ORIGINAL ARTICLE

Surgeon's Definition of Complicated Appendicitis: A Prospective Video Survey Study

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Abstract

Aim: Definition of the type of appendicitis is based on examination of the peritoneum and appendix. Gomes et al. proposed a laparoscopic grading system of acute appendicitis (grades 1 and 2, noncomplicated appendicitis, grade 3–5 complicated appendicitis). The aim of this study was to evaluate the reproducibility of this score.

Patients and methods: All patients managed for acute appendicitis between January 2016 and June 2016 were included in this single-center prospective study. Laparoscopic appendectomy procedures were filmed by analogy to Sugerbaker's peritoneal carcinomatosis score (9 quadrants, all of the abdomen was filmed). The videos were then analyzed by seven staff surgeons blinded to each other and the operative report. The primary endpoint was to determine the concordance between staff surgeons for grading of appendicitis using the laparoscopic grading system of acute appendicitis described by Gomes et al.

Results: A total of 40 patients were included in this study. A concordance was observed between the seven staff surgeons in 85% of cases. For regional peritonitis, the mean ± (SD) number of quadrants in which the staff surgeons reported signs of peritonitis was 1.44 ± 0.63. For diffuse peritonitis, the mean (SD) number of quadrants in which the staff surgeons reported signs of peritonitis was 2.59 ± 0.51. On ROC curve analysis, two quadrants was the best cut-off between grade 4B (local peritonitis) and five (diffuse peritonitis) acute appendicitis (AUC = 0.92, Se = 100%, Sp = 92%, $p = 0.005$).

Conclusion: The classification used to determine the type of appendicitis is reproducible.

Clinical significance: To give a definition of complicated appendicitis.

Keywords: Appendicitis, Generalized, Localized, Peritonitis.

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Introduction

Acute appendicitis (AA) is one of the most frequent surgical emergencies with a lifetime risk of 7–8%.[1] Various types of appendicitis are described, ranging from noncomplicated appendicitis to fecal peritonitis.[2]

Definition of the type of appendicitis (based on the appearance of the appendix and peritoneum) is important, as it determines the type of preoperative management (ambulatory surgery or immediate surgery),[3-5] intraoperative management (aspiration, lavage) and subsequent management (hospitalization, postoperative antibiotic therapy). The type of appendicitis also has a direct impact on postoperative morbidity.

The nature of appendicitis (complicated or not) can be determinate preoperatively with high specificity,[6] but this definition must be confirmed preoperatively. Localized or generalized appendicitis must also be confirmed peroperatively. Definition of the type of appendicitis is an operative diagnosis. Complicated appendicitis is defined as perforated appendicitis, periappendicular abscess or peritonitis, defined as acute inflammation of the peritoneum secondary to infection of the appendix. Purulent peritonitis is defined by the presence of purulent fluid and fecal peritonitis corresponds to the presence of fecal matter in the peritoneal cavity. However, operative description of peritonitis has not been standardized (in particular, the distinction between regional and diffuse peritonitis remains unclear), and can vary from one surgeon to another, but this description has a direct impact on the preoperative, operative and postoperative management of patients and can have a direct impact on the reproducibility of the outcomes of studies on the management of appendicular peritonitis. A clear definition of complicated appendicitis is essential to design studies, interpret data, and, more generally, ensure appropriate management of patients. In 2012, Gomes et al. proposed a laparoscopic grading system of acute appendicitis.[7] This score classifies appendicitis based on the description of the appendix and the peritoneum into 5 grades. Grades 1 and 2 correspond to uncomplicated appendicitis and grades 3–5 correspond to complicated appendicitis (Table 1). The authors compared the laparoscopic grading system to the histopathological assessment of the removed appendix and biochemical analysis of the peritoneal fluid. No external validation of this score has been performed.

The aim of this study was to perform an external validation of this score by evaluating the concordance of this score between surgeons to propose a clear definition for each type of appendicitis.

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Conflict of interest: Nil

Table 1: Laparoscopic grading system of acute appendicitis

Grade	*Laparoscopic findings*
0	Normal looking appendix
1	Hyperemia and edema
2	Fibrinous exudate
3A	Segmental necrosis
3B	Base necrosis
4A	Abscess
4B	Regional peritonitis
5	Diffuse peritonitis

Patients and Methods

Study Design

All patients managed for acute appendicitis between January 2016 and June 2016 were included in this prospective single-center study. The appearance of the appendix and peritoneum was clearly described in all operative reports. Laparoscopic appendectomy is always the first choice. Laparoscopic appendectomy procedures were filmed using an HD camera from the insertion of the camera into the abdomen until the end of laparoscopy. The entire abdomen (9 quadrants) was systematically filmed. A video montage was then performed by one of the authors (MM) to produce one-minute sequences showing the nine quadrants of the abdomen by analogy with Sugerbaker's score of peritoneal carcinomatosis and the appendix, as described below. All videos were then saved in a dedicated file. A blinded number was randomly assigned to all the videos. The videos were then analyzed by seven staff surgeons (three first year consultant surgeons, three second year consultant surgeons and one surgeon with 5 years of experience) blinded to each other and to the operative report. The surgeons reported their findings using the Gomes classification on an Excel file using the blinded number of each video. Grades 1 and 2 corresponded to uncomplicated appendicitis and grades 3, 4 and 5 corresponded to complicated appendicitis (Table 1).

Inclusion Criteria

All patients with acute appendicitis, operated as an emergency by laparoscopy during the study period and in whom all quadrants of the abdomen could be explored by laparoscopy were included in the study. Patients operated by laparotomy or operated by laparoscopy with poor quality video or in whom certain quadrants could not be explored were not included in the study.

Endpoints

Primary Endpoint

The primary endpoint was to determine the concordance between staff surgeons for grading of appendicitis using the laparoscopic grading system of acute appendicitis described by Gomes et al.[7] Concordant grading was arbitrarily defined when at least five of the seven staff surgeons agreed on the grade of appendicitis.

Secondary Endpoints

The secondary endpoints were:

- For grades 4B and 5 of the laparoscopic grading system of acute appendicitis, to determine the mean number of quadrants in which the surgeon reported signs of peritonitis and to provide a clear definition of regional (grade 4B) and diffuse peritonitis (grade 5).
- To determine the concordance between the staff surgeons and the initial operative report after unblinding.
- To compare the difference between postoperative antibiotic therapy guidelines according to the type of peritonitis (regional, diffuse, purulent, fecal) and actual prescription of postoperative antibiotic therapy.

Definitions

Gomes Laparoscopic Grading System of Acute Appendicitis[7]

The laparoscopic grading system of acute appendicitis was developed by Gomes et al.[7]

In their prospective study, the authors described 5 laparoscopic grades of acute appendicitis (Table 1) and correlated this score with histopathological examination of the removed appendix and biochemical analysis of the peritoneal fluid. The sensitivity, specificity, and accuracy for the diagnosis of acute appendicitis grade were: 63%, 83.3%, and 80.1%, respectively. Two main groups of patients can be distinguished: grades 1 and 2 correspond to noncomplicated appendicitis and grades 3, 4 and 5 correspond to complicated appendicitis.

Video Recording of Laparoscopy

All procedures were performed by one of the seven staff surgeons. A standard laparoscopic appendectomy operative technique was performed. All procedures were filmed in high definition. Whenever possible (no adhesions), an exploratory laparoscopy was performed prior to any surgical procedure, comprising exploration of all quadrants of the abdomen by analogy with Sugerbaker's score of peritoneal carcinomatosis.[8] Patients in whom all quadrants of the abdomen could not be explored were not included in this study.

Analysis of Video Recordings

The videos were analyzed independently and blindly with no additional information about the patients by seven staff surgeons. The videos were saved in a computer file, and all seven staff surgeons had direct access to the video and an individual Excel file (without access to the Excel files of the other staff surgeons).

They determined the status of the appendix according to the laparoscopic grading system of acute appendicitis (Table 1). In the case of grade 4B and grade 5, they also classified whether the peritonitis was purulent or fecal. In the presence of peritonitis, they also determined the number of quadrants contaminated.

Postoperative Antibiotic Therapy

According to national guidelines, patients should not receive postoperative antibiotic therapy in the absence of peritonitis, patients should receive 48–72 hours of postoperative antibiotic therapy in the presence of regional peritonitis, patients should receive 5 days of postoperative antibiotic therapy in the presence of diffuse peritonitis, and patients should receive 7–10 days of postoperative antibiotic therapy in the presence of fecal peritonitis. The duration of the postoperative antibiotic therapy can be considered to be a surrogate endpoint for the appearance of the peritoneum and was used to verify matching between the description of the peritoneum and the duration of postoperative antibiotic therapy.[9]

Statistical Analysis and Ethical Approval

Chi-square tests or Fisher's exact tests were used to compare categorical variables and Student's or Mann–Whitney tests were used to compare quantitative variables. ROC curve analysis was performed to determine the best cutoff between regional and

diffuse peritonitis (grade 4B and 5) as described by the 7 staff surgeons. A p value <0.05 was considered to be statistically significant. All variables with a p value <0.05 were included in the multivariate model. As the concordance test was applicable for more than 30 patients, 40 patients were therefore included in the study. All statistical analyses were performed with statistical package for the social sciences (SPSS) for Macintosh® software (version 22.0, SPSS Inc., Chicago, IL, USA). This observational non-therapeutic study was conducted according to the national guidelines and no specific IRB or inform consent was required.

Results

A total of 40 patients were included in the study: 26 men (65%) with a mean (SD) age of 35 years ± 14, and a mean ± (SD) body mass index (BMI) of 23.8 ± 8.8. Patient characteristics are detailed in Table 2.

Endpoints

Primary Endpoint

A concordance for the laparoscopic grading system of acute appendicitis was observed for 34 (85%) of the 40 appendectomies. For these 34 patients, all staff surgeons agreed on the laparoscopic grading system of acute appendicitis for 15 patients (44%), 6 staff surgeons agreed for 11 patients (32%), and 5 staff surgeons agreed for 8 patients (24%).

Among the 6 patients in whom a consensus was not reached:

- Three patients were classified as grade 1 by 3 surgeons and grade 2 by 4 surgeons (no impact on patient management).
- One patient was classified as grade 4B by 3 surgeons and grade 5 by 4 surgeons (possible impact on the duration of postoperative antibiotic therapy).
- One patient was classified as grade 1 by 4 surgeons and grade 4B by 3 surgeons (possible impact on overall management).
- One patient was classified as grade 2 by 3 surgeons and grade 4B by 4 surgeons (possible impact on overall management).

Secondary Endpoints

In patients for whom staff surgeons described grade 4B acute appendicitis (regional peritonitis), the mean ± (SD) number of quadrants reported to present signs of peritonitis was 1.44 ± 0.63. In patients for whom staff surgeons described grade 5 acute appendicitis (diffuse peritonitis), the mean (SD) number of quadrants reported to present signs of peritonitis was 2.59 ± 0.51. On ROC curve analysis, two quadrants were the best cutoff between grade 4B and grade 5 acute appendicitis (AUC = 0.92, Se = 100%, Sp = 92%, p = 0.005).

The overall concordance between the staff surgeons and theinitial operative report for laparoscopic grading system of acute appendicitis was 85% (n = 29/34). The concordance was 100% for grade 1 (n = 9/9), 100% (n = 6/6) for grade 2, 100% for grade 3 (n = 1/1), 66% (n = 8/12) for grade 4B, and 83% for grade 5 (n = 5/6).

The concordance between the appearance of the peritoneum defined by the seven staff surgeons and postoperative antibiotic therapy guidelines was 73% (n = 25/34). Among patients with uncomplicated appendicitis, 10 patients (66%) received no antibiotic therapy, in accordance with national guidelines. The mean duration of antibiotic therapy for the other patients was 1.2 days ± 0.3.

Among patients with grade 3 or grade 4B (regional peritonitis), nine patients (69%) received postoperative antibiotic therapy, for a duration complying with national guidelines in four patients (30%). The mean duration of antibiotic therapy in this group of patients was 1.7 days ± 0.8 (shorter than recommended).

Among patients with grade 5 (diffuse peritonitis), six patients (100%) received postoperative antibiotic therapy, for a duration complying with national guidelines in five patients (83%). The mean duration of antibiotic therapy in this group of patients was 4.5 days ± 1.2 (shorter than recommended).

Table 2: Study population characteristics

	N = 40
Epidemiological data	
Gender (M/F), n (%)	26 (65) /14 (35)
Mean age (years ± SD)	35 ± 14
BMI (kg/m^2)	23.8 ± 8.8
ASA score (mean ± SD)	2 ±1
Charlson score (mean ± SD)	3± 2
Presentation at diagnosis	
Fever, n (%)	4 (10)
Tenderness in the right iliac fossa, n (%)	17 (42.5)
Mean leukocytosis n/mm^3 ± SD	13500 ± 4300
Mean CRP (mg/l ± SD)	49 ± 48
Intraoperative data	
Laparoscopy, n (%)	40 (100)
Conversion rate, n (%)	0 (0)
Procedure, n (%)	
Appendectomy	38 (95)
Cecectomy	2 (5)
Drainage of the abdominal cavity, n (%)	0 (0)

Discussion

Only limited data are available concerning the definition of complicated appendicitis. Gomes et al.[7] tried to standardize the definition of complicated appendicitis by classifying appendicitis into 5 grades according to the laparoscopic appearance of appendicitis. This classification includes the appearance of both the appendix and the peritoneum. No data concerning the reproducibility of this classification are currently available. In the present study, we showed the good reproducibility of this score with an 85% concordance between surgeons for this score and, in the 6 cases without concordance, the surgeons mainly classified patients as grades 1 and 2, which had no impact on operative and postoperative management. Two main groups of patients can be distinguished based on the Gomes score: grades 1 and 2 corresponding to uncomplicated appendicitis and grades 3, 4 and 5 corresponding to complicated appendicitis. In the complicated appendicitis group, it remains important to determine whether peritonitis is regional (grade 4B) or diffuse (grade 5) in order to define the duration of postoperative antibiotic therapy. In the original publication by Gomes et al.,[7] grade 4B appendicitis was defined as pathological fluid in the pelvis, right lower quadrant or right flank. The seven staff surgeons were not aware of this classification at the time of this study, and the best cutoff used by surgeons to classify peritonitis as regional or diffuse was found to be two quadrants.

This is the first study to address this crucial issue, as the distinction between complicated and uncomplicated appendicitis and between regional and diffuse peritonitis is the key to the management of appendicitis (ambulatory surgery, need for postoperative antibiotic therapy, duration of antibiotic therapy and information to the patient about the risk of postoperative complications). This distinction also was also used to define the

inclusion criteria of a nationally funded ongoing trial evaluating the need for postoperative antibiotic therapy in localized peritonitis of appendicular origin (ABAP trial, Programme Hospitalier de Recherche Clinique 2017-000334-59).

In early 2017, Rogers et al. published a call for a standardized definition of perforated appendicitis.[10] In this study, the postoperative abscess rate after surgery for perforated appendicitis (20.9%) was significantly higher than that published by the ACS NSQIP for perforated appendicitis (7.6%), which was lower thathatn published in the 18 most recently published studies (14.4%). Rogers et al. reported that this marked variation in the postoperative abscess rate was due to the lack of a clear definition of perforated appendicitis.

It can be argued that Berard et al., in 1964, were the first to try to provide a clear definition of the operative field, by describing the degree of microbial contamination present at the time of surgery, and operative cases were divided into four categories: (1) clean, (2) clean/contaminated, (3) contaminated, and (4) dirty.[11] The main drawback of this classification is that this classification is not used in most guidelines for the prescription of postoperative antibiotic therapy.[9] In a recent study, Wang-Chan et al. found that the correlation between the surgeons and a trained nurse (after reading the operative and pathological reports) was low (interrater reliability <0.2).[12] The study by Gomes, therefore, constituted real progress toward a clearer definition. This study shows that the Gomes classification is easy to use, useful to guide prescription of postoperative antibiotic therapy and can, therefore, be useful for trials on appendicitis. The main bias that must be taken into account is that all surgeons were from the same institute and, although the study was blinded and no definition was provided before the study, contamination during there practice between surgeons is possible.

Conclusion

The classification used to determine the type of appendicitis and the appearance of the peritoneum is simple and reproducible and can be used for trials on appendicitis. A cutoff of two quadrants is the best cutoff to determine whether peritonitis is regional or diffuse.

Clinical significance

To give a definition of complicated appendicitis.

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