Original Article

Radiology-Guided Selection and Surgical Outcomes in ACR TI-RADS 3 Thyroid Nodules: Comparing Total Thyroidectomy under General Anesthesia versus Cervical Block

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Abstract

Background: Thyroid nodules classified as ACR TI-RADS 3 are considered mildly suspicious but often require surgical excision when symptomatic or enlarging. While general anesthesia (GA) is the conventional choice for thyroidectomy, cervical block anesthesia (CBA) has gained attention for its safety, reduced postoperative morbidity, and faster recovery. Comparative data on outcomes in this specific patient subgroup remain limited. **Material and Methods:** A total of 120 patients (mean age: 44.7 ± 11.2 years; 32 males, 88 females) with TI-RADS 3 nodules undergoing total thyroidectomy were enrolled. Patients were randomized into two groups: Group A (n=60) underwent thyroidectomy under GA, and Group B (n=60) under CBA. Parameters assessed included operative duration, intraoperative blood loss, postoperative pain using a visual analogue scale (VAS), recovery time, hospital stay, and complications. Statistical analysis was performed using the chi-square test and independent t-test, with $p < 0.05$ considered significant The mean operative time (98.4 ± 15.2 min vs. 95.1 ± 13.9 min, $p = 0.27$) and intraoperative blood loss (82.5 ± 20.6 mL vs. 79.3 ± 19.8 mL, $p = 0.39$) were comparable between Group A and Group B. However, Group B demonstrated significantly lower postoperative VAS scores at 6 hours (3.8 ± 1.1 vs. 5.2 ± 1.3, $p < 0.001$), shorter recovery time (9.2 ± 2.8 hours vs. 14.6 ± 3.2 hours, $p < 0.001$), and reduced hospital stay (2.4 ± 0.9 days vs. 3.6 ± 1.2 days, $p < 0.001$). Complication rates, including transient hypocalcemia and recurrent laryngeal nerve palsy, were similar between groups. Patient satisfaction was significantly higher in the CBA group ($p < 0.01$). **Conclusion:** Radiology-guided selection of ACR TI-RADS 3 nodules provides accurate indications for surgery. For total thyroidectomy in these patients, cervical block anesthesia is as safe as general anesthesia and offers superior outcomes regarding postoperative pain, recovery speed, hospital stay, and patient satisfaction. CBA represents a viable and often preferable alternative to GA in appropriately selected patients.

Keywords: ACR TI-RADS 3, thyroid nodule, total thyroidectomy, general anesthesia, cervical block, surgical outcomes.

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Introduction

Thyroid nodules are a common clinical entity, detected in up to 65% of the general population through high-resolution ultrasound.[1] The vast majority of these nodules are benign; however, a systematic approach is necessary to identify the 7-15% that harbor malignancy.[2] The American College of Radiology (ACR) Thyroid Imaging, Reporting and Data System (TI-RADS) has emerged as a standardized, ultrasound-based risk stratification system that categorizes nodules from benign (TI-RADS 1) to highly suspicious (TI-RADS 5).[3] ACR TI-RADS 3 nodules, characterized as "mildly suspicious," have a low risk of malignancy (<5%) and are typically round, isoechoic or hyperechoic, and lack highly suspicious features.[4]

While surveillance is often the initial management strategy for TI-RADS 3 nodules, surgical intervention becomes necessary for various reasons, including compressive symptoms (dysphagia, dyspnea), cosmetic concerns, significant interval growth, or patient preference.[5] In such cases, total thyroidectomy is frequently performed, especially in the context of multinodular goiter or contralateral nodules, to provide a definitive therapeutic and diagnostic solution and avoid the need for reoperation.[6]

The standard anesthetic technique for thyroid surgery has historically been general anesthesia (GA) with endotracheal intubation. This approach provides complete control of the airway, muscle relaxation, and immobility, ensuring optimal surgical conditions.[7] However, GA is associated with several

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drawbacks, including hemodynamic instability, postoperative nausea and vomiting (PONV), sore throat from intubation, and delayed recovery, which can prolong hospital stays and increase healthcare costs.[8]

In recent years, regional anesthetic techniques, particularly cervical block anesthesia (CBA), have gained traction as an alternative for thyroid and parathyroid surgery. CBA, which involves ultrasound-guided injection of local anesthetic to block the superficial and intermediate cervical plexus, offers several potential benefits. These include preserved airway reflexes, reduced stress response, excellent postoperative analgesia, lower incidence of PONV, and faster patient recovery.[9,10] Despite these advantages, concerns regarding patient comfort, intraoperative conversion to GA, and potential for incomplete blockade have limited its widespread adoption.

Several studies have compared GA and CBA for thyroid surgery, generally favoring CBA for its improved postoperative outcomes.[11,12] However, there is a paucity of data specifically evaluating these anesthetic techniques in the well-defined patient population with ACR TI-RADS 3 nodules undergoing total thyroidectomy. This subgroup is clinically important, as the decision for surgery is often based on symptoms rather than a high suspicion of malignancy, making patient-centered outcomes like comfort, recovery speed, and satisfaction particularly relevant. This study was therefore designed to bridge this research gap by prospectively comparing the safety and efficacy of total thyroidectomy performed under GA versus CBA in patients selected based on ACR TI-RADS 3 classification. The primary aim was to evaluate operative and postoperative outcomes, including pain, recovery time, hospital stay, and complications.

Materials and Methods

Study Design and Setting: This prospective, randomized, comparative study was conducted at the Department of Radiodiagnosis, General Surgery and Anaesthesia of Al-Azhar Medical College and Super Speciality Hospital from June 2022 to May 2024.

Patient Population and Sample Size: A total of 120 consecutive patients scheduled for total thyroidectomy for ACR TI-RADS 3 nodules were enrolled. Sample size was calculated based on a pilot study, determining that 58 patients per group would be needed to detect a 25% difference in mean hospital stay with a power of 80% and an alpha of 0.05. This was rounded up to 60 patients per group to account for potential dropouts.

Inclusion Criteria: (1) Age between 18 and 70 years; (2) Preoperative ultrasound diagnosis of one or more ACR TI-RADS 3 nodules; (3) Clinical indication for total thyroidectomy (e.g., compressive symptoms, substernal extension, significant growth on follow-up, or patient preference after counseling); (4) American Society of Anesthesiologists (ASA) physical status I or II; (5) Ability to provide informed consent.

Exclusion Criteria: (1) Patient refusal to undergo regional anesthesia; (2) Known allergy to local anesthetics; (3) Previous surgery on the neck or cervical spine deformity; (4) Coagulation disorders or use of anticoagulant therapy that could not be safely discontinued; (5) Severe cardiopulmonary, renal, or hepatic disease (ASA III or IV); (6) Confirmed or highly suspected malignancy (TI-RADS 4 or 5); (7) Inability to communicate or cooperate during the procedure.

Randomization and Blinding: Patients who met the eligibility criteria were randomized into two equal groups using a computer-generated random number sequence. The allocation was concealed in sequentially numbered, opaque, sealed envelopes, which were opened by a designated staff member not involved in patient care just before the procedure. Group A (n=60) was assigned to receive general anesthesia (GA), and Group B (n=60) was assigned to receive cervical block anesthesia (CBA). Due to the nature of the interventions, blinding of the patients and the intraoperative surgical team was not possible. However, the postoperative data collectors and statisticians were blinded to the group allocations.

Anesthetic and Surgical Procedures: All procedures were performed by one of two senior surgeons with extensive experience in both GA- and CBA-assisted thyroidectomies to minimize technique-related variability.

Group A (General Anesthesia): Patients received standard premedication with midazolam. Anesthesia was induced with propofol (2-2.5 mg/kg) and fentanyl (1-2 mcg/kg). Tracheal intubation was facilitated by rocuronium (0.6 mg/kg). Anesthesia was maintained with sevoflurane in an oxygen/air mixture, with intermittent boluses of fentanyl as required. At the end of the procedure, neuromuscular blockade was reversed with neostigmine and glycopyrrolate, and patients were extubated once airway reflexes returned.

Group B (Cervical Block Anesthesia): Patients received light sedation with an infusion of dexmedetomidine (0.2-0.7 mcg/kg/hr) to maintain a state of conscious sedation (Ramsay Sedation Scale score 2-3). A bilateral superficial and intermediate (deep to the investing fascia but superficial to the prevertebral fascia) cervical plexus block was performed under ultrasound guidance using a high-frequency linear probe. A 22-gauge needle was used to inject a solution containing 0.375% Ropivacaine with 2% lignocaine 1:200,000 epinephrine combination, with approximately 15-20 mL administered per side. The surgical field was also infiltrated with local anaesthetic along the planned incision line.

Surgical Technique: A standardized total thyroidectomy was performed through a transverse cervical incision. The recurrent laryngeal nerves (RLNs) were identified and preserved bilaterally. At least two parathyroid glands were identified and preserved in situ with their blood supply. Hemostasis was meticulously secured. A closed suction drain was placed at the surgeon's discretion.

Outcome Measures

The following parameters were prospectively collected:

Demographics: Age and sex.

Intraoperative Variables: Operative duration (from skin incision to skin closure in minutes) and intraoperative blood loss (estimated by measuring the volume in the suction canister minus irrigation fluid, plus the weight of soaked surgical gauzes).

Postoperative Variables:

Pain: Assessed using a 10-point Visual Analogue Scale (VAS; 0

= no pain, 10 = worst imaginable pain) at 6, 12, and 24 hours postoperatively.

Recovery Time: Defined as the time in hours from the end of surgery until the patient was able to ambulate unassisted and tolerate a soft diet.

Hospital Stay: Calculated in days from the day of surgery to the day of discharge.

Complications: Monitored until discharge and at a one-month follow-up visit. This included transient hypocalcemia (symptomatic or serum corrected calcium <8.0 mg/dL), recurrent laryngeal nerve palsy (RLNP, confirmed by laryngoscopy if hoarseness persisted), and wound hematoma requiring intervention.

Patient Satisfaction: Assessed at discharge using a 5-point Likert scale (1 = very dissatisfied, 5 = very satisfied).

Statistical Analysis: Data were analyzed using SPSS Statistics for Windows, Version 26.0 (IBM Corp., Armonk, NY). Continuous variables were presented as mean ± standard deviation (SD) and compared using the independent samples t-test. Categorical variables were presented as frequencies and percentages and compared using the Chi-square test or Fisher's exact test, as appropriate. A p-value of less than 0.05 was considered statistically significant.

Results

Patient Demographics and Baseline Characteristics: A total of 120 patients were included in the final analysis, with 60 patients in each group. The two groups were well-matched in terms of demographic and baseline clinical characteristics. The mean age of patients was 44.2 ± 11.8 years in Group A (GA) and 45.1 ± 10.7 years in Group B (CBA) (p = 0.65). The female-to-male ratio was comparable, with 43 females (71.7%) in Group A and 45 females (75.0%) in Group B (p = 0.68). There were no significant differences in ASA classification between the groups [Table 1]. No patients in the CBA group required conversion to general anesthesia.

Table 1: Demographic and Baseline Characteristics of Patients.

Characteristic	Group A (GA, n=60)	Group B (CBA, n=60)	p-value
Age (years), mean ± SD	44.2 ± 11.8	45.1 ± 10.7	0.65
Sex, n (%)			0.68
Male	17 (28.3%)	15 (25.0%)	
Female	43 (71.7%)	45 (75.0%)	
ASA Status, n (%)			0.81
I	38 (63.3%)	40 (66.7%)	
II	22 (36.7%)	20 (33.3%)	

Intraoperative and Postoperative Outcomes:

Intraoperative outcomes, including operative time and blood loss, were not significantly different between the two groups. The mean operative time was 98.4 ± 15.2 minutes in the GA group and 95.1 ± 13.9 minutes in the CBA group (p = 0.27). Similarly, the mean intraoperative blood loss was 82.5 ± 20.6 mL and 79.3 ± 19.8 mL for Group A and Group B, respectively (p = 0.39).

In contrast, significant differences were observed in all major postoperative outcomes. Postoperative pain, as measured by VAS scores at 6 hours, was significantly lower in the CBA group (3.8 ± 1.1) compared to the GA group (5.2 ± 1.3; p < 0.001). The mean recovery time was substantially shorter for patients in Group B (9.2 ± 2.8 hours) than in Group A (14.6 ± 3.2 hours; p < 0.001). This was mirrored by a significantly shorter mean hospital stay for the CBA group (2.4 ± 0.9 days) compared to the GA group (3.6 ± 1.2 days; p < 0.001). These results are summarized in [Table 2].

Table 2: Comparison of Intraoperative and Postoperative Outcomes

Parameter	Group A (GA, n=60)	Group B (CBA, n=60)	p-value
Operative Duration (min), mean ± SD	98.4 ± 15.2	95.1 ± 13.9	0.27
Blood Loss (mL), mean ± SD	82.5 ± 20.6	79.3 ± 19.8	0.39
Postoperative VAS at 6 hours, mean ± SD	5.2 ± 1.3	3.8 ± 1.1	<0.001
Recovery Time (hours), mean ± SD	14.6 ± 3.2	9.2 ± 2.8	<0.001
Hospital Stay (days), mean ± SD	3.6 ± 1.2	2.4 ± 0.9	<0.001

GA: General Anesthesia; CBA: Cervical Block Anesthesia; SD: Standard Deviation; VAS: Visual Analogue Scale. P-values calculated using independent t-test. Bold values indicate statistical significance.

Complications and Patient Satisfaction: The incidence of postoperative complications was low and statistically similar between the two groups. Transient hypocalcemia was the most common complication, occurring in 5 patients (8.3%) in Group A and 4 patients (6.6%) in Group B (p = 0.72). All cases were managed successfully with oral calcium supplementation and resolved within one month. Transient recurrent laryngeal nerve palsy was observed in 2 patients (3.3%) in each group (p = 1.00); vocal cord mobility returned to normal in all four patients at the one-month follow-up. No cases of permanent RLNP, permanent hypoparathyroidism, or wound hematoma requiring re-exploration were reported in either group. There was no perioperative mortality.

Patient satisfaction scores were significantly higher in the CBA group. The mean satisfaction score was 4.6 ± 0.5 in Group B, compared to 3.9 ± 0.7 in Group A (p < 0.01). The detailed comparison is presented in [Table 3].

Table 3: Comparison of Postoperative Complications and Patient Satisfaction

Parameter	Group A (GA, n=60), n (%)	Group B (CBA, n=60), n (%)	p-value
Complications			
Transient Hypocalcemia	5 (8.3%)	4 (6.6%)	0.72
Transient RLNP	2 (3.3%)	2 (3.3%)	1.00
Wound Hematoma	0 (0%)	0 (0%)	-
Patient Satisfaction			<0.01
Very Satisfied (5)	18 (30.0%)	42 (70.0%)	
Satisfied (4)	30 (50.0%)	15 (25.0%)	
Neutral (3)	12 (20.0%)	3 (5.0%)	
Dissatisfied (2)	0 (0%)	0 (0%)	
Very Dissatisfied (1)	0 (0%)	0 (0%)	

Discussion

This prospective randomized study demonstrates that while both general and cervical block anesthesia are safe for total thyroidectomy in patients with ACR TI-RADS 3 nodules, CBA offers significant advantages in the postoperative period. Our findings confirm that CBA is associated with reduced postoperative pain, faster recovery, shorter hospital stays, and higher patient satisfaction, without increasing the risk of surgical complications.

The comparable operative times and intraoperative blood loss between the two groups are a key finding. This suggests that CBA, when performed by an experienced team, provides adequate anesthesia and surgical conditions that do not impede the surgeon's performance.[13] This addresses a common concern that patient movement or discomfort under regional anesthesia could prolong or complicate the procedure. Our results align with previous studies that found no significant difference in surgical duration between GA and CBA for thyroidectomy.[14,15]

The most prominent benefits of CBA were observed postoperatively. The significantly lower VAS scores at 6 hours in the CBA group can be attributed to the long-acting local anesthetic, which provides prolonged analgesia extending well into the postoperative period.[16] This reduces the immediate need for systemic opioids, thereby mitigating their associated side effects like sedation and nausea, which in turn contributes to a faster recovery. The avoidance of endotracheal intubation in the CBA group also eliminates postoperative sore throat, a common complaint after GA that can contribute to overall discomfort.[8]

The expedited recovery time and shorter hospital stay in the CBA group are clinically and economically significant. A faster return to ambulation and oral intake, as documented in our study, is a well-established factor in reducing overall hospital stay.[17] These findings are consistent with the principles of Enhanced Recovery After Surgery (ERAS) pathways, which emphasize multimodal, opioid-sparing analgesia and early mobilization.[18] By facilitating these goals, CBA can contribute to more efficient resource utilization and reduced healthcare costs, a crucial consideration in modern healthcare systems.

The safety profile of CBA in our study was excellent and comparable to GA. The incidence of transient hypocalcemia and RLNP was low and did not differ between the groups. This is a critical point, as it demonstrates that the choice of anesthetic technique does not adversely affect the most feared complications of thyroid surgery. The preservation of laryngeal nerve function under CBA may even offer a theoretical advantage, as intraoperative voice monitoring is possible in an awake patient, though this was not a specific endpoint in our study.[19] The similar complication rates reinforce the idea that surgical outcomes are primarily dependent on meticulous surgical technique rather than the type of anesthesia used.

Patient satisfaction is an increasingly important metric in assessing the quality of care. The significantly higher satisfaction rates in the CBA group likely reflect a combination of factors: less pain, absence of PONV, feeling more alert and in control after surgery, and a quicker return to normalcy.[12,20] This highlights the importance of considering the patient's perioperative experience, particularly in surgeries for low-risk conditions like TI-RADS 3 nodules, where the quality of life impact of the intervention is paramount.

This study has several strengths, including its prospective, randomized design, the use of a homogenous patient cohort based on a standardized radiological classification (ACR TI-RADS 3), and the application of standardized surgical and anesthetic techniques. However, some limitations must be acknowledged. First, this was a single-center study, which may limit the generalizability of our findings. Second, the surgeons and patients could not be blinded to the anesthetic technique, which may have introduced a potential for bias, although postoperative assessors were blinded. Finally, our follow-up was limited to one month, which is sufficient for assessing transient complications but does not provide data on long-term outcomes.

Conclusion

In conclusion, this study provides strong evidence supporting the use of cervical block anesthesia for total thyroidectomy in patients with ACR TI-RADS 3 nodules. CBA is as safe as traditional general anesthesia regarding major surgical complications but is superior in providing a more comfortable and rapid postoperative recovery. The observed benefits of reduced pain, shorter recovery times, decreased hospital stays, and enhanced patient satisfaction make CBA a highly attractive and viable alternative to GA. Based on these findings, healthcare institutions should consider incorporating CBA into their standard practice for selected patients undergoing thyroid surgery, thereby improving the quality of patient care and optimizing hospital resource utilization.

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Conflicts of interest

There are no conflicts of interest.

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