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# Comparison of three locoregional anesthesia techniques for the postoperative pain management after pneumothorax surgery: erector spinae plane block, serratus anterior plane block and intrathecal morphine injection

Dany Hamidi

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Université de Nice Sophia-Antipolis  
Faculté de médecine de Nice  
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## **THESE D'EXERCICE DE MÉDECINE**

En vue de l'obtention du  
**Diplôme d'État de Docteur en Médecine**

Présentée par Dany HAMIDI  
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# **Comparison of three locoregional anesthesia techniques for the postoperative pain management after pneumothorax surgery: erector spinae plane block, serratus anterior plane block and intrathecal morphine injection**

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# SUMMARY

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# LIST OF ABBREVIATIONS

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*By alphabetical order*

<b>ERAS</b>	Enhanced recovery after surgery
<b>ESPB</b>	Erector spinae plane block
<b>ITM</b>	Intrathecal morphine
<b>PACU</b>	Post anesthesia care unit
<b>PONV</b>	Postoperative nausea and vomiting
<b>SAP</b>	Serratus anterior plane block
<b>VAS</b>	Visual analogue scale
<b>VATS</b>	Video assisted thoracoscopic surgery

# INTRODUCTION

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Video-assisted thoracoscopic surgery (VATS) pleurodesis is the most common technique for patients with primary or secondary spontaneous pneumothorax with an indication for a definitive procedure. Although it is becoming a minimally invasive procedure, moderate to intense acute post-operative pain due to VATS remains a concern. This is notable during the first post-operative 72h and especially during the first 24h (1). Moreover, the incidence of chronic pain following VATS for spontaneous pneumothorax can reach up to 37% of patients(2).

Pain management after VATS requires the use of loco-regional anesthesia in order to control acute post-operative pain and improve enhanced recovery after surgery (ERAS) protocols (3). While many studies evaluated different loco-regional techniques for VATS, such reports were mainly focused on surgeries performed for pulmonary resections. Therefore, there is not much data concerning VATS for pneumothorax and its pain management. Given that this procedure presents very distinct medico-surgical features, the applicability of certain techniques shown to be effective in previous studies is restricted. Indeed, the population concerned is mostly younger and the surgery targets primarily the parietal pleura which is the only portion of the pleura that can sense pain (4). Regarding the use of thoracic epidural analgesia, the potential risks and complications it presents outweigh its advantages in this situation. Even though epidural catheter placement is the gold standard in major surgery (5) including thoracic surgery, it probably provides no additional benefit in minimal invasive procedures such as VATS (6). Moreover, paravertebral block is considered less effective because of the loss of the parietal lining of the pleura during pleurectomy (7).

In the absence of guidelines and randomized controlled studies focusing on surgery for spontaneous pneumothorax, many loco-regional anesthesia techniques are performed in this situation. For instance, intrathecal morphine (ITM) injection has proven to be efficient in major surgery (8). Additionally, new ultrasound guided interfascial plane blocks such as the erector spinae plane block (ESPB) and the serratus anterior plane (SAP) block appear to be effective depending on the context. Both of these techniques showed promising results in thoracic surgery (9)(10)(11)(12) (13)(14) and thus may be of interest in spontaneous pneumothorax surgery (15). Short of high evidence studies comparing both blocks in thoracic surgery, no guidelines can be made concerning loco-regional anesthesia in pneumothorax surgery.

In order to propose optimal postoperative pain management for patients undergoing VATS for spontaneous pneumothorax, we aimed to compare the efficacy and side-effects of the erector-

spinae plane block, the serratus plane block and intrathecal morphine in a cohort of patients selected in our facility.

# MATERIALS AND METHODS

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## **Patient recruitment**

We designed a prospective observational cohort study in the Thoracic Surgery Department at the PASTEUR 1 University Hospital of Nice, France. Inclusion criteria consisted of all patients over 16 years of age, undergoing VATS for spontaneous pneumothorax between March 2020 and June 2021. Exclusion criteria were: secondary pneumothorax, contra-indications to loco-regional techniques and secondary conversion of VATS to thoracotomy.

## **Peroperative management**

Anesthesia and analgesia management was standardized for all patients undergoing VATS for pneumothorax, except for the choice of the loco-regional technique. Anesthesia induction was performed using propofol and remifentanyl targeted concentration infusion between 3 and 6 µg/ml and was adapted using a Bispectral index monitor to reach a target value ranging between 30 and 60 during surgery. All patients received a 0,5 mg/kg dose of atracurium for muscle relaxation except for patients needing a rapid sequence intubation, in which case celcurine or rocuronium was used according to contra-indications. Co-analgesic IV drugs were used as described in opioid free anesthesia protocols, thus patients also received lidocaine 1 mg/kg and ketamine 0,5 mg/kg. Intraoperative clonidine was also used 1-2 µg/kg, in absence of hypotension, unstable coronaropathy and β-blocker therapy. All patients systematically received dexamethasone 8 mg as a co-analgesic and also to reduce postoperative nausea and vomiting (PONV). Intravenous multimodal analgesia was routinely administered before incision and included paracetamol 1 g, Nefopam 20 mg and Ketoprofen (50 -100 mg) if no contraindications were found. Tramadol administration was left to the discretion of the anesthesiologist in charge. All patients were intubated with a Carlens type double lumen selective tube and surgery was performed in lateral decubitus position. Patients were extubated at the end of the procedure and were monitored immediately in post-intervention surveillance room until a modified Aldret score > 9 was achieved, thereby allowing a discharge in the thoracic surgery ward.

After patient installation and before surgical incision, each physician performed loco-regional anesthesia with a choice between erector spinae plane block, serratus anterior plane block and intrathecal morphine injection. The ESPB was performed with ultrasound guidance according to

*Forrero et al.* (16) using a 50 mm needle (Stimuquick-TELEFLEX) with a single shot injection of 30 ml ropivacaine 3,75 mg/ml regarding the T5 spinous process. The serratus anterior plane block was performed under ultrasound guidance using a 50 mm needle (Stimuquick-TELEFLEX) as described by *Blanco et al.*(17) with a single shot injection of 30 ml of ropivacaine 3.75 mg/ml. The intrathecal morphine injection was executed with a pencil-point 25Ga needle at a lumbar level (L3-L4 or L4-L5), and with an injection of morphine 200 µg and sufentanil 10 µg.

VATS for pneumothorax is a standardized procedure in our establishment and was performed systematically using a three-portal incision technique. Trocar insertions were done with a first incision behind the scapula inferior angle in the sixth intercostal space. The last two ports were placed under vision control with two incisions on the axillary anterior line, in the sixth intercostal space and the ninth intercostal space. Pleurodesis technique was at the discretion of the surgeon and included pleurectomy, pleural abrasion, chemical pleurodesis with talc, or a combination of the above. Potential blebs or bullae were resected at the same time using a stapling technique. At the end of the procedure, one or two 24F chest tubes were introduced through the surgical incisions under vision control.

A post-operative pain management protocol was established for the first 72h with oral multimodal analgesia comprising systematic paracetamol and nefopam, as well as ketoprofen for the first 24h. Tramadol was administered as a first rescue therapy when pain visual analogue scale (VAS) value was > 3/10 and Oxynorm came as a last resort if VAS was > 5/10 despite other oral analgesics.

## **Data Collection**

Concerning data collection, we recorded for each patient demographics, medical history, smoking status, drug consumption, presence of chronic pain and medications that can interfere with hemostasis. Regarding surgical data, the side of the pneumothorax, the presence of a chest tube before surgery, the number of chest tube after surgery, the surgical technique chosen, and the duration of the procedure were also noted. Total doses of propofol and remifentanil along with all co-analgesic and multimodal analgesic agents were documented. Pain was evaluated before anesthesia induction, in the post-anesthesia care unit (PACU) and 4 times a day during the first 72h after surgery. We used a pain intensity score ranging from 0-10 on a visual analogue scale and recorded data at rest and on coughing for each value. Total oral morphine consumption and the time for the first request of oral morphine was collected. Cumulative dose of analgesics such as tramadol and ketoprofen was noted. Moreover, adverse effects were also recorded and included hypotension, the need for vasopressors during the procedure, post-operative occurrence of nausea, vomiting,



urinary retention and oxygen requirements. Finally, the duration of chest drainage and total hospital length of stay starting from the day of the surgical procedure until discharge were logged.

### **Primary outcome and secondary endpoints**

The primary outcome was the cumulative dose of morphine (mg) during the first postoperative 72h. Secondary endpoints were morphine requirements in the PACU and during the first postoperative 24h, VAS postoperative pain score at rest and on coughing, time for the first request of oral morphine, incidence of side effects such as postoperative nausea and vomiting, oxygen requirements, length of chest drainage and length of stay.

### **Statistical Analysis**

Shapiro Wilk test was used to test for normal distribution of variable. Continuous variable were summarized as mean +/- SD or median [interquartile range] as appropriate, and categorical variables were summarized as counts and percentages. Comparisons between variables were tested with Kruskal-Wallis test for non-normal variables and Fisher or Chi-2 test for normal variables. Survival curves with 95 % confidence interval for the first morphine request during the first 24 postoperative hours were computed using the Kaplan-Meier method. Log rank test was subsequently applied to compare these curves for each loco-regional anesthesia technique. Univariate logistic regression was performed to compare morphine requirement in the first 24 hours for each type of locoregional anesthesia employed.

All tests were two-tailed and used a P-value threshold of 0.05 to determine statistical significance. All analyses were performed using RStudio software [RStudio Team (2020). RStudio: Integrated Development for R. RStudio, PBC, Boston.

## RESULTS

From March 2020 to June 2021, 46 patients met the inclusion criteria and underwent VATS for spontaneous pneumothorax. Twenty-two (48%) patients had an erector spinae plane block, eleven (24%) had a serratus plane block and thirteen (28%) had an intrathecal morphine injection. The patient's demographic data and the surgical procedure characteristics are reported in Table 1 and 2. Population was essentially male, and the median age was 29,5 [22,5; 41,5] years. The most common surgical procedure performed was pleurectomy (76%) and the median operative time was 47,5 min [35.0; 55.0]. No difference was found between the three groups with respect to demographic, preoperative, or surgical data. No failures or complications were reported whilst performing locoregional anesthesia during the study period.

**Table 1. Demographic and preoperative data of study population \***

	ESPB (n = 22)	Intrathecal morphine (n = 13)	Serratus (n = 11)	p
<b>Age, year</b>	33.0 [26.2; 52.5]	27.0 [23.0; 36.0]	28.0 [21.0; 40.0]	0.41
<b>Sex ratio (M/F)</b>	13/9	11/2	7/4	0.3
<b>ASA class</b>	1.00 [1.00; 2.00]	1.00 [1.00; 2.00]	2.00 [1.00; 2.00]	0.27
<b>BMI, kg/m<sup>2</sup></b>	20.5 [17.7; 24.4]	19.0 [18.3; 22.3]	17.7 [17.0; 19.8]	0.14
<b>Toxic Consumption</b>	16 (73%)	9 (69%)	7 (64%)	0.92
<b>Chronic Pain</b>	2 (9.1%)	2 (15%)	0 (0%)	0.56
<b>Chronic Morphine Consumption</b>	0 (0%)	0 (0%)	1 (9.1%)	0.24
<b>Preoperative pain VAS scores</b>				
At rest	1.50 [0; 2.75]	0 [0; 1.00]	1.00 [0; 3.00]	0.33
On coughing	3.00 [0; 4.00]	1.00 [0; 3.00]	1.00 [0; 3.50]	0.8

\*Data are presented as n(percentage) or median [IQR 25<sup>th</sup> - 75<sup>th</sup> percentile]

**Table 2. Surgical data of study population\***

	ESPB (n = 22)	Intrathecal morphine (n = 13)	Serratus (n = 11)	p
<b>Pleurectomy, n (%)</b>	18 (82%)	9 (69%)	8 (73%)	0.67
<b>Bullae resection, n (%)</b>	10 (45%)	7 (54%)	5 (45%)	0.88
<b>Chemical pleurodesis, n (%)</b>	6 (27%)	5 (38%)	5 (45%)	0.57
<b>Adhesiolysis, n (%)</b>	3 (14%)	1 (7.7%)	1 (9.1%)	1
<b>Surgery Duration, min</b>	45.0 [31.2; 56.5]	50.0 [35.0; 55.0]	45.0 [35.0; 50.0]	0.82
<b>Number of Chest Tubes, n (%)</b>				
1	19 (86%)	11 (85%)	10 (91%)	1
2	3 (14%)	2 (15%)	1 (9.1%)	1

\*Data are presented as n(percentage) or median [IQR 25<sup>th</sup> -75<sup>th</sup> percentile]

The perioperative opioid consumption according to locoregional anesthesia technique is reported in Table 3. Regarding our primary outcome, the total morphine consumption during the first 72h was 22.5 mg [5.00; 42.5] in the erector spinae plane block group, 5.00 mg [0; 15.0] in the intrathecal morphine group, and 15 mg [7.50; 22.5] in the serratus group with no significant difference (p 0,39). No significant difference was observed concerning the median intra-operative dose of remifentanyl between the ESPB group (356 µg [214;625]), the intrathecal morphine group (559 µg [449;645]) and the serratus group (489 µg [329;664]) (p 0,33). There was no substantial variation in the PACU morphine consumption. However, the number of patients requiring morphine during the first postoperative 24h was statistically different according to the type of locoregional anesthesia employed: 14 patients in the ESPB group (64%), one patient in the intrathecal morphine group (7,7%) and nine patients in the serratus plane block group (82%) (p < 0,001). Univariate logistic regression analysis showed that intrathecal morphine is associated with less morphine requirements during the first postoperative day (odds ratio 0,09; 95% CI 0,01–0,40; p = 0,005), but this finding was not consistent across both interfascial plane block groups (Table 4). Kaplan-Meier survival curve analysis for the first oral morphine administration revealed that patients in the ITM group required morphine significantly later than in the two other groups (fig 1; p = 0,016) during the first postoperative 24 hours.

**Table 3. Perioperative morphine consumption**

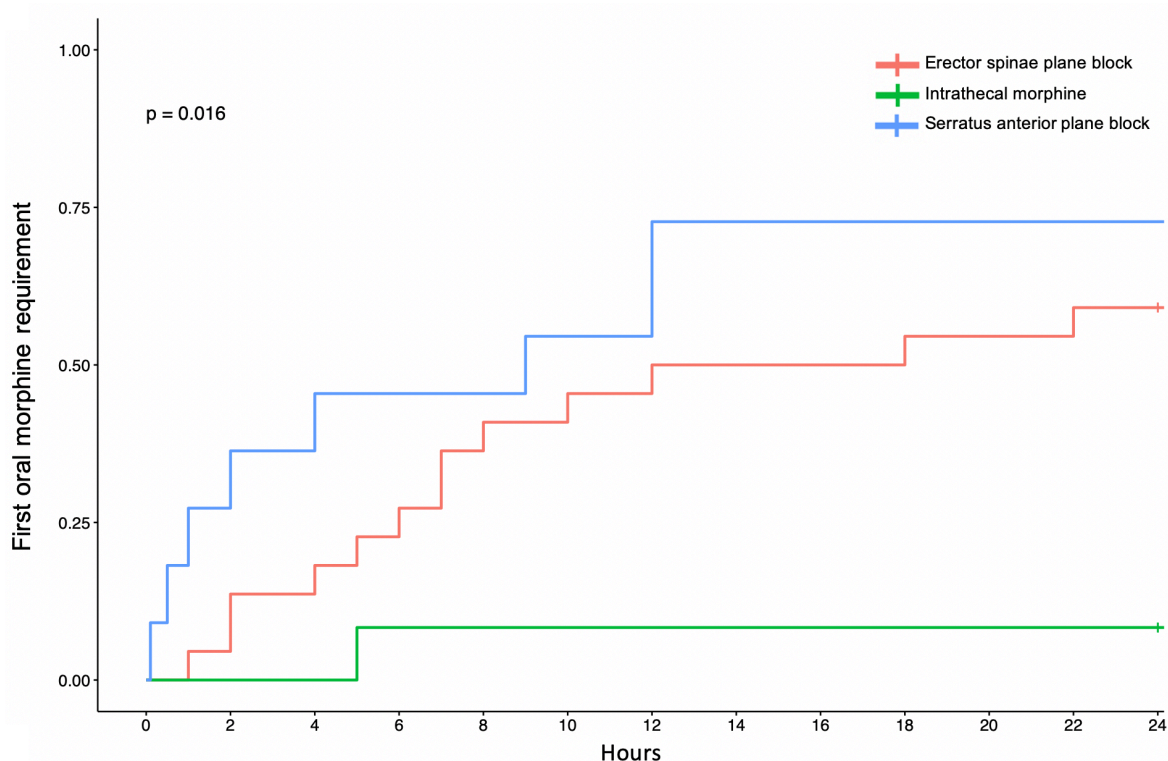
	ESPB (n = 22)	Intrathecal morphine (n = 13)	Serratus (n = 11)	p
Peroperative total Remifentanyl consumption, µg	356 [214; 625]	559 [449; 645]	489 [329; 664]	0.33
PACU morphine consumption, mg	0 [0; 5.00]	0 [0; 0]	0 [0; 7.50]	0.48
Total oral tramadol requirements during first 72h, mg	300 [25.0; 388]	100 [0; 250]	100 [100; 200]	0.26
Total oral morphine requirements during first 72h, mg	22.5 [5.00; 42.5]	5.00 [0; 15.0]	15.0 [7.50; 22.5]	0.39
Patients requiring morphine during the first 24 hours	14 (64%)	1 (7.7%)	9 (82%)	<b>&lt;0.001</b>

\*Data are presented as n(percentage) or median [IQR 25<sup>th</sup> -75<sup>th</sup> percentile]

**Table 4. Logistic regression of the univariate analysis of postoperative morphine requirement during the first 24h**

	Odd-Ratio (95%CI)	p
Serratus (n=11)	5.06 (1.10-36.57)	0,058
ESPB (n=22)	1.91 (0.59-6.49)	0,288
Intrathecal morphine (n=13)	0.09 (0.01-0.40)	<b>0,005</b>

VAS score values for pain are reported in Table 5 (supplementary). There was no statistical difference between groups concerning maximal and mean pain values during the first seventy-two postoperative hours, except during PACU stay where pain levels on cough were dissimilar with respectively: 5 [2,25;6,00] in the ESPB group, 0 [0;3,00] in the intrathecal morphine group and 4,5 [1,75;7,00] in the serratus group (p = 0,035).



**Figure 1.** Kaplan-Meier survival curve for first oral morphine requirement ( $p = 0,016$ , log-rank test)

There was no difference observed regarding the incidence of postoperative nausea and vomiting, hypotensive events, vasopressor use and oxygen requirements between groups. Finally, hospital length of stay as well as thoracic drainage duration were not different with regards to the loco-regional technique employed (Table 6).

**Table 6.** Post-operative outcomes and adverse effects

	ESPB (n = 22)	Intrathecal morphine (n = 13)	Serratus (n = 11)	p
<b>Length of stay, day</b>	4.00 [4.00; 5.00]	4.00 [4.00; 5.00]	4.00 [4.00; 5.50]	0.5
<b>Thoracic Drainage duration, day</b>	3.00 [3.00; 4.00]	3.00 [3.00; 4.00]	3.00 [3.00; 4.00]	0.52
<b>Urinary retention</b>	0 (0%)	2 (15%)	0 (0%)	0.3
<b>PONV</b>	3 (14%)	2 (15%)	2 (18%)	1
<b>Oxygen requirement</b>				
Day 0	7 (32%)	4 (31%)	4 (36%)	1
Day 1	2 (9.1%)	1 (7.7%)	2 (18%)	0.69
Day 2	0 (0%)	1 (7.7%)	1 (9.1%)	0.27
Day 3	0 (0%)	1 (7.7%)	1 (9.1%)	0.27

\*Data are presented as n(percentage) or median [IQR 25<sup>th</sup> -75<sup>th</sup> percentile]

# DISCUSSION

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To our knowledge, this study is the first of its kind to address the comparison of three locoregional anesthesia techniques in the pain management of VATS for spontaneous pneumothorax. We showed that ITM was associated with a decreased morphine consumption during the first 24h after pneumothorax surgery. This is in line with the results of many studies that highlighted the beneficial effects of intrathecal opioid administration on pain management after major abdominal surgery, reducing the need for systemic opioid up to 24 hours postoperatively (8). The original aspect of our work resides in the fact that it is a first attempt at evaluating the efficacy of ITM in VATS. Hence the emergence of findings and encouraging results provide a first documented report in this specific context. We did not report any difference regarding the occurrence of side effects, but this aspect was probably undervalued because of the reduced sample size. In that sense, concerns about tolerance must be kept in mind, specifically regarding the risk of potentially life-threatening delayed respiratory depression (8). In fact, patients undergoing thoracic surgery with systemic opioid requirements may be at higher risk of respiratory depression after ITM : systematic monitoring up to 24 hours after surgery should be mandatory (18). This pitfall may limit ERAS protocol and increase the cost of the stay.

Our population is similar to other published analyses focusing on VATS for pneumothorax (2)(15) with regards to age, ASA score and sex. Our study did not demonstrate the benefit of one technique over another in addressing the global morphine consumption during the first postoperative 72h. Nonetheless, we found a relatively low global morphine consumption compared to other studies focusing on the same subject. For instance, in a similar population *Allain et al.*(15) reported a morphine consumption twice higher. This difference can be explained by the fact that in our study all patients received a locoregional anesthesia emphasizing on the need to perform it regardless of the technique chosen, especially since we did not report any complication nor side effects following the execution of the block.

In our study the serratus plane block seemed to be the less effective technique in terms of reduction of morphine requirements. *Allain et al.*(15) found contrasting results however their protocol compared serratus block to systemic analgesia alone or paravertebral block. Furthermore, the morphine consumption in their study remained relatively high even with a serratus plane block. This lack of efficacy can be explained by the absence of local anesthetics covering the nervous

territory of the posterior and posterolateral sides of the chest wall which are often targeted during pneumothorax surgery.

When looking at the erector spinae plane block group, there was no benefit in terms of cumulative morphine consumption and pain scores. However there seems to be an effect when compared to the serratus plane block group, with less morphine requirements during the first 24 postoperative hours. This is in accordance with recent randomized trials focusing on minimal invasive thoracic surgery (19)(20). In the study by *Finnerty et al.* comparing both interfascial blocks in VATS procedures including pleurectomy and pleurodesis, the erector spinae plane block was more effective in terms of pains scores during the first 24h and time to first opioid consumption in the PACU. This difference can be explained by the observation that the serratus plane block targets mainly the anterior branches of the intercostal nerves whereas the erector spinae plane block focuses on the ventral and dorsal rami of the thoracic spinal nerves (16). Consequently, this allows pain control not only on the anterior and lateral chest wall but also on its posterior side, which is of notable importance during VATS for pneumothorax, especially if a pleurectomy is performed.

Moreover, the results concerning pain scores indicate high intensity values that persist after the first postoperative 24h. This observation can be explained firstly because of a depletion of the analgesic effect due to the locoregional anesthesia, and secondly because of the duration of thoracic drainage which turns out to be of 3 [3,00; 4,00] days in our study. The use of adjuvant therapeutics, the insertion of catheters for continuous infusion of local anesthetics or a combination of both to extend the efficacy of locoregional anesthesia, as well as a revision of the duration of postoperative thoracic drainage (21) could be interesting for postoperative pain management.

Our study has several limitations, first of which being underpowered with only a few patients included in the protocol. The monocentric nature of the study coupled with the occurrence of the COVID 19 pandemic probably led to limiting the extent of patient recruitment. In addition, appropriately performing the locoregional anesthesia techniques takes time with a learning curve that can heavily depend on the operators experience. This might have impacted our results especially relating to the erector spinae plane block, as it is a relatively recent technique.

## CONCLUSION

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VATS for pneumothorax remains a challenge in terms of post-operative pain management. Our study however demonstrated that using a locoregional technique allows to reduce post-operative morphine consumption regardless of the block chosen. Finally, intrathecal morphine injection seems to be more effective during the first postoperative 24h with a relatively high safety. Hence, a randomized control study is needed to determine the optimal technique for pain management in pneumothorax surgery.



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# SUPPLEMENTARY

**Table 5. VAS pain scores during hospital stay\***

		ESPB (n = 22)	Intrathecal morphine (n = 13)	Serratus (n = 11)	p
<b>PACU</b>					
<b>At rest</b>		3.00 [0; 5.00]	0 [0; 0]	4.50 [0; 8.00]	0.057
<b>On coughing</b>		5.00 [2.25; 6.00]	0 [0; 3.00]	4.50 [1.75; 7.00]	<b>0.035</b>
<b>DAY 0</b>					
<b>At rest</b>	<i>Max</i>	2.50 [0; 3.00]	1.00 [0; 2.00]	2.00 [1.00; 5.00]	0.39
	<i>Mean</i>	1.00 [0; 2.12]	0.500 [0; 1.00]	1.50 [0.750; 4.00]	0.24
<b>On coughing</b>	<i>Max</i>	4.00 [2.00; 5.00]	1.00 [0; 3.00]	3.00 [0; 4.50]	0.32
	<i>Mean</i>	2.00 [0.300; 3.80]	0.500 [0; 2.00]	1.50 [0; 4.50]	0.39
<b>DAY 1</b>					
<b>At rest</b>	<i>Max</i>	2.00 [0; 5.50]	2.00 [1.00; 4.00]	3.00 [1.50; 5.00]	0.58
	<i>Mean</i>	0.500 [0; 2.50]	1.00 [0.400; 1.60]	1.25 [0.750; 2.45]	0.63
<b>On coughing</b>	<i>Max</i>	3.50 [0.500; 5.75]	3.00 [1.00; 5.00]	5.00 [4.50; 6.00]	0.2
	<i>Mean</i>	2.00 [0; 3.60]	1.60 [0.500; 2.00]	2.70 [2.40; 3.00]	0.23
<b>DAY 2</b>					
<b>At rest</b>	<i>Max</i>	2.00 [1.00; 4.00]	1.00 [1.00; 3.00]	2.00 [0; 3.00]	0.88
	<i>Mean</i>	0.550 [0.200; 1.87]	1.00 [0.250; 1.25]	1.00 [0; 1.15]	0.89
<b>On coughing</b>	<i>Max</i>	4.00 [2.00; 5.00]	3.00 [1.00; 5.00]	3.00 [2.00; 4.00]	0.63
	<i>Mean</i>	2.08 [1.19; 3.21]	1.50 [0.750; 2.50]	1.40 [1.00; 2.85]	0.44
<b>DAY 3</b>					
<b>At rest</b>	<i>Max</i>	1.00 [0; 2.00]	1.00 [0; 2.00]	2.00 [0.500; 2.50]	0.57
	<i>Mean</i>	0.200 [0; 0.750]	0.250 [0; 0.670]	1.00 [0.150; 1.30]	0.29
<b>On coughing</b>	<i>Max</i>	2.00 [0; 3.00]	2.00 [1.00; 4.00]	3.00 [1.50; 3.00]	0.58
	<i>Mean</i>	0.400 [0; 1.50]	0.750 [0.300; 1.33]	1.60 [1.00; 1.95]	0.12

\*Data are presented as n(percentage) or median [IQR 25<sup>th</sup> -75<sup>th</sup> percentile]

# ABSTRACT

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## **Comparison of three locoregional anesthesia techniques for the postoperative pain management after pneumothorax surgery: erector spinae plane block, serratus anterior plane block and intrathecal morphine injection**

### **Introduction**

Surgery for primary spontaneous pneumothorax is performed through video-assisted thoracoscopic surgery (VATS) and mainly consists of pleurectomy. To this date, there are still no specific guidelines concerning the perioperative pain management of such a procedure. With the growth of enhanced recovery after surgery protocols (ERAS), locoregional anesthesia appears to be essential for better postoperative care. Nevertheless, no technique has been proven to be more effective in the case of pneumothorax surgery. In that regard, our study was aimed towards assessing the efficacy of various techniques and their adverse effects during the perioperative management of surgical pneumothorax.

### **Materials and Methods**

Our study is a prospective monocentric observational cohort conducted between March 2020 and June 2021, on patients undergoing a VATS for spontaneous pneumothorax. All patients received a standardized protocol for intraoperative management, as well as multimodal analgesics for the first 72 postoperative hours. Prior to surgical incision, the attending physician could perform an erector spinae plane block (ESPB), a serratus anterior plane block (SAP) or an intrathecal morphine injection (ITM). Pain scores and adverse effects were then gathered during the follow-up period. The main outcome was the cumulative oral morphine consumption during the three postoperative days. Secondary endpoints included, but were not limited to, morphine consumption during the first postoperative 24 hours, delay to first morphine consumption, occurrence of side effects and hospital length of stay. Statistical analysis used univariate models with survival curve description as well as a logistic regression model to determine the association between specific variables.

### **Results**

46 patients were included in our study with 11 patients in the SAP group, 13 in the ITM group and 22 in the ESPB group. Demographic and surgical data were similar between groups. Population was essentially male with low ASA score and the most common procedure was pleurectomy. The cumulative dose of morphine did not differ significantly between groups (22.5 [5.00; 42.5], 5.00 [0; 15.0], 15.0 [7.50; 22];  $p = 0,39$ ). ITM was associated with a reduction in morphine requirements during the first postoperative 24 hours (OR 0.09 [0.01-0.40],  $p = 0,005$ ). Survival curve analysis showed longer time to morphine request in the ITM group in comparison to ESPB and SAP ( $p = 0,016$ ). No major side effects were observed in any of the study groups.

### **Conclusion**

This study suggests that ITM may have some benefits during the first 24h postoperatively but no technique showed to be more advantageous in terms of global morphine consumption. Further randomized control studies are needed in order to confirm these results and refine the choice of locoregional techniques for the pain management of VATS for pneumothorax.

**Key words:** Video-assisted thoracoscopic surgery, pneumothorax, pain management, Erector spinae plane block, serratus anterior plane block, intrathecal morphine.

# SERMENT d'HIPPOCRATE

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**Au moment d'être admis à exercer la médecine, je promets et je jure d'être fidèle aux lois de l'honneur et de la probité.**

**Mon premier souci sera de rétablir, de préserver ou de promouvoir la santé dans tous ses éléments, physiques et mentaux, individuels et sociaux.**

**Je respecterai toutes les personnes, leur autonomie et leur volonté, sans aucune discrimination selon leur état ou leurs convictions. J'interviendrai pour les protéger si elles sont affaiblies, vulnérables ou menacées dans leur intégrité ou leur dignité. Même sous la contrainte, je ne ferai pas usage de mes connaissances contre les lois de l'humanité.**

**J'informerai les patients des décisions envisagées, de leurs raisons et de leurs conséquences.**

**Je ne tromperai jamais leur confiance et n'exploiterai pas le pouvoir hérité des circonstances pour forcer les consciences.**

**Je donnerai mes soins à l'indigent et à quiconque me les demandera. Je ne me laisserai pas influencer par la soif du gain ou la recherche de la gloire.**

**Admis dans l'intimité des personnes, je tairai les secrets qui me seront confiés. Reçu à l'intérieur des maisons, je respecterai les secrets des foyers et ma conduite ne servira pas à corrompre les mœurs.**

**Je ferai tout pour soulager les souffrances. Je ne prolongerai pas abusivement les agonies. Je ne provoquerai jamais la mort délibérément.**

**Je préserverai l'indépendance nécessaire à l'accomplissement de ma mission. Je n'entreprendrai rien qui dépasse mes compétences. Je les entretiendrai et les perfectionnerai pour assurer au mieux les services qui me seront demandés.**

**J'apporterai mon aide à mes confrères ainsi qu'à leurs familles dans l'adversité.**

**Que les hommes et mes confrères m'accordent leur estime si je suis fidèle à mes promesses ; que je sois déshonoré et méprisé si j'y manque.**