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Erector spinae plane block for postoperative pain control after lumbar spine fusion: a comparative and retrospective study

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► To cite this version:

Pierre-Emmanuel Marsan. Erector spinae plane block for postoperative pain control after lumbar spine fusion: a comparative and retrospective study. Human health and pathology. 2020. dumas-03130588

HAL Id: dumas-03130588

<https://dumas.ccsd.cnrs.fr/dumas-03130588>

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UNIVERSITÉ de CAEN NORMANDIE

UFR SANTÉ

FACULTÉ de MÉDECINE

Année 2019/2020

THÈSE POUR L'OBTENTION
DU GRADE DE DOCTEUR EN MÉDECINE

Présentée et soutenue publiquement le 15 mai 2020

par

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Né le 15/01/1991 à Marseille (13)

TITRE DE LA THÈSE :

Le Bloc du Plan des Muscles Erecteurs du Rachis Pour l'Analgésie Après
Arthrodèse Lombaire. Etude Rétrospective, Comparative.

Erector Spinae Plane Block for Postoperative Pain Control After Lumbar
Spine Fusion. A Comparative and Retrospective Study.

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Tout ce travail est pour nous Marie, parce que tu m'as suivi jusqu'à Caen, cette nouvelle vie nous faisait peur avant de l'adorer. Merci pour tous ces moments où tu as su me réconforter, et m'encourager. Merci pour toutes les relectures que tu as dû effectuer et les fautes que tu as dû corriger dans ce travail. J'espère te rendre heureuse maintenant. A notre avenir.

J'aimerais remercier mon directeur de thèse et ami, le Dr Kamga, sans qui tout ce travail n'aurait pas été possible. Par ton exigence et tes idées tu as su me motiver pour obtenir le meilleur. Tu es un exemple dans la prise en charge des patients et j'aimerais pouvoir exercer la médecine avec autant de bienfaisance. Grâce à tes explications, tu as pu rendre les choses simples. Et c'est avec un grand plaisir que j'ai pu travailler avec toi et j'espère que ce travail ne sera que le début d'une longue coopération.

Je remercie le Pr Gérard, par votre travail et votre bienveillance envers les étudiants, vous avez su nous montrer l'exemple et nous protéger dans les situations difficiles.

Je remercie le Pr Fischer, pour votre accueil et votre enseignement en réanimation cardiaque, par votre passion pour l'hémodynamique vous nous avez appris à prendre en charge les patients les plus fragiles.

Un grand merci au Pr Emery, vous avez su m'accueillir au sein de votre bloc opératoire et me sensibiliser aux enjeux neurochirurgicaux du traitement des malades.

A mes parents qui m'ont soutenu durant toutes ces années d'études et qui étaient inquiets à chacun de mes examens, j'espère que maintenant vous êtes rassurés. Vous avez su m'apprendre le goût du travail même si cela n'a pas été facile tous les jours. Une autre vie commence, et nous aurons encore une fois besoin de votre aide. Je sais que je peux compter sur vous.

A mon frère Matthieu avec qui j'ai connu mes premiers accidents de vélo et qui a continué le sport toujours à fond. Je ne crois pas qu'un jour je puisse te rattraper en triathlon mais je sais que tu m'aideras à progresser.

A ma petite sœur Anne-Claire, je sais que tu vas réussir ton internat et que tu choisiras ce que tu veux. J'ai toujours cru en toi et ta motivation est incroyable. Continue comme ça, ça vaut le coup.

Merci à Stéphanie et Anthony pour avoir toujours cru en nous. Je sais que nous pouvons compter sur vous.

A Anahit et Guy, pour m'avoir accueilli dans la famille à bras couverts et leur bienveillance au quotidien.

A Coralie et Marc, parce que vous faites maintenant parti de la famille.

Pour Régis, toi qui m'as donné l'envie de faire ce métier depuis mon enfance, tu es un modèle de réussite.

Merci Céline pour ton sens de l'organisation et ta bienveillance tout au long de mon internat.

Au Carpentrasien Jason je me rappelle cette première année infernale, aux moments que nous avons partagés, plus d'une fois tu as su m'aider.

Au Sudiste Hugo, notre amitié est infinie, j'ai hâte de te retrouver pour faire la mont Ventoux.

Un grand merci à toute ma famille, je pense à vous tous les jours.

A mes co-internes,

Merci Alicia et Didier pour avoir partagé votre don pour la photographie.

A toutes les personnes avec qui j'ai eu plaisir à travailler, Vive le PATEC !

Abbreviations

ASA American Society of Anesthesiologists

BMI Body mass index

CI confidence intervall

EO Abdominal external oblique muscle

ESM Erector spinae muscle

ESPB Erector spinae plane block

IQR Interquartil range

IO Abdominal internal oblique muscle

ITM Intrathecal morphine

LRA Locoregional Anesthesia

PACU Post Anesthesia Care Unit

PLSF posterior lumbar spine fusion surgery

PONV Postoperative nausea and vomiting

Pso Psoas muscle

QLM Quadratus lumborum muscle

T Transverse abdominal muscle

TP Transverse Process

SD Standard deviation

SP Spinous Process

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ABSTRACT:

Introduction: Posterior lumbar spine fusion surgery (PLSF) is associated with high postoperative pain. Management with intrathecal morphine (ITM) is the gold standard, but is associated with several adverse effects. The erector spinae plane block (ESPB) is a new ultrasound-guided regional anesthesia technique. It could provide good postoperative pain relief without the adverse effects associated with ITM. The aim of this study was to evaluate ESPB for pain management after PLSF.

Methods: We conducted a retrospective and comparative study from 2015 to 2019. Patients admitted for PLSF were included in 3 groups: group 1 with standard multimodal analgesic management, group 2 standard multimodal analgesic plus ESPB and group 3 standard multimodal analgesic plus ITM. The primary outcome was the amount of morphine consumption during the first 24 postoperative hours. Secondary outcomes were the use of morphine rescue therapy, postoperative pain scores, and hospital length of stay.

Results: 114 patients were included: 35 in group 1; 38 in group 2 and 41 in group 3. The amount of morphine during the first 24hrs was 83 +/- 46mg; 53/-37 mg and 39 +/-28 mg in groups 1, 2 and 3, respectively ($p = 0.001$). The use of morphine rescue therapy was 49 %, 16 % and 12 % in groups 1, 2 and 3 ($p = 0.002$). The pain scores and the length of stay were not different between the groups.

Conclusion: In this study, ESPB seems better than standard multimodal analgesia and not different to ITM for postoperative pain management after PLSF.

INTRODUCTION

A large proportion of chronic pain is due to lumbar spine degenerative diseases. Surgery may be required to treat a herniated disk, a lumbar canal stenosis or spondylolisthesis. Spine fusion is used to block an unstable spine. This surgery is known to provide a high level of postoperative pain.¹

In addition, the postoperative pain intensity is a known risk factor for chronic pain.² Nearly 18% of patients will become regular morphine users after spine surgery and 50% of opioid consumers before the procedure will remain on opioids after surgery.³ Postoperative pain management is therefore particularly important. Multimodal analgesia is recommended by learned societies.⁴ It involves the use of several techniques in order to achieve a synergistic effect on pain while reducing the side effects associated with each technique.

Nowadays, intrathecal morphine (ITM) is the gold standard for analgesia after posterior lumbar spine fusion surgery (PLSF). It provides good analgesia⁵ but is associated with several side effects: cerebrospinal fluid leakage,⁶ pruritus,⁷ postoperative nausea and vomiting,⁸ respiratory distress and sedation.⁹

Peripheral locoregional anesthesia techniques could reduce postoperative pain associated with PLSF without exposing patients to all the ITM side effects.¹⁰ The erector spinae plane block (ESPB), described in 2016 by Forero et al,¹¹ was recently described in case reports for PLSF postoperative pain management.¹² Therefore, we designed this study to evaluate the efficacy of ESPB for postoperative pain management after PLSF.

MATERIALS AND METHODS:

We conducted a monocentric, comparative and retrospective study at the Caen University Hospital. This work was approved by the Local Ethics Committee for Health Research (ID-CLERS-495).

All consecutive patients operated for PLSF between November 1, 2015 and March, 31 2019 were included. The medical data was computerized and then anonymized. Three groups of patients were defined : The first group received multimodal anesthesia (group 1), the second multimodal anesthesia and bilateral ESPB (group 2), and the third multimodal anesthesia and ITM at the dose of 200 µg (group 3).¹³ Multimodal analgesia was a combination of paracetamol, ketoprofen, nefopam, ketamine and/or lidocaine depending on the practitioner in charge of the patient. The exclusion criteria were emergency surgery, ITM dose other than 200µg, the use of a peripheral locoregional anesthesia (LRA) technique other than ESPB.

Both methods of locoregional analgesia were performed before surgery. ITM was administrated in the lumbar region according to the description made before.⁶ Morphine at the dosage of 200 µg diluted in 2ml of normal saline was injected into the intrathecal space. A Whitacre pencil-point needle of 25G and 90mm length (Vygon, Ecoen, France) was used. The induction of general anesthesia was performed after and the patient placed in prone position.

The ESPB was performed after induction of general anesthesia on a patient in prone position (Figure 1, Supplementary 1). It was ultrasound guided (General Electric Logic-e) with a linear probe of 12Hz. The level of puncture corresponds to the surgical level of PLSF. After skin antisepsis, the transverse process of the vertebra was identified. The needle (21G, 55mm Temena GmbH, Felsberg, Germany) was then inserted in the latero-medial direction within the ultrasound plane, perpendicular to the body's axis until it reaches the transverse process. The goal was to inject the local anesthetic between the erector spinae muscle and the vertebral transverse process. Twenty milliliters of ropivacaine 2mg/mL were administered on each side of the spinous process. The injection of the local anesthetic causes the spinae erector muscle to lift off the vertebrae's transverse process (Figure 2).

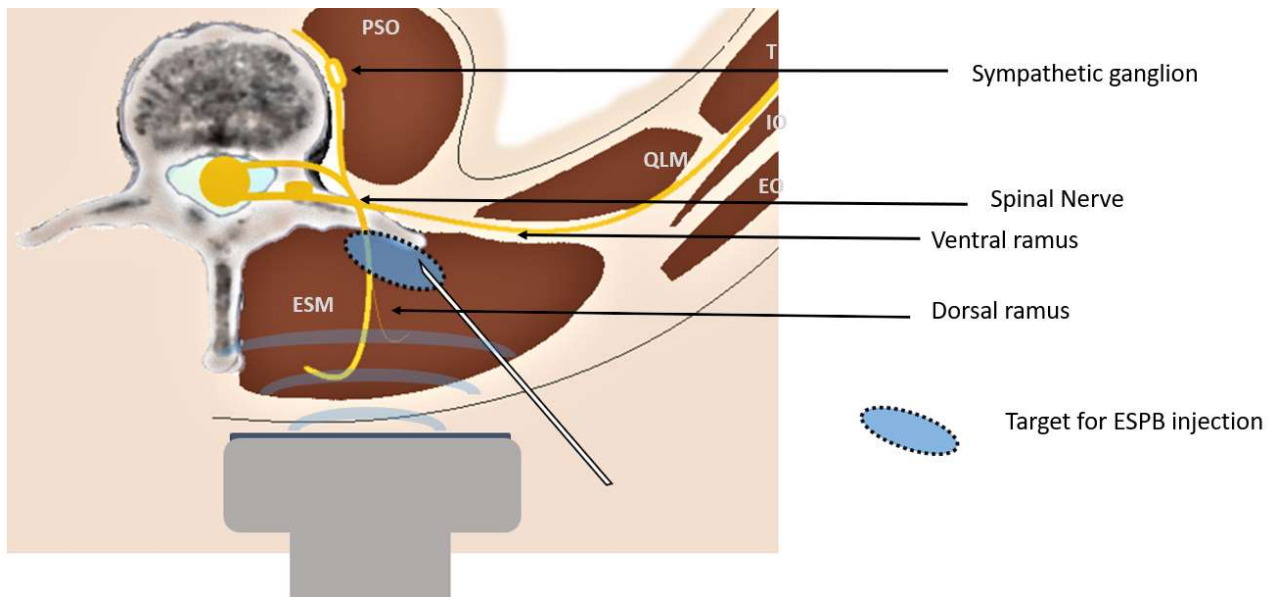


Figure 1: *The “in plane” ultrasound guided Erector Spinae Plane Block (ESPB)*

Abbreviations: ESM, Erector spinae muscle; ESPB, Erector Spinae Plane Block; QLM, Quadratus lumborum muscle; Pso, Psoas muscle; T, Transverse abdominal muscle; IO, Abdominal internal oblique muscle; EO, Abdominal external oblique muscle.

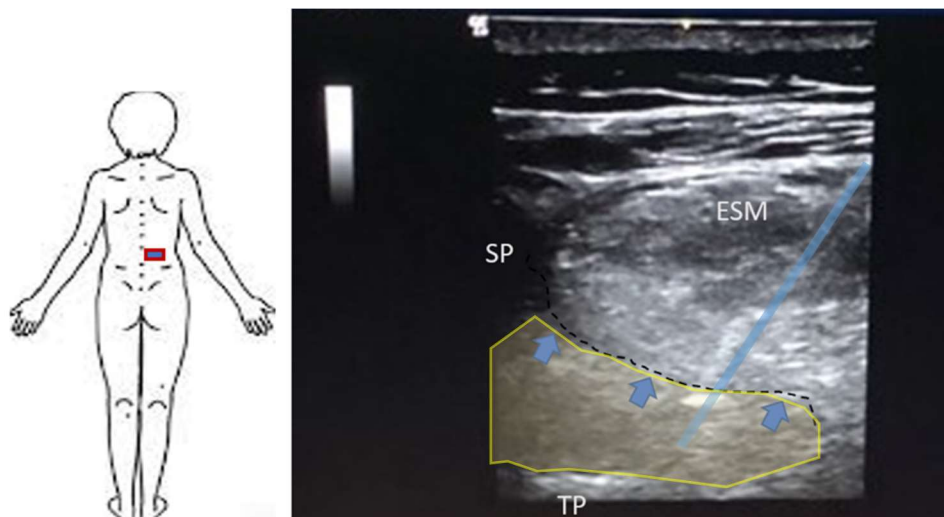


Figure 2: *The ultrasound guided ESPB*

The injection is performed under the Erector Spinae Muscle (ESM) and lifts it from the Transverse Process (TP). The Spinous Process (SP) is in the ultrasound field.

The primary endpoint was the total amount of morphine consumption during the first 24 hours converted into equivalent oral morphine dose according to usual standards.¹⁴ Secondary criteria were: The need for an intravenous morphine rescue therapy in the post anesthesia care unit (PACU); the use of analgesics during surgery, the duration of surgery, the length of stay in PACU; the occurrence of postoperative nausea and vomiting obtained by the ondansetron use; Pain scores during the first postoperative 48 hours assessed by the numerical rating scale and the hospital length of stay.

The data were collected on Excel software (Microsoft, Seattle, WA, USA) and analyzed by SPSS software (IBM SPSS Version 24.0. Armonk, NY: IBM Corp, Chicago, IL, USA). Based on preliminary results showing a total amount of morphine consumption during the 24 hours following surgery at 80 +/-35mg for 10 patients with standard multimodal analgesia and 50 +/- 30mg for 10 patients with multimodal treatment and ESPB. We calculated that at least 29 patients per group were mandatory to show such a difference (decrease up to one third of morphine consumption) with 80 % power and 5 % alpha risk. We compared ESPB with standard multimodal analgesic treatment and ITM to estimate its efficacy. Quantitative data are expressed with mean and standard deviation. The qualitative data in absolute frequency and percentages. The Chi-squared test or the exact Fisher test were used to analyze qualitative data. The Kruskal-Wallis test was used for continuous ones, since ANOVA is highly sensitive to deviations from normality. When the omnibus test was significant, Mann-Whitney tests with Bonferroni corrections were used for two-group comparisons. A $p < 0.05$ was defined as a statistically significant difference.

RESULTS:

From November 2015 to March 2019, 466 patients underwent posterior lumbar spine fusion surgery at the Caen University Hospital. A total of 114 patients were included in the study: 35 in the standard group (group 1), 38 in the ESPB group (group 2) and 41 in the intrathecal morphine group (group 3). (Flow chart, figure 3)

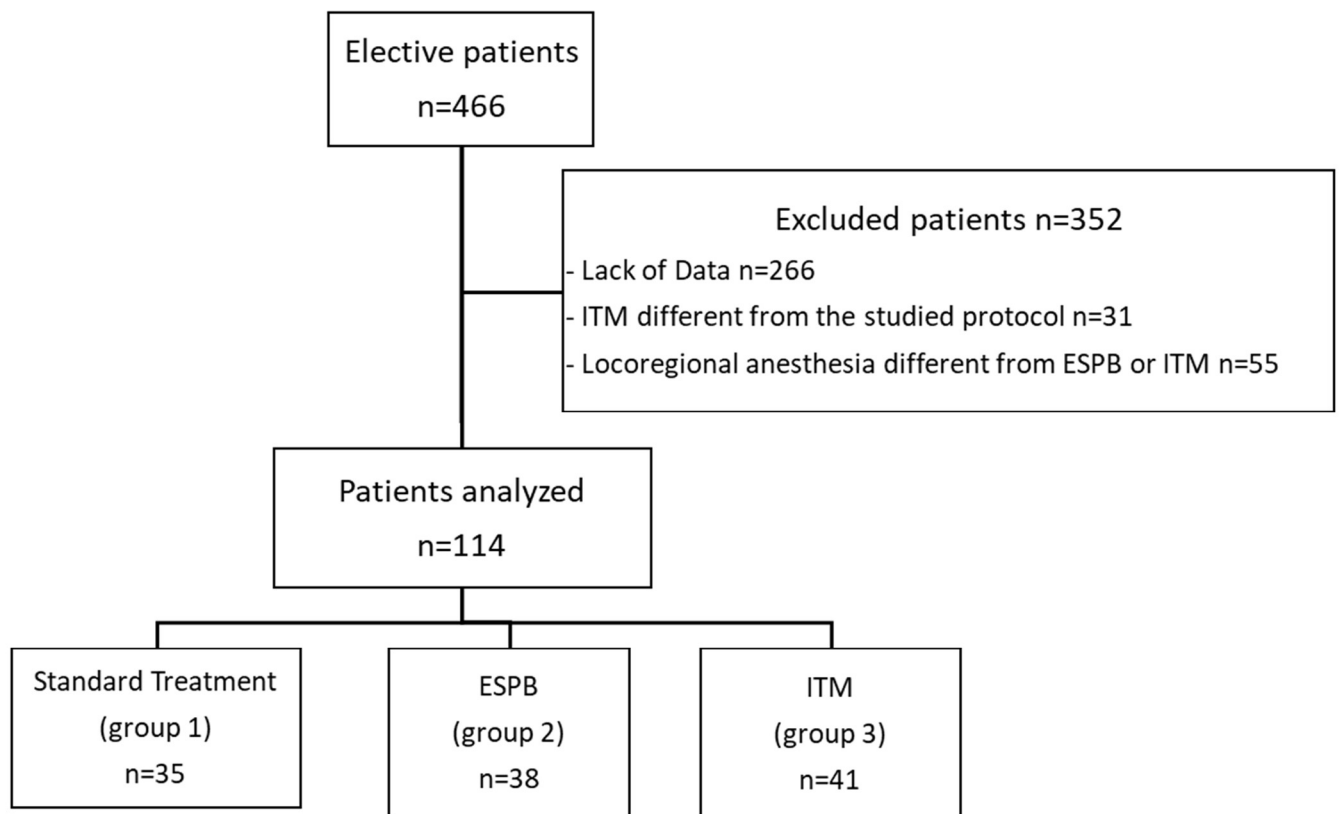


Figure 3: Flow chart

Abbreviations: ITM, Intrathecal Morphine; ESPB, Erector Spinae Plane Block;

Patient characteristics are presented in Table 1.

Table 2 Patients Characteristics

	Group 1	Group 2	Group 3	p
Sample size, n	35	38	41	-
Mean Age in years (SD)	68 (12)	62 (13)	64 (16)	0.229
Mean BMI in kg/m ² (SD)	28 (05)	27 (07)	28 (06)	0.280
ASA classification, n (%)				
ASA 1	03 (09)	01 (06)	03 (07)	0.156
ASA 2	17 (49)	30 (65)	27 (66)	
ASA 3	14 (40)	07 (27)	10 (24)	
ASA 4	01 (03)	-	01 (02)	
Sex ratio M/F, n (%)	13/35 (37)	17/38 (37)	18/41 (44)	0.810
Chronic morphine use before surgery, n (%)	12 (34)	14 (37)	18 (44)	0.695
Median number of levels fused (IQR)	1 (1-2)	1 (1-2)	1 (1-2)	0.201

Abbreviations: SD, standard deviations; IQR, interquartile range; ASA, American Society of Anesthesiologists, BMI, body mass index

a: p-value compare group 1, group 2 and 3

b: Kruskal-Wallis test was used for continuous data, The Khi-squared test or the exact Fisher test were used to analyze qualitative data.

The main result is presented in Figure 4.

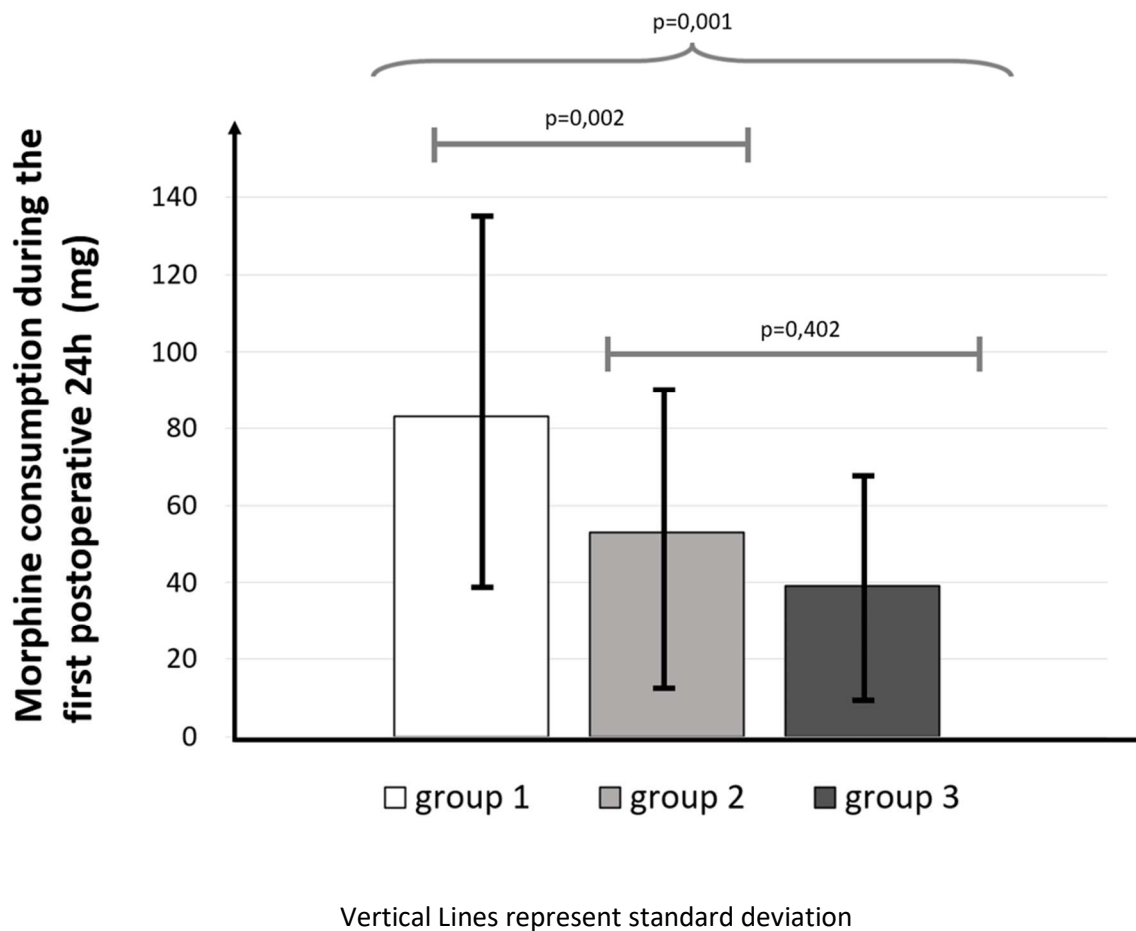


Figure 4: *Morphine consumption during the first 24 hours;*

a: Kruskal-Wallis test was used for three group comparison

b: Mann-Whitney tests with Bonferroni corrections were used for two-group comparison

Patients who received multimodal analgesia, (group 1), multimodal analgesia and ESPB (group 2) multimodal analgesia and intrathecal morphine (group 3) had respectively: 83 +/-46mg, 53 +/-37mg and 39 +/-28mg oral equivalent morphine during the first 24 postoperative hours (p=0.001). There was a difference of 29 mg(CI 95%[8;51]) between groups 2 and 1 (p=0.002); 14 mg(CI 95%[-06;35]) between groups 2 and 3 (p=0.402) and 44mg (CI 95%[23;65]) between groups 1 and 3 (p=0.001).

Secondary results are presented in Table 2:

Table 2: *Secondary Results*

	Group 1 (n=35)	Group 2 (n=38)	Group 3 (n=41)	p
Mean surgical time (SD) in minutes	135 (46)	172 (52)	170 (81)	0.009
Mean perioperative morphine consumption (SD):				
- Sufentanil (µg)	36 (8)	28 (12)	33 (11)	0.003
- Remifentanil (µg)	1673 (1000)	1475 (1500)	1483 (1100)	0.370
Morphine rescue therapy in PACU, n (%)	16 (49)	06 (16)	05 (12)	0.002
Mean PACU length of stay in minutes (SD)	122 (55)	105 (39)	121 (13)	0.332
PONV, n (%)	4 (11)	5 (13)	4 (10)	0.935
Median length of hospital stay in days (IQR)	5 (4-8)	5 (4-7)	5 (4-7)	0.766
Analgesics, n (%)				
- Paracetamol	35 (100)	38 (100)	41 (100)	-
- Ketoprofen	23 (66)	35 (92)	34 (83)	0.018
- Dexamethasone	18 (51)	27 (73)	30 (71)	0.097
- Lidocaine IV	06 (17)	15 (40)	11 (27)	0.108
- Ketamine	26 (74)	20 (53)	32 (78)	0.044
- Nefopam	22 (63)	16 (42)	22 (54)	0.217

Abbreviations: PONV: Postoperative nausea and vomiting PACU, Post anesthesia care unit; SD, Standard deviations; IQR, Interquartile range;

a: p-value compared group 1, group 2 and group 3.

b: Kruskal-Wallis test was used for continuous data, The Khi-squared test or the exact Fisher test were used to analyze qualitative data.

Pain scores obtained during the first 48 postoperative hours are shown in Figure 5.

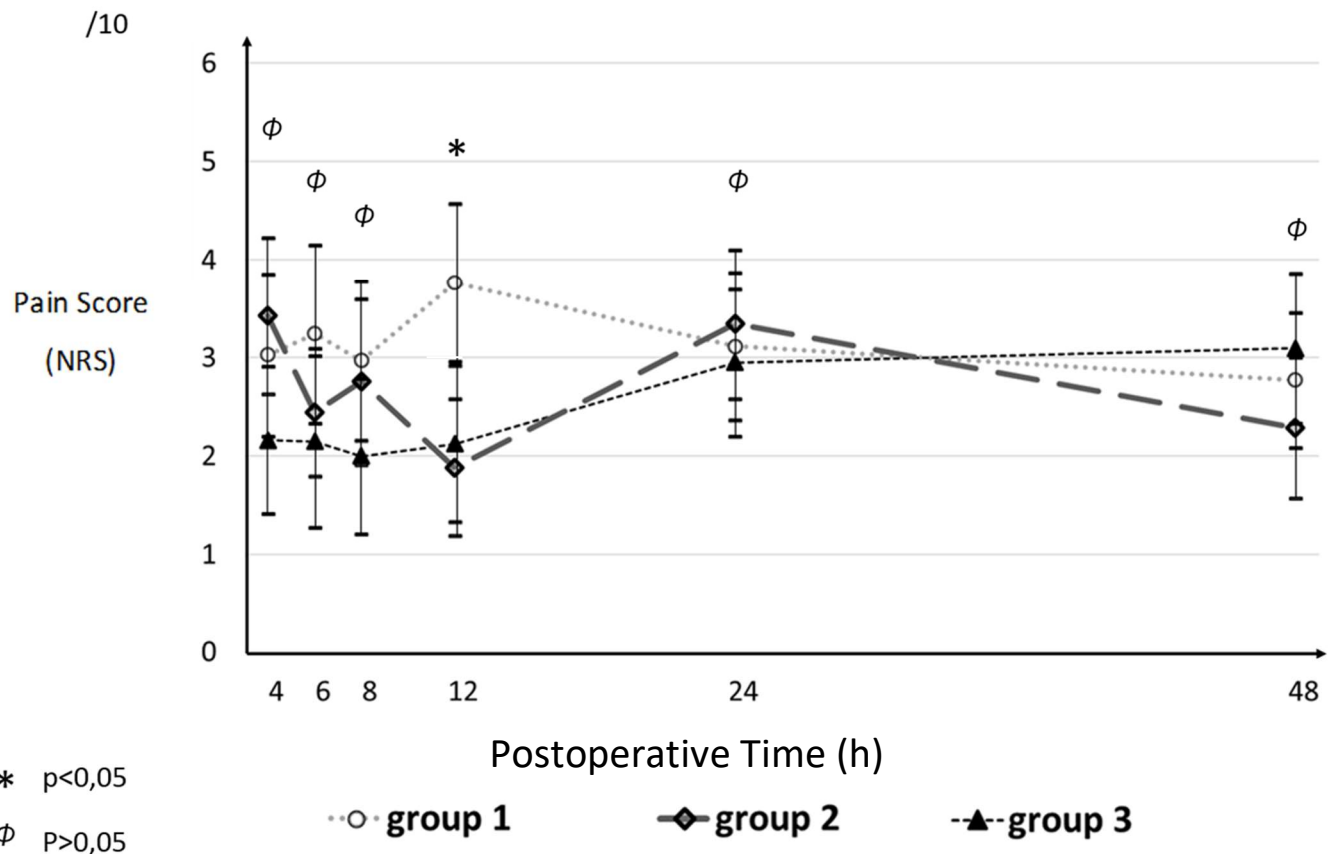


Figure 5: Pain scores during the first 48 postoperative hours;

a: Kruskal-Wallis test was used for three group comparison

Pain scores were collected at 4, 6, 8, 12, 24 and 48 postoperative hours, and scored on a numeric rating scale of 0 to 10, 10 was the worst pain. They are presented with mean and 95% confidence interval.

DISCUSSION:

The amount of morphine consumption in oral morphine equivalent during the first 24 postoperative hours was lower in ESPB plus multimodal analgesia group compare to standard multimodal analgesia group. The difference was 29 mg (CI 95% [8;51]) between groups 2 and 1 (p=0.002). In contrast, the morphine consumption was not different between the group ESPB plus multimodal analgesia and ITM plus multimodal analgesia. The difference was 14 mg (CI 95% [-06; 35]) between group 2 and 3 p = 0,402. These results suggest that an analgesic strategy based on multimodal analgesia and EPSB is more potent than multimodal analgesia alone and may be as potent as ITM, the technic of reference for postoperative pain management after PLSF. If analgesic efficacy is well described for ITM,⁵ in this study, the ESPB shows a greater efficacy than standard multimodal analgesic and no difference with ITM. Because of its ease of realization with degenerative spine and lower risk of complications, the ESPB could present a safer method for spine surgery analgesia. In fact, it has the advantage unlike other LRA techniques available for spinal surgery (epidural anesthesia, spinal anesthesia) of little to no disruption to postoperative neurological clinical monitoring¹² that is of paramount importance in this surgery.¹⁵⁻¹⁶

Moreover, the proportion of patients requiring intravenous morphine rescue therapy in PACU was reduced in groups 2 and 3 compared to group 1. EPSB analgesic effect is present soon after awakening from general anesthesia. In the study of Ziegeler et al, ITM efficacy is shown 4 hours after the surgery.¹⁷ These authors performed intrathecal morphine at the end of the procedure. Due to the preoperative realization of LRA, we obtained earlier analgesia right in PACU after extubation on our patients. Other advantages expected from this strategy is the perioperative opioid consumption reduction and better hemodynamic stability.¹⁸

Indeed, we observed a decrease of sufentanil perioperative use in our study. With reduction of per and postoperative morphine consumption ESPB could be a suitable component for early rehabilitation programs after spinal surgery.

Pain scores in the first 48 hours were low and similar between the groups. However in the group without LRA (group 1), a higher consumption of morphine was noted during the first postoperative hours to achieve this result. We haven't seen any pain rebound after 24 hours due to hyperalgesia that could theoretically be induced by ITM. On the other hand, the single administration of ropivacaine 2mg/mL ESPB appears to provide an analgesic effect lasting around 24 hours. This prolonged effect of a unique injection of ropivacaine has been described in other types of locoregional blocks.¹⁹⁻²⁰ Multimodal analgesia should thus be maintained as an analgesic bridge to wear off of the locoregional analgesia effect.

In this study, ketoprofen was used more often in the ESPB group (group 2) than in the other groups. Cozowicz et al showed a decrease of 8.4% in postoperative morphine consumption with the use of nonsteroidal anti-inflammatory drugs after lumbar spine surgery.²¹ In PACU, we noted a decrease in morphine intravenous rescue therapy rate between groups 1 and 2 (49% vs 16%). The use of ketoprofen in our case seems insufficient alone to explain such a difference. Unfortunately, the limited number of patients included in this study does not allow us to perform adjusted subgroups analyses.

Ketamine is a well-known drug with analgesic and anti-hyperalgesic properties²² and many side effects.²³ We found that ketamine use was less common in the group receiving ESPB. Nevertheless, morphine consumption was lower in the ESPB group than in group 1 with NRS scores similar during the first 48 hours. This could be correlated with the analgesic and anti hyperalgesic properties of ESPB²⁴ suggesting that with this block, the attending physician could not feel the need to use ketamine. With this strategy, one could save up to 30% of ketamine-related side effects.²³

The duration of surgery was longer in the ITM and ESPB groups compared to the standard group. This longer management time may be related to LRA's time of realization. The length of hospital stay was not different between the groups. Immediate postoperative pain is only one of the determining factors of length of stay. Comprehensive management by all stakeholders in an Enhanced Recovery program after spine surgery could be the next step in optimizing perioperative management of these patients.²⁵

The results of our study should only be interpreted in the context of its limitations. The main limitation of this work is its retrospective nature. However, to our knowledge, this is one of the first comparisons of ESPB to a reference technique for postoperative pain management after spinal surgery. The recent use of computerized medical records and the practitioner's learning time of this new tool could explain why we have some lacking data. Unlike the recommendations of learned societies, ESPB was realized on asleep patients. The first reason is that it appears unsuitable to put the patient in the prone position in order to realize the block than put him back in the supine position to give the general anesthesia and have the patient turned again back in the prone position for surgery. Secondly, like with the TAP-Block²⁶⁻²⁷ the ultrasound-guided ESPB is rather simple with easy anatomical landmarks and low risk of failure. We have used an "in plane" ultrasound guidance technique, which we felt was safer and easier to reproduce.

Conclusion:

In this study, we report a better efficacy of ESPB plus multimodal analgesia than multimodal analgesia alone and similar efficacy with ITM plus multimodal analgesia after PLSF. This LRA technique could be an interesting alternative to ITM. It is not associated with the risks of intrathecal morphine and has the huge advantage of not interfering with postoperative neurological monitoring.¹² ESPB could represent a new safe and efficient component of multimodal analgesia for lumbar spine fusion surgery and a significant step in the enhanced recovery program of these patients. These results should be confirmed in a prospective study.

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Annexe 1 :

ESPB realization on asleep patient and prône position



Annexe 2 :



C.L.E.R.S

Comité Local d'Éthique de la Recherche en Santé



CHU de CAEN Normandie – Université de CAEN Normandie

Caen, le 4 Septembre 2019

Objet : Avis Favorable

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Cher collègue,

Vous trouverez ci-dessous l'avis favorable du CLERS suite à votre demande.

Réponse du questionnaire	
ID de la réponse	495
Date de soumission	2019-04-10 00:09:29
Avis du CLERS	FAVORABLE
Date de transmission de l'avis au demandeur	04/09/2019
Demandeur [Nom]	Marsan
Demandeur [Prénom]	Pierre-Emmanuel
Demandeur [e-mail]	
Titre de l'étude	Le bloc du plan des muscles érecteurs du rachis pour l'analgésie après arthrolyse lombaire. Etude comparative, rétrospective, monocentrique.

Cordialement

Le Président du CLERS

« Par délibération de son Conseil en date du 10 Novembre 1972, l'Université n'entend donner aucune approbation ni improbation aux opinions émises dans les thèses ou mémoires. Ces opinions doivent être considérées comme propres à leurs auteurs ».

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Pour le Président
de l'Université de CAEN et P.O

Le Doyen

Le bloc du plan des muscles érecteurs du rachis pour l'analgésie après arthrodèse lombaire. Etude rétrospective, comparative.

Introduction : L'arthrodèse lombaire provoque des douleurs post-opératoires importantes. La rachimorphine procure une analgésie satisfaisante au prix de nombreuses complications. Le bloc du plan des muscles érecteurs du rachis (ESPB) nouvellement décrit, pourrait permettre de contrôler les douleurs post opératoires tout en réduisant les effets secondaires de la morphine intrathécale. Le but de ce travail est d'évaluer l'efficacité de l'ESPB pour la prise en charge de la douleur après arthrodèse lombaire.

Matériels et méthodes : Etude rétrospective monocentrique, comparative menée de 2015 à 2019. Nous avons inclus tous les patients opérés pour arthrodèse lombaire. Trois groupes ont été constitués : Le groupe 1 a reçu un traitement antalgique standard, groupe 2 l'ESPB et le groupe 3 la rachimorphine. Le critère de jugement principal est la consommation de morphine des 24 premières heures. Les critères secondaires sont le taux de titration morphine au réveil, les scores de douleur post-opératoires et la durée de séjour hospitalier.

Résultats : 114 patients ont été inclus : 35 dans le groupe 1 ; 38 dans le groupe 2 et 41 dans le groupe 3. La consommation de morphine sur les 24 premières heures post opératoires est de 83 +/-46mg ; 53+/-37mg et 39 +/-28mg dans les groupes 1 ; 2 et 3 respectivement ($p=0.001$). Le taux de titration morphine était de 49%, 16% et 12% dans le groupe 1, 2 et 3 $p=0.002$. Les scores de douleurs post-opératoires et la durée de séjour ne sont pas différents entre les trois groupes.

Conclusion : Associé à une analgésie multimodale, l'ESPB est comparable à la rachimorphine et supérieur au traitement standard pour la prise en charge de la douleur post-opératoire après arthrodèse Lombaire.

MOTS CLES : Analgésie – Anesthésie locorégionale – Douleur postopératoire – Rachis lombaire – réhabilitation améliorée – Bloque nerveux – Échographie du rachis – Arthrodèse lombaire.

Erector Spinae Plane Block for Postoperative Pain Control After Lumbar Spine Fusion. A Comparative and Retrospective Study.

Introduction: Posterior lumbar spine fusion surgery (PLSF) is associated with high postoperative pain. Management with intrathecal morphine (ITM) is the gold standard, but is associated with several adverse effects. The erector spinae plane block (ESPB) is a new ultrasound-guided regional anesthesia technique. It could provide good postoperative pain relief without the adverse effects associated with ITM. The aim of this study was to evaluate EPSB for pain management after PLSF.

Methods: We conducted a retrospective and comparative study from 2015 to 2019. Patients admitted for PLSF were included in 3 groups: group 1 with standard multimodal analgesic management, group 2 standard multimodal analgesic plus ESPB and group 3 standard multimodal analgesic plus ITM. The primary outcome was the amount of morphine consumption during the first 24 postoperative hours. Secondary outcomes were the use of morphine rescue therapy, postoperative pain scores, and hospital length of stay.

Results: 114 patients were included: 35 in group 1; 38 in group 2 and 41 in group 3. The amount of morphine during the first 24hrs was 83 +/- 46mg; 53/-37 mg and 39 +/-28 mg in groups 1, 2 and 3, respectively ($p = 0.001$). The use of morphine rescue therapy was 49 %, 16 % and 12 % in groups 1, 2 and 3 $p = 0.002$. The pain scores and the length of stay were not different between the groups.

Conclusion: In this study, ESPB seems better than standard multimodal analgesia and not different to ITM for postoperative pain management after PLSF.

KEY WORDS : Analgesia – Regional Analgesia – Pain Medecine – Spine – Enhanced recovery – Nerve Block – Spinal ultrasound – Lumbar spine fusion.