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Feasibility and safety of laparoscopy in acute non-traumatic emergency abdominal surgery: A prospective study

Ammari Smail [1,*], Nait Slimane N [1], A. Tibiche [2], Boukerrouche A [3], Naili S [4] and Taieb M [1]

[1] *General Surgery department, Ain Taya Hospital, Algiers, Faculty of Medicine of Algiers, Algiers University 1, Algeria.*
[2] *Department of Epidemiology, University Hospital of Tizi Ouzou, Faculty of Medicine of Tizi Ouzou, Algeria.*
[3] *General Surgery department, Rouiba Hospital, Algiers, Faculty of Medicine of Algiers, Algiers University 1, Algeria.*
[4] *Algiers University 1, Algeria.*

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Abstract

Introduction: The use of laparoscopy in emergency abdominal surgery is considered high-risk due to its elevated morbidity, requiring expertise in laparoscopic surgery.

Objective: Assessing the feasibility, reproducibility, and safety of laparoscopy in non-traumatic acute abdominal surgery.

Methods: Descriptive, prospective and evaluative study, conducted between February 2018 and October 2021. We have included in this study: acute appendicitis and its complications, lithiasis acute cholecystitis (LAC), peritonitis by perforation of peptic ulcer, adhesive acute intestinal obstruction, adnexal torsion, extra-uterine pregnancies, and non-specific acute abdominal pain.

Results: We operated on 337 patients laparoscopically, with an average of 02 surgeries per medical shift. In 62.6%, surgeries were performed outside of regular working hours. We encountered temporary, material, and human difficulties in 10.8% of the cases. Average age of the patients is 38 years ±15 years. F/H sex ratio =1.29. Diagnostic accuracy of laparoscopy was 100 %. Intraoperative laparoscopic scanning corrected the preoperative diagnosis in 15.73% of cases. Average operative time was 52.09 min ± 24.14 min. One conversion recorded (0.3%). Rate of postoperative complications was 6.2%. These complications are classified at grade I according to the Clavien-Dindo classification in 85.71%. Only one patient (0.3%) required a second operation. Average length of overall hospitalization was 1.5 days.

Conclusion: Our results suggest that emergency laparoscopy is feasible, safe, and reproducible. So it can claim to replace laparotomy in the management of acute, non-traumatic abdominal emergencies.

Keywords: Acute abdomen; Conversion; Emergency laparoscopy; Preoperative difficulties.

1. Introduction

Since the early 1990s, many authors have suggested conducting research and studies to better define the role of laparoscopy in acute abdomen management [1].

* Corresponding author: Ammari Smail

Randomized and controlled trials conducted, demonstrated that laparoscopy is also safe, and effective as open surgery [2]. Thus, becoming the gold standard for many abdominal emergency Diseases. However, its place in the management of acute non-traumatic abdominal emergencies remains imprecise, and requires more evidence [1, 3-5].

For some authors, laparoscopy in emergency remains a difficult field, even risky for several reasons such as: need for great expertise in laparoscopic surgery and emergency surgery, frequency of deep collections, high rate of surgical revision, longer operating time, technical difficulties in cases such as: diffuse peritonitis, anesthesia problems especially in patients with comorbidities, limited resources in the operating room during the night and after regular working hours [2, 3, 6, 7].

For these reasons, we conducted this study to assess the feasibility, reproducibility, and safety of laparoscopic surgery in non-traumatic acute abdominal surgery.

2. Material and Methods

2.1. Material

Descriptive, prospective, and evaluative study conducted between February 2018 and October 2021. Conducted in the general surgery department at Ain Taya Hospital (East of Algiers UH, Algeria).

A set of 337 patients were included in this study, all patients were over 15 years old, with only acute non traumatic abdominal surgical emergencies where laparoscopy is already recognized as gold standard or with a high level of evidence, such as acute appendicitis and its complications (plastrons, abscesses, and generalized peritonitis), lithiasis acute cholecystitis, whose onset of symptomatology dates back to less than 07 days, peritonitis by perforation of peptic ulcer, adhesive acute intestinal obstruction, adnexal torsion , extra-uterine pregnancies, and non-specific acute abdominal pain.

The non-inclusion criteria are summarized in Table 1

Table 1 Inclusion criteria

Septic and/or hypovolemic shock states
Traumatic emergencies: abdominal wounds and bruises
Patients classified ASA: IV

2.2. Methods

Before hospitalization, all patients received a complete and thorough clinical examination, a complete preoperative assessment, a radiological examination according to the suspected pathology (abdominal and pelvic ultrasound, abdominal and pelvic CT-scan, magnetic resonance imaging (MRI), etc…

In cases of significant discrepancy between clinic, radiology and biology, laparoscopy was used for diagnostic and possibly therapeutic purposes. All patients received a preoperative anesthesia consultation with an ASA classification.

Diseases exposing patients to complications and which may put their immediate life prognosis (such as peritonitis by ulcer perforation, appendicular peritonitis, acute appendicitis...etc.) are operated without delay, immediately after their admission. Acute lithiasis cholecystitis is performed in the first 07 days (between the onset of symptomatology and admission to the operating theatre).

2.2.1. Surgical procedures

Surgical procedures are performed under general anesthesia. The set up of the first trocar with pneumoperitonea creation are create by « open laparoscopy » in most cases. In rare cases we et up the first trocar and created pneumoperitonea by impaction, especially in adhesive acute intestinal obstruction. The location of trocars varies depending on the pathology and the organ to be treated.

The optical trocar is placed almost always at the umbilicus, except in case of acute intestinal occlusion, where it is placed away from the old scars.

All of our patients are put on paracetamol just before extubating for the treatment of post-operative pain. Analog Visual Scale (AVS) assessment of post-operative pain: No pain = AVS 0, Low pain = (AVS 0 – 3), Average pain = (AVS 4 – 6), Severe pain = (AVS > 6).

Patients are discharged according to the operated pathology and post-operative data.

2.2.2. Evaluation parameters and judging criteria

Intra-operative and post-operative morbidity, overall mortality rate, conversion rate, operative time, pre, per and post-operative difficulties, post-operative pain on the analog visual scale AVS, length of hospitalization, surgical schedule [(A: 08H00 –16H00), (B:16H00 – 00H00), (C:00H00 – 08 H00)], the laparoscopic diagnostic accuracy, and the rate of purely diagnostic laparoscopy.

The duration of the surgery: is the time that elapses between the anesthetic induction until extubating.

The operative time: is the duration of the surgery that extends between the cutaneous incision and the cutaneous closure.

2.3. Statistical Analysis

The results of the descriptive analyses are expressed as frequencies (proportions) for the qualitative variables with their 95% confidence intervals. As a mean standard ± deviation for quantitative variables. Comparisons between qualitative variables were made using the chi-square test. The threshold of significance required to conclude a significant difference was 0.05. Data Capture and Analysis was performed on IBM-SPSS version 23.

3. Results

In our study, 337 patients were included and operated on. Among these patients, 190 were women (56.4%), with an average age of 38 ± 15 years, (extremes 15 - 82 years). Body mass index (BMI) is over 25 in 179 patients (53.11%). Comorbidities were found in 109 patients (32.3%) and a scar abdomen in 90 patients (26.7%). Patients are classified as ASA I in 74.8 % (252 patients), ASA II in 22 % (74 patients), and ASA III in 3.3 % (11 patients). Pregnant women account for 4.2 % (08 patients), with an average gestational age of 15 weeks of amenorrhea (WA) ± 07.29 WA, (extreme: 07 - 29 WA).

In preoperative, the diagnosis was accurate in 310 patients (92%), and uncertain in 27 patients (8.1%), of which: 13 patients (3.86%) had a strong suspicion of ovarian cyst torsions, 07 patients (2.1%): suspicion of acute appendicitis, and 07 patients (2.1%) Non-specific acute abdominal pain. Radio-clinical discrepancies were noted in 4.15% (14 patients). Between hospitalization and admission to the operating room, we encountered material and human (nursing staff) ad hoc and transitory difficulties in 10.8% (36 patients), (Table n°02).

Laparoscopy was used therapeutically in 310 patients (92%), diagnostic and therapeutic in 20 patients (5.94%), and purely diagnostic in 07 patients (2.1%).

Surgery is performed day and night. We operated on 211 patients (62.6%) outside regular working hours (Between 4:00 pm and 8:00 am). The breakdown of surgical procedures according to their schedule was as follows: from 08H00 to 16H00 we operated on 126 patients (37.4 %), from 16H00 to 00H00: 189 patients (56.10 %), and from 00H00 to 08H00: 22 patients (06.2 %).

In our study, the diagnostic accuracy of laparoscopy, diagnostic sensitivity, diagnostic specificity, positive predictive value, and negative predictive value are 100 % accurate.

Comparison of preoperative and perioperative data shows that intra-operative laparoscopic scanning corrected the preoperative diagnosis in (15.73% = 53 cases). Preoperative ultrasound diagnosis was corrected in intraoperative 25 patients (07.5%). Preoperative CT diagnosis is corrected in 05 cases (1.5%) (Table 03).

Table 2 Difficulties between hospitalization and admission to the operating room

Type of difficulties encountered between hospitalization and admission to the operating room	**n**	**%**
Emergency capnography failure/ waiting for release of 2nd capnography (reserved for elective surgery)	15	4.5
Waiting for CO2 supply	11	3.3
Emergency laparoscopic column failure/ waiting for 2nd column availability (reserved for selective surgery)	05	1.5
Reluctance of the caregivers to perform emergency laparoscopic surgery at night	05	1.5
Overall	36	10.8

Table 3 Surgical pathologies

Preoperative diagnosis			**Intraoperative diagnosis**		
Pathologies	N	%	Pathologies	N	%
Acute appendicitis (Simple and complicated)	177	52.6	Acute appendicitis (simple and complicated)	178	53
Acute lithiasis cholecystitis	88	25.9	Acute lithiasis cholecystitis	88	25.9
Adnexal torsion	24	04.5	Adnexal torsion	27	07.5
Ectopic pregnancy	23	06.9	Ectopic pregnancy	23	06.9
Perforation of bulbar ulcer	10	3	Perforation of bulbar ulcer	09	2.7
			Ileal perforation	01	0.3
Adhesive acute intestinal obstruction	08	2.4	Adhesive acute intestinal obstruction	7	2.1
			Small bowel obstruction on stromal tumor	01	0.3
Non-specific acute abdominal pain.	07	2.1	Acute appendicitis	01	0.3
			Adnexal torsion	03	0.89
			Retrocecal internal hernia	01	0.3
			No etiology	02	0.6

The average surgical time common to all pathologies is 52.09 ± 24.14 min (Extremes: 14-178 minutes). The overall duration of anesthesia (duration of surgery) is 75.35 ± 25.17 min (Extremes: 29 - 203 minutes). In peroperative, we encountered technical difficulties in 11.7 % of cases (39 patients) (Table 04).

Table 4 Different types of intra-operative difficulties

Types of intra-operative difficulties	**n**	**%**
Difficulties related to inflammation and complications of certain operated pathologies.	32	9.7
Learning curve challenges in some pathologies	03	0.9
Difficulties in full peritoneal cleansing during generalized peritonitis	03	0.9
Difficulties related to obesity: Trocars not adapted with the large thickness of the adipose panniculus of the patients.	01	0.3
Total	39	11.7

Intraoperative morbidity is 0.3 %. It's a small-bowel wound of about 01 centimeters. The overall conversion rate is 0.3%. In addition, we performed three (03) coelio-assisted surgical procedures for extracorporeal intestinal resections. No deaths are observed.

Laparoscopy prevented unnecessary appendectomies in 05 patients (1.5%) and avoided unnecessary median laparotomies in 03 patients (0.9%).

Recovery of transit in our patients occurred at the first post-operative day in 64.1%, second postoperative day in 30.3% and 3rd postoperative day in 5.6% of the cases.

Postoperative pain is low in 73% and 68.5%, respectively at J0 and J1 postoperative. The average duration of this post-operative pain is two days with extremes of zero to 06 days.

The average length of overall hospitalization is 1.5 days (Extremes: 1 to 8.5 days), and the average length of post-operative hospitalization is 1 day (Extremes: 01 to 7.5 days).

The rate of postoperative complications is 6.2% (n = 21 patients), (Table 05). According to Clavien-Dindo classification, these postoperative complications are classified respectively grade I in 85.71 % of the cases (n=18 patients), Grade IIIa in 4.76% of the cases (n=01 patients), and grade IIIb in 9.52 % of the cases (n=02 patients). The management of these complications is detailed in Table 06.

Table 5 Type of Postoperative Complications

Type of complications	**n**	**%**
Superficial sepsis of umbilical orifice	13	3.9
Purulent collections around the trocar orifice	03	0.9
Intraperitoneal deep collections	03	0.9
External bile fistula (poor sealing of the cystic stump)	01	0.3
Parietal sepsis in the mini laparotomy	01	0.3
Total	21	6.2

Table 6 Management of Early Post-Operative Complications

Types of complications	**Course of action**	**N**	**%**
Collections profondes	Re-hospitalization + resuscitation + surgical revision	02	0.6
	Re-hospitalization + echo-guided drainage + antibiogram	01	0.3
External bile fistula	Re-hospitalization + rehydration and monitoring	01	0.3
Parietal collections around the trocar orifice	Drainage under local anesthesia + local care	03	0.3
Wall sepsis	Local care	14	4.2
Total		21	6.2

4. Discussion

Laparoscopic surgery (scheduled or emergency), has benefited greatly from the technological advances the world is currently experiencing [3, 6, 8-10]. The laparoscopy columns are very sophisticated with high-definition image quality. The current instrumentation is quality, adapting to all situations. Introduction of new instruments such as: articulated pliers, high-performance endoscopic staplers, and scissors using a variety of modern energies, contributed to the refinement of techniques laparoscopic [3].

The enthusiasm and experience gained by the new generation of laparoscopic surgeons are some of the other factors that have enabled the development and expansion fields of use for laparoscopic surgery, becoming the gold standard for most abdominal surgical diseases [03].

Despite all the achieved progress, the use of laparoscopy in emergency abdominal surgery is unclear, it is considered a risky surgery, and several criticisms have been made of it [6,7].

In our series, despite encountering some temporary and transitory challenges which occurred at the beginning of the experiment, mainly associated with the human factor (healthcare teams' reluctance to use laparoscopy in emergency situations, especially at night), and secondarily with the material factor (technical issues related to the equipment), we successfully addressed these challenges. On one front, we employed communication and psychological strategies with caregivers, while on the other, we established a systematic checklist at the beginning of each medical shift. As a result, we conducted various surgical procedures during laparoscopic shifts, sometimes performing up to six surgical procedures per medical shift. These procedures covered various non-traumatic abdominal emergencies, all executed without compromising the quality of our patients' treatment.

Several studies have blamed laparoscopy at night, for an increased risk of complications [11, 12] and conversion [12] due to fatigue and lack of physical freshness on the part of health care personnel. This was not the case in our study. We operated on 62.6% of patients (n=211) at night between 4PM and 8AM, and there was no significant relationship between the time of surgery and overall post-operative morbidity (p value =0.3). The only conversion we recorded was occurred during the day and at the beginning of our experiment.

In addition, two series compared cholecystectomy performed during the day, with that performed at night, for lithiasis acute cholecystitis, showed that laparoscopy is safe and feasible at night and day, complications rates, and night conversion do not differ from those of the day [13-15].

Changes in the positions of the operating table (sloping and tilting position), as well as the insufflation of CO2 during laparoscopy, lead to hemodynamic and respiratory changes [16]. Therefore, laparoscopic anesthesia, particularly in emergency surgery, is considered a risky anesthesia. In our study, 74 patients (22%) are classified as ASA II and 11 patients (03.3%) are classified as ASA III. This did not require any particular preparation for laparoscopic surgery, and did not delay the management of our patients. The evolution of anesthetic protocols and the improvement of surveillance techniques make it possible to provide satisfactory answers to these new requirements and give good safety to this type of gesture [17,18]. With hardware development, laparoscopy is used in longer and longer procedures, and in patients with increasing comorbidities [17].

In our series, the diagnostic accuracy of laparoscopy, its sensitivity, its diagnostic specificity, its positive and negative predictive values were 100%. It corrected the preoperative diagnosis in 15.73%, and avoided five (05) unnecessary appendectomies (1.5%), and three (03) unnecessary median laparotomies (0.9%). In the literature, the diagnostic accuracy of laparoscopy varies from 89% to 100% [19-21], allowing exploration of the entire peritoneal cavity through mini parietal incisions. This is a major advantage in emergency situations (especially at night) in case of radio-clinical discordance, and in case of non-specific acute abdominal pain, after having carried out all necessary examinations. If it is necessary to choose between an exploratory laparotomy and a diagnostic laparoscopy, the choice is not debatable. We must opt for laparoscopy because it is more efficient and less invasive, with a double interest, both diagnostic and therapeutic. No mortality directly related to this procedure has been reported, and its overall morbidity in the hands of experts ranges from 0% to 08% [22-24].

Several series have shown that laparoscopy avoids unnecessary laparotomies in 36% to 95% [22, 25, 26]. Other randomized studies have demonstrated the value of early diagnostic laparoscopy as a substitute for hospital surveillance [27, 28].

In our series, the per operative difficulties (11.7% of cases, n= 36 patients) are similar to those reported in the literature, and they did not also lead to the failure of the use of laparoscopy in emergency. We recorded only one conversion (0.3%) on all operated patients, and the average operative time is 52.09 ±24.14 minutes. The main intraoperative difficulties in emergency laparoscopy, reported in the literature, are:

Access difficulties in the peritoneal cavity: due to adhesions, which are at the origin of iatrogenic intestinal wounds [2, 7, 29-35].

- Intraoperative poor exposure [30, 31, 36,]
- Difficulty in identifying causal lesions [2, 32].
- Technical difficulties in resecting intestinal loops within the body [37].
- Obesity [38,39].
- Technical difficulties in suturing ulcer perforations greater than 10 mm, [2, 40,41].
- Technical difficulties in making a peritoneal toilet [41].
- Inflammation: difficulties in recognizing anatomical structures [07, 33, 42].

Operative times reported in the literature are not longer, they vary between 68 minutes and 86 minutes [7, 29, 43]. Similarly, conversion rates remain acceptable and ranging from 01% to 13% [44,45].

In our series we have no deaths related to laparoscopic surgery. Mortality related to laparoscopic surgery, regardless of the pathology operated is exceptional 2 to 5 per 100000 laparoscopic surgeries [46,47]. In other series, mortality varies from 0 to 4.6% [48].

The main criticism of emergency laparoscopy is its high morbidity, especially the frequency of deep collections, and the frequency of surgical recovery [6,7]. In our study the rate of post-operative morbidity (including all pathologies): 06.2% (n=21 cases). These complications are classified Grade I according to Clavien-Dindo classification 85.71%, (n=18 cases). Only one patient (0.3%) required surgery. The overall morbidity of emergency laparoscopy ranges from 0% to 24% in the Italian series [4, 20,48]. For some authors, the abscess rate is the same between the laparoscopic and conventional pathways [49,50], and not using laparoscopic pathway for fear of having deep abscesses is not justified [51].

In our study, the average duration of hospitalization is 1.5 days (extremes: 1 to 7.22 days), thus confirming one of the major benefits of laparoscopy, namely the reduction in the duration of hospitalization. The short duration of hospitalization with early recovery of socio-professional activities, are known and recognized as advantages of laparoscopic surgery, especially in the era of improved rehabilitation. The shorter length of hospitalization is particularly evident in patients with pelvic disease, small bowel obstruction or acute lithiasis cholecystitis [48, 52-56].

Compared to open surgery, reducing the intensity of post-operative pain is another greater advantage of laparoscopy compared with open surgery [57]. This observation is established in our study.

5. Conclusion

While bringing the well-known benefits of laparoscopic surgery, our results suggest that laparoscopy is feasible, safe and reproducible in the management of non-traumatic abdominal emergencies. This would be more profitable with the establishment of a good work organization, reliable and sustainable logistics, and sufficient material resources. Thus, laparoscopy can claim to completely replace laparotomy, day and night while knowing that conversion is an option and not a failure.

Compliance with ethical standards

Disclosure of conflict of interest

The author and co-authors declare that they have no conflicts of interest.

Statement of ethical approval

The results of this work come from a thesis work carried out by the main author (S. Ammari), and supervised by Professor M. Taieb at General Surgery department of Ain Taya University Hospital.

Before starting this thesis work. A project was submitted to 03 experts at Algiers Faculty of Medicine who gave their approval to begin this research work. Thus, we had the authorization of the scientific council of Algiers Faculty of Medicine.

Statement of informed consent

All patients are consenting for their inclusion in this work and for the publication of the results.

Author Contributions

All authors contributed to this work.

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Availability of Data and Materials

The data (Patient records, information sheets for each patient) are available and entered in Excel and Word formats.

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