

RESEARCH ARTICLE

Open Access



# The Operative management in Bariatric Acute abdomen (OBA) Survey: long-term complications of bariatric surgery and the emergency surgeon's point of view

Belinda De Simone<sup>1\*</sup>, Luca Ansaloni<sup>2</sup>, Massimo Sartelli<sup>3</sup>, Yoram Kluger<sup>4</sup>, Fikri M. Abu-Zidan<sup>5</sup>, Walter L. Biffi<sup>6</sup>, Arianna Heyer<sup>7</sup>, Federico Coccolini<sup>8</sup>, Gian Luca Baiocchi<sup>9</sup>, the OBA trial supporters and Fausto Catena<sup>10</sup>

## Abstract

**Background:** The number of bariatric procedures is increasing worldwide. No consensus or guidelines about the emergency management of long-term complications following bariatric surgery are currently available. The aim of this study is to investigate by a web survey how an emergency surgeon approaches this unique group of patients in an emergency medical scenario and to report their personal experience.

**Method:** An international web survey was sent to 197 emergency surgeons with the aim to collect data about emergency surgeons' experience in the management of patients admitted in the emergency department for acute abdominal pain after bariatric surgery. The survey was conceived as a questionnaire composed by 26 (multiple choice and open) questions and approved by a steering committee.

**Results:** One hundred seventeen international emergency surgeons decided to join the project and answered to the web survey with a response rate of 59.39%.

**Conclusions:** The aim of this WSES web survey was to highlight the current management of patients previously submitted to bariatric surgical procedures by ES.

Emergency surgeons must be mindful of postoperative bariatric surgery complications. CT scan with oral intestinal opacification may be useful in making a diagnosis if carefully interpreted by the radiologist and the surgeon. In case of inconclusive clinical and radiological findings, when symptoms fail to improve, surgical exploration for bariatric patients presenting acute abdominal pain, by laparoscopy if expertise is available, is mandatory in the first 12–24 h, to have good outcomes and decrease morbidity rate.

**Keywords:** Complication bariatric surgery, Outcome bariatric surgery, Emergency surgery, Acute abdomen, Abdominal pain after bariatric surgery

## Background

The World Health Organization (WHO) reported that the worldwide prevalence of obesity nearly tripled between 1975 and 2016. There are 340 million children and adolescents (age 5–19) who are overweight or obese. In 2016, more than 1.9 billion adults aged 18 years and older were overweight. Of these, over 650 million adults were obese.

Overall, about 13% of the world's adult population (11% of men and 15% of women) were obese in 2016 [1].

Morbid obesity occurs in 2–5% of the Western population and is associated with a high incidence of multiple preventable co-morbidities such as diabetes, cancer, and cardiovascular disease. Morbid obesity increases the risk of mortality [1].

Bariatric surgery is the only method that has been shown to achieve long term weight loss and treat co-morbidities [2].

\* Correspondence: [desimone.belinda@gmail.com](mailto:desimone.belinda@gmail.com)

<sup>1</sup>Department of General and Emergency Surgery, Azienda UsI Reggio Emilia IRCCS, Reggio Emilia, Italy

Full list of author information is available at the end of the article



The number of bariatric procedures performed by bariatric surgeons is increasing in specialist centers and abroad due to the phenomenon of health tourism [2–3]. The most recent International Federation for the Surgery of Obesity and metabolic Disorders (IFSO) Worldwide Survey [3] reported that 634,897 bariatric operations were performed worldwide in 2016.

The IFSO worldwide survey 2014 reported that the current most commonly performed bariatric procedures are the sleeve gastrectomy (SG), Roux en-Y gastric bypass (RYGB) and laparoscopic adjustable gastric band (LAGB). These procedures represent respectively 45.9, 39.6, and 7.4% of all bariatric procedures performed worldwide. RYGB is the most common bariatric surgery in the UK followed by SG, although the latter has been gaining in popularity and is now the most common bariatric surgery in countries where most bariatric surgeries are performed such as other European and North American countries. A total of 6391 bariatric surgical procedures were performed in the UK in 2014 compared with 191,920 in the USA and 46,960 in France [3–4].

The number of bariatric procedures performed is increasing, leading to more post-operative bariatric patients that will present with an acute abdomen in the emergency department.

Patients with early postoperative complications may be managed in specialist centers by the bariatric surgeon during the hospital stay but patients with acute abdominal pain that occurs after months or years post-operatively may present for assessment and management in the local emergency units.

Complications following surgical treatment of severe obesity vary based upon the procedure performed and can be as high as 40% [4]. Due to the wide variety of surgical bariatric techniques, the functional outcomes and late or long-term complications (those that occur after 1 month after surgery) from bariatric surgery remain not completely known or well understood.

No consensus or guidelines about the emergency management of long-term complications following bariatric surgery are currently available.

The aim of this study is to investigate by a web survey how an emergency surgeon approaches this unique group of patients in an emergency medical scenario and to report their experience.

## Method

This study reports data collected by an international web survey carried out with the aim to collect data about emergency surgeons' experience in the management of patients admitted in the emergency department for acute abdominal pain (AA) after bariatric surgery.

The survey was conceived as a questionnaire composed by 26 (multiple choice and open) questions and

was sent on January 28, 2018, via Google Forms, after the approval of the World Society of Emergency Surgery (WSES) project steering committee represented by Fausto Catena (Parma Trauma Center, Italy), Luca Ansaloni (Cesena Trauma Center, Italy), Yoram Kluger (Rambam Health Care Center, Israel), and Walter L. Biffl (Scripps Clinic, San Diego, USA) to the mailing list of the WSES members.

The deadline to participate was March 28, 2018.

The project's main objectives were the following:

- 1) To extrapolate epidemiological characteristics and clinical-pathological features about this population of patients admitted to the emergency department for acute abdominal pain;
- 2) To highlight life-threatening complications and outcomes of bariatric surgery;
- 3) To analyze the decision-making algorithms of the emergency surgeons in the management of AA in patients previously treated with bariatric surgical procedures to determine best practices for early diagnosis, and best operative and non-operative treatments to decrease morbidity and in-hospital mortality rates.

## Results

The invitation to participate in the web survey was sent to 197 surgeons.

One hundred seventeen international emergency surgeons (ES) decided to join the project and answered to the web survey with a response rate of 59.39%.

Sixty-four percent (61/95) of ES worked in a university hospital, 26.31% (25/95) in a public hospital, 16.8% (16/95) in a private hospital and 13.6% (13/95) in a trauma center level I, 7.4% (7/95) in a trauma center level II, 2.1% (2/95) in a trauma center level III as summarized in Fig. 1

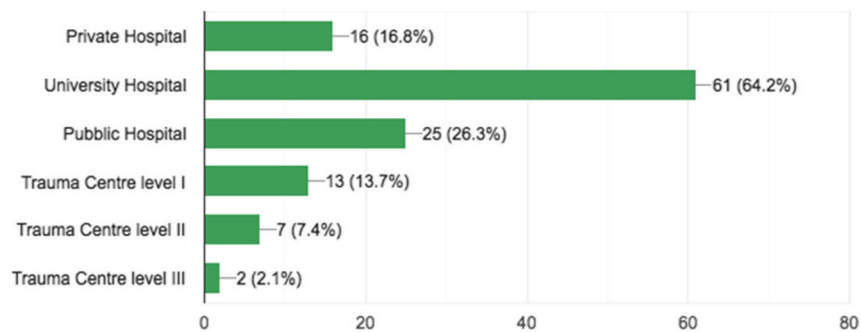
Most participants (51.8%; 68/117 ES) declared to have over 10 years of surgical experience and 25.6% (30/117) have surgical experience of 5 to 10 years.

The majority of ES (55.6%; 65/117) work in a hospital with a bariatric unit and almost all (97.4%; 114/117 ES) in a hospital with an intensive care unit (ICU). 59.5% of responders (69/117) declared to have no experience in bariatric procedures, but almost all surgeons (98.3%; 115/117) have been called to evaluate an AA after bariatric surgery in an emergency department (ED). The majority of ES reported to have managed less than 10 bariatric patients in their experience (52%; 61/117), 24% (29/117) between 10 and 20 bariatric patients, and 23% (27/117) more than 20 patients.

According to the answers, 36.8% (43/117) of bariatric patients examined presented with AA after less than 4 weeks from the bariatric surgical procedure, 22.2% (26/117) between 4 weeks and 6 months, 16.2% (19/117) between 6 months and 1 year, and 25% (29/117) after over 1 year following bariatric surgery. The majority of

### Type of Medical Institution

95 responses



**Fig. 1** Participants' affiliations

patients were female (76.7%; 91/117) over 40 years old (59.8%; 70/117), and capable of reporting their surgical history and specific type of bariatric surgical procedure previously performed (77%; 91/117).

Most of the examined patients (44/117; 37.6%) had been operated on in the same hospital as that of the ES on call, while 32.5% (38/117) were operated in a private hospital, 28% (33/117) in another public hospital and 1.7% (2/117) were operated on in a different country.

The majority of patients had received a sleeve gastrectomy (38.5%; 45/117), and 31.6% (37/117) a laparoscopic Roux-en-Y gastric bypass as summarized in Table 1.

The most common complaint was generalized abdominal pain (65%; 76/117), followed by vomiting (52%; 61/117) and localized abdominal pain (40.2%; 47/117) as summarized in Fig. 2.

In evaluating the patients, 37.6% (44/117) of the ES asked for the following diagnostic laboratory exams, as summarized in Table 2: complete blood count (CBC), dosage of electrolytes, protein C-reactive (PCR), and/or procalcitonin (PCT).

Eighty-seven/117 (74.4%) of ES reported that laboratory exams were a useful diagnostic tool, and 30/117 (25.6%) of ES reported that they were not.

Radiological exams performed to aid in diagnosis included plain abdominal radiography and enhanced computed tomography (CT) in 41.9% of responses (49/117),

abdominal CT with intestinal opacification in 41.9% of responses (49/117), and plain abdominal radiography in standing position and abdominal US, in 13.7% of responses (16/117), as summarized in Table 3.

Radiological exam results were useful in the decision-making of 109/117 ES (93.2%).

62/117 (53%) of ES took patients to the operating room because of a clear diagnosis, 60/117 (51.3%) of ES because of worsening abdominal pain, and 31/117 (26.5%) of ES for inconclusive findings as summarized in Fig. 3.

Timing for surgery was between 12 and 24 h in 51/117 responses (43.5%), < 12 h for 41.9% (49/117) of responses, > 24 h for 12.8% (15/117) of responses, variable according to diagnosis for 2/117 (1.7%) of responses as summarized in Table 4.

Surgical exploration was performed by laparoscopy in more than 50% of bariatric patients for 57/117 of ES (48.7%), by laparoscopy in less than 50% of cases for 24/117 (20.5%) of ES, by laparotomy in more than 50% of cases for 19/117 (16.2%) of ES, by laparotomy in all cases for 16/117 surgeons (13.7%), by laparotomy in less than 50% of cases for 1/117 ES (0.9%) as summarized in Table 5.

Intra-operative findings reported were summarized in Table 6.

In-hospital mortality rate reported was < 10% in 69.2% (81/117) of answers, between 10 and 50% for 19/117 (16.2%) of ES, "low" for 1 surgeon (0.9%), and unknown for 16/117 (13.7%) of ES.

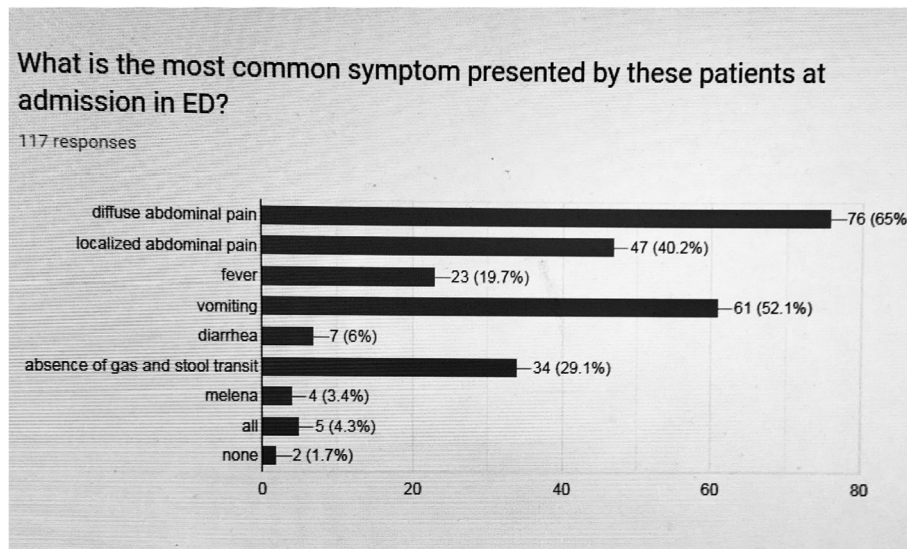
Fifty-six/117 (47.9%) of ES reported that their patients required admission to the ICU after surgery; 15/117 (12.8%) of ES reported that theirs did not; and 46/117 (39.3%) of ES answered "maybe."

Most ES, 112/117 (95.7%), reported that their patients were discharged alive.

72.6% (85/117) of ES declared to be worried about bariatric patients presenting with AA.

**Table 1** Type of bariatric surgery previously undergone by patient presenting with acute abdominal pain

| Type of bariatric surgery               | Number of answers | %    |
|---|-------------------|------|
| Sleeve gastrectomy                      | 45/117            | 38.5 |
| Laparoscopic Roux en Y gastric bypass   | 37/117            | 31.6 |
| Open Roux en Y gastric bypass           | 4/117             | 3.4  |
| Unknown                                 | 9/117             | 7.7  |
| Laparoscopic adjustable gastric binding | 22/117            | 18.8 |



**Fig. 2** Most common symptoms presented by bariatric patients admitted in emergency department

**Discussion**

The present international survey was conceived to assess knowledge and clinical practice about the management of AA in patients previously submitted to bariatric surgery, in an emergency setting. 59.3% of invited ES decided to join the project, confirming the increasing interest to explore this topic, especially in light of the current lack of consensus and guidelines.

The quality of data collected by this questionnaire derives from the seniority (51.8% of respondents declared to have a surgical practice of more than 10 years) and the internationality of the respondents.

The survey reported that not all ES have experience in bariatric surgery and not all hospitals have a bariatric surgery unit, consequently bariatric patients needing re-intervention for acute abdomen were managed by the ES on call.

Late complications following bariatric surgery have been poorly analyzed and their management is not clearly assessed in the emergency setting.

Collected data showed that most of the bariatric patients (BP) admitted in the ED were female, mean age of greater than 40 years and presenting with acute

generalized abdominal pain (65% of answers) and vomiting (52.1% of answers) within 4 weeks after the surgical intervention.

The survey showed that SG was the most commonly reported surgical procedure (38.5%), followed by LRYGB (31.6%).

Clinical signs and physical examination of BP presenting with AA can be atypical, insidious, often resulting in delayed management due to inconclusive clinical and radiological findings, with poor outcomes and high morbidity rate. Tachycardia is considered the alarm sign for all bariatric surgeons in the early postoperative time. Late complications can be revealed by hemodynamic instability, respiratory failure or renal dysfunction. However, these are not always present.

Several studies confirmed that abdominal pain is one of the most common and sometimes frustrating problems after bariatric surgery and some authors affirmed that anywhere from 15 to 30% of patients will visit the emergency room or require admission within 3 years of gastric bypass [5–8].

In particular, Saunders et al. [7] reported that the overall 1-year readmission rate for abdominal pain in a high volume bariatric center was 18.8% and that most of the patients were re-admitted after LRYGB (24.2%), whereas LAGB showed the lowest readmission rate of 12.69%.

Another study confirmed this data showing that the ≤ 90-day all-cause postoperative ED visit rate was 18% (65/361 BP) in a bariatric center [6].

The most common postoperative complications of bariatric procedures described in literature are summarized in Table 7 [9–16].

**Table 2** Common laboratory tests requested at admission of bariatric patients

| Laboratory tests requested  | Number of answers | %     |
|---|-------------------|-------|
| CBC, dosage electrolytes, dosage CPR, and/or PCT                                  | 45/117            | 38.4  |
| CBC, blood gas analysis, lactates, CPR, and/or PCT                                | 39/117            | 33.33 |
| CBC, liver function tests, dosage lipase, dosage troponin, dosage CPR, and/or PCT | 33/117            | 28.2  |

**Table 3** Common radiological exams requested to evaluate acute abdomen in bariatric patients

| Radiological exams requested                         | Number of answers | %    |
|--|-------------------|------|
| Abdominal CT scan with oral intestinal opacification | 49/117            | 41.9 |
| Plain XR, enhanced CT scan                           | 49/117            | 41.9 |
| Plain XR, US   | 16/117            | 13.6 |
| Plain XR   | 1/117             | 0.85 |
| UGI, CT  | 1/117             | 0.85 |

Complication rates are reported higher after LRYGB but we cannot confirm that: most surgeons reported evaluating patients presenting with abdominal pain after SG [11–14].

In agreement with available studies [17–23], the WSES survey reported that ES used enhanced abdominal computed tomography (CT) with oral intestinal opacification to make a diagnosis in BP, even if only 53% of ES declared that diagnosis after radiological exams was clear.

Diagnostic value of imaging in BP depends on the careful interpretation of the new anatomical landmarks and on the knowledge of the potential complications following bariatric surgery.

Several studies described the new radiological anatomy after bariatric surgery at CT scan. The administration of oral and intravenous contrast is fundamental to find landmarks for the interpretation of images [19–23]. For example, after gastric bypass, the identification of the gastric pouch, gastrojejunal anastomosis, jejunal Roux limb, jejunojejunal anastomosis, and biliopancreatic limb on CT is

essential for detecting potential complications such as internal hernias and small bowel obstruction (SBO). Positive oral contrast material administered just prior to image acquisition helps differentiate the gastric pouch and Roux limb from the excluded stomach and biliopancreatic limb, which are not opacified. The Roux limb should be followed along its antecolic or retrocolic course to the jejunojejunal anastomosis, typically in the left mid-abdomen. The excluded stomach should be visualized on CT images and is normally collapsed [19, 20].

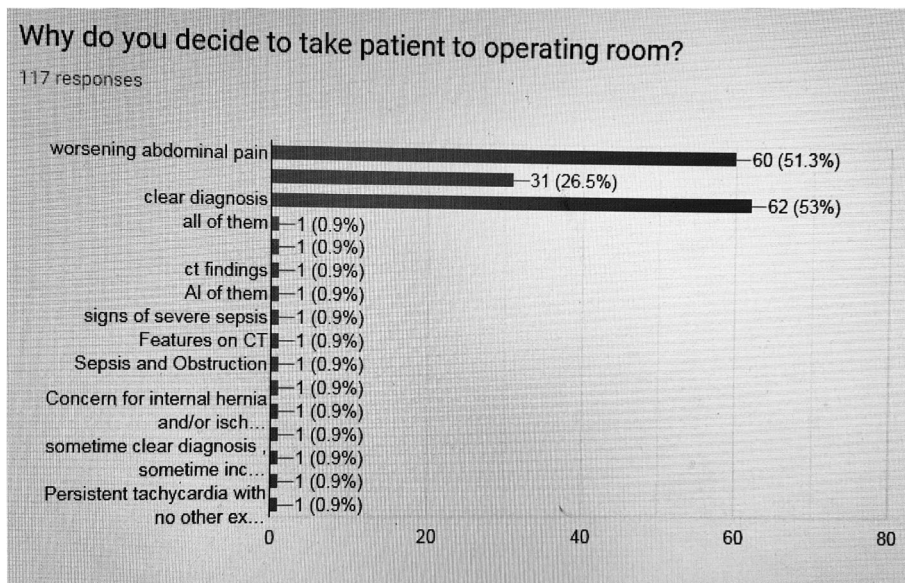
According to CT scan findings, SBO following RYGB is classified on the features of the Roux-alimentary limb, bilio-pancreatic limb and distal common channel involvement [18].

After SG, CT scan is the right radiological exam to assess for abscesses, perforation, staple line dehiscence, and other complications such as splenic injury or infarction [19, 20].

Our survey reported that internal hernia (49.6% of answers) and adhesions (41.9% of answers) were common intraoperative findings at surgical exploration (Table 6), suggesting that SBO is the leading cause of abdominal pain after bariatric surgery.

SBO occurs in approximately 5% of cases after gastric bypass and is due frequently to adhesions or to internal herniation. Other causes of SBO are incisional hernia through a trocar opening or intussusception of the small bowel [21].

Internal herniation occurs in approximately 6% of patients after gastric bypass or biliary pancreatic shunting and it can be a potentially fatal complication [22, 23].



**Fig. 3** Why emergency surgeons decide to take the bariatric patient into the operating room

**Table 4** Delay from admission to operating room

| Delay                           | Number of answers | %     |
|---------------------------------|-------------------|-------|
| < 12 h                          | 50/117            | 42.73 |
| 12–24 h                         | 49/117            | 41.9  |
| > 24 h                          | 15/117            | 12.8  |
| < 24 h                          | 1/117             | 0.85  |
| Variable according to diagnosis | 2/117             | 1.7   |

UGI upper gastrointestinal series CT abdominal computed tomography, US ultrasonography, XR X-ray

It is promoted by massive weight loss and by characteristic mesenteric defects that develop after LRYGB that are in the transverse mesocolon for a retrocolic Roux limb, a mesenteric defect near the jejunojejunal anastomosis and a defect posterior to the Roux limb (i.e., Petersen’s defect).

Internal hernias are very difficult to reveal clinical inquiry and from radiological investigations and requires a high index of suspicion. The sensitivity of CT scan in identifying the “mesenteric swirl sign,” the most sensitive CT scan sign suggestive of internal hernia, has been reported to be between 68 and 89% [17].

Anastomotic stenosis can cause an obstruction and it usually involves the gastrojejunal anastomosis. It occurs in approximately 12% of patients after bypass and typically develops a month or more after surgery with a peak occurring 50 days after gastric bypass [16, 17].

Patients presenting with bariatric surgery complications in an emergency setting have a poor outcome, largely related to delayed diagnosis and re-operation, but no data are available.

Our survey showed that in-hospital mortality related to re-operated BP is < 10% for 69.2% of ES and that the majority of patients were discharged alive (95.7% of answers).

Diminishing the delay in surgery is crucial to avoid catastrophic scenarios such as generalized peritonitis due to intestinal perforation or massive bowel ischemia.

Our survey reported that the majority of ES do not wait for more than 24 h to decide in favor of surgical exploration if the patient presents with worsening

**Table 5** Technique for surgical emergency exploration in patients presenting acute abdomen previously submitted to bariatric surgery

| Technique for surgical emergency exploration | Number of answers | %    |
|--|-------------------|------|
| Laparoscopy in < 50% of cases                | 24/117            | 20.5 |
| Laparoscopy in > 50% of cases                | 57/117            | 48.7 |
| Laparotomy in all cases                      | 16/117            | 13.7 |
| Laparotomy in < 50% of cases                 | 1/117             | 0.85 |
| Laparotomy in > 50% of cases                 | 19/117            | 16.2 |

**Table 6** Common intra-operative findings in bariatric patients

| Intraoperative findings              | Number of answers | %    |
|--------------------------------------|-------------------|------|
| Internal hernia                      | 58/117            | 49.5 |
| Adhesions                            | 49/117            | 41.8 |
| Anastomotic stenosis                 | 15/117            | 12.8 |
| Intussusception                      | 9/117             | 7.6  |
| Volvulus                             | 9/117             | 7.6  |
| Leak                                 | 5/117             | 4.2  |
| Complications of gastric band        | 4/117             | 3.4  |
| Gastric perforation                  | 1/117             | 0.85 |
| Hemorrhagic ulcer in esclude stomach | 1/117             | 0.85 |
| Peritonitis                          | 3/117             | 2.5  |
| Leaking stapler line                 | 1/117             | 0.85 |
| Cholecystitis                        | 1/117             | 0.85 |
| Bleeding, abscesses                  | 1/117             | 0.85 |
| Perforation                          | 1/117             | 0.85 |
| Bleeding, mesenteric thrombosis      | 1/117             | 0.85 |

abdominal pain and inconclusive radiological findings (Fig. 3).

Our data showed that surgical exploration was made by laparoscopy for the majority of ES, in more than 50% of BP.

This is in accordance with several available studies that investigated the role of explorative laparoscopy to assess chronic abdominal pain after bariatric surgery. These studies demonstrated that the laparoscopic approach is safe and feasible in BP presenting with abdominal pain of unknown etiology [24, 25].

**Table 7** Common complications following bariatric surgery

| Bariatric surgical procedures | Early complications  | Late complications   |
|-------------------------------|--|--|
| Sleeve gastrectomy            | Leak/fistula<br>stricture<br>hemorrhage  | Gastroesophageal reflux  |
| Gastric bypass                | Leak/fistula<br>obstruction/anastomotic<br>stricture<br>hemorrhage             | Anastomotic ulcer (bleeding, perforation)<br>bowel obstruction (internal hernia)   |
| Adjustable gastric binding    | Esophageal and/or gastric perforation<br>acute dilatation of the gastric pouch | Infection<br>connector tubing rupture<br>gastric pouch dilatation and slippage of the AGB<br>erosion and intragastric migration<br>esophageal dilatation |

All of these studies express concerns regarding chronic pain in BP and the diagnostic value of explorative laparoscopy. Other (case reports and retrospective studies) authors reported data about the management of AA after bariatric surgery by laparoscopy confirming that laparoscopy is feasible and safe even in the emergency setting, if expertise is available and the patient is hemodynamically stable [26–28].

Despite a good correspondence between the data resulting from our survey and the current data available in literature about the management of acute abdomen in bariatric patients, 85/117 (72.6%) of ES declared to be worried when asked to manage acute abdomen in patients with a previous history of bariatric surgery. This indicates the ES' desire to be familiar with the various types of bariatric surgery, to understand the new anatomy, radiological findings, and long-term bariatric complications, to be able to appropriately manage them in the emergency setting.

We acknowledge the limitations of the present study, some due to the intrinsic nature of surveys (answers may not be honest and accurate, responders represent an intrinsic selection bias because non-responders may answer differently, answer options may be interpreted differently by different responders), and some related to the nature of our data, not linked to a population of patients but to the personal experience and opinion of 117 international ES.

## Conclusions

Bariatric procedures are increasing and this results in an increased number of bariatric patients admitted in the ED for AA. ES have a crucial role in the management of this group of patients and no consensus or guidelines are available.

The aim of this WSES web survey was to highlight the current management of bariatric patients in the ED by ES.

Emergency surgeons must be mindful of postoperative bariatric surgery complications. CT scan with oral intestinal opacification may be useful in making a diagnosis if carefully interpreted by the radiologist and the surgeon.

In the case of inconclusive clinical and radiological findings, when symptoms fail to improve, early surgical exploration, by laparoscopy if expertise is available, is mandatory in the first 12–24 h, to have good outcomes and decrease morbidity rate.

## Abbreviations

AA: Acute abdomen; BP: Bariatric patient(s); CT: Abdominal computed tomography; ED: Emergency department; ES: Emergency surgeon(s); LAGB: Laparoscopic adjustable gastric binding; RYGB: Roux en Y gastric bypass; SBO: Small bowel obstruction; SG: Sleeve gastrectomy

## Acknowledgements

We like to knowledge contributors from WSES: the OBA Trial supporters\* \*)The OBA trial supporters:

1. Fabio Cesare Campanile campanile@surgical.net
2. Dente Mario, Clinique Bonnefon, France; m.dente@clinique-bonnefon.fr
3. Asnat Razieli; doctor@asnatraziel.com

4. Alberto Zaccaroni; department of endocrine and general surgery; Forlì Hospital, alberto.zaccaroni@auslromagna.it
5. Antonio Tarasconi, Emergency Surgery Department, Parma University Hospital, Parma, Italy; atarasconi@gmail.com
6. Alessandro Dazzi, Italy; Italy; alled78@yahoo.it
7. Konstantinos Lasithiotakis; Department of Surgery, University Hospital of Heraklion, GR; kwstaslasith@gmail.com
8. Stefano Maccatrozzo, Istituto Beato Matteo-Vigevano, Pavia, stefanomacca@me.com
9. Orestis Ioannidis; 4th Surgical Department, Medical School, Aristotle University of Thessaloniki, Thessaloniki; telonakos@hotmail.com
10. Francesco Pata, Surgical Department, Sant'Antonio Abate Hospital, Gallarate, Italy; francesco.pata@gmail.com
11. Maciej Walędziak, Department of General, Oncological, Metabolic and Thoracic Surgery, Military Institute of Medicine, Warsaw, Poland; maciej.waledziak@gmail.com
12. Agron Dogjani University Hospital of Trauma, Albania; agrondogjani@yahoo.com
13. Affirul Chairil Ariffin, Universiti Sains Islam, Malaysia; affirul@gmail.com
14. Vladimir Khokha, Mozyr City hospital, Belarus; vladimirkhokha@gmail.com
15. Ling Kho, Pennine acute NHS Trust, United Kingdom; lingkho.9@gmail.com
16. Boris Kessel, Hillel Yaffe Medical Center, Israel, bkessel01@gmail.com
17. Ionut Negoii, General Surgery Department, Emergency Hospital of Bucharest, Carol Davila University of Medicine and Pharmacy Bucharest, Romania; negoiiionut@gmail.com
18. Eftychios Losteridis, 1st Department of Surgery, Kavala General Hospital, Kavala, Greece, elosteridis@gmail.com
19. Luigi Conti, Azienda Ospedaliera G. Da Saliceto, Piacenza; dr.luigiconti@gmail.com
20. Luca Ponchietti, Torrevieja University Hospital, Spain; lponchietti@gmail.com
21. Francesco Saverio Papadia, Ospedale Policlinico San Martino, Genova, Italy; francesco.papadia@unige.it
22. Giorgio Ghilardi, Università degli Studi di Milano - DiSS, Italy; giorgio.ghilardi@unimi.it
23. Valentin Calu, Elias Emergency Hospital, University of Medicine and Pharmacy "Carol Davila" Bucharest, Romania; drcalu@gmail.com
24. Tuna Bilecik, Adana City Training and Research Hospital, Turkey; tbilecik@yahoo.com
25. Berhanu N. Alemu, Ethiopia; b\_nega@yahoo.com
26. Martin Reichert, Department of General, Visceral, Thoracic, Transplant and Pediatric Surgery, University Hospital of Giessen, Germany; martin.reichert@chiru.med.uni-giessen.de
27. Martin Hutan, Surgical department, Landeskrankenhaus Hainburg, Austria; martin.hutan@yahoo.com
28. Charalampos Seretis, George Eliot Hospital NHS Trust, West Midlands, United Kingdom, babismed@gmail.com
29. MOLDOVANU Radu, Department of Surgery, Clinique Ste. Marie, Cambrai, France; rmoldovanu@gmail.com
30. Carlos Augusto Gomes, Hospital Terezinha de Jesus Faculdade de Ciências Médicas e da Saúde de Juiz de Fora (Suprema), Brazil; caxiaogomes@gmail.com
31. Faruk Karateke, Health Sciences University, Adana City Hospital, Department of General Surgery, Turkey; karatekefaruk@hotmail.com
32. Vinicius Cordeiro da Fonseca, Hospital VIValle, Brazil; drvinciuscirurgia@icloud.com
33. Arda Isik, pittsburgh university magee womens hospital, USA; kararda@yahoo.com
34. Ioannis Nikolopoulos, Lewisham & Greenwich NHS Trust, UK; inikolopoulos@gmail.com
35. Anfrii Fomin, Ukraine; tryshlandia@gmail.com
36. Wagih Ghnnam, Mansoura faculty of medicine .General surgery department, Egypt; wghnnam@gmail.com
37. Ruslan Sydorчук, General Surgery Department, Bukovinian State Medical University, Ukraine; rsydorchuk@bsmu.edu.ua
38. Ciro Paolillo, Emergency Department Spedali Civili di Brescia, Brescia, Italy; ciropaolillo@gmail.com
39. Andrea Sagnotta, Azienda Ospedaliera Santa Maria Terni, Italy; andrea.sagnotta@gmail.com

40. Leonardo Solaini, General and Oncologic Surgery, Morgagni-Pierantoni Hospital, Forlì, Italy; leonardo.solaini2@unibo.it
41. Robert G. Sawyer, Western Michigan University, USA; rws2k@virginia.edu
42. David A. Spain; Stanford University, USA; dspain@stanford.edu
43. Michael McFarlane, Department of Surgery, Radiology Anaesthesia and Intensive Care, University of the West Indies, Mona, Jamaica; michaelm500@yahoo.com
44. Catherine ARMEUX, Clinique universitaire de chirurgie Digestive et de l'urgence, GRENOBLE-ALPES UNIVERSITY HOSPITAL, France; carieux@chu-grenoble.fr
45. Andrey Litvin Immanuel Kant Baltic Federal University, Regional Clinical Hospital, Kaliningrad, Russia; aalitin@gmail.com
46. Bruno M Pereira, Vassouras University, Brazil; drbrunompereira@gmail.com
47. Teresa Giménez Mauer, Hospital Universitario Miguel Servet, Zaragoza; teresagm87@gmail.com
48. Andrea Barberis, E.O. Ospedali Galliera, Genova, Italy; andrea.barberis@galliera.it
49. Mahir Gachabayov, Vladimir City Clinical Hospital of Emergency Medicine, Russia; gachabayovmahir@gmail.com
50. Donal B O'Connor, Tallaght Hospital, Trinity College Dublin, Ireland; oconnd15@tcd.ie
51. Daniel Rios Cruz, HOSPITAL CENTER VISTA HERMOSA, Mexico; dr\_riosacruz@outlook.com
52. Elif Colak, University of Health Sciences, Samsun Training and Research Hospital, Turkey; elifmangancolak@hotmail.com
53. Cristian Mesina, Emergency County Hospital of Craiova, Romania; mesina.cristian@doctor.com
54. Ramiro Manzano-Nunez, Fundacion Valle del Lili, Colombia; ramiro.manzano@correounivalle.edu.co
55. Abdelkarim, Jordan university of Science and technology, Jordan; Omari akomari@just.edu.jo
56. Tadeja Pintar, UMC Ljubljana, Slovenia; tadeja.pintar@kclj.si
57. Renol Koshy, UHCW, Coventry, UK; renolkoshy@gmail.com
58. Georgios Triantos, Rhodes General Hospital - 1st Surgical Department, Rhodes, Greece; geotriantos@gmail.com
59. Subash Gautam, Fujairah hospital, UAE; scgautam@gmail.com
60. Ali GUNER Karadeniz Technical University, Trabzon/Turkey; draliguner@yahoo.com
61. Zaza Demetrashvili, Georgia; zdemetr@yahoo.com
62. Carlos A. Ordoñez, Division of Trauma and Acute Care Surgery, Department of Surgery, Fundación Valle del Lili; Colombia; ordonezcarlosa@gmail.com
63. Dimitrios K. Manatakis, Department of Surgery; Athens Naval and Veterans Hospital, Athens, Greece; dmanatak@yahoo.gr
64. Massimo Chiarugi, University of Pisa Medical School -Emergency Surgery Unit; Italy; massimo.chiarugi@med.unipi.it
65. Luis BUONOMO, Argentina; lbuonomo@gmail.com
66. Piotr Major, 2nd Department of General Surgery, Jagiellonian University Medical College, Poland; majorpiotr@gmail.com
67. Hecker, Andreas, Dept. of General & Thoracic Surgery, University Hospital of Gießen, Germany; andreas.hecker@chiru.med.uni-giessen.de
68. Derek J. Roberts, University of Calgary, Canada; derek.roberts01@gmail.com
69. Jill R. Cherry-Bukowicz, University of Michigan, USA; jillcher@umich.edu
70. Koray Das, Adana City Education and Research Hospital, Turkey; koraydas@yahoo.com
71. Andrea Costanzi, Ospedale di Desio, Italy; a.costanzi@asst-monza.it
72. Harry van Goor, Radboud University Medical Center, Nijmegen, The Netherlands; harry.vangoor@radboudumc.nl
73. Kenneth Y. Y. Kok, Jerudong Park Medical Center, Brunei; koky@brunet.bn
74. Aleix Martínez-Pérez, Department of General and Digestive Surgery, Hospital Universitario Doctor Peset, Valencia, Spain; aleix.martinez.perez@gmail.com
75. Roberta Villa, Policlinico San Marco; Italy; robe.villa@tiscali.it
76. Luca Fattori, HS Gerardo, Italy; luca.fattori@fastwebnet.it
77. Gabriela Elisa Nita, Ausl Reggio Emilia; Italy; nitagabriela2001@yahoo.com
78. Dimitrios Damaskos, Ηνωμένο Βασίλειο; dimitris.damaskos@gmail.com
79. KUO-CHING YUAN, Taipei Medical University Hospital, Taiwan; traumayuan@gmail.com
80. Aintzane Lizarazu; Spain; aintzanelizarazu@hotmail.com
81. Michael Denis Kelly, Albury Hospital, Australia; mk@mdkelly.com
82. Isidoro DI CARLO, University of Catania, Italy; idicarlo@unict.it
83. Marco Ceresoli, Department of General Surgery, University of Milano-Bicocca, Italy; marco.ceresoli89@gmail.com
88. Raffaele Galleano, s.c. chirurgia generale ospedale santa corona pietra ligure asl 2 savonese, Italy; raffagalleano@tin.it
85. Herzog, St. Josef Hospital Bochum, Ruhr University Bochum, Germany; t.herzog@klinikum-bochum.de
86. Christos Chatzakis, MSc 4th Surgical Department of Aristotle University of Thessaloniki, Thessaloniki, Greece; cchatzakis@gmail.com
87. Miklosh Bala, Hadassah Hebrew University Medical Center, Israel; rbalam@hadassah.org.il
88. Frank Piscioneri, The Canberra Hospital, Australia; frank@arkpacific.com
89. Stefano Bonilauri, AUSL Reggio Emilia, Italy; bonilauri.stefano@ausl.re.it
90. Helmut Alfredo Segovia Lohse, Hospital de Clinicas, Paraguay; hhaassll@gmail.com
91. Zaza Demetrashvili, Surgery Department, Tbilisi State Medical University, Georgia; zdemetr@yahoo.com (1)
92. Dmitry Smirnov, South Ural State Medical University, Russian Federation; surgeon.smirnov@yahoo.com
93. Dennis Kim, Harbor-UCLA Medical Center, USA; dekim@dhs.lacounty.gov
94. Francesca Martina francesca.lombardo89@gmail.com
95. Giovanni Bruni, EHS, Italy; pierogiovanni.bruni@gmail.com
96. Giampiero Campanelli, EHS, Italy; giampiero.campanelli@grupposandonato.it
97. Marta Cavalli, EHS, Italy; marta\_cavalli@hotmail.it
98. VICTOR KONG Department of Surgery, University of KwaZulu Natal Durban South Africa; victorywkong@yahoo.com
99. Nickos Michalopoulos, 3rd Department of Surgery, Ahepa University Hospital, Aristotle University, Greece; nickos.michalopoulos@gmail.com
100. Yunfeng Cui, Tianjin Nankai Hospital, Tianjin Medical University, China; yunfengcuidocor@aliyun.com
101. Michele Diana, IHU-Strasbourg, Institute of Image-Guided Surgery, France; michele.diana@ircad.fr

#### Authors' contributions

BDS and FC conceived the study. BDS wrote the questionnaire. FC revised the questionnaire. BDS collected and analyzed data, and wrote the manuscript. FAZ revised the statistical analysis. FC, GLB, LA, MS, YK, WB, and Fco read and approved the manuscript. All authors read and approved the final manuscript.

#### Funding

No funding received for this article

#### Availability of data and materials

Not applicable

#### Ethics approval and consent to participate

Not applicable

#### Consent for publication

Not applicable

#### Competing interests

The authors declare that they have no competing interests

#### Author details

<sup>1</sup>Department of General and Emergency Surgery, Azienda USL Reggio Emilia IRCCS, Reggio Emilia, Italy. <sup>2</sup>Department of Emergency and Trauma Surgery, Bufalini Hospital, Cesena, Italy. <sup>3</sup>Department of General Surgery, Macerata's Hospital, Macerata, Italy. <sup>4</sup>Department of Emergency and Trauma Surgery, Rambam Health Campus, Haifa, Israel. <sup>5</sup>Department of Surgery, College of Medicine and Health Sciences, UAE University, Al-Ain, United Arab Emirates. <sup>6</sup>Department of Trauma and Acute Care Surgery, Scripps Memorial Hospital, La Jolla, California, USA. <sup>7</sup>Sidney Kimmel Medical College, Thomas Jefferson University, Philadelphia, Pennsylvania, USA. <sup>8</sup>Department of Surgery, Pisa University Hospital, Pisa, Italy. <sup>9</sup>Department of Surgery, University of Brescia, Brescia, Italy. <sup>10</sup>Department of Emergency and Trauma Surgery, Parma University Hospital, Parma, Italy.



Received: 30 August 2019 Accepted: 16 December 2019

Published online: 06 January 2020

## References

- Obesity and Overweight Fact Sheet. 2018. February 2018. <http://www.who.int/news-room/factsheets/detail/obesity-and-overweight> (accessed 5 Aug. 2018 2018).
- Angrisani L, Santonicola A, Iovino P, et al. Bariatric surgery worldwide 2013. *Obes Surg*. 2015;25:1822–32.
- Angrisani L, Santonicola A, Iovino P, Vitiello A, Zundel N, Buchwald H, et al. Bariatric surgery and endoluminal procedures: IFSO worldwide survey 2014. *Obes Surg*. 2017;27:1–11. 12.
- Ponce J, EJ DM, Nguyen NT, Hutter M, Sudan R, Morton JM. American society for metabolic and bariatric surgery estimation of bariatric surgery procedures in 2015 and surgeon workforce in the United States. *Surg Obes Relat Dis*. 2016;12:1637–9. <https://doi.org/10.1016/j.soard.2016.08.488>.
- Kellogg TA, Swan T, Leslie DA, Buchwald H, Ikramuddin S. Patterns of readmission and reoperation within 90 days after Roux-en-Y gastric bypass. *Surg Obes Relat Dis*. 2009;5(4):416–23.
- Greenstein AJ, O'Rourke RW. Abdominal pain after gastric bypass: suspects and solutions. *Am J Surg*. 2011;201(6):819–27. <https://doi.org/10.1016/j.amjsurg.2010.05.007>.
- Saunders J, Ballantyne GH, Belsley S, Stephens DJ, Trivedi A, Ewing DR, Iannace VA, Capella RF, Wasilewski A, Moran S, Schmidt HJ. One-year readmission rates in a high volume bariatric surgery center: laparoscopic adjustable gastric banding, laparoscopic gastric bypass, and vertical banded gastroplasty-Roux-en-Y gastric bypass. *Obes Surg*. 2008;18(10):1233–40.
- Chen J, Mackenzie J, Zhai Y, O'Loughlin J, Kholer R, Morrow E, Glasgow R, Volckmann E, Ibele A. Preventing Returns to the Emergency Department Following Bariatric Surgery. *Obes Surg*. 2017 Aug;27(8):1986–92. <https://doi.org/10.1007/s11695-017-2624-7>.
- Healy P, et al. Complications of bariatric surgery – What the general surgeon needs to know. *Surgeon*. 14(2):91–8.
- Radwan Kassir, Tarek Debs, Pierre Blanc, Jean Gugenheim, Imed Ben Amor, Claire Boutet, Olivier Tiffet, Complications of bariatric surgery: Presentation and emergency management, *International Journal of Surgery*, Volume 27, 2016, Pages 77-81, ISSN 1743-9191, <https://doi.org/https://doi.org/10.1016/j.ijso.2016.01.067>.
- Joel F. Bradley, Samuel W. Ross, Ashley Britton Christmas, Peter E. Fischer, Gaurav Sachdev, Brant Todd Heniford, Ronald F. Sing, Complications of bariatric surgery: the acute care surgeon's experience, *The American Journal of Surgery*, Volume 210, Issue 3, 2015, Pages 456-461, ISSN 0002-9610, <https://doi.org/https://doi.org/10.1016/j.amjsurg.2015.03.004>.
- Wernick, B., Jansen, M., Noria, S., Stawicki, S. P., & El Chaar, M. (2015). Essential bariatric emergencies for the acute care surgeon. *European Journal of Trauma and Emergency Surgery*, 42(5), 571–584. doi:<https://doi.org/10.1007/s00068-015-0621-x>
- Kligman MD. Acute care surgery for bariatric surgery emergencies. In: Khwaja K, Diaz J, editors. *Minimally Invasive Acute Care Surgery*. Cham: Springer; 2018.
- Walsh C, Karmali S. Endoscopic management of bariatric complications: a review and update. *World J Gastrointest Endosc* 2015; 7(5): 518-523 <https://dx.doi.org/https://doi.org/10.4253/wjge.v7.i5.518>
- Schulman AR, Thompson CC. Complications of bariatric surgery: what you can expect to see in your GI practice. *Am J Gastroenterol*. 2017 Nov;112(11):1640-1655. doi: <https://doi.org/10.1038/ajg.2017.241>. Epub 2017 Aug 15. Review.
- Kassir R, Debs T, Blanc P, Gugenheim J, Ben Amor I, Boutet C, Tiffet O. Complications of bariatric surgery: presentation and emergency management. *Int J Surg*. 2016 Mar;27:77-81. doi: <https://doi.org/10.1016/j.ijso.2016.01.067>. Epub 2016 Jan 22.
- Goudsmedt F, Deylgat B, Coenegrachts K, et al. Internal hernia after laparoscopic Roux-en-Y gastric bypass: a correlation between radiological and operative findings. *Obes Surg*. 2015;25:622–7.
- Tucker, O.N., Escalante-Tattersfield, T., Szomstein, S. et al. The ABC system: a simplified classification system for small bowel obstruction after laparoscopic roux-en-Y gastric bypass. *Obes Surg* (2007) 17: 1549. <https://doi.org/https://doi.org/10.1007/s11695-007-9273-1>
- Carucci LR, Turner MA, Yu J. Imaging evaluation following Roux-en-Y gastric bypass surgery for morbid obesity. *Radiol Clin North Am*. 2007;45(2):247–60.
- Carucci LR. Imaging obese patients: problems and solutions. *Abdom Imaging*. 2013;38(4):630–46.
- Yu J, Turner MA, Cho SR, et al. Normal anatomy and complications after gastric bypass surgery: helical CT findings. *Radiology*. 2004;231(3):753–60.
- Levine MS, Laura R. Carucci imaging of bariatric surgery: normal anatomy and postoperative complications. *Radiology*. 2014;270(2):327–41.
- Clayton RD, Caress LR. Imaging following bariatric surgery: roux-en-Y gastric bypass, laparoscopic adjustable gastric banding and sleeve gastrectomy. *Br J Radiol*. 2018;91:1089.
- Alsulaimy, M., Puchai, S., Ali, F.A. et al. The utility of diagnostic laparoscopy in post-bariatric surgery patients with chronic abdominal pain of unknown Etiology. *Obes Surg* (2017) 27: 1924. <https://doi.org/https://doi.org/10.1007/s11695-017-2590-0>
- Pitt T, Brethauer S, Sherman V, et al. Diagnostic laparoscopy for chronic abdominal pain after gastric bypass. *Surg Obes Relat Dis*. 2008;4:394–8.
- Descloux A, Basilicata G, Nocito A. Omental torsion after laparoscopic roux-en-Y gastric bypass mimicking appendicitis: a case report and review of the literature. *Case Rep Surg*. 2016;2016:7985795. <https://doi.org/10.1155/2016/7985795>.
- Kalaiselvan, Ramya et al. Incidence of perforated gastrojejunal anastomotic ulcers after laparoscopic gastric bypass for morbid obesity and role of laparoscopy in their management. *Surg Obes Relat Dis*. 2012;8(4):423-8. <https://doi.org/10.1016/j.soard.2011.06.008>. Epub 2011 Jun 24.
- Fringeli Y, Worreth M, Langer I. Gastrojejunal anastomosis complications and their management after laparoscopic roux-en-Y gastric bypass. *J Obes*. 2015;2015:698425. <https://doi.org/10.1155/2015/698425>.

## Publisher's Note

Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

**Ready to submit your research? Choose BMC and benefit from:**

- fast, convenient online submission
- thorough peer review by experienced researchers in your field
- rapid publication on acceptance
- support for research data, including large and complex data types
- gold Open Access which fosters wider collaboration and increased citations
- maximum visibility for your research: over 100M website views per year

At BMC, research is always in progress.

Learn more [biomedcentral.com/submissions](https://biomedcentral.com/submissions)

