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DECOMPRESSION OF ACCIDENTAL PNEUMOPERITONEUM IN TEP AND eTEP HERNIA SURGERIES USING VERESS NEEDLE AND 5 mm TROCAR - A COMPARATIVE STUDY

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ABSTRACT
Background: An unintended peritoneal breach leading to accidental pneumoperitoneum ranks among the most frequent intraoperative challenges during totally extraperitoneal (TEP) and extended totally extraperitoneal (eTEP) hernia repair. As carbon dioxide tracks into the peritoneal cavity, the preperitoneal working space collapses, visualisation deteriorates, and conversion to an alternative approach may become necessary. Several strategies have been proposed to address this problem, but deliberately decompressing the pneumoperitoneum remains the most direct and effective solution. This study evaluates and compares the safety and effectiveness of two decompression techniques, the Veress needle and the 5 mm trocar, in both TEP and eTEP repairs.
Methods: Operative records of 550 consecutive extraperitoneal hernia repairs (250 TEP, 300 eTEP) carried out at Saveetha Medical College and Hospital between January 2017 and June 2024 were reviewed retrospectively. Accidental pneumoperitoneum was noted in 80 patients (14.5 %): 50 of 250 TEP repairs (20.0 %) and 30 of 300 eTEP repairs (10.0 %), and these 80 patients constituted the study cohort. Group A (n = 38; 27 TEP, 11 eTEP) was decompressed using a Veress needle, while Group B (n = 42; 23 TEP, 19 eTEP) was decompressed using a 5 mm trocar, both introduced at Palmer's point following nasogastric decompression and exclusion of splenomegaly. Demographic characteristics, operative duration, ease of decompression, intraoperative and postoperative complications, and VAS pain scores were analysed and compared between groups using the Chi-square test and Student's t-test, with statistical significance set at $p < 0.05$.
Results: TEP repairs were complicated by accidental pneumoperitoneum twice as often as eTEP repairs (20.0 % vs 10.0 %; $\chi^2 = 10.97$, $p < 0.001$). Baseline age, BMI, sex, and hernia type did not differ significantly between the two decompression groups (p = 0.721, 0.746, 0.133, and 0.838, respectively). The 5 mm trocar group had a significantly shorter mean operative time (94.1 ± 35.9 vs 119.5 ± 38.0 min; p = 0.003) and shorter hospital stay (2.4 ± 0.5 vs 2.7 ± 0.6 days; p = 0.018) compared with the Veress needle group. Complications were infrequent and comparable: seroma 2 vs 1, haematoma 2 vs 1, paralytic ileus 3 vs 0 (p = 0.103) and surgical emphysema 1 vs 0. There were no bowel, vascular or splenic injuries and no mesh infections in either group. VAS pain scores were similar at 24 h (4.8 ± 0.7 vs 4.6 ± 0.6; p = 0.176) and at 48 h (3.5 ± 0.5 vs 3.7 ± 0.6; p = 0.108), with no clinically or statistically significant difference at either time point.
Conclusion: Both techniques of decompression are safe and feasible in TEP as well as eTEP repair. The 5 mm trocar provided faster and more sustained decompression, shortening operative time without added morbidity. Incorporating trocar decompression as a standardised step may improve workflow during extraperitoneal repairs, particularly when the peritoneal rent occurs early in the dissection.

KEYWORDS: TEP; eTEP; accidental pneumoperitoneum; peritoneal rent; Veress needle; 5 mm trocar; Palmer's point; decompression; laparoscopic hernia repair.

INTRODUCTION

Laparoscopic extraperitoneal repair is widely considered one of the preferred approaches to hernia management. Totally extraperitoneal (TEP) repair was the earliest of these techniques to achieve broad acceptance, delivering a tension-free repair while avoiding entry into the peritoneal cavity and, consequently, the risk of mesh–viscera adhesion [8,9]. More recently, the extended totally extraperitoneal (eTEP) technique has expanded the possibilities of extraperitoneal surgery even further, permitting more versatile port placement, a wider working space, and access to ventral and incisional defects, all while preserving the benefit of staying outside the peritoneal cavity [5,6].

Notwithstanding these benefits, an inadvertent peritoneal tear resulting in accidental pneumoperitoneum continues to be among the most frequent technical obstacles in both procedures. As insufflated carbon dioxide leaks through the tear, pressure within the peritoneal cavity rises to match and then surpass that of the preperitoneal space, causing the peritoneum to bulge forward. This collapses the working space and obscures the surgical view, sometimes leaving the surgeon with no option but to abandon the extraperitoneal plane in favour of a transabdominal preperitoneal (TAPP) or open approach [1,3].

A range of options exists for managing a peritoneal tear. Minor tears can often be left untreated, whereas larger defects generally warrant closure with a suture, endoloop, clip, or pre-tied ligature [2]. Regardless of whether closure is undertaken, however, restoring the working space requires evacuating the gas that has already leaked into the peritoneal cavity. Prompt, effective decompression of this trapped gas is therefore key to continuing the operation without delay. The Veress needle and the 5 mm trocar are the two instruments most commonly used for this purpose [4], although evidence directly comparing their practicality and safety within TEP and eTEP surgery remains sparse [1].

The present study set out to compare these two decompression methods in a large consecutive series of TEP and eTEP repairs, examining the incidence of accidental pneumoperitoneum, the efficiency of decompression, operative duration, perioperative complications, and overall safety.

MATERIALS AND METHODS

Study design and population

This comparative retrospective analysis was carried out in the Department of General Surgery at Saveetha Medical College and Hospital, Chennai, encompassing all TEP and eTEP hernia repairs performed between January 2017 and June 2024. A total of 550 consecutive repairs — 250 TEP and 300 eTEP — were undertaken during this interval.

Accidental pneumoperitoneum was recorded in 80 of these 550 procedures (14.5 %) — 50 of the 250 TEP repairs (20.0 %) and 30 of the 300 eTEP repairs (10.0 %) — and these 80 cases formed the study cohort, grouped according to the decompression method employed:

Group A — Veress needle decompression (n = 38): 27 TEP and 11 eTEP repairs.

Group B — 5 mm trocar decompression (n = 42): 23 TEP and 19 eTEP repairs.

Selection of the decompression device was left to the operating surgeon and was not allocated by randomisation.

Inclusion and exclusion criteria

Inclusion criteria: patients aged above 18 years who underwent TEP or eTEP repair for inguinal, ventral, or incisional hernia and who developed intraoperative accidental pneumoperitoneum necessitating decompression.

Exclusion criteria: patients converted to an open or TAPP procedure prior to any attempt at decompression; a history of major abdominal surgery, especially involving the upper abdomen or left upper quadrant; hemodynamic instability or significant cardiopulmonary comorbidity; and splenomegaly, since this precludes safe puncture at Palmer's point.

Technique of decompression of accidental pneumoperitoneum

Once a peritoneal tear during TEP or eTEP surgery gives rise to accidental pneumoperitoneum, the extent to which the working space is compromised depends on the size of that tear. Difficulty is governed not only by the size of the defect but also by the stage of the operation at which it occurs. A tear that develops early, before the preperitoneal space has been adequately established, makes continued dissection markedly harder and frequently necessitates conversion to a TAPP procedure, whereas a tear occurring later, once the space has been developed and the mesh site prepared, is tolerated far more easily.

In every case requiring decompression, the following stepwise protocol was followed.

1. Preliminary measures — nasogastric and urinary decompression. In every patient, a Ryle's tube is inserted following induction of anaesthesia and the stomach is emptied by aspiration; a distended stomach can extend well below the costal margin on the left and lie directly along the trajectory of a needle or trocar entering the left hypochondrium, so emptying it eliminates the single greatest cause of visceral injury at this site. The bladder is similarly emptied — either by voiding just before surgery or through catheterisation — to keep it clear of the operative field.

2. Exclusion of splenomegaly. Of the structures in the left hypochondrium, the spleen carries the greatest risk of injury from puncture. Splenic enlargement is assessed clinically in every patient, with ultrasound or cross-sectional imaging obtained if there is any uncertainty. Because splenomegaly, a palpable mass in the left upper quadrant, or a history of splenic or left upper quadrant surgery all preclude safe use of Palmer's point [11,12], patients with any of these findings were excluded from the study. When Palmer's point cannot be used, an alternative right-hypochondrial site, or deliberate widening of the existing peritoneal tear under direct vision, offers a suitable alternative.

3. Identification of Palmer's point. Palmer's point lies roughly 3 cm beneath the left costal margin along the midclavicular line. It is favoured as an entry site because adhesions rarely form there, it sits well away from the umbilical scar and major vessels, and the overlying abdominal wall is thin [11,12]. The point is marked out before insufflation distorts the surface anatomy, with the patient positioned supine and level; a steep Trendelenburg tilt is avoided while the puncture is made.

4A. Decompression with the Veress needle. Before use, the needle's spring mechanism and lumen patency are checked. Following a 3 mm skin incision at Palmer's point, the needle is passed perpendicular to the abdominal wall while the wall is steadied between the operator's finger and thumb; two discrete clicks signal passage through the fascia and then the peritoneum in turn. Correct intraperitoneal placement is verified with the aspiration test, the hanging-drop (saline) test, and a low initial insufflator pressure. Opening the tap then allows the trapped gas to vent passively, and the surgeon observes the distended peritoneum recede from the telescope as the preperitoneal space re-expands. The needle can be taped in place with its tap left open for the remainder of the case, continuously venting any gas that re-enters through the tear, and is removed at the close of surgery; the puncture site does not require formal closure.

4B. Decompression with the 5 mm trocar. Through the same skin marking, a 5 mm incision is made at Palmer's point, and the trocar is advanced perpendicular to the abdominal wall using a controlled twisting motion, with the free hand guarding against over-insertion; an optical trocar is used when one is available. Successful entry is signalled by an audible rush of gas once the obturator is withdrawn, and, if the tear is sufficiently large, the cannula tip can be seen directly from the preperitoneal aspect. After the obturator is removed, the cannula is left with its valve open, its broad lumen allowing gas to escape quickly; it can, if needed, be attached to suction, or used to pass a 5 mm scope for inspecting the viscera or a grasper should conversion to TAPP be required. The cannula stays in place for the remainder of the procedure, continuing to vent gas that crosses the tear, and is withdrawn at the end of the case — a 5 mm port site needs only skin closure, with no fascial repair necessary.

5. Management of the rent and completion. With the working space re-established, the tear itself is addressed as appropriate — small defects are left to heal spontaneously, whereas larger ones are closed using an endoloop, intracorporeal suturing, or a clip. Insufflation pressure is restored to its operating level, and dissection, mesh placement, and fixation then continue as usual.

Figure 1. Technique of Veress needle decompression at Palmer's point.

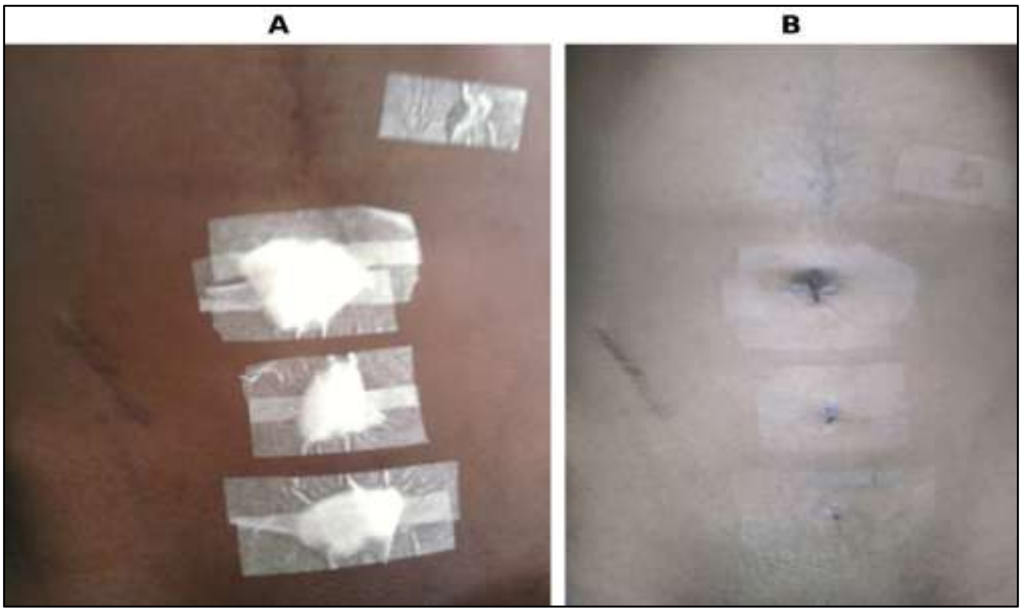

Figure 2. Postoperative appearance of Veress needle port sites: (A) dressings in situ on the first postoperative day; (B) port sites after dressing removal, showing well-healed puncture marks with no evidence of infection or hernia formation.

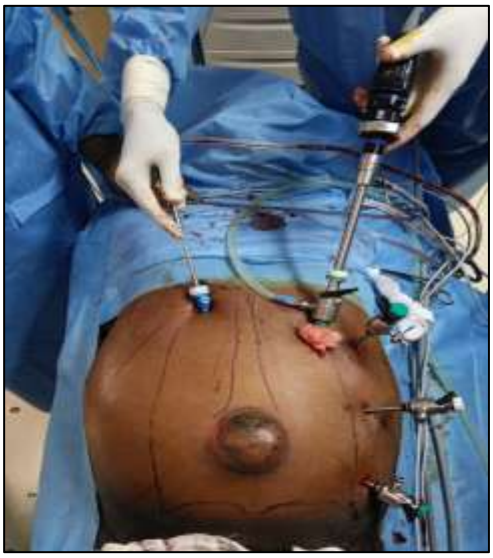

Figure 3. Technique of 5 mm trocar decompression at Palmer's point.

Data collection and statistical analysis

Operative notes and case records provided the data for this study, covering patient demographics, hernia type, procedure type (TEP or eTEP), intraoperative parameters (total operative duration, timing of the tear, ease and completeness of decompression, need for conversion, and other intraoperative findings), and postoperative outcomes (VAS pain scores at 24 h and 48 h, complications, and length of hospital stay). Continuous variables were compared using Student's t-test and categorical variables using the Chi-square test, with a p-value below 0.05 taken to indicate statistical significance. All analyses were conducted in SPSS version 25.

RESULTS

Among the 550 extraperitoneal repairs carried out during the study period, 80 were complicated by accidental pneumoperitoneum, giving an overall incidence of 14.5 %. This complication occurred twice as often after TEP as after eTEP (50/250, 20.0 % vs 30/300, 10.0 %), a difference that was highly significant ($\chi^2 = 10.97$, $p < 0.001$). Table 1 and Figure 4 set out the composition of the cohort and the decompression method used in each arm.

Table 1. Distribution of accidental pneumoperitoneum and decompression method by type of repair.

Parameter	TEP (n = 250)	eTEP (n = 300)	Total (n = 550)	χ^2	p Value
Accidental pneumoperitoneum	50 (20.0 %)	30 (10.0 %)	80 (14.5 %)	10.97	**< 0.001***
Veress needle decompression	27 (54.0 %)	11 (36.7 %)	38 (47.5 %)	2.26	0.133
5 mm trocar decompression	23 (46.0 %)	19 (63.3 %)	42 (52.5 %)		

Percentages for the decompression methods are of the number of pneumoperitoneum cases in that arm. * $p < 0.05$ considered statistically significant.

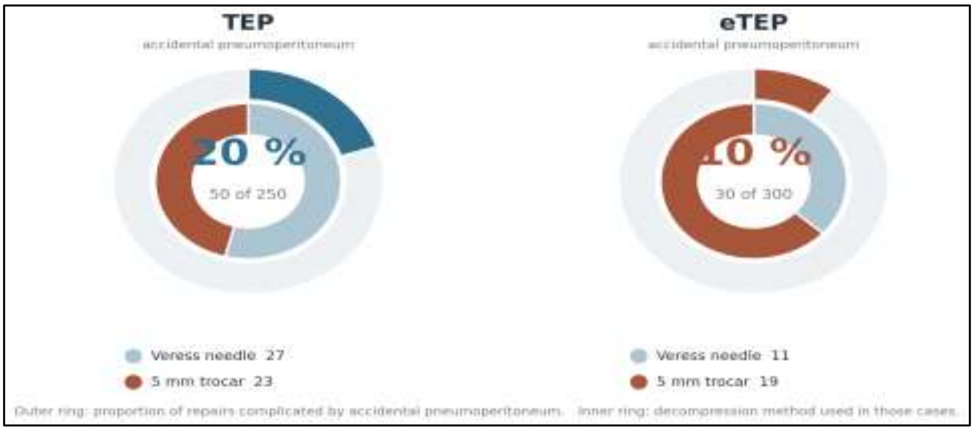

Figure 4. Incidence of accidental pneumoperitoneum in TEP and eTEP repairs (outer ring), with the decompression method used in the affected cases (inner ring).

The two decompression groups did not differ significantly in baseline demographic characteristics or hernia type, confirming that the two arms were well matched (Table 2).

Table 2. Demographic and operative characteristics of the two decompression groups.

Parameter	Veress needle (n = 38)	5 mm trocar (n = 42)	p Value
Mean age (years)	44.8 ± 10.2	45.6 ± 9.7	0.721
Male : Female	27 : 11	23 : 19	0.133
Mean BMI (kg/m²)	25.3 ± 2.6	25.1 ± 2.9	0.746
TEP : eTEP	27 : 11	23 : 19	0.133
Inguinal hernia, n (%)	20 (52.6 %)	22 (52.4 %)	0.838†
Ventral hernia, n (%)	10 (26.3 %)	13 (31.0 %)	0.838†
Incisional hernia, n (%)	8 (21.1 %)	7 (16.7 %)	0.838†
Mean operative time (min)	119.5 ± 38.0	94.1 ± 35.9	0.003*
— Inguinal hernia UNILATERAL TEP - Inguinal hernia BILATERAL TEP	90 ± 30 110	60 ± 15 90	0.001*
— Ventral hernia (primary) ETEP	140 ± 20	120 ± 10	0.013*
— Incisional hernia ETEP	160 ± 20	140 ± 20	0.076
Mean hospital stay (days)	2.7 ± 0.6	2.4 ± 0.5	0.018*
VAS pain score at 24 h	4.8 ± 0.7	4.6 ± 0.6	0.176
VAS pain score at 48 h	3.5 ± 0.5	3.7 ± 0.6	0.108

Operative-time p values are for the unilateral inguinal TEP, ventral eTEP and incisional eTEP subgroups respectively (Welch's t-test); the bilateral inguinal TEP subgroup (n = 3 per group, standard deviation not recorded) was too small for a separate statistical comparison. * $p < 0.05$ considered statistically significant.

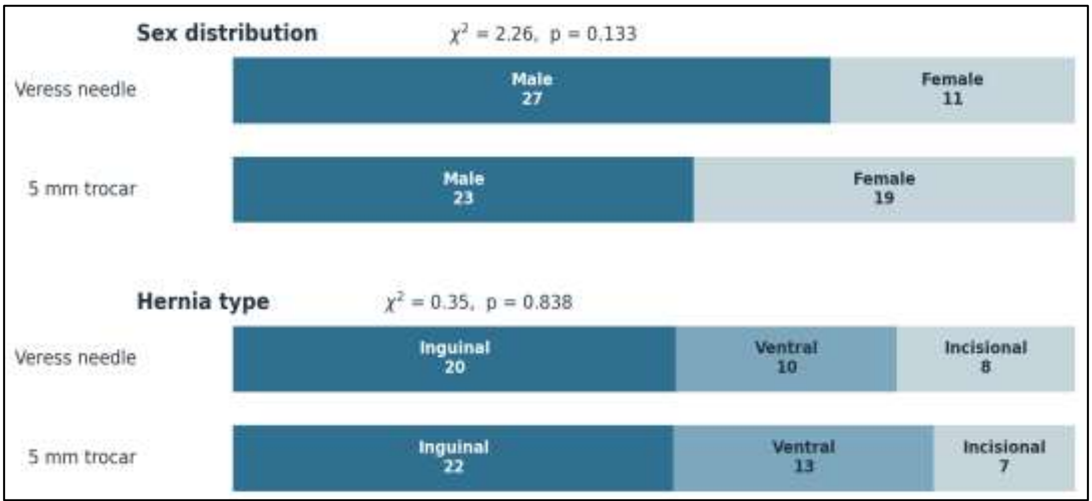

Figure 5. Sex distribution and hernia type composition of the two decompression groups.

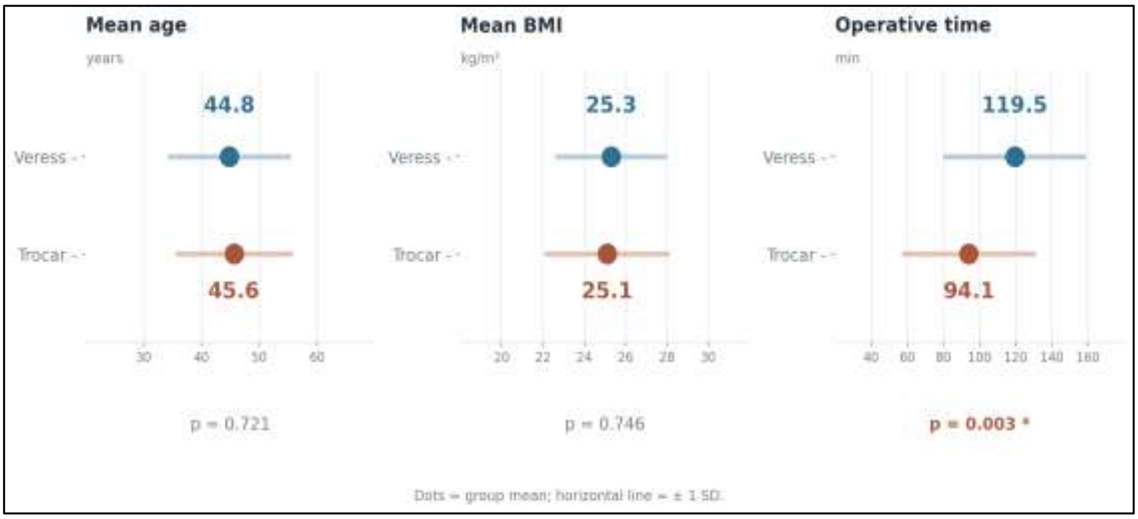

Figure 6. Age, body mass index and operative time by decompression group.

Figure 7. Postoperative VAS pain scores at 24 h and 48 h by decompression group.

Table 3. Postoperative complications.

Complication	Veress needle (n = 38)	5 mm trocar (n = 42)	p Value
Seroma formation	2 (5.3 %)	1 (2.4 %)	0.602
Haematoma	2 (5.3 %)	1 (2.4 %)	0.602
Paralytic ileus	3 (7.9 %)	0 (0 %)	0.103
Surgical emphysema	1 (2.6 %)	0 (0 %)	0.475
Mesh infection	0 (0 %)	0 (0 %)	—
Bowel injury	0 (0 %)	0 (0 %)	—
Vascular injury	0 (0 %)	0 (0 %)	—
Splenic injury	0 (0 %)	0 (0 %)	—
Total complication events	8	2	—
Patients with ≥ 1 complication	0	0	---

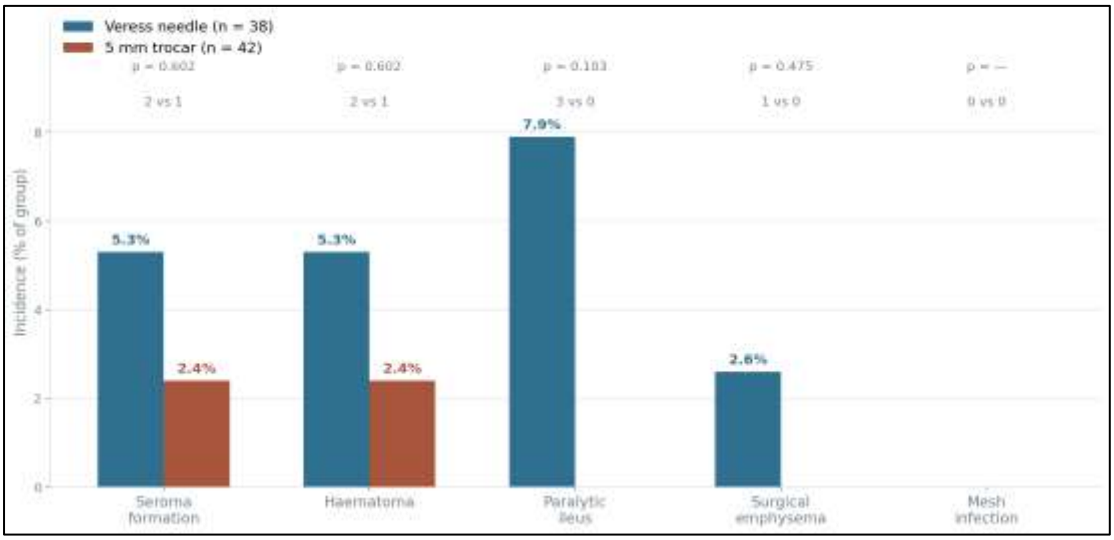

Figure 8. Postoperative complications by decompression group (bars = incidence in each group, with event counts and p values above).

DISCUSSION

Accidental pneumoperitoneum continues to pose a technical challenge in TEP and eTEP surgery, with the potential to interrupt the flow of the operation. It complicated 14.5 % of the 550 consecutive extraperitoneal repairs in this series, a rate that falls within the range reported previously [1,2].

A marked difference in incidence emerged between the two approaches: 20.0 % following TEP versus 10.0 % following eTEP ($p < 0.001$). This is plausibly explained by several factors. Conventional TEP dissection starts in a tight infraumbilical pocket just beneath the posterior rectus sheath, a location where the overlying peritoneum is thin and tightly adherent, making it prone to tearing during balloon or telescopic dissection — particularly near the arcuate line and the hernial sac. eTEP, on the other hand, is initiated in the retrorectus plane at a distance from the peritoneum, offering a longer, more adaptable working axis, ports positioned away from the dissection field, and a roomier working space, all of which lower the chance of an unintended peritoneal breach [5,6]. The more favourable instrument angles achievable in eTEP may also lessen the tangential forces exerted on the peritoneum.

At baseline, the two decompression groups were well balanced. No statistically significant differences emerged in age, BMI, sex distribution, or hernia type ($p = 0.721$, 0.746, 0.133, and 0.838, respectively; Figures 5 and 6), indicating that differences in case mix did not confound the comparison of operative and postoperative outcomes. eTEP repairs were somewhat more likely to use the 5 mm trocar than TEP repairs (63.3 % vs 46.0 %), though this trend did not reach statistical significance ($p = 0.133$).

The 5 mm trocar group had, on average, an operative time about 25 minutes shorter (94.1 ± 35.9 min vs 119.5 ± 38.0 min; $p = 0.003$), a finding in keeping with the device's wider lumen, which vents gas more efficiently and can be attached to continuous suction if needed [4]; unlike the Veress needle, which often needed repositioning when omentum or bowel came to lie against its tip, the trocar cannula can simply be left open in place. Hospital stay, too, was shorter with the trocar (2.4 ± 0.5 vs 2.7 ± 0.6 days; $p = 0.018$); although this 0.3-day difference reached statistical significance given the cohort size, its clinical relevance is modest and may in part reflect discharge policies at the study institution rather than a true effect of the decompression method.

Both groups experienced few complications, and none of the between-group comparisons reached statistical significance. Rates of seroma and haematoma were nearly identical. Three Veress-group patients developed paralytic ileus compared with none in the trocar group, and surgical emphysema occurred in a single Veress case; Fisher's exact testing found neither difference to be significant ($p = 0.103$ and $p = 0.475$), though the rarity of these events leaves the study underpowered to detect a modest true difference. Importantly, no patient in either group sustained a bowel, vascular, or splenic injury, nor was there any mesh infection. That splenic injury did not occur across 80 punctures in the left hypochondrium speaks to the safety of the precautions followed here — nasogastric decompression, exclusion of splenomegaly, and accurate localisation of Palmer's point [11,12] — and indicates that the theoretical hazard of this entry site can be well managed when these precautions are observed [4,10].

Pain scores were closely matched between groups at both assessment points. At 24 hours, the Veress group scored marginally higher (4.8 ± 0.7 vs 4.6 ± 0.6), though not significantly so ($p = 0.176$); by 48 hours this pattern reversed, with the trocar group reporting slightly higher scores (3.7 ± 0.6 vs 3.5 ± 0.5), again without reaching significance ($p = 0.108$). Since a 0.2-point VAS difference falls well short of the widely accepted minimal clinically important difference of roughly 1.0 to 1.3 points, these findings are best read as showing no clinically meaningful distinction between the two techniques at either time point. A slightly greater degree of local discomfort from a 5 mm port, relative to a needle puncture, once the early visceral pain has settled remains biologically plausible, though this study was not sized to detect a difference of that scale.

Collectively, these results suggest that the 5 mm trocar decompresses the pneumoperitoneum more quickly and shortens the operation, with no discernible cost in complications and, at most, a negligible difference in later pain. Several limitations warrant mention. This was a single-centre, retrospective analysis in which the decompression device was chosen at the operating surgeon's discretion rather than by randomisation, raising the possibility of selection bias — for instance, a surgeon might have preferred the trocar for larger tears where decompression was expected to proceed smoothly. Over the four-and-a-half-year study period, evolving operator experience may have affected both the frequency of peritoneal tears and the recorded operative times, and this analysis does not control for that learning curve. Operative time itself is a composite endpoint shaped by the entire procedure, not the decompression step in isolation. Confirmation of these findings will require prospective, randomised, multicentre studies, ideally designed in accordance with current European guidelines for laparoscopic ventral and inguinal hernia repair [7,9].

CONCLUSION

Accidental pneumoperitoneum complicated 14.5 % of 550 consecutive extraperitoneal hernia repairs and was twice as common during TEP as during eTEP. Both the Veress needle and the 5 mm trocar are safe and feasible methods of decompressing it, with no bowel, vascular or splenic injury in either group. The 5 mm trocar, introduced at Palmer's point after nasogastric decompression and exclusion of splenomegaly, achieved significantly shorter operative times and a marginally shorter hospital stay without any increase in complications. Adopting trocar decompression as a standardised step could enhance operative efficiency in both TEP and eTEP practice, and may reduce the need for conversion when a peritoneal rent occurs early in the dissection. In our own practice, the Veress needle was initially the only method used for decompression; the 5 mm trocar has since been progressively and now widely adopted, and the findings of this study confirm it to be a safe and effective alternative to the Veress needle for this purpose.

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