Original Article

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Efficacy and Safety of Cervical Epidural Anesthesia for Thyroid Surgery

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Abstract

Background: Cervical epidural anesthesia (CEA) has been employed successfully for various types of surgical procedures involving upper limb surgery, thoracic wall surgery, carotid artery surgery, and neck dissections. Anesthesia for thyroidectomy in a patient with tracheal deviation due to the large size or altered functional status of the thyroid can be complicated. Endotracheal intubation is difficult in such cases and more prone to cardiac arrhythmia under the influence of inhalational anesthetics.

Objectives: This prospective study was designed to assess the effectiveness and safety of CEA for thyroid surgery.

Materials and Methods: Patients were divided on an alternate basis into two groups of 25 each. Group A to receive 10 ml of local anesthetic (1% lignocaine with adrenaline). Group B to receive conventional general anesthesia (GA) with endotracheal tube intubation. We compared their efficacy in terms of hemodynamic parameters, pulmonary parameters, blockade quality, and complications.

Results: Of the total study: In Group A, 25 patients completed the study successfully. Sensory block attained the median dermatomal range of C_2-$T_{4/5}$. Hemodynamic parameters and respiratory parameters decreased, but none of the patients had any complications. In Group B, 25 patients received GA. Hemodynamic parameters and respiratory parameters in the beginning and end of the procedure were increased, attributed to intubation and extubation. Post-operative pain that required rescues analgesics.

Conclusion: Cervical epidural route can be considered as a safe alternative to conventional GA for patients undergoing thyroid surgery where difficult intubation is anticipated and vulnerable to cardiovascular complications.

Key words: Anesthesia, Cervical epidural, General anesthesia, Neck dissection

INTRODUCTION

Thyroid surgeries are conventionally performed under general anesthesia (GA).[1] Safe and effective anesthesia for thyroid surgery can become a problem for the anesthesiologists; this becomes especially relevant in large goiter with tracheal deviation.[2] Endotracheal intubation is difficult in such cases, and can be hazardous if associated with functional thyroid disorders.[3] Patients with hypo and hyperthyroidism are more prone to cardiac rhythm disorders that might get aggravated under the influence of GA agents.[4,5]

Regional anesthetic techniques are safer than GA in high-risk patients where endotracheal intubation is difficult or cardiac arrhythmias are anticipated.[6] Regional anesthesia is not a conventional option for thyroid surgery. Cervical epidural anesthesia (CEA) has been employed successfully for various types of surgical procedures involving thoracic wall surgery,[7,8] carotid artery surgery,[9,10] upper limb surgery,[11-13] and neck dissections[12] with good results, so CEA provides an alternate choice for thyroid surgery. Here, we describe our experiences of using this technique for thyroid surgery.[14,15]

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MATERIALS AND METHODS

Total 50 patients of ASA physical Status I-II, aged 18-60 years, posted for thyroid surgery, over a period of 2-year, were included in the prospective study conducted in Bidar Institute of Medical Sciences, Bidar. Ethical clearance was obtained by Ethical Committee Approval and written informed consent was also obtained from subjects. Patients were randomly divided into one of the two groups (25 each).

Pre-anesthetic check-up was done. A detailed case history was taken along with general physical examination and systemic examination. Airway assessment and spinal column examination were done. The following laboratory examination were done in selected cases - Hemoglobin, urine analysis, blood sugar, blood urea, serum creatinine, coagulation profile, blood grouping and Rh typing, electrocardiogram (ECG), chest X-ray, fine needle aspiration cytology, and ultrasound neck. X-ray neck anteroposterior and lateral view were taken when suspected tracheal deviation was present. Bedside pulmonary function tests were also done. The size of the thyroid, medical co-morbidities, and difficult intubation evaluated before the surgery. The procedure of CEA explained, and the patient was informed to communicate to the anesthesiologist about the perception of any pain or discomfort during the surgery.

Cases randomly allotted to either group of elective thyroidectomy alternatively under CEA and GA as per the preplanned protocol.

- Group A to receive 10 ml of local anesthetic (1% lignocaine with adrenaline)
- Group B to receive conventional GA with endotracheal tube intubation.

We compared their efficacy in terms of hemodynamic parameters, pulmonary parameters, blockade quality, and complications.

The Technique of CEA

On arrival to the operation theater, standard monitors were attached; an intravenous access was achieved with 18 gauge cannula and patient positioned in the lateral decubitus position with the neck flexed and chins on the chest. Under strict aseptic precautions the neck was prepared and draped, cervical epidural space was identified with an 18 gauge Tuohy epidural needle, at the C_7-T_1 interspaces using the loss of resistance technique. An epidural catheter was then introduced 4 cm into the epidural space. After negative aspiration, the catheter was secured in place, and patients were made to lie supine. The test dose, 1% lignocaine with adrenaline (3 ml) was injected via an epidural catheter; vitals (ECG, heart rate [HR], noninvasive blood pressure (BP), SpO_2, respiratory rate, and consciousness), were monitored for 5-10 min for any sign of a complication. In the absence of such signs 7-10 ml of lignocaine with adrenaline was further injected through the epidural catheter. The sensory blockade assessed by response to pinprick method in an ascending fashion starting from the T_{12} dermatome (the onset of sensory block was defined as the time to loss of sensation to pinprick in the C_3 dermatome). Hemodynamic parameters monitored before and after the blockade.

The patients were maintained in a state of conscious sedation with midazolam (mean dose, 0.05 mg/kg IV) throughout the surgery. Vocal cord functions were monitored intermittently by verbal communication with the patient. Any intraoperative discomfort in the neck or request for pain relief was managed by administering epidural top-up of 5-8 ml of 1% lignocaine with adrenaline. Post-operative, monitoring of vital signs, visual analogue scale (VAS) scores and sedation scores were done. The incidence of hypotension (arterial BP <20% of baseline), bradycardia (HR <50 beats/min), nausea, vomiting monitored in the recovery room. Epidural top-ups were given on complaints of pain by the patient using 5 ml of 0.125% of bupivacaine.

Sedation scores were assessed every 15 min both intraoperative and post-operative using a four-point score described by Chernin *et al.*

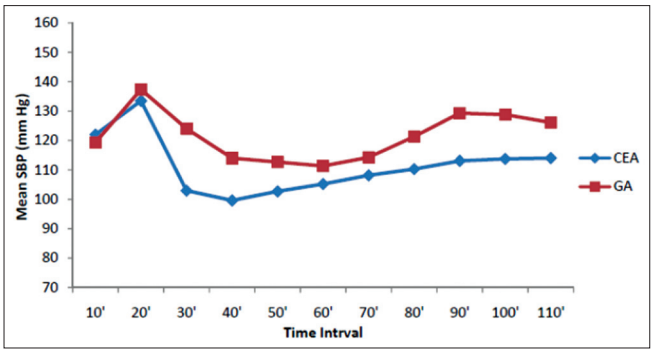
- Grade 0: Patient wide awake
- Grade 1: Patient is sleeping comfortably, but responding to verbal commands
- Grade 2: Deep sleep but arousable
- Grade 3: Deep sleep, unarousable.

GA

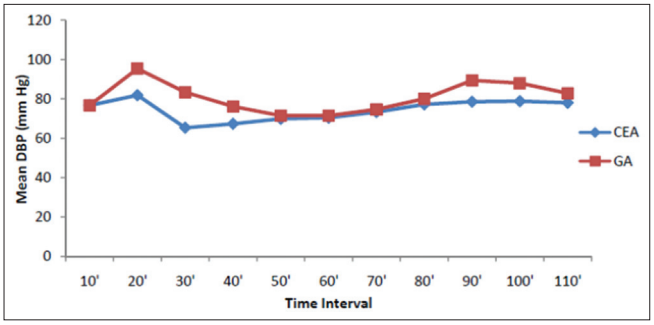
After usual premedication with intravenous glycopyrrolate, midazolam and fentanyl, induction was done using intravenous thiopentone sodium followed by intravenous succinylcholine. The airway was secured using appropriate size endotracheal tube and fixed after confirming bilateral air entry equal. The patient was maintained on oxygen, nitrous oxide, isoflurane and intravenous vecuronium. Ketamine and halothane were avoided. The patient was reversed with neostigmine and glycopyrrolate and extubation done after airway reflexes intact.

Throughout the perioperative period, pulse rate, BP, respiratory rate, ECG, and SpO_2 were monitored in all the patients.

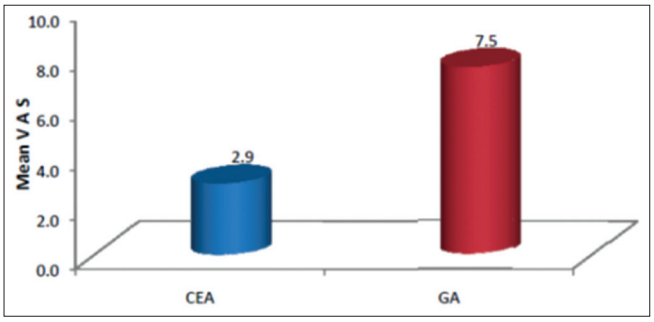
The Statistical software namely SPSS 19.0, Stata 8.0, were used for the analysis of the data and Microsoft Word and Excel have been used to generate Graphs 1-3, Table 1, etc.



Graph 1: Changes in systolic blood pressure



Graph 2: Changes in diastolic blood pressure



Graph 3: Distribution of VAS scale

Table 1: Age distribution

Age	Sex		Total
	Female	Male	
15-25	5	1	7
26-35	10	7	20
36-45	16	3	21
46-55	8	2	10
>55	1	1	2
Total	36	14	50

RESULTS

The study consisted of 50 patients for ASA physical Status I-II, aged 18-60 years, posted for thyroid surgery. The technique of CEA was successful in 25 out of 28 patients in whom it was attempted (one patient had patchy block, and two patients had hemorrhagic tap). The median time of duration of surgery was 70 min (50-90 min). No patient reported pain during the procedure. The upper margin of sensory block was assessed in $C_{2/3}$ dermatome in all patients, and the median of the lower margin of sensory block was $T_{4/5}$ (minimal extent C_2-T_1; maximal extent C_2-T_{10}). The patients were not in distress during surgery and did not complain of dyspnea during the procedure and in the post-operative period. There was no case of dura mater puncture. Patients were comfortably maintained sedated but awake during the procedure with no untoward effect. Monitoring of the vitals was carried out, and all patients' vital parameters were within normal limits, none of the patient's required additional intervention.

GA performed in 25 patients following normal induction and intubation, except for one case that had difficulty in intubation due to large goiter and deviated trachea.

Age Distribution

50% of the patients in the study were in the age group between 16 and 45 years.

Systolic BP

Before surgery, systolic BP was found to be normal in both the groups. Intraoperative, Mean systolic BP in the CEA group to be 108.36 ± 5.4 mm of Hg and GA group was 126.24 ± 10.5 mm of Hg. In both the groups, the systolic BP remained within normal limits. In the GA group, there was an increase in systolic BP and was attributed to intubation and extubation. Statistically, there were no significant changes in both the two groups ($P > 0.05$).

Diastolic BP

Diastolic BP was found to be normal in both the groups preoperatively. The Mean Diastolic BP in the CEA group to be 70.3 ± 6.3 mm of Hg and GA group was 76.2 ± 12.14 mm of Hg. In the GA group, there was an increase diastolic in BP and was attributed to intubation and extubation. Statistically, there were no significant changes in both the two groups ($P > 0.05$).

HR

The mean pulse rate in the CEA group to be 68.5 ± 5.4/min and GA group was 80.29 ± 8.48 per min. The pulse rate remained normal in both the groups; however, CEA group had lower readings compared to GA. There was no need of any additional intervention required. Statistically, there were no significant changes in both the two groups ($P > 0.05$).

SpO_2

There were no significant changes in oxygen saturation in both the groups. The mean SpO_2 in the CEA group to be 98.02 ± 1.06 and GA group was 98.95 ± 0.6. Statistically,

there were no significant changes in both the two groups ($P > 0.05$).

Respiratory Rate

The mean respiratory rate in the CEA group found to be increased (25 ± 3/min). In GA group controlled ventilation was done (16 ± 2/min).

Post-operative

Pulmonary function tests

Forced expiratory volume (FEV) and forced vital capacity (FVC) decreased by 10-15%, but these changes were not clinically significant. Statistically, there were no significant changes in the pulmonary parameters between the two groups ($P > 0.05$).

Pain

Post-operative pain is comparatively less in the cervical epidural group with VAS of 3 as compared to GA group with the VAS of 7.5. Statistically, there were significant changes in the Post-operative pain between the two groups at corresponding time intervals with significance value <0.05.

DISCUSSION

The efficacy of CEA compared with GA in terms of hemodynamic changes, pulmonary changes, quality of blockade and complications.

Hemodynamic changes

In CEA blockade of sympathetic fibers consequently decreases HR, cardiac output and contractility. The mean BP is unchanged/decreased depending on peripheral systemic vascular resistance. The baroreflex activity is also partly impaired. CEA can be beneficial to the patients with limited cardiac reserve due to prolongation of coronary perfusion time and decreased ventricular after load. In our study, the HR is slightly lower in CEA compared with GA and clinically not significant. BP remains within normal limits, toward the beginning and end of procedure there was an increase in BP in GA group was attributed to intubation and extubation.

Jain[3] HR decreased significantly in all the three groups. No vasopressor agent was required in any of the cases; however, two patients developed one episode of bradycardia, which was managed promptly by a bolus dose of atropine 0.6 mg IV.

Macchiarini *et al.,*[5]: CEA results in the sympathetic blockade and thereby reduces the HR, cardiac output and myocardial contractility. BP decreases or remains unchanged depending on the systemic vascular changes. Sympathetic blockade also reduces myocardial ischemia

Capdevila *et al.*,[16]: The major concern with CEA has been its effects on HR and hemodynamic stability. CEA blocks the sympathetic cardiac accelerator fibers that arise at T_1-T_4. Consequently decreases HR, cardiac output and contractility. The most frequently reported side effects of CEA are hypotension in 10.9% and bradycardia in 2.8%.

Pulmonary parameters

Effects of CEA on respiratory function especially phrenic nerve controlled diaphragmatic movements. Lignocaine with adrenaline when used in a lower concentration of 1%, in the epidural space, the diaphragmatic function is not affected. Hence, we used 1% lignocaine for this study. Pulmonary function test after CEA decreased by 10-15%, were clinically not significant comparative to GA.[17-19]

Jain[3] Pulmonary variables demonstrated a significant decline in FVC and FEV1 in all the patients, none of the patients developed dyspnea or hoarseness during the perioperative period.

Stevens *et al.*,[15] found a measurable reduction in bedside pulmonary function test after CEA. They found that the FEV and FVC decreased by 12-16% after using 300 mg of lignocaine, but these changes were not clinically significant. They concluded that the motor block of phrenic nerve was incomplete after CEA.

Santpur *et al.,*[5] CEA causes minimal respiratory and hemodynamic inhibition and hence the technique was preferred in chronic obstructive pulmonary disease patients. Groeben *et al.* found no significant changes in lung functions under high thoracic segmental epidural anesthesia with ropivacaine or bupivacaine in patients with severe obstructive pulmonary disease undergoing breast surgeries.

Shilpashri[1] CEA decreases for post-operative pain in high-risk patients can improve pulmonary functions by reducing the incidence of pneumonia and respiratory failure, improving oxygenation, decreasing the duration of mechanical ventilator support while hemodynamic parameters remain normal. In our study, the hemodynamic and respiratory changes were similar to finding concluded by Shilpashri *et al.*

Blockade quality

The segment of sensory block seen in CEA was from C_2-$T_{4/5}$ dermatome in all the patients. Median time to onset of the sensory block is 10 min. Most studies have successfully conducted surgeries under CEA using 10-15 ml of local anesthetic volumes. The local anesthetic required is approximately 1.0 and 1.5 ml a segment in cervical and thoracic epidural space, respectively (i.e., nearly 10-15 ml volume for spread to 8 to 10 segments).[4] In our study, we have used 10 ml of 1% lignocaine with adrenaline initially

and top up a dose of 5 ml was given when required, all patients had an excellent blockade.

Complications

Thyroidectomy under GA, in patients with goiter is associated with:

- Difficult and traumatic intubation in cases of tracheal deviation and compression
- Arrhythmias with the use of anesthetic gases like halothane
- Intubation stress response in associated co-morbid conditions
- Polypharmacy
- Post-operative nausea and vomiting
- Post-operative pain requires more rescue analgesia.

CEA is found to be a suitable alternative to GA in all the problems above. CEA is not practiced in routine anesthesia, commonly due to operator inexperience and risk of potential complications such as a dural puncture, neurovascular injury, epidural bleed/hematoma, or abscess formation. Bonnet *et al.* noted, dural puncture in 2 (0.5%) and epidural venipuncture in 6 (1.5%) patients, in a retrospective analysis of 394 patients. Hakl *et al.* reported bloody epidural tap in four patients, migration of local anesthetic solution into subarachnoid space in six patients and failed epidural puncture in three patients. We observed a hemorrhagic tap in two patients during epidural space localization thus mandating conversion to GA. None of our patients had a dural puncture. Previous studies have documented a proportionately higher risk of hypotension and arrhythmias during thyroid surgeries under GA.[20-22]

In contrast, Khanna and Singh mentioned no cardiovascular complications during thyroid surgeries under CEA.[2]

CEA has gained popularity due to its safety, stable hemodynamic and pulmonary parameters. Furthermore, decreases the stress response by excellent pain relief and enhances early post-operative recovery with minimal morbidity[2,14] we used CEA as sole anesthetic technique for thyroid surgery.

It has several advantages. Patients are operated under CEA can be maintained in a state of conscious-sedation. The relative bloodless field and the possibility of monitoring the vocal cord movements using the verbal contact in a conscious patient during surgery is a distinct advantage of this procedure. Other noted benefits of epidural anesthesia are (1) less bleeding, (2) lack of electrolyte imbalance, (3) early ambulation and recovery, (4) no post-operative atelectasis of lung, (5) minimum BP drop, (6) little nausea or vomiting, (7) no vascular spasms or post-operative phlebothrombosis, and (8) little or no motor nerve block.

In our study, respiratory and hemodynamic functions were within normal limits and other complications were not observed, thereby proving that epidural anesthesia can be immensely useful as a sole anesthetic agent for thyroid surgeries.

CONCLUSION

CEA provides stable vital parameters, excellent control of pain extending into post-operative period and early recovery with reduction in stress response, blood loss and post-operative morbidity; we conclude that CEA can be used as a safe alternative to GA for thyroid surgeries, especially in patients with co-morbidities of respiratory system, cardiovascular system and deranged thyroid profiles.

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