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RESectability **S**mall **B**owel **O**bstruction **LAP**aroscopic (**RESBOLAP**) Score. Multicentric Data Registry.

STUDY PROTOCOL

Protocol version number: 1.3 5/12/2022

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Site Principal Investigators: Coordinators of Emergency or Surgery Department Units (therefore maximum 3-4 members) of each participating center.

INTRODUCTION

Albeit the role of laparoscopy in the treatment of acute small bowel obstruction (SBO) has grown significantly over the last decade [1–3], the inability to obtain an adequate evaluation of compromised bowel segments has been considered as real limitation [1,4–6]. This is essentially due to a reduced field of view owing to intestinal distension, the minimized haptic feedback obtained and limited bi-dimensional visualization [4–7]. As a consequence the presence of the normal visual clues to irreversible vascular insufficiency is much reduced.

Such signs include stable discoloration of the bowel wall, absence of peristaltic movements and apparent mesenteric pulsation [4]. Intestinal perfusion and viability are largely assessed by means of the clinical eye. However, this method lacks objectivity and accuracy, irrespective of a surgeon's experience [8]. Routinely clinical judgement may be appropriate, but the rate of conversion due to concerns regarding bowel viability can be high [4–6, 9]. Where there are concerns for intestinal ischaemic injury without absolute indications to bowel resection (areas of mural gangrene or bowel necrosis with perforation) intestinal compromise can be appraised by real-time fluorescent analysis of the vascular supply [10].

Some authors reported their experience on the use of the ICG fluorescent angiography (FA) to assess bowel viability during laparoscopic approach in emergency surgery for SBO, with promising results.[11,12,13,14,15,]. Nowadays, an important drawback of qualitative intraoperative assessment of bowel compromise with FA is the interpretation and definition of the boundaries between bowel viability and irreversible ischemia in order to avoid or reduce the rate of delayed bowel necrosis and perforation. An instrument more objective as possible to help surgeons during the intraoperative decision-making is lacking. A resectability score could be resolute.

AIM OF THE STUDY

The aim of this study to develop a Resectability Laparoscopic Score as a helpful instrument during the **intraoperative** decision-making in the setting of emergency laparoscopic surgery for SBO by analysing a multicenter data registry.

DESIGN OF THE STUDY

This is a multicenter study composed of a first phase of prospective data collection from patients that undergo laparoscopic surgery with a diagnosis of SBO and undergo ICG FA for doubts about bowel viability after the resolution of the obstructive mechanism; the second phase of retrospective analysis to develop the Resectability Score.

METHODS

The FA should be performed in all patients undergoing laparoscopic surgery for SBO that presents concerns bowel viability after the resolution of the occlusive mechanism, with consequent intraoperative enrolment in the study Registry.

We adopted the modified Bulkley classification [16] of the fluorescent patterns to identify which patients need more FA to assess bowel vitality. (**Table 1** and **Fig 1**).

It is expected that the majority of patients for whom the FA will be performed are those with patterns 2 or 3, representing the study's main object.

All participant centers must adopt the same technique to perform FA with the attempt to homogenize the procedure.

Twenty-five milligrams of ICG powder (Verdyne, Diagnostic Green GmbH, or similar) is suspended in 10 ml of sterile water and administered intravenously through a peripheral vein and in small repeatable boluses of 2 ml in order to evaluate the intestinal microcirculation extemporaneously. The presence and pattern of arterial supply is tested and compared with that of healthy bowel. Proper clearance of the dye was also appraised to verify adequate venous drainage. Following the reversal of the underlying cause of the ischaemic injury, and after generous irrigation with warm saline, the involved bowel segment was further evaluated with FA after 10 min, regardless of the return of visible peristalsis.

Routine postoperative clinical judgment will be considered sufficient to check bowel vitality.

The need for a second-look surgery and delayed resections will be recorded.

All centers could participate with a maximum of 3-4 members (co-authorship)

Data will be recorded by a simple and brief **online Case Report Form (CRF)** [**Tab 2**] on which upload also a photo/brief video of the FA, will be filled out by every participating center for each patient.

A link to a **Google Form** will be sent to every center after they have accepted to participate in the study.

Endpoints

Outcome analyzed are (**the items in bold are those that will be utilized to develop the intraoperative score**):

- ASA score
- Preoperative Imaging diagnosis (CT scan, abdominal X-ray, abdominal US)
- Preoperative blood exams (lactates, CRP, WBC)
- Clinical signs (Blumberg)
- Time from symptoms presentation to diagnosis
- Time from diagnosis to surgery
- Date of surgery
- **Intraoperative findings**
- **Cause of SBO**

- **Length of compromised bowel**
- **Quality of peritoneal fluid**
- **Peristalsis after resolution of the obstruction at 5-10-15-20 minutes**
- **Return to healthy bowel coloration after resolution of the obstruction at 5-10-15-20 minutes**
- **ICG-fluorescence angiographic patterns**
- Numbers of iv boluses of ICG performed
- **Bowel resection (YES/NO)**
- Length of bowel resection
- **Surgical procedure (adhesiolysis, resection, etc)**
- Associated surgical procedures (hernioplasty, etc.)
- **Reintervention**
- **Date of reintervention**
- Blood exams on day of reintervention (lactates, CRP, WBC)
- **Delayed bowel resection (YES/NO)**
- Mortality (YES/NO)
- Date of death
- Length of stay

Finally, when the registry will be completed, a logistic regression analysis will be used to identify independent predictive factors of bowel resectability by calculation of odds ratios and its 95% CI based on delayed bowel resection rate too. Significant continuous variables will be transformed into categorical variables using receiver operating characteristic (ROC) curves. The sample size required for the development for the Score was determined according to previous reports. The number of unnecessary bowel resection has been estimated around 46% [16]. Two studies [11,12] on ICG-fluorescence angiography use during laparoscopic surgery for SBO reported 28.6% of resection rate. We adopted this degree of difference as the maximum error tolerance of 17.4%. Considering a power of 0.9, a significance level of 0.05, a 95% CI with its two sides of 0.112 and 0.46, the required sample size will be of 26 subjects that will undergo to bowel resection that must be associated with other 26 subjects with non bowel resection and other 26 will undergo delayed bowel resection, for a total of 78 patients. According to this sample size the score will have a sensitivity of 0.28, a specificity of 0.73, a positive predictive value of 0.22, a negative predictive value of 0.73 and a precision value of 0.39. The optimal cut-off point with the highest sum of sensitivity and specificity will be chosen for each variable, also the overall predictive value of the Score will be assessed. Finally, a score will be developed by assigning coefficient points to each variable.

INCLUSION CRITERIA

We include in our study:

- All centers that routinely perform emergency laparoscopic surgery for SBO and have imaging systems with technology for the detection of near-infrared/indocyanine green fluorescence
- All patients more than 18 years old undergoing emergency laparoscopic surgery for SBO with intraoperative doubts about bowel viability after the resolution of the occlusive mechanism

EXCLUSION CRITERIA

- Open surgical procedure for SBO

STUDY TIMING

- Start of Data collection: 15 December 2022

- Deadline of data collection: 15 December 2023

DATA MANAGING AND PRIVACY

Patients' information will be anonymized and de-identified prior to analysis by an Excel file sent to all participants centers. Clinical data will be obtained from medical records, hospital informatics systems, and prospective clinical databases.

Results will be the property of AO Ospedali Riuniti Marche Nord and of the researchers involved in the conduction of the multicenter project.

ETHICAL CONSIDERATIONS

No clinical decision for all involved patients will be influenced by this analysis, with full compliance with the principles of ethical conduct in human research. This study will be submitted to the ethics committee of Regione Marche.

References

1. Johnson KN, Chapital AB, Harold KL, Merritt MV, Johnson DJ. Laparoscopic management of acute small bowel obstruction: evaluating the need for resection. *J Trauma Acute Care Surg.* 2012;72(1):25–31; discussion 30–1.
2. Wullstein C, Gross E. Laparoscopic compared with conventional treatment of acute adhesive small bowel obstruction. *Br J Surg.* 2003;90:1147–51.
3. Bailey IS, Rhodes M, O'Rourke N, Nathanson L, Fielding G. Laparoscopic management of acute small bowel obstruction. *Br J Surg.* 1998;85:84–7.
4. Di Saverio S, Gori A, Chisari E, Wheeler J, Lim R. Laparoscopic management of adhesive small bowel obstruction with strangulation: when to resect and how to distinguish reversible from non-reversible bowel ischaemia – a video vignette. *Colorectal Dis.* 2019;21:727–9.
5. Behman R, Nathens AB, Byrne JP, Mason S, Look Hong N, Karanicolas PJ. Laparoscopic surgery for adhesive small bowel obstruction is associated with a higher risk of bowel injury: a population-based analysis of 8584 patients. *Ann Surg.* 2017;266:489–98.
6. Quah GS, Eslick GD, Cox MR. Laparoscopic versus open surgery for adhesional small bowel obstruction: a systematic review and meta-analysis of case-control studies. *Surg Endosc.* 2019;33:3209–17.
7. Urbanavičius L, Pattyn P, de Putte DV, Venskutonis D. How to assess intestinal viability during surgery: a review of techniques. *World J Gastrointest Surg.* 2011;3:59–69.
8. Karliczek A, Harlaar NJ, Zeebregts CJ, Wiggers T, Baas PC, van Dam GM. Surgeons lack predictive accuracy for anastomotic leakage in gastrointestinal surgery. *Int J Colorectal Dis.* 2009;24(5):569–76.
9. Martin MJ, Pakula AM. Minimally invasive surgery techniques for the management of urgent or emergent small bowel pathology: a 2018 EAST master class video presentation. *J Trauma Acute Care Surg.* 2018;85:229–34.
10. Guerra F, Eugeni E, Patrìti A. Real-time fluorescent angiography to assess bowel viability during laparoscopic surgery for acute small bowel obstruction. *Ann R Coll Surg Engl.* 2020;102:468–9.
11. Guerra F, Coletta D, Greco PA, Eugeni E, Patrìti A. The use of indocyanine green fluorescence to define bowel microcirculation during laparoscopic surgery for acute small bowel obstruction. *Colorectal Dis.* 2021;00:1–6. <https://doi.org/10.1111/codi.15680>
12. Nakashima K, Ryu S, Okamoto A, Hara K, Ishida K, Ito R, Nakabayashi Y. Usefulness of blood flow evaluation with indocyanine green fluorescence imaging during laparoscopic surgery for strangulated bowel obstruction: A cohort study. *Asian J Surg.* 2022 Mar;45(3):867-873. doi: 10.1016/j.asjsur.2021.08.020.

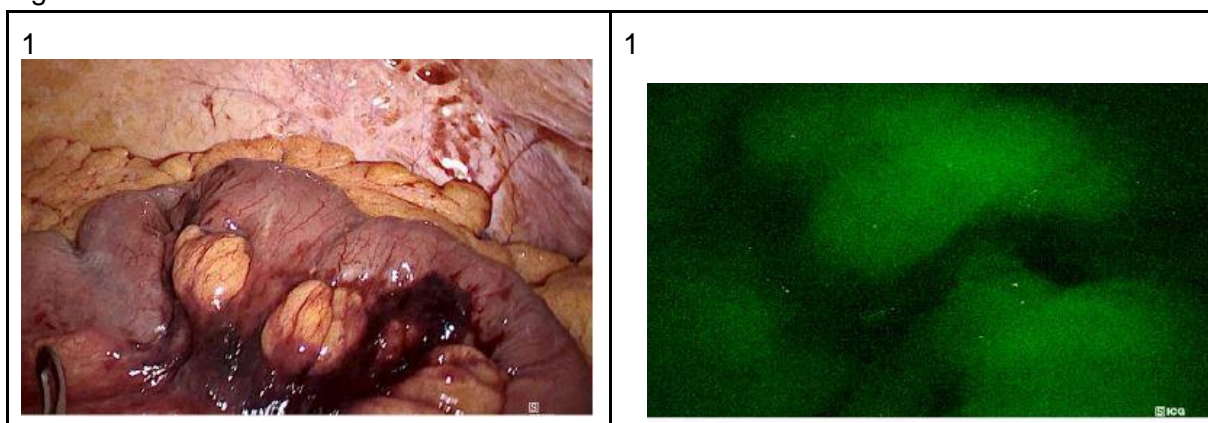
13. Vaassen HGM, Sprakel J, Lips DJ. Fluorescence angiography to assess intestinal viability during emergency laparoscopy for small bowel obstruction-A video vignette. *Colorectal Dis.* 2022 Jun 4. doi: 10.1111/codi.16214.
14. Ryu S, Hara K, Goto K, Okamoto A, Kitagawa T, Marukuchi R, Ito R, Nakabayashi Y. Fluorescence angiography vs. direct palpation for bowel viability evaluation with strangulated bowel obstruction. *Langenbecks Arch Surg.* 2022 Mar;407(2):797-803. doi: 10.1007/s00423-021-02358-8.
15. Joosten JJ, Longchamp G, Khan MF, Lameris W, van Berge Henegouwen MI, Bemelman WA, Cahill RA, Hompes R, Ris F. The use of fluorescence angiography to assess bowel viability in the acute setting: an international, multi-centre case series. *Surg Endosc.* 2022 Feb 23. doi: 10.1007/s00464-022-09136-7.
16. Bulkley GB, Zuidema GD, Hamilton SR, O'Mara CS, Klacsmann PG, Horn SD. Intraoperative determination of small intestinal viability following ischemic injury: a prospective, controlled trial of two adjuvant methods (Doppler and fluorescein) compared with standard clinical judgment. *Ann Surg.* 1981;193:628–37.

Table 1

	PATTERN	TEXTURE	MANAGEMENT
1	Hyperaemic/normal	Increased/normal	Preservation
2	Irregular/patchy	Fine granular	Preservation*
3	Irregular/patchy	Nonfluorescent patches > 5 mm	Resection*
4	Perivascular/nonfluorescent	Only perivascular areas stained/none	Resection

*The table should be utilized only as a guide for angiographic patterns classification and not as the indication for treatment. E.g. Patients with pattern 2 could undergo resection and those with pattern 3 could undergo a preservative treatment if deemed appropriate. This represents the study's main object.

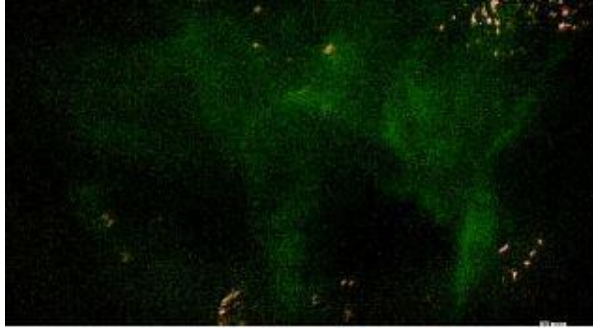
Figure 1



2



2



3



3



4



4

