Laparoscopic approach to acute abdomen: how clinical features and laboratory exams can help the emergency surgeon in a period characterized by limited resources.

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Abstract

Introduction: In challenging times due to novel COVID-19 outbreaks worldwide, is important elaborate a new practical strategy in order to make the right decisions with limited resources. Due to the reduced availability of radiological procedures, especially in the emergency setting, clinical features and laboratory tests are back to guide the decision of surgeons.

Methods: We retrospective analysed data of patients with a diagnosis of acute abdomen, who underwent laparoscopic surgery in urgency settings. Admission diagnoses, demographic and clinical features and biochemical parameters were retrospective collected, in order to analyse their relationship with the conversion risk.

Results: We included 340 patients with a diagnosis of acute abdomen and managed with laparoscopic surgery. Age ≥ 49 years, ASA-score ≥ III, previous abdominal surgery, diffuse abdominal pain and CRP ≥ 66,05 mg/L have been found significantly predictive factors for risk of conversion whereas localized Blumberg's sign, was significantly associated with lower risk of conversion.

Conclusion: Laparoscopy can be used in certain contexts with an adequate patient selection. Age ≥ 49 years, ASA-score≥ III, previous abdominal surgery, diffuse abdominal pain, localized Blumberg, CRP ≥ 66,05 mg/L are useful for an adequate preoperative patient assessment, in order to choose the appropriate surgical approach. The importance of our findings is highlighted non-radiological parameters to choose the adequate surgical approach with a reduction of diagnostic work up, its risk of infective exposure, its cost and finally the waste of time with an improvement of surgical outcome.

keywords: Laparoscopic surgery; Acute abdomen; COVID-19, emergency setting; surgical approach; patient selection.

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Introduction:

Acute abdomen results usually from peritoneal irritation due to inflammation, obstruction or rupture of an abdominal organ, and as nosology entity represents the most common clinical condition in emergency surgery. Laparoscopy has represented, since the Nineties, the beginning of a new era for general surgery1, thanks to its numerous advantages in comparison to open technique. In the context of emergency general surgery, laparoscopy has progressively gained a more relevant role and several studies2,3 highlighted the feasibility of the mini-invasive technique in cases of acute abdomen. The major indications for laparoscopy in case of an emergency are appendicitis, cholecystitis and perforated peptic ulcers (PPU) while, for perforated diverticulitis (PD) and small bowel obstruction (SBO) there is still debate. Mesenteric ischemia, suspected perforated cancer and faecal peritonitis are currently considered relative contraindication for a laparoscopic approach. Lack of expertise in laparoscopy is an absolute contraindication in emergency4.

Usually an accurate workup of acute abdomen in emergency room including clinical evaluation, blood samples, ultrasound and/or computed tomography, leads to a correct etiologic diagnosis and subsequently can guide the surgeon to the most appropriate surgical approach5.

In recent times, as resources become more and more limited and intra-hospital patient handling should be kept to the bare minimum, clinical features and biochemical parameters become extremely relevant for the preoperative assessment of the patients with acute abdomen and, therefore, the surgical indications. Herein we focused our study on non-radiological parameters to emphasize their relationship with the success of an end to end laparoscopic approach to the surgical acute abdomen.

METHODS

Study patients

We analysed data of patients admitted at the 3rd Surgical Unit of

Padova University Hospital between 01.01.2016 and 01.01.2020 with an acute abdomen diagnosis and treated with laparoscopic approach. Exclusion criteria were (i) severe hemodynamic instability (ii) abdominal trauma (iii) complicated abdominal or incisional hernias (iv) faecal peritonitis (v) perforated tumour (vi) intestinal ischemia (vii) laparotomic approach. A limited number of cases of PPU (7 case in the study period) did not allow appropriate statistical analyses so they were excluded from the study.

The whole cohort was defined into two groups: patients who underwent laparoscopic surgery in which the operation was completed laparoscopically (laparoscopic group) and patients who underwent laparoscopic surgery in which the operation required a laparotomic conversion (converted group). Admission diagnoses were collected and analysed for each patient (Table 1). Demographic and anamnestic variables, preoperative clinical and biochemical parameters (Table 2) were retrospective collected. All parameters were assessed at the time of the specialist surgical evaluation in emergency room, by the same operative team. In this study ASA-score has been dichotomized as follows: "≤II / ≥III"6.

Table 1. *[A]Distribution of admission diagnoses between two groups, with conversion rate (CR). Table 1B Logistic regression analysis for the conversion risk of these variables. NSAP acute non-specific abdominal pain; SBO small bowel obstruction; PD perforated diverticulitis; CR conversion rate; OR odds ratio; 95% IC 95% Confidence interval*

Admission diagnoses[A]	Laparoscopic[A]	Converted[A]	CR %[A]	OR[B]	95% CI[B]	*P*-value[B]
Acute appendicitis, n	160	11	6.4%	0.267	0.101-0.704	0.008
NSAP, n	32	3	8.6%	0.150	0.029-0.764	0.022
Acute cholecystitis, n	17	4	19%	0.941	0.941-3.493	0.9
SBO, n	42	32	43.2%	4.200	1.619-10.89	0.003
PD, n	29	10	25.6%	2.400	0.444-12.980	0.309
Total, n	280	60	17.6%			

Table 2. *Demographic, clinical-anamnestic and biochemical parameters in laparoscopy and converted group.*

Admission diagnoses[A]	Laparoscopic[A]	Converted[A]	CR %[A]	OR[B]	95% CI[B]	*P*-value[B]
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Statistical analysis

Categorical variables were expressed in absolute values and in percentages and were analysed through Chi-square test and Fisher's exact test when appropriate. Continuous variables were expressed as median and interquartile range (IQR) and analysed through Mann-Whitney U-test. Continuous variables were categorized according to cut-offs that were obtained through the creation of ROC curves for the conversion risk (Table 3). The strength of association between categorical variables, ROC-cut-off-categorized variables and converted group were examined through Cramer's Phi test. Risk analysis for laparotomic conversion was carried out through a logistic univariate model and Odds Ratios (OR) for the conversion risk of each variable was calculated. P-value < 0.05 in two-sided test was considered as statistically significant. Analyses were carried out with SPSS software, version 21.0 (Chicago, IL).

Table 3. *Cut off result from ROC curve analysis of the conversion risk for continuous variables of interest. 95% IC 95% Confidence interval*

Continuous variables	Area under curve	95% IC	Cut-off
Age	0.770	0.708-0.832	49
Body temperature	0.445	0.353-0.537	37.5
WBC	0.487	0.399-0.575	13.7
CRP	0.569	0.476-0.662	66.05

RESULTS

During the study period, 814 patients were admitted in urgency at the Third Surgical Unit with an acute abdomen diagnosis, 340 of which underwent surgery thus meeting the criteria of this study. In our cohort 280/340 (82.3%) completed the operation entirely in laparoscopy (laparoscopic group) while 60/340 (17.7%) required subsequently a laparotomic conversion (converted group). The most frequent admission diagnoses were acute appendicitis, following by SBO and NSAP and conversion rate ranged from 6.4% for acute appendicitis to 43.2% for SBO (Table 1a). As reported in Table 2, patients of laparoscopic group were significantly younger (p<0.001) with fewer rate of ASA score ≥ III (p<0.001), with lower previous hospitalization rate for same cause (p 0.004) and with lower rate of previous abdominal surgery (p <0.001) compared to converted group. At clinical evaluation, they had lower incidence of diffuse abdominal pain (p<0.001) and higher incidence of localized Blumberg's sign (p<0.001).

Cramer's analysis of association between variables of interest and converted group (Table 4) demonstrated a very strong association with age ≥ 49 (Cramer's Phi 0.369; p<0.001) and with previous abdominal surgery (Cramer's Phi 0.251; p<0.001), a strong association with ASA score ≥ III (Cramer's Phi 0.211; p < 0.001) and with diffuse abdominal pain (Cramer's Phi 0.190; p 0.001) and a moderate association with CRP level ≥ 66.05 mg/L (Cramer's Phi 0.122; p 0.041).

Table 4. *Cramer's Phi test for association analysis between preoperative variables and converted group.*

Variable	Cramer's Phi	P-value
Age ≥ 49.5 years	0.369	<0.001
Sex M	0.033	0.581
ASA-score ≥ III	0.211	0.001
Previous abdominal surgery	0.251	<0.001
Previous hospitalization for the same cause	0.094	0.115
Diffuse abdominal pain	0.190	0.001
Localized Blumberg	-0.129	0.031
Diffuse Blumberg	0.060	0.315
Body Temp. ≥ 37.55°C	-0.059	0.326
WBC ≥ 13.695 x109/L	0.028	0.695
CRP ≥ 66.05 mg/L	0.122	0.041

At logistic regression analysis, risk of conversion of SBO (OR, [95%IC] 4.2, [1.619-10.890]) was statistically higher compared to other admission diagnoses. Odds Ratio analysis for acute appendicitis and NSAP highlighted low risk of conversion whereas acute cholecystitis and PD did not show any significantly increase or decrease likelihood for the conversion risk (Table 1b). Analysis of preoperative variables (Table 5) revealed that Age ≥ 49 years (10.047, [4.322-23.350]), ASA-score ≥ III (3.641; [1.663-7.971]), previous abdominal surgery (3.716, [1.965-7.026]), diffuse abdominal pain (3.004, [1.491-6.053]) and CRP ≥ 66,05 mg/L (1.913; [1.019-3.590]) were significantly associated with high risk of conversion while localized Blumberg's sign (0.5 [0.265-0.944]) was significantly associated with low risk of conversion.

Table 5. *Logistic regression analysis and Odds Ratio calculation of the conversion risk for preoperative variables. OR odds ratio; 95% IC 95% Confidence interval*

Variable	OR	95% IC	*P*-value
Age ≥ 49.5 years	10.047	4.322-23.354	<0.001
Sex M	1.191	0.640-2.219	0.581
ASA-score ≥ III	3.641	1.663-7.971	0.001
Previous abdominal surgery	3.716	1.965-7.026	<0.001
Previous hospitalization for the same cause	1.711	0.873-3.355	0.118
Diffuse abdominal pain	3.004	1.491-6.052	0.002
Localized Blumberg	0.500	0.265-0.944	0.033
Diffuse Blumberg	1.392	0.729-2.656	0.316
Body Temp. ≥ 37.55°C	0.708	0.355-1.413	0.328
WBC ≥ 13.695 x10^{9} /L	1.133	0.607-2.115	0.695
CRP ≥ 66.05 mg/L	1913	1.019-3.590	0.043

DISCUSSION

Acute abdomen represents the most common clinical condition in emergency general surgery and laparoscopy has progressively gained a more relevant role, becoming the gold standard approach for the treatment of surgical acute abdomen2,3. An accurate diagnostic workup in emergency room would include clinical evaluation, blood samples, ultrasound and/or computed tomography5. Unfortunately in challenging times due to novel COVID-19 outbreaks worldwide, emergency surgeons have to confront daily with the reduced availability of radiological procedures and with the need to avoid patients handling as much as possible7 therefore clinical features and laboratory tests often are back to guide surgical decision.

Despite some authors have suggested that emergency laparoscopy should be avoided during COVID era, due to risk of aerosolization of viral particles with pneumoperitoneum8 there is no data to support the evidence of disease transmission through laparoscopic insufflation gas9. Moreover, laparotomic approach, with its inherent increased likelihood of intensive care unit stay and increased risk of surgical complications and prolonged hospital would increase harmful exposures for both patients and healthcare workers. In summary, we agree with authors that support that laparoscopy, with the appropriate precautions, is a feasible and safe approach to urgent surgical patients in the COVID-19 era10.

The choice of analysing these variables as possible predictive factors for conversion comes from the expertise of emergency general surgeons and from scientific evidence reported in literature, mostly in studies concerning acute cholecystitis, acute appendicitis and small bowel obstruction 11,12,13,14,15,16,17,18,19,20,21,22, 23. Furthermore, the evaluation of these parameters is easy, rapid and reproducible.

Localized Blumberg's sign (i.e. in a single abdominal quadrant) is negatively associated with the converted group and showed a significantly low likelihood of conversion risk. This evidence, never described previously, could be explained by the presence of physiological mechanisms14 which contain and compartmentalize the inflammatory process within the abdomen; as the inflammatory process is restrained by omental adhesions, this delimitation makes it easier and safer to treat the pathologic condition laparoscopically.

The results of our study, in accordance with data from literature15,16, show that laparoscopy can be used safely and effectively in case of acute appendicitis and NSAP. Moreover in front of a patient with abdominal pain of unclear diagnosis, explorative laparoscopy proved to be an effective approach to obtain an intraoperative diagnosis and consequent treatment, showing its usefulness and applicability in these clinical contexts17.

For what concerns acute cholecystitis, perforated diverticulitis (Hinchey II-III), perforated peptic ulcer (small sample of cases) and especially acute small bowel obstruction, our evidences can be useful to appropriately assess patients before the operation. These conditions can be managed laparoscopically in certain contexts with an adequate patient selection and we were able to draw a flow chart to better represent our approach to the acute abdomen and the parameters considered in choosing either laparoscopic or open access. (Figure 1)

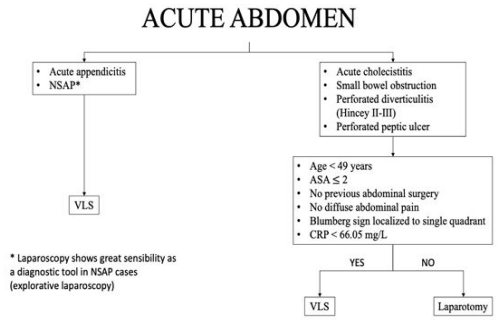

Figure 1. *Proposed flow chart for the laparoscopic approach to acute abdomen. NSAP acute non-specific abdominal pain*

CONCLUSION

All the parameters considered are non-radiological: this evidence shows that clinical, anamnestic and biochemical parameters can give a valid support to choose the adequate surgical approach; in the current period, these parameters assume an even greater relevance as an assessment tool compared to imaging, since radiological examinations are being limited due to the risk of infective exposures. The choice of the appropriate surgical technique is paramount to minimize the waste of time and resources during the diagnostic work up process and it also has a relevant impact on cost-effectiveness and on surgical outcomes.

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