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Research article

Analgesic efficacy of ultrasound guided versus landmark-based bilateral superficial cervical plexus block for thyroid surgery

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ABSTRACT

Background: The use of bilateral superficial cervical plexus block (BSCPB) to provide analgesia for thyroid operations remains debatable. This study was done to assess the analgesic efficacy and safety of ultrasound (US) guided or landmark-based BSCPB, performed under general anesthesia, compared to systemic narcotics in thyroid surgery.

Patients and methods: A total of 69 patients ASA I and II scheduled for thyroid surgery were randomly assigned into three groups (23 patients each): Group (US) received US guided BSCPB. Group (LM) received landmark-based BSCPB. In both groups, the block was performed under general anesthesia and before surgery using 0.5% bupivacaine 12 ml on each side. Group (C) who didn't receive any block. We measured intra-operative hemodynamics and fentanyl requirements. We also measured postoperative analgesia within 24 h of surgery as regard: pethidine consumption, visual analogue scale (VAS) pain scores and time to first rescue analgesic demand. Postoperative nausea and vomiting (PONV) and other adverse events were noted as well.

Results: There was a significant reduction in systolic blood pressure (SBP) and heart rate (HR) in groups US and LM compared with group C. Intra-operative fentanyl requirements were significantly increased in group C compared to groups US and LM. Time to first analgesic request was significantly longer in groups US and LM than in group C. Postoperative pethidine consumption and VAS scores, measured during the first postoperative day, were significantly higher in group C than groups US and LM. No significant difference was noted between the three groups regarding PONV. No other adverse events were recorded. No significant differences were noted between groups US and LM.

Conclusion: BSCPB (US guided or landmark-based), performed under general anesthesia, effectively decreased peri-operative analgesic requirements in thyroid operations. However, there was no significant difference in analgesic efficacy or safety between US guided and landmark based BSCPB.

1. Introduction

The importance of preemptive analgesia has been driven from an assumption that specific changes happen in higher centers in the brain and the spinal cord in response to pain. These changes may result in stimulation and enhancement of pain transmission and perception. Accordingly, postoperative analgesia should be considered before the start of surgery, together with intraoperative analgesia [1].

Patients may complain of moderate pain that is generally of short duration following thyroid surgery but none the less, some patients ask for analgesics in the form of narcotics or non-opioid analgesics during the first day after thyroid operations. Postoperative pain management after thyroid surgery has also gained more importance and attention because thyroid surgery is recently being performed on a day case basis [2].

Non-steroidal anti-inflammatory drugs (NSAIDS) may not produce effective pain relief and at the same time may increase the risk of postoperative bleeding with the thyroid being a highly vascular organ. On the other hand, opioid analgesics may increase the risk of postoperative nausea and vomiting (PONV) or produce postoperative respiratory depression [1].

One of the well-established regional anesthesia modalities that can offer analgesia for thyroid surgery is superficial cervical plexus block, performed bilaterally [3]. The ventral rami of cervical nerves (C1-4) form the cervical plexus. The nerves pass laterally along the corresponding transverse process behind the vertebral vessels. The

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deep branches are purely motor, while the superficial ones are sensory supplying skin and subcutaneous tissues of the neck [4]. Some authors have reported that SCPB combined with general anesthesia for thyroid surgery has significantly reduced analgesic requirements [5,6]. However, other authors reported conflicting results [7]. Most of the published work that was done to assess the analgesic efficacy of SCPB in thyroid surgery, has adopted the landmark-based technique where local anesthetic mixture is injected based on anatomical landmarks without the use of ultrasound [3].

The superficial branches of the cervical plexus can be visualized and demonstrated with their relation to the surrounding structures and anatomy with the use of ultrasound machine. Ultrasound (US) guided SCPB has many privileges over the conventional landmark-based block, including the ability to witness the anesthetic mixture diffuse in the right intermuscular plane that has been targeted and to avoid injury of important nearby structures [4].

The aim of the present study was to evaluate and compare the analgesic efficacy and safety of pre-surgical (US) guided or landmark-based BSCPB versus systemic narcotics alone in thyroid surgeries.

2. Patients and methods

After approval of the ethical committee in charge sixty-nine adult euthyroid patients were consented to participate in this prospective, double-blind, randomized work at Ain Shams university hospital. The patients were ASA physical status I-II male or female, scheduled to undergo elective thyroid operations that will be carried out under general anesthesia. Abnormal thyroid functions, sub-sternal goiters or the need for lymph node dissection were all criteria for patients' exclusion. If narcotics or non-opioid analgesics were given to patients preoperatively, those patients were excluded from the study. Other exclusion criteria were: Patients who suffered coagulopathies or any other contraindication to regional anesthesia, age < 18 years, patients who have known allergy to local anesthetic drugs, pregnant females and patients who had to undergo emergency re-operations in the first day after surgery.

All patients included were allocated randomly (using computer-generated number lists and opaque sealed envelopes) into three groups: group US (n = 23) who received ultrasound guided bilateral superficial cervical plexus block (BSCPB); Group LM (n = 23) who received landmark-based BSCPB. Group US and LM received 12 ml 0.5% bupivacaine on each side of the neck, after general anesthesia was established and before proceeding with surgery. Group C (n = 23) who received general anesthesia with systemic narcotics and no block.

Pre-anesthetic evaluation including patient's history, examination and investigations was performed one day before surgery. All patients fasted overnight, were given 150 mg Ranitidine and 4 mg ondansetron slowly IV via an 18G cannula inserted peripherally before induction of general anesthesia. The patients were also premedicated with midazolam 0.02 mg/kg IV. A standard monitor and baseline vital readings were recorded. IV lactated ringer's solution infusion 6–8 ml/kg was started. The visual analogue score (VAS) was explained to all participants preoperatively.

Induction of general anesthesia was done using propofol 2 mg/kg, fentanyl 1 ug/kg, and atracurium 0.5 mg/kg for orotracheal intubation. Maintenance of anesthesia was done with isoflurane (1.2%) in an oxygen-air mixture (60/40%). Patients who showed more than 20% increase in systolic blood pressure (SBP) or heart rate (HR), compared to baseline readings, were given additional doses of fentanyl (0.5 mcg/kg) intraoperatively. Thyroid surgery was done according to a standardized procedure.

The block was done by a well-trained anesthesiologist, after induction of general anesthesia and before proceeding with surgery in groups US and LM.

2.1. Ultrasound guided BSCPB

The following equipment was prepared: Honda electronics HS-2100 portable ultrasound machine with linear probe 6–12 MHz, sterile sleeve, and gel. Regional anesthesia tray with sterile towels, gloves and gauze packs. Two 20 ml syringes containing the anesthetic mixture. A 2.5-in., 23-gauge needle attached to extension tube. The block was performed with the patient lying supine and head turned to the contra lateral side. The transducer was situated transversely over the lateral aspect of the patient's neck, after skin sterilization, at the middle of the posterior edge of the sternocleidomastoid (SCM). The transducer was displaced backwards to identify and visualize the tapering posterior edge of the muscle in the middle of the view captured on the screen. The plexus appears as nodules that are hypoechoic below the prevertebral fascia and immediately above the inter-scalene groove. The needle was introduced from the posterior aspect, with an in-plane technique, through the skin and platysma adjacent to the plexus, deep to SCM, under the prevertebral fascia and above the inter-scalene groove. After negative aspiration, 12 ml of local anesthetic was deposited in this plane, just behind the posterior border of SCM. The local anesthetic spread was witnessed in the right plane (Fig. 1).

2.2. Landmark-based BSCPB

Patient positioning was the same as ultrasound guided block. Same equipment was prepared as in the ultrasound guided block but without the ultrasound. Landmark was the posterior border of the SCM, point of injection was at the midpoint of the posterior border of SCM – this is usually at the level of the cricoid cartilage. The needle was inserted to half the depth of the muscle and 8 ml of local anesthetic (LA) were injected cephalic and caudal at the posterior border of the SCM to block the supraclavicular, occipital and auricular branches. Additional local anesthetic was injected transversely above the muscle to anesthetize the transverse cervical nerve, to give a total volume of 12 ml of the prepared LA solution on each side. The depth of mixture injection was not >5 mm to prevent spread to phrenic or recurrent laryngeal nerve.

The onset of action for this block is 10–15 min. Intraoperatively, systolic blood pressure (SBP) and heart rate (HR) were noted: (a) at the time of skin incision (around 15 min from the block) then (b) every 15 min till the end of surgery. The duration of surgery and fentanyl requirements were also recorded. At the end of the surgical procedure, reversal of neuromuscular block was done, and assessment of vocal cord mobility by laryngoscopy was performed before extubation. All patients were transferred to post anesthesia care unit (PACU).

Postoperative analgesia was evaluated by: (a) VAS (visual analogue score), (b) total postoperative pethidine consumption, (c) time to first rescue analgesic request. The VAS was noted when the patients were transferred to PACU, then every four hours for the first 24 h. The VAS was assessed during three phases: at rest, while swallowing and during lateral neck rotation. The VAS is a horizontal line 10 cm in length, where 0 cm means no pain and 10 cm means the worst pain ever. The patient marks on the line the point that represents their pain. Patients with VAS 3 or more at rest or VAS 4 or more whilst swallowing or lateral neck rotation were given rescue analgesic medication in the form of pethidine 0.5 mg/kg IV.

Total postoperative pethidine (mg) given in the first 24 h and time to first rescue analgesic demand (minutes) were measured. Incidence of PONV in the first 24 h was recorded. Nausea and

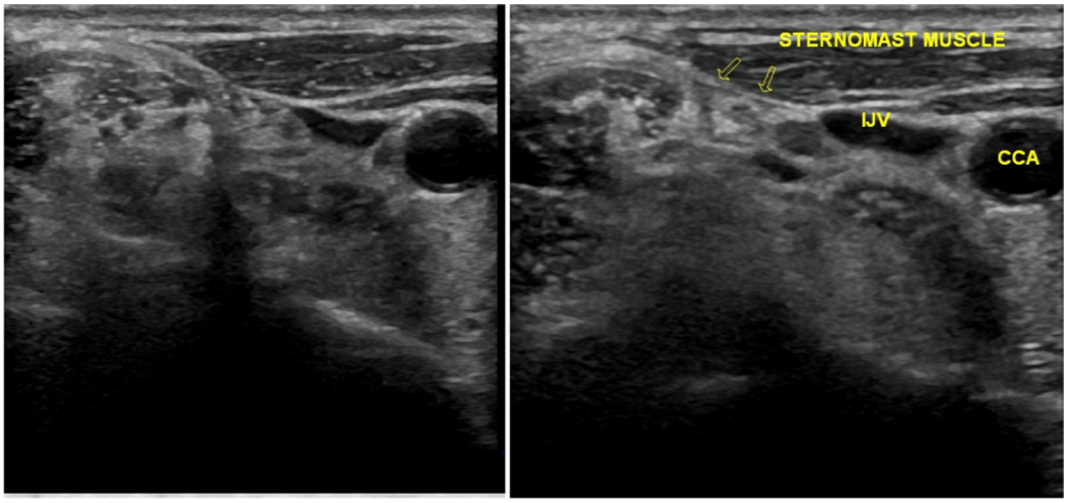

Fig. 1. Ultrasound guided superficial cervical plexus block: arrows pointing at sternocleidomastoid-scalene inter muscular plane where local anesthetic is injected (right side of the neck). IJV: internal jugular vein, CCA: common carotid artery.

vomiting were evaluated by PONV score; 1 = no nausea, 2 = mild nausea, 3 = severe nausea, 4 = retching and/or vomiting. Severe PONV were considered as grades 3 and 4 whereas mild or no PONV were defined as grades 1 and 2. When severe PONV occurred, ondansetron 0.08 mg/kg IV was given.

The primary outcome was total pethidine consumption in the first 24 h post-operatively. The secondary outcomes were intraoperative fentanyl requirements, hemodynamic differences between the three groups, postoperative VAS pain scores and time to first rescue analgesic request. All adverse events like phrenic nerve or recurrent laryngeal nerve palsy and other complications related to surgery and the regional anesthetic technique were recorded as well.

All data were collected by an observer blinded to the technique used in any of the three groups.

3. Sample size calculation

In a one-way ANOVA study, sample sizes of 21 patients per group will achieve 80% power to detect differences among the means versus the alternative of equal means using an F test with a 0.05 significance level. The size of the variation in the means is represented by their standard deviation which is 16.33. The common standard deviation within a group is assumed to be 30.00. The number of patients included in each group was 23 to replace the dropouts.

4. Statistical methods

Data were analyzed using SPSS 21.0 for Windows (SPSS, Chicago, IL, USA). Analysis of variance was used to compare the three groups for quantitative parametric data with post hoc Tukey's test performed if there was a significant difference among the groups, a. Kruskal-wallis test was used for quantitative non-parametric data. Chi square test was used for comparison of qualitative data. Continuous parametric data was presented as mean ± SD, non-parametric data as median (IQR) and categorical data was presented as number of patients. P-values of <0.05 were considered significant and <0.001 highly significant.

5. Results

The present work was conducted on 69 patients randomly assigned into three equal groups; group US: received pre-surgical US guided BSCPB under general anesthesia, group LM: received pre-surgical landmark-based BSCPB under general anesthesia and group C: received only systemic narcotics. All 69 patients enrolled completed the study protocol (Fig. 2).

Patients' characteristics and duration of the procedure were similar in all three groups ($P > 0.05$) (Table 1).

Intraoperative measurements included hemodynamics (SBP and HR) and intraoperative fentanyl requirements. There was a statistically significant reduction in HR (Bpm) noted at the time of surgical incision and mean heart rate throughout surgery in groups US and LM compared with group C ($p < 0.001$). Whereas, there was no statistically significant difference observed between groups US and LM. SBP (mmHg) at the time of surgical incision and mean SBP throughout the procedure were also significantly higher in group C than groups US and LM ($p < 0.001$), but no significant difference was detected between groups US and LM (Table 2).

Intraoperative fentanyl requirements (mcg) were significantly higher in group C (73.9 ± 29.19 mcg) compared to groups US and LM ($p < 0.001$), at the same time no significant difference was detected between groups US and LM with minimal fentanyl requirements (two patients required fentanyl in group US received 40 and 50 mcg respectively, and two patients in group LM received 50 and 40 mcg respectively).

Postoperative measurements included: time to first rescue analgesic request (min), total postoperative pethidine consumption (mg) in the first 24 h, VAS scores (at rest, on swallowing and lateral neck rotation) recorded at PACU admission then every 4 h for the first 24 h postoperatively and PONV. Time to first rescue analgesic demand was significantly longer in groups US and LM than group C ($p < 0.001$), but no statistically significant difference was found between US and LM. Total postoperative pethidine consumption was significantly increased in group C compared with groups US and LM ($p < 0.001$), but no difference of significance was found between US and LM. There was no statistically significant difference between the three groups regarding the incidence of PONV ($P = 0.921$). No other adverse event (as phrenic nerve or recurrent laryngeal nerve palsy) was noted in any group (Table 2).

There was a significant reduction in VAS scores at all three phases (at rest, during swallowing and lateral neck rotation) and at all times of measurement in groups US and LM compared with group C (p-value < 0.001)., but no significant difference was observed between US and LM (Figs. 3–5).

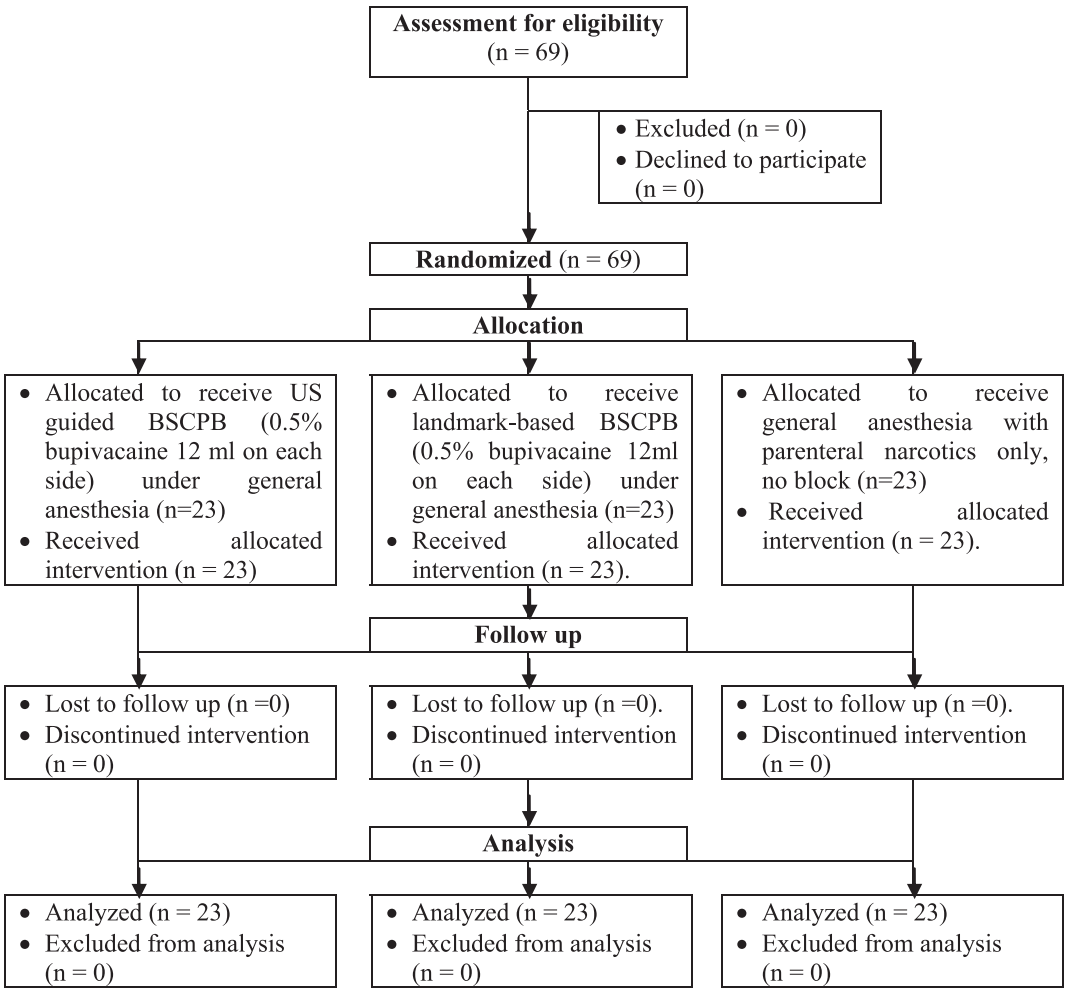

Fig. 2. CONSORT flow diagram showing number of patients at each phase of the study.

Table 1
Patients'characteristics and duration of the procedure.

	Group US (n = 23)	Group LM (n = 23)	Group C (n = 23)	p-value
Age (year)	37.5 ± 8.473	36.16 ± 7.28	41.1 ± 7.36	0.075
Sex (M/F)	8/15	5/18	7/16	0.538
Weight (kg)	77.15 ± 7.2	76.4 ± 7.87	80.48 ± 7.27	0.148
Duration of the procedure (min)	116.8 ± 14	114.2 ± 9.2	113.9 ± 11.96	0.43

US: ultrasound, LM: landmark, C: control. M/F: Male/Female, min: minute. Group US: received pre-surgical US guided BSCPB. Group LM: received BSCPB based on external anatomical landmarks. Group C: received only general anesthesia.
Data are presented as mean ± SD.
P > 0.05 was considered statistically non-significant between the 3 groups.

Table 2
Intraoperative hemodynamics, time to rescue analgesia, postoperative pethidine consumption and PONV.

	Group US (n = 23)	Group LM (n = 23)	Group C (n = 23)	p-value
Mean HR (Bpm)	55.23 ± 12	59.06 ± 5	87.03 ± 3.06[1]	<0.001
SBP incision (mmHg)	121.14 ± 12	117.8 ± 13.67	146 ± 9.2[1]	<0.001
Mean SBP (mmHg)	112.14 ± 10.3	107.86 ± 10.2	131 ± 3.51[1]	<0.001
HR incision (Bpm)	74.77 ± 6.47	72.69 ± 6.15	99.8 ± 8.8[1]	<0.001
Time to rescue analgesia (min)	412.56 ± 28.25	408.4 ± 28.77	18.8 ± 6.69[1]	<0.001
Postoperative Pethidine (mg)	34.77 ± 6.26	35 ± 6.22	113.3 ± 21.4[1]	<0.001
PONV score	2(1–2)	2(1–2)	1(1–2)	0.921

US: ultrasound, LM: landmark, C: control. HR: heart rate, Bpm: beat per minute, SBP: systolic blood pressure, PONV: Postoperative nausea and vomiting. Group US: received pre-surgical US guided BSCPB. Group LM: received BSCPB based on external anatomical landmarks. Group C: received only general anesthesia.
Data are presented as mean ± SD or median (IQR).
P < 0.05 was considered statistically significant between the 3 groups.
[1] P < 0.05 was considered statistically significant between group C & groups US, LM.

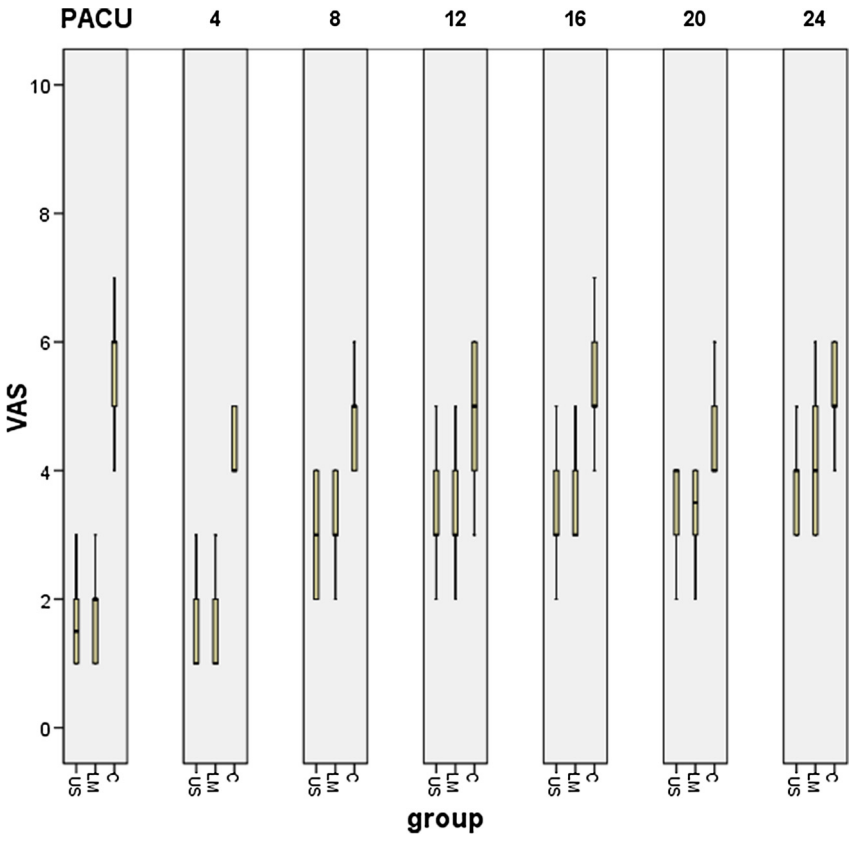

Fig. 3. The graph shows VAS pain scores on swallowing noted at PACU admission then every 4 h for the first 24 h. Patients in Group US had ultrasound guided pre-surgical BSCPB, those in group LM had pre-surgical BSCPB without ultrasound guidance (landmark-based) and those in group C had no block. The middle black solid line represents the median, the upper and lower margins of the boxes are IQR and the whiskers are maximum and minimum values.

6. Discussion

In the present work, we concluded that BSCPB, done under general anesthesia in patients undergoing thyroid operations using ultrasound guided or landmark-based techniques, significantly reduced postoperative analgesic requirements compared to systemic narcotics alone. VAS pain scores were significantly reduced in the first 24 h postoperatively and time to first rescue analgesic requirement was also prolonged with BSCPB indicating more efficient analgesia. However, no difference in analgesic efficacy or safety of BSCPB was observed when performed using US guided or landmark-based techniques.

Pain during swallowing, sense of burning in throat and pain due to incision may be among patients' complaints following thyroid operations [8]. Patients may need acute pain management in the first 24 h post-operatively. The acute pain following thyroid surgery may be treated using NSAIDS or opioids. Surgeons are hesitant, however, to use NSAIDS because of fear of bleeding which may be seriously problematic and life threatening after this type of surgery [9].

Analgesic agents that induce nausea or vomiting such as opioids are better to be avoided for pain relief following thyroid operations because these types of surgeries are famous to be associated with high incidence of PONV [10].

Pain relief after thyroid operations can be managed with BSCPB performed alone or some may perform combined superficial and deep cervical plexus blocks [8]. However, the life threatening serious adverse events (like phrenic nerve palsy) that may unfortunately occur with deep cervical plexus block render it inappropriate to perform such a block bilaterally [10]. It has been suggested that pain management after thyroid operations can be delivered by performing SCP block alone on both sides of the neck, providing the same analgesic efficacy as when combined with deep cervical plexus block [11].

US guidance has been used successfully and validated in other types of regional anesthesia and nerve blocks such as brachial plexus, sciatic and femoral nerve blocks [12]. Moreover, US can be used to block sensory nerves like the saphenous nerve, to identify and visualize intermuscular planes where local anesthetic mixtures are injected as in transversus abdominis plane (TAP) and obturator nerve blocks [13,14].

Commonly, the SCP block is performed using the conventional landmark-based technique where local anesthetic mixture is injected under the skin at the posterior edge of the SCM muscle [15].In the present work, we relied on US in one of our study groups to identify the plane between sternocleidomastoid and scalene muscles where the terminal branches of the SCP are found. We set out to validate US guided BSCPB in thyroid surgery by comparing it to landmark-based technique regarding intra- and postoperative analgesic efficacy and safety. We also compared both groups to systemic narcotics.

In a study performed by Andrieu et al. [10], they compared three groups of patients undergoing total thyroidectomy who received pre-surgical BSCPB as follows: one group received BSCPB with saline, another received BSCPB with ropivacaine (R) and the last one received BSCPB with ropivacaine and clonidine (RC). The block was landmark-based and a three-direction injection technique was used. Their primary outcome was nefopam consumption in the first day post-surgery. They demonstrated that BSCPB with ropivacaine or ropivacaine and clonidine was effective in decreasing analgesic needs after thyroid surgery and reducing postoperative pain. At PACU admission, pain scores were

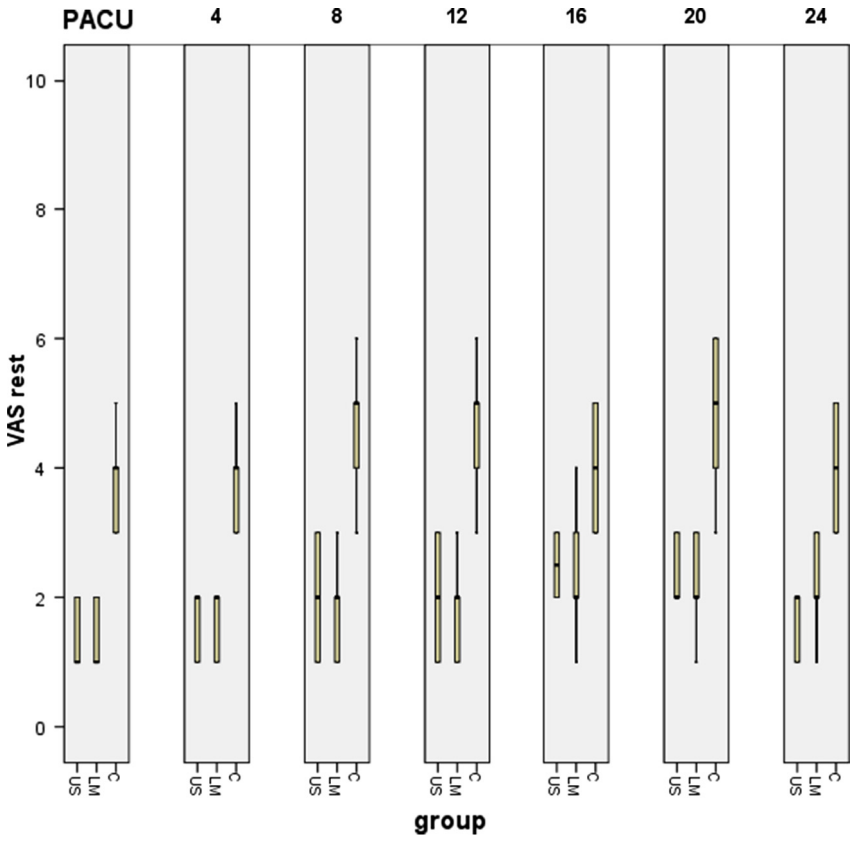

Fig. 4. The graph shows VAS pain scores at rest noted at PACU admission then every 4 h for the first 24 h. Patients in Group US had ultrasound guided pre-surgical BSCPB, those in group LM had pre-surgical BSCPB without ultrasound guidance (landmark-based) and those in group C had no block. The middle black solid line represents the median, the upper and lower margins of the boxes are IQR and the whiskers are maximum and minimum values.

significantly lower in patients who received BSCPB. This was consistent with our results, as we also observed that patients who received landmark based BSCPB had significantly reduced postoperative analgesic requirements and pain scores compared to patients who didn't receive any block. We used a three- direction injection technique as well.

Shih and colleagues [8], demonstrated results that were the same as the present study concerning time to first rescue analgesic request. They randomly assigned 162 patients undergoing elective thyroid surgery to receive pre-surgical BSCPB with isotonic saline (control), bupivacaine 0.5%, or levobupivacaine 0.5%. They injected 12 ml on each side after general anesthesia was established. They reported a significant prolongation in the time that elapsed before first analgesic dose was given in patients who received BSCPB as bupivacaine or levobupivacaine ($p < 0.001$). 24 h postoperative pain VAS scores were markedly reduced in the two groups who received local anesthetic agent in the block ($p < 0.001$) and that too was consistent with our results.

Karthikeyan and colleagues [2], similarly showed that first rescue analgesic demand time was significantly longer in patients who received BSCPB (for thyroid surgery after general anesthesia was established), as 0.25% bupivacaine alone or combined with clonidine, compared to patients who were given 0.9% normal saline in the block.

Kale and colleagues [1] randomly allocated sixty patients to receive BSCPB either before surgery (group A) or after completion of surgery (group B) or control group who received only systemic narcotics (group C). They found that Patients who were given BSCPB (groups A and B) had significant lower VAS pain scores (at rest, vocalization, movement and swallowing) compared to control group. The time for first rescue analgesic dose needed was longer with BSCPB than in the control group. Therefore, their results were consistent with the present work.

The analgesic efficacy of BSCPB and combined superficial and deep cervical plexus block after thyroidectomy, was compared by Suh and colleagues [16]. They observed that BSCPB with or without deep cervical plexus block decreased pain at rest and during swallowing at 0, 2, and 4 h after surgery compared to the control group.

Similarly, Gurkan and colleagues [17] performed a study to assess the analgesic effect of US guided BSCPB in patients undergoing thyroid surgery; fifty patients were assigned to either SCPB or no block. Bilateral SCPB was done before surgery using US with 10 ml 0.25% bupivacaine for each side. They demonstrated that postoperative morphine consumption was lower in BSCPB group compared to control group. However, unlike the present study, the VAS scores at 1st, 6th, 12th, and 24th h after surgery, were similar in SCPB and control groups, this difference may be related to the lower concentration and smaller volume of bupivacaine they used (10 ml 0.25% versus 12 ml 0.5% used in the current study).

Dieudonne and colleagues [18] performed a study on 90 patients who underwent thyroid surgery under general anesthesia. They received either: 20 ml isotonic sodium chloride or 20 ml 0.25% bupivacaine with epinephrine as landmark-based BSCPB at the end of operation. The block was performed using a three-direction injection technique as in the current study. They showed that BSCPB decreased postoperative morphine consumption with a smaller number of patients given morphine in the bupivacaine group. They also noted reduced severity of postoperative pain in patients who were given bupivacaine in BSCPB compared to the control group but not to the same extent that we found. This may be related to the fact that the block was performed at the end of surgery, after skin closure, whereas in the current study

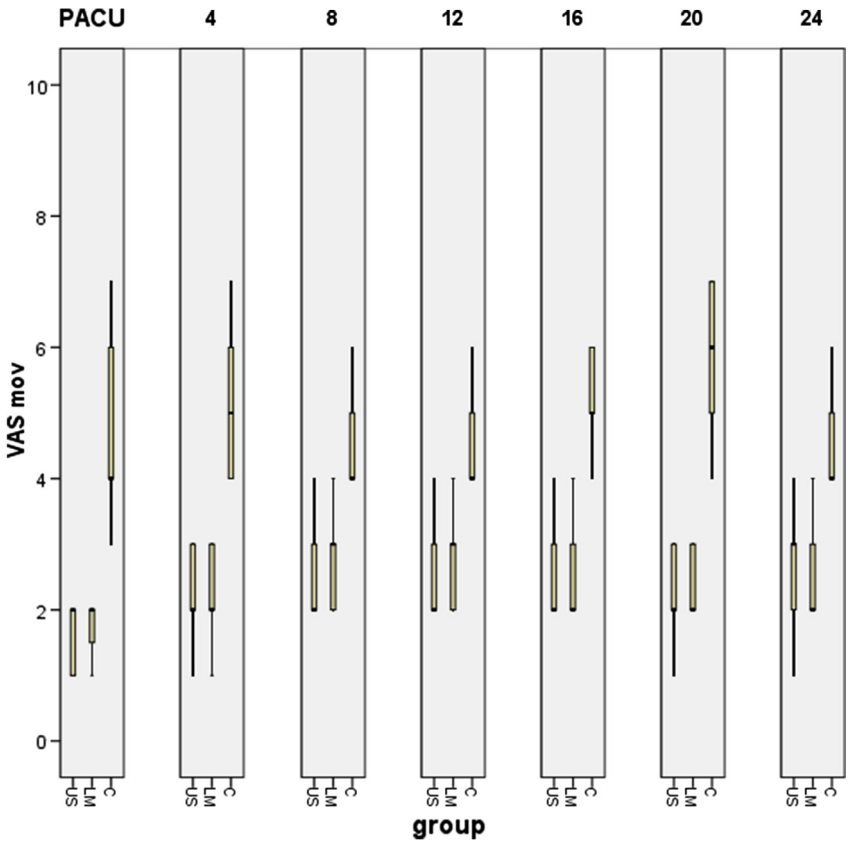

Fig. 5. The graph shows VAS pain scores at lateral neck rotation noted at PACU admission then every 4 h for the first 24 h postoperatively. Patients in Group US had ultrasound guided pre-surgical BSCPB, those in group LM had pre-surgical landmark-based BSCPB and those in group C had no block. The middle black solid line represents the median, the upper and lower margins of the boxes are IQR and the whiskers are maximum and minimum values.

the block was pre-surgical. This may have led to increased demand for analgesics when patients were discharged to PACU due to slow onset of action of bupivacaine (>20 min).

Herbland and colleagues [7] however, demonstrated results that were not consistent with the present study. They compared three groups; a group that didn't receive any block, one that received pre-surgical BSCPB and another that received post-surgical BSCPB under general anesthesia. They showed that BSCPB (performed with 0.75% ropivacaine) didn't improve postoperative analgesia (no differences were observed between the groups in postoperative morphine requirement or pain scores) after total thyroidectomy whether administered before or after surgery. The difference noted in our study may be attributed to the additional analgesia (anesthesia of the transverse cervical branch in addition to the main branches) provided by the three-injection technique we used compared to the two-injection method they adopted.

Eti et al. [19], performed a study to compare the effectiveness of analgesia provided with BSCPB versus wound infiltration with local anesthetic following thyroid surgery. They yielded results that were different from our work. They compared three groups; one received pre-surgical BSCPB with 0.25% bupivacaine alone (15 ml on each side) after induction of general anesthesia, another received local anesthetic infiltration of the wound with 20 ml of 0.25% bupivacaine and a control group where no block was given. They concluded that BSCPB or local wound infiltration didn't decrease postoperative analgesic consumption or reduce VAS pain scores. The difference between their conclusion and the results derived from the present study may be attributed to the fact that they used lower concentration of bupivacaine (0.25%) while we used bupivacaine (0.5%). This low concentration may have contributed to early recession of the block. However, their results were the same as the current study regarding time to first analgesic demand which was characteristically prolonged in BSCPB compared to the other two groups.

Another study conducted by Sardar and colleagues [20] reported results different from the present work. They randomly assigned 60 patients to receive either: landmark-based BSCPB with 0.25% bupivacaine (15 ml on each side), after induction of general anesthesia in thyroid surgery (n = 30), or no regional block was given (n = 30). VAS scores and postoperative analgesic consumption didn't differ between the groups. This may be explained by the lower concentration of bupivacaine they used (0.25%). However, Sardar and colleagues noted that time to first analgesic demand, in consistence with our results, was significantly prolonged in BSCPB group than in the control group.

Regarding intraoperative hemodynamics and intraoperative fentanyl requirements, the present study showed a significant decrease in SBP, HR (both at the time of incision and throughout the study) and intraoperative fentanyl given in BSCPB patients (groups US and LM) compared with group C (patients who received no block). However, no difference was detected between groups US and LM. In consistence with our results, Moussa in 2006 [11] compared 3 groups, 12 patients each: Group A, received SCPB bilaterally, prior to surgery after induction of general anesthesia, with 10 ml 0.5% bupivacaine and epinephrine. Group B received the same as group A combined with deep cervical plexus block with 5 ml 0.5% bupivacaine and epinephrine at the level of C3. Group C: received only general anesthesia. Intraoperative opioid supplemented in groups A & B was significantly lower compared with the control group, but without significant difference between groups A and B. Similarly, Karthikeyan et al. [2] reported that fentanyl supplemented during surgery was significantly reduced in

patients who received BSCPB with 0.25% bupivacaine alone or combined with clonidine (P = 0.012).

Hayes and colleagues [21] performed a study on twenty-eight patients undergoing unilateral neck dissection who were randomly allocated into two groups: one was the control group who received saline and the other group received bupivacaine in unilateral combined (superficial and deep) cervical plexus block. They reported that heart rate, systolic and diastolic blood pressures, showed a significant decrease intraoperatively in the group who received combined cervical plexus block compared to the control group with p-value (0.000). However, in the present work we anesthetized the superficial cervical plexus only.

Nausea and vomiting after thyroid surgery may be attributed to a variety of factors; inhalational anesthetics, opioid analgesics or manipulations by the surgeon [8]. The current work noted no statistically significant difference between the groups regarding the incidence of PONV which may be attributed to the administration of ondansetron preoperatively in all the study groups. Andrieu et al. [10] reported that although intraoperative opioids given were much less in patients blocked with ropivacaine and clonidine, yet it was not sufficient to reduce PONV compared to the control group. There was no difference in the incidence of PONV between the three study groups. They reported that 35.6% of patients suffered PONV which is a higher incidence compared to the present study. This may be attributed to the absence of prophylactic anti-emetics.

In contrast to the present work, Karthikeyan et al. [2] observed significant decrease in the incidence of PONV in group BC (BSCPB with bupivacaine and clonidine). This may be related to the effect of clonidine.

Serious complications have not been previously reported with SCPB, however care should be taken to avoid injecting excessive volume of local anesthetic or too deep injections. Large volumes or deep injections may result in spread to the phrenic nerve, recurrent laryngeal nerve, deep cervical plexus or brachial plexus. BSCPB has the advantage of being safer and devoid of serious complications [22]. In the present work, we observed no significant adverse events, particularly there was no incidence of recurrent laryngeal nerve or phrenic nerve palsy by the spread of local anesthetics.

The present study showed no significant differences regarding analgesic efficacy or incidence of block related adverse events between US guided or landmark-based BSCPB. The peri-operative analgesic efficacy was nearly the same in the two groups US and LM. This may be explained by the assumption that the investing layer of fascia thought to be under the SCM may not exist at all [23,24], therefore drugs injected subcutaneously without the use of US can diffuse easily into the targeted intermuscular plane [24] and produce effective anesthesia of the SCP. Moreover, the superficial location of the branches of the SCP renders them easy to be anesthetized blindly by subcutaneous injection of local anesthetic mixture [23,24]. Our practice didn't report any adverse events with the landmark-based BSCPB because the volume of local anesthetic was not excessive and depth of injection was not >5 mm, while performing the block, to avoid spread of local anesthetics to phrenic nerve or recurrent laryngeal nerve.

Tran and colleagues [15], demonstrated that US did not increase the success rate of SCPB compared with a landmark-based technique. They randomly allocated forty patients undergoing surgical procedures involving clavicle or shoulder to receive a block of the SCP using ultrasound guidance (n = 20) or the landmark-based technique (n = 20). They evaluated success rate, which they defined as loss of cold sensation for all branches of plexus at 15 min. They showed no difference in success rates, or occurrence of complications. Unlike the present work, intra-operative anesthesia and postoperative pain were not assessed, or compared because patients received general anesthesia or inter-scalene nerve block after 15 min evaluation time. Another study performed by Antonakakis et al. [25] reported results consistent with the present work concerning US compared to landmark-based regional blocks. They evaluated the success rate of ultrasound guided versus landmark-based deep peroneal nerve anesthesia and they reported no significant differences between the two groups.

7. Conclusions

BSCPB whether US guided or landmark based significantly reduces analgesic requirements during and after thyroid surgery with reduced postoperative pain scores and no adverse events of significance. However, there was no significant difference in analgesic efficacy or safety between US guided and landmark-based BSCPB.

8. Recommendations

We recommend the performance of additional studies to demonstrate the analgesic efficacy of various adjuvants (dexmedetomidine, clonidine, epinephrine) added to local anesthetic in BSCPB to further improve the quality of perioperative analgesia.

9. Limitations

Detection of small differences between US guided and the conventional landmark-based BSCPB may have been hindered by the small sample size we used. Moreover, we used a single injection method in US guided block versus three-injection technique in the landmark-based block so the possibility still stands that multiple injections in the US guided BSCPB may have yielded statistically significant differences between the two groups US and LM. Confirmatory studiesare recommended. Another limitation may have been that our sample size was not big enough to detect significant differences between the groups in the incidence of PONV.

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