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Case Series

The use of optical trocars in abdominal entry among patients with obesity - A case series

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ABSTRACT

Introduction: Bariatric and metabolic procedures are becoming more common worldwide and laparoscopic surgery is the primary method to perform these operations. Accessing the peritoneum remains a challenge in obese patients and this study aims to assess the safety of optical trocars in bariatric surgery.

Methods: A retrospective study was conducted on all patients that have undergone bariatric surgery in our center between the years of 2017–2019 to examine the method by which pneumoperitoneum was established. We studied the incidence and type of complications associated with creating pneumoperitoneum in obese patients, along with the rates of converting to an open procedure.

Results: A total of 821 patients underwent bariatric surgery in our center over the 3 year period. They had an average age of 34.2 years (range = 13–65) with an average BMI of 45.9 kg/m^2. Optical trocars successfully established pneumoperitoneum in all these patients. Complications attributed to optical trocar entry were encountered in 8 patients (0.97%), 3 males and 5 females. The average BMI of these 8 patients is 52.7 kg/m^2, 4 of which had a BMI >50 kg/m^2. The complications encountered included 3 liver lacerations, 4 mesenteric injuries and 1 omental vessel laceration. Four injuries were caused by 12 mm optical trocars while the other 4 injuries were caused by 5 mm optical trocars. These complications were managed laparoscopically and no patients had to be converted to a laparotomy.

Conclusion: The use of non-bladed, optical trocar entry into the abdomen can be considered a safe method in the establishment of pneumoperitoneum in patients with obesity. However, more studies are required randomizing the use of optical trocars to the open Hasson technique in order to further validate this method.

1. Introduction

Obesity is a worldwide epidemic and bariatric surgery has established itself as the most effective modality in combating the condition. In the United States, surgical techniques transitioned from predominantly open procedures in 1993 to around 98% of all bariatric procedures being conducted laparoscopically in 2016 [1].

Establishing pneumoperitoneum is classically performed using a Veress needle or the open Hasson technique [2]. Obesity presents its own challenges when using these techniques including a thickened abdominal wall, varying anatomical landmarks, difficult and time consuming dissection, air leakage, inadequate pneumoperitoneum, subcutaneous emphysema and difficulty in fascial closure. Optical trocars were seen to provide a safe, quick and reliable alternative by allowing the ability to visualize the abdominal wall layers while accessing the peritoneum [3]. This study aims to assess the safety of optical trocars in patients undergoing bariatric surgery.

2. Methods

2.1. Study design

This is a retrospective case series spanning a three year period in a single center, from January 1st, 2017 to December 31st, 2019. The record of every patient undergoing bariatric surgery in our center was recorded on a database as part of the statistics submitted to the

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International Federation for the Surgery of Obesity (IFSO). The electronic database was accessed between the 11th of March 2020 and 12th of June 2020. The operative notes for each patient were thoroughly explored by 3 different researchers to identify the method used to establish pneumoperitoneum as well as the associated injuries caused by the utilized method.

The parameters recorded included gender, age, comorbidities, BMI and the size of the optical port used to establish pneumoperitoneum. It also included data regarding whether the bariatric procedures performed were index or revisional procedures alongside any history of previous abdominal surgeries. No patients were excluded from the study as every single record was retrieved. If a technique other than an optical trocar was used, the reason behind that was to be identified and recorded. Moreover, the patients' post-operative follow up notes were also examined in order to look for any mention of port site hernias. If any post operative CT scans were performed, those would be reviewed for any port site hernias at the site of the initial trocar insertion.

A total of 4 surgeons were involved in establishing pneumoperitoneum under the guidance of a single bariatric surgery consultant with experience of more than 2000 bariatric procedures. The other 3 general surgeons included a senior registrar and 2 junior registrars all of which had laparoscopic surgery experience and were involved in over 300 laparoscopic cases each.

This paper was reported in line with the PROCESS criteria [15].

2.2. Operative technique

Pneumoperitoneal establishment started with the insertion of a 30° 5 mm laparoscope or a 30° 10 mm laparoscope into a 5 mm or 12 mm optical trocar respectively. These optical trocars were non-bladed and subsequently the view was focused and white-balanced onto a gauze.

The patient was positioned in a slight reverse Trendelenburg position. A skin incision is made using a 11 blade at a point 15–18 cm inferior to the xiphisternum and 2 cm left of the midline (Image 1). The skin incision was made big enough to allow the port to be inserted and advanced easily without any resistance and without the need for any excessive force. The combined versaport/laparoscope was inserted into the skin incision and optical trocar was advanced by applying gentle pressure and a twisting motion inferiorly with a 60° diagonal offset targeting the left upper quadrant. The layers of the abdominal wall are readily identifiable as linea alba was avoided due to the off midline placement of the trocar.

After traversing the subcutaneous fat, the anterior rectus sheath was visualized followed by the rectus muscle and subsequently the posterior rectus sheath. The peritoneum was the final layer penetrated. Upon piercing the peritoneum, the optical trocar was not advanced any further and insufflation was immediately initiated. The perforator and laparoscope complex was removed and hence the port alone was left within the abdominal wall as insufflation continued. The laparoscope was then introduced into the port and the peritoneal cavity was visualized. The port was subsequently advanced further into the peritoneal cavity over the laparoscope and under vision and the area beneath the entry site was examined for any bleeding, hollow or solid organ injury. At the end of the procedure, the fascial defect was not closed.

2.3. Statistical analysis

The statistical analysis was conducted using Minitab® v18.1 (Minitab LLC., Pennsylvania, USA). As the values were categorical, a Chi square analysis was performed for the univariate analysis. p values of <0.05 were considered statistically significant.

3. Results

Over the course of 3 years, a total of 821 patients underwent laparoscopic bariatric procedures in our center. The average BMI of these patients is 45.9 kg/m^2. Most patients BMI fell between 40.0 and 44.9 kg/m^2 with 244 individuals in this group. This was followed by the 45.0–49.9 kg/m^2 group with 193 individuals. 209 patients had a BMI $>$50.0 kg/m^2 while 175 patients had a BMI between 30.0 and 39.9 kg/m^2 (Table 1).

The patients were divided into 534 females (65%) and 287 males (35%) with a mean patient age of 34 years (range 13–65 years). 111 patients had diabetes mellitus (13.5%), while hypertension and dyslipidemia were encountered in 95 (11.5%) and 71 (8.6%) patients respectively.

Most of the procedures were index cases representing 788 patients (95.9%) while 33 cases were revisional bariatric procedures (4.1%). The index procedures were divided into 729 sleeve gastrectomies, 30 single anastomosis gastric bypasses, 24 roux en y gastric bypasses and 5 biliopancreatic diversions. The revisional bariatric procedures included 6 patients who were converted to a sleeve gastrectomy following a removal of gastric bands. They also included 14 patients who were converted to single anastomosis gastric bypasses, as well as 12 patients who were converted into roux en y gastric bypasses and 1 sole removal of gastric band. A total of 177 patients (21.6%) had a history of previous abdominal operations (Table 2).

Optical trocars were utilized to establish pneumoperitoneum in all patients undergoing bariatric surgery. The Verress needle was never used to inflate the abdomen prior to the insertion of any of these trocars. Neither was the Hasson technique used to establish pneumoperitoneum in any of the patients. The optical trocars used were either the 12 mm VersaPort™ [Medtronic, Minneapolis, MN, USA] or the 5 mm Kii Optical Access System [Applied Medical, Rancho Santa Margarita, CA, USA]. Peritoneal access was established by a total of 5 surgeons, 4 of which were registrars and a single consultant bariatric surgeon. In total, 5 mm optical trocars were used to establish pneumoperitoneum in 571 patients while the 12 mm optical trocar was used in 250 patients.

Injuries caused by optical trocars while establishing pneumoperitoneum was encountered in 8 of the 821 patients studied (0.97%). The injuries encountered included 4 mesenteric vessel injuries, a single omental vessel laceration and 3 liver lacerations. No postoperative port site hernias were reported. None of these patients required conversion to a laparotomy and these complications were managed laparoscopically. The mesenteric vessel injuries were recognized immediately upon withdrawal of the perforator as the arterial blood was instantly recognizable. Nonetheless, insufflation was continued and pneumoperitoneum established. Secondary trocars were promptly inserted in both the right and left upper quadrants. The bleeding site from the mesentery was identified and using a gauze, direct pressure was applied onto the site. The intraperitoneal blood was suctioned and once no further bleeding was noted, the mesenteric laceration was visualized and sutured with 3–0 PDS. This strategy was also used for the omental laceration. The bleeding encountered from the liver lacerations was initially controlled by applying pressure using a gauze and hemostasis was then ensured using a hemostatic agent (SURGICEL® Fibrillar™ – Ethicon). (Table 3).

Amongst the patients with optical trocar related injuries, 5 were female while 3 were male with an average age of 34.5 years. Between these 8 patients, they had an average BMI of 52.7 kg/m^2 with 4 patients

Table 1
Patient BMI distribution.

Patient's BMI	Number of Patients (n)
Mean BMI (kg/m^2)	45.9
BMI Distribution Groups (kg/m^2)	
30.0–34.9 (Class I Obesity)	23
35.0–39.9 (Class II Obesity)	152
40.0–44.9 (Class III Obesity)	244
45.0–49.9 (Class III Obesity)	193
50.0–59.9 (Class IV Obesity)	169
$>$60.0 (Class IV Obesity)	40

Table 2
Patient summary.

Parameters	Value
Patients (n)	821
Male	287
Female	534
Mean Age (years)	34.2
Index Procedures (n)	788
Sleeve Gastrectomy	729
Single Anastomosis Gastric Bypass	30
Roux-en-y Gastric Bypass	24
Biliopancreatic Diversion	5
Revisional Procedures (n)	33
Conversion to Sleeve Gastrectomy	6
Conversion to Single Anastomosis Gastric Bypass	14
Conversion to Roux-en-y Gastric Bypass	12
Removal of Gastric Band Only	1
Port Size (n)	571
5 mm port	250
12 mm port	
Patients with Previous Abdominal Operations (n)	177
Patients with Comorbidities (n)	111
Diabetes Mellitus	95
Hypertension	71
Dyslipidemia	

having a BMI >50 kgm^2 (p-value = 0.112). All of these injuries occurred in patients that were scheduled to undergo laparoscopic sleeve gastrectomies. In 4 patients, 5 mm optical trocars were used while 12 mm ports were used in the other 4 patients (p-value = 0.47). Amongst the 8 patients who had injuries related to optical trocar entry, 3 had a history of previous abdominal operations (p-value = 0.38). These procedures included a laparoscopic appendectomy, laparoscopic cholecystectomy and an open appendectomy all noted in separate patients. No significant intra-abdominal adhesions were encountered at the operative sites or at the sites of optical trocar entry. For all 8 patients, the bariatric procedures were all noted to be index cases (p-value = 1). Comorbidities were encountered amongst these 8 patients, as diabetes mellitus was reported in 1 patient (p-value = 1), hypertension in 4 patients (p-value = 0.008) and dyslipidemia amongst 4 patients (p-value = 0.003). (Table 4).

4. Discussion

The direct trocar insertion technique was described by Dingfelder in 1978. He trialed his technique of trocar insertion without prior pneumoperitoneum in 301 patients and reported no technical failures amongst them [4]. The technique was modified in 1994 to include a laparoscope and allow the visualization of the abdominal wall layers during access [3]. These trocars have been developed to either be bladed or blunt tipped trocars and their use have facilitated peritoneal access amongst obese patients.

Bladed optical trocars were used by Bernante et al. [5] and Sabeti et al. [3] to establish pneumoperitoneum in obese patients. In conjunction with our technique, and to ensure the safe insertion of these trocars, Bernante described an off midline trocar insertion as well as positioning the patient in a steep reverse Trendelenberg position with gastric deflation using a nasogastric tube. He reported no vascular or visceral injuries amongst 200 patients in which he used this technique [5]. Moreover, Sabeti et al.'s method to ensure safety while inserting the optical trocar included aborting the use of the trocar if any confusion arose regarding the position of the port within the abdominal wall. They avoided its use all together if the patient had a palpable aorta [3].

Similar to our study, experience in the use of bladeless optical trocars in establishing pneumoperitoneum amongst patients with obesity was reported by Madan et al. [6], Berch et al. [7] and Rosenthal et al. [8]. Between them, none of these authors reported any vascular or visceral injuries in their series with a combined total of 1399 patients. Nevertheless, there were notable differences regarding the site they chose for optical trocar entry.

The left upper quadrant of the abdomen was the optical trocar entry site used by Madan et al. as well as Berch et al. [6,7]. The latter favored this site as the ribs provided an anchor for the abdominal wall muscles and allowed separation from the viscera below allowing for a certain degree of safety upon the introduction of the optical trocar. On the other hand, the use of the paraumbilical region as an initial entry site for the optical trocar was reported by Rosenthal et al. [8] as well as Tinelli et al. [9] and Rabl et al. [10]. Rosenthal et al. used a supraumbilical incision to introduce the trocar reporting no injuries amongst 844 patients [8] while Tinelli et al. used a intra-umbilical incision and proceeded to dissect down to the fascia before introducing the optical trocar. Tinelli reported no injuries in his series of 181 patients [9], unlike Rabl et al. who noted 3 injuries (2 mesenteric injuries, 1 omental injury) amongst his series of 196 patients having located his incision just left of the umbilicus [10].

Visceral and vascular injuries were in patients with obesity in whom optical trocars were used to establish pneumoperitoneum. Liver lacerations were reported by Loureiro et al. in 10 out of 588 (1.7%) patients in which he used this technique to create pneumoperitoneum indicating that the hepatomegaly associated with obesity should be taken into consideration when inserting the optical trocar [11]. Additionally, Sundbom et al. reported on 5470 obese patients in which optical trocars were used to establish pneumoperitoneum. He noted a total of 6 major vascular injuries (0.11%) (5 aortic and 1 inferior mesenteric artery)

Table 3
Details of patients with optical trocar injuries.

Parameters	Patient 1	Patient 2	Patient 3	Patient 4	Patient 5	Patient 6	Patient 7	Patient 8
Age (Years)	35	57	38	38	26	31	24	27
Gender	Female	Female	Female	Female	Male	Male	Female	Male
BMI (kg/m^2)	57.0	47.8	49.2	55.8	49.3	55.8	62.4	44.6
Scheduled Procedure	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy	Laparoscopic Sleeve Gastrectomy
Injury Type	Mesenteric Vessel Injury	Liver Laceration	Omental Laceration	Mesenteric Vessel Injury	Mesenteric Vessel Injury	Liver Laceration	Liver Laceration	Mesenteric Vessel Injury
Optical Trocar Size (mm)	12	5	12	5	5	12	12	5
Index/ Revisional Procedure	Index	Index	Index	Index	Index	Index	Index	Index
Previous Abdominal Procedures	Open Appendectomy	Laparoscopic Cholecystectomy				Laparoscopic Appendectomy		
Comorbidities	Hypertension, Dyslipidemia	Diabetes Mellitus, Hypertension, Dyslipidemia	Dyslipidemia	Hypertension		Hypertension, Dyslipidemia		

Table 4
Univariate Analysis of Patients with Optical Trocar Injuries Exploring Potential Factors that can Predispose to Injury.

Parameters	Value	P Value
Patients (n)	8	–
Vascular Injuries	5	
Visceral Injuries	3	
Optical Trocar Sizes Causing Injuries (n)		0.47
5 mm port	4	
12 mm port	4	
Mean BMI (kg/m^2)	52.7	0.112
BMI <50	4	
BMI ≥50	4	
History of Previous Abdominal Procedures (n)	3	0.38
Yes	5	
No		
Type of Procedure (n)		1
Index	8	
Revisional	0	
Diabetes Mellitus (n)		1
Yes	1	
No	7	
Hypertension (n)		0.008
Yes	4	
No	4	
Dyslipidemia (n)		0.003
Yes	4	
No	4	

signifying that central adiposity and the increased distance from the skin to the abdominal cavity is not protective against retroperitoneal injuries [12].

Many surgeons might be wary of adhesions when considering using the optical trocar to create pneumoperitoneum. Rabl et al. favored the open Hasson technique in any patient with a history of a midline laparotomy [10]. Our study did not show a correlation between a previous history of abdominal operations and intraperitoneal injuries caused by the use of optical trocars. This finding was reciprocated by Berch et al. who reported no complications in 327 patients in whom he used this technique despite 181 patients (55%) having a history of abdominal surgical operations [8]. Similarly, our study did not demonstrate a risk of initial trocar site hernias associated with the use of optical trocars. Both Rabl et al. [10] and Coşkun et al. [13]. reported similar findings in their series. This can be attributed to the diagonal offset when inserting the optical trocar causing the abdominal fascia to be penetrated at different sites hence preventing the facial defects from lining up and reducing the risk of a port site hernia.

The limitations of this study include a lack of randomization that would directly compare the Open Hasson technique and Verres needle to the optical trocar in the induction of pneumoperitoneum. Although there are some randomized controlled studies (RCTs) that compare laparoscopic access techniques, they tend to exclude obese patients [14] and are hence required to further validate the use of optical trocars in obese patients. Moreover, the study was conducted under the supervision of a single consultant in a single center. The recruitment of more centers, consultant and patients is needed to further validate this method. Furthermore, there is a clear lack of standardization, even amongst the international community, with regards to the optimal placement of the initial trocar and this issue requires supplementary investigation.

5. Conclusion

Our study highlights an important technique that can facilitate access into the peritoneal cavity in patients with obesity. The 100% success rate in establishing pneumoperitoneum supports the use of optical trocars in creating pneumoperitoneum the obese population. Moreover, although our 0.97% complication rate is comparable to some reports by other surgeons, further modifications to our operative technique, including the site of initial trocar insertion, need to be considered to reduce this rate even further. Extreme caution should always be used when utilizing this approach as it is not immune to major injuries as demonstrated. The most important safety factor is the surgeon's experience and familiarity with the use of this technique.

Author contribution

Abdulmenem Abulsel: Conceptualization; review & editing; Project administration; Supervision. Ashish Mhatre - Research, Investigation; Methodology; Validation. Marwan Bucheeri: Writing - original draft; Discussion and Resources. Sujit Menon: Data collection and Formal analysis.

Guarantor

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Data statement

The individual patient data is available with the authors and will be provided upon request.

Ethical approval

The paper was approved by the ethics committee in our local hospital.

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Informed consent

Written informed consent was obtained from all patients included in the study after detailed explanation of the operation.

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Declaration of competing interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.amsu.2021.102698.

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