

Transumbilical access technique in laparoscopy: a comparative study

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ABSTRACT

Aim: Gaining access to the peritoneal cavity is the most critical step in laparoscopic surgery, and half of all complications occur during this step. The aim of this study was to compare the transumbilical technique with other common entry methods.

Methods: This prospective study included all patients who underwent laparoscopic surgery over a 2-year period. Four entry techniques were compared in terms of time of access, occurrence of entry complications and postoperative port site pain. Data were statistically analysed using SPSS version 23.

Results: A total of 984 patients were included in the study. The most commonly performed procedure was laparoscopic cholecystectomy (72%; $P < 0.001$). The transumbilical entry method was associated with significantly reduced access time, gas leakage, extraperitoneal insufflations and port site pain ($P < 0.001$). One major vascular injury and three bowel injuries related to laparoscopic entry occurred during the study period.

Conclusion: Transumbilical access is safer, faster and associated with reduced postoperative port site pain when compared to the open, Veress needle and direct trocar insertion techniques. There was no bowel nor vascular injuries which were however very low in the other three techniques.

Keywords: Vascular system injuries; Pneumoperitoneum; Laparoscopy; Pain

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Introduction

Laparoscopy is widely used in the surgical field for both diagnostic and therapeutic purposes. Laparoscopic techniques have advanced surgical practices, the benefits of which include decreased postoperative pain, earlier return to normal activities following surgery, and fewer postoperative complications (e.g., wound infection, incisional hernia) when compared to open techniques.⁽¹⁾

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Gaining access to the peritoneal cavity to create a pneumoperitoneum is the first and most critical step of laparoscopic procedures. This access can cause vascular and bowel injuries, and at least 50% of major complications related to gaining access occur before the start of the index surgical procedure. This has led to the development of several techniques for entry, including the open method, the Veress needle method, direct trocar insertion, and the use of specialised instruments such as optical trocars. Pozzo et al. described a modified open technique (transumbilical) utilising the congenital fascial defect that is located under the umbilicus, which is present in almost all patients.^(2,3)

In this study, we compared four techniques for laparoscopic access: open method, Veress needle, direct trocar entry, and the transumbilical technique described by Pozzo et al. These techniques were compared in terms of time taken for access, occurrence of gastrointestinal or vascular injuries, rate of extraperitoneal insufflations, gas leakage and port site pain.

Methods

This prospective study included all adult patients who underwent a laparoscopic procedure from July 2017 to July 2019. All procedures were performed at Prince Hashim Bin Abdullah II Hospital. Patients with previous laparotomy or laparoscopy were excluded from the study. Simple randomisation was used to allocate patients to a specific access technique, with patients consecutively assigned to one of the four access techniques. Due to the nature of the operative procedure, neither the patients nor physicians were blinded.

The data collected included the patient's age, sex, comorbidities, procedure type, access technique used, time to successful entry, occurrence of bowel or vascular injury, and occurrence of extraperitoneal insufflation or gas leakage. In addition, port site pain was assessed postoperatively using a visual analogue scale (VAS) from 0 to 10.

Data were analysed using SPSS version 23. Descriptive statistics and students t-tests were used to calculate the means and frequencies. The chi-square test and logistic regression were used to analyse binary variables while nominal regression was used to assess the different access techniques. P-values less than 0.05 were considered statistically significant.

Access techniques used

Open method

An infra- or supraumbilical incision was made, then the subcutaneous tissue was dissected down to the fascia which was grasped by two clamps and elevated. The fascia was incised, and entry into the peritoneal cavity was confirmed visually. Two sutures are inserted in the fascia to fix the canula and to be used subsequently for defect closure. The canula was subsequently inserted (without trocar) and fixed to the skin, then gas insufflations were started at a rate of 6 L/min.

Veress needle method

A small puncture was made in the infraumbilical crease, the skin was tented, and the needle was inserted directed toward the anus. The position was confirmed by aspiration, injection and the hang drop test. Gas insufflations were started at a rate of 1 L/min. Upon reaching the pre-set pressure, the needle was withdrawn, the incision was extended to 1 cm and the canula (with its trocar) was inserted.

Direct trocar insertion (DTI) method

An incision was made in the infra- or supraumbilical skin. The skin below the umbilicus was tented and the canula (with its trocar) was inserted blindly. Successful entry into the abdomen was confirmed by the camera after insertion.

Transumbilical (modified open) method

The base of the umbilicus was clasped with two toothed forceps and completely everted to the outside. The skin over the top was then incised approximately 1 cm in the vertical or transverse directions. A 9-inch Kelly clamp was used to probe the congenital defect, which was found in almost all patients. The clamp was used to dilate this defect and the canula (without trocar) was inserted. Successful entry was confirmed using the camera, and gas insufflation was started. There was no dissection in subcutaneous tissue and the fascia is not incised (as in open technique) and no sutures were inserted in the fascia.

Results

A total of 984 patients with a mean age of 43.7 years (range 18–69 years) were included in the study. The male to female ratio was 1:1.3. Laparoscopic cholecystectomy accounted for 72% of all laparoscopic procedures performed during the study period. Patient characteristics are presented in Table I. Patients were divided into four groups according to the type of entry method used. Patients were comparable in terms of age, sex and comorbidities.

The time needed to establish pneumoperitoneum using each of the entry methods is presented in Table II. The difference between techniques was statistically significant, with the transumbilical technique requiring the shortest time (mean 1.61 min, SD ± 0.521) while the Veress needle method needed the longest time (mean 6 min, SD ± 1.65). Post hoc tests showed statistically significant differences between each of the four entry methods.

Complications at the access site and port site pain for the four methods are presented in Table III. There was one case of major vascular injury in the DTI group involving the right common iliac artery. This injury was recognised instantly and repaired primarily, and the patient recovered completely. DTI was also associated with two cases of small bowel injury. The first one was recognised intraoperatively in the form of multiple through and through injuries, for which conversion to laparotomy was carried out and the injury was repaired primarily. The second one was recognised on the second postoperative day, and the patient was returned to the theatre for repair. This patient later died due to small bowel fistula and complications related to total parenteral nutrition. A third injury occurred in the Veress group in the form of gastric perforation, which required no further intervention.

The transumbilical technique showed the least association with gas leakage, pneumo-omentum and incidence of extraperitoneal insufflations among the tested methods ($P < 0.001$). The open method was responsible for about half of the cases of gas leakage during surgery, while the Veress needle method had a significantly higher incidence of extraperitoneal insufflations and pneumo-omentum ($P < 0.001$).

Using the VAS, patients in the transumbilical group reported less port site pain than the other three groups ($P < 0.001$). In the post hoc tests, there was no difference in pain score between the Veress group and the DTI group ($P = 0.461$).

Table I. Patient characteristics and clinical data.

	Total (n = 984)	Open method (n = 246)	Veress needle (n = 246)	DTI ^a (n = 246)	Transum- bilical (n = 246)	P-value
Age (years)						
Mean	43.7	43	43.5	45	44	0.743
Range	18–69					
Gender						
Male	433	104	108	103	118	0.508
Female	551	142	138	143	128	
Diabetes						
No	751	189	181	184	197	0.348
Yes	233	57	65	62	49	
Hypertension						
No	766	190	183	193	200	0.319
Yes	218	56	63	53	46	
Procedure						
Cholecystectomy	704	159	188	195	162	<0.0001
Bariatric surgery	92	49	15	10	18	
Appendicectomy	81	21	19	21	20	
Inguinal hernia	33	8	4	11	10	
Incisional hernia	21	0	13	3	5	
Diagnostic laparoscopy	53	9	7	6	31	

^a DTI, direct trocar insertion.

Table II. Access time for methods of entry.

Entry method	Access time (min) mean ± SD
Open method	5.38 ± 1.088
Veress needle method	6.00 ± 1.656
DTI ^a	2.01 ± 0.456
Transumbilical method	1.61 ± 0.521
P-value <0.0001	

^a DTI, direct trocar insertion.

Table III. Access complications and port site pain.

	Open method (n = 264)	Veress needle (n = 264)	DTI ^a (n = 264)	Transumbilical method (n = 264)	P-value
Major vascular injury, n (%)	0	0	1 (0.004%)	0	0.391
Bowel injury, n (%)	0	1 (0.4%)	2 (0.8%)	0	0.298
Pneumo-omentum, n (%)	4 (1.6%)	12 (4.9%)	0	0	<0.001
Gas leak, n (%)	103 (41.9%)	61 (24.8%)	42 (17.1%)	20 (8.1%)	<0.001
Extraperitoneal insufflations, n (%)	10 (4.1%)	30 (12.2%)	7 (2.8%)	4 (1.6%)	<0.001
Port site pain, mean (\pm SD)	6.06 (\pm 1.504)	5.45 (\pm 1.427)	5.35 (\pm 1.397)	4.98 (\pm 1.542)	<0.001

^a DTI, direct trocar insertion.

Discussion

Gaining access to the peritoneal cavity is the first and most critical step in minimally invasive surgery. However, it is still not clear which technique is the most suitable.^(4,5)

The Veress needle method, introduced in 1974 by Royl Palmer for the creation of a pneumoperitoneum,⁽⁶⁾ is the most widely used technique.⁽⁷⁾ It is essentially a blind technique that is thought to result in many injuries, thus some surgeons have adopted the open technique described by Harrith Hasson.⁽⁸⁾

In our study, we found that the open technique, compared to the Veress needle method, was associated with a reduced risk of bowel injury, extraperitoneal insufflations and pneumo-omentum. Furthermore, the open technique took a shorter time for access compared to the Veress needle method. On the other hand, however, the open method was found to be associated with greater gas leakage. These findings are supported by other studies.^(6,9-11)

In 1978, Dingfelder published the first direct trocar insertion method for laparoscopic surgery.^(12,13) In this technique, a sharp trocar is directly inserted without prior peritoneal insufflation. Many authors recommend this technique as a safe and fast alternative to the Veress needle and open techniques.⁽¹³⁻¹⁷⁾ In our study, we found that DTI was associated with a shorter access time and reduced risks of extraperitoneal insufflations, pneumo-omentum and gas leakage compared to both the Veress needle and open methods. However, we encountered one major vascular injury and two bowel injuries (one of the patients died) when using DTI. About 36 cases of major vascular injuries associated with DTI have been reported in the literature.⁽¹⁸⁾ Despite this, a meta-analysis by Molloy et al.⁽¹⁹⁾ found that the direct entry technique is associated with a significantly reduced major injury incidence of 0.5/1000 when compared to both the open and Veress entry procedures (1.1/1000 and 0.9/1000, respectively; P = 0.0005). These findings are supported by other studies.⁽²⁰⁻²³⁾

The umbilicus has always been considered an attractive site for laparoscopic entry as it is centrally located, it allows strategic access to all quadrants of the abdomen, scars can be easily hidden, it is the thinnest point of the abdomen where the skin and fascia fuse, and it has no significant blood vessels.⁽²⁴⁾ In addition, Roger et al.⁽³⁾ demonstrated the presence of a physiologic fascial defect under the umbilicus in all 963 patients in their study. These authors used a modified version of the open technique where they directly inserted a trocar after minimal dilation of the fascial defect. There were no access complications reported in their study. In our study, the

transumbilical access technique conferred the shortest time for access and the least gas leakage and extraperitoneal insufflations. We did not encounter any cases of major vascular or bowel injury using this technique. O’Hanlan et al.⁽²⁵⁾ also used this method and encountered only two minor injuries among the 2271 patients included in their study. Furthermore, we found that the transumbilical technique caused the least postoperative port site pain when compared to the Veress needle, open and DTI techniques ($P < 0.001$), although other authors have found that this difference is not statistically significant.⁽²⁶⁾

An outcome that was not assessed in our study is the rate of infection associated with the umbilical route. It has been reported that intraumbilical incisions have four-times higher risk of surgical site infection when compared to periumbilical incision,⁽²⁶⁾ which approached statistical significance (16% versus 4%, $P = 0.070$). However, others have found no significant difference and concluded that infection at the umbilicus seems to be related to the retrieval of organs through the umbilicus rather than entry itself.^(24,27-29)

Our study is not without limitations. Firstly, some variables like incidence of port site hernia and port site infection were not assessed due to the need for long follow up of the patients and we intended to concentrate in our study on the technical aspects of the procedure only. Secondly, the procedures were performed by more than one surgical team. Thus, further research that controls for these variables is required.

Conclusion

The transumbilical (modified open) laparoscopic entry method is superior to the open, Veress needle and direct trocar insertion techniques in terms of safety, access time and postoperative pain. There was no bowel nor vascular injuries which were however very low in the other three techniques. Further studies controlling for patient- and surgeon-related variables are still required.

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