Ann Colorectal Res. 2019 June; 7(2):e90905. doi: 10.5812/acr.90905.

Published online 2019 July 7. **Research Article**

Feasibility and Outcome of Laparoscopic Approach for Acute Generalized Peritonitis in Africa: Single Low-Center Results After 25 Consecutive Cases in Cameroon

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Received 2019 February 21; **Accepted** 2019 May 21.

Abstract

Background: Peritonitis is a quite common surgical emergency. For this condition, many reports have shown that laparoscopic surgery is associated with lower morbidity and mortality. However, the laparoscopic approach to the management of peritonitis remains marginalized in low and middle-income countries (LMICs) due to financial and technical limitations.
Methods: We conducted a seven-year prospective study on patients with acute generalized peritonitis in Yaoundé, Cameroon. Inclusion criteria were an age range of between 5 to 55 years, admission within 48 hours after the onset of symptoms, hemodynamic stability, and no major comorbidities. Excluded from this study were patients with colonic perforation, prior history of abdominal surgery, or primary and localized peritonitis after proper resuscitation. The patients included were managed via laparoscopy; operative and postoperative data were collected and analyzed. Some technical artifices were used to circumvent the lack of standard equipment.
Results: The study involved twenty-five patients with a mean age of 32.1 years. The etiology of peritonitis was identified as appendicitis in 20 cases, perforated duodenal ulcer in 2 cases, gastric ulcer perforation in 2 cases, and jejunal perforation in 1 case. In two cases (8%), the operation was converted to laparotomy. The postoperative course was uneventful in 21 cases (84%), whereas morbidity was seen in 4 cases (16%); no mortality was recorded. The mean length of hospital stay was 5.5 days.
Conclusions: This study demonstrates that the laparoscopic management of acute generalized peritonitis in African LMICs is a feasible, safe, and effective surgical option in properly selected patients.

Keywords: Acute Generalized Peritonitis, Laparoscopy, Africa, Morbidity, Low and Middle-Income Country

1. Background

Acute generalized peritonitis (AGP) is one of the most common causes of non-trauma related death (1). Peritonitis may be primary or secondary depending on its causative mechanism. Primary peritonitis rarely requires surgical intervention, unlike the more common secondary peritonitis. Secondary peritonitis is related to intra-abdominal lesions which allow the passage of infectious organisms into the peritoneum (2). Management of secondary peritonitis includes supportive therapy with adequate resuscitation, administration of systemic antibiotics, adequate source control and clearance of all residual collections.

Historically, these objectives were achieved via exploratory laparotomy. The laparoscopy approach was initially contraindicated in such cases due to fear of both an increased bacteremia by pneumoperitoneum (3) and a limited view due to adhesions and bowel distension (4). Nowadays, its known that the laparoscopic management of AGP is feasible and improves patient outcomes, with significantly lower morbidity having been demonstrated (4-9). However, the laparoscopic management of AGP can be technically challenging for surgeons as it involves a steep learning curve and requires advanced laparoscopic suturing skills.

In Africa, particularly sub-Saharan Africa, laparoscopy is still marginalized in daily surgical practice due to the high cost of laparoscopic instruments, the lack of social in-

surance programs, and the inadequate training programs for both residents and surgeons.

2. Objectives

After developing our laparoscopic skills in different procedures such as colectomy (10, 11), hernia repair (12), acute postoperative small bowel obstruction (13), and Heller myotomy (14), we conducted this study with the aim of evaluating the feasibility and outcome of the laparoscopic management of AGP in Cameroon-a low and middle-income country (LMIC).

3. Methods

3.1. Study Design

We conducted a sever-year prospective study from January 2010 to December 2016 in our department (visceral surgery unit of the National Social Insurance Fund Health Center of Yaoundé). Yaoundé is the capital city of Cameroon, a LMIC of central Africa. This institution is a level III health facility. The visceral unit has a total admission capacity of 23 beds. Surgical interventions were carried out by the same team composed of a senior surgeon and three junior surgeons. All procedures conducted by the junior surgeons were performed under the supervision of the senior surgeon.

3.2. Patients

In this study, we included all patients with AGP aged between 5 to 55 years, admitted within 48 hours after the onset of symptoms, who were hemodynamically stable with no major comorbidities, namely ischemic heart disease, heart failure, chronic kidney disease, severe sepsis, and severe coagulopathy. AGP was defined as any acute abdominal pain with generalized tenderness, typical presentation on abdominal X-ray, ultrasonography or CT, and peroperatively a diffuse intra-abdominal infection extending beyond the transverse mesocolon (Figure 1).

Excluded from this study were patients with colonic perforation, prior history of abdominal surgery, as well as patients with primary peritonitis, localized peritonitis, preoperative shock, and those for whom laparotomy was performed in first intention.

Each patient provided consent prior to inclusion in the study. Formal consent was obtained from the parents/guardians of underage patients.

3.3. Preoperative Management

We inserted a nasogastric tube for each patient, besides a urinary catheter if needed. Crystalloid intravenous fluids were administrated with triple antibiotic therapy (cephalosporin, metronidazole, and an aminoglycoside).

Routine laboratory tests were done. All patients underwent abdominal X-rays; in the case where X-ray was not conclusive, an ultrasonography or CT-scan was performed.

3.4. Surgical Procedure

Under general anesthesia, we inserted a 10 mm optic port in the supra-umbilical region by "open-coelioscopy", and pneumoperitoneum was achieved via this access. A systematic and thorough visual exploration of the abdominal cavity was performed to identify the organs involved.

If a gastric/duodenal perforation was found (Figure 2), two or three 5 mm working ports were inserted (in both flanks and in the epigastric region if needed) under sight control, and intracorporeal suturing was performed in interrupted fashion using absorbable 3/0 sutures without an omental patch.

In the case of appendicular etiology (Figure 3), two working ports (right flank and suprapubic area) were inserted. If the appendix was gangrenous and its base was digested, intracorporeal appendectomy was performed (appendix ligated via intracorporeal sutures) and the appendix was removed via a sterile glove finger used as an endobag. In non-gangrenous forms, the appendix was exteriorized via the supra-umbilical or flank port and resected after ligation.

If a small bowel perforation was found, intracorporeal suturing was performed.

In all cases, a thorough cleaning of the peritoneal cavity was performed using saline, with special attention being directed to sloping areas. In the case of a large gastric/duodenal perforation (size > 2 cm) or a gangrenous appendix base, a catheter drain was inserted via one port site in the subhepatic or pelvic space, respectively.

3.5. Postoperative Management

The nasogastric tube and urinary catheter were removed within 48 hours following surgery. Commencement of feeds was dependent on nasogastric output and presence of bowel opening signs. All patients were commenced on clear feeds (such as water, clear fruit juices), which was escalated to full feed and solid diet as tolerated thereafter.

Therapeutic antibiotics were continued postoperatively for a duration depending on the resolution of the signs of infection. Patients with gastric/duodenal perforation were prophylactically placed under H. pylori eradication therapy.

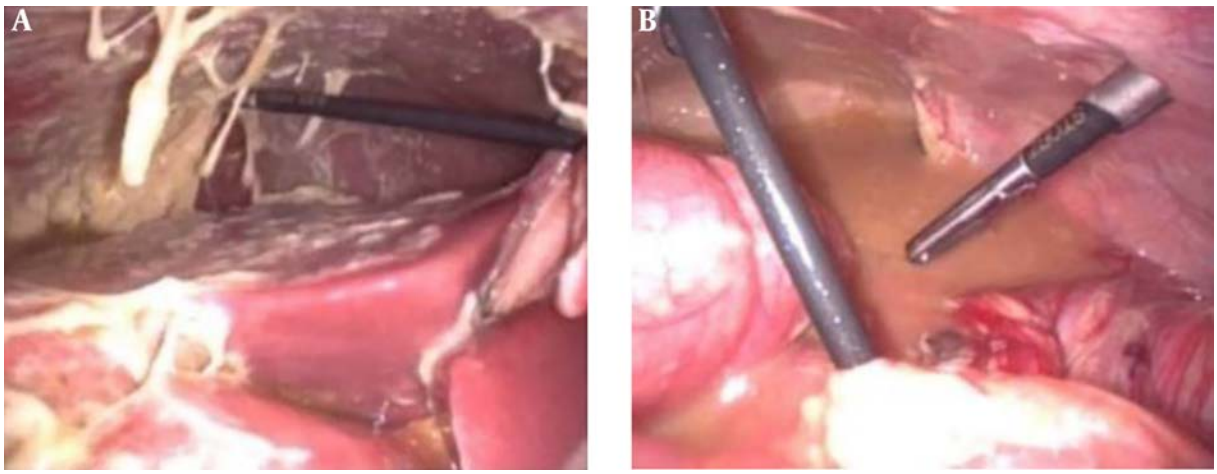

Figure 1. Generalized peritonitis with diffuse effusion in subdiaphracmatic region (A) and in the pelvic space (B)

Figure 2. Perforated duodenal ulcer

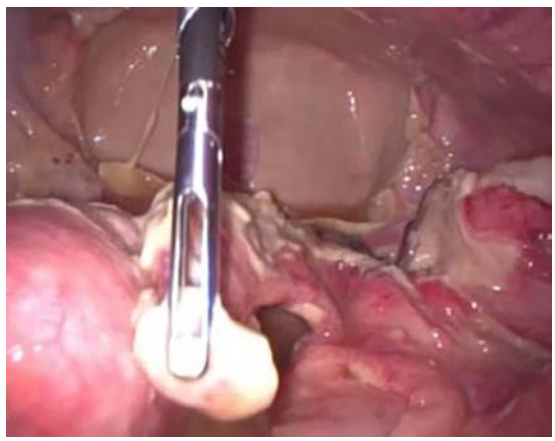

Figure 3. Appendicitis with necrotic base

Demographics, preoperative findings, surgical record and duration, intraoperative complications, conversion, length of hospitalization, wound complications, presence of ileus (defined as daily nasogastric output > 500 mL, nil passing of flatus), need for repeat operations, and mortality were reviewed.

4. Results

Using the patient selection flowchart shown in Figure 4, 32 patients met our inclusion criteria, though laparoscopy was not possible in 7 cases (21.9%) due to the high cost of the laparoscopic procedure (patients without insurance) or the unavailability of the laparoscopic column (out of order). Our study group therefore comprised 25 patients, among whom 15 were male and 10 were female, with a mean age of 32.1 years (range: 6 - 55). The mean duration of symptoms at admission was 25.2 hours (range: 12 - 48); the most common symptoms were diffuse abdominal pain (100%), fever (75%), and abdominal tenderness (98%). All patients (100%) had leukocytosis. The diagnosis of AGP was advocated clinically in all cases. Imaging investigations consisted mostly of ultrasound (18 cases; 72%), followed by abdominal X-ray (4 cases; 16%) and abdominal CT (3 cases; 12%).

In 6 cases (24%), the preoperative exams were unable to determine the etiology of the peritonitis. By laparoscopic exploration, we were able to identify this etiology in all cases, meaning a laparoscopic diagnosis accuracy of 100%.

The cause of peritonitis (Table 1) was appendicitis in 20

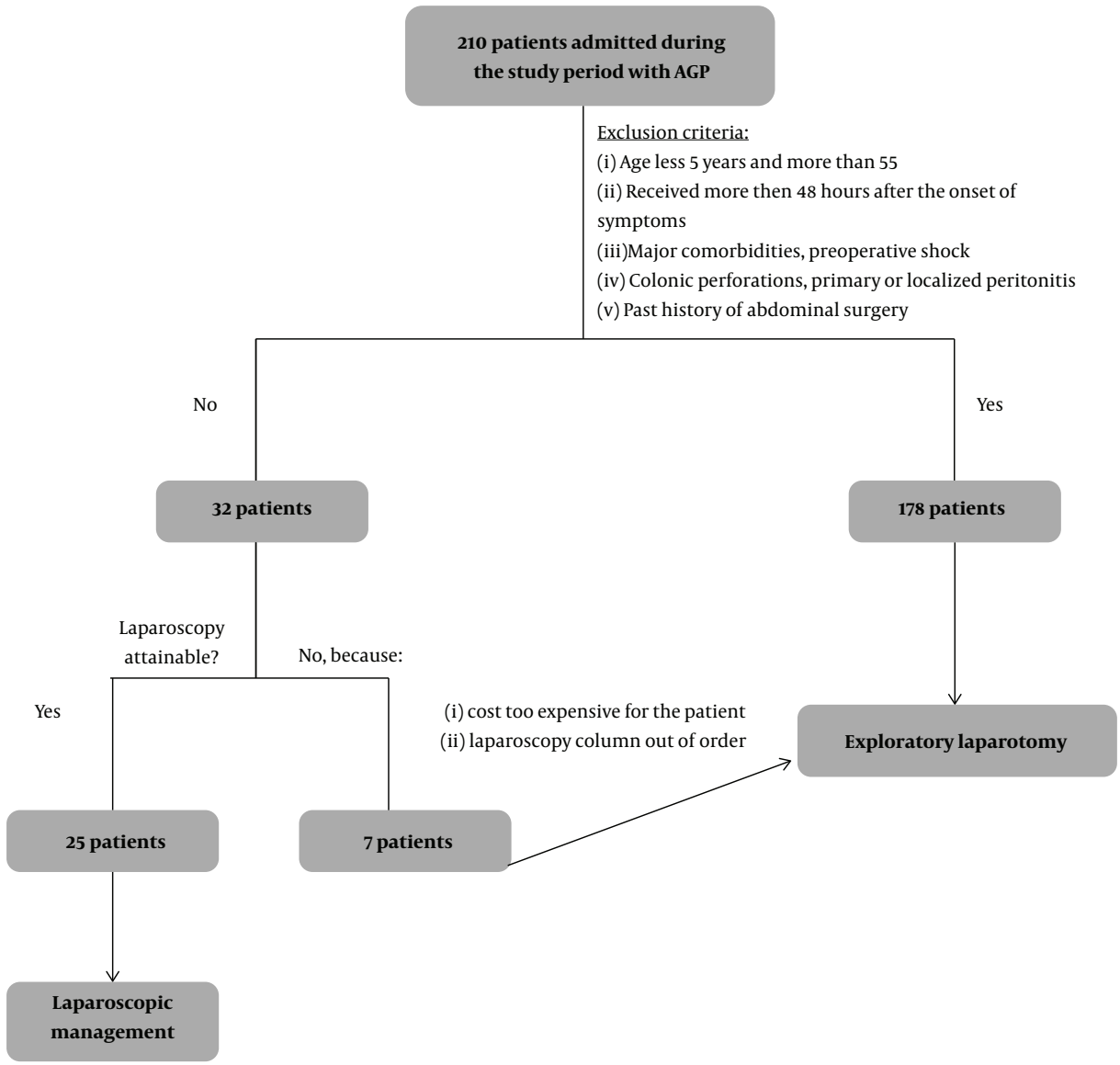

Figure 4. Flowchart of patients' selection

cases (80%), perforated duodenal ulcer in 2 cases (8%), gastric ulcer perforation in 2 cases (8%), and jejunal perforation (after an abdominal blunt trauma) in 1 case (4%).

Two cases (8%) were converted to laparotomy due to massive bowel distension related to appendicitis with difficulties in performing the appendectomy. These two cases occurred within the first year of our study. For the remaining 23 cases, we were able to perform the entire procedure through laparoscopy, meaning a therapeutic accuracy of 92%.

The mean operative time of laparoscopic repair was 78 min (range: 45 - 118). No peroperative complications were recorded. The postoperative course was uneventful in 21 cases (84%), whereas morbidity was recorded in 4 cases (16%), among which were the 2 cases converted to laparotomy (wound infection in one case, prolonged ileus in the other). When considering the 23 procedures conducted entirely through laparoscopy, morbidity was recorded in 2 cases (8%), including a superficial port site infection and a case of a residual pelvic abscess drained laparoscopically at postoperative day 4. The re-intervention rate in this group was thus 4%.

Table 1. Causes of Peritonitis and Feasibility of Laparoscopy

Etiology	Total, No. (%)	Laparoscopic Diagnosis Accuracy, %	Conversion, No.
Appendicitis	20 (80)	100	2
Perforated ulcer			
Duodenal	2 (8)	100	-
Gastric	2 (8)	100	-
Jejunal perforation	1 (4)	100	-

When the procedure was performed entirely via laparoscopy, oral feeding was started 36.7 hours (range: 18 - 144) after surgery on average. No mortalities were recorded.

The mean length of hospital stay was 5.5 days (range: 5 - 8).

Table 2 summarizes the main outcomes of the 23 procedures conducted entirely via laparoscopy.

Table 2. Outcome of the 23 Procedures Conducted Entirely Through Laparoscopy

Intraoperative complications	**Nil**
Mean operative time	78 min (range, 30 - 118)
Postoperative complications	2 cases (8%)
Port site infection	1 case
Residual pelvic abscess	1 case
Re-intervention	1 case (4%)
Death	Nil
Return to oral diet	36.7 h (range, 18 - 144)
Mean length of hospital stay	5.5 days (range, 5 - 8)

5. Discussion

To date, few studies have focused on the laparoscopic management of AGP in Africa, with no such study having been conducted previously in Cameroon. AGP remains a great challenge in most African countries, with data on the burden and outcome of this pathology being scarce. Furthermore, surgeons in Africa face difficulties related to inadequate medical equipment, absence of health insurance, inadequate programs for residents/surgeons, and limited access to intensive care units. This study demonstrates that the laparoscopic management of AGP in African LMICs is a feasible surgical approach for properly selected cases, with a high diagnosis and therapeutic yield, as well as reasonable open conversion and postoperative complication rates.

Laparoscopic surgery has become popular over the past two decades but remains controversial in the management of some abdominal surgical emergencies such as acute small bowel obstruction and AGP. However, a policy of universal laparotomy for all patients with AGP in the era of minimally invasive surgery is unjust due to both short-term and long-term morbidities (15). Studies have shown that emergency laparotomies are associated with 5% mortality, 20% morbidity, and a 3% long-term risk of bowel obstruction (16). In Africa, exploratory laparotomies for AGP are associated with 9.2 to 31.5% morbidity and 2.4 to 15.1% mortality (1, 17); when considering peritonitis due to typhoid perforation of the terminal ileum, this mortality rate rises to 34.7% (1). Several studies have demonstrated the efficiency of the laparoscopic approach in peritoneal lavage and closure of bowel perforations, which has significantly lower morbidity than open surgery (4-9). The major benefits of laparoscopic surgery stem from the requirement of only a few small incisions, which results in improved recovery, better cosmetic outcomes, and less pain compared with open surgery (15).

In line with the position paper of the World Society of Emergency Surgery (5), we believe that proper selection of patients to be managed via laparoscopy is fundamental. We started our practice in this study by excluding all patients who were in shock, had severe comorbidities, or were too young or too old (old according to the Cameroonian life expectancy of 57.93 years). We believe that in these patients, the risks related to pneumoperitoneum and the high median duration of laparoscopic surgery (4, 15) are too elevated, meaning that open surgery here is the best surgical approach. In the same way, we excluded patients with a past history of abdominal surgery because of the risk of performing adhesiolysis and extended operative time. In Africa, late presentation of AGP is a major concern; some patients with peritonitis have been seen in hospitals 13 days after the onset of symptoms (18, 19). These patients present with major bowel distension and important hydroelectrolytic disorders, leading to poor surgical prognosis. Poverty, illiteracy, first resort to traditional medicine/self-medication, and unavailability of medical facilities are some reasons for such delays in hospitalization. We therefore decided to also exclude patients who were received more than 48 hours after the onset of the

first symptom. Our restrictive inclusion criteria explain the relatively limited numbers of patients in this study. Moreover, seven patients who met the inclusion criteria could not be managed via laparoscopy and were also excluded from the study. Indeed, our department has only one column of laparoscopy and it is sometimes unavailable for maintenance reasons. On the other hand, the cost of laparoscopic surgery is higher than that of open surgery, and patients who do not have health insurance often cannot afford laparoscopy. These technical and financial limitations remain as major obstacles to the popularization of laparoscopic surgery in the African continent.

In this study, laparoscopy was a good diagnostic tool of the peritonitis' etiology, with an accuracy of 100%. This is while in 24% of cases, the preoperative exams were unable to determine the etiology. Similar to our finding, the diagnostic accuracy of laparoscopic exploration has been reported at around 90% (9, 20, 21). The most important challenge to laparoscopic exploration was bowel distension; gentle and methodical bowel mobilization, with the use of an operating table allowing lateral tilts, Trendelenburg and reverse Trendelenburg positioning, permitted us to conduct a thorough examination of the abdominal cavity in all cases.

Our conversion rate to open surgery was 8% (2 cases); in both cases, this was due to difficulties in suturing related to bowel distension. This conversion rate is comparable to those of previous studies, which reported 4% - 12% conversion (4, 21, 22). The two converted cases were operated within the first year of our study, with no further conversions occurring thereafter. We believe that by climbing the learning curve and attaining improved laparoscopic skills, it became easier for us to manage such cases with bowel distension over time.

Due to the high cost of laparoscopic instruments and our poor socio-economic milieu, we faced a lack of certain materials like endoloops and endobags. This situation is advocated by some African surgeons as a reason for avoiding laparoscopy. We demonstrated in this study that a sterile glove finger can be used as an endobag to remove a sectioned appendix. We previously described this approach in laparoscopic cholecystectomy for removal of the gallbladder (23). Another technical artifice is the laparoscopic suturing of the appendix base in the absence of an endoloop. We think that these technical artifices can increase the feasibility of laparoscopic management of AGP in LMICs.

Our study demonstrated good results regarding the laparoscopic approach for management of AGP. In 92% of cases, the management was comprised of laparoscopy exclusively, with a mean operative time of 78 min, no peroperative complications, a morbidity rate of 8%, no mortality registered, and a mean hospital stays of 5.5 days. Navez et al. (21) reported the morbidity and mortality of the laparoscopic management of AGP at 9% and 1%, respectively, while Sangrasi et al. (9) reported these figures at 6.2% and 0%, respectively. The largest study conducted in our country on the management of AGP via laparotomy found 31.5% morbidity and 15.1% mortality (1). Even if our study is not comparable to that study (although conducted in the same milieu), we agree with the authors in that the "laparoscopic approach is likely to influence the outcome of patients with AGP" (1). Our operative time is comparable to reports in the literature of about 75 min (24-26).

In a review conducted in 2010, residual abscesses and re-interventions were higher in laparoscopic repair of peritonitis versus open surgery without statistical significance (27). In our study, we found just 1 case (4.34%) of residual pelvic abscess, which was drained laparoscopically at postoperative day 4. Since "dilution with solution is the solution to pollution", we were able to conduct a meticulous peritoneal lavage under sight in contrast to sponge stick sweep conducted when performing open surgery.

This study had a few limitations. First, we had a small sample and our results, although satisfactory, must be interpreted with modesty, and do not allow us to draw any major conclusions. The other limitation is the heterogeneity of our sample since we included etiologies of both sus- and sub-mesocolic peritonitis.

5.1. Conclusions

This study demonstrates that in African LMICs, the laparoscopic management of AGP for properly selected patients and with the use of some technical artifices is a feasible, safe and effective surgical approach with reasonable open conversion and postoperative complication rates.

Footnotes

Authors' Contribution: Bang Guy Aristide and Nana Oumarou Blondel conceived, drafted the study. Savom Eric Patrick and Bwelle Moto Georges collected the data and the literature review. Essomba Arthur Georges gave the final approval of the version and agreed to be accountable for all aspects of the work

Conflict of Interests: The authors declare that they have no competing interests.

Ethical Approval: A formal written consent was obtained on each case based on our institute Ethical Committee recommendations. Before the beginning of the study, we obtained the approval of the Ethics Committee of the National Social Insurance Health Center of Yaounde (Cameroon).

Funding/Support: Personal support of authors. No institutional funding.

Patient Consent: For minor patients, consent for participation was obtained from parents or guardian.

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