

# Open or laparoscopic appendectomy?

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Videosurgery and other miniinvasive techniques 2009; 4 (3): 110-114

## Abstract

**Introduction:** Laparoscopy is now used more and more frequently in the treatment of patients with acute surgical abdominal diseases. Acute appendicitis is the commonest indication for emergency abdominal surgery.

**Aim:** To present the results of the treatment of patients with acute appendicitis and to compare the results of laparoscopic and open appendectomies.

**Material and methods:** Seven hundred and fifteen patients with acute appendicitis were operated on in the 2<sup>nd</sup> Department of General Surgery of the Jagiellonian University from 1996 to 2005. We performed 450 laparoscopic (63%) and 265 open procedures (37%). There were 249 females (55%) and 201 males (45%) in the laparoscopic group. Open approach was used in 109 women (41%) and 156 men (59%). The average age of patients in the laparoscopic group was 29.1 years (SD = 14.9) and 35.4 years (SD = 18.2) in the open group.

**Results:** Laparoscopic appendectomies were performed more and more frequently over the analyzed period. The complication rate in the minimally invasive procedure group was 3.3% as compared to 15.1% in the open group. The average hospital stay was shorter after laparoscopic appendectomy (4.8 vs. 10.4 days). The conversion rate was low (4.5%).

**Conclusions:** Laparoscopic appendectomy is a safe procedure associated with shorter hospital stay and decreased complication rates as compared to the open procedure.

**Key words:** laparoscopic appendectomy, open appendectomy, results, conversions.

## Introduction

The launch of laparoscopic technique has definitely changed contemporary surgery. With accumulation of experience and progress in armamentarium technology the number and types of procedures routinely performed with minimally invasive technique have grown. Laparoscopy is more often applied not only in planned surgery, but also in emergency procedures done for acute abdominal disease [1].

Suspected appendicitis is undoubtedly the most common indication for emergency surgical intervention. From the first time laparoscopic appendectomy was performed by Semm, after an initial

period of scepticism, it gradually became a more and more popular treatment method [1-3].

Many papers confirm the benefits afforded by minimally invasive appendectomy when compared to open surgery. These benefits are attributable to reduction of post-operative pain, shortening of hospital stay and decreased risk of complications, especially wound healing complications, as much as to faster recovery of normal life activity [4-11]. In addition, results of meta-analyses, including the 2004 Cochrane group report, unquestionably recommend laparoscopy in suspected acute appendicitis [6, 7]. There are however notions showing only minimal benefit from laparoscopic appendectomy, with higher cost of this method of surgical treatment [12-14]. Yet,

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significant increase in popularity of laparoscopic appendectomy for acute appendicitis can now be seen with numerous centres using this method routinely [6, 15].

## Aim

The aim of this study was retrospective analysis of classical and laparoscopic appendectomy results, comparison of utilization dynamics of the latter technique over the years, and assessment of benefits attributable to the minimally invasive method.

## Material and methods

The study was performed in patients treated in the 2<sup>nd</sup> Department of General Surgery of the Jagiellonian University *Collegium Medicum* for acute appendicitis in 1996-2005. Retrospective analysis included such factors as: number of patients, age, sex and type of performed surgery. Number of laparoscopic and classical procedures performed for appendicitis each year was compared. Analysis included also complications and conversions which occurred in the study group.

Apart from trauma surgery, appendectomy for acute appendicitis is the most common emergency surgery performed in emergency service. In the analyzed period 715 patients had an appendectomy performed in the 2<sup>nd</sup> Department of Surgery of *Collegium Medicum* of the Jagiellonian University. The majority of them – 450 – were operated on with laparoscopy. Thus, minimally invasive procedures accounted for 63% of all these procedures.

Among patients operated on with laparoscopy, 249 (55%) were women and 201 (45%) were men. Classical appendectomy was done in 109 women (41%) and 156 men (59%). Mean age of patients appendectomized with the minimally invasive method was 29.1 years (SD = 14.9) and was a little shorter than in patients who underwent classical surgery (35.4 years, SD = 18.2).

Of 450 patients in whom laparoscopic appendectomy was performed, acute appendicitis was confirmed intra-operatively in 369 (82%), including 45 simple appendicitis (10%), 271 phlegmonous (60%), 36 gangrenous (8%) and 17 perforated (4%) cases. In the remaining 81 (18%) patients operated on with minimally invasive technique no pathological findings were encountered within the appendix.

Of the latter group, 27 patients (6%) had undergone some additional procedures, i.e.: laparoscopic suturing of perforated peptic ulcer, inflamed Meckel's diverticulum resection, and gynaecological procedures (most often for ovarian cyst). In 54 of these patients (12%), no intra-abdominal pathology requiring surgical treatment was found, with mesenteric lymphadenitis, salpingitis or ovulation being a cause of abdominal symptoms.

In 265 patients who underwent classical appendectomy, pre-operative diagnosis was confirmed in 220 patients (83%), including 13 (5%) patients with simple, 152 (57%) with phlegmonous, 42 (16%) with gangrenous and 13 (5%) with perforated appendicitis. The remaining 45 patients (17%) had abdominal symptoms of other origin: in 24 (9%) patients pathology requiring emergency surgery was found, and in 21 (8%) patients other procedures were performed simultaneously (gynaecological, inflamed Meckel's diverticulum resection).

Choice of the appendectomy method each time relied on the individual decision of the operating surgeon.

Pre-operative patient workout was identical in both groups. Basic lab tests, abdominal ultrasound, chest X-ray and electrocardiogram were performed in each case. All patients were consulted by an anaesthesiologist prior to surgery. Combination general anaesthesia was applied. In laparoscopic appendectomies, pneumoperitoneum was achieved with CO<sub>2</sub> until 12 mm Hg pressure. When anti-coagulation prophylaxis was indicated, low molecular weight heparin was administered in the peri-operative period until complete patient mobilization. Classical appendectomies were performed in a typical manner, using lower paramedian incision. After mesoappendix ligation, the stump of the appendix was invaginated into the caecum with a running purse-string suture.

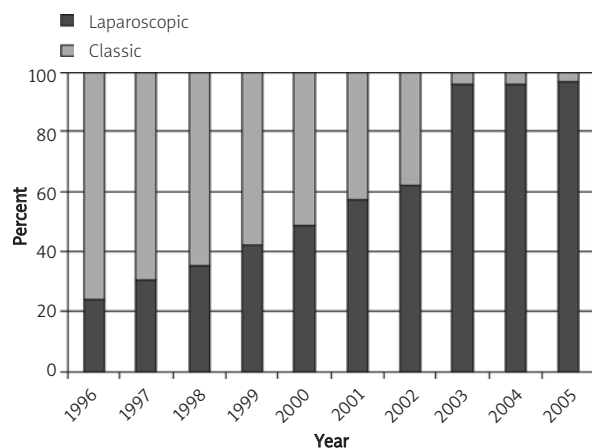
In the beginning of the analyzed period minimally invasive procedures were sporadic, but their number has increased greatly since an experienced laparoscopic surgeon is always available on call and each patient is qualified for this type of surgery. During laparoscopic procedures the patient was lying in a supine position with legs joined together, while the surgeon and assistant stayed at his/her left side. Usually, three trocars were placed: 10 mm in the umbilicus, 12 or 15 mm above the pubic symphysis, and 5 mm port above the right iliac crest. After

mobilization of the appendix, its mesentery was cut with one of a few methods. A harmonic scalpel was used most often, bipolar coagulation less frequently, and clips or a vascular laparoscopic stapler were seldom applied. Then, the appendix was cut at its base with an Endo-GIA laparoscopic stapler or an intra-abdominal running purse-string suture was placed for appendiceal stump invagination into the caecum, similarly to the classical procedure.

### Results

Frequency of laparoscopic appendectomies has increased greatly over the analyzed period. In the beginning, in 1997 they represented only 24%, in 2000 already 51%, in 2002 62%, and in the latest years nearly all patients with suspected acute appendicitis were qualified for minimally invasive procedure and open surgeries were virtually only conversion cases (Figure 1).

Mean hospitalization time in patients after laparoscopic appendectomy was 4.8 days (SD = 2.4). No death was observed in the analyzed group of patients. Complications developed in 15 patients



**Figure 1.** Rate of laparoscopic and classical appendectomies in each year of the analyzed period

(3.3%) including 1 intraoperative lesion of the right ureter requiring its post-operative catheterization and 14 post-operative complications (3.1%) with 2 intra-abdominal abscesses, 2 bleedings requiring repeated laparoscopy, 6 wound infections in trocar sites, 2 urinary tract infections and 2 cases of pneumonia. The procedure was commenced laparoscopically in 471 patients and in 21 conversion to open technique was necessary (usually in retrocaecal localization of the appendix). Thus, the conversion rate in the studied period was low (4.5%).

Patients after classical appendectomy remained longer in hospital, on average 10.4 days (SD = 7.9). Two deaths were seen in this group. Altogether, complications were seen in 40 patients operated on with open technique, which represents 15.1%. All complications occurred in the post-operative period. Wound infection was seen in 27 patients, wound haematoma in 2, wound dehiscence requiring re-suturing in 2, intra-abdominal abscess treated with percutaneous drainage occurred in 2 patients, respiratory insufficiency which required temporary ventilatory support was observed in 1 patient, pneumonia in 4 patients and urinary tract infection in 2.

Results from both study groups are shown in Table I.

### Discussion

Acute appendicitis is the most common indication for emergency surgical intervention [16]. In the era preceding laparoscopy, for over a century treatment consisted of classic appendectomy. In recent years, the frequency of laparoscopic appendectomies, which is a valuable alternative to open surgery, has been increasing [1-3, 16-18]. There are centres using this technology routinely. Until now however, in the literature there is no valid consensus regarding minimally invasive appendectomy as a method of choice in treatment of patients with suspicion of acute

**Table I.** Results of laparoscopic and classical appendectomies performed in 1996-2005

Type of procedure	Number of patients	Mean age [years] (SD)	Men n (%)	Women n (%)	Mean hospital stay [days] (SD)	Post-op complication rate [%]	Post-op wound infection rate [%]
laparoscopic	450	29.1 (14.9)	201 (45%)	249 (55%)	4.8 (2.4)	3.3	1.3
classical	265	35.4 (18.2)	156 (59%)	109 (41%)	10.4 (7.9)	15.1	10.2

appendicitis. Most authors believe laparoscopy brings substantial benefit for the patient. Shortening of postoperative hospitalization, less postoperative pain and – above all – lower rate of infectious complications in comparison to classic procedures are emphasized [4-9]. However, there are also notions which negate these observations and stress the higher direct cost of this method of surgical treatment [12-14]. Results obtained in our material show significant advantages of the minimally invasive method in treatment of patients with acute appendicitis and hence, after an initial period of applying both methods, laparoscopy has now become a routine procedure.

No mortality was observed in patients operated on with laparoscopy. This is concordant with the majority of other publications, which point to very low mortality (approximately 0.05%) attributed to minimally invasive appendectomy when compared to much higher mortality (0.3%) in classical procedures [9]. Our results also indicate that laparoscopic appendectomy is a safe procedure which can be broadly applied.

The total complication rate after minimally invasive procedures was 3.3%. So, it was significantly lower than after classic procedures, which were complicated in 15.1% of operated patients. Our results are in accordance with other authors' data [4-6, 19, 20].

Some authors point to a significantly higher rate of intra-abdominal abscesses after minimally invasive appendectomy, especially when perforation or gangrene is present [9]. Accurate surgical technique with thorough, although sometimes time-consuming peritoneal lavage, proper drainage and adequate antibiotic therapy can have a significant impact on reduction of the intra-abdominal abscess rate after laparoscopic appendectomy [20]. In our group, intra-abdominal abscess was seen only in 2 patients (0.4%) after laparoscopic appendectomy and in 2 (0.8%) after the classic procedure.

Wound infections were seen in the laparoscopy-operated group in 6 patients (1.3%). The wound infection rate was a few times higher after the classic procedure and corresponded to 10.2% (27 patients). These complications significantly increased the hospitalization time of patients operated on with the open technique. Besides, infection in a minute wound after trocar placement is a totally different problem than infection in a much longer laparotomy incision. Lower frequency of infections after laparoscopic

appendectomy has been described by numerous authors [9, 21]. In our opinion, reduction of the surgical site infection rate can be achieved with removal of the appendix in a sheath.

The mean hospitalization time observed by us was significantly shorter after laparoscopic appendectomy (4.8 vs. 10.4 days). This is fully concordant with the literature. Smaller surgical trauma with laparoscopic appendectomy allows for faster introduction of a normal diet and recovery of preoperative fitness and life activity. Relatively long hospitalization times in both compared groups in our material result from long-term postoperative hospitalization times in the early years of the studied period. In the latest period, post-operative hospital stay has shortened significantly.

Conversion rate in the analyzed period was as low as 4.5%. Change of laparoscopic to open technique was most often forced by retrocaecal localization of the appendix or significant inflammatory infiltrate which prevented a safe laparoscopic procedure. Infrequent conversions in our material result from substantial operative team experience in this type of procedure.

Obese patients may also benefit from the laparoscopic method of appendectomy, mostly due to improved post-operative course and reduced complication rate, especially from the wound site, which is a serious problem in this group of patients. According to some authors, laparoscopic appendectomy is a method of choice in these patients and gives much better results than classic access [22, 23].

Childbearing age women are another group of patients who may benefit from the laparoscopic method. Gynaecological diseases or even ovulation are common causes of acute abdominal symptoms in these patients. When there are doubts in decision making for surgery, laparoscopy makes definite determination of intra-abdominal pathology possible and allows for avoidance of unnecessary laparotomy and risk of adhesions, which can be a cause of intestinal obstruction or infertility in long-term observation [24].

## Conclusions

In suspected acute appendicitis, laparoscopy is a safe method allowing precise diagnosis and definite treatment in the prevailing majority of patients. Moreover, patients undergoing laparoscopic appendectomy benefit from all the advantages

of minimally invasive technique. Application of this method particularly influences post-operative hospital stay and, especially infectious, complication rate.

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