


# Current status of laparoscopy for acute abdomen in Italy: a critical appraisal of 2012 clinical guidelines from two consecutive nationwide surveys with analysis of 271,323 cases over 5 years

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## Abstract

**Background** Several authors have demonstrated the safety and feasibility of laparoscopy in selected cases of abdominal emergencies. The aim of the study was to analyse the current Italian practice on the use of laparoscopy in abdominal emergencies and to evaluate the impact of the 2012 national guidelines on the daily surgical activity. **Methods** Two surveys (42 closed-ended questions) on the use of laparoscopy in acute abdomen were conducted nationwide with an online questionnaire, respectively, before (2010) and after (2014) the national guidelines

publication. Data from two surveys were compared using Chi-square or Fisher's exact test, and data were considered significant when  $p < 0.05$ .

**Results** Two-hundred and one and 234 surgical units answered to the surveys in 2010 and 2014, respectively. Out of 144,310 and 127,013 overall surgical procedures, 23,407 and 20,102, respectively, were abdominal emergency operations. Respectively 24.74 % (in 2010) versus 30.27 % (in 2014) of these emergency procedures were approached laparoscopically,  $p = 0.42$ . The adoption of laparoscopy increased in all the considered clinical scenarios, with statistical significance in acute appendicitis (44 vs. 64.7 %;  $p = 0.004$ ). The percentage of units approaching Hinchey III acute diverticulitis with laparoscopy in 26–75 % of cases (14.0 vs. 29.7 %;  $p = 0.009$ ), those with >25 % of surgeons

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confident with laparoscopic approach to acute diverticulitis (29.9 vs. 54 %;  $p = 0.0009$ ), the units with >50 % of surgeons confident with laparoscopic approach to acute appendicitis, cholecystitis and perforated duodenal ulcer, all significantly increased in the time frame. The majority of respondents declared that the 2012 national guidelines influenced their clinical practice.

**Conclusions** The surveys showed an increasing use of laparoscopy for patients with abdominal emergencies. The 2012 national guidelines profoundly influenced the Italian surgical practice in the laparoscopic approach to the acute abdomen.

**Keywords** Laparoscopic surgery · Abdominal emergencies · Acute abdomen · Laparoscopy · National survey · Nationwide survey on laparoscopy · Emergency laparoscopy guidelines · Clinical audit · Laparoscopy acute abdomen · Laparoscopic acute care surgery

The advantages of laparoscopy are already widely accepted for elective procedures. However, several authors have demonstrated its safety and benefits also in selected patients with abdominal emergencies [1].

In fact, in emergency surgery, the laparoscopic approach is able to provide a better view of the entire abdominal cavity with minimal trauma, giving the opportunity for a precise diagnosis and, at the same time, a definitive treatment. Indeed, the advantages of minimally invasive surgery (a decreased operative trauma ultimately leading to the reduction of post-operative pain, lower incidence of wound infections and incisional hernias and last but not least a decreased inflammatory response in septic patients by inflicting less surgical trauma) are particularly attractive in an emergency setting [2–4].

However, 20 years after the first pioneering experiences on the use of minimally invasive surgery in emergency setting, its role in the daily management of acute abdomen still remains an interesting and challenging field, strongly influenced by the laparoscopic skills of the operating surgeon, the technical challenges in the presence of diffuse peritonitis or adhesions and, the anesthesiological concerns in the treatment of the elderly, frail or high-risk patients.

The 2006 EAES (European Association for Endoscopic Surgery) consensus statement on laparoscopy for abdominal emergencies identified some conditions where the minimally invasive approach was recommended [5].

Five years later, in 2012, the Scientific and Educational Committee of the “Joined Italian surgical societies working group” (SICE: Società Italiana di Chirurgia Endoscopica e nuove tecnologie—Italian Society for Endoscopic Surgery and new technologies; the ACOI: Associazione dei Chirurghi Ospedalieri Italiani—Italian

Association of Hospital Surgeons; the SIC: Società Italiana di Chirurgia—Italian Society of Surgery; the SICUT: Società Italiana di Chirurgia d’Urgenza e del Trauma—Italian Society of Emergency and Trauma Surgery; the SICOP: Società Italiana di Chirurgia nell’Ospedalità Privata—Italian Surgical Society of Private Hospitals) under the auspices of the EAES updated the indications for minimally invasive approach in emergency scenarios [6].

At the same time, the group decided to assess the diffusion of the emergency laparoscopic surgery in Italy and to establish the basis for an evaluation of the real impact of the 2012 National guidelines on the Italian surgical practice.

For this reason, the state of the daily use of the laparoscopic approach in an emergency setting was recorded using a nationwide survey on this topic. Two years after the publication of the Italian consensus, a second e-survey provided a thorough overview on the use of laparoscopy for acute care surgery in Italy and of the changes induced by the 2012 consensus statement.

The aim of the research was to evaluate the effects of the guidelines on the emergency surgical activity of the Italian hospital system, and, in particular, analyse whether any changes in the daily practice have been adopted following the publication of the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement. The study also served the purpose to examine the current status of the diffusion of laparoscopy for abdominal emergencies and acute abdomen among Italian general surgeons.

With these objectives, in 2010, the “Joined Italian surgical societies working group” invited the Italian surgical units to take part in the first national audit on the use of laparoscopy in emergency abdominal surgery. In 2014, the same structured e-survey has been submitted again to the same Italian surgical units, in order to analyse the changes occurred in the time frame and to assess the real impact of the 2012 consensus statement on the daily use of laparoscopy for abdominal emergencies.

## Methods

The “Joined Italian Surgical Societies Working Group” invited all the hospital surgical units registered in the database of the Italian Ministry of Health to participate in two nationwide e-surveys. They took place before (2010) and after (2014) the development and publication of the SICE-ACOI-SIC-SICUT-SICOP and EAES consensus conference statements and guidelines about the use of laparoscopy in emergency surgery [6]. Both surveys were conducted using the same online questionnaire. However, in 2014 the question regarding the knowledge of the 2006 EAES guidelines was addressed to the newly published

2012 guidelines and items about the perceived changes introduced after publication of the guidelines were added. The surveys were restricted to one delegate for each surgical unit. They were informed of the purpose of the study and asked to complete details about the use of laparoscopy in acute abdominal surgical conditions. The entire list of the Italian surgical unit was obtained from the Ministry of Health. The invitations were sent by email to the addresses included in the database of the scientific societies involved. The participants were addressed to a questionnaire posted on the website of one of the scientific societies of the working group. The participation in the surveys was also solicited on the websites of the other involved surgical scientific societies, and a link to the questionnaire was made available on their main page. However, the participation remained voluntary, and no incentives were offered to the participants. All the mentioned websites are visited by the surgeons who are members of the scientific society. The data were collected within a three-month time frame for each survey.

The questionnaire included 42 closed-ended questions, divided into two sections. The first section included general questions about the year of the introduction of laparoscopy in the surgical unit, the number of surgeons involved in the laparoscopic activity both for routine and for emergency operations; the safety and feasibility of the laparoscopic approach for the acute abdomen, such as indications, rates and causes for conversion to open surgery and complications.

The second section included specific questions on the use of the laparoscopic approach for the following conditions: acute appendicitis, cholecystitis, diverticulitis, small bowel obstruction, perforated duodenal ulcer and abdominal trauma. Only closed-ended questions were used. To get homogeneous answers, the list of alternatives for every single quantitative question included a percentage category as follows: less than 25 % of the cases performed laparoscopically, 26–50 %, 51–75 % and more than 75 % of the cases. We have decided to use categorical data (identifying the described categories) rather than continuous and discrete data, in order to allow an easier aggregation and analysis of the information collected from the 610 surgical units involved in the two consecutive national surveys. No adaptive questioning was included. All the items had to be completed, and questionnaires with missing items prompted a warning and could not be saved. Therefore, no procedure for handling incomplete questionnaires was necessary. The usability and technical functionality of the electronic questionnaire have been tested before the invitations were sent. The name and the location of the surgical unit were stored with the questionnaire. Multiple entries from the same individual (surgical unit) were manually searched and eliminated in three instances, as they did not include contradictory answers. Automated consistency and

completeness checks were not available to the participants, who were able to review and change their answers through a *Back* button.

The study has been examined and approved by the board of all the societies involved and carried out in agreement with the Helsinki Declaration. All parts of the study and the present manuscript have been checked and presented according to the checklist for Reporting Results of Internet E-Surveys (CHERRIES), the reporting standards suggested in the EQUATOR (Enhancing the QUALity and Transparency Of health Research) Network, and the “guide” published by Burns et al. [7–10].

A summary of the results of the surveys has been presented in June 2015, during the ACOI National Congress in Genoa, as well as in September 2015 during the SICE National Congress in Ferrara and in October 2015, during the SIC National Congress in Milan, Italy.

### Statistical analysis

Statistical Package for the Social Sciences (SPSS), version 22 (SPSS Inc., Chicago, IL, USA) was used to perform the statistical analysis. Categorical variables were reported using counts and percentages when appropriate. The data from the 2010 and 2014 surveys were compared using the Chi-square Fisher’s exact test. The differences were considered significant when  $p < 0.05$ .  $P$  values of the study have been reported as calculated by the statistical software, which were both bilateral (i.e.  $p=$ ) and unilateral (i.e.  $p<$ ).

### Results

Six hundred and ten surgical units were invited to both national surveys. The overall response rate was 38 % (234 replies, of whom 12.8 % were University Hospitals) in 2010 and 33 % (201 replies, of whom 14.9 % were University Hospitals) in 2014. Overall 66.53 % of the surgical units requested have answered to both the surveys.

In 2010, 35.9 % of the respondents declared to have read the 2006 EAES guidelines, while 44.4 % knew their existence but had not read them and 19.6 % were not aware of the guidelines. The knowledge of the 2012 guidelines was much higher in the 2014 survey: most respondents had read the publication (76.1 %), 5.4 % had heard of but had not read them and 18.4 % was not even aware of their existence.

The vast majority (62.7 %) of the respondents started performing laparoscopy, for emergency conditions, during the 1990s. The questionnaires reported a total of 144,310 surgical operations in 2010 and 127,013 in 2014. About 16 % of them were done in an emergency setting (including laparoscopic and open) in both surveys.

Laparoscopy for emergency conditions represented 4.01 % of the 2010 and 4.79 % of the 2014 total number of surgical operations. However, laparoscopic surgery was adopted in about a quarter of the procedures performed for an abdominal emergency, with an increased trend over the study period (24.74 % in 2010 vs. 30.27 % in 2014), although this variation did not reach a statistically significant difference ( $p = 0.42$ ).

The highest conversion rate occurred at the beginning of the laparoscopic practice of each surgical unit, as reported both in 2010 (59 %) and 2014 (55 %), without a statistically significant difference ( $p = 0.66$ ). Both in 2010 and 2014, the respondents did not consider diffuse peritonitis, sepsis and compromised general conditions as absolute contraindications to laparoscopy. Only 0.42 % of surgical units in 2010 and 0.49 % in 2014 considered elderly patients (defined as patients aged over 70 years) to be unsuitable for the laparoscopic approach.

Unclear anatomy was the most common cause of inability to complete the procedure laparoscopically and conversion to open surgery both in 2010 (41 %) and 2014 (48 %) ( $p = 0.39$ ).

The most frequent intra-operative complication that induced a conversion to laparotomy was intra-abdominal bleeding. Its incidence did not significantly change in the time frame of the study (62 % in 2010 and 55 % in 2014,  $p = 0.27$ ).

According to the surgeons involved in the surveys, the minimally invasive approach provided a positive impact on health care costs: 81 % of surgeons in 2010 and 87 % in 2014 ( $p = 0.33$ ) thought that laparoscopy was cost-effective, even for emergency operations. The reduction of the post-operative hospital stay was considered the major factor for cost effectiveness (43 % in 2010 and 46 % in 2014,  $p = 0.77$ ).

In the case of unfortunate need for themselves or their relatives, 98 % of surgeons both in 2010 and 2014 stated that they would recommend a laparoscopic approach for acute abdomen.

In Tables 1, 2, 3, 4, 5 and 6 the main results of the study are summarized.

### Acute appendicitis

Laparoscopic appendectomy was considered appropriate for all categories of patients mentioned in the survey (obese patients, elderly patients, clinical suspicion of inflammatory bowel disease and women of childbearing age) in 66 % of surgical units in 2010 and 75 % in 2014. Nonetheless, the difference was not statistically significant ( $p = 0.2$ ). The reported timing for laparoscopic surgical treatment of acute appendicitis was within 24 h for the vast majority of the units both in 2010 and 2014 (86 vs. 94 %, respectively), without any statistically significant difference ( $p < 0.001$ ). The analysis of the data collected in

2010 and 2014 showed that an increasing number of surgical units started managing acute appendicitis by laparoscopy. In fact, the rate of units performing laparoscopic appendectomy in 75–100 % of cases of acute appendicitis increased from 44 % in the 2010 to 64.7 % in 2014 ( $p = 0.004$ ). On the other hand, the percentage of units approaching acute appendicitis laparoscopically in less than 50 % of the cases dropped to 16.9 % (32.9 % in 2010) ( $p = 0.005$ ). The rest of the units (19.6 % in 2010 and 18.4 %) adopted the laparoscopy in 51–75 % of the appendectomies. In 2010, only 41.5 % of surgical units involved in the survey declared that more than 50 % of the surgeons were confident in treating acute appendicitis by a laparoscopic technique, while in 2014 the figure increased to 75.1 % ( $p = 0.03$ ).

The rate of conversion to open surgery showed no differences from 2010 to 2014 (0–25 % in more than 85 % of surgical units,  $p = 0.98$ ).

Finally, 72 % declared that their institutional management of acute appendicitis had been modified following the publication of the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement.

### Acute cholecystitis

The units offering a laparoscopic cholecystectomy for acute cholecystitis in more than 75 % of all the cases increased from 65.8 % in 2010 to 70.2 % in 2014 ( $p = 0.64$ ). The fraction of units adopting laparoscopy only in <50 % of cholecystectomies for acute cholecystitis decreased from 22.6 to 18.4 %. The remaining units (10.7 vs. 10.4 %) offered a laparoscopic approach between 26 and 50 % of the acute cholecystitis cholecystectomies. The reported conversion rate was <25 % in 85.8 % of the participating units in 2010 and 85.4 % in 2014 ( $p = 1.00$ ).

The percentage of units with more than 50 % of their surgeons confident in the laparoscopic approach for acute cholecystitis significantly increased from 36.7 % in 2010 to 64.1 % in 2014 ( $p = 0.0002$ ). In conclusion, 78.6 % of surgical units involved in the national survey declared that their management algorithm of acute cholecystitis was modified following the publication of the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement.

### Acute diverticulitis

The units with more than 25 % of surgeons familiar with the laparoscopic treatment of acute diverticulitis increased from 29.9 % in 2010 to 54 % in 2014 ( $p = 0.0009$ ).

In 2010, laparoscopic surgery was offered by 83.8 % (87.9 in 2014) of the respondents for stages Hinchey IIb. For the vast majority (71.3 % in 2011 vs. 70.6 % in 2014,

**Table 1** Major results of the first section: general questions about the laparoscopic approach in Italy

	2010	2014	<i>p</i> value
Number of units invited to the survey: <i>n</i>	610	610	
Number of units involved: <i>n</i> (%)	234 (38 %)	201 (33)	0.55
Overall number of surgical procedures in the units involved: <i>n</i>	144.310	127.013	
Laparoscopic procedures for abdominal emergencies calculated on the overall number of surgical procedures in the units involved (%)	4.01 %	4.79	1.00
Mean number of surgical procedures performed in each unit: <i>n</i>	616.7	631.9	
Abdominal emergencies approached by laparoscopy: <i>n</i> (%)	5.791 (24.74 %)	6.085 (30.27)	0.42
Major factor for cost-effectiveness according to surgeons: reduction of post-operative hospital stay (%)	43 %	46	0.77

**Table 2** Conversion to open surgery

	2010	2014	<i>p</i> value
<i>Causes—unable to complete the procedure laparoscopically</i>			
Unclear anatomy (%)	41	48	0.39
Adhesions (%)	33	32	1.00
Severe inflammation (%)	19	14	0.44
Other (%)	7	6	1.00
<i>Causes—intra-operative complications</i>			
Bleeding (%)	62	55	0.27
Viscus perforation (%)	28	32	0.64
Vascular lesion (%)	1	7	0.06
Other (%)	9	6	0.59
<i>Period</i>			
Beginning of laparoscopic activity (%)	59	55	0.66
Central (%)	19	19	1.00
Equal distribution (%)	16	22	0.36
Latest (%)	5	3	0.72
Other (%)	1	1	1.00

$p = 0.98$ ) both in 2010 and 2014, an exploratory laparoscopy with lavage and drainage was considered appropriate as the first laparoscopic option in this stage of the disease.

Resection with primary anastomosis (with or without diverting ileostomy) was indicated as the first line of laparoscopic treatment, respectively, in 24.3 % and 15.9 % ( $p = 0.2$ ). The rest of the units considered a laparoscopic Hartmann resection as the most appropriate course of action.

Laparoscopy for the treatment of Hinchey III was available in 62.4 % of the units in 2010 and 75.2 % in 2014 ( $p = 0.06$ ). In most of them, however, only a limited number of patients were actually treated laparoscopically: 6.8 % in 2010 versus 8.3 % in 2014 ( $p = 1.00$ ) of the units offered laparoscopy in more than 75 % of their series. The number of units adopting a laparoscopic approach in 26–75 % of cases has increased; however, from 14 to 29.7 % ( $p = 0.009$ ), most of the units (67.90 vs. 61.6 %;  $p = 0.008$ ) adopted a laparoscopic treatment only for

<25 % of their cases. In 2010, an exploratory laparoscopy with washout and drainage was considered the first-line laparoscopic approach in 48.7 % of the units, a laparoscopic resection with primary anastomosis (with or without diverting ileostomy) in 29 % and a laparoscopic Hartmann resection in the remaining 22.3 %. In the 2014 survey, the percentages became, respectively, 37, 25 and 38 %.

The most popular surgical option in Italy for Hinchey IV acute diverticulitis was still open surgery, with 64.1 % (59.8 in the first survey) of the surveyed units choosing to discard a laparoscopic approach if this stage was suspected.

Lastly, 68.1 % of surgical units involved in the national survey declared that they modified the management of complicated acute diverticulitis following the publication of the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement.

### Small bowel obstruction

The units facing a small bowel obstruction only by laparotomy decreased from 15.8 to 11.9 % between 2010 and 2014. At the same time, the proportion of units approaching a small bowel obstruction by laparoscopy in more than 50 % of cases increased from 10.3 to 13.4 % ( $p = 0.65$ ). In 17.0 versus 22.3 %, the laparoscopic option was selected in 26–50 % of the cases ( $p = 0.47$ ), and the majority (72.6 vs. 64.1 %) adopted it in <25 % of their series ( $p = 0.22$ ).

Only 5.1 % of surgical units in 2010 and 14.3 % in 2014 had in their team more than 50 % of the surgeons confident with the laparoscopic treatment of the small bowel obstruction, but the increase was not statistically significant ( $p = 0.06$ ).

Moreover, no statistically significant difference was found in the rate of conversion to open surgery. More than 50 % of surgical units (64.1 % in 2011 vs. 57.2 % in 2014,  $p = 0.38$ ) reported conversion rates lower than 50 %.

Post-operative adhesions and volvulus (72 % in 2010 vs. 73 % in 2014,  $p = 0.98$ ) were most commonly found at

**Table 3** Laparoscopic portion of the caseload

Question	2010	2014	<i>p</i> value
<i>Acute appendicitis</i>			
Units that approached acute appendicitis by laparoscopy in <50 % of cases	32.9	16.9	0.005
Units that approached acute appendicitis by laparoscopy in 51–75 % of cases	19.6	18.4	0.85
Units that approached acute appendicitis by laparoscopy in >75 % of cases	44	64.7	0.004
<i>Acute cholecystitis</i>			
Units that approached acute cholecystitis by laparoscopy in <50 % of cases	22.6	18.4	0.48
Units that approached acute cholecystitis by laparoscopy in 51–75 % of cases	10.7	10.4	1.00
Units that approached acute cholecystitis by laparoscopy in >75 % of cases	65.8	70.2	0.64
<i>Acute diverticulitis</i>			
Units that approached Hinchey III by laparoscopy in <25 % of cases	79.0	61.6	0.008
Units that approached Hinchey III by laparoscopy in 26–75 % of cases	14.0	29.7	0.009
Units that approached Hinchey III by laparoscopy >75 % of cases	6.8	8.3	1.00
<i>Small bowel obstruction</i>			
Units that approached small bowel obstruction by laparoscopy in <25 % of cases	72.6	64.1	0.22
Units that approached small bowel obstruction by laparoscopy in 26–50 % of cases	17.0	22.3	0.47
Units that approached small bowel obstruction by laparoscopy in >50 % of cases	10.3	13.4	0.65
<i>Perforated duodenal ulcer</i>			
Units that approached perforated duodenal ulcer by laparoscopy in >50 % of cases	47	53	0.47
<i>Trauma</i>			
Units that approached blunt abdominal trauma in hemodynamically stable patients by laparoscopy in <25 % of cases	79.9	78.6	0.98
Units that approached blunt abdominal trauma in hemodynamically stable patients by laparoscopy in >50 % of cases	9.8	9.9	1.00

Results are intended as % of surgical units

**Table 4** Units with more than 50 % (or 25 %) of surgeons confident with laparoscopy for acute abdomen

		2010	2014	<i>p</i> value
Acute appendicitis	>50 %	41.5	75.1	0.0001
Acute cholecystitis	>50 %	36.7	64.1	0.0002
Acute diverticulitis	>50 %	10.2	17.7	0.15
	>25 %	29.9	54.0	0.0009
Small bowel obstruction	>50 %	5.1	14.3	0.05
Perforated duodenal ulcer	>50 %	18	37	0.004

Results are intended as % of surgical units

laparoscopy. In conclusion, 63.6 % of surgical units involved in the national survey declared that management of the small bowel obstruction was modified after the publication of the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement.

### Perforated duodenal ulcer

The percentage of surgical units using laparoscopy to manage more than 50 % of cases of gastro-duodenal

**Table 5** Units which offered laparoscopy for acute abdomen scenarios

	2010	2014	<i>p</i> value
Acute appendicitis	96.6	100	0.24
Acute cholecystitis	99.2	99.1	1.00
Acute diverticulitis			
Hinchey IIb stage	83.8	87.6	0.54
Hinchey III stage	62.4	75.2	0.06
Hinchey IV stage	40.2	35.8	0.66
Small bowel obstruction	84.2	88.1	0.54
Perforated duodenal ulcer	88.8	95.1	0.19
Trauma—exploratory laparoscopy	67.6	68.2	1.00

Results are intended as % of surgical units

perforation increased from 47 % in 2010 to 53 % in 2014, without any statistically significant difference ( $p = 0.47$ ).

Moreover, 18 % of surgical units in 2010 and 37 % in 2014 declared to have within their team more than 50 % of surgeons confident in the laparoscopic management of perforated duodenal ulcer, with a statistically significant difference between the two surveys ( $p = 0.004$ ). Conversion rates <25 % occurred in roughly 70 % of surgical

**Table 6** Units which have changed the way to manage acute abdomen scenarios after publication of 2012 national guidelines

Acute appendicitis	72.0 %
Acute cholecystitis	78.6 %
Acute diverticulitis	68.1 %
Small bowel obstruction	63.6 %
Perforated duodenal ulcer	70.0 %
Trauma—exploratory laparoscopy	76.0 %

Results are intended as % of surgical units

units involved in the surveys (68.3 % in 2010 and 70.1 % in 2014,  $p = 0.87$ ).

In conclusion, 70 % of surgical units participating in both national surveys declared that the management of perforated duodenal ulcer has been modified by the publication of the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement.

## Trauma

During the period between 2010 and 2014, the use of exploratory laparoscopy for blunt abdominal trauma in hemodynamically stable patients did not achieve a wide diffusion. In fact, roughly 80 % of Italian surgical units involved in both surveys of the audit have used this approach in <25 % of cases of blunt abdominal trauma (79.9 % in 2010 and 78.6 % in 2014,  $p = 0.98$ ).

The indication to use a minimally invasive technique did not show any change over time. It was used in more than 50 % of cases for only diagnostic purpose (57 % in 2010 vs. 51 % in 2014,  $p = 0.47$ ), whereas only in <10 % of cases as a therapeutic approach to treat injuries of the intra-abdominal organs (6.8 % in 2010 and 9.9 % in 2014,  $p = 0.61$ ).

Nevertheless, in 2014, 76 % of surgical units declared that the 2012 SICE-ACOI-SIC-SICUT-SICOP and EAES consensus statement modified their management of blunt abdominal trauma.

## Discussion

The development of practice guidelines has been the source of concern and a significant amount of work in surgical practice, as they can become a strong asset both for surgeons and for patients, making the decision for surgery safer [11].

However, after the release of guidelines, their real impact on the clinical practice needs to be assessed, to verify possible advantages and drawbacks of their application. To the best of our knowledge, this is the first study that analysed the real impact of a specific consensus

statement within a large group of national surgical units, by the same questionnaire administered two different times: before and after the guidelines publication.

The representativeness of the study sample supports the validity of the results: generally, e-surveys are limited because of the possibility that the respondents do not reflect, close enough, the target population. In our case, the study sample is the entire target population (the surgical units of the Italian national health system), identified by the official list obtained from the Ministry of Health.

Still, surveys do have limitations, and our study is not without shortcomings. The obtained response rate (38 and 33 %) cannot preclude having non-response biases; however, the coincidence of the sample with the target population makes us confident that the respondents reflect the attributes of the Italian surgical population. A meta-analysis by Shih and Fan showed that e-mail surveys generally have lower response rate (about 20 % lower on the average) than mail surveys; however, the average response rate for email surveys is 33 % ( $\pm 22$  %); our response rate falls within those limits [12]. A recent report demonstrated that surveys administered on a surgical topic are expected to get a lower response rate if given electronically (36.4 %) and nationally (42 %) [13]. Furthermore, the results of that study have been achieved with responses given by residents (expected to be younger and more keen to complete surveys). In that perspective, our current response rate of 38 % seems to be fair and satisfactory. As a matter of fact, a high response rate minimizes the potential for bias and enhances the value of the study; however, it has been stressed that there is no scientifically established minimum acceptable response rate and it may not be associated with survey reliability or quality [14]. A more important consideration in determining reliability is the degree to which sampled respondents differ from the target population. In our study, they are closely related.

Our questionnaire design did not allow the presence of missing items. This aspect avoided the need to manage incomplete responses, but may have unfavourably influenced the response rate.

It is also obvious that the technique chosen for administration of the survey (e-survey and invitation by e-mail) may have resulted in a selection bias because not all surgeons have the same degree of confidence with the e-mail and internet communication. Moreover, the members of the scientific societies are probably more sensible and interested in the specific topic and more prone to respond to the invitation. Last but not least, we must acknowledge that, with only about 40 % of units providing feedback, the scope for bias due to laparoscopic enthusiasts responding is high. Therefore, we may have sampled more of the surgeons interested and enthusiastic in the topic, and the use of laparoscopy in an emergency may be higher in our study than

in the general target population. On the other side, the main aim of our research is the analysis of the changes in practice brought by the guideline publication. For that purpose, our study is peculiar in comparing two sequential questionnaires administered to the same group of participants (study sample). Therefore, the extent of a possible selection bias is presumptively similar in both surveys and the comparative analysis of the results is likely to be less affected by it.

Lastly, because all respondents were aware of the aim and content of the surveys, it cannot be ruled out neither a potential Hawthorne effect (subconscious modification of the answers due to the awareness of being studied) nor the influence of the “open-book exam theory” (consultation of guidelines to verify responses) [15].

### Diffusion of laparoscopy for emergency conditions

Laparoscopy for acute abdomen gained an increasing diffusion during the 4 years of the study, as shown by the increased, although not statistically significant, the rate of abdominal emergencies approached by laparoscopy (24.74 % in 2010 vs. 30.27 % in 2014,  $p = 0.42$ ). Currently, most Italian surgeons trust the safety and efficacy of minimally invasive surgery: in the case of need of emergency surgery for themselves or their relatives, they would recommend a laparoscopic approach for acute abdomen (98 % of surgical units involved in the surveys).

Most of the involved units offered the laparoscopic option in all the surveyed scenarios (Table 5). The adoption of the laparoscopic surgery increased in all the considered clinical conditions (except for acute cholecystitis, where it was already maximized in 2010) albeit the changes were not statistically significant. However, the minimally invasive option was often limited to a relatively small part of the caseload (Table 3) that, interestingly, increased in 2014. This finding may be the result of an established trend favouring mini-invasiveness and, in part, of the publication of the national guidelines and their widespread adoption, also supported by several meetings on the topic held in Italy during the studied 4 years.

Significant changes are found in the penetration of laparoscopic appendectomy: the number of units adopting the mini-invasive technique for more than 75 % of their caseload increased from 44 to 64.7 % ( $p = 0.004$ ). Conversely, the units limiting the laparoscopy to <50 % of cases dropped from 32.9 to 16.9 % ( $p = 0.005$ ). It must be noted that a particular attention was devoted to the laparoscopic appendectomy, and during the study period, the results of a specific National Consensus Conference on the topic were also published [16].

In addition, significant changes were recorded in the penetration of laparoscopic surgery for acute diverticulitis. In particular, in 2014, a larger part of the caseload was

managed laparoscopically, as shown by the increase in the number of units that declared to treat Hinchey III diverticulitis by a mini-invasive technique in 26–75 % (29.7 vs. 14.0 %;  $p = 0.009$ ) and, at the same time, the decrease of those limiting laparoscopy to <25 % of cases (61.6 vs. 79.0 %;  $p = 0.008$ ). Interestingly the number of units adopting the laparoscopic approach in more than 75 % did not change (6.8 vs. 8.3 %,  $p = 1.00$ ).

A similar result was shown for the laparoscopic cholecystectomy for acute cholecystitis albeit a statistical significance was not reached (65.8 vs. 70.2 %;  $p = 0.64$ ). The mentioned 2012 consensus statements considered laparoscopic cholecystectomy as the gold standard for patients with acute cholecystitis and recommended that surgery should be performed as soon as possible after the onset of symptoms. The evidence data about the management of acute cholecystitis were also diffused and emphasized in Italy during the study period during several meetings [17–22].

National surveys from the USA, Greece, Sweden, Denmark and Scotland provided in the last decade interesting data on the use of minimally invasive approach for acute cholecystitis [23–27]. Our findings are comparable with the results of other recent studies [28, 29].

The routine recourse to laparoscopy in a more considerable part of their practice also augmented for the small bowel obstruction and perforated peptic ulcer, but the changes were not statistically significant. Open surgery remains the first-line approach in about 70 % of all operations for small bowel obstruction and in more than a half of perforated ulcers.

### Number of surgeons confident with emergency laparoscopy

The data analysis of the number of surgeons within each unit who were confident in performing laparoscopic surgery for emergency conditions is also relevant. It shows an encouraging, and statistically significant, increased rate of Italian surgeons being familiar with the technique. It must be emphasized that the findings not derived from a self-assessment as often occur in similar surveys. In fact, the respondent is generally the director of the surgical unit, who is well aware of the ability of his staff. Therefore, the notorious unreliability of self-assessment is avoided [30].

Agresta et al., in 2004, studied 26.863 cases of laparoscopic appendectomy and appraised that, at that time, only 47.3 % of surgeons felt confident in routinely approaching laparoscopically an acute abdomen suspicious for acute appendicitis [31].

Our results show a highly statistically significant increase in the number of surgeons able to perform a laparoscopic appendectomy (75.1 vs. 41.5;  $p = 0.00001$ ).



The number of surgeons confident with laparoscopy even in an emergency setting is significantly increased also for all the conditions examined (Table 4). These data are extremely helpful for the purpose to analyse the current status of the diffusion of laparoscopy for abdominal emergencies and acute abdomen among Italian general surgeons and are a clear indicator of the progress of the Italian surgical community. However, the total amount of surgeons who are confident with the laparoscopic approach for conditions such as complicated acute diverticulitis or small bowel obstruction is still small and constitutes a limiting factor.

## Trauma

In Italy, 80 % of surgical units involved in the two surveys have used laparoscopy in <25 % of cases of blunt abdominal trauma. However, the indication for the minimally invasive approach was diagnostic in more than 50 % of the cases. The results are in conformity with previous reports from the literature. In their meta-analysis of 2563 patients with penetrating abdominal trauma who underwent diagnostic laparoscopy, O'Malley et al. [32] found that the procedure was therapeutic only in 13.8 % of cases, while 51.8 % of patients were spared a non-therapeutic laparotomy. Our results showed that laparoscopy was used as therapeutic approach in only 6.8 % of cases in 2010 and 9.9 % in 2014 ( $p = 061$ ); nonetheless, the role of laparoscopy as a potential diagnostic tool has been widely accepted by the Italian surgical units.

## The perceived impact of the guidelines

The improved knowledge of the guidelines (75.1 vs. 35.9 %) confirmed the beneficial effects of their diffusion over the study period and the interest raised by the update of the guidelines.

The large majority of respondents declared that the issuance of the 2012 guidelines changed their approach to the management of the single conditions taken into consideration in the survey (Table 6). The amount of perceived change appears to be related to the number of surgeons confident with the technique. In fact, the clinical situations less susceptible to changes were small bowel obstruction (63.6 % declared to have been influenced by the guidelines) and acute diverticulitis (68.1 %) in which <20 % of the units have most surgeons confident with the laparoscopic technique. The data confirm that confidence, training and experience are relevant limiting factors to the diffusion of the emergency laparoscopy.

However, the guideline impact on the surgical clinical practice cannot be analysed aside from the consideration that the use of laparoscopy is much more controversial in

some diseases than others. While emergency appendectomy and cholecystectomy are routinely approached laparoscopically in many developed health care systems, other conditions are not. While in penetrating abdominal trauma, diagnostic and eventually therapeutic laparoscopy might be of value [33], the use of laparoscopy for blunt abdominal trauma is still rather occasional and only performed by experienced and dedicated operators, with skills in both minimally invasive trauma surgeries [34].

The data about acute diverticulitis should be interpreted with extreme caution after the results of a major multicentre trial published after the surveys were administered [35]. From the LOLA arm of the LADIES trial, a strong argument against laparoscopic lavage for advanced Hinchey grade diverticulitis is apparent, as the study was terminated early by the data and safety monitoring board because of an increased event rate in the lavage group. Nonetheless, the preliminary results from the analysis of a propensity score-matched cohort published more recently seem to further clarify the issue of use of laparoscopy for acute perforated diverticulitis, since when a sigmoid resection is performed rather than a laparoscopic lavage, laparoscopic sigmoidectomy is superior to open sigmoidectomy for perforated diverticulitis with regard to post-operative morbidity and hospital stay, with a further advantage of having observed a higher stoma reversal rate after laparoscopic Hartmann's procedure [36]. Last but not least, preliminary observations from some of the patients enrolled within the DIVA arm of the Trial seem to suggest the possibility of the feasibility and safety in experienced hands and with advanced laparoscopic skills, of a fully laparoscopic sigmoidectomy and primary anastomosis, with excellent outcomes in selected and stable patients [37].

## Conclusions

The critical analysis of the data from the audit conducted in 2010 and 2014 has confirmed that Italian surgeons read the 2012 SICE-ACOI-SIC-SICUT-SICOP national guidelines on the laparoscopic approach to acute abdomen and adhered to their recommendations. The laparoscopic management of acute abdomen in Italy during the last 4 years has been deeply influenced by the publication of the 2012 national consensus statement.

The diffusion of the laparoscopy even in an emergency situation is increasing, and the knowledge of the guidelines is a likely promoting factor. However, confidence and experience with the most advanced laparoscopic techniques are still limited in many Italian hospitals and restrict a wider dissemination of the mini-invasive emergency surgery.

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#### Compliance with ethical standards

**Disclosures** Ferdinando Agresta, Fabio Cesare Campanile, Mauro Podda, Nicola Cillara, Graziano Pernazza, Valentina Giaccaglia, Luigi Ciccoritti, Giovanna Ioia, Stefano Mandalà, Camillo La Barbera, Arianna Birindelli, Massimo Sartelli and Salomone Di Saverio have no conflicts of interest or financial ties to disclose.

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