Annals of Medicine and Surgery 75 (2022) 103445

Contents lists available at ScienceDirect

Annals of Medicine and Surgery

journal homepage: www.elsevier.com/locate/amsu

Randomised Controlled Trial

Efficacy of superficial cervical plexus block versus cervical retrolaminar block both combined with auriculotemporal nerve block in parotid surgeries

Ghada S. Mohammed [a,*], Alaa M. Mazy [a], Nahla S. El-Ebahnasawy [a], Mohammed N. Mohammed [a]

[a] Department of Anesthesia, Intensive Care and Pain Management, Faculty of Medicine, Mansoura University, Mansoura, Egypt

ARTICLE INFO

Keywords:
Cervical retrolaminar
Superficial cervical plexus
Auriculotemporal nerve
Parotid
Analgesia

ABSTRACT

Background: Regional techniques in parotid surgeries include superficial cervical plexus block (SCPB) and auriculotemporal nerve (ATN) block, which can be used as an anesthetic technique for awake parotidectomy. This study aimed to evaluate the efficacy of cervical retrolaminar block (RLB) as an alternative to SCPB both, used in combination with auriculotemporal nerve (ATN) block, in parotid surgery.

Material and methods: A total of 40 patients undergoing parotid surgery were prospectively randomized into either the SCPB group (n = 20) or the cervical RLB group (n = 20) using 20 ml of 0.25% bupivacaine plus 5 mcg \mL epinephrine. Both were combined with ATN block using 5 ml of 0.25% bupivacaine plus 5 mcg\mL epinephrine.

Results: The time to first request for analgesia was longer in the RLB group than the SCPB group. Total intra operative fentanyl consumption and post-operative pethidine consumption in the first 24h were lower in group RLB. All patients (n = 20) in the SCPB group required rescue analgesia using pethidine, while only 40% of patients required pethidine in the RLB group. Visual analog scale was lower in the RLB group from 2 to 24-h post-operatively, but it was associated with hypotension and longer block technique time occurred with RLB than SCPB. There was no significant difference in side effects except for 20% Horner's syndrome in the SCPB group.

Conclusion: Cervical RLB is more effective analgesic technique than SCPB, as the cervical RLB showed longer time to first analgesic request, lower intraoperative anesthetic consumption, lower total post-operative pethidine consumption and lower VAS.

1. Introduction

Superficial cervical plexus block (SCPB) and auriculotemporal nerve (ATN)block were used in awake parotidectomy alternatives to general anesthesia in high-risk patients [3,12]. Retrolaminar block (RLB) is an alternative to paravertebral block. Pfeiffer et al. [4] published the first case report employing this landmark technique by introducing the needle posterior to vertebral lamina at the level of T4. The use of ultrasound, reduces the risk of complications [5]. Until now, there have been insufficient studies on cervical RLB as an analgesic technique for neck surgeries, through it has been shown to provide effective analgesia in breast surgeries [6,7], rib fractures [8], and abdominal surgeries, such as retroperitoneal nephrectomy [9].

2. Materials and methods

This prospective randomized study was conducted for two years from 2019 to 2021 in Oncology Center, Mansoura University. After receiving approval from the Institutional Research Board (MD. 19.03.162) and clinical trial registry (NCT04138147), written informed consent was obtained from 40 patients scheduled for elective parotid surgery. Inclusion criteria were: Adult patients with American Society of Anesthesiologists (ASA) physical status I -II of both sexes aged 20–60 years. Exclusion criteria were: Patient's refusal, coagulopathy, psychiatric diseases, local skin infection and sepsis at site of the block, known intolerance to the study drugs, and body mass index >40 kg/m^2. This study was reported in line with the CONSORT statement [10].

Patients were randomly allocated to one of two equal groups (n = 20

* Corresponding author. Department of Anesthesiology, Faculty of Medicine, Mansoura University, El Gomhouria St, Dakahlia, Governorate, 35516, Egypt.
E-mail address: dr_adamghada@yahoo.com (G.S. Mohammed).

https://doi.org/10.1016/j.amsu.2022.103445
Received 10 January 2022; Received in revised form 24 February 2022; Accepted 28 February 2022
Available online 2 March 2022

each) using the closed envelope technique:

- Ultrasound-guided SCPB (Group S): 20 mL 0.25% bupivacaine + 5 mcg/mL epinephrine in supine position combined with ATN block using 5 mL 0.25% bupivacaine + 5 mcg/mL epinephrine.
- Ultrasound-guided cervical RLB (Group R): 20 mL of 0.25% bupivacaine + 5 mcg/mL epinephrine) in lateral position with ATN block using 5 mL of 0.25% bupivacaine + 5 mcg/mL epinephrine.

All patients were assessed pre-operatively by history, physical examination, laboratory evaluation (CBC, liver and renal function tests, coagulation profile). The day before the surgery, the study protocol and the block procedure to be done were explained to all patients and written informed consent was obtained. Patients were instructed about using visual analog scale (VAS). All patients fasted 6 h before surgery. patients were premedicated using 0.03–0.05 mg/kg intravenous midazolam.

After placing standard monitors on the patients, general anesthesia was induced using intravenous propofol (2–3 mg/kg), intravenous fentanyl (1 μ/kg) and atracurium besylate (0.6 mg/kg) to facilitate intubation. Then patient was mechanically ventilated to keep end -tidal at CO2 at 30–35 mmHg. Anesthesia was maintained using minimum alveolar concentration of isoflurane 1.2% and 60% room air to 40% oxygen mixture with top - up doses of atracurium as required.

This study was not blind to the anesthesiologist due to different techniques, but the assessors of post-operative data were blinded. All techniques were performed after induction of general anesthesia and under ultrasound (SIEMENS ACUSON P300) aseptic precautions. Technique time calculated from the start of the position of the patient to the completed injection of local anesthetics.

SCPB was performed in the supine position with the head turned slightly away from the side to be blocked. Using posterior in-plane approach, high-frequency linear transducer (7–12 MHz) was placed in a transverse orientation across the neck with the probe marker facing medial. A 22-gauge needle was inserted at the posterior border of the SCM at the level of the cricoid cartilage. Local anesthetic was injected after negative aspiration [11].

Cervical RLB was performed in the lateral position of the patients. The patient's neck was slightly flexed forward, and the anesthesiologist who stood behind the patient. First, the landmark was the identification of cervical vertebrae number 7, as it is the largest and most prominent spinous process by palpation in the axial plane. Then counting up the spinous processes until reaching C5. Then the high-frequency curved transducer (2–9 MHz) placed in transverse position in the mid sagittal plane of C5 spinous process. Visualization of the vertebral lamina which appeared sonographically as continuous hyperechoic (bright, reflective) structures, the muscles above it were imaged. The deep neck muscle group has a distinctive tear drop shape (semispinalis cervicis, multifidus, and rotators) [12]. The 22-gauge needle was introduced using the out -of- plane approach to reach the lamina. After negative aspiration the local anesthetic was injected through the needle under ultrasound visualization [13].

ATN block was performed in all patients in both groups. The patient was in a supine position with head turned away from side of the block. A high-frequency linear ultrasound transducer (7–12 MHz) was placed between the tragus and temporomandibular joint. Color Doppler imaging was used to identify superficial temporal artery pulsations. The injection needle was inserted anterior to the tragus posterior to the temporal artery using the (out-of-plane approach), 1–1.5 cm until it reached the periosteum. The out-of-plane approach was used because the superficial temporal artery is in the way of needle entry in the in-plane approach during auriculotemporal nerve block. Following negative aspiration local anesthetic was injected [14].

After completion of surgery and reversal of the muscle relaxants, patients were extubated and sent to the post-anesthesia care unit (PACU) and then to the ward. The patients received 30 mg/8h intravenous ketorolac.

2.1. Study measurements

Heart rate (HR), mean arterial blood pressure (MBP) and oxygen saturation (SaO_2) were assessed basal and intraoperatively, then at 0, 1, 2, 6, 12 and 24 h post-operatively. Any increase in intraoperative HR or MBP of more than 20% was managed by giving fentanyl intravenously in increments of 25 mcg. A decrease in MBP to less than 55 mmHg was considered a hypotensive episode, which was managed by ephedrine in increments of 5 mg.

The time of first analgesic request, and VAS at 0, 1, 2, 6, 12 and 24 h were recorded. Total post-operative pethidine consumption as pethidine was given as rescue analgesia in 25 mg intravenously when VAS $\geq$4. Sensory block was assessed post-operatively when the patient was fully awake by skin pinprick sensation at superficial cervical nerves dermatomal distribution [15, 16]. Assessment of diaphragmatic dysfunction was conducted using ultrasound when there was desaturation (SaO2< 90%), tachypnea or difficult breathing, which was confirmed by chest x-ray if there was suspicion of diaphragmatic dysfunction [17]. Complications observed were nausea, vomiting, headache, and Horner's which manifested by ptosis, miosis, anhidrosis, and enophthalmos.

2.2. Statistical analysis

The sample size was calculated based on the first analgesia request from a pilot study that included 10 patients. Using a two-tailed test with the G*- Power program, patients were allocated into two groups: a SCPB group and a cervical RLB group. The mean duration to first request of analgesia after the SCPB was 11.31 h and SD of 3.38 while that for RLB group was 16.23 h and SD 4.49. Assuming an effect size of 1.238, $\alpha = 0.05$ and a power of 95%. The sample size was 36 patients, 10% were added to compensate for possible drop out. Thus, 40 cases were recruited to be analyzed, 20 in each group.

Statistical analysis of the collected data was done using IBM's Statistical Package for the Social Science (SPSS) statistics for Windows (version 25). Microsoft Excel for Windows 2019 and the SPSS chart builder were used to generate charts. The normality of the data distribution was checked using the Shapiro-Wilk test. Mean ± SD was used for expression of normally distributed continuous variables, while abnormally distributed continuous variables and categorical variables were expressed as median and inter-quartile range or number and percentage. Normally and abnormally distributed continuous data were analyzed using the Student's t-test and Mann-Whitney, respectively. Categorical data were analyzed using the Chi-squared test with the crosstabs function in SPSS. A 95% confidence interval (95% CI) was used with all tests. The difference was considered statistically significant when the P (probability) value was <0.05.

3. Results

This randomized study included 40 ASA I-II patients who were statistically analyzed. There were no excluded patients after the start of the study flow (Fig. 1). Patients demographic data and surgical data showed no statistically significant difference in two studied groups (Table 1).

Technique time was significantly longer in Group R. Intraoperative fentanyl requirement other than induction dose and atracurium requirement were significantly lower in Group R than Group S. Hypotensive episodes and subsequent ephedrine consumption were significantly higher in group RLB (Table 2).

There was a significantly lower HR in Group R perioperatively (Fig. 2). MBP was significantly lower in Group R perioperatively up to 12 h (Fig. 3). VAS was also significantly lower in Group R than Group S from 2 to 24 h (Table 3).

The time to first request for analgesia was longer in Group R than Group S. Both total pethidine consumption and its administration

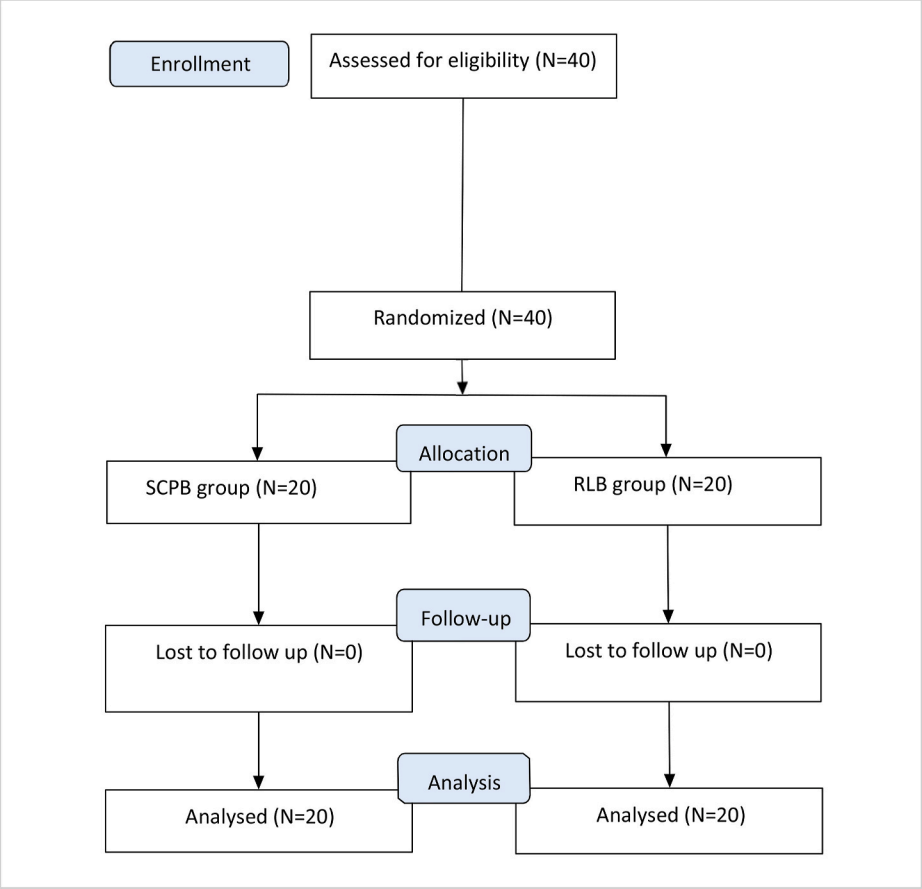

Fig. 1. Consort flow chart for patient eligibility.

Table 1
Demographic characteristics and surgical data of the studied groups (n = 40).

		Group R (n = 20)	Group S (n = 20)	95% CI	P value
Age (years)		44.45 ± 11.98	40.65 ± 10.25	−3.34, 10.94	0.288
Gender	Male % (n)	35.0% (7)	45.0% (9)	–	0.519
	Female% (n)	65.0% (13)	55.0% (11)		
Weight (kg)		74.50 ± 8.53	73.10 ± 8.67	−4.11, 6.91	0.610
Height (cm)		169.30 ± 6.08	170.25 ± 5.27	−4.60, 2.70	0.601
ASA	**I % (n)**	35.0% (7)	35.0% (7)	–	1
	II% (n)	65.0% (13)	65.0% (13)		
Duration of surgery (min)		133.50 ± 29.9	132.0 ± 22.6	- 15.49, 18.49	0.859

Data are expressed as mean and standard deviation or as percentage and frequency. P is significant when< 0.05.

Table 2
Intraoperative details in the studied groups (n = 40).

	Group R (n = 20)	Group S(n = 20)	95% CI	P value
Technique Time (minutes)	5.75 ± 0.4*	4.0 ± 0.0	1.55, 1.95	< **0.001**
Fentanyl dose after induction (μg)	0 (0)	0 (0–50)*	−22.78, −3.72	**0.008**
Number of fentanyl episodes (doses) n (%)	0 (0.0%)	6 (30.0%)*	–	**0.008**
Atracurium dose after induction (mg)	33.00 ± 6.95	38.50 ± 9.74*	−10.92, −0.08	**0.047**
Ephedrine consumption (mg)	5 (0–15)*	0 (0)	3.19, 7.81	< **0.001**
Hypotension episodes n (%)	10 (50%)	0 (0.0%)	0.64, 1.56	< **0.001**

Data are expressed as mean and standard deviation or as median and range or as percentage and frequency. P is significant when < 0.05.

episodes were significantly higher in Group S (Table 4).

There was no difference between the two groups regarding the great auricular nerve block. However, transverse cervical and supraclavicular nerve blocks were more common in Group S. Instance of Horner's syndrome was significantly higher (20%) in Group S (Table 5).

There was no post-operative diaphragmatic dysfunction or vomiting in either group. There was also a low incidence of headache (5%), which occurred in Group R only.

4. Discussion

In this study, cervical RLB was first used as an analgesic technique, in combination with ATN block in parotid surgery. Analgesia was longer than associated with SCPB. Cervical RLB has been used as an effective analgesic technique for acute radicular pain in cervical disc prolapse. One study showed that an injection at the lamina of the affected level with 4 ml of lidocaine 0.5% and 1 ml of dexamethasone, reduced VAS to 50% post-procedure compared to pre procedure [18].

In a cadaveric study, fluoroscopy demonstrated the contrast spread of 5 ml dye injected at the level of C6. Spread was seen up to C2 cranially, T1 caudally, the articular pillars of C4 to C7, and the neural foramen of C6 laterally [17]. RLB is volume dependent, and high volume (40 ml) injection at T5 level in a cadaveric study revealed dye distribution to neural foramina, and to higher extent to epidural space

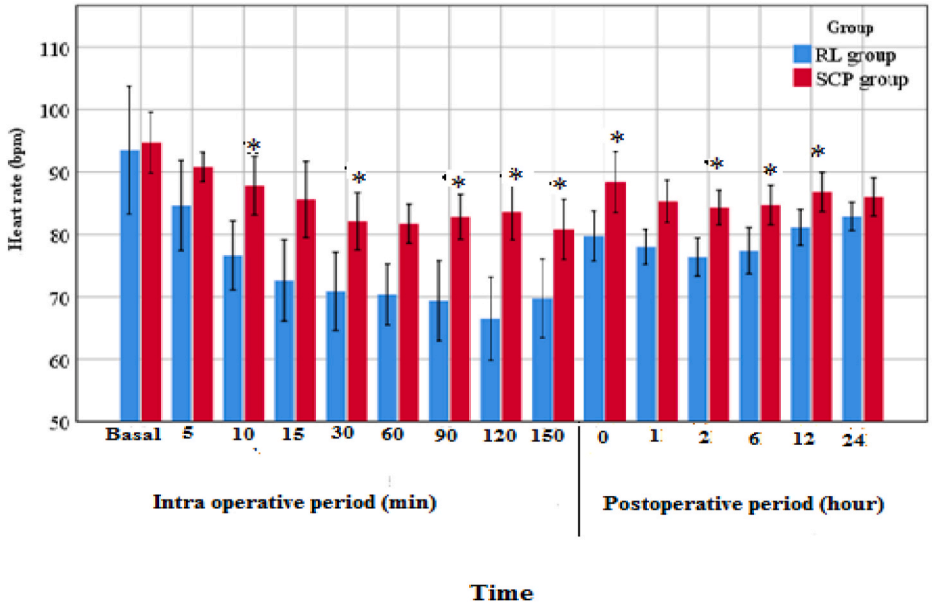

Fig. 2. Peri-operative heart rate (beat/min) measurements in both studied groups. *Significant intergroup difference $p \leq 0.05$.

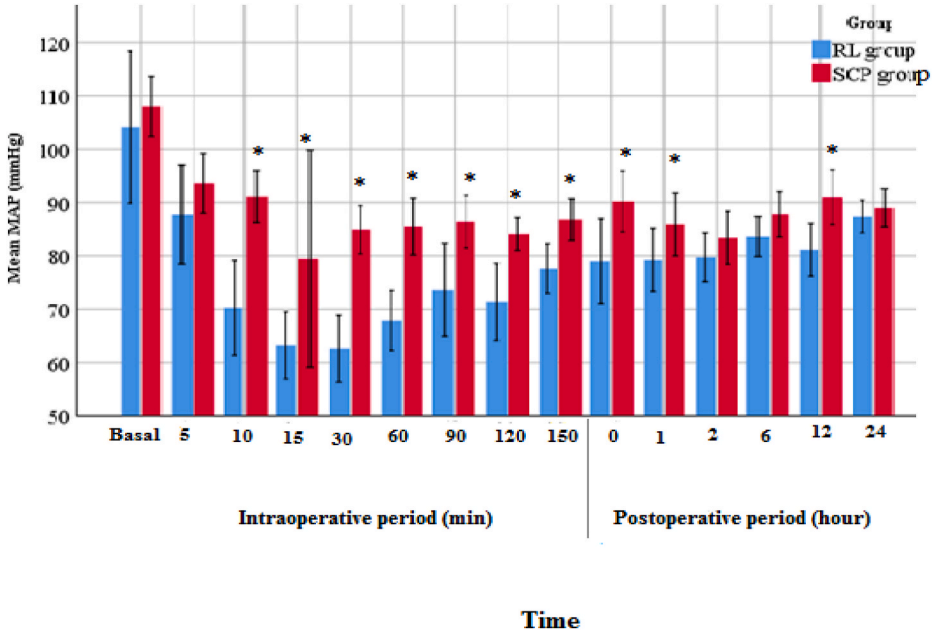

Fig. 3. Peri-operative mean arterial blood pressure (mmHg) measurements in both studied groups. *Significant intergroup difference $p \leq 0.05$.

Table 3
Post-operative VAS score in the studied groups (n = 40).

VAS	Group R (n = 20)	Group S (n = 20)	95% CI	P value
0 h (Immediate)	0 (0)	0 (0)	–	–
1 h	0 (0)	0 (0)	–	–
2 h	0 (0–2)	2 (0–3)*	−1.62, −0.38	**0.002**
6 h	2 (0–3)	2 (2–3)*	−1.84, −0.76	**< 0.001**
12 h	2 (0–5)	3 (3–6)*	−2.17, −0.73	**< 0.001**
24 h	3 (2–5)	4 (3–5)*	−1.22, −0.28	**0.002**

Data are expressed as median and range. P is significant when < 0.05.

Table 4
First Analgesia request and postoperative pethidine requirement in first day in the studied groups.

	Group R (n = 20)	Group S (n = 20)	95% CI	P value
Time of 1st Analgesia request (hours)	19.40 ± 3.67*	10.40 ± 2.41	7.01, 10.99	**< 0.001**
Pethidine requirement (mg)	0 (0–25)	50 (25*75)*	46.22, -29.78	**< 0.001**
Number pethidine episodes n **(%)**	8 (40%)	20 (100%)*	–	**< 0.001**

Data are expressed as mean and standard deviation or as median and range. *statistically significant ($p < 0.05$).

Table 5
Neural block characteristics in the two studied groups (n = 40).

Sensory nerve n (%)	Group R (n = 20)	Group S (n = 20)	P value
Transverse cervical (C2,3)	0 (0.0%)	20 (100.0%)*	**< 0.001**
Great auricular (C2,3)	6 (30.0%)	8 (40.0%)	0.507
Lesser occipital (C2,3)	6 (30.0%)	8 (40.0%)	0.507
Supraclavicular (C3,4)	6 (30.0%)	20 (100.0%)*	**< 0.001**
Axillary (C5,6)	1 (5.0%)	0 (0.0%)	0.311
Radial (C6,7)	1 (5.0%)	0 (0.0%)	0.311
Horner syndrome	0 (0.0%)	4 (20.0%)*	**0.035**

Data are expressed as percentage and frequency. P is significant when < 0.05.

involving five levels. In addition, dye diffusion was confined to the area between the spinous processes and the edge of the bony lamina [19].

In this study, we chose a total volume of local anesthetic (LA) of 20 ml, suggesting that high volumes (20–25 mL) would be required to achieve an effective analgesia. For RLB, 20 mL has been found to be more satisfactory than 10 or 15 mL, and 25 mL was equivalent to 20 mL in patients undergoing radical mastectomy [20]. In the high-volume group, injectate spread from the retrolaminar to PV space was observed in all studied cadavers. In the low-volume group, injectate spread to the PV space was not observed [21]. High volumes of LA injected into the retrolaminar space has been shown to generate pressures might allow for trickling of the injectate into the PV space through the anatomical communications between the two spaces [22].

Another cadaveric study using 20 ml of injectate at a level of T4 showed spread of injectate into either the thoracic paravertebral space (62.25%), epidural space (75%) or intervertebral foramina (50%) [23].

Anatomically, in the cervical region, there are three layers of deep cervical fascia: superficial, middle, and deep layers, which are also referred to as investing, peritracheal, and prevertebral, respectively. The prevertebral layer connects to the ligamentum nuchae and completely encircles the vertebrae, scalene, erector spinae, and associated vertebrae muscles, as well as neurological structures like the cervical sympathetic trunk ganglia, phrenic nerve and brachial plexus [24]. As a result, any injections beneath the prevertebral layer may cause spread to the surrounding structures [25].

In this study, the time to the first analgesia request was significantly longer in Group R. VAS was also significantly lower up to 24 h in Group R group. In a study involving breast surgery, RLB at T4 showed first analgesic request was at 4.8 (3.0–24) h when using 20 ml of a 0.375% levobupivacaine [6]. Another study in breast surgery using 20 ml of 0.5% ropivacaine at T7 reported duration of analgesia of up to 12 h, lower VAS from 4 to 12 h [7]. Different surgeries, levels of injection and no additives explained the different analgesic durations. A study investigating RLB for analgesia in rib fractures showed the duration of analgesia to be up to 24 h, with significantly lower VAS from 2 to 24 h using 20 ml of 0.5% ropivacaine [8]. In laparoscopic retroperitoneal nephrectomy, multiple-level injections at T8, 9, 10 with a total volume of 30 ml of 0.4% ropivacaine, showed the duration of analgesia in RLB to be up to 48 h, though VAS varied significantly from 6 to 48 h [9].

In this study, total opioid consumption and its episodes were significantly lower in Group R. RLB for breast surgery, using 20 ml of a 0.375% levobupivacaine at level T4 also showed lower opioid consumption than the control group (204 vs 293 mg, p = 0.05) [7]. In multiple rib fractures, RLB using 20 ml of 0.5% ropivacaine showed a decrease in morphine consumption of about 50% compared with erector spine plane block (7.35 ± 1.55 vs 14.73 ± 2.18 mg, p = 0.001) [8].

There was no control group in this study, which may be a limitation. However, following a parotidectomy, individuals feel variable degrees of pain and discomfort. Although pain tolerance is subjective and individualized, the VAS pain score is a reliable measure for subjective pain measurement. Foghsgaard et al. [26] reported that pain was found to be worst on the first post-operative day, gradually improving with each passing day. On day one, 31% of the participants had VAS 1, and 69% patients had VAS scores up to 6.5, with the average pain score being 3.0 [26].

Despite the superior analgesia in RLB, it took a longer time for performance in this study. This may be related to the acquiring positions of patients when performing the block, as Group R we assumed a lateral position, as well as deeper level identification by ultrasound.

We did not confirm the drug distribution through dye or radiological facilities in this study. However, in the Group R, 30% of patients showed sensory block of the great auricular nerve (C2, 3), lesser occipital nerve (C2, 3), and supraclavicular nerve (C3, 4), with 5% extended to the axillary nerve (C5, 6) and radial nerve (C6, 7), so we can conclude that the distribution of the sensory block in RLB was from C2 to C7**.** Sensory block was not evident in all patients despite extended analgesia for up to 19 h. This can be explained by the spread of LA to the epidural space or lateral spread to peripheral nerves via neural foramina [19]. Many studies have also shown that RLB can provide effective analgesia without causing sensory block [4,7,8].

Hypotensive episodes occurred in 50% of patients in Group R. Hypotension may be an indirect effect of sympathetic block in RLB, which may be due to paravertebral or epidural spread. Perioperative MBP was significantly lower in Group R up to 12 h**.** Liu et al. [9] reported that 31.5% of RLB patients with multiple rib fractures required ephedrine.

In Group S, the time of first analgesia request was 10.40 ± 2.41 h. Previous studies using SCPB in parotid surgery did not declare the duration to the first analgesia request [1–3]. However, Yaho et al. [27] showed that the first analgesic request following SCPB was 18 h in thyroid surgery**,** as they used higher concentration of LA 10 ml ropivacaine 0.5% [27]. Also, in a different study in thyroid surgeries, using 10 ml of 0.25% bupivacaine (without epinephrine) in SCPB, the 1st analgesic request was 132.3 ± 71.5 min [28].

Sensory block in Group S showed that the great auricular nerve (C2, 3) and lesser occipital nerve (C2, 3) were blocked in 40% of patients, while the transverse cervical (C2, 3) and supraclavicular nerves (C3, 4) were blocked in all patients. In thyroid surgeries using 6 mL of 0.5% ropivacaine for bilateral SCPB, a study showed that 1 out of 70 patients had left upper limb paresis after surgery, which cor-reacted to the blocking of C5-T1 dermatomes. However, after 12 h, the patient's motor function had recovered with no residual effects. This may be due to some leakage of the LA agent into the deep cervical space, blocking the nerve roots [29].

Sympathetic block was evident in both groups in our study. In Group S sympathetic block may be explained by stellate ganglion block presented as Horner's syndrome in 20% of patients. The syndrome resolved after 12 h in 2 cases, 10 h in the third case, and 16 h in the fourth case. Horner's syndrome may develop as a result of the deep spread of more than 3–5 mL of local anesthetic. Larger volumes of local anesthetic may cause higher intra-compartment pressures and enhance the deeper spread of the local anesthetic into the deep cervical fascial plane, which contain the phrenic nerve, brachial plexus, and stellate ganglion [25]. Nash et al. [30] reported that the investing layer of the deep cervical fascia is nearly non-existent in the anterior triangle of the neck, implying that fat and connective tissues surrounding the neck's neurovascular structures provide direct communication between the subcutaneous tissue and the prevertebral layer beneath the deep cervical fascia.

No cases of difficult breathing occurred in either group excluding diaphragmatic dysfunction. The phrenic nerve originates from the anterior rami of C3, 4, 5 nerve roots [31]. The phrenic nerve can be blocked as it arises at the lateral border of the anterior scalene muscle. It then passes inferiorly over the anterior surface of the anterior scalene, deep into the prevertebral layer of the cervical fascia. Injections of local anesthetics beneath the prevertebral layer may cause spread to the surrounding structures through which the phrenic nerve passes [25]. Zhao et al. [8] confirmed that the diaphragm was not affected in RLB [8]. Another study reported that the incidence of phrenic nerve block was 0% with SCPB [32], while the phrenic nerve was blocked in 61% of patients with deep cervical plexus block [33].

In this study, there was no significant difference in Post-operative

nausea and vomiting (PONV) in either group. In thyroid surgery, there was a reduction of PONV in the SCPB group (6%) when compared with the control (46%) has been seen [34].

5. Conclusion

Cervical RLB is more effective analgesic technique than SCPB, as the cervical RLB showed longer time to first analgesic request, lower intraoperative anesthetic consumption, lower total post-operative pethidine consumption and lower VAS.

Availability of data and materials

The data that support the findings of this study are available from the corresponding author upon request.

Ethical approval

Ethical approval was obtained from the Institutional Research Board with code number (MD. 19.03.162).

Funding sources

This research was self-funded and did not receive any specific grants.

Registration of research studies

ClinicalTrials.gov Number: NCT04138147.

Consent for publication

Written informed consent was obtained from all patients.

Provenance and peer review

Not commissioned, externally peer-reviewed.

Declaration of competing interest

The authors declare no competing interests.

Acknowledgements

Thanks to my colleague, Ahmed El-Shamy, for participation in statistical analysis of the data.

References

[1] M.A.S. Tesseroli, F.B. Zasso, H. Hepp, A.V.M. Priante, A.L.L. de Mattos Filho, A. Sanabria, Parotidectomy under sedation and loco regional anesthesia with monitoring of brain activity, Head Neck 39 (2017) 744–747, https://doi.org/10.1002/hed.24674.

[2] M. Ibrahim, Superficial parotidectomy under local anesthesia, case report, Egypt. J. Anaesth. 33 (2017) 303–305, https://doi.org/10.1016/j.egja.2017.01.002.

[3] K. Shahid, B.K. Siddiqui, M.H. Tahir, S. bin Ayub, G.M. Memon, A. Yousuf, Total parotidectomy under local anesthesia: a novel technique, J. Coll. Phys. Surg. Pak. 17 (2007) 116–117. https://ecommons.aku.edu/pakistan_fhs_mc_bbs/681.

[4] G. Pfeiffer, N. Oppitz, S. Schöne, I. Richter-Heine, M. Höhne, C. Koltermann, Analgesia of the axilla using a paravertebral catheter in the lamina technique, Anaesthesist 55 (2006) 423–427, https://doi.org/10.1007/s00101-005-0969-0-.

[5] C. Voscopoulos, D. Palaniappan, J. Zeballos, H. Ko, D. Janfaza, K. Vlassakov, The ultrasound-guided retrolaminar block, Can. J.of Anesth. 60 (2013) 888–895, https://doi.org/10.1007/s12630-013-9983-x.

[6] S. Sotome, A. Sawada, A. Wada, H. Shima, G. Kutomi, M. Yamakage, Erector spinae plane block versus retrolaminar block for postoperative analgesia after breast surgery: a randomized controlled trial, J. Anesth. 35 (2021) 27–34, https://doi.org/10.1007/s00540-020-02855-y.

[7] B.Y. Hwang, E. Kim, J.Y. Kwon, J.Y. Lee, D. Lee, E.J. Park, et al., The analgesic efficacy of a single injection of ultrasound-guided retrolaminar paravertebral block for breast surgery: a prospective, randomized, double-blinded study, Kor. J. Pain 33 (2020) 378–385, https://doi.org/10.3344/kjp.33.4.378.

[8] Y. Zhao, Y. Tao, S. Zheng, N. Cai, L. Cheng, H. Xie, et al., Effects of erector spinae plane block and retrolaminar block on analgesia for multiple rib fractures: a randomized, double-blinded clinical trial, Brazil. J. Anesthesiol. 72 (2021) 115–121, https://doi.org/10.1016/j.bjane.2021.04.004.

[9] D. Liu, X. Xu, Y. Zhu, X. Liu, F. Zhao, G. Liang, et al., Safety and efficacy of ultrasound-guided retrolaminar block of multiple injections in retroperitoneal laparoscopic nephrectomy: a prospective randomized controlled study, J. Pain Res. 14 (2021) 333, https://doi.org/10.2147/JPR.S282500.

[10] M.K. Campbell, G. Piaggio, D.R. Elbourne, D.G. Altman, Consort 2010 statement: extension to cluster randomised trials, BMJ 345 e5661 (2012), https://doi.org/10.1136/bmj.328.7441.702.

[11] A.A. Herring, M.B. Stone, O. Frenkel, A. Chipman, A.D. Nagdev, The ultrasound-guided superficial cervical plexus block for anesthesia and analgesia in emergency care settings, AJEM (Am. J. Emerg. Med.) 30 (2021) 1263–1267, https://doi.org/10.1016/j.ajem.2011.06.023.

[12] E. Kristjansson, Reliability of ultrasonography for the cervical multifidus muscle in asymptomatic and symptomatic subjects, Man. Ther. 9 (2004) 83–88, https://doi.org/10.1016/S1356-689X(03)00059-6.

[13] M. Stokes, J. Hides, J. Elliott, K. Kiesel, P. Hodges, Rehabilitative ultrasound imaging of the posterior paraspinal muscles, J. Orthop. Sports Phys. Ther. 37 (2007) 581–595. https://www.jospt.org/doi/10.2519/jospt.2007.2599.

[14] S.H. Im, H.J. Lee, J.S. Shim, K. Min, Ultrasound-guided auriculotemporal nerve block for post-herpetic auriculotemporal neuropathy: a case report, Neurol. Asia 22 (2017).

[15] Y. Asher, Hadzic's peripheral nerve blocks and anatomy for ultrasound-guided regional anesthesia, Anesthesiology 119 (2013), https://doi.org/10.1097/ALN.0b013e31828f4d80, 493-493.

[16] D. Casal, T. Cunha, D. Pais, I. Iria, M. Angélica-Almeida, G. Millan, et al., A stab wound to the axilla illustrating the importance of brachial plexus anatomy in an emergency context: a case report, J. Med. Case Rep. 11 (2017) 1–6, https://doi.org/10.1186/s13256-016-1162-6.

[17] T. Lioyd, Y. Tang, M. Benson, S. King, Diaphragmatic paralysis: the use of M mode ultrasound for diagnosis in adult, Spinal Cord 44 (2006) 505–508, https://doi.org/10.1038/sj.sc.3101889.

[18] U. Hochberg, M.F. Perez, S. Brill, M. Khashan, J. de Santiago, A new solution to an old problem: ultrasound-guided cervical retrolaminar injection for acute cervical radicular pain: prospective clinical pilot study and cadaveric study, Spine 15 (46) (2021) 1370–1377, https://doi.org/10.1097/BRS.0000000000004024.

[19] S.D. Adhikary, S. Bernard, H. Lopez, K.J. Chin, Erector spinae plane block versus retrolaminar block: a magnetic resonance imaging and anatomical study, Reg. Anesth. Pain Med. 43 (2018) 756–762, https://doi.org/10.1097/AAP.0000000000000798.

[20] T. Murouchi, M. Yamakage, Retrolaminar block: analgesic efficacy and safety evaluation, J. Anesth. 30 (2016) 1003–1007, https://doi.org/10.1007/s00540-016-2230-1.

[21] M. Damjanovska, T.S. Pintaric, E. Cvetko, K. Vlassakov, The ultrasound-guided retrolaminar block: volume-dependent injectate distribution, J. Pain Res. 11 (2018) 293–299, https://doi.org/10.2147/jpr.s.153660.

[22] S. Nair, H. Gallagher, N. Conlon, Paravertebral blocks and novel alternatives, BJA Educ. 20 (2020), https://doi.org/10.1016/j.bjae.2020.01.006.

[23] A.S. Sabouri, L. Crawford, S.K. Bick, A. Nozari, T.A. Anderson, Is a Retrolaminar approach to the thoracic paravertebral space possible: a human cadaveric study? Reg. Anesth. Pain Med. 43 (2018) 864–868, https://doi.org/10.1097/AAP.0000000000000828.

[24] S.C. Borene, R.W. Rosenquist, R. Koorn, N. Haider, A.P. Boezaart, An indication for continuous cervical paravertebral block (posterior approach to the interscalene space), Anesth. Analg. 97 (2003) 898–900, https://doi.org/10.1213/01.ANE.0000072702.79692.17.

[25] J.J. Pandit, R. Satya-Krishna, P. Gration P, Superficial or deep cervical plexus block for carotid endarterectomy: a systematic review of complications, Br. J. Anaesth. 99 (2007) 159–169, https://doi.org/10.1093/bja/aem160.

[26] S. Nair, H. Gallagher, N. Conlon, Paravertebral blocks and novel alternatives, BJA Educ. 20 (2020), https://doi.org/10.1016/j.bjae.2020.01.006.

[27] Y. Yao, C. Lin, Q. He, H. Gao, L. Jin, X. Zheng, Ultrasound-guided bilateral superficial cervical plexus blocks enhance the quality of recovery in patients undergoing thyroid cancer surgery: a randomized controlled trial, J. Clin. Anesth. 61 (2020), 109651, https://doi.org/10.1016/j.jclinane.2019.109651.

[28] Y.B. Woldegerima, A.G. Hailekiros, G.L. Fitiwi, The analgesic efficacy of bilateral superficial cervical plexus block for thyroid surgery under general anesthesia: a prospective cohort study, BMC Res. Notes 13 (2020) 1–6, https://doi.org/10.1186/s13104-020-4907-7.

[29] S.Y. Hoh, Y.K. Doon, S.S. Chong, K.L. Ng, Randomized controlled trial comparing bilateral superficial cervical plexus block and local wound infiltration for pain control in thyroid surgery, Asian J. Surg. 42 (2019) 1001–1008, https://doi.org/10.1016/j.asjsur.2019.01.017.

[30] L. Nash, H.D. Nicholson, M. Zhang, Does the investing layer of the deep cervical fascia exist? Anesthesiology 103 (2005) 962–968, https://doi.org/10.1097/00000542-200511000-00010.

[31] N. Toddard, J.R. Heil, D.R. Lowery, Anatomy, Thorax, mediastinum, 2020. StatPearls [Internet], https://www.ncbi.nlm.nih.gov/books/NBK539819/.

[32] R. Martusevicius, F. Swiatek, L.G. Joergensen, H.B. Nielsen, Ultrasound-guided loco regional anesthesia for carotid endarterectomy: aprospective observational

study, Eur. J. Vasc. Endovasc. Surg. 44 (2012) 27–30, https://doi.org/10.1016/j.ejvs.2012.04.008. .

[33] M.R. Castresana, R.D. Masters, E.J. Castresana, S. Stefansson, I.J. Shaker, W. H. Newman, Incidence and clinical significance of hemi diaphragmatic paresis in patients undergoing carotid endarterectomy during cervical plexus block anesthesia, J. Neurosurg. Anesthesiol. 6 (1994) 21–23, https://doi.org/10.1097/00008506-199401000-00003. .

[34] Y.J. Suh, Y.S. Kim, J.H. In, J.D. Joo, Y.S. Jeon, H.K. Kim, Comparison of analgesic efficacy between bilateral superficial and combined (superficial and deep) cervical plexus block administered before thyroid surgery, Eur. J. 26 (2009) 1043–1047, https://doi.org/10.1097/EJA.0b013e32832d6913.