> 45 minutes<sup>10</sup> and 64 minutes<sup>11</sup> for open appendectomy, there would not appear to be a significant increase in operating-room times for the laparoscopic procedure. Most of these patients are discharged from hospital the same day, therefore hospital costs should be considerably less than for open appendectomy. Complication rates were not significantly higher in the laparoscopic appendectomy group, therefore costs after discharge should not be higher. Given all of this we conclude that laparoscopic appendectomy should incur considerably less cost than open appendectomy.

Our series represents consecutive patients with signs and symptoms consistent with appendicitis referred to general surgeons at a small community hospital and selected for operative intervention. We have demonstrated that laparoscopic appendectomy can be safely performed as a day-care procedure in selected patients, even in some with a gangrenous or perforated appendix. This likely represents a cost-effective therapeutic strategy for appendicitis.

## References

- Hart R, Rajgopal C, Plewes A, Sweeney J, Davies W, Gray D. Laparoscopic versus open appendectomy: a prospective randomized trial of 81 patients. *Can J Surg* 1996;39(6):457-62.
- Apelgren KN, Molnar RG, Kisala JM. Laparoscopic is not better than open appendectomy. *Am Surg* 1995;61(3):240-3.
- Martin LC, Puente I, Sosa JL, Bassin A, Breslaw R, McKenney MG, et al. Open versus laparoscopic appendectomy. A prospective randomized comparison. *Ann Surg* 1995;222(3):256-61.
- Mutter D, Vix M, Bui A, Evrard S, Tasseti V, Breton JF, et al. Laparoscopy not recommended for routine appendectomy in men: results of a prospective randomized study. *Surgery* 1996;120(1):71-4.
- Ortega AE, Hunter JG, Peters JH, Swanstrom SL, Schirmer B. A prospective, randomized comparison of laparoscopic appendectomy with open appendectomy. Laparoscopic Appendectomy Study Group. *Am J Surg* 1995;169(2):208-12.
- Canadian Pharmaceutical Association. *Compendium of pharmaceuticals and specialties*. 32nd ed. Ottawa: The Association; 1997.
- Schwartz SI. Appendix. In: Schwartz SI, Shires GT, Spencer FC. *Principles of surgery*. 6th ed. New York: McGraw-Hill; 1994. p. 1307-18.
- Kollias J, Harries RH, Otto G, Hamilton DW, Cox JS, Gallery RM. Laparoscopic versus open appendectomy for suspected appendicitis: a prospective study. *Aust N Z J Surg* 1994;64(12):830-5.
- Hansen JB, Smithers BM, Schache D, Wall DR, Miller BJ, Menzies BL. Laparoscopic versus open appendectomy: prospective randomized trial. *World J Surg* 1996;20(1):17-20.
- Schroder DM, Lathrop JC, Lloyd LR, Boccaccio JE, Hawasli A. Laparoscopic appendectomy for acute appendicitis: Is there really any benefit? *Am Surg* 1993;59(8):541-7.
- Heinzelmann M, Simmen HP, Cummins AS, Largiader F. Is laparoscopic appendectomy the new 'gold standard'? *Arch Surg* 1995;130(7):782-5.