

# Prospective Comparative Study between Conventional TAPP and Tumescence TAPP

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**Introduction:** Transabdominal preperitoneal approach (cTAPP) is effective method in treatment of inguinal hernia. Technical difficulties and long learning curve are the main disadvantages. We suggest that tumescent injection in the preperitoneal space during TAPP before dissection may facilitate technical difficulties and decrease the learning curve with subsequent improvement of the competence of the trainee to do the surgery.

**Patients and methods:** From March 2020 to March 2022, our study enrolled 200 patients, evenly split between those receiving conventional TAPP (cTAPP) and Tumescence TAPP (tTAPP). The surgeries were performed by trainees under supervision. The surgical procedure involved injecting a mixture of 50 ml of 0.5% Bupivacaine and adrenaline diluted to 1 in 200,000 into the extraperitoneal space. The rest of the operation was consistent with the conventional techniques of TAPP repair.

**Results:** There was a highly significant difference between both study groups as regards operative time with higher mean time among cTAPP cases. There was a highly significant difference between both study groups as regards pain score 24 hours after operation with higher mean time among cTAPP cases. Yet, no significant difference was found in pain score 2 weeks, 30 days and 1 year after operation. Regarding the competence and learning of the trainees, there was significant difference in overall competence with favor to tTAPP group.

**Conclusion:** The application of Tumescence technique in TAPP surgery could potentially reduce the learning curve, abbreviate the duration of the operation, and alleviate postoperative discomfort for patients when contrasted with the traditional TAPP method.

**Key words:** Laparoscopic inguinal hernia repair, Laparoscopic transabdominal preperitoneal hernia repair (cTAPP), Tumescence laparoscopic transabdominal preperitoneal hernia repair (tTAPP).

## Introduction

Laparoscopic transabdominal preperitoneal (TAPP) inguinal hernia repair has been reported since the 1990s.<sup>1</sup>

Laparoscopic repair of inguinal hernias has become a preferred method over traditional open mesh repair, offering advantages such as diminished postoperative discomfort, expedited recovery, and a decrease in long-term pain.<sup>2-7</sup>

An additional benefit of the TAPP inguinal hernia repair technique is that it facilitates detection of bilateral hernias and minimizes the possibility of missing a femoral hernia.<sup>8</sup>

However, McCormack et al reported that 13.5 % of patients were left with chronic pain after TAPP.

Laparoscopic repair for inguinal hernias, while effective, presents a more challenging learning curve compared to open mesh repair due to its higher technical complexity.<sup>9-14</sup>

The technical complexity of the procedure primarily stems from the extensive dissection required for the delicate peritoneum and the inguinal floor, which includes Cooper's ligament. This is compounded by the inherent difficulty in discerning anatomical features and the potential for variable amounts of bleeding during the dissection process,<sup>15</sup> as well as potential for bleeding, can increase the risk of complications such as recurrence, conversion to

open surgery, and injury to surrounding organs.<sup>16</sup>

The peritoneal dissection is one of the main difficulties in cTAPP and most of the complications happen in this stage (About 50% of intraoperative complication rate) and it requires longer time for the trainee to able to do it in proper time without complications (About 50 cases to achieve the training).<sup>16,17</sup>

Lovisetto et al. have reported a 4.6% intraoperative complication rate during TAPP, half of which (2.2%) were related to the peritoneal dissection stage of the procedure.<sup>18</sup>

So we tried tumescent TAPP to reduce these complications. The tumescent TAPP procedure entails the injection of a substantial volume of diluted tumescent anaesthetics and epinephrine before proceeding to the conventional TAPP procedure. This approach is designed to enhance the surgical field visibility and patient comfort during the procedure.<sup>19-21</sup>

The goal of this study is to compare the outcomes of tumescent TAPP and conventional TAPP in terms of operative time, intraoperative and postoperative complications, and the competence of trainee surgeons to perform the procedure. By evaluating the effectiveness of tumescent TAPP, we hope to better understand the impact of this technique on the learning curve for surgeons and the overall outcomes for patients undergoing inguinal hernia repair.

## Patients and methods

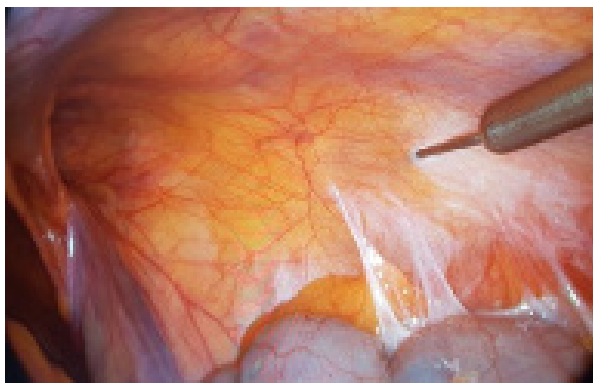
This is a prospective interventional comparative study. From March 2020 to March 2022, our study enrolled 200 patients, evenly split between those receiving conventional TAPP (cTAPP) and Tumescent TAPP (tTAPP). The surgeries were performed by residents in their third year or higher, under the guidance of a consultant experienced in TAPP procedures. The trainees were 10, each one did 20 cases, 10 in each group. The inclusion criteria were as follows: male patients over the age of 16 who were mentally competent and had a unilateral hernia, whether it was a first occurrence or a recurrence. Exclusion criteria included patients who previously underwent laparoscopic hernia repair, those with significant comorbidities, bilateral hernias, large chronic inguinoscrotal hernias, incarcerated or strangulated hernias, and female patients. Participating trainees were required to have completed a minimum of twenty TAPP procedures, either independently or under supervision, prior to joining the study.

The research protocol received the endorsement of the Faculty of Ain Shams University, General Surgery Department research ethics committee. All study participants provided their written and oral consent for both the treatment and the dissemination of this report's findings. Data privacy was ensured by implementing encryption, anonymization, secure storage, access controls, robust consent processes, and regular security audits.

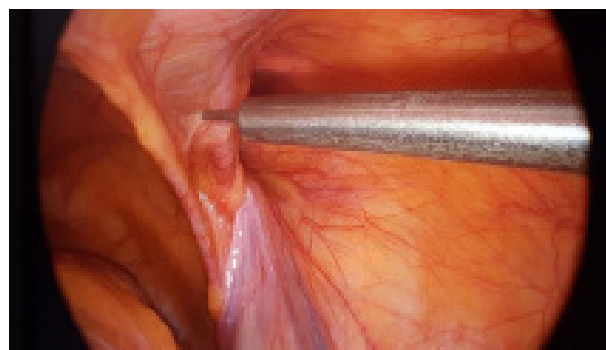
### Technique of tumescent TAPP:

The surgical procedure involved the use of three trocars: a 12 mm trocar at the navel and two working ports, each 5 mm, placed just below and to the sides of the central trocar. Following the creation of pneumoperitoneum, a mixture of 50 ml of 0.5% Bupivacaine and adrenaline diluted to 1 in 200,000 was administered into the extraperitoneal space using a 5 mm needle.

The injection began at the anterior superior iliac spine and proceeded medially towards the prevesical space, with careful measures taken to prevent intravascular injection (**Figs. 1,2**).



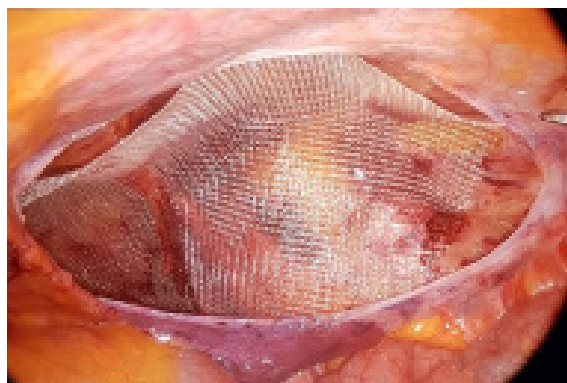
**Fig 1: Puncturing the peritoneum.**



**Fig 2: Tumescent injection at extraperitoneal space.**

Once the injection was complete, the rest of the operation was consistent with the conventional techniques of TAPP repair.

- An incision was made in the peritoneum from above the iliac spine to the umbilical ligament, extending upwards at the medial end, using a monopolar electrocautery hook for precise cutting.
- The preperitoneal space was then dissected, and the hernial sac was carefully separated and repositioned.
- Key landmarks, such as the pubic tubercle and Cooper's ligament, were identified. After fully dissecting the preperitoneal space and the cord structures, a polypropylene mesh measuring 15 × 10 cm was placed in Bogros space, ensuring it covered the hernial openings adequately (**Fig. 3**).



**Fig 3: Proline mesh insertion into Bogros space covering the hernial orifice.**

- The mesh was secured medially to Cooper's ligament and laterally above the inguinal ligament using ProTack TM (Covidien, TM), avoiding sensitive areas known as the triangles of pain and danger.
- Finally, the peritoneum was sutured over the mesh with ProTack TM to complete the procedure.

Patients were sent home the following day with

instructions to take paracetamol (1 gm every six hours for three days) for pain management. Follow-up appointments were scheduled at the outpatient clinic two weeks post-discharge, with additional phone check-ins on the 30th day and after one year. Patients experiencing any complications, including pain, during the follow-up period were asked to return to the clinic for evaluation and ongoing monitoring.

During the surgery, we gathered data on operative duration, blood loss, surgical observations, and the patients' overall condition. In the postoperative phase, we documented pain levels and any complications that arose. Pain was measured using the Visual Analogue Scale (VAS) on the first- and fourteenth-days post-surgery.

A questionnaire was administered to the trainees to gauge their proficiency and level of satisfaction with the procedure.

#### Data management and statistical analysis:

The collected data was revised, coded, tabulated, and introduced to a PC using Statistical package for Social Science (IBM Corp. Released 2017. IBM SPSS Statistics for Windows, Version 25.0. Armonk, NY: IBM Corp). Shapiro wilk's test was used to evaluate normal distribution of quantitative variables, which were expressed as mean and SD or as median (interquartile range) in cases of skewed distributions. Categorical variables were expressed as frequency and percent. Student's t test or Mann Whitney test were used to compare a quantitative variable between two study groups depending on the distribution of data. Categorical variables were compared using the Chi-square or Fisher exact test. A P-value < 0.05 was considered statistically

significant

#### Results

This study involved 200 patients divided into two groups, the cTAPP and the tTAPP, each comprised 100 patients. There was no significant difference between both study groups as regards demographic data. **(Table 1).**

There was no significant difference between both study groups as regards intra-operative and early post-operative characteristics. However, a highly significant difference was found as regards operative time with higher mean time among (cTAPP) **(Table 2).**

There was a highly significant difference between both study groups as regards pain score 24 hours after operation with higher mean time among group 1 cases (cTAPP). However, no significant difference between both study groups as regards hospital stay and pain score at 24 hours, 2 weeks, 30 days and 1 year after operation **(Table 3, Fig. 4).**

To assess the proficiency and learning curve of the trainees, the surgical procedure was segmented into five principal steps to facilitate straightforward evaluation. Subsequently, overall proficiency was scored on a scale from 1 to 5. Notable disparities were observed in the mesh insertion and peritoneal closure stages, with trainees demonstrating greater adeptness in the tTAPP technique. Moreover, there was a markedly significant contrast in performance between the two groups concerning the entry into the preperitoneal space, anatomical identification, sac dissection, and cumulative competence, with the tTAPP group exhibiting superior results **(Table 4, Fig. 5).**

**Table 1: Comparison between the 2 study groups as regards socio-demographic characteristics**

	(cTAPP)	(tTAPP)	P	Sig
<b>Age (Mean ±SD)</b>	36.74 ± 9.52	39.38 ± 10.60	0.065‡	NS
<b>Type of hernia</b>				
Not recurrent	84 (84%)	88 (88%)	0.415*	NS
Recurrent	16 (16%)	12 (12%)		
<b>Side</b>				
Right	70 (70%)	76 (76%)	0.339*	NS
Left	30 (30%)	24 (24%)		

‡Student t test, \*Chi-Square Tests.

**Table 2: Comparison between the 2 study groups as regards intra and early post-operative characteristics**

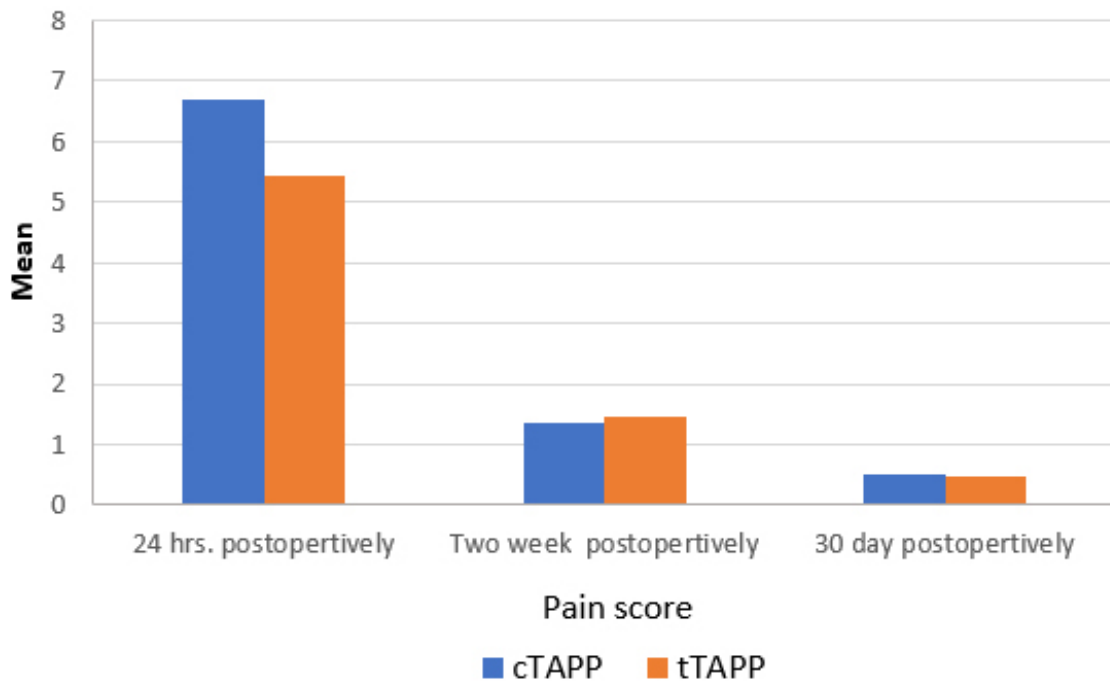
	cTAPP	tTAPP	P value	Sig
Operative time Mean ±SD	82.06 ± 7.08	63.54 ± 8.66	0.001‡	HS
Bleeding	8 (8%)	6 (6%)	0.579*	NS
Peritoneal tear	14 (14%)	6 (6%)	0.059*	NS
Seroma	10 (10%)	8 (8%)	0.621*	NS
Vas deferens injury	4 (4%)	2 (2%)	0.683**	NS
Urinary retention	10 (10%)	4 (4%)	0.096*	NS

‡Student t test, \*Chi-Square Tests, \*\*Fisher exact test.

**Table 3: Comparison between 2 study groups as regard post-operative characteristics**

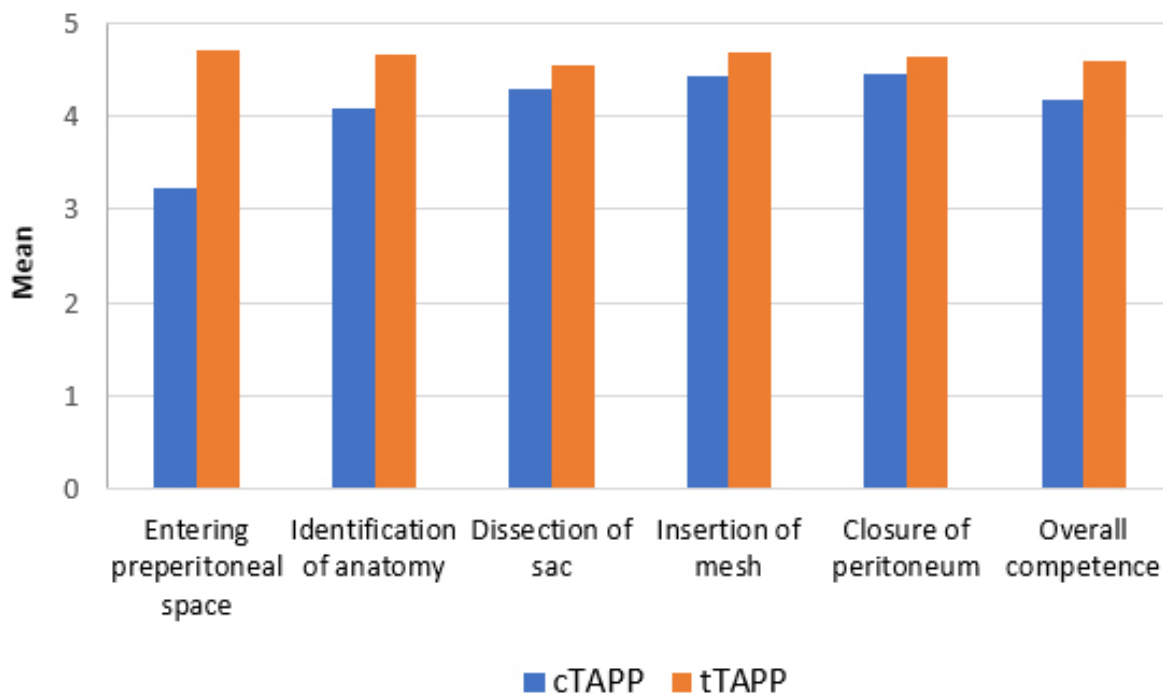
	cTAPP	tTAPP	P value	Sig
Hospital stay	1.50 ±1.09	1.40 ±0.94	0.995‡	NS
Pain at 24 hrs.	6.68 ±1.50	5.42 ±1.73	0.001‡	HS
Pain at two weeks	1.34 ±1.64	1.44 ±1.82	0.975‡	NS
Pain at 30 days	0.50 ±1.26	0.46 ±1.10	0.789‡	NS
Pain one year (Chronic pain)	10 (10%)	4 (4%)	0.09*	NS
Recurrence	4 (4%)	2 (2%)	0.683**	NS

‡Mann-Whitney Test, \*Chi-Square Tests, \*\*Fisher exact test.

**Fig 4: Pain score at 24 hours, 2 weeks, 30 days.****Table 4: Comparison between 2 study groups as regard competency and surgeon satisfaction**

	Group				P value	Sig
	(cTAPP)		(tTAPP)			
	Mean	±SD	Mean	±SD		
Entering preperitoneal space	3.22	0.97	4.72	0.70	0.001*	HS
Identification of anatomy	4.08	0.85	4.66	0.68	0.001*	HS
Dissection of sac	4.30	0.81	4.56	0.78	0.005*	HS
Insertion of mesh	4.43	0.81	4.68	0.55	0.032*	S
Closure of peritoneum	4.46	0.73	4.64	0.69	0.037*	S
Overall competence	4.18	0.90	4.60	0.72	0.001*	HS

\*Mann-Whitney Test.



**Fig 5: Competency and surgeon satisfaction.**

## Discussion

The initial use of tumescent local anaesthesia was for liposuction, where a significant volume of a diluted solution containing lidocaine and epinephrine was administered. The epinephrine present in the tumescent solution acts to constrict blood vessels, which not only minimizes bleeding but also slows down the entry of local anaesthetics into the bloodstream. This action significantly diminishes the potential toxicity and adverse effects that can arise from local anesthetics.<sup>19</sup>

The tumescent solution in TAPP facilitates dissection, reduces bleeding and extends the duration of analgesia during and after the operation, similar to its use in liposuction procedures.<sup>22,23</sup>

In our study we only used a liquid solution as a tumescent. In the study conducted by Tokumura and colleagues, 400 patients undergoing tumescent Transabdominal Preperitoneal (TAPP) hernia repair received an injection of approximately 120 ml of tumescent solution along with 60 ml of CO<sub>2</sub> gas into the preperitoneal space near the inguinal area<sup>24</sup>. They concluded that injecting 120 ml of the tumescent solution into the preperitoneal layer was optimal for achieving effective tumescence without harming the peritoneum or causing side effects commonly associated with local anesthetics.<sup>24</sup>

CO<sub>2</sub> gas injected facilitated dissection more efficiently than with only the tumescent solution without causing any gas embolism or postoperative pulmonary complications.<sup>15</sup>

In Hu et al study, the tumescent solution comprised 0.2mL (0.2 mg) of epinephrine, 30mL (300 mg) of lidocaine hydrochloride, and 170mL of physiological saline solution.<sup>25</sup>

Regarding operative time, despite adding one step to the operation, the results of our study found that cTAPP had a significantly longer mean operative time compared to tTAPP (82.06 minutes vs 63.54 minutes,  $p=0.001$ ). This finding is consistent with previous studies that have found tTAPP to be a faster and less invasive procedure compared to cTAPP.<sup>16,19,24-26</sup>

The results of our study suggest that tTAPP may result in fewer complications, such as peritoneal tears and urinary retention, compared to cTAPP ( $P=0.059$  and  $p=0.096$ , respectively). However, these differences were not statistically significant.

Our study indicated that patients who received the transabdominal preperitoneal (tTAPP) procedure reported considerably lower levels of postoperative pain after 24 hours, with average pain scores of 5.42 compared to 6.68 for the conventional TAPP (cTAPP) method, a difference that was statistically significant ( $p=0.001$ ). However, while there was a tendency for reduced pain at the 2-week and 30-day marks following tTAPP, these differences were not statistically significant, with  $p$ -values of 0.975 and 0.789, respectively. These outcomes are consistent with additional research,<sup>27,28</sup> that supports the conclusion that tTAPP is associated with less postoperative pain than cTAPP.



The recurrence rate in our study was 4% for cTAPP and 2% for tTAPP with no significant difference. The results are consistent with results of other studies.<sup>18,28,29</sup>

Our study found that tTAPP was associated with significantly higher scores for surgeon competence in various aspects of the procedure, such as entering the preperitoneal space, identification of anatomy, dissection of the sac, insertion of mesh, closure of the peritoneum, and overall competence ( $P < 0.05$  for all comparisons). These findings suggest that tTAPP may be a more technically challenging procedure, but also that it may result in improved outcomes compared to cTAPP. The same results were reported by Tokumura et al<sup>24</sup> who stated tTAPP offers technical and clinical improvements to conventional TAPP.

### Conclusion

The application of Tumescence technique in TAPP surgery could potentially reduce the learning curve, abbreviate the duration of the operation, and alleviate postoperative discomfort for patients when contrasted with the traditional TAPP method.

### Limitations and recommendations

The study needs to be done on large scale of patients.

### Financial support and sponsorship

Nil.

### Conflict of Interest

The authors declare that they have no conflicts of interest.

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