Review

Regional Anesthesia in Patients Who Underwent Thyroid and Parathyroid Surgery

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Review

Regional Anesthesia in Patients Who Underwent Thyroid and Parathyroid Surgery

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Abstract: Background/Objectives: Globally, thyroid and parathyroid diseases are common and often require surgery. This review evaluates the current literature on the use of regional anesthesia in these surgeries, highlighting its advantages, limitations, and areas requiring further research. **Methods**: MEDLINE (via PubMed) and ResearchGate, the largest academic social network, were utilized to retrieve literature on the topic. **Results**: Fifteen studies with few patients and largely uncontrolled on the use of loco-regional anaesthesia (LRA) not combined with General Anesthesia (GA)$were found. While twenty-two better quality studies involving several patients on LRA Combined GA$were found. **Conclusions**: LRA, in combination with GA, has been proven to be the most reliable evidence for reducing opioid use and postoperative nausea and vomiting. LRA, not combined with GA has been used in a few well-conducted studies, it seems to be feasible to use even in patients with severe systemic disease. Future controlled studies will need to validate its effectiveness and safety.

Keywords: thyroid surgery; parathyroid surgery; regional anesthesia; cervical epidural anesthesia; cervical plexus block; regional anesthesia

1. Introduction

Thyroid and parathyroid hormones are fundamental in human metabolism. Their role in metabolic pathways, growth, development, cognition, energy homeostasis, and temperature regulation is well known [1]. In large population-based studies, disorders in their functions are between 2-6%. Globally, thyroid and parathyroid dysfunctions are common endocrinological and oncological issues. [2]

The incidence of thyroid nodules in the general population is 30%-50%. The median age of these patients is 40-60 years, with a gender distribution of 3-4:1 (female: male). [3]

Goiters are common as well. When they become voluminous, apart from being a cosmetical problem, they may cause compression of the respiratory and upper digestive tracts and the recurrent laryngeal nerve (RLN). Surgery is frequently indicated in these types of pathologies, especially when the goitres become intrathoracic, causing compression of important structures, such as vessels and trachea.

From 1990 to 2019, age-standardized prevalence rates indicated a global increase in thyroid cancer (TC), with around 18.3 million cases in 2019. [4]

Female preponderance is seen in parathyroid dysfunctions as well. Primary hyperparathyroidism is most common in post-menopausal women while in hypoparathyroidism, most of the patients (>75%) are the result of surgery for thyroid disorders, which are more common in women. The average age of patients with primary hyperparathyroidism is about a decade older than that of hypoparathyroidism patients. [5]

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Surgeries of these glands are one of the most performed. Every year, in European countries, between 45,000 and 60,000 thyroidectomies are performed.

These surgeries are traditionally performed under general anesthesia (GA). However, increasing attention has been given to regional anesthesia (RA) techniques. The advantages of these techniques are to avoid the risks associated with general anesthesia, minimize postoperative pain, and enhance recovery. These techniques are particularly intriguing for individuals who are at high surgical risk (ASA III or IV) or intolerant to general anesthesia. The most common regional anesthesia techniques for thyroid and parathyroid surgeries include superficial and deep cervical plexus blocks, as well as local anesthetic infiltration. This review evaluates the current literature on the use of regional anesthesia in these surgeries, highlighting its advantages, limitations, and areas requiring further research.

2. Materials and Methods

A search of the biomedical literature was conducted to review the published clinical data on regional anesthesia in patients who underwent thyroid and parathyroid surgery. *In primis*, MEDLINE (via PubMed) was searched, with no temporal limits, for articles using the following terms "(local OR regional OR locoregional) AND (anesthesia) AND ((thyroid) OR (parathyroid)) AND surgery". Additionally, ResearchGate, which has the highest number of active users in academic social networks, was utilised to find manuscripts that were not included in MEDLINE. For each study, we identified the year of publication, the clinical setting, the study methodology (type), the total number of participants (patients enrolled), the participants assigned to locoregional (LR) intervention (LR technique) and the group of participants assigned to a control (the control arm), the outcome of the various studies and their time of exploration, the results and any adverse events reported.

3. Results

3.1. Local/Locoregional Anesthesia Not Combined to General Anesthesia

For more than three decades, local anesthesia has been explored in thyroid surgeries; Hochman et al. in 1991 performed 43 sequential thyroidectomies: 21 performed using LA and 22 under GA. For the authors, LA is a valid option for reducing patients' in-stay in less invasive procedures. [6] Successively, Lo Gerfo et al. performed 236 BNE, from 1988 to 1999, under LA. Intravenous sedation was used to give more comfort to the patient. This study demonstrated that LA is a safe alternative to GA in performing BNE in patients with thyroid disease and nonlocalized adenoma. [7]

Ishiguro et al. in their case series, performed between 1997 and 2002, 18 parathyroidectomies under LA. They demonstrated that LA can be a valid strategy in performing minimally invasive parathyroidectomies in a day surgery regimen, improving patients' quality of life. [8]

Spanknebel et al. in a large prospective study, on 1,025 patients, studied the efficacy of LA on thyroidectomy. The types of interventions went from total thyroidectomies to lobectomies and partial resections. As in previous studies, a key to the success of LA in performing thyroid surgery is in the experience of the surgeon. In this study, the authors establish that LA is safe and applicable in almost all patients, including those with a high ASA score.[9]

Snyder et al. divided 58 patients into 2 groups: 29 performed thyroidectomy under GA, and 29 under LA + MAC. The main objective was to study the effectiveness and safety of LA for this type of procedure. Secondary outcomes were patients' satisfaction and cost benefits of LA. There were no conversions from LA to GA and PACU stay was less in the LA group. Cost savings were of 315$ per patient receiving LA + MAC. Patients' satisfaction was similar between the two groups. [10]

Banasiewicz et al. performed 37 subtotal bilateral thyroidectomies and 12 lobectomies or partial lobectomies, using LA with 1% lignocaine. In their setting, LA was a valid alternative to GA, due to technical issues. This anesthesia was well tolerated by the patients especially when intravenous sedatives were combined with LA. The authors mention some technical difficulty when patients had stimulus for coughing, making surgery more difficult. [11]

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Kim et al. divided 60 patients into two groups: 30 patients received LA-MAC and 30 patients GA. The main outcomes explored were PONV, postoperative discomfort, postoperative pain, odynophagia, dyspnea, and patient satisfaction. There were no differences between the groups in postoperative pain, odynophagia, dyspnea, and patient satisfaction levels. The LA-MAC group had fewer PONV episodes, throat discomfort, and voice changes. [12]

Haugen et al., in their case series, performed 28 thyroidectomies in LA. An important factor that influenced the efficacy of the procedure was the surgeons' experience in LA. Intraoperative pain score, between 0-10 was evaluated, with a median score of 3.4. The success rate of LA was of 96%, only 1 patient required GA due to airway issues. Seventy-one percent of the patients tolerated surgery with only LA not requiring sedation at all. The amount of lidocaine 2% used was of 24 ml.[13]

Mamede et al. in their RCT, in 2006, evaluated the efficacy of superficial cervical plexus block (SCPB), cost-effectiveness, laryngotracheal injuries, and patient's satisfaction in patients undergoing hemithyroidectomy. The main results of this study were that differences in hospital stay between the two groups were not statistically significant. The mean duration of anesthesia was higher in the SCPB group. Costs were lower in the LA group. In the SCPB group, there were no laryngotracheal injuries, in the GA group 51% of patients presented them.[14]

Lombardi et al. in a case series of 5 patients undergoing video-assisted thyroidectomy, after signing informed consent, had their surgery performed under LR instead of GA. After adequate premedication, using diazepam 0,2mg/kg by mouth 45 minutes before surgery, a cervical block was performed using bupivacaine 0,25% and carbocaine 0,5%. The technique used was a landmark technique, injecting a total of 20 mL. Five mL of LA was injected by the surgeon, to infiltrate the upper pole and the thyroid capsule. At the end of surgery, ketorolac 30mg and ranitidine 100mg were administered. No conversion to general anesthesia occurred. The visual analogue scale (VAS) was used to assess pain. Thirty minutes after the beginning of the operation, the median VAS score was 2.0, and at the end of the procedure mean score was 1.5. No complications were observed, and only one patient required ketorolac as a rescue analgesic. [20]

Stephen et al. performed BSCPB with 1.0% Xylocaine with adrenaline (2-3 ml/kg body weight) in thyroid surgery in rural hospitals. In this setting, LA demonstrated to be a valid alternative to GA, in terms of safety, efficacy, and spending review. [15]

Inabnet et al., in a prospective trial in 2009, performed 10 thyroidectomies under LA. The main outcomes were the evaluation of the feasibility of the procedure under LA and the evaluation of the efficacy of EBSLN monitoring and VHI-10 score for 3 weeks after surgery. The monitoring of EBSLN under LA helped the surgeon to identify the nerve and avoid injuries in 70% of the procedures. With the isolation and avoidance of ESBLN patients did not experience changes in voice after 3 weeks as evaluated by VHI-10 score.[16]

Suri et al. studied 95 patients undergoing thyroid and parathyroid surgeries. They divided these patients into two groups: 64 received standard GA and 31 received BSCPB+ sedation. Patients who underwent surgery with the LR technique had advantages in the recovery including a faster return to normal daily activity and satisfaction with the anesthesiologic management.[17]

Raman et al. performed nine cases of surgery for thyroid disorders under superficial or deep cervical plexus block. The advantages observed were less intraoperative bleeding. The avoidance of endotracheal intubation was a time saving procedure, a faster recovery, and capacity for oral nutrition. All of the patients studied in this case series were operated under regional anesthesia combined with intravenous sedation.[18]

Santosh et al. conducted 29 thyroid surgeries only under regional anesthesia. In 20 patients, DSCPB was performed and in 9, cervical epidural anaesthesia (CEA) was the anesthesiologic option. Patients were comfortable during the procedure and no episodes of PONV were reported after surgery. Between the two techniques, there were no statistical differences in the time of surgery and patients' satisfaction. The surgeon was also able to monitor the vocal cords' status.[19]

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Table 1. Loco-regional anaesthetics (LRA) not Combined to General Anesthesia (GA).

Author	Year	Setting	Study type	N. Patients enrolled	LR technique	Control arm	Outcome explorated	Evaluation time	Results	Adverse events
Hochman et al. [6]	1991	University Hospital	Retrospective	43	LA	GA	Reducing recovery time	NS	LA enhance discharge time	Not reported
Lo Gerfo et al. [7]	1999	University Hospital	Case series	236	LA+ sedation	/	Patient compliance	0-3-6h	Acceptable	Not reported
Ishiguro et al. [8]	2002	University Hospital	Case series	18	LA	/	Patient compliance	NS	Acceptable	GA (1)
Spanknebel et al. [9]	2005	University Hospital	Prospective	1,686	LA	GA	Efficacy, Safety and LOS	NS	Not inferior	RLN injuries (30), hematoma (5), HC (1), tracheostomy (1), SSI (1)
Snyder et al. [10]	2006	University Hospital	RCT	58	LA + MAC	GA	Efficacy, Safety and LOS	NS	Not inferior	RLN injurie in each group (1)
Banasiewicz et al. [11]	2011	University Hospital	Case series	49	LA	/	Efficacy	NS	Acceptable	Not reported
Kim et al. [12]	2017	University Hospital	RCT	60	LA + MAC	GA	PONV, Safety, postoperative pain	NS	Not inferior	Not reported
Haugen et al. [13]	2019	Medical Center	Case series	28	LA	/	Patient compliance, intraoperative pain.	NS	Acceptable	Airway complication (1)
Mamede et al. [14]	2006	University Hospital	RCT	42	SCPB	GA	Efficacy, Safety, Anesthesia duration, Patient compliance.	NS	Not inferior LOS. Anesthesia duration higher in LR group. Costs were fewer in the LR group.	Not reported
Lombardi et al. [20]	2003	University Hospital	Case series	5	BSCPB	/	Intra and postoperative VAS score. Postoperative NSAID consumption	0-6-18-24 h	VAS score had a median value of 2 in the intraoperative and 1.5 in the end of the procedure	Not reported
Stephen et al. [15]	2008	University Hospital	Case series	11	BSCPB	/	Efficacy	NS	Not inferior	Not reported
Inabnet et al. [16]	2009	University Hospital	Case series	7	BSCPB +DPPB	/	Efficacy	3 weeks	Acceptable	Not reported
Suri et al. [17]	2010	University Hospital	RCT	95	BSCPB + sedation	Standard GA	Recovery advantages	NS	LR experienced a return to work sooner and normal energy levels.	Not reported
Rahman et al. [18]	2011	University Hospital	Case series	9	BSCPB or DSCPB	/	Bleeding, Operative time, Recovery advantages.	/	Accettable	Temporary dysphagia (1)
Santosh et al. [19]	2015	University Hospital	RCT	29	DCPB	Cervical epidural	Efficacy	NS	Not inferior	Not reported

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	anesthesia (CEA)

3.1.2. Local/Locoregional Anesthesia Combined with General Anesthesia

Dieudonne et al. performed a RCT on 90 patients undergoing elective thyroid surgery. In the group block, BSCPB was performed at the end of surgery. The main outcomes were the evaluation of pain scores (NRS-11) during PACU admission and the total dose and request of opioids, such as morphine. Median values of NRS were lower in patients receiving LA. The Bupivacaine group had a smaller proportion of patients receiving opioids (66.0% vs 90.0%). The authors concluded that BSCPB could relieve postoperative pain but not provide optimal analgesia alone.[21]

Andrieu et al., evaluated the efficacy of bilateral SCPB executed before thyroid surgery in GA. Three groups were randomized to receive saline, ropivacaine 0,487% or ropivacaine 0,478% plus clonidine 5 mcg ml. Sufentanil was given if vital parameters gave a suspicion for pain and all patients received paracetamol for 24 h after surgery. Pain score was evaluated every 4h after surgery (NRS) and is >4 nefopam was used as rescue therapy. This study showed that in the group receiving SCPB with ropivacaine, with or without clonidine, the use of opioids in the intraoperative phase, and rescue therapy in the postoperative, were significantly reduced.[22]

Kale et al. evaluated the efficacy of BSCPB when executed before or after surgery. Patients were divided into 3 groups receiving BSCPB pre- or post-surgery, or no block at all. All patients were induced in GA. Patients receiving LA had a lower post-operative VAS score, with a mean value of 2.27-2.66. Fentanyl requirements were lower in the group that had the block executed before surgery (103◎ 0.8mcg). The group that received BSCPB in the post-operative phase was the one that had a later request of analgesics, and both groups receiving LA had less incidence of PONV. [23]

Liu et al., in their randomized controlled trial, evaluated the efficacy and safety of opioid-free anesthesia (OFA) combined with BSCPB confronting it with opioid-based anesthesia in thyroid surgery. In both groups, GA was performed and in the OFA group, BSCPB was executed after intubation. The primary outcome was the incidence of nausea, which occurred in 2 patients in the OFA group and 13 patients in the control group. Vomiting did not occur in the OFA group but occurred in 5 patients in the control arm. VAS score was less in the OFA group when the patients were in PACU and 2h and 4h after surgery, but no significant difference was observed 24h after surgery. In the ward 1 patient of the OFA group received analgesics and 8 patients in the opioid group had a rescue analgesic. The QoR-40 score, a recovery questionnaire, was higher in the OFA group. No adverse events related to LA were observed.[24]

Suh et al., compared the efficacy between BSCPB and combined (superficial and deep) cervical plexus block administered before thyroid surgery. Patients in ASA I and II risk, were divided in a control group CO, a BSCPB group S and a combined C group. In S group 18ml of 0,25% bupivacaine was administered and in the C group 14ml were administered in the BSCPB and 4 ml in the deep cervical plexus block (DCPB). Average concentration of remifentanil was significantly reduced in S group as well as incision pain at rest and swallowing measured 0,2,4h after surgery. The requirement of opioids as analgesics in the recovery room was significantly reduced in groups S compared with groups C and CO. Incidence of PONV was reduced in group S and patients' satisfaction was higher in this group. [25]

Woldergerima et al., in a prospective cohort study, evaluated the efficacy of analgesic BSCPB for thyroid surgery performed under GA. The block was performed just before induction and 10ml of 0,25% bupivacaine was injected. Median NRS-11 scores were reduced in patients receiving RA, and time for first analgesic request was more prolonged in these patients (132.3 min vs 71.4 min). PONV occurred in 27% of the patients in the block group and 35.1% of the patients in the non-block group but no statistical difference was observed.[26]

Shih et al., randomly assigned patients that were candidates for elective thyroid operations to receive BSCPB with isotonic saline (group A), bupivacaine 0,5% (group B) or levobupivacaine 0,5% (group C), after induction of general anesthesia. The main outcomes evaluated were intraoperative anesthetics, the consumption of post-operative rescue analgesia and VAS score, and the incidence of

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PONV, hospital stay and discomfort in swallowing. Patients in group A received higher doses of desfluorane (5,8% vs 3,9% vs 3,8%) respectively in groups A, B and C. In patients receiving LA, it took longer to receive adjunctive analgesics. VAS score was lower in groups B and C. Hospital stay was lower in groups B and C. [27]

Gurkan et al. evaluated postoperative opioid consumption and median VAS score, of 50 patients undergoing thyroid surgery who were randomly assigned to a group receiving BSCPB or standard GA. Opioid-related side effects, such as PONV, were examined too. Morphine consumption at 6,12, and 24 hours postoperatively was higher in the control group. VAS scores for pain were similar in both groups. Six patients of the SCPB group had nausea and 4 of them had vomiting too. In the control group 8 patients had nausea and 4 had vomiting. Seven patients in SCPB had hoarseness following the block. [28]

Yao et al. in a randomised controlled trial, evaluated the effects of BSCPB on the quality of recovery through the QoR-15 questionnaire. Secondary outcomes studied were acute postoperative pain, time to first rescue analgesia, number of patients requiring rescue analgesia, length of post-anesthesia care unit (PACU) stay, the incidence of PONV and dizziness, and patients' satisfaction. The global QoR-15 scores in the SCPB group were higher (median difference 8%). VAS scores in the 24h in the postoperative were lower in the patients receiving regional anesthesia, especially in the first 8h, but no statistical differences were found 24h after surgery. Median time for the first rescue analgesia was longer in the SCPB group than in the control group (18.8h vs 8.1h) and postoperative morphine use was reduced. Preoperative block performance reduced PACU stay and improved patients' satisfaction. [29]

Steffen et al. studied the impact of BSCPB executed before or after surgery on postoperative pain, analgesic use and length of hospital stay. Patients receiving BSCPB had less pain than the placebo group, not depending on the timing of the block. There was no difference between the groups on analgesic use and the length of hospital stay was the same between the block group and placebo. [30]

Ozgun et al. divided 60 patients into Group 1 receiving thyroid surgery under a standard GA and Group 2 were patients received a BSCPB with levobupivacaine 0,5%. Patients in the LA group at 2,6,12 and 24 hours post-operatively had lower NRS scores, required less rescue analgesia and less consumption of tramadol. Two cases of postoperative subcutaneous emphysema were reported in Group 2, which regressed spontaneously after 12 hours. No other complications related to BSCPB were reported. [31]

Karakis et al. randomized 46 patients, undergoing total thyroidectomy, in a group receiving GA and another one receiving GA+BSCPB with bupivacaine 0,25%. The outcomes evaluated were the intraoperative remifentanil requirements, and VAS score post extubation, at 15 minutes, 30 minutes, 1,2,6,12,24, and 48 h. Total tramadol, paracetamol and ondansetron use were reported as well. The intraoperative opioid consumption was significantly lower in the LA group, as well as the postoperative pain scores. Postoperative opioid and analgesic requirements were lower in the BSCPB group as well as the incidence of PONV. [32]

Goulart et al. studied the ability of BSCPB to control pain and reduce the side effects of GA in patients undergoing thyroidectomy. In this RCT, 100 patients were divided into Group 1, receiving GA alone, and Group 2 receiving GA *plus* BSCPB. Hemodynamic parameters were better controlled in group 2, during PACU stay at 15-30-45 and 60 minutes. These patients had better pain control and a lower opioid consumption. The incidence of nausea and vomiting was lower in patients receiving BSCPB. [33]

Eti et al. divided 45 patients into three groups. In Group I, after the induction of general anaesthesia, BSCPB with 0,25% bupivacaine was performed, in Group II, wound infiltration with LA was performed, and in Group III, no regional block was administered. In this study, there were no differences in VAS scores among the different groups, and the total patient-controlled analgesia (PCA) with meperidine was no different. The first analgesic request time was longer in Group I. The incidence of PONV was similar between the three groups. [34]

Herbland et al. divided 111 patients into 3 groups of 37. In Group CONT no block was performed, in Group PRE BSCPB was performed before surgery under GA, and in Group POST

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BSCPB was performed after surgery. The main outcomes evaluated by the authors were total morphine administration and consumption in the first 36h, and pain intensity scores. No statistical differences resulted in NRS scores between the different groups as well as the first analgesic requirement in the PACU and morphine requirements. [35]

Karthikeyan et al. divided 60 patients undergoing thyroid surgery into a control group (group S) and two other groups. One of these (group B) received BSCPB with only bupivacaine 0,25%, and the other group (group BC) received o,25% bupivacaine + clonidine 1mcg/kg. The main outcomes were intra and postoperative analgesic requirements, postoperative pain scores, incidence of PONV and sedation. BSCPB, performed with only LA or with adjuvants, was effective in reducing both intra and postoperative analgesic requirements, and clonidine reduced the incidence of PONV. The median VAS score in between the three groups was the lowest in group BC. The difference in time for the first analgesic requirement was statistically different between group S and group B, and between group S and group B. [36]

Kesisoglou et al. randomized 100 patients undergoing total thyroidectomy into 2 groups: group S did not receive LA, and in group R BSCPB was performed under GA with 15ml of 0,75% of plain ropivacaine. A reduction in median VAS score was noted at all timings, except 12h, in group R. Additional analgesia (dextropropoxyphene hydrochloride) was required for 7 patients in group S and 8 patients in group R. Sufentanil was required in 2 patients in group S and 1 patient in group R. [37]

Sardar et al. performed BSCPB with 15 ml of 0,25% bupivacaine for each side in patients undergoing thyroid surgery. When confronted with control group, BSCPB did not reduce median VAS score for the first 24h, nor intravenous analgesic doses. Patients that received LA had fewer episodes of PONV and first analgesic time requirement was longer. The authors concluded that BSCPB did not decrease analgesic requirements after thyroid surgery. [38]

Cai et al. randomized 135 patients undergoing thyroid surgery in a control group, receiving a standard GA, and a group receiving BSCPB with 20ml of ropivacaine 0,5%. The main outcomes explored were the incidence of PONV, the request of rescue antiemetics and postoperative VAS scores, evaluated every 4h after surgery for the first 24h. The incidence of PONV was significantly lower in the ropivacaine group as well the request of antiemetics. VAS scores were lower in the ropivacaine group at 0-4-8h, but no differences were observed at 12-16-24h after surgery. [39]

Negmi et al. evaluated the effect of BSCPB in patients undergoing total thyroidectomy. The main outcomes evaluated were postoperative pain, patients' satisfaction and the total amount of morphine administered. The measures were repeated every 4h for the first 24h after surgery. When confronted with the control group, patients receiving LA had lower median VAS scores, a reduced amount of morphine required to control postoperative pain, and the patients were more satisfied of the analgesia. [40]

Ahiskalioglu et al. randomized 60 patients undergoing thyroidectomy into 3 groups. Group C (control) received a standard GA, Group SC received a BSCPB with bupivacaine 0,25% and Group SC+T received oral tizanidine and BSCPB. This study showed that BSCPB was effective in reducing postoperative pain scores, opioid consumption, and side effects. Patients that received tizanidine had a reduced early postoperative opioid consumption, posterior neck pain and occipital headache. [41]

Aweke et al. studied the efficacy of BSCPB in 66 patients undergoing thyroid surgery. The main outcomes evaluated were postoperative NRS scores, time to the first analgesic requirement, and the incidence of PONV. Patients in the LA group showed reduced postoperative pain scores, a statistically significant difference in time of first analgesic requirement and a reduced incidence of PONV. [42]

Table 2. Loco-regional anaesthetics (LRA) Combined to General Anesthesia (GA).

Author	Year	Setting	Study type	N. Patients enrolled	LR technique	Controlled arm	Outcome explorated	Evaluation time	Results	Adverse events

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Dieudonne et al. [21]	2001	University Hospital	RCT	90	BSCPB	Standard GA	Postoperative pain. Opioid consummation.	0-2-6-24 h	Reduced postoperative pain; Opioid consummation in LRA	Not reported
Andrieu et al. [22]	2007	University Hospital	RCT	87	BSCPB	Standard GA	Intra/Postoperative pain; Opioid and nefopam consumption. PONV	0-3-6-9-12-18-24h	Reduced Intra/Postoperative pain; Opioid and nefopam consumption in LRA	PONV LRA (23); PONV GA (8); RLN injurie LRA (10), RLA injurie GA (4).
Kale et al. [23]	2015	Teaching Hospital	RCT	60	BSCPB pre- or post-surgery	Standard GA	Postoperative pain; Opioid consumption. PONV	0-1-2-4-8-12-18-24-36-48h	Reduced Postoperative pain, PONV and Opioid consumption in LRA	PONV LRA (1); PONV GA (6).
Liu et al. [24]	2023	Municipal Hospital	RCT	75	BSCPB and OFA anesthesia	Opioid-based anesthesia	Safety, Postoperative pain; PONV	2-4-6-24h	Postoperative pain and PONV reduced in LRA	PONV LRA (2); PONV GA (18)
Suh et al. [25]	2009	University Hospital	RCT	90	BSCPB and combined SCPB and DCPB	Standard GA	Postoperative pain; Opioid consumption. PONV	0-4-6-12-24h	Reduced Postoperative pain and Opioid consumption in LRA	PONV LRA (13); PONV GA (14)
Woldergerima et al. [26]	2020	University Hospital	Prospective	74	BSCPB	Standard GA	Postoperative pain; Opioid consumption	0-2-6-12-24h	Reduced Postoperative pain and Opioid consumption in LRA	PONV LRA (10); PONV GA (13)
Shih et al. [27]	2010	Tertiary Care Hospital	RCT	162	BSCPB	Standard GA + placebo	Desfluorane compsuntion, Postoperative pain and rescue analgesia, LOS.	2-6-10-14-18-22-26h	Reduced Desfluorane compsuntion, Postoperative pain and rescue analgesia, LOS in LRA	Transient diaphragmatic paresis LRA (1); PONV LRA (34/106); PONV GA (21/56)
Gurkan et al. [28]	2014	University Hospital	RCT	50	BSCPB	Standard GA	Postoperative pain; Opioid consumption	1-6-12-24h	Reduced Postoperative pain; Opioid consumption in LRA	Transient Hoarseness LRA (7) and ear lobe numbness LRA (1).
Yao et al. [29]	2019	University Hospital	RCT	74	BSCPB	Standard GA	Postoperative pain, recovery quality and rescue analgesia; LOS	0,5-1-2-4-8-24h	Reduced Postoperative pain; Opioid consumption and LOS with a	PONV LRA (1); PONV GA (17)

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									better recovery quality in LRA	
Steffen et al. [30]	2010	Teaching Hospital	RCT	159	BSCPB	Standard GA	Postoperative pain and analgesic consumption; LOS	Q8h for 3 days	Postoperative pain and analgesic consumption in LRA; No differences in LOS	Transient ear lobe numbness LRA (41).
Ozgun et al. [31]	2022	State Hospital	RCT	60	BSCPB	Standard GA	Postoperative pain and rescue analgesia, Opioid consumation	2-6-12-24 h	Reduced Postoperative pain and rescue analgesia, Opioid consummation in LRA	Subcutaneous emphysema LRA (2).
Karakis et al. [32]	2019	University Hospital	RCT	46	BSCPB	Standard GA	Postoperative pain and Opioid, paracetamol, and ondansetron consumation	0,25-0,5-1-2-6-12-24-48 h	Reduced Postoperative pain and Opioid paracetamol, and ondansetron consummation in LRA	PONV LRA (2); PONV GA (11)
Goulart et al. [33]	2019	University Hospital	RCT	100	BSCPB	Standard GA	Intra/Postoperative pain; Opioid consumption. PONV	0,25-0,5-0,75-1-4-8-12-h	Reduced Intra/Postoperative pain; Opioid consumption and PONV in LRA	PONV LRA (5); PONV GA (22)
Eti et al. [34]	2006	University Hospital	RCT	45	BSCPB	Standard GA ± LA	Opioid consumption	1-2-4-8-12-16-20-24h	No differences in opioid consumption.	PONV LRA (7); PONV GA (10)
Herbland et al. [35]	2006	University Hospital	RCT	111	BSCPB	Standard GA	Postoperative pain; Opioid consumption. PONV	q4h for 1,5 days	No differences in postoperative pain and opioid consumption	Transient left brachial paresthesia (1) and arm partial motor block (1) in LRA. PONV LRA (22/74); PONV GA (15/37)
Karthikeyan et al. [36]	2012	University Hospital	RCT	60	BSCPB	Standard GA	Intra/Postoperative pain; Opioid consumption. PONV	2-4-6-8-16-24h	Reduced Intra/Postoperative pain; Opioid consumption and PONV in LRA	PONV LRA (11/40); PONV GA (10/20)
Kesisoglou et al. [37]	2009	University Hospital	RCT	100	BSCPB	Standard GA	Postoperative pain; Opioid consumption.	0-3-6-9-12-24h	Reduced postoperative pain and	Not reported

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								opioid consumption in LRA (first 12h)	
Sardar et al. [38]	2013	University Hospital	RCT	60	BSCPB	Standard GA	Postoperative pain; Opioid consumption.	/	No differences in postoperative pain an opioid consumption.	Not reported
Cai et al. [39]	2012	University Hospital	RCT	135	BSCPB	Standard GA	Postoperative pain; Opioid consumption. PONV	0-4-8-16-24h	Reduced Postoperative, Opioid consumption and PONV in LRA	Transient Horner syndrome (12) in LRA; PONV LRA (29); PONV GA (51)
Negmi et al. [40]	2005	Teaching Hospital	RCT	50	BSCPB	Standard GA	Postoperative pain; Opioid consumption. Patients' satisfaction.	0-4-8-16-24h	Reduced Postoperative pain, Opioid consumption with excellent patient satisfaction in LRA	Not reported
Ahiskaliog lu et al. [41]	2018	University Hospital	RCT	60	BSCPB	Standard GA	Postoperative pain; Opioid consumption. Safety	0-1-2-4-8-12-24h	Reduced Postoperative pain; Opioid consumption in LRA	Transient Hoarseness LRA (2/40); PONV LRA (14/40); PONV GA (7/20)
Aweke et al. [42]	2018	University Hospital	RCT	66	BSCPB	Standard GA	Intra/Postoperative pain; Opioid consumption. PONV	3-6-12-24h	Reduced Intra/Postoperative pain, Opioid consumption and PONV in LRA	PONV LRA (20); PONV GA (25)

4. Discussion

The purpose of this review is to report on current concepts regarding regional anesthesia role in the thyroid and parathyroid surgery by anesthesiologist point of view. On the other hand, in regional anesthesia, the surgeon may encounter difficulties during surgery due to the lack of muscle release caused by the absence of neuromuscular blocking agents. Surgical difficulties may increase the risk of bleeding and possible reoperations. Unfortunately, this review does not reveal any controlled studies on the topic and in only one case series the BSCPB was described as effective in reducing bleeding, time saving, allowed a faster oral nutrition, and early mobility. [18]

Another concern is that in other surgical settings, the discharge of loco-regional patients may be delayed further by the additional need of sedation; the length of stay and direct costs increase significantly when the boarding period in post-anesthesia care units is prolonged. [43,44] Interestingly, in thyroid surgery even the mean duration of anesthesia is higher in the SCPB group than GA group there is no statistical differences in hospital stay between the two groups [14]; additionally, patients who were in the LR group experienced a faster return to work. [17]

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In the last two decades, intraoperative neural monitoring (IONM) has become a standard method for monitoring the RLN during thyroid surgery.[45] Unfortunately, there are no studies of IONM in patients who undergo thyroid surgery under LRA not combined to GA.

The most reliable evidence has been found to be the use of LRA in combination with GA, it appears that the use of LRA combined to GA has an opioid-sparing impact, enhancing recovery and reducing PONV. [24,25,46]

The analgesic efficacy in the perioperative period after thyroid surgery and the reduced opioid use and PONV is confirmed by a recent systematic review with meta-analysis including 2,273 patients enrolled in 31 studies, published between January 2022, comparing the effect of BSCPB to no block or placebo block with saline. [46]

The CDC recognized the need for Guidelines on Pain Management to improve appropriate opioid prescribing while minimizing opioid-related risks, as the United States is experiencing an opioid epidemic. [47] However, the use of regional loco anesthesia seems to be desirable to reduce the prescription of opioid analgesics.

5. Conclusions

This LRA, in combination with GA, has been proven to be the most reliable evidence for reducing opioid use and postoperative nausea and vomiting in thyroid and parathyroid surgeries.

LRA, not combined with GA, has been used in a few well-conducted studies, although it seems feasible to use even in patients with severe systemic disease, future well-conducted controlled studies will need to validate its effectiveness, safety and feasibility with IONM.

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