Carotid Endarterectomy under Regional Anesthesia; Early Results

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ABSTRACT

Aim of the study: *In this study we aimed to examine the efficacy of carotid Endarterectomy (CEA) that was done under regional anesthesia. And furthermore, we compared the efficacy and anesthesia-related complications associated with the two different regional anesthetic techniques; the cervical plexus block (CPB) and the cervical epidural (CE).* ***Material and Methods:*** *From January 2012 to June 2015, 30 patients (19 men and 11 women) had Carotid endarterectomy (CEA) done under regional anesthesia. We recorded the peri and postoperative data and studied the outcome of the procedure. Patients were classified into 2 groups; Group I included 20 patients who had the CEA under combined deep and superficial cervical plexuses block (CPB), while Group II included the remaining 10 had their CEA under cervical epidural anesthesia (CE). Patients were followed up for 1 year.* ***Results:*** *No perioperative mortality. No major stroke was detected in all cases. We recorded only one case of minor stroke (3.3%). Cranial nerve concussion postoperatively with significant chocking (hypoglossal nerve affection) occurred only in a single patient. In terms of anesthesia related complications; significant postoperative hypotension was detected in 4 patients in both groups (13.3%) only one in Group I (5%) and 3 (30%) patients in groups II we also recorded one patient of Laryngeal nerve injury in group I and none in group II. Primary patency rate was 100% (30/30), 100% (29/30) & 95% (28/30) at 1, 6 & 12 months respectively.* ***Conclusion:*** *CEA under regional anesthesia is safe procedure with low rate of complications. Both CPB and CE are very effective anesthetic techniques but CPB is easier and with lower rate of anesthetic related complications than CE.*

Kewy Words: *Carotid endarterectomy, Cervical blaok, Cervical eipidual*

INTRODUCTION

Carotid artery stenosis is usually caused by atherosclerotic plaques formed at carotid bifurcation that leads to narrowing of the artery or embolization of thrombus or plaque debris causing transient ischemic attacks or stroke. The risk of stroke has been estimated at about 5% per year for asymptomatic and about 10% per year for patient has transient ischemic attack [1].

Carotid Endarterectomy is a leading way to prevent stroke in high grade occlusive disease of carotid artery [2]. Since Debakey et a, performed first carotid Endarterectomy in 1954, there has been much debate about the safest anesthetic method for this procedure [3].

Many studies could not demonstrate which anesthetic technique is superior. Regional anesthesia commonly used is cervical plexus block (CPB). Superficial plexus block is reported to be as effective as the combined superficial and deep CPB with a potentially lower risk of complications. In addition, some surgeons use only local anesthetic infiltration [4, 5, 6, 7]. Cervical epidural (CE) anaesthesia is an alternative option for carotid endarterectomy but seems to be rarely selected as the technique of choice [8, 9].

The aim of this study was to detect the efficacy and the frequency of complications of CEA under regional anesthesia and to compare between two regional anesthetic techniques (CPB and CE anesthesia) in carotid endarterectomy.

MATERIALS AND METHODS

After written informed consent, thirty patients (19 men and 11 women) in whom 30 CEA procedures were done from January 2012 to December 2015. All patients in this study were symptomatic; 20 presenting with TIA_S (66.7%) or stroke (33.3%). All patients were assessed preoperatively by duplex scan examination combined with CT angiography and/or MRA of carotid arteries. Criteria indicated intervention were plaque at carotid bifurcation causes significant stenosis of 70% and more and/or peak systolic velocity more than 200 cm/sec. Exclusion criteria were: non-cooperative patients or refusing regional anesthesia, patients on anticoagulant medications, any intraoperative complications which necessitate induction of general anesthesia and patients with high carotid bifurcation in whom higher dissection or mandibular dislocation may be needed during the operation.

Coronary angiography was performed in all patients were presenting either with unstable angina or significant ECG changes before the surgery. Antihypertensive drugs, beta blockers and calcium channel blockers were continued until the morning of the operation. Furthermore, all of them were premedicated with midazolam 0.05 mg/ kg IV two hours before the operation. All procedures were conventional CEA_S with patch closure. All procedures were done under regional anesthesia. However, patients were classified into two groups, Group I (20 patients), in whom CPB was the technique of anesthesia and Group II (10 patients), in whom CE was applied.

Postoperative follow up for patency and rate of degree of stenosis at 1, 6 and 12 months follow up period.

Techniques of Anesthesia

Deep Cervical Block Anesthesia

Our procedure for deep cervical plexus blockade is based on the Moore technique. With the patient supine, the head is turned away from the side to be blocked with no elevation under the shoulders, anatomic landmarks are marked along a line that runs from the tip of the mastoid process to the prominent anterior tubercle of the sixth cervical vertebra (Chassaignac's tubercle), which lies at the level of the cricoid cartilage. A second line is drawn parallel 1.0 cm posterior to the first. The transverse process of the C2 vertebra is generally 2.5 cm beneath the mastoid process along this line; the C3 process is 1.5 cm from C2, half way between the two lines; and the process for C4 is 1.5 cm from C3, almost on the superior line. Skin wheels are raised over the transverse processes. After skin sterilization, at each injection site, a 22G, 5-cm insulated needle (plexolong; Pajunk, melsungen, Germany), connected to a nerve stimulator (innervator; peripheral nerve stimulator and locator, NS 272, from Fischer & Paykel, NewZeeland), is introduced perpendicular to the skin and directed posterior and slightly caudad until it rests on the transverse process with starting output of 0.8 mA. It is important to maintain the caudad direction in order to avoid entry directly into the intervertebral foramina. When the twitches of deep anterior cervical muscles were seen, the current was gradually decreased to 0.3-0.5 mA. A test aspiration for blood or cerebrospinal fluid is necessary. Before injection, when proper position of the needle is confirmed, 10 ml of 0.25% bupivacaine hydrochloride and lidocaine 1% is injected along each transverse process.

Superficial CPB

The needle was inserted perpendicularly at the midpoint of the posterior border of the sterno-cleidomastoid muscle. Local anaesthetic (10ml) of bupivacaine 0.25% was injected at this point in a fan shaped manner cranially and caudally.

Fentanyl 1ug/kg IV was planned to be given as rescue analgesic intraoperatively or postoperatively if needed.

Cervical epidural technique

Patients were placed in the sitting position with the head flexed and resting on the thorax, in order to open the lowest cervical interspaces. The spinous process of C7, this is horizontal in this position, was easily identified. An 18-gauge Tuohy needle was inserted by a midline approach into the C6-C7 or C7-T1 interspaces after cutaneous local anesthesia. The epidural space was identified by loss of resistance technique using 10 ml saline solution. Careful aspiration ensured that the needle had not entered the subarachnoid space nor penetrated an epidural vein, and an epidural catheter was inserted gently to a depth of 4-5 cm. patients were then placed in the supine or Trendelenberg position and the local anesthetic solution was injected after a test dose of 2 ml of 2 % lidocaine. The solution consisted of 10 ml, 0.5 % bupivacaine. Fentanyl 50 ug was

administered into the epidural space together with bupivacaine to improve analgesia. Sensory blockade was evaluated by ice cold sensation. Ephedrine 3 to 6 mg was injected IV when systolic arterial pressure decreased more than 30 per cent of the pre-anesthetic value or to less than 95 mmHg or when neurological symptoms developed during carotid artery clamping, associated with a decrease in blood pressure. Decreases in heart rate to less than 45 beats /min were treated with IV atropine. another dose of bupivacaine 0.5% (5ml) was administered epidurally every 60 min. postoperatively bupivacaine 0.1% as continuous infusion at 6ml/h (after giving 5 ml of bupivacaine 0.25% as bolus dose) was started if the patient needs analgesia . The epidural catheter was removed after 24h when activated coagulation time was normal.

Surgical technique

Conventional CEA was done for all patients. longitudinal incision along the anterior border of sternomastoid muscle, followed by exposure of internal jugular vein (IJV), ligation of common facial vein which is the land mark for the common carotid artery (CCA) bifurcation, looping for CCA, internal carotid (ICA) and external carotid arteries (ECA), infiltration of carotid bifurcation adventia by xylocaine 0.5% (2-5 ml) using small insulin syringe, heparin given IV at a dose of 70 unit/kg before Carotid cross clamping; clamping of ICA, CCA, and ECA sequentially with monitoring the conscious level of the patient and motor power in contralateral hand, Pruitt Inahara shunt (LeMaitre Vascular) was used in cases in whom there were signs of decrees in cerebral perfusion, Teflon carotid patch was used for closure of arteriotomy using Proline 6/0 suture, proper hemostasis with suction drain inserted routinely in all cases. Postoperative all patients were sent to ICU for close monitoring dependent unit for 24-48 hours.

Intraoperative Monitoring

Five-lead ECG monitoring was used during surgery. Leads II and V5 were displayed and multi-lead ST segment monitoring was used throughout the operation.

SpO2 was monitored and arterial blood pressure was measured invasively using a radial artery cannula. The patient's level of consciousness was monitored by means of verbal contact and the motor function of the contralateral arm was monitored using a rubber whistling toy placed in the patient's hand. A carotid shunt was inserted if the patient's neurological status deteriorated after carotid clamping. Rises in systemic blood pressure were treated with antihypertensive drugs if the systolic blood pressure increased over 180 mm Hg or if the signs of acute heart decompensation were present (dyspnea, ECG ST-segment changes, chest discomfort/ pain). Heparin, 70 unit/ kg, was IV injected before carotid artery clamping.

RESULTS

We recorded demographic data, surgically related complication and patency rate for patients in both groups all together, while anesthesia related complications, intraoperative data and hemodynamic changes were recorded for each group separately.

The age range was between 52-77 years, with mean 68 years. Presenting symptoms & medical co morbidity including IHD, history of CABG before, diabetes, hypertension, dyslipidemia, renal impairment, smoking and obesity, all are shown in table 1.

Table 1: Demographic Data:

Patients criteria	Value (%)
Age (mean)	68 years old
Male gender	19 (63.3%)
Diabetics	17 (56.7%)
Hypertension	16 (53.3%)
IHD	9 (30%)
s/p CABG	5 (16.7%)
Renal impairment	5 (16.7%)
Smoking	10 (33.3%)
Obesity	3 (10%)
s/p TIAs	20 (66.7%)
s/p non disabling Stroke	10 (33.3%)

Intraoperative data (Table 2) showed no significant differences between both groups as regard the operation time, CXC time, the number of patients who required supplemental analgesia or the number of the patient who showed neurological symptoms that necessitates shunt insertion. The onset of complete block was significantly longer in group II (13.5 minutes) as compared to group I (8.8 minutes). Three patients (30%) from group II had intraoperative hypertension while no patient from group I showed this sign.

Table 2: Intraoperative data

	Group I (no=20)	Group II (no=10)
Mean onset of the block (min)	8.8	13.5
Mean operation time (min)	68	74
Mean CXC time (min)	33	29.5
No. of patients who required analgesia	4 (20%)	1 (10%)
No. of patients who need shunt insertion	4 (25%)	2 (20%)
Intraoperative hypotension(no. of patients)	0 (0%)	3 (30%)

The hemodynamic changes which are related to the anesthetic & surgical techniques included in table 3. It showed that the mean arterial pressure (MAP) was significantly lower in group 2 as compared to group 1 before and after carotid cross clamp (CXC). The MAP was 95.1 in group I and 84.5 in group 2 before CXC. After CXC it was 86.1 and 112.6 in groups II and I respectively. Heart rate (HR) showed no significant differences between both groups before & after CXC. There were no significant differences between both groups as regard the respiratory rate (RR) through the surgery time.

Table 3: Haemodynamic changes

Haemodynamic changes	Group I (no.=20)	Group II (no.=10)
MAP(mmHg)		
Before CXC	95.1	84.5
After CXC	112.6	86.1
HR (beat/min)		
Before CXC	68.4	66.5
After CXC	73.7	75.3
RR (Breath/min)	13.2	12.9

The complications related to the anesthesia techniques include hypotension, bradycardia & hematoma at the site of needle insertion. The incidence of hypotension is much higher at group II. There is no difference between both groups as regard the bradycardia. The hematoma development at the neck is higher in group I than group II.

Table 4: Complications related to anesthesia technique

	Group I (no=20)	Group II (no=10)
Hypotension(no. of patients)	1 (5%)	3(15%)
Bradycardia (no. of patients)	2 (10%)	1(10%)
Laryngeal nerve neuropraxia (no. of patients)	1 (5%)	0 (0%)

The incidence of post-operative surgical complications including stroke or TIAs, reperfusion hypertension, post-operative hypotension, acute cardiac event, hoarseness of voice (hypoglossal nerve concussion) & significant cervical hematomas are shown in table 5.

Table 5: Peri & post-operative surgical complications

Surgical complications	Group I (n=20)
TIAs	0 (0%)
Stroke	1 (3.3)%
Surgical hematoma	1 (3.3%)
Hypoglossal concussion	1 (3.3%)
Reperfusion hypertension	2 (6,67%)

Follow up the patency was detected by duplex examinations at intervals of 1, 6 & 12 months post-operatively. The degree of recurrent stenosis criteria included reduction of the luminal diameter more than 50% and PSV is higher than 200 cm/sec. Table 6 showed the total primary patency rate in both groups.

Table 6 primary patency

Months	*No of patients (%)*
1	100% (30/30)
6	100% (29/30)
12	95% (28/30)

Figure 2 & 3 showed cases with CPB & CE anesthesia techniques

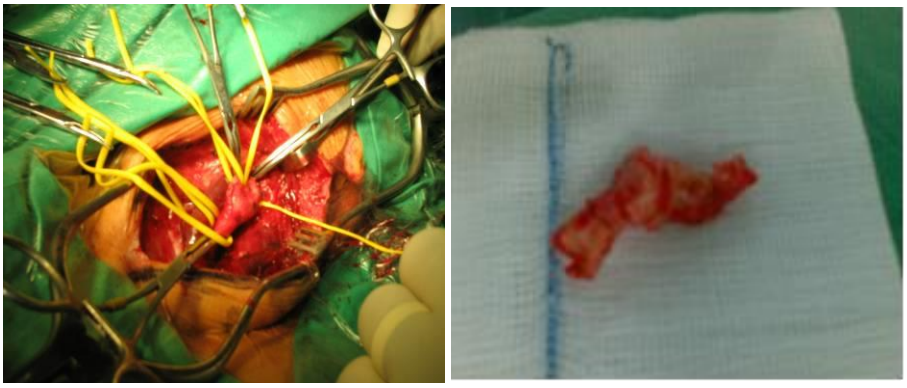

Figure 4 & 5: Showed CEA & plaque extraction

DISCUSSION

A number of retrospective and prospective studies have compared the frequency of both perioperative and postoperative complications in patients who have had carotid endarterectomy under general or regional anaesthesia.[9–11]

Deep cervical block requires identification of the second, third and sometimes the fourth cervical nerve roots on the same side as the surgical field. Moreover, a superficial block must be performed because of frequent cutaneous sensory anastomoses with some branches of the lower cervical plexus and of the trigeminal nerve. Anatomical difficulties may be encountered especially in obese patients with a short neck,[11]. Cervical epidural anesthesia (CE), first described by Dogliotti in 1933 4 for thoracic surgery, is used mainly for relief of chronic pain in the head and neck or cancer pain due to Pancoast syndrome [12].

Literature reviews was to examine the various practices in regard to anesthetic choice for CEA. The quest ion remains: Is there clear and convincing evidence that either method of anesthetic technique is associated with an improvement inpatient t out com e? To date, large, prospective e, randomized studies are lacking answers on this issue, and, thus, the absence of scientific evidence limits our ability to draw concrete conclusion on or put forth broad generalizations. Conversely, some ad vantages to the regional anesthetic technique are beginning to emerge through non randomized, retrospective studies in the literature 13-17. There is a clear cost advantage to performing CE A under a regional anesthetic block; however, the technique should be chosen based on patient specific criteria and the technique that is safes t for the patient. It is evident from reviewing the existing studies that the best monitoring modality to assess neurologic status is an awake patient. However, this does not disqualify the fact that general anesthetic can be safely performed while maintaining adequate cerebral blood flow in some patients. In regard to hemodynamic stat us, the literature suggests that patients who undergo general anesthesia for CEA require more vasoactive medications, a longer hospital stay, and more invasive monitoring in the perioperative period. However, the data suggest that catecholamine levels are increased in awake patients and can lea d to cardiac ischemia. The choice of anesthetic technique is constantly under debate in an attempt to reduce the morbidity and mortality for a procedure that is preventive [18, 19].

In summary the reviewed literatures suggest a possibility of distinct advantages to performing CEA s under regional anesthesia. Advantages such as decreased cost and resource utilization, better neurologic outcomes, and the possibility of decreased myocardial events have been documented [20, 21].

Regional anesthesia is frequently selected as the anesthetic of choice during carotid artery surgery as it offers the advantage of allowing reliable monitoring of brain perfusion, selective intraluminal shunting, and arguably better perioperative cardiovascular stability[22-24]. Our study suggests that, of two methods of regional anesthesia, CPB and CE anesthesia—the former is associated with a lower incidence block-related complications. For both blocks, broadly similar failure rates to those we report here have been described in previous studies. [22-25]. The hemodynamic changes with two techniques Local anesthesia have no difference as regard the heart rate but with higher incidence with hypotension with CE block. This matches with other studies that confirm the same hypotension rates.

Limitations of this study

This study suffers from the limited number of patients. A large multicenter prospective randomized study (‘Level 1’) would be necessary to confirm the conclusions of our study. Nonetheless, we have shown that the overall complication rate is high in the small number of patients especially at group of CE anesthesia. At this study, anesthetists preferred CPB over the CE anesthesia because they were more experienced with the block. This limits the number of the patients were included in the group of CE anesthesia.

Implications for clinical practice

Both methods of regional anesthesia seem to be acceptable techniques for carotid artery surgery. Since combined CPB has a statistically lower frequency of serious anesthesia-related complications, we suggest that this technique would be preferred to epidural anesthesia. CE anesthesia would not be better to performed for routine carotid endarterectomy. It may have a place in more extensive procedures such as carotid cross-overs and combined carotid-subclavian reconstructions. In such cases, the epidural may be supplemented for longer procedures and also can be extended to provide a more extensive area of block.

REFERENCES

1. Wilke HJ II, Ellis JE, McKinsey JF. Carotid endarterectomy: perioperative and anesthetic considerations. J Cardiothoracic Vasc Anesth 1996; 10: 928–49
2. Erickson KM, Cole DJ. Review of developments in anesthesia for carotid endarterectomy. Curr Opin Anaesthesiol 2005; 18: 466–70
3. Pandit JJ, Bree S, Dillon P, et al. A comparison of superficial versus combined (superficial and deep) cervical plexus block for carotid endarterectomy: a prospective randomized study. Anesth Analg 2000; 91: 781–6

4. Stoneham MD, Doyle AR, Knighton JD, et al. Prospective, randomized comparison of deep or superficial cervical plexus block for carotid endarterectomy surgery. Anesthesiology 1998; 89: 907–125
5. Stoneham MD, Knighton JD. Regional Anesthesia for carotid endarterectomy. Br J Anaesth. 1999; 82:910-919.
6. Bonnet F, Derosier JP, Pluskwa F, et al. Cervical epidural anesthesia for carotid artery surgery. Can J Anaesth 1990; 37: 353–8
7. Kainuma M, Shimada Y, Matsuura M. Cervical epidural anesthesia in carotid artery surgery. Anesthesia 1986; 41: 1020–3
8. Fiorani P. General anesthesia versus cervical block and perioperative complications in carotid artery surgery. Eur J Vasc Endovasc Surg 1997; 13:37–42
9. Mc Cleary AJ, Maritati G, Gough MJ. Carotid endarterectomy: local or general anesthesia? Eur J Vasc Endovasc Surg 2001; 22:1–12
10. National Institute for Neurological Disorders. Stroke treatment: Carotid endarterectomy. 2002. 3, 2002.
11. Sbarigia E, DarioVizza A, and Antonini M, et al. Loco regional versus general anesthesia in carotid surgery: is there an impact on perioperative myocardial ischemia? Results of a prospective randomized trial. J Vasc Surg 1999; 30: 131–8
12. Aallen BT, Anderson CB, Rubin BG, et al. The influence of anesthetic technique on perioperative complications after carotid endarterectomy. J Vasc Surg 1994; 94: 834–43
13. Abd Pandit JJ, Satya-Krishna R, McQuay H. A comparison of the complication rate associated with superficial versus deep (or combined) block for carotid endarterectomy. Anesth Analg 2003; 96: S279
14. Papavasiliou AK, Magnadottir HB, Gonda T, Franz D, Harbaugh RE. Clinical outcomes after carotid endarterectomy: comparison of the use of regional and general anesthetics. J Neurosurg. 2000; 92:291-296.9.
15. Shah DM, Darling RC, III, Chang BB. Carotid endarterectomy in awake patients: its safety acceptability and outcome. J Vasc Surg 1994; 19: 1015–9
16. Michalek P, Jurenka B, Sebesta P, et al. Regional anesthesia and intraoperative clinical patient monitoring vs. stump pressure as indicators for intraluminal shunting during carotid surgery. Cardiovasc Surg 2002; 10:73
17. Harris RJ, Benveniste G. Recurrent laryngeal nerve blockade in patients undergoing carotid endarterectomy under cervical plexus block. Anaesth Intensive Care 2000; 28: 431–3
18. Emery G, Handley G, Davies MJ, Mooney PH. Incidence of phrenic nerve block and hypercapnia in patients undergoing carotid endarterectomy under cervical plexus block. Anaesth Intensive Care 1998; 26: 377–81
19. Veering BT, Cousins MJ. Cardiovascular and pulmonary effects of epidural anesthesia. Anaesth Intensive Care 2000; 28: 620–35
20. Ricotta, JJ. Hargadon, T, O'Brien-Irr M. Cost management strategies for carotid endarterectomy. Am J Surg. 1998; 176:188-192.
21. Harbaugh DE, Magnadottir HB. Carotid endarterectomy in high risk patients. Neurol Res 2002; 24: S66–S70
22. Knighton JD, Stoneham MD. Carotid endarterectomy. A survey of UK anesthetic practice. Anesthesia 2000; 55: 481–5
23. Telford RJ, Stoneham MD, Pandit JJ. Correct nomenclature of superficial cervical plexus block. Br J Anaesth 2004; 92: 775–6
24. Michalek P, David I, Adamec M, Janousek L. Cervical epidural anesthesia for combined neck and upper extremity surgery. Anesth Analg 2004; 99: 1833–6
25. BJ, Moran JC, Wilkerson DK, Zatina MA. Supervised training of general surgery residents in carotid endarterectomy performed on awake patients under regional block is safe and desirable. Am Surg. 2000;66:781-786.