



A Comparative study on Postoperative Pain among Laparoscopic Guided Transversus Abdominis Plane (TAP) Block vs Port site Infiltration of Local Anaesthetic in Laparoscopic Cholecystectomy

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KEYWORDS

Laparoscopic Cholecystectomy, Postoperative Pain, Laparoscopic guided Transversus Abdominis Plane Block, Port site Infiltration, Bupivacaine

Background: Postoperative pain management is a critical aspect of recovery following laparoscopic cholecystectomy. Various analgesic techniques, including transversus abdominis plane block (TAPB) and port-site infiltration (PILA), have been utilized to alleviate pain. Objective: To evaluate the role of laparoscopic-guided TAPB in comparison to port-site infiltration with 0.25% bupivacaine in managing postoperative pain in patients undergoing laparoscopic cholecystectomy.

Methods: This was a single centre, hospital based comparative study conducted in the inpatient wards of the Department of General Surgery, JSS Medical College, Mysuru, Karnataka, India for a duration of 18 months (between June 2023 and December 2024) among patients with symptomatic cholelithiasis undergoing elective laparoscopic cholecystectomy.

Results: A total of 120 patients were enrolled, with 60 in each group. Baseline characteristics, including age, gender, duration of pain, and body mass index, were comparable between the two groups. The mean duration of surgery did not differ significantly between the groups (TAPB: 52.9 minutes, PILA: 55.1 minutes; $p = 0.181$). However, the TAPB group had a significantly shorter hospital stay (1.5 days vs 2.0 days, $p < 0.001$) and a lower need for rescue analgesia. At 48 hours postoperatively, 53.3% of TAPB patients required two doses of analgesia, compared to 45.0% of PILA patients, and none in the TAPB group required three doses, unlike 38.3% in the PILA group. Pain scores, assessed using the Visual Analog Scale (VAS), were significantly lower in the TAPB group at all postoperative time points. On the day of surgery, pain scores were comparable between the groups, but by 3 hours postoperatively, the TAPB group reported significantly lower pain ($p < 0.001$). These differences persisted at 6, 12, 24, and 48 hours.

Conclusion: The TAPB group experienced superior pain control, reduced analgesic requirements, and a quicker recovery, suggesting that laparoscopic-guided TAPB is a more effective option for postoperative pain management in laparoscopic cholecystectomy.

Introduction

Laparoscopic cholecystectomy is one of the most commonly performed surgeries, indicated for conditions such as acute and chronic cholecystitis, cholelithiasis, choledocholithiasis, gallbladder calcification, biliary colic, biliary pancreatitis, and carcinoma of the gallbladder.(1) It offers benefits

such as fast recovery, short hospital stays, early return to work, and minimal scarring. However, postoperative pain management following laparoscopic cholecystectomy remains a significant concern for both surgeons and anaesthesiologists.(2) Pain relief after this procedure is crucial, as pain may have multiple origins: incisional, local visceral,



peritoneal, and referred.(3) Postoperative pain typically arises within hours, often localized to the port sites or the right shoulder, although it can also present as generalized abdominal pain.(4) The pain is multifactorial, with somatic pain associated with the port sites and visceral pain, typically in the right shoulder or abdominal region, due to stretching from the pneumoperitoneum.(5) Furthermore, residual gas retained in the peritoneal cavity after the procedure can contribute to postoperative pain, potentially delaying recovery, extending hospitalization, and disrupting daily activities.(6) Analgesics such as opioids and diclofenac sodium are commonly used, but they carry their own adverse effects.(7)

Several methods have been employed to provide effective and safe analgesia, including nonsteroidal anti-inflammatory drugs (NSAIDs), cyclooxygenase-2 (COX-2) inhibitors, gabapentinoids, local anaesthetics, and transversus abdominis plane (TAP) blocks,(7, 8) each with its own advantages and disadvantages. Among these, port-site infiltration with long-acting local anaesthetics and TAP blocks are the most commonly used.(9) Infiltration with a local anaesthetic, such as 0.25% bupivacaine, is a standard approach to reduce postoperative pain in patients undergoing laparoscopic cholecystectomy. A meta-analysis published in 2014 demonstrated that local anaesthetic wound infiltration reduces pain within the first 24 hours without increasing the incidence of serious adverse events.(10) However, it was found that while 0.25% bupivacaine infiltration provided better short-term postoperative analgesia, it was less effective over a longer duration in terms of patient satisfaction, early discharge, return to work, and quality of life.(11)

Nerve blocks, including ultrasound-guided TAP blocks, have been incorporated into multimodal analgesia regimens to reduce analgesic consumption and provide better pain relief, facilitating enhanced recovery after laparoscopic cholecystectomy.(12) Ultrasound guidance allows direct visualization of the spread of local anaesthetics, improving success rates. However, ultrasound may not be available in all hospitals, particularly in developing countries, and not all anaesthesiologists or surgeons are trained

to use it.(13, 14) In such cases, laparoscopic guidance can serve as an alternative for performing a TAP block when ultrasound is unavailable or technical expertise is lacking. Against this background, the present study compares laparoscopic TAP block with port-site infiltration of 0.25% bupivacaine in patients undergoing laparoscopic cholecystectomy, assessing not only postoperative pain but also length of hospital stay, time to resume routine activities, and need for additional analgesia.

Materials and Methods

This was a single centre, hospital based comparative study conducted in the inpatient wards of the Department of General Surgery, JSS Medical College, Mysuru, Karnataka, India for a duration of 18 months (between June 2023 and December 2024). The study was approved by the Institutional Human Ethics Committee (IHEC) with reference number JSS/MC/PG/2046/116/2023-24 dated 23/06/2023. The participants (and their attenders) were given the Participant Information Sheet (PIS) in their native language, and its contents were verbally explained to ensure their understanding and satisfaction. Enrolment into the study proceeded upon receipt of written informed consent. The study had enrolled adults aged 18–65 years of either sex who presented with symptomatic cholelithiasis, were scheduled for elective laparoscopic cholecystectomy, and had been classified preoperatively as ASA physical-status I or II, provided they gave written informed consent. However, patients with significant comorbidities such as coagulopathy, liver or renal failure, those with choledocholithiasis, procedures lasting longer than two hours, cases converted to open cholecystectomy, operations requiring extension of the extraction incision, and patients classified as ASA III–V were excluded.

Sample-size calculations, based on a significance level of 0.05 ($Z\alpha = 1.96$), 80% power ($Z\beta = 0.84$), an assumed population standard deviation of 1.53, and a clinically meaningful effect size of 0.56, yielded a requirement of 120 participants. Simple random sampling was then employed. A thorough history was taken, focusing on the duration of pain, its



periodicity, any aggravating or relieving factors, and any previous history of similar complaints. Clinical examinations were conducted, and all necessary investigations, along with a proper pre-anaesthetic evaluation, were completed. Informed written consent was then obtained from the selected patients to undergo laparoscopic cholecystectomy. Each patient was assigned a unique numerical identifier (e.g., 1, 2, 3, 4, etc.), and all odd-numbered patients were assigned to receive a laparoscopic-guided TAP block intraoperatively, while even-numbered patients received port-site infiltration of a local anaesthetic (0.25% bupivacaine). Patients receiving the laparoscopic-guided TAP block were administered 0.25% bupivacaine using a 23-gauge needle, instilled at four points: 10 mL was injected bilaterally at the subcostal area between the anterior axillary line and midclavicular line, and 15 mL was injected bilaterally just above the iliac crest in the midaxillary line. The needle placement and the spread of the local anaesthetic were confirmed through direct visualization with the laparoscope, ensuring proper drug instillation in the plane containing the thin fibers of the transversus abdominis muscle.

In patients receiving port-site infiltration, 20 mL of 0.25% bupivacaine was administered, divided into 6 mL for the umbilical and epigastric ports and 4 mL for the right midclavicular line and anterior axillary line ports. This infiltration occurred in the subcutaneous plane before the closure of the incisions. Following the procedure, all patients were administered 100 mg of tramadol injection in the immediate postoperative period, in accordance with the standard protocol. Pain intensity was recorded at intervals of 3, 6, 12, 24, and 48 hours postoperatively using a VAS. Patients were also followed up to assess the duration of their hospital stay, the time taken to return to routine activities, and the need for additional analgesia.

Statistical analysis: The collected data was manually entered into Microsoft Excel and analyzed using Stata v16. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as mean (standard deviation) or median (interquartile range), depending on the normality of the data assessed

using the Kolmogorov–Smirnov and Shapiro–Wilk tests. Statistical significance was determined using the Chi-square test or Fisher's exact test for categorical variables and the independent t-test or Mann-Whitney U test for continuous variables. A p-value of less than 0.05 was considered statistically significant.

Results

The study included two groups of 60 patients each: one receiving a laparoscopic-guided TAP block and the other undergoing port-site infiltration with 0.25% bupivacaine. The mean age was nearly identical (46.9 ± 15.7 years for TAPB vs. 47.2 ± 13.2 years for PILA; $p = 0.905$), and females formed the majority in both groups (63.3% vs. 58.3%; $p = 0.575$). The duration of biliary pain (2.6 ± 1.1 vs. 2.8 ± 1.1 years; $p = 0.262$), interval since the last cholecystitis episode (4.7 ± 2.1 vs. 5.1 ± 1.9 months; $p = 0.281$), body mass index (26.1 kg/m^2 in both groups; $p = 0.998$), and operative time (52.9 ± 9.5 vs. 55.1 ± 9.9 minutes; $p = 0.181$) were also similar, ensuring that both cohorts were demographically and clinically equivalent before the interventions.

Among the 120 patients studied (60 per group), those who received a laparoscopic TAPB had a markedly shorter mean hospital stay than the port-site infiltration with local anaesthetic cohort (1.5 ± 0.5 days vs 2.0 ± 0.8 days; $p < 0.001$). Analgesic requirements also differed significantly: nearly half of the TAPB group needed only a single rescue dose of analgesia (46.7% vs 16.7%), whereas over a third of PILA patients required three doses (0% vs 38.3%; $p < 0.001$). Immediate postoperative pain scores were comparable (VAS 6.7 ± 1.1 vs 6.4 ± 1.2 ; $p = 0.171$), but TAPB consistently yielded lower pain intensities thereafter—at 3 h (5.7 ± 1.0 vs 6.6 ± 1.1), 6 h (4.6 ± 1.0 vs 5.7 ± 1.0), 12 h (4.1 ± 1.5 vs 5.2 ± 1.4), 24 h (2.5 ± 1.0 vs 4.0 ± 0.8) and 48 h (1.5 ± 0.5 vs 2.8 ± 0.8), with all differences beyond the immediate period reaching statistical significance ($p < 0.001$).

Discussion

The present study aimed to compare the efficacy of laparoscopic-guided transversus abdominis plane block with port-site infiltration of 0.25%



bupivacaine in managing postoperative pain in patients undergoing laparoscopic cholecystectomy. This study involved 120 patients, with 60 in each group, and was designed to evaluate baseline characteristics, including age, gender, duration of pain, and BMI. The demographic analysis revealed that the mean age of participants in both groups was 46.9 years (SD = 15.7) in the TAPB group and 47.2 years (SD = 13.2) in the PILA group, with no significant difference between groups. This indicates a balanced distribution of age across the study groups, suggesting that any differences in postoperative pain outcomes are unlikely to be confounded by age. Age is a key factor influencing pain perception and recovery;(15) however, studies have shown that the effect of age on postoperative pain management tends to vary depending on the individual and the method of pain control.(16, 17) Additionally, the distribution of patients within age categories did not show significant differences between the two groups, supporting the assumption that age was not a confounding factor.

In terms of gender distribution, the TAPB group consisted of 36.7% males and 63.3% females, whereas the PILA group had 41.7% males and 58.3% females, with no significant difference. This indicates that the gender composition was comparable across both groups. Gender differences in pain sensitivity are well documented, with females typically reporting higher pain scores and requiring more analgesia postoperatively.(18, 19) However, the lack of significant differences in gender between the groups in this study suggests that gender did not contribute to any disparities in pain outcomes. Regarding the duration of pain and the time since the last attack of cholecystitis, the study found no significant differences between the groups. The mean duration of pain was 2.6 years (SD = 1.1) in the TAPB group and 2.8 years (SD = 1.1) in the PILA group ($p = 0.262$), and the mean duration since the last attack of cholecystitis was 4.7 months (SD = 2.1) in the TAPB group and 5.1 months (SD = 1.9) in the PILA group ($p = 0.281$). This indicates that the baseline clinical characteristics were similar between the groups, which is important for ensuring that differences in pain outcomes can be attributed to the treatment technique rather than pre-existing

clinical conditions. The duration of pain is an important factor influencing the postoperative pain experience. Patients with chronic pain may require more intensive analgesia due to heightened central sensitization.(20, 21) However, since there were no significant differences in pain duration between the two groups, this factor is unlikely to have influenced the study's primary outcome.

Both groups had a mean BMI of 26.1 kg/m², with standard deviations of 4.2 in the TAPB group and 4.0 in the PILA group, with no statistically significant difference. BMI is a known risk factor for complications following surgery, including prolonged pain and delayed recovery.(22) However, the absence of a significant difference in BMI between the groups suggests that body weight did not affect the pain outcomes in this study. The comparison of surgical duration between the two groups revealed no statistically significant difference, with the TAPB group having a mean surgical time of 52.9 minutes (SD = 9.5) and the PILA group having a mean time of 55.1 minutes (SD = 9.9). This indicates that the time required to perform the surgery was similar for both groups, suggesting that the TAPB technique did not add substantial time to the surgical procedure. This finding is consistent with other studies that have shown that the application of TAP blocks does not significantly extend the operative time.(23, 24) Nair et al.(23) noted that the mean duration of surgery in the TAP block group was 88.9 minutes, while that of the non-TAP group was 93.6 minutes. The absence of any significant difference in surgery duration implies that the TAPB intervention is feasible without causing delays in surgical workflow.

One of the key findings in this study was that the TAPB group had a significantly shorter hospital stay compared to the PILA group. The TAPB group had a mean stay of 1.5 days (SD = 0.5), whereas the PILA group had a mean stay of 2.0 days (SD = 0.8), with a highly significant difference ($p < 0.001$). This result aligns with previous studies that have highlighted the role of effective postoperative pain management in reducing hospital length of stay.(22) Shorter hospital stays are not only beneficial in terms of cost-effectiveness but also indicate more rapid recovery and fewer complications related to



prolonged hospitalization.(25, 26) The shorter stay in the TAPB group could be attributed to more effective pain control, which may have facilitated earlier mobilization and reduced the need for prolonged observation.

The study also assessed the need for rescue analgesia, with the TAPB group showing a lower requirement for additional pain relief compared to the PILA group. In the TAPB group, 46.7% of patients required only one dose of rescue analgesia, while in the PILA group, only 16.7% required just one dose. More strikingly, 38.3% of the PILA group required three doses of rescue analgesia, compared to no patients in the TAPB group. This disparity in the need for rescue analgesia strongly suggests that the TAPB technique provided more effective pain control than PILA. The reduced need for additional analgesia in the TAPB group aligns with the results of other studies demonstrating that TAP blocks reduce postoperative opioid consumption and enhance patient satisfaction by improving pain management.(27, 28) The significant difference in analgesic requirements between the two groups underscores the potential of TAPB as a more effective analgesic strategy following laparoscopic cholecystectomy.

The study also compared postoperative pain scores using the Visual Analog Scale (VAS) at multiple time points. On the day of surgery, there was no significant difference in pain scores between the TAPB and PILA groups, with VAS scores of 6.7 (SD = 1.1) and 6.4 (SD = 1.2), respectively ($p = 0.171$). However, significant differences emerged at subsequent time points. At 3 hours postoperatively, the TAPB group reported lower pain scores (5.7, SD = 1.0) compared to the PILA group (6.6, SD = 1.1), with a highly significant difference ($p < 0.001$). This trend continued throughout the postoperative period, with TAPB patients consistently reporting significantly lower pain scores at 6, 12, 24, and 48 hours postoperatively. These findings suggest that TAPB provides superior analgesia in the early postoperative period, which is crucial for improving patient comfort, facilitating recovery, and reducing the need for additional analgesic interventions. The observed pattern of lower pain scores in the TAPB group is consistent with findings from other studies

on the efficacy of TAP blocks in laparoscopic procedures. For example, Vindal et al. (2021) reported that TAP blocks provided more effective postoperative pain relief compared to placebo or conventional analgesia.(29) Similarly, Ravichandran et al. (2017) demonstrated that TAP blocks reduced opioid consumption and significantly improved pain scores following abdominal surgeries, including laparoscopic cholecystectomy.(30)

One of the limitations of this study is that it did not assess opioid consumption, which would have provided a more comprehensive understanding of the analgesic effectiveness of the two techniques. Without this data, it is difficult to fully evaluate the impact of TAPB and PILA on opioid use and potential opioid-sparing effects. Additionally, the study focused only on short-term postoperative outcomes, and the long-term effects of both techniques, including their impact on chronic pain or complications, were not explored. A longer follow-up period could offer more insights into the sustainability of the benefits observed. Another limitation is the relatively small sample size, as the study included only 120 patients, which may limit the generalizability of the findings. A larger sample size would provide more robust data, particularly regarding subgroup analyses based on factors such as age, gender, or comorbidities.

Conclusion

In conclusion, this study demonstrated that laparoscopic-guided transversus abdominis plane block (TAPB) is more effective than port-site infiltration (PILA) in managing postoperative pain following laparoscopic cholecystectomy. Patients in the TAPB group experienced significantly lower pain scores at multiple postoperative time points, required fewer doses of rescue analgesia, and had a shorter duration of hospital stay compared to those in the PILA group. These findings suggest that TAPB provides superior analgesia and may contribute to faster recovery and reduced reliance on additional pain medications.



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Table 1: Baseline characteristics of the study groups

		Laparoscopic TAPB	PILA	P value
		N = 60	N = 60	
		n (%)	n (%)	
Age (in years), Mean (SD)		46.9 (15.7)	47.2 (13.2)	0.905
Age (in years)	≤30	9 (15.0)	8 (13.3)	0.380
	31 to 40	16 (26.7)	14 (23.3)	
	41 to 50	10 (16.7)	15 (25.0)	
	51 to 60	8 (13.3)	13 (21.7)	
	>60	17 (28.3)	10 (16.7)	
Gender	Male	22 (36.7)	25 (41.7)	0.575
	Female	38 (63.3)	35 (58.3)	
Duration of pain (in years), Mean (SD)		2.6 (1.1)	2.8 (1.1)	0.262
Duration from the last attack of cholecystitis (in months), Mean (SD)		4.7 (2.1)	5.1 (1.9)	0.281
Body mass index (in kg/m ²), Mean (SD)		26.1 (4.2)	26.1 (4.0)	0.998
Duration of surgery (in minutes), Mean (SD)		52.9 (9.5)	55.1 (9.9)	0.181

*Statistically significant at p<0.05



TAPB, Transversus abdominis plane block; PILA, Port site infiltration of local anaesthetic; SD, Standard deviation

Table 2: Comparison of study groups, by duration of hospital stay and need for rescue analgesia

		Laparoscopic TAPB	PILA	P value
		N = 60	N = 60	
		n (%)	n (%)	
Duration of hospital stay (in days), Mean (SD)		1.5 (0.5)	2.0 (0.8)	<0.001*
Rescue analgesia	One dose	28 (46.7)	10 (16.7)	<0.001*
	Two doses	32 (53.3)	27 (45.0)	
	Three doses	0 (0.0)	23 (38.3)	
Pain scores (VAS)	Postoperative	6.7 (1.1)	6.4 (1.2)	0.171
	3 hours	5.7 (1.0)	6.6 (1.1)	<0.001*
	6 hours	4.6 (1.0)	5.7 (1.0)	<0.001*
	12 hours	4.1 (1.5)	5.2 (1.4)	<0.001*
	24 hours	2.5 (1.0)	4.0 (0.8)	<0.001*
	48 hours	1.5 (0.5)	2.8 (0.8)	<0.001*

*Statistically significant at p<0.05

TAPB, Transversus abdominis plane block; PILA, Port site infiltration of local anaesthetic; SD, Standard deviation

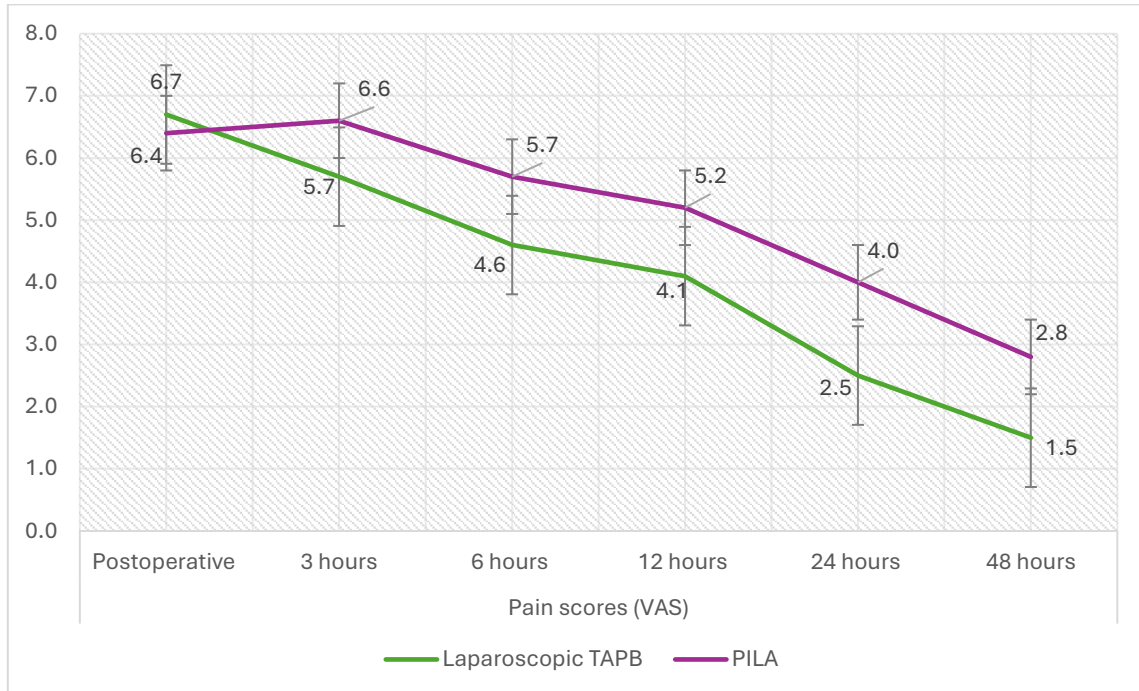


Figure 1: Comparison of study groups, by pain scores (assessed using VAS)

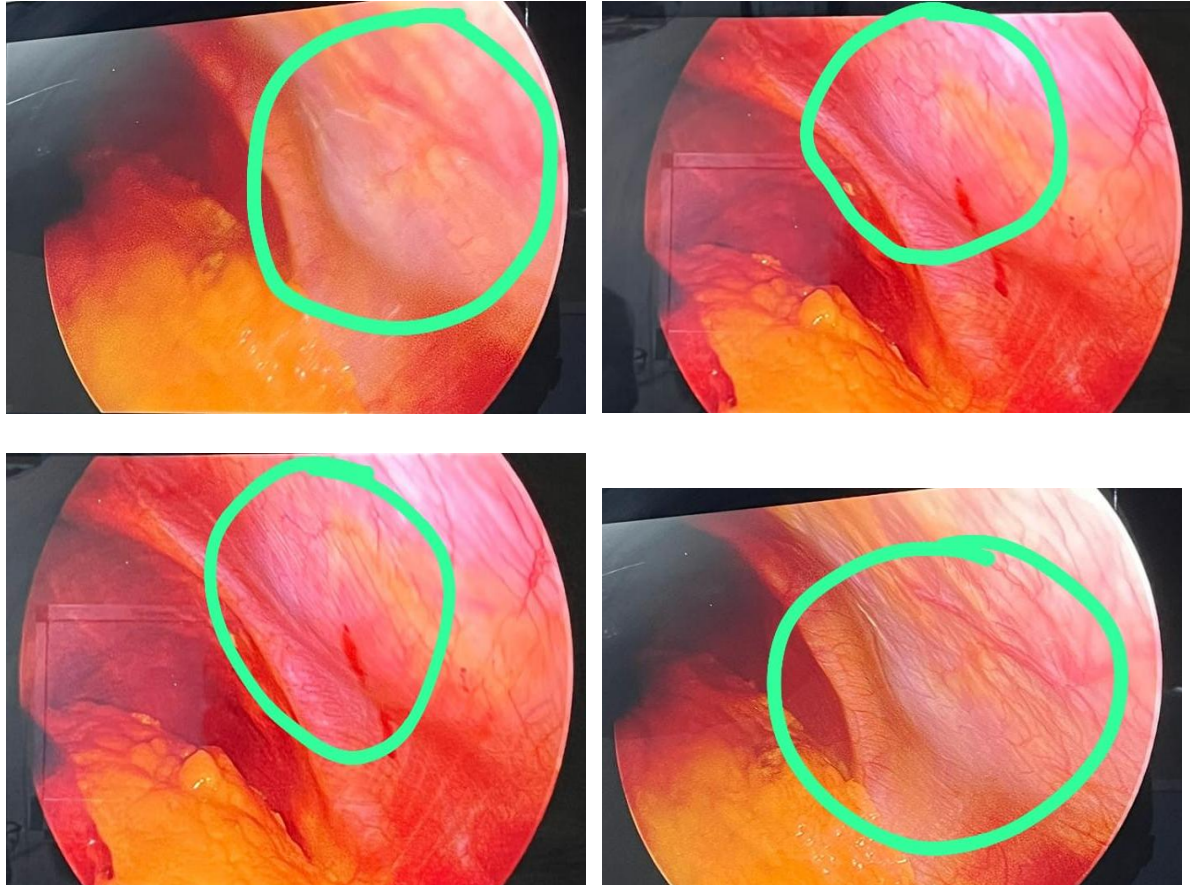


Figure 2: Intraoperative images showing TAP blocks provided – highlighted areas indicate the bulge from administration of local anaesthetics in the correct plane