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Comparative study between true umbilical versus supra umbilical technique as an open access for pneumoperitoneum during laparoscopic surgery

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Abstract--Background: To start laparoscopic procedures, accessing the peritoneal cavity and establishing a carbon dioxide pneumoperitoneum are critical. The placement of the primary trocar is an important step in laparoscopic surgery. Many techniques have been reported in order to limit complications associated with the placement of the first trocar. In the study we describe a surgical method that offers quick, safe, and reliable preliminary entry into the peritoneal cavity with incredible functional and cosmetic results. Methods: A prospective randomised comparative study was conducted on 202 candidates for various laparoscopic surgery, comparing true

umbilical versus supra umbilical open access for pneumoperitoneum from November 2021 to May 2022 in our surgical department. Results: There were 202 patients in the study, 109 (women) and 93 men. The port site entry per seconds was 41.3 ± 1.2 in true umbilical technique (group A) and 132.9 ± 5.5 in supra umbilical open technique (group B), and that was a statistically significant difference ($p < 0.0001$). There was a statistically significant difference in the mean time of port site wound closure (<0.0001) and port site gas leaking in the true umbilical access group compared to the supra umbilical access group (0.000161). In group A, five patients had port-site infections, three had seroma, and only one had incisional hernia post operatively. Conclusions: True umbilical access technique is safe, feasible, fast entry, minimal leak, and has an utmost cosmetic effect, but in some deeply seated umbilicus, we start with a verus needle to facilitate pneumoperitoneum before entry through the umbilicus.

Keywords---True umbilical, Laparoscopy, Pneumoperitoneum, Umbilicus.

1. Introduction

In every laparoscopic procedure, the safe placement of the primary trocar for pneumoperitoneum establishment is the most important phase (Şentürk *et al.*, 2018), because it's linked to bowel, vascular, and bladder injuries (Sakamoto *et al.*, 2017). The open technique is gradually replacing the Veress needle procedure for trocar insertion (Ogaick, Martel 2014). Because it allows for peritoneal access under direct vision, it is preferable (Majeed *et al.*, 2020). In the literature, a number of procedures have been reported that use a variety of approaches and equipment (Imran *et al.*, 2014). The goal of developing an open access method through the umbilical cicatrix tube was to make it simple, safe, and accessible. It is not advised in patients who have had a previous midline incision (Perunovic *et al.*, 2009). Obesity widens the gap between the skin and the fascia, as well as the fascia and the peritoneum. With increasing distance, it becomes more difficult to insert the Veress needle or trocar into the peritoneal cavity (Robinson and Isaacson, 2005). The condition is made worse by preperitoneal gas insufflation. Furthermore, using an open (Hasson) approach, dissection to the level of the fascia may necessitate incision extension, which raises the risk of postoperative wound infection (Krishnakumar and Tambe, 2009). There is debate about what constitutes a sufficient pneumoperitoneum prior to the insertion of the main trocar. It has traditionally been characterised as achieving a volume of 1–4 litres, depending on the patient's BMI and parity. An intra-peritoneal pressure of 10-15 mm Hg is commonly used to achieve this (Toro *et al.*, 2012).

The aim of the study is to compare true umbilical versus supra umbilical open access for pneumoperitoneum during laparoscopic surgery regarding the feasibility, safety, the time for port site entry, air port leak, the time for port site closure, postoperative pain, intraoperative and postoperative complications, and cosmetic outcome.

2. Patients and Methods

Prospective comparative Randomized blinded study was conducted on 202 candidates for laparoscopic surgery from November 2021 to May 2022 in surgical department of Theodor Bilharz Research Institute. Informed consent was obtained from all the participants in the study. Demographic data, age, sex, and BMI were documented. Patients were divided into two groups: true umbilical technique (group A) and supra umbilical technique (group B). All patients scheduled for laparoscopic surgery were included in the study. Patients with a history of midline or transverse laparotomy with distortion of the anatomy of the umbilicus and patients with umbilical and paraumbilical hernia were excluded.

Preoperative preparation involved informed written consent, routine laboratory investigations [complete blood count, liver function and renal function tests, coagulation profile and specific tests relevant to each case], and abdominal ultrasonography and chest radiography. An intravenous antibiotic on anaesthetic induction was done.

Ethical approval

The study's protocol was approved by the TBRI institutional review board under Federal Wide Assurance (FWA 00010609), and the research was conducted in accordance with the World Medical Association's Code of Ethics for Human Experiments (Declaration of Helsinki) and its Later Amendments (GCP guidelines) or comparable ethical standards.

2.1. True umbilical Technique (Group A):

Start by holding the umbilical skin fold with 2 allis forceps (Fig., 1A). Then, a vertical trans umbilical incision of 10 mm will be performed with a scalpel (fig 1B), followed by blunt dissection by inserting a Kelly clamp through the defect and the fascia till reaching the intraperitoneal cavity. Then a 10-mm blunt trocar is introduced (Fig., 1C). At the end of the procedure, one or two high dermal inverted Absorbable vicryl 2/0 stitches were used for umbilical skin suturing (Fig., 1D). In obese patients (chubby abdomen), we started with Veress needle insertion at the left subcostal (palmer's point), then we proceeded to the true umbilical technique (Fig., 1E).

2.2. Supra umbilical technique:

Supra umbilical skin incision of 10 mm was performed with a scalpel, followed by blunt dissection to identify the sheath (fig 2A). Traction was applied to the sheath by two Kocher forceps and cut with a scalpel, and then the peritoneum was reached where a blunt trocar was introduced under direct vision. At the end of the procedure, the sheath was closed with vicryl 0 stitch, and then the skin was closed with high dermal inverted Absorbable vicryl 2/0 stitches (fig 2B). Depending on the severity of postoperative pain, patients were given oral paracetamol 500 mg, 2 tablets on demand. According to fast track surgery, all patients were discharged home on the same day, unless clinically indicated otherwise. All patients were requested to keep a meticulous record of the number

of analgesics necessary during each 24-hour period. This was recorded on the patient information sheet.

All patients are followed up in the outpatient clinic in the first and fourth weeks after discharge. The patients were asked to report their maximum pain score on a visual analogue scale for the day using a numeral analogue pain score from 1 to 10. The pain was evaluated by a score of 0 (no pain) to 10 (very severe pain) at home before going to bed. Operative parameters involving timing for port entry in seconds, port site gas leakage, wound closure timing in seconds, and visceral injury, or major vascular injuries were documented. Post-operatively, all patients will be evaluated by physicians after 1 week and 4 weeks after surgery regarding postoperative patient satisfaction, cosmetic outcome, pain score, analgesia score, wound infection, seroma, and port site incisional hernia were recorded in clinical charts.

2.3. Statistical analysis

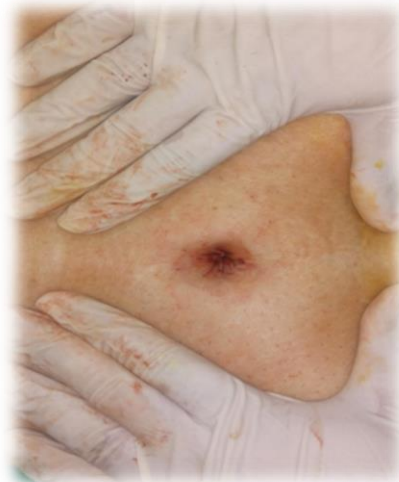
The data will be computerised and statistically analysed using SPSS for Windows version 25.0 statistical software. Means (SE) were used to describe the measurement data, and the t test was used to analyse it. The categorical data was described as frequency (n) and analysed with the chi-square test.



Fig. 1 :(A): True umbilical skin incision, (B): dissection till reaching the intraperitoneal cavity



(C): True umbilical Port insertion



(D): closure of site of true umbilical port



(E): true umbilical Port insertion with veress needle



Fig. 2: (A): supra umbilical skin incision and dissection



Fig. 2: (B): Skin closure in supra umbilical

3. Results

A total of 202 patients (109 girls and 93 males) ranging in age from 18 to 60 years old were operated on utilizing the two procedures for pneumoperitoneum access. In group A there were 51 patients overweight, 38 normal weight, and 21 cachectic, while group B included 41 patients over weight, 42 normal weight, and 18 cachectic. The demographic data of both groups and the type of laparoscopic procedure were matching (Table, 1).

Table 1: Patients' demographics and study variables

	group A (n=101)	group B (n= 101)
age (Mean±SD)	41.0±7.45	39.02±7.57
Gender (No. & %)		
Male	45(22.2 %)	48(23.7%)
Female	56(27.7 %)	53(26.2 %)
BMI (No. & %)		
cachectic	12(5.9 %)	18(8.9 %)
normal weight	38(18.8 %)	42(20.7 %)
over weight	51(25.2 %)	41(20.2 %)
Types of Laparoscopic surgery (No. & %)		
Cholecystectomy	65(32.1 %)	57(28.2 %)
Lap exp for Staging cancer	12(5.9 %)	8(3.9 %)
Lap exp for Perforated viscus	3(1.4 %)	7(3.4 %)
Appendectomy	5(2.4 %)	15(7.4 %)
TAPP for inguinal hernia	14(6.9 %)	10(4.9 %)
Varicocelelectomy	2(0.9 %)	4(1.9 %)

True umbilical technique group A was done in 101 patients, distributed as 65 cases candidate for cholecystectomy, 12 cases of laparoscopic exploration for staging cancer, 3 cases of laparoscopic exploration for perforated viscus, 5 cases of appendectomy, 14 cases of TAPP for inguinal hernia, and 2 cases of Varicocelelectomy. In the supra umbilical technique group B 101 patients were distributed as 57 cases of Cholecystectomy, 8 cases of laparoscopic exploration for staging cancer, 7 cases of laparoscopic exploration for perforated viscus, 15 cases of appendectomy, 10 cases of TAPP for inguinal hernia, and 4 cases of Varicocelelectomy. We started with a verus needle in 15 patients with a deeply seated umbilical scar in group A. There were no visceral or vascular complications in our study (Table, 1).

The operative timing for umbilical port site entry in seconds was 41.3 ± 1.2 in true umbilical technique (group A) and 132.9 ± 5.5 in supra umbilical open technique (group B), a statistically significant difference ($p < 0.0001$) (Table, 2). The operative timing for closure of the umbilical port site wound in true umbilical technique (group A) was 47.0 ± 2.2 while it was 136.0 ± 6.7 in supra umbilical open techniques (group B), a statistically significant difference ($p < 0.0001$) (Table, 2).

Regarding post-operative analgesia, the mean \pm SD for true umbilical techniques (group A) was 1.1 ± 0.17 and for supra umbilical open techniques (group B) was 1.9 ± 0.22 , with no statistically significant difference ($p = 0.0187$) (Table, 2). Umbilical port site gas leakage in true umbilical technique (group A) was reported in 6 cases compared with 25 cases in supra umbilical open techniques (group B), with a significant value of importance ($p = 0.000161$) Table (2). 5 cases had postoperative wound infection in true umbilical technique (group A) compared with 16 patients in supra umbilical technique (group B), which was a statistically significant difference ($P = 0.011218$) in (Table, 2).

Postoperative seroma occurred in 3 patients of the true umbilical technique (group A) compared with 6 patients of the supra umbilical technique (group B), with no significant difference ($P = 0.306284$). One case had postoperative incisional hernia in true umbilical technique (group A) discovered on follow-up compared to two cases in supra umbilical technique (group B), with no significant difference ($P = 0.560778$).

Table 2: comparison of operative & postoperative data in both groups

	group A (n= 101)	group B (n= 101)	P value
Time for port site entry (Mean \pm SD) seconds	41.3 \pm 1.2	132.9 \pm 5.5	<0.0001*
Time of port site wound closure (Mean \pm SD) seconds	47.0 \pm 2.2	136.0 \pm 6.7	<0.0001*
Postoperative analgesia score(Mean \pm SD)	1.1 \pm 0.17	1.9 \pm 0.22	0.0187
Port site gas leakage (No. & %)	6	25	0.000161*
Postoperative complications (No. & %)			
Wound infection	5	16	0. 011218*

Seroma	3	6	0.306284
incisional hernia	1	2	0.560778

(All values are presented as mean \pm standard error of mean, between groups was used Mann-Whitney test (U-test); and Chi square test.

4. Discussion

Laparoscopic surgery has become the most commonly performed procedure in surgery around the world (Djokovic *et al.*, 2016). Many surgeons have surpassed the learning curve for most procedures, and therefore, major complications have been significantly reduced (Sadhu *et al.*, 2009). The open technique for the placement of the first trocar in laparoscopic surgery has become the preferred method due to the reduced number of complications associated with it. This is consistent with a study done by Shih *et al.* to show the efficacy of transumbilical access during laparoscopic procedures, which provides it as a fast, effective, and secure way of accessing the peritoneal cavity (Shih *et al.*, 2020).

Another factor that needs to be considered is obesity. In these patients, the advantage of the true umbilical incision was emphasized, since dissection of a thick layer of subcutaneous fat was unnecessary. We use a veress needle first to create pneumoperitoneum and then start a true umbilical approach. Whereas when the supra umbilical incision was used, the skin incision often needed to be extended just to reach the fascia. This is similar to several studies which report that the open method is safer to practice (Ulusoy, 2018). In a cohort study showing injuries caused by closed techniques (veress needle) for the creation of pneumoperitoneum, the incidence of vascular injuries was 0.018 and visceral injuries was 0.0024 (De Azevedo *et al.*, 2006).

Many hospitals, including our institution, have described and widely accepted a procedure using the umbilical cicatrix. It allows direct peritoneal access. This is a straightforward technique that is both safe and simple to master. It is a quick and safe way to introduce the first port under vision. This is in line with a study conducted on 6000 cases by Lal *et al.*, 2012. to demonstrate the safety of the open approach for first-trocar implantation in laparoscopic surgery¹⁵. Also, the guidelines from the European Association for Endoscopic Surgeries conclude that available data favours the use of open technique; however, they agree that major vascular injuries most often occur with the Veress approach (Neudecker *et al.*, 2002).

In our study, true umbilical port entry in seconds is better and of more significant value than supra umbilical port entry. The timing for closure of a true umbilical port is faster and more significant than the supra umbilical technique. This is consistent with a prospective study done on 100 by Moberg *et al.* that showed that the median time for access was 93 seconds. The study also reported that the transumbilical technique is simple, fast, and easy to learn. Once mastered, it can be performed without delaying the operation (Moberg *et al.*, 2007). In our study, we now have 101 cases in which the true umbilical technique was used. The technique seems to be well adopted among surgeons with reasonable entry time. As well, the technique is applicable to obese patients (BMI > 30). This technique is consistent with several studies which conclude that the simplicity, rapidity, and

inherent safety of first port insertion through the umbilical cicatrix (Mah and Qsu, 2019).

In our study, post-operative port site infection in group A true umbilical technique is better and more significant than in group B supra umbilical technique ($p = 0.001218^*$). This is in line with a study conducted by Roger et al. In their series, the surgical site infection rate was 0.84%, which is similar to that reported in the literature (0.6%) (Pozzo et al., 2016). Lastly, in our study, the cosmetic effect of an umbilical incision is believed to be superior, as the scar gets hidden by the umbilicus itself when depressed into its natural position. Resutra *et al.*, (2019) found that the transumbilical incision, rather than a supra- or infraumbilical incision, has a better cosmetic scar and a nearly normal-looking umbilicus. Transumbilical camera port insertion leaves no scar (Resutra *et al.*, 2019).

Conclusion

True umbilical access technique is safe, feasible, fast entry, minimal gas leak, and has an utmost cosmetic effect, but in some deeply seated umbilicus, we start with a verus needle to facilitate pumoperitonum before entry through the umbilicus. We strongly recommend this technique for laparoscopic procedures.

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No funding was received from any resource for this research project.

Conflicts of interest

Authors declared that they have no competing interests

Availability of the data and materials

All relevant data analyzed during this study are presented in tabular form in this published article. The original datasets used during the current study are available from the corresponding author on reasonable request

Informed consent statement was obtained from all the participants in the study.

Authors' contribution

Mohamed Elashry and Ahmed Abdelaziz were involved in the concept and design of the study. Mohamed Elashry, Mohamed S. Hedaya, Ahmed Abdelaziz and Aymen Nafeh were involved data analysis, interpretation and manuscript writing. Ahmed Abdelaziz, Aymen Nafeh, and, Hesham A. Elmeligy retrieved data from medical records. All authors have reviewed and approved of the final manuscripts.

Ethical approval

The study's protocol was approved by the TBRI institutional review board under Federal Wide Assurance (FWA 00010609), and the work was carried out in accordance with the World Medical Association's Code of Ethics for Human Experiments (Declaration of Helsinki) and its Later Amendments (GCP guidelines) or comparable ethical standards.

Consent for publication

Not applicable

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