Original Article

Effect of ultrasound-guided bilateral superficial cervical plexus block versus perioperative intravenous lidocaine infusion on postoperative quality of recovery in patients undergoing thyroidectomy: A randomised double-blind comparative trial

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ABSTRACT

Background and Aims: Recent studies have found that ultrasound-guided (USG) bilateral superficial cervical plexus block (BSCPB) and intravenous infusion of lidocaine (IVL) have the potential to improve the quality of postoperative recovery. This study aimed to investigate and compare their effects on postoperative quality of recovery in patients undergoing thyroidectomy. **Methods:** A total of 135 patients were randomised to Group N: BSCPB with 10 mL 0.75% ropivacaine on each side, Group L: intravenous lidocaine (1.5 mg/kg for 10 min, followed by 1.5 mg/kg/h) and Group C: intravenous saline combined with BSCPB saline. The primary objective was quality of recovery-40 (QoR-40). Other parameters compared were numeric rating pain scale (NRS) score, haemodynamic data, opioid dosage and incidence of adverse effects. Statistical analysis was performed using the one-way analysis of variance (ANOVA), the Kruskal-Wallis test and the Chi-square test. **Results:** Compared to Group C, both groups N and L had higher QoR-40 total scores as well as scores indicating physical comfort, emotional state and pain dimensions on postoperative day (POD) 1 and POD2 ($P < 0.001$). The QoR-40 total and pain dimension scores in Group N were higher on POD1 and POD2 ($P < 0.05$). The NRS scores and the change in haemodynamics were lower in Group N compared to groups L and C ($P < 0.05$). The results of other parameters were lower in groups N and L than in Group C ($P < 0.05$). **Conclusion:** USG BSCPB and IVL are comparable in improving the quality of postoperative recovery in patients undergoing thyroidectomy.

Keywords: Analgesia, lidocaine, quality of recovery, thyroidectomy, ultrasound-guided cervical plexus block

INTRODUCTION

Thyroidectomy is a primary treatment method for thyroid tumours.[1] Intraoperative tissue injury, postoperative inflammatory response and oedema can lead to postoperative pain, anxiety, depression and other negative emotions which in turn, affect the patient's breathing and feeding activities, reduce the quality of early postoperative recovery and hinder rapid postoperative recovery.[2] To minimise the physiological and psychological stress experienced

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by patients, reduce postoperative complications and enhance recovery after surgery (ERAS), the guidelines for thyroid ERAS recommend the use of ultrasound-guided (USG) bilateral superficial cervical plexus block (BSCPB) and perioperative intravenous infusion of lidocaine (IVL).[3] The evaluation of the quality of early postoperative recovery has evolved from focusing on a single aspect to a multidimensional assessment that includes physical comfort, pain, emotional state, physical independence and psychological support. The Quality of Recovery-40 (QoR-40) scale is an effective and comprehensive tool for accurately assessing the quality of a patient's recovery following anaesthesia and surgery.[4]

A BSCPB, when combined with general anaesthesia, can effectively reduce surgical stimulation and the incidence of peripheral nerve injury, alleviate stress reactions and decrease the need for analgesics and the occurrence of postoperative complications.[5] In addition, research has demonstrated that perioperative IVL has the potential to alleviate postoperative pain and the dosage of opioids.[6] Although several studies are reporting these two regimens in improving the quality of postoperative recovery in patients undergoing thyroid surgery, the differences between BSCPB and IVL in enhancing the quality of postoperative recovery in patients are unclear.[7,8] This research aimed to compare the effects of USG-BSCPB and IVL on the quality of postoperative recovery in patients undergoing thyroidectomy under general anaesthesia.

METHODS

This single-centre, randomised, double-blind clinical trial was carried out after obtaining approval from the institutional ethics committee (vide approval number HEYLL202206, dated 30/08/2022). The study was registered at www.chictr.org.cn (registration number: ChiCTR2200065273, dated 01/11/2022). All procedures performed in research involving human participants were in accordance with the ethical standards of the institutional and national research committee, as well as the 1975 Helsinki Declaration and its later 2013 amendments and good clinical practice. After obtaining written and inforned consent for participation in the study and use of the patient data for research and educational purposes, patients who met the inclusion criteria were randomised into three groups: the USG-BSCPB group (Group N), the lidocaine group (Group L) and the saline control group (Group C).

A total of 135 patients who underwent elective thyroidectomy between August 2022 and April 2023 were included in the study. The inclusion criteria were patients between 18 and 65 years of age with an American Society of Anesthesiologists (ASA) physical status I/II and undergoing thyroidectomy under general anaesthesia (including total thyroidectomy, subtotal thyroidectomy and thyroid carcinoma resection). Patients having major organ disease (such as heart, brain, lung, liver or kidney disease), uncontrolled hypertension or hyperthyroidism, patients requiring a change in surgical scope, patients with coagulation disorders or haematological diseases, patients with an allergy to experimental drugs (such as lidocaine) or having adverse drug reactions, pregnant and lactating women, those with surgical puncture site or systemic infection, and those with airway difficulties during induction of anaesthesia requiring a change in the routine tracheal intubation method were excluded from the study.

The randomisation sequence was generated by a computer and handed over in sealed, opaque, sequentially numbered envelopes. The envelope was opened by an anaesthetist who was not involved in the study, and drugs were dispensed as per the allocation card. The configured medications were then handed over to experienced anaesthetists who were not aware of the subgroups and who performed USG-BSCPB.

Before surgery, all patients followed a routine fasting period of more than 8 h without food or drink, and no premedication drugs were administered. Upon arrival in the operating room, each patient was routinely monitored with non-invasive blood pressure, pulse oximeter, electrocardiogram and entropy index. After 5 min of preoxygenation, intravenous (IV) midazolam 0.05 mg/kg, sufentanil 0.5 μg/kg, 1% propofol 1.5 mg/kg and rocuronium bromide 0.6 mg/kg were administered for routine fast-track anaesthesia induction. After that, tracheal intubation was performed, lungs were ventilated with tidal volume of 8–10 mL/kg, inspiratory/expiratory ratio of 1:2 and end-tidal carbon dioxide concentration of 35–40 mmHg, were set by adjusting the respiratory rate. Group L patients were given IVL (1.5 mg/kg) for 10 min before induction of anaesthesia, followed by 1.5 mg/kg/h infusion until the end of the surgery. After induction of anaesthesia, USG-BSCPB was performed, and an equal volume of

normal saline was injected. Group N patients were infused with IV normal saline for 10 min before induction of anaesthesia, followed by 1.5 mg/kg/h infusion until the end of the surgery. After induction of anaesthesia, 10 mL of 0.75% ropivacaine was administered to each side for USG-BSCPB using a 6–13 MHz linear array ultrasound transducer (MyLabTwice; Esaote S.p.A, Senova, Italy). Group C patients were infused with IV normal saline for 10 min before induction of anaesthesia, followed by 1.5 mg/kg/h infusion until the end of the surgery. After induction of anaesthesia, USG-BSCPB was performed, and an equal volume of normal saline was injected.

IV propofol and remifentanil infusion rates were adjusted to attain entropy index response (RE) to state entropy (SE) ratio of 40–60. Vasoactive medications, including IV atropine and ephedrine, were administered as needed to maintain the mean arterial pressure (MAP) within 20% of the basal value. After surgery, the tracheal tube was removed once the patient met the criteria for tracheal extubation, including restoration of the patient's consciousness, cough and swallowing reflexes, a tidal volume greater than 5 mL/kg and a respiratory rate below 20 breaths per min. In the post-anaesthesia care unit (PACU), remedial analgesia was administered with IV ketorolac tromethamine 30 mg if the patient's numeric rating pain scale (NRS) score was ≥5 or if the patient required analgesia.

All scales were assessed by an independent anaesthesiologist blinded to group allocation. The primary endpoint was the quality of recovery, assessed on postoperative day (POD) 1 using the QoR-40 scale. The QoR-40 scale includes five dimensions: physical comfort, pain, emotional state, physical independence and psychological support, with 40 items and a total score of 200 points. The quality of recovery improves with a higher score.[4] Secondary endpoints such as QoR-40 score on a preoperative day (PRE) and POD2, NRS score at 1, 2, 4, 6, 12 and 24 h postoperatively, and MAP and heart rate (HR) after placing the patient on the operating table, before induction, before intubation, immediately after intubation, 5 min after intubation, beginning of the surgery, end of the surgery, just before extubation and immediately after extubation were recorded. The other parameters, such as the consumption of opioids (including sufentanil and remifentanil), the number of patients requiring rescue analgesia, awakening time and extubation time, and the occurrence of postoperative sore throat (POST), were also recorded.

According to a previous study, a difference of at least 6.3 points in the QoR-40 score is clinically significant.[9] The sample size was determined using Power Analysis and Sample Size (PASS) Version 15.0 (NCSS, Kaysville, UT, USA). Based on the pre-experimental results, the minimum required sample size at a 5% level of significance, 80% power and standard deviation of 13, was 35 patients in each group. We decided to enrol 45 participants in each group, considering a 20% dropout rate. The data was analysed using Statistical Package for the Social Sciences (SPSS) Version 26.0 (International Business Machines Corporation, Armonk, NY, USA). One-way analysis of variance (ANOVA) was employed to compare groups, while repeated measures ANOVA was used to compare different time points within the groups. The QoR-40 dimensions and NRS scores were reported as medians (interquartile ranges [IQR]) and compared using the Kruskal–Wallis test. The Chi-square test or Fisher's exact test was used to compare categorical variables such as the incidences of adverse effects. Other parameters such as the total QoR-40 score, the consumption of opioids sufentanil and remifentanil, the number of patients requiring rescue analgesia, awakening time and extubation time were analysed using ANOVA. A *P*-value less than 0.05 was considered statistically significant.

RESULTS

The study enroled 135 patients [Figure 1]. However, four patients were excluded due to dislodged ligatures requiring reoperation after thyroid surgery, and another four patients were excluded because they could not complete the scoring after surgery. Demographic characteristics and intraoperative data, including type of surgery, duration of surgery and anaesthesia, were comparable among the three groups [Table 1].

There was no significant difference in the preoperative total QoR-40 score and the scores of the five dimensions among the three groups ($P > 0.05$). However, in groups N and L, the total QoR-40 score and the scores of the physical comfort, emotional state and pain dimensions on POD1 and POD2 were higher than in Group C ($P < 0.05$). Furthermore, the total QoR-40 scores in Group N were higher than in Group L on POD1 and POD2 ($P = 0.023$ on POD1, $P = 0.042$ on POD2). Group N also had higher scores than Group L on the pain dimension of the QoR-40 scale on POD1 and POD2 ($P = 0.047$ on POD1, $P = 0.023$ on POD2) [Table 2].

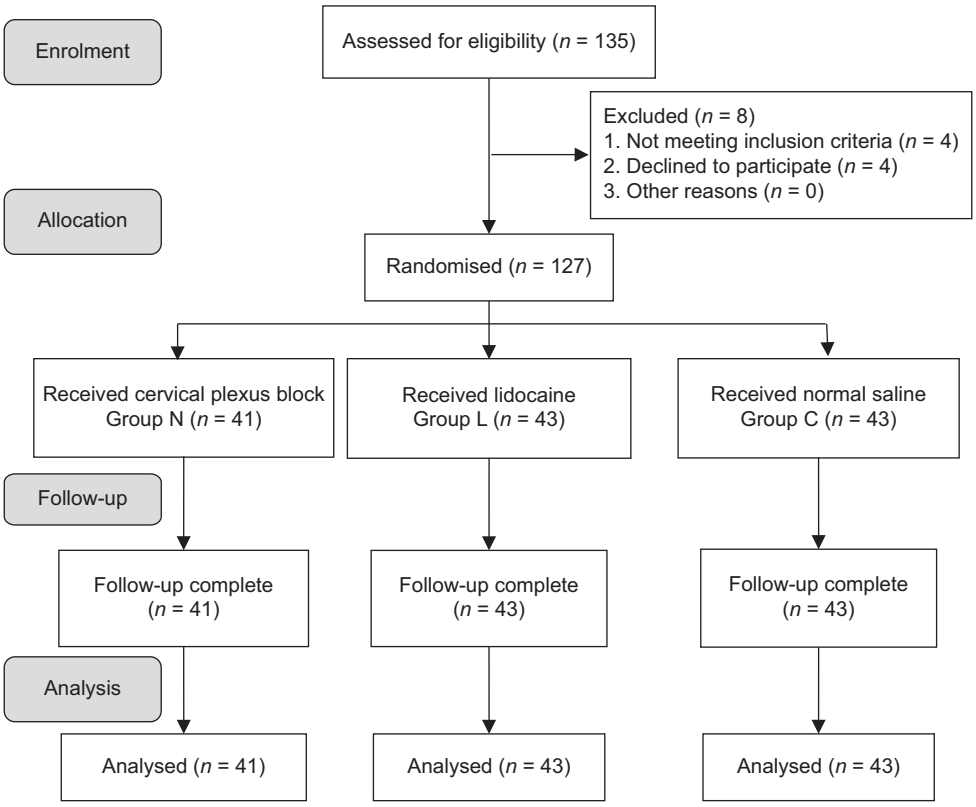

Figure 1: Consolidated standards of reporting trials (CONSORT) flow of participants

Table 1: Demographic data and baseline parameters

	Group C (*n*=43)	Group L (*n*=43)	Group N (*n*=41)
Age (years)	52.09 (7.94)	48.74 (9.34)	47.85 (11.19)
Gender (male/female)	12/31	15/28	12/29
Height (cm)	163.33 (6.54)	165.67 (7.15)	163.37 (6.82)
Weight (kg)	65.77 (9.74)	67.90 (9.08)	64.15 (9.35)
BMI (kg/m^2)	24.57 (2.59)	24.70 (2.44)	24.02 (3.08)
ASA (I/II)	38/5	37/6	36/5
Smoking history (yes/no)	8/35	6/37	5/36
Hypertension (yes/no)	8/35	5/38	7/34
Surgical type, (n)			
Total thyroidectomy	13	7	3
Subtotal thyroidectomy	9	9	14
Thyroid carcinoma resection	21	27	24
Duration of surgery (min)	91.74 (33.06)	89.19 (31.49)	100.12 (34.96)
Duration of anaesthesia (min)	109.53 (34.62)	105.77 (33.82)	121.32 (35.98)

Data expressed as mean (standard deviation) or number. Group C: Control group, Group L: Lidocaine group, Group N: Cervical plexus block group. ASA=American Society of Anesthesiologists, BMI=Body mass index

The NRS scores of Group C were considerably higher than those of groups N and L at 1, 2, 4, 6, 12 and 24 h postoperatively. ($P < 0.05$). The NRS score of Group N was lower than that of Group L at 6 and 12 h postoperatively ($P = 0.047$ at 6 h, $P = 0.048$ at 12 h) [Table 3]. In T0, T1, T2 and T6, there was no significant difference in MAP or HR among the three groups ($P > 0.05$). However, at T3, T4, T5, T7, and T8, MAP and HR in groups N and L were significantly lower than in Group C ($P < 0.05$). Furthermore, MAP and HR in Group N were significantly lower than in Group L at T7 and T8 ($P < 0.05$). For the rest of the time points, there was no significant difference in MAP or HR between the N and L groups ($P > 0.05$) [Figure 2].

There was no significant difference in propofol consumption among the three groups ($P > 0.05$). However, the remifentanil consumption and the number of patients requiring rescue analgesia were lower in Group N and Group L than in

Table 2: Comparison of differences between the total QoR-40 score and each dimension score

	Group C (*n*=43)	Group L (*n*=43)	Group N (*n*=41)	F/Z (DF, *n*-DF)	*P*
QoR-40 scores					
PRE	185.58 (5.09) (184.02-187.15)	185.09 (5.42) (183.43-186.76)	185.78 (5.50) (184.04-187.52)	0.186 (2,214)	0.831
POD1	167.02 (6.99) (164.87-169.17)	175.05 (7.31) (172.80-177.30)	178.56 (6.64) (176.46-180.66)	28.110 (2,124)	<0.001
POD2	175.00 (6.47) (173.01-176.99)	182.40 (5.46) (180.71-184.08)	185.07 (5.97) (183.19-186.96)	25.264 (2,124)	<0.001
QoR-40 dimensions scores					
Physical comfort					
PRE	54 (52,56) (52.51-54.47)	54 (50,56) (52.20-54.49)	55 (52,56) (52.74-54.97)	0.849 (2,124)	0.626
POD1	47 (45,52) (48.60-51.81)	53 (47,55) (50.94-53.11)	54 (49,57) (51.49-54.27)	6.209 (2,124)	<0.001
POD2	52 (47,54) (50.05-53.11)	54 (51,56) (52.78-55.04)	54 (52,58) (53.08-55.56)	8.970 (2,124)	<0.001
Emotional state					
PRE	40 (38,42) (39.12-40.51)	39 (38,40) (38.82-40.02)	40 (38,41) (38.93-40.24)	0.763 (2,124)	0.742
POD1	35 (35,36) (35.14-36.21)	37 (36,38) (36.16-37.56)	36 (36,38) (36.30-37.50)	12.950 (2,124)	<0.001
POD2	37 (37,39) (37.20-38.24)	39 (38,39) (38.46-39.44)	39 (37.5,40) (38.30-39.50)	13.873 (2,124)	<0.001
Physical independence					
PRE	25 (25,25) (24.73-24.99)	25 (25,25) (24.64-24.90)	25 (25,25) (24.63-24.93)	1.838 (2,124)	0.468
POD1	24 (24,24) (22.83-23.36)	24 (23,24) (23.06-23.78)	24 (24,24) (23.74-24.16)	17.480 (2,124)	0.341
POD2	25 (24,25) (24.28-24.65)	24 (24,25) (23.86-24.24)	25 (24,25) (24.53-24.83)	22.509 (2,124)	0.074
Psychological support					
PRE	35 (35,35) (34.58-34.91)	35 (35,35) (34.48-34.87)	35 (35,35) (34.63-34.98)	1.526 (2,124)	0.613
POD1	34 (33,35) (32.73-33.31)	34 (32,34) (32.69-33.55)	34 (34,34) (33.61-34.14)	14.230 (2,124)	0.115
POD2	35 (34,35) (34.17-34.62)	34 (34,35) (33.82-34.27)	35 (34,35) (34.43-34.84)	16.375 (2,124)	0.065
Pain					
PRE	33 (32,34) (32.28-33.06)	33 (32,34) (32.53-33.23)	33 (32,34) (32.37-33.14)	0.187 (2,124)	0.911
POD1	25 (24,27) (24.82-26.01)	30 (28,31) (28.93-30.23)	31 (30,32) (30.49-31.51)	74.850 (2,124)	<0.001
POD2	28 (27,28) (27.49-28.51)	31 (31,32) (30.98-31.76)	33 (32,33) (32.12-32.95)	81.879 (2,124)	<0.001

Data expressed as mean (standard deviation) (95% confidence interval) or median (interquartile range) (95% confidence interval). Group L: lidocaine group, Group N: cervical plexus block group, Group C: control group; QoR-40 = Quality of Recovery-40, PRE = preoperative day, POD1 = postoperative day 1, POD2 = postoperative day 2, DF= degree of freedom

Table 3: Comparison of pain scores at each time point after the surgery

	Group C (*n*=43)	Group L (*n*=43)	Group N (*n*=41)	*Z* (DF)	*P*
NRS scores					
1 h	3 (2.4) (2.28–3.16)	2 (1.3) (1.57–2.38)	1 (1.2) (1.25–1.92)	16.524 (2)	<0.001
2 h	3 (2.4) (2.59–3.41)	2 (2.3) (2.21–2.86)	2 (1.2) (1.68–2.32)	16.090 (2)	<0.001
4 h	4 (3.4) (3.03–4.86)	3 (2.3) (2.46–3.07)	2 (2.3) (1.92–2.51)	22.727 (2)	<0.001
6 h	4 (2.4) (2.52–4.29)	2 (2.3) (2.33–2.78)	2 (2.2) (1.83–2.31)	13.928 (2)	<0.001
12 h	3 (2.4) (2.25–3.01)	2 (2.2) (1.88–2.30)	2 (1.2) (1.43–1.84)	19.128 (2)	<0.001
24 h	2 (1.3) (1.93–2.81)	1 (1.3) (1.46–2.22)	1 (1.2) (1.18–1.75)	10.098 (2)	0.006

Data expressed as median (interquartile range) (95% confidence interval). Group C: control group, Group L: lidocaine group, Group N: cervical plexus block group. NRS=numeric rating pain scale, DF=degree of freedom

Group C ($P < 0.05$). Moreover, the awakening and extubation times were shorter in Group N and Group L than in Group C ($P < 0.001$). The incidence of POST was lower in Group N (34.1%) and Group L (20.9%) than in Group C (51.2%) ($P = 0.01$). There was no significant difference between Group N and Group L regarding the remifentanil dosage, the number of patients requiring rescue analgesia, awakening time, extubation time and the incidence of POST [Table 4]. Complications such as Horner syndrome and toxic effects of local anaesthetics related to BSCPB and IVL were not observed in this study.

DISCUSSION

We observed from our study that USG-BSCPB and IVL are comparable in improving the quality of postoperative recovery in patients undergoing thyroidectomy under general anaesthesia.

The QoR-40 scale used in this study effectively, comprehensively and accurately assesses the quality of patients' postoperative recovery.[10,11] We found that Group N and Group L had considerably higher scores than Group C in physical comfort, emotional state and pain dimensions, which aligns with Yao *et al*.'s[12] findings. Shu *et al*.[13] also reported significantly higher total QoR-15 scores in the lidocaine group compared to those in the control group. Similarly, in a trial by Hu *et al*.,[14] it was shown that uremic patients with secondary hyperparathyroidism who had parathyroidectomy exhibited a higher QoR-40 score on POD1 in the group receiving BSCPB compared to the group receiving saline as a control. In addition, Group N had higher total QoR-40 scores and pain dimension scores in POD1 and POD2 than Group L ($P < 0.05$). However, the average disparity in QoR-40 scores between Group N and Group L was only 3.5 points on POD1 and 2.7 points on POD2, which is lower than the minimum clinically significant difference (MCID) of 6.3. Therefore, both BSCPB and IVL can significantly enhance the quality of postoperative recovery for patients who have undergone thyroidectomy. Still, it is impossible to consider BSCPB superior to IVL in improving the quality of postoperative recovery. These results suggest that BSCPB and IVL can effectively alleviate postoperative pain in patients. BSCPB may provide better pain relief than perioperative IVL, which aligns with the results reported by Mayhew *et al*.[15]

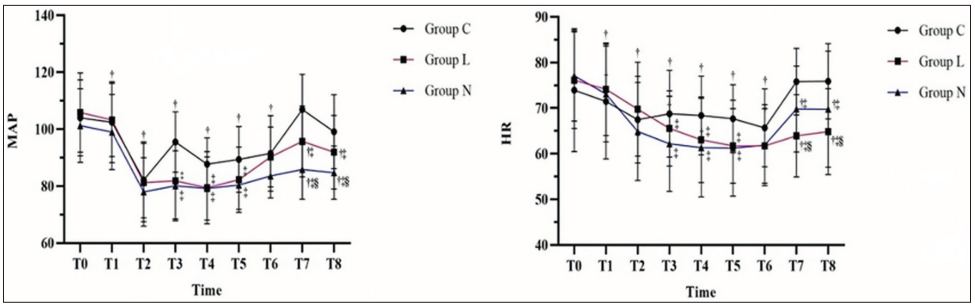

Figure 2: Haemodynamics of the three groups at T0–T8 during the operation. T0, after placing the patient on the operating table; T1, before induction; T2, before intubation; T3, immediately after intubation; T4, 5 min after intubation; T5, beginning of the surgery; T6, end of the surgery; T7, just before extubation; T8, immediately after extubation. Group C: control group, Group L: lidocaine group, Group N: cervical plexus block group. †*P*-value comparing T0 versus T1–T8 within the group. ‡*P* comparing Group C versus Group L and Group N. §*P* comparing Group L versus Group N. HR = heart rate, MAP = mean arterial pressure

Table 4: Comparison of the other perioperative indices among the three groups

	Group C (*n*=43)	Group L (*n*=43)	Group N (*n*=41)	*F*/*Z* (DF)	*P*
Propofol (mg)	706.16 (242.92) (631.40–780.92)	702.74 (217.84) (635.70–769.78)	719.29 (228.33) (647.22–791.36)	0.060 (2)	0.942
Remifentanil (μg)	547.67 (173.12) (494.40–600.95)	348.49 (114.32) (313.31–383.67)	394.15 (118.93) (356.61–431.68)	24.393 (2)	<0.001
Awakening time (min)	24.07 (9.50) (21.15–26.99)	16.07 (6.51) (14.07–18.07)	14.71 (6.10) (12.79–16.62)	19.138 (2)	<0.001
Extubation time (min)	25.05 (9.80) (22.03–28.06)	17.12 (6.68) (15.06–19.17)	15.29 (6.50) (13.24–17.34)	18.628 (2)	<0.001
POST, *n* (%)	22 (51.2%)	9 (20.9%)	14 (34.1%)	16.001 (2)	0.013
Number of patients requiring rescue analgesia, *n* (%)	10 (23.3%)	4 (9.3%)	2 (4.9%)	7.079 (2)	0.047

Data expressed as mean (standard deviation) (95% confidence interval) or number. Group C: Control group, Group L: Lidocaine group, Group N: Cervical plexus block group. POST=Postoperative sore throat, DF=Degree of freedom

Studies have shown that POST is the most common form of postoperative pain experienced by patients undergoing thyroid surgery.[16-18] In our experiment, the trial revealed a reduced occurrence of POST in groups N and L compared to Group C, which aligns with the differences in pain dimension scores observed in the three groups. In accordance with the outcomes of our investigation, the findings indicated that an intracuff injection of lidocaine and IV lidocaine had significant efficacy in preventing POST at 1 and 24 h postoperatively when compared to lidocaine spray and tracheal tube lidocaine application.[19] There are few studies on whether BSCPB can reduce the incidence of POST in patients undergoing thyroid surgery. Suh *et al*.[20] found that BSCPB reduced the incidence of incision pain better after thyroid surgery than combined superficial and deep cervical plexus block, but the effect on POST is still inconclusive.

One possible explanation for the use of lidocaine to prevent POST is its association with the inhibition of airway sensory C-fibre activation and sensory neuropeptide release.[18,21] Another explanation is that lidocaine reduces the risk of damage to the tracheal mucosa during extubation, thereby reducing the occurrence of POST.[22] Also, we observed that compared to Group C, the intake of remifentanil decreased significantly in both Group N and Group L, and the postoperative awakening and extubation times were shortened. We believe that this may be due to the analgesic effects of the cervical plexus block and lidocaine, which lessen the consumption of opioids used during the operation and hasten patients' recovery afterwards.

We observed that Group N and Group L demonstrated a more stable haemodynamic environment than Group C during tracheal intubation, skin incision and extubation. In addition, Group N exhibited greater haemodynamic stability than Group L during extubation.

The strength of our study is that it is the first time that these two perioperative analgesic techniques are compared to explore a safer and more effective perioperative anaesthesia-assisted technique, which can accelerate patients' rapid recovery. However, the research has several limitations. First, we did not use a standardised scale to assess the degree of POST at different time points postoperatively, and further experimental studies are needed to confirm the hypothesis. Second, we should have evaluated the effects of these two options on patients' emotional state, duration of hospital stay and cost, which need to be evaluated and explored in more studies in the future.

CONCLUSION

USG-BSCPB and IVL are comparable in improving the quality of postoperative recovery in patients undergoing thyroidectomy under general anaesthesia.

Study data availability

De-identified data may be requested with reasonable justification from the authors (email to the corresponding author) and shall be shared after approval per the authors' institution policy.

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Conflicts of interest

There are no conflicts of interest.

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