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Comparison of sedoanalgesia versus general anesthesia in surgical resection of carotid body tumors: A retrospective cohort study

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Ethics Committee Approval
All procedures in this study involving human participants were performed in accordance with the 1964 Helsinki Declaration and its later amendments.

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Abstract

Background/Aim: Carotid body tumors (CBTs) are very rare. There is no uniform agreement on the method of anesthesia according to the Shamblin classification. The aim of this study was to report and compare outcomes and complications of different anesthesia methods according to the Shamblin classification in patients operated for CBTs.
Methods: The data of 52 patients (40 males, 12 females) diagnosed with CBT Shamblin Type 1 or Type 2 and surgically treated were enrolled. General anesthesia (Group G) and sedoanalgesia (Group S) were administered in 35 and 17 patients, respectively. We retrospectively compared the surgical outcomes and complications between the groups to evaluate which anesthetic approach was more appropriate for early recognition of complications, hemodynamic stability, and surgical satisfaction in CBT surgeries.
Results Group S patients were more stable hemodynamically. Hypertension, tachycardia, hypotension were significantly more frequent in Group G ($P<0.001$). Intraoperative blood loss was significantly less in the Group S ($P=0.024$). Both patient and surgeon satisfaction scores were significantly higher in Group S ($P=0.071$). In Group G, transient ischemic attack developed in 1 patient, postoperative dysphagia developed in 4 patients due to possible nerve injury during resection. Deviation and ptosis of the tongue due to facial nerve damage developed in 3 patients in Group G and in 2 patients in Group S ($P=0.028$).
Conclusions: Sedoanalgesia may be more helpful for patients compared to general anesthesia in tumor surgery of patients with CBT classified as Shamblin Type 1 and 2.

Keywords: Carotid body tumors, General anesthesia, Sedoanalgesia

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Introduction

Carotid body tumors (CBTs) are primary tumors of chemoreceptor tissue and were first described by Von Haller in 1743 [1]. CBTs are malignant at a ratio of 5-6% and require surgical intervention. While benign tumors occur later in life (between 40 and 70 years), malignant tumors occur at earlier ages [2]. CBT is classified according to growth patterns by Shamblin et al. Type 1 tumors are regional masses and easily excised, while type 2 tumors surround the carotid arteries. Type 3 tumors are adherent, completely incarcerate the carotid arteries, and can be excised by a challenging surgery that requires graft replacement of the internal carotid artery. Type 3 tumors represent 25% of the cases and most of the CBTs are non-functional [3]. Resection of the tumor is the most recommended treatment approach [4]. Although literature suggests that the carotid body gland is localized in the adventitia near the carotid artery bifurcation, most surgeons experienced in carotid body dissection indicate that it is more peripherally located within the peri-adventitial tissue. This is critical because dissections in the deeper planes of the carotid artery are associated with complications related to vascular injury [5]. Removal of the tumor requires surgical experience due to cranial nerves, close proximity to the arterial structures, and complex anatomy of the head and neck region. The most important complications of surgery are hemiplegia and cranial nerve injury at the surgical region. Surgical excision should be performed as soon as possible due to the risk of airway obstruction and pulmonary aspiration, hemorrhage, and the possibility of metastasis [6]. Digital subtraction angiography is considered the golden standard for the final diagnosis of CBT. Magnetic resonance imaging (MRI), arteriogram and embolization, lower extremity ultrasonography for possible femoral graft, urinary catecholamines due to the rare risk of adrenal pheochromocytoma, vanillylmandelic acid, and metanephrine test are other methods used in diagnosis [5].

Although general anesthesia is a commonly used method, it has some disadvantages in CBT surgery. Since there is no cooperation of the patient during the operation, possible ischemic events and nerve injuries often go unnoticed.

In this study, we compared patients that underwent general anesthesia or sedoanalgesia during CBT surgeries. We evaluated which anesthetic approach was more appropriate for early recognition of complications, hemodynamic stability, and surgical satisfaction in CBT surgeries.

Materials and methods

We investigated the data of 52 patients who were diagnosed with CBT and operated by single cardiovascular surgeon (YK) between March 2012 and January 2021 in the Department of Cardiovascular Surgery. Thirty-five patients were operated under general anesthesia (Group G) and 17 patients were operated with sedoanalgesia (Group S), respectively. Data from the patients were retrospectively reviewed and included in the study. While carotid body surgery was previously performed under general anesthesia, it is recently being performed with sedoanalgesia. Thus, the patients were enrolled in the study according to the date of surgery. Patient characteristics were similar in both groups. Patients, assessed as Shamblin classification Type 1 and Type 2, were included. Type 3 patients were excluded from the study since sedoanalgesia is insufficient in these types. We excluded patients that underwent carotid artery surgery due to reasons other than CBT or whose histological examination of specimens revealed that the final diagnosis was not CBT. The patients' electronic and paper records were used to gather data. All patients in the study were operated by the same cardiovascular surgeon (YK). All patients that underwent anesthesia were managed and followed by anesthesiology department professionals.

Demographic data and characteristics of the patients

Patients' age, gender, ASA score (American Society of Anesthesiologists), Mallampati score, comorbid diseases, side of tumor, duration of operation, changes in intraoperative blood pressure and heart rhythm (bradycardia, tachycardia), the amount of blood loss, the amount of used blood or blood products, intraoperative inotropic drug use, duration of hospital stay and intensive care unit stay, type and characteristics of tumor, Shamblin classification, and complications associated with cranial nerve and vascular structures were recorded. Also, Pain score (VAS: Visual analogue scale) was measured postoperatively in recovery room and at the 1st hour after surgery.

Systolic blood pressure over 140 mmHg was considered hypertension. Heart rhythm over 100 per minute was considered tachycardia, and under 50 was considered bradycardia. Patient and surgeon satisfaction scores were assessed with a 5-point scale (1: very satisfied, 2: satisfied, 3: average, 4: poor, 5: very poor). Demographic and clinical characteristics of patients are shown in Table 1.

Table 1: Demographic and clinical characteristics of 52 patients

	Patients
Age, years mean (SD)	54 (10.3)
Sex, M / F	40/12
Comorbidities, n(%)	
HT	40 (77)
DM	35 (67)
CODP	20 (38)
CAD	20 (38)
PAD	2 (4)
Tumor characteristics, n(%)	
Mean Tumor diameter	3.56 (1.24)
Unilateral / Bilateral	47 / 5
Benign / Malign	52 /-
Functional /Nonfunctional	- / 52

HT: Hypertension; DM: Diabetes mellitus; COPD: Chronic obstructive pulmonary disease; CAD: Coronary artery disease; PAD: Peripheral artery disease

Anesthetic management

Complete blood count (CBC), electrolytes, liver and renal function tests, and chest-X-ray examination were conducted preoperatively in all patients of both groups. Color Doppler sonography were performed in all cases. CT scans of the mediastinum and retroperitoneal sonography were performed in patients with multifocal tumors and family history to determine whether there was a spread. MRI was used in some cases; in addition, patients with 2-year disease history were evaluated with Spiral CT angiography (SCTA).

The patients were given 0.05 mg / kg i.v. midazolam for premedication purposes and all patients in both groups were in the supine position during the surgery. At least two large-caliber IV cannulas were placed. Ringer's lactate was typically administered at a rate of 100 ml/hour through an intravenous cannula of 18G (Range 14-22G). The patients were monitored and pulse oximetry, 3-channel electrocardiography, continuous heart rate (HR), and noninvasive blood pressure (NIBP) were measured when they were taken to the operation room. Nasopharyngeal temperature monitoring was performed. A total of 10 patients underwent invasive BP through left radial artery and central venous pressure (CVP) via left subclavian vein due to elderly ages and coronary artery disease. Intravenous fluid was adjusted to maintain an average arterial blood pressure of 55-60 mmHg and CVP of 10-12 mmHg. Ephedrine was administered at a 5 mg bolus dose for decreases in blood pressure. Inotropic support infusions were initiated in cases of insufficient blood pressure despite the use of adequate fluid replacement and ephedrine. For systemic medication purposes, 10 mg of Dexamethasone i.v. was used. Cerebral oxymeter (Masimo RDS7A, Masimo Corp., Irvine, California, USA) was used for intraoperative cerebral monitoring in the required cases.

Group G: Patients in general anesthesia group were preoxygenated for 3 minutes at the beginning of the operation. Then, induction was initiated in most patients with Thiopentone 2.5 % (4-6 mg/kg), while 1% propofol (2-3 mg/kg) was needed in 6 patients. All patients undergoing general anesthesia were intubated using Atracurium (10 mg/ml) as muscle relaxant. Cuffed Portex oral 7.5-8 mm endotracheal tubes were used and the transoral intubation tube was taped to the contralateral side of the surgical area. The administration of general anesthesia was mainly achieved by applying volume-controlled ventilation using oxygen and nitrous oxide (1:1) and volatile anesthetic agents (isoflurane, sevoflurane). In addition, total intravenous anesthesia (TIVA) was achieved in 6 patients with propofol. Fentanyl (2 mcg/kg) and remifentanil infusion (0.2 mcg/kg/min) were administered for analgesia. Intraoperative fluid replacement was performed with the Hartmann's solution at an average of 1500 ml (range: 1000-2500 ml). Bridion (Sugammadex; 2 mg/kg i.v.) in 10 patients and a combination of atropine (0.5 mg) and neostigmine (2.5 mg i.v.) in 7 patients were used as reversal agents at the end of surgery. Conscious patients that met the extubation criteria, responded to verbal commands, and had adequate spontaneous breathing were extubated in operation room. patients in general anesthesia group were extubated in the operating room at the end of the surgery.

Paracetamol (1 gr i.v.) was used for analgesia in postoperative recovery room and Tramadol (100 mg i.v.) was given to patients whose Visual Analogue Score (VAS) was 5 or greater. The patients were followed up for one day mostly in the high dependency unit (HDU) after the operation. A total of 4 patients were followed up in the postoperative ICU among Group G. The mean duration of hospital stay was 4 (3-6) days. There was no mortality in patients undergoing CBT surgery.

Group S: Patients in the sedoanalgesia group were given Midazolam (0.05 mg/kg i.v.) for premedication purposes. In patients in the operation room, sedation and anxiolysis was achieved using Midazolam (0.05 mg / kg i.v.) and analgesia was achieved using Fentanyl (1 mcg/kg i.v.) with the administration by an experienced anesthesiologist. When a patient was uncomfortable, it was interpreted as pain and 2-5 ml of 1% lidocaine (100-200 mg) was infiltrated by surgeons during the operation. If the pain could not be well controlled by local anesthetic, then additional fentanyl (25 mcg i.v.) was administered. In cases where the desired sedation effect could not be achieved during the procedure, midazolam was added intravenously. The patients were conscious during surgery. Blood pressure and heart rate changes, duration of operation, pain score/discomfort, amount of hemorrhage, cranial and facial nerve function, and cerebral ischemia development were recorded during surgery. Patients were followed in the recovery room during the postoperative period. Paracetamol (1 gr i.v.) was administered to patients requiring analgesia. Tramadol (100 mg i.v.) was administered if the pain was more severe. None of the patients in Group S needed hospitalization in the ICU. All patients were followed up for one day in the high dependency unit (HDU). After an average of 3 days of (2-4) hospital stay, patients were discharged with oral antibiotics. All patients were followed up for 3 months regularly in the cardiovascular surgery outpatient department. Any complications in the postoperative period were noted and dealt with accordingly.

Surgical technique

Horizontal incisions were made lateral to the anterior border of the sternocleidomastoid (SCM) muscle to explore the cervical region. SCM and jugular vein were identified to make the tumor and adjacent cranial nerves visible posteriorly. Special attention was paid to protect cranial nerves, X, XI, XII, superior laryngeal nerve and sympathetic trunk during surgery. After common carotid artery, the internal carotid vein, the cranial nerves X, XI, XII, Superior laryngeal nerve, the accessory nerve, and sympathetic trunk were made clearly visible. The proximal (3 to 4 cm) and distal (2 cm) portions of vessels (common and internal carotid, and multiple branches of the external carotid) were sufficiently liberated with a good separation. If there were vessel loops around the common and internal carotid arteries, unnecessary tension was avoided. The proximal end of the tumor artery and the common carotid artery were blocked by blood vessel blocking bands to control blood flow. Then, vessels feeding the tumor were separated throughout the tumor mass so they could be completely excised. Tumor mass was incised in a Y-shape through the tumor tissue from the anterior region to the carotid artery media layer using a loupe or microscopic magnification. Dissection was performed beginning from the region between the adventitia and carotid media layer toward the mass using bipolar cautery. The dissection was initiated slowly and carefully approximately 0.5 cm from the distal margin of the unaffected side of the tumor's end point. A manual saline irrigation was used during bipolar activation. Finally, the excision of carotid body tumor, progressing throughout the region between the adventitia and media layers of the carotid artery, was performed with a careful dissection. Hemorrhage observed during the dissection phase was sutured with 6/0 polypropylene. At the end of the procedure, a 10 mm flat Jackson Pratt drain was placed in the surgical site and antibiotic ointment was ordered. After surgery, the patients were followed for blood pressure, hemorrhage, or late stroke. All patients included in our study were Shamblin classification type 1 and type 2. No graft or bypass was used for any patient in either group.

Statistical analysis

In the power analysis based on the data of previous studies, a sample size of 32 patients were needed at 95% power

(1-β err prob=0.95) and 5% error margin (α err prob=0.05). Available 52 patients were enrolled in the study after taking possible loss of data into consideration.

The statistical analysis of the data were performed using the Statistical Package for the Social Sciences (SPSS version 21.0, SPSS Inc., Armonk, NY, USA). Categorical variables were expressed as numbers and percentages. Continuous variables were presented as mean (standard deviation). Kolmogorov–Smirnov test was used to check the normality of data. When normality was rejected, a nonparametric test was used. A *P*-value of less than 0.05 was considered statistically significant.

Results

Of the 52 patients included in the study, most were males**.** The majority of patients in each group consisted of the elderly population. There was no mortality in both groups during hospital stay or within 6 months after surgery. In the preoperative evaluation, it was determined that patients in each group with hypertension generally use beta blockers, calcium channel blockers, ACE inhibitors and angiotensin receptor blockers. CBT was more common on right side of the neck (n=30), while 22 were in the left side. Tumor characteristics of the groups are given in Table 2.

Table 2: Clinical features and tumor characteristics of the groups

	General anesthesia (n=35)	Sedoanalgesia (n=17)	*P*-value
Age, years (SD)	53.2 (9.2)	54.32 (10.3)	0.708*
ASA scores, n (%)			
1	2 (5.7)	1 (5.9)	0.043**
2	29 (82.9)	15 (88.2)	
3	4 (11.4)	1 (5.9)	
Shamblin, n (%)			
Type 1	5 (14.2)	7 (41)	0.021**
Type 2	30 (85.7)	10 (59)	
Surgery duration, min	105 (19	72 (22	0.034*
Intraoperative conditions, n (%)			
Hypertension	20 (57.1)	5 (29.4)	<0.001**
Tachycardia	20 (57.1)	2 (11.7)	<0.001**
Hypotension	15 (42.8)	2 (11.7)	<0.001**
Blood transfusions	4 (11.4)	2 (11.7)	0.024**
VAS for pain			
At the end of surgery	3 (0.7)	1 (0.6)	0.013*
At the 1st hour after surgery	2 (0.6)		
Satisfaction score			
Patient	3 (0.7)	2 (0.5)	0.071*
Surgeon	4 (0.7)	1	<0.001*
Length of hospital stay	4.1 (0.8)	2.6 (0.5)	0.001*
Postoperative complications			
Dysphagia (10. CN injury)	4 (11.4)		0.028**
Facial nerve injury	3 (8.5)	2 (11.7)	
Hypoglossal nerve injury	2 (5.7)		

* Mann Witney U test, ** Chi-Square test

Radiological imaging associated with the Carotid Body Tumors are shown in Figures 1-4.

Figure 1: 45-year-old female patient with right sided glomus tumor (white arrow) located at the carotid bifurcation represented on 3D computed tomography angiography (CTA) image.

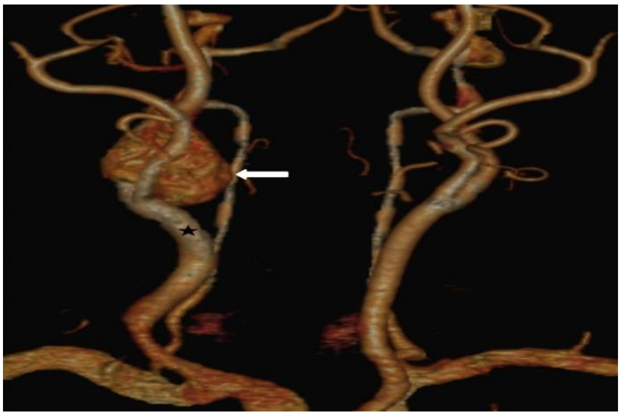


Figure 2: Axial Ce CT image demonstrates the enhanced glomus tumor (white arrow) located between internal carotid artery (ICA) and external carotid artery (ECA).

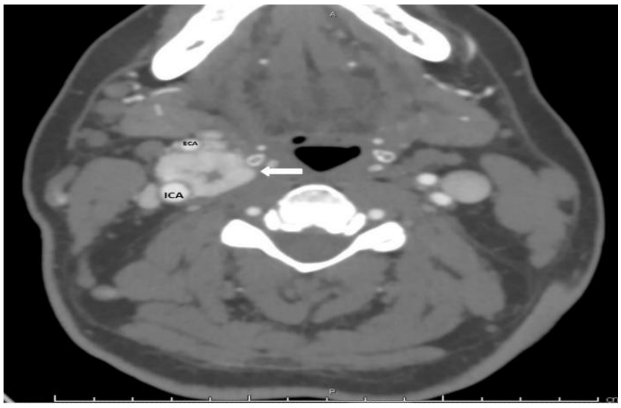
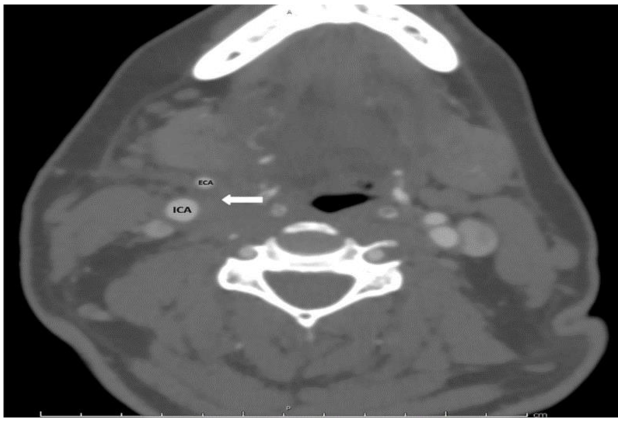


Figure 3: There is no residual mass or lesion recurrence on postoperative control 3D CTA image (white arrow).

Figure 4: Axial Ce CT image demonstrates normal structures (white arrow) between internal carotid artery (ICA) and external carotid artery (ECA).



Group S patients were more stable hemodynamically and their vital findings were more regular, while almost 50% hemodynamic instability and irregularities in vital findings were observed in group G. Average arterial blood pressure in General anesthesia group (Group G) was 81 (4) whereas average arterial blood pressure in Sedoanalgesia group (Group S) was 78 (3).

In Group G, intraoperative blood pressure was more labile and change in arterial pressure, especially during induction phase and surgical manipulation, was more prominent. During tumoral excision, hypertension and tachycardia developed in 20 patients in group G whereas hypertension developed in 5 patients and tachycardia developed in 2 patients in group S. Esmolol (40 mg IV) and Glycerol trinitrate (Perlinganid) were used for hypertension, and Labetolol (5 mg) was used for tachycardia. A decrease in systolic arterial pressure below 80 mmHg was considered hypotension. When hypotension developed in both groups, bolus dose ephedrine 5-10 mg i.v. was administered. Fluid replacement was increased, and inotropic support infusion was initiated in cases in which adequate levels of arterial pressure could not be achieved with ephedrine. Bradycardia developed in 5 patients in group G and in 2 patients in group S. Patients with bradycardia were administered atropine (0.5 mg IV). Patients were asked to cough and atropine was needed in 2 patients in group G. The median heart rate in bradycardia attacks was 46 per minute (range: 40 - 48/min).

Intraoperative blood loss was less in Group S than in Group G (585ml (162) vs 303 (213), respectively*)*. This was associated with the fact that arterial pressure was more stable than the other group. Erythrocyte suspensions were transfused in 4 patients in Group G and in 2 patients in Group S. Cerebral oximetry values did not decrease more than 25% of pre-induction baseline values after tumor excision and at the end of surgery. However, the decrease was more prominent in Group G.

Postoperative pain was assessed using visual analogue scale (VAS). In the postoperative period, the need for additional analgesic agents was lower in Group S.

In Group G, 1 patient was followed up closely for first postoperative day in the surgical intensive care unit (SICU) due to transient ischemic attack (TIA). The patient's neurological status improved after 1 day. All the other patients were monitored in the high dependency ward. No cerebral infarct developed in any patient except one transient ischemic attack. There were no aphasia or epileptic sequelae.

In Group G, postoperative dysphagia developed in 4 patients due to possible injury of N. Vagus and Recurrent laryngeal nerve during resection. In Group S, dysphagia and related nerve injury were not observed. Mild tongue deviation and left eye ptosis due to facial nerve injury developed in 3 patients in the Group G and in 2 patients in Group S. In Group S, facial nerve weakness was less pronounced, only a slight deviation of the tongue was observed, and it recovered early in the postoperative period. In addition, hypoglossal nerve injury developed in 2 patients in Group G. Within postoperative 6 months, the findings improved in 3 patients with vagal nerve injury, in 1 patient with facial nerve injury, and in all patients with hypoglossal injury, but sequelae were permanent in others. Postoperative baroreceptor failure and loss of reflex respiratory stimulation did not develop in any of the patients in both groups. Finally, there was no mortality during intraoperative and postoperative follow-up period in patients that underwent CBT surgery in both groups in this study.

Discussion

CBTs are very rare tumors that occur at the bifurcation of carotid artery, sensitive to carbon dioxide and partial pressure of oxygen, and originate from chemoreceptor cells playing an important role in the control of ventilation during acidosis, hypoxia and hypercapnia [7]. Although CBT has been reported to be more common in females compared to males in the literature [8], there were 40 males and 12 females in the 52-patient cohort in our study.

Genetic factors and hypoxic conditions seem to play an important role in the pathogenesis of the disease. Living in high altitudes or chronic hypoxia conditions such as sleep apnea syndrome seem to trigger hyperplasia in the carotid body. In genetically predisposed individuals with a family history, the disease has been observed to occur at earlier ages [9]. Digital subtraction angiography (DSA) is the gold standard for the final diagnosis of CBT [10]. The advantage of DSA is that it allows the evaluation of Shamblin classification and intracranial-extracranial blood circulation, as well as the embolization of blood vessels. These tumors may be confused with neuroendocrine carcinoma, thyroid medullary carcinoma, middle ear adenoma, schwannoma, and meningioma [11]. Rarely, these tumors may be associated with phaeochromocytomas and may secrete catecholamines and serotine etc. This may be symptomized by excessive sweating, uncontrolled hypertension, tachycardia, and facial flushing. We did not observe inappropriate catecholamine secretion-induced symptoms suggesting phaeochromocytomas in any of our patients.

Shamblin classification groups CBTs as Type 1, 2, and 3 according to the relationship between tumor mass and the carotid artery wall. For Shamblin type 2 and 3, extensive surgery may be required [12]. During CBT type 2 and Type 3 surgery, neuronal and vascular damage is more likely to develop, and the amount of bleeding is greater, and the duration of operation is longer [13]. Sukanya et al. [14] emphasized the possibility of intraoperative rapid blood loss due to involvement of the carotid artery and jugular veins in Type 2 and Type 3. Rapid blood loss of 1 liter has been reported in the literature [15]. If there is a risk of rapid blood loss, a blood vessel ligation band and atraumatic hemostatic forceps should be prepared before surgical separation. Especially in Shamblin Type 3, cross-clamping can be performed to prevent possible bleeding during tumor resection [16]. If there is stenosis in the contralateral carotid artery, a shunt can be used during clamping. In literature, embolism or carotid artery dissection during shunting has been reported as 1-3% [17]. Only one of the patients included in our study had a transient ischemic attack and the patient's findings improved after 24 hours. This clinical finding was thought to be associated with embolism due to its close proximity to the vascular structures of the surgical site.

For Shamblin classification type 3, more extensive surgical resection may be needed. For this reason, unwanted complications related to neurological and vascular structures are encountered more frequently [12]. Radiotherapy may be a more appropriate treatment approach in patients diagnosed with CBT type 3, elderly patients, or patients with chronic diseases due to intraoperative crucial vascular and neurologic injuries and stroke associated with operation [18]. We did not include patients with type 3 CBTs in this study, because they required more complicated surgeries and management of sedoanalgesia with anesthesia was difficult. In a total of 52 patients undergoing CBT surgery in this study, tumor type was Shamblin classification type 2 in 44 cases and Shamblin classification type 1 in 8 cases.

Sedoanalgesia does not appear to be sufficient because the surgical operation of Type 3 tumors is difficult. However, we started with sedoanalgesia in the last 10 cases of Type 3 where the carotid artery had to be taken under control. We continued with general anesthesia after test clamping to minimize the risk of stroke.

Presently, there has been no consensus on anesthetic management in CBT surgery. However, general anesthesia has been observed to be mostly preferred in these surgeries when the literature was reviewed. It has been reported that these surgeries were performed with local anesthesia and cervical plexus block instead of general anesthesia in some centers. In a high-risk patient due to Eisenmenger syndrome, a case of successful tumor resection without any complication using continuous cervical plexus block was reported in the literature [19]. Although the cervical plexus block is a more appropriate method for carotid artery surgery, there are some risks associated with needle use in block surgery in CBT surgery [20]. The hypervascularity of these tumors and their localization at the carotid bifurcation may cause bleeding and unwanted punctures of the tumoral mass [21]. This unwanted condition may cause instability in the hemodynamic state of patient due to catecholamine release from the tumoral mass.

The main goal of anesthesia management in CBT surgery is to maintain stable hemodynamic circulation, optimal cerebral perfusion, minimal blood loss, early detection and management of complications that may arise due to anatomical closeness of vital structures such as cranial nerves and vessels to tumor, and better operating conditions for surgeon and patient satisfaction.

We used general anesthesia in 35 patients and sedoanalgesia in 17 patients among a total of 52 patients that underwent CBT surgery. In the majority of 35 patients that underwent tumor surgery with general anesthesia, we used thiopentone 2.5%, which has been shown to provide neuroprotection at an infusion rate of 3-5 mg / kg / h by Bilotta et al. [22]. In 6 patients, propofol 1% was used for induction. The most important goal in anesthesia management is to prevent cerebral focal ischemia development by providing optimal cerebral perfusion. There have been studies in literature about the protective effects of barbiturates against possible ischemia during the surgical procedure by protecting tissues against focal ischemia and positively contributing to redistribution [16]. An ischemic event leads to brain edema and the use of mannitol may be beneficial in reducing this [23]. In this type of tumor surgeries, temperature management is also very important since cerebral metabolic rate decreases by 7% at each 1°C decrease in body temperature.

In our study, we observed that the arterial pressure was more labile during both the induction and resection phases in patients in Group G, whereas hemodynamics was more stable in Group S.

In a study of 100 patient series, Birch et al. [24] found that sedoanalgesia is a safe, effective, and acceptable anesthesia management method unrelated to preoperative accompanying diseases. In our study, patient's consciousness provided an important advantage in CBT surgeries with sedoanalgesia, as cooperation with patient continued and early detection of unwanted complications related to possible cranial nerves or other cerebral infarcts was possible. Comparing with general anesthesia, hemodynamic stability was better in the sedoanalgesia group. This made cerebral perfusion more optimal and also provided benefit by resulting in less hemorrhage.

Comparing both groups in this study in terms of neurological and cranial nerve involvement, complications related to neurological and cranial nerve involvement were less frequent in the Sedoanalgesia group. One patient underwent transient ischemic attack (TIA) in the general anesthesia group and recovered at the first postoperative day without sequelae. None of the patients in the groups developed cerebral infarct except this patient with TIA. There was no neurological incident requiring surgery such as decompressive craniectomy or frontal-temporoparietal lobectomy. In addition, no patient developed Aphasia or epileptic sequelae.

In Group G, 4 patients developed postoperative dysphagia associated with possible injury of N. Vagus and recurrent laryngeal nerve. In Group S, there was no dysphagia or related nerve injury. Again, hypoglossal nerve injury developed in 2 patients in the general anesthesia group. During 6 months of follow-up after surgery, findings completely improved in 3 patients with vagal nerve injury and in one patient with hypoglossal nerve injury. Conversely, sequela was permanent in one patient. Mild tongue deviation and left eye ptosis due to facial nerve injury developed in 3 patients in Group G. One of these patients improved, while sequela was permanent in others. Despite the findings of facial nerve involvement in 5 patients in Group S, facial nerve weakness was less pronounced, and only a slight deviation of the tongue was observed, which recovered early in the postoperative period. There were no patients with permanent sequela in this group. Postoperative baroreceptor failure and loss of reflex respiratory stimulation did not develop in any of the patients from both groups.

Conclusions

We showed that anesthetic management in CBT patients is important during and after surgery. Surgery of CBTs requires vigilance for an anesthesiologist during the removal of CBT. The success of the surgery depends on basic objectives in anesthesia management such as maintaining optimal cerebral perfusion, sustaining stability of intraoperative blood pressure levels, detecting neurological and vascular complications early, taking precautions for possible hemorrhage, and providing optimal surgical field.

The present study shows that tumor surgery of patients with CBT, especially those classified as Shamblin classification Type 1 and Type 2, can be accomplished successfully under sedoanalgesia by infiltrating a local anesthetic agent of 1% lidocaine (100-200 mg) in necessary cases. Comparing sedoanalgesia method with general anesthesia in surgeries of Type 1 and Type 2 tumors revealed that there are significant advantages directly affecting surgical success such as intraoperative well-oriented patient, constant consciousness control, less neurological and vascular injuries, more stable hemodynamic conditions, lower risk of hemorrhage, more comfortable surgical environment, higher patient and surgeon satisfaction, less postoperative pain in patients, and shorter duration of surgery and hospital stay.

The sedoanalgesia method may be more helpful for the patients compared to general anesthesia in certain CBT surgeries, especially in tumors evaluated as Shamblin classification Type 1 and Type 2.

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