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# The Efficacy of Bilateral Superficial Cervical Plexus Block under Ultrasound Guidance for Pain and hemodynamic Control after thyroid surgery

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**Abstract**: Background: thyroid surgery can cause hemodynamic instability and postoperative pain. Regular general anesthesia and analgesia provide adequate effect for post operative pain control. Bilateral superficial cervical plexus block (BSCPB) provides an adjuvant technique to facilitate this approach, but there is great evidential heterogeneity in previous studies. Aims: to evaluate the efficacy of BSCPB under ultrasound guidance for pain and hemodynamic control after thyroid surgery. Patients and Methods: This is a prospective interventional study including 60 consecutive patients scheduled for elective thyroidectomy under general anesthesia. Patients were randomly assigned in to two equal groups each with 30 patients: block and non-block group. In block group, 5 ml of 0.375% bupivacaine was bilaterally injected into the subcutaneous space under ultrasound guidance, while non-block group had a routine anesthesia without such intervention. Results: During the zero min, 30 min and 1 hr. post recovery, block group showed lower mean SBP than non-block group with highly significant differences ($p<0.001$). Furthermore, block group demonstrated lower mean DBP during 30 min and 1 hr. post recovery than non-block group with highly significant differences ($p<0.01$). The remarkable differences between the two group in heart rate (HRE) started at zero hr. through 30 min, 1 hr. until 2 hr. post recovery in which the block group displayed lower mean HR with highly significant differences ($p<0.001$). From zero hr. until the last time point, block group showed lower mean pain score than non-block group with highly significant differences ($P<0.001$). Conclusions: Bilateral superficial cervical plexus block is feasible, safe, and effective for improving outcomes in patients undergoing thyroidectomy in terms of reducing pain, the systemic analgesic requirements following thyroid surgery and stabilizing of hemodynamic parameters.

**Keywords:** Thyroid surgery, bilateral superficial cervical plexus block, pain score, vital signs.

## INTRODUCTION

Currently, thyroid surgery is the most common and safe operation worldwide. The increase in local anatomy knowledge, the standardization of surgical approaches, the improvement in operating skills, the application of new technologies, and the emphasis on specialty training contribute to the advancement in surgical operation (Bobanga, I. D., & McHenry, C. R. 2019). Nevertheless, thyroidectomy is still not free from the risks of complications and death due to the complexity of the anatomical structure and physiological function of the thyroid gland (Nicholson, K. J. *et al.*, 2019)

Thyroid surgery is a painful procedure demanding analgesia (Suh, Y. J. *et al.*, 2009). The skin overlying the neck, ear, angle of the mandible, shoulder, and clavicle is supplied by the superficial cervical plexus(SCP), which is a sensory neural plexus formed from the ventral rami of the first four cervical nerves (C1–C4). It emerges behind the posterior border of sternomastoid muscle. The cervical plexus includes also deep branches to the neck muscles and the phrenic nerve (C3, C4, and C5) in addition to communicating branches to the superior cervical sympathetic ganglion, hypoglossal, and spinal accessory nerves (Singh, S. K. 2015).

In general, analgesic regimens including nonopioid medications were associated with improved pain control and reduced postoperative opioid use (Oltman, J. *et al.*, 2017). However, consistent measurement of outcomes, including standardized pain scales used at specified time points, procedure-related variables (e.g., surgical complications, readmissions, use of local anesthetics), and patient variables (e.g., time required to return to daily activities and work, number of pills prescribed versus used, satisfaction), should be included in future research to gauge the impact of tested analgesic regimens.

As pain is subjective, it remains challenging to evaluate and treat. Several clinical trials have examined the role of varying adjuncts to narcotics in providing acceptable analgesia. Preemptive analgesia remains controversial regarding its effectiveness with respect to post-procedural pain (Kissin, I. 2000). A randomized trial demonstrated decreases in post-operative pain scores and IV morphine use in patients who received gabapentin 2 hours prior to thyroidectomy or parathyroidectomy (Al-Mujadi, H. *et al.*, 2006) Another trial explored the effect of music therapy on same-day inguinal herniorrhaphy patients and found a significant decrease in plasma cortisol levels in those who received music postoperatively compared to the control group (Nilsson, U. *et al.*, 2005).





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**Aims of the Study**

The present study aimed to evaluate the efficacy of bilateral superficial cervical plexus block under ultrasound guidance for pain and hemodynamic control after thyroid surgery.

## PATIENTS AND METHODS

This is a prospective observational study including 60 consecutive patients scheduled for elective thyroidectomy under general anesthesia (GA) during the period from May 2021 to April 2022 in the department of Surgery/ AlKathemia Teaching Hospital. The study protocol was approved by the Arabic board of Medical specializations.

Inclusion Criteria

- Both sexes, aged 18-78 years.
- Have elective surgery under GA.
- Have American Society of Anesthesiologists (ASA) I or II.
- Exclusion Criteria
- Any patient allergic to bupivacaine .
- Any patient with previous neck surgery.
- Any patient have previous trauma or burn in the neck.
- Patient have anatomical abnormalities.
- Patient refusal.

A written consent from each participant was obtained prior to data collection after explaining the aim of study. The confidentiality of data throughout the study was guaranteed and the patients were assured that data will be used for research purpose only.

A complete preoperative assessment including detailed history, clinical examination was done with particular attention to hemodynamic parameters. Patients were randomly assigned in to two equal groups each with 30 patients: block and non-block group.

Both groups were evaluated by the same anesthesiologist before anesthesia. Patient premedicated by administering 0.1 mg/kg intravenous midazolam 30 minutes before the surgery.

The following procedures were adopted at the operating room:

Monitoring of the Group1 and Group2 patients was performed using pulse oximetry, noninvasive arterial blood pressure (NIABP), heart rate (HR), continuous capnography.

The data were recorded at 8 time points: before anesthesia induction; post recovery , 30 min, 1 hr., 2hr., 4hr., 6 hr. and 8 hr. postoperatively.

Anesthesia induction in non-block groups was performed as follows: after 20-gauge peripheral venous catheterization and preoxygenation for 3 minutes via a face mask at an oxygen inspired fraction (FiO2) of 100%, patients received 15 mg/kg paracetamol. Anesthesia was slowly induced by intravenous bolus of fentanyl 1mcg/kg , propofol at 1-2 mg/kg sleeping dose, and atracurium at 0.5 mg/kg and 25 mg ketamine. The mechanical ventilation parameters were a tidal volume of 8 ml/kg, positive end-expiratory pressure (PEEP) of 5 mmHg, respiratory frequency to maintain capnography between 35 and 40 mmHg, and FiO2 of 100% (oxygen). The anesthesia was maintained by isoflurane 1.5%. No additional doses of fentanyl was administered. For intraoperative hydration, Ringer's lactate solution was infused .

Anesthesia induction in block group was performed as follows: after anesthesia induction as described above for block groups and after the end of surgery, the patients' heads were rotated to the contralateral side of the blockade. After antiseptic technique, the posterior border of the clavicular sternocleidomastoid head muscle (inserts from the mastoid process to the clavicle) was identified. The block prepared with the following equipment's (sterile towel, gauze packs, 5ml syringe, with 0.375% bupivacaine attached to 22gauge needle via flexible tube and sterile gloves). The patient is in supine position with the head facing away from side to be blocked after cleaning skin with an antiseptic solution and cover the linear probe by plastic shield which is used in all cases the needle is inserted along the posterior border of sternocleidomastoid in in-plane technique and three injections of 5 ml of 0.375% bupivacaine are injected behind the posterior border of sternocleidomastoid perpendicularly ,cephalad and caudad in a 'fan' fashion, the other side had been done the same procedure.

After induction in both the block and non-block groups, 1 g ceftriaxone, metoclopramide 10mg, and 8 mg dexamethasone were administered. At the end of the surgery, the patients were extubated in a deep manner that avoided coughing and were then transferred to the post anesthesia care unit (PACU). At PACU, patients were asked to report their pain based on the 10-point numerical pain score as soon as the patient starts to fully respond to verbal command.

Data were analyzed using IBM SPSS version 24 (SPSS Inc., Chicago, Illinois, USA) and excel





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Microsoft office 2016. Numerical data were expressed as mean± standard deviation (SD) or median and range, as appropriate and analyzed with Student t-test. A p-value less than 0.05 was considered significant.

## RESULTS

The mean age of the patients in block group was 48.03±12.18 years (range=30-72 years) compared with 52.97±13.6 years (range= 30-75 years) for non-block group with no significant difference. Likewise, there was no significant difference between the two groups regarding the distribution of gender and body weight. However, multinodular goiter was more common indication in block than non-block group (43.33% vs. 23.33%). In contrast, thyroid mass was more frequent among non-block than block group (63.33% vs. 13.33%) with significant differences. Although failure to block occurred in two patients in block group compared with none in non-block group, the difference was not significant (Table 1).

**Table 1:** Demographic characteristics of the Patients.

| Variables | Block group (n=30) | Non-block group (n=30) | p-value |
|---|---|---|---|
| Age, years<br>Mean ± SD<br>Range | <br>48.03±12.18<br>30-72 | <br>52.97±13.6<br>30-75 | <br>0.144 |
| Gender<br>Male<br>Female | <br>10(33.33%)<br>20(66.67%) | <br>15(50%)<br>15(50%) | <br>0.190 |
| Weight, kg<br>Mean ± SD<br>Range | <br>74.97±11.26<br>55-100 | <br>78.93±12.52<br>66-98 | <br>0.202 |
| Indications<br>Single nodular goiter<br>Multinodular goiter<br>Thyroid mass<br>Thyroid cancer | <br>6(20%)<br>13(43.33%)<br>4(13.33%)<br>7(23.33%) | <br>0(0%)<br>7(23.33%)<br>19(63.33%)<br>4(13.33%) | <br><br><br><br>**<0.001** |
| Complication<br>No<br>Failure to analgesia | <br>28(93.33%)<br>2(6.67%) | <br>30(100%)<br>0(0%) | <br>0.492 |

The time trend of SBP in block and non-block groups is shown in figure 1. During the zero hr., 30 min and 1 hr. post recovery, block group showed lower mean SBP (135.5±16.7 mmHg, 131.8±15.6 mmHg and 127.7±15.0 mmHg, respectively) than non-block group (150.7±13.1 mmHg, 147.0±13.9 mmHg and 140.0±12.6 mmHg, respectively) with highly significant differences. Nevertheless, these differences were no more significant at 2 hr and 4 hr post recovery. Interestingly, during 6 hr and 8 hr post recovery, non-block group showed lower mean SBP (121.7±9.8 mmHg and 119.0±10.3 mmHg, respectively) than block group (131.4±13.3 mmHg and 130.5±14.8 mmHg, respectively) with highly significant differences.

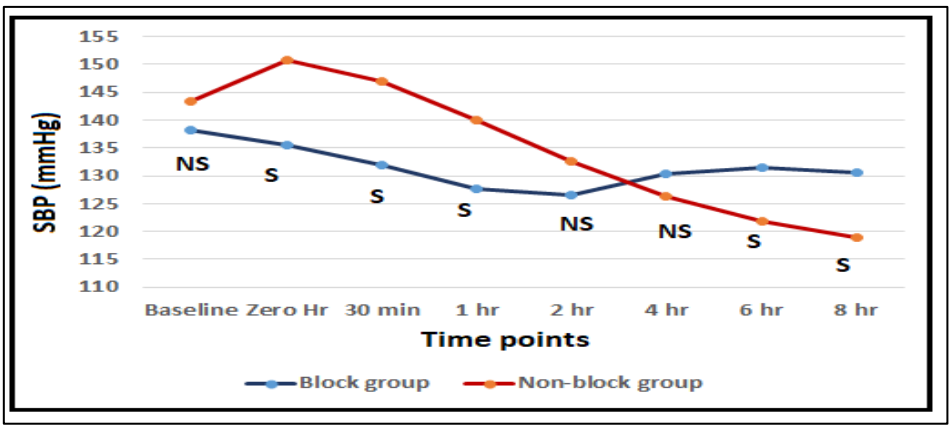


**Figure 1:** Time trend of SBP (mmHg) in block and non-block group.





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During baseline and zero hr., there was no significant differences between the two groups in DBP. However, block group demonstrated lower mean DBP during 30 min and 1 hr. post recovery (80.5±80.2 mmHg and 80.3±80.7 mmHg, respectively) than non-block group (86.5±4.8 mmHg and 85.5±5.6 mmHg, respectively) with highly significant differences. From 2 hr. until the last time point post recovery, DBP value become very close between the two groups with no significant differences (figure 2).

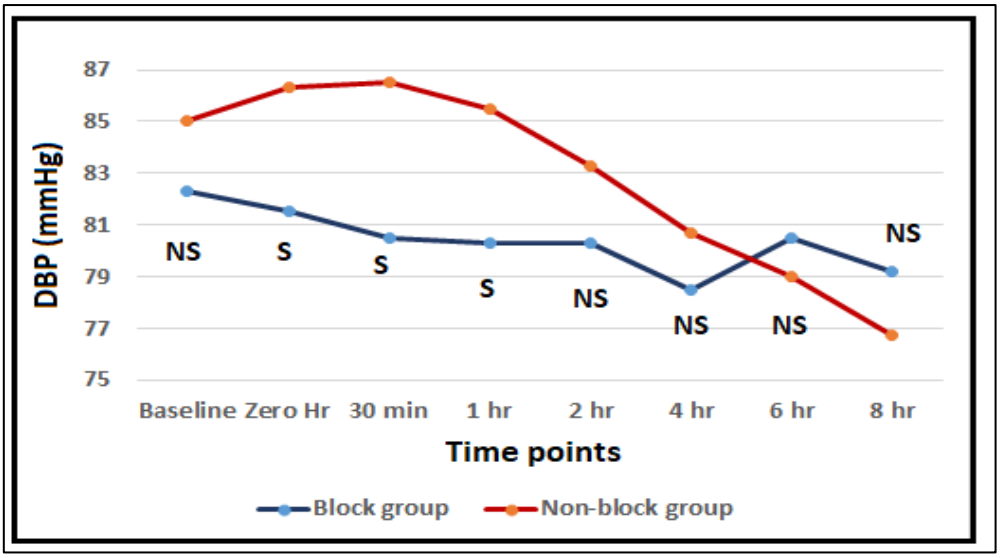


**Figure 2:** Time trend of DBP (mmHg) in block and non-block group.

The remarkable differences between the two group in HR started at zero hr. through 30 min, 1 hr. until 2 hr. post recovery in which the block group displayed lower mean HRE (85.6±7.4 beats/min, 85.2±7.1 beats/min, 84.2±6.8 beats/min and 83.2±7.9 beats/min, respectively) than non-block group (95.4±3.9 beats/min, 92.9±3.4 beats/min, 80.5±3.9 beats/min and 88.6±4.0 beats/min, respectively) with highly significant differences. After that, a gradual dropping in HRE has occurred in both groups and the differences become less noticeable (figure 3).

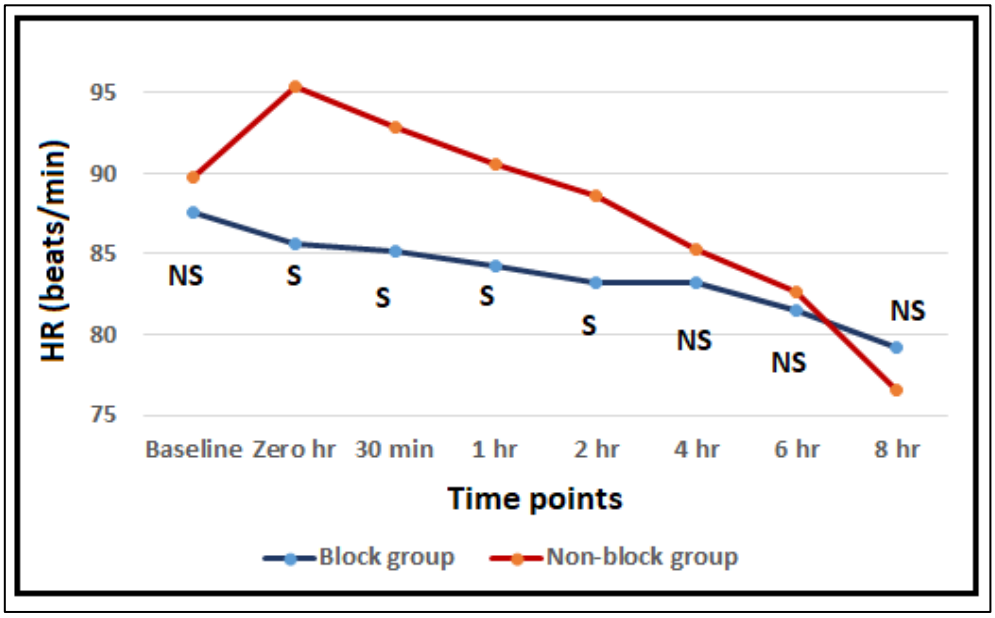


**Figure 3:** Time trend of HRE (beats/min) in block and non-block group**.**

The mean $SPO_2$ was very close between the two groups (range between 97.4% to 98.6%) in all included time points with no significant differences (figure 4).





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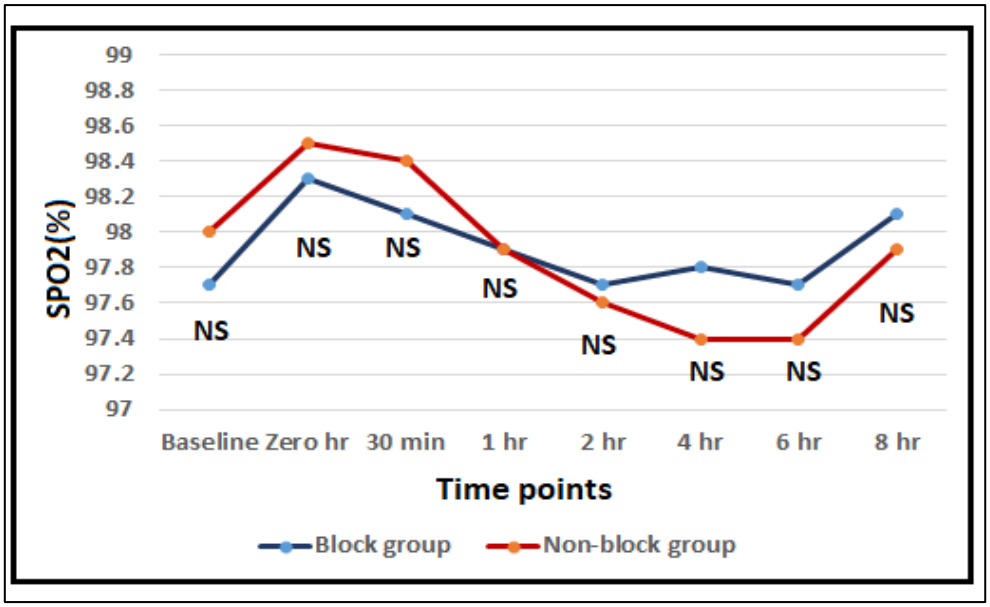


**Figure 4:** Time trend of $SPO_2$ (%) in block and non-block group.

Regarding to pain score; from zero hr. until the last time point, block group showed lower mean pain score than non-block group with highly significant differences. In block group, pain score was 3.27±1.8 at zero hr. and gradually dropped to reach 0.6±1.2 at 8 hr. post recovery. In non-block group, pain score was 7.57±0.57 at zero hr. It also gradually dropped to reach 1.4±0.9 at 8 hr post recovery (Table 2, figure 5).

**Table 2:** Time trend of pain score in block and non-block group.

| Variables | Block group (n=30) | Non-block group (n=30) | p-value |
|---|---|---|---|
| Zero hr | 3.27±1.8 | 7.57±0.57 | **<0.001** |
| 30 min | 2.73±1.74 | 6.7±0.53 | **<0.001** |
| 1 hr | 1.93±1.6 | 6.0±0.61 | **<0.001** |
| 2 hr | 1.6±1.6 | 5.2±0.76 | **<0.001** |
| 4 hr | 1.1±1.5 | 4.1±0.96 | **<0.001** |
| 6 hr | 0.73±1.5 | 2.73±0.87 | **<0.001** |
| 8 hr | 0.6±1.2 | 1.4±0.9 | **0.005** |

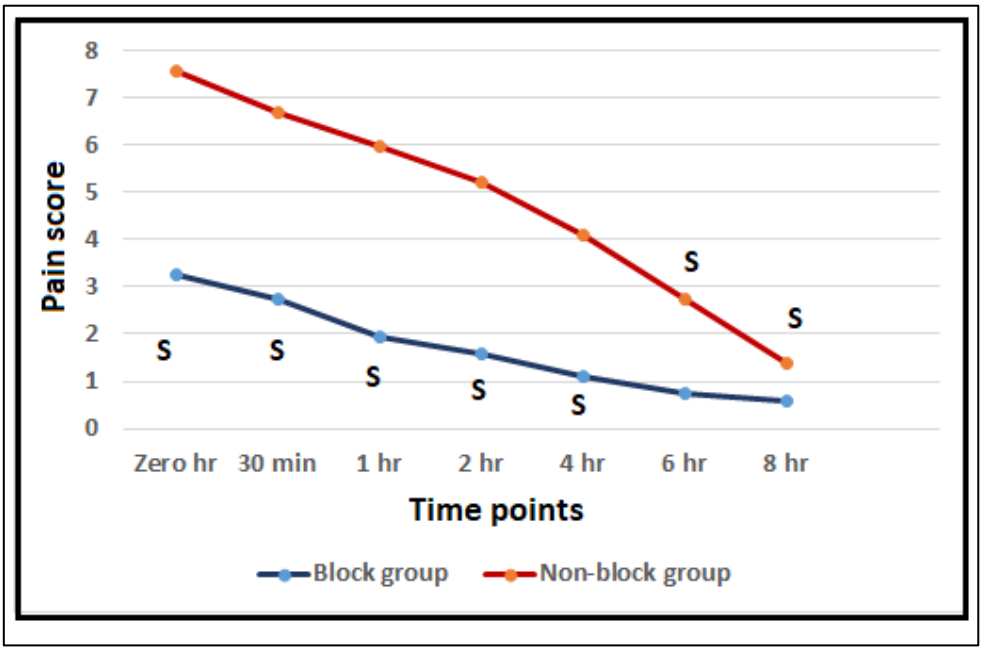


**Figure 5:**Time trend of pain score in block and non-block group.





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## DISCUSSION

The present study aimed to evaluate the efficacy of bilateral superficial cervical plexus block under ultrasound guidance for pain and hemodynamic control after thyroid surgery.

According to the result of the study, bilateral superficial cervical plexus block associated with lower SBP, DBP and heart rate especially during the first hour after recovery. These results are in accordance with many previous studies worldwide.

(Goulart *et al.,* 2019) prospectively studied 100 consecutive patients who underwent total thyroidectomy. The patients were divided into two groups: 50 patients received general anesthesia alone and 50 patients received general anesthesia with bilateral superficial cervical plexus blockade. The mean arterial blood pressure and heart rate were 12% lower in block compared with non-block group (92.3 mmHg vs. 101 mmHg, p=0.001).

(Shih, *et al.,* 2010) compared the perioperative outcome between BSCPB and GA technique during total thyroidectomy of 60 patients. Patients with BSCPB showed reduced SBP and DBP due the effect of BSCPB and conscious sedation. Moreover, SBP and DBP after 5 minutes, 15 minutes, 30 minutes, 45 minutes and at the end of operation were reduced in group BSCPB, and the changes were statistically significant. It was observed that there was minimal or no change of MAP in BSCPB group and more fluctuation in GA. During recovery period SBP, DBP and MAP was measured just after recovery, at 15 minutes, at 30 minutes, at 45 minutes and at 60 minutes interval. There was minimal change in BSCPB group and significant fluctuation in GA group.

However, (Mamede & Raful, 2008) compared SCBPB and general anesthesia patients regarding the incidence of bradycardia. The authors indicated a statistically significantly higher rate of bradycardia in SCBPB. (Luchetti *et al.,* 2008) in a 28-patient study, compared patients undergoing carotid endarterectomy with a superficial cervical plexus block to a superficial cervical plexus block together with general anesthesia. The mean arterial pressure (MAP) was higher in the patients who had a superficial cervical plexus block only.

On the other hand, (Ivanec *et al.,* 2008) comparing superficial cervical plexus block to combined superficial and deep cervical plexus block in two groups of patients, failed to identify a statistically significant difference in hemodynamic parameters other than heart rate (systolic and diastolic blood pressure and mean arterial blood pressure). The heart rate was slightly more elevated in the group with a combined block than in the group with the superficial block only (88 vs. 83 min−1, respectively).

In fact, most of these studies measure the hemodynamic parameters intraoperatively rather that post recovery as the case of the current study. This may explain the variation in the results.

In the present study, pain score was reduced significantly during all time point in block group compared with non-block group. A large number of international studies confirmed this result. In a meta-analyses including 14 studies with a total of 1154 patients. (Mayhew, *et al.,* 2018) reported that pain scores were significantly improved in the BSCPB cohort at T0, T4, and T24. BSCPB increases the time until first analgesic request by a mean time of 1 h and 44 min. The calculated NNT of 4.4 in favor of BSCPB to reduce the requirement for rescue analgesia in the first 24 h after operation does portend its beneficial effect. Intraoperative analgesic use demonstrated a statistically significant difference in the quantity of morphine equivalent used when the block was instituted compared with control group (standard mean difference 0.55; 95% CI 1.07, 0.03; P=0.04). Dieudonne et al. employed a three-point injection and demonstrated that BSCBP (20 mL of 0.25% bupivacaine) decreased the postoperative pain intensity and postoperative opioid requirement (Mayhew, D. *et al.,* 2018). Furthermore, (Andrieu, G. *et al.,* 2007) reported that BSCPB with ropivacaine (0.487%) or ropivacaine and clonidine was effective in reducing analgesic requirements following thyroid surgery. On the contrary, Herbland et al. suggested that BSCPB (0.75% ropivacaine) before or after surgery did not improve postoperative analgesia following total thyroidectomy (Herbland, A. *et al.,* 2006). (30 mL of 0.25% bupivacaine or 20 mL 0.25% bupivacaine with local wound infiltration) reported that neither local wound infiltration nor BSCPB decreased the opioid requirement or pain scores following thyroid surgery (Eti, Z. *et al.,* 2006). (Woldegerima, Y. B. *et al.,* 2020) reported that BSCPB using 10 mL of 0.25% bupivacaine just before induction prolonged the time to first analgesic requirement, and reduced opioid and total analgesic consumption in the first 24 hours postoperatively. demonstrated a reduction in opioid consumption and postoperative pain



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intensity in patients who underwent thyroid surgery (Karakış, A. *et al.*, 2019).

(Mukhopadhyay, S. *et al.*, 2012) demonstrated no advantage of BSCPB for thyroid surgeries. In that study, patients underwent blockade with 0.5% ropivacaine. However, the technique applied included two punctures with a total volume of 6 ml on each side. In a blockade, it is important that the anesthetic is spread to as many fibers as possible. The spread of anesthetic is proportional to its volume. In the present study, 10 ml of ropivacaine was administered on each side. Nevertheless, compared the blockade, the sole anesthetic technique, with general anesthesia. In our study, all patients received general anesthesia. The blockade was added to compare the postoperative conditions and patient outcomes. Moreover, no blockade complications were observed.

But in contrast to such a finding, a study done in Turkey did not show efficacy of the block. Mean VAS score at first hour was 23 + 19.3 in the BSCPB group compared to 20.7 + 13.3 in the control group with 0–100 VAS ($p > 0.05$) (Andrieu, G. *et al.*, 2007).

This variation between different studies may be explained by several factors, the most important of which are the variation in study design, sample size and demographic characteristics of the patients.

## CONCLUSIONS

- Bilateral superficial cervical plexus block is feasible, safe, and effective for improving outcomes in patients undergoing thyroidectomy.
- This technique associated with the stability of hemodynamic parameters (SBP, DBP and heart rate ) especially during the first hour post recovery.
- BSCPB with 0.375% bupivacaine is effective in reducing pain and thus the systemic analgesic requirements following thyroid surgery.

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