CAROTID BODY TUMORS SURGERY: EXPERIENCE OF 13 CASES AT A TERTIARY CARE HOSPITAL

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ABSTRACT

Objective: To share five year experience and a half years with emphasis on some technical aspects which will help those managing such cases.
Study Design: Descriptive case series.
Place and Duration of Study: Combined Military Hospital Rawalpindi, from Jul 2010 to Dec 2015.
Material and Methods: All cases of CBT presenting to our department from Jul 2010 to Dec 2015 were included in the study and analyzed.
Results: A total of 13 patients were treated at our institute in the last 5 and half years. Average age of patients was 38.5 years with a range of 22-55 years. Male to female ratio was 1:6.5. Mean interval between symptoms onset and presentation was 38.7 ± 16 months. None of the tumors were bilateral or malignant. Two patients had type I tumor (15%), seven patients had tumor of type II (54%) and four (31%) patients underwent resection for type III tumor. Type I and Type II tumor was removed by simple excision. Three cases of type III tumor were managed by excision, use of temporary shunt and followed by reconstruction of internal carotid artery. One of the type III tumor was excised with ligation of internal carotid artery. There was no mortality or stroke, three patients with type III tumors had transient dysphagia; One of them had marginal mandibular nerve palsy as well. We used bipolar diathermy in all cases, Harmonic TM Scalpel (Ethicon Endo-Surgery) in three cases and LigaSureTM (Covidien Ltd, Dublin Republic of Ireland) in three cases. Use of newer energy sources made dissection less bloody, quick and easier.
Conclusion: CBT are rare tumors. Surgical excision should be carefully planned and executed with the help of modern energy sources to avoid any serious complications.

Keywords: Carotid body tumors, Harmonic Scalpel, Internal carotid artery reconstruction, Internal carotid artery ligation, Paragangliomas.

INTRODUCTION

Carotid body tumors (CBT) are rare tumor originating from carotid body. Carotid body lies in the adventitia at the bifurcation of common carotid arteries. Most of the blood supply of carotid body originates from external carotid artery through Mayer ligament[1]. CBT are the commonest paragangliomas of head and neck region and have been variously named chemodectomas and glomus tumors as well.

They commonly present as painless, slow growing mass at angle of mandible. They have been divide into sporadic (commonest, 85%), familial and hyperplastic (occurring in people suffering chronic hypoxia, like living at high altitudes and suffering from chronic obstructive pulmonary disease) forms. Almost 10% are malignant[2]. Shamblin classification is based extent of involvement of carotid vessels[3]; it was modified later to correlate with morbidity and technical challenge expected in tumor excision[4]. The risk of morbidity and mortality increases from type I to III on account of difficult resection of tumor[5].

Surgery is considered most effective mode of treatment[6]. Surgery of these tumors can be challenging and used to be associated with significant mortality and morbidity because of their vascularity, involvement of internal carotid artery and proximity to cranial nerves. Various

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authors have suggested different methods to reduce mortality and morbidity. Preoperatively determining tumor dimensions and how far the tumor is located from the base of the skull and tumor volume, when used in combination with the Shamblin grade, better predict bleeding and cranial nerve injury risk[6]. Because of their rarity not many centers have extensive experience in managing these tumors. It is therefore important that experience of surgeons managing these tumors may be pooled for improving management in future.

Here we present our experience in managing these rare tumors with some helpful tips for those embarking on this challenging surgery.

MATERIAL AND METHODS

This is a retrospective analysis of all the patients of CBT presenting to our hospital from July 2010 to Dec 2015. All patients who were operated for CBT were included in this study. Hospital records of these patients were retrieved and analyzed. Ethical approval was taken from hospital Ethical Review Committee for the purposed study.

As per protocol of treatment of these tumors, all patients with diagnosed carotid body tumors were assessed clinically to rule out functional tumors. All had duplex scans and computed tomography (CT) Angiography of neck vessels. magnetic resonance imaging (MRI) was only done if there was some suggestion of involvement of adjacent structures. Due to non availability, Succinate dehydrogenase gene mutation analysis was not done. Our approach to surgical excision of these tumors is making curved incision starting close to mastoid process and taking it down over the anterior border of sternomastoid and then curving it anteriorly. We have used bipolar diathermy in all cases and after initial few cases we have been using modern energy sources like LigaSureTM (Covidien Ltd) and Harmonic scalpel (Ethicon Endo-Surgery). These are very useful, because in most of these tumors one finds unusual, small vessels even in the carotid sheaths and bleeding from them is a nuisance and also obscures the operating field. The small tip of these instruments can easily dissect the tumor off carotid vessels. After taking the control of common carotid artery (CCA) we identify internal (ICA) and external carotid arteries (ECA) and vagus nerve. If it is a Shamblin I or II tumor then we proceed with conventional dissection in the sub adventitial plane. But if the tumor is encasing the vessels partially or completely then we use a combination of craniocaudal[5] and retrocarotid techniques[6]. After taking proximal control, we dissect all around the carotid bifurcation as much as can be done safely then start distally to identify the distal portions of ICA and ECA. ECA is identified and ligated or clamped proximally and distally. This reduces the vascularity of the tumor and helps in further dissection[7,8]. If it is not possible to dissect off the tumor completely from ICA, then a reverse saphenous vein graft or a synthetic graft is and pulled over a Javid TM/Pruitt Inihara® shunt. ICA is excised and the shunt is placed from CCA to ICA. The tumor is then excised. Distal anastomosis is done over the shunt, back wall of proximal anastomosis is done partially by parachute technique and then the shunt is pulled out and the anastomosis is completed.

All data was analyzed using SPSS 21. Frequencies and percentages were calculated for quantitative variables. Means and Standard Deviation were calculated for quantitative variables.

RESULTS

A total of 13 patients were treated at our hospital in the last 5 and half years. Average age of patients was 38.53 ± 10 years with a range of 22-55 years. Male to female ratio was 1:6.5. Patient's characteristics are listed in the table.

Mean interval between symptoms onset and presentation was 38.7 ± 16 months. None of the tumors were bilateral or malignant. Two patients had type I tumor (15%), seven patients had tumor of type II (54%) and 4 (31%) patients underwent resection for type III tumor. Type I and type II tumor was removed by simple excision. Three of the four cases of type III tumor were managed by

excision followed by reconstruction of internal carotid artery with use of temporary shunt. In one case the saphenous vein graft was used while PTFE was used instead of saphenous vein in two other cases because, saphenous vein were of small caliber. The fourth Shamblin III patient had a large tumor which was high and eroding base of skull. In this patient the tumor along with the when the ICA was divided accidently the actual diagnosis was made and vascular surgeon was called in. A Javid TM (Bard Peripheral Vascular, Inc. USA) shunt was placed immediately, tumor was excised and then the ICA was replanted on CCA. There was no neurological deficit post-operatively although the clamp time was around 20 minutes. In one case the external carotid artery

Table: Patient's characteristics.

S. No.	Age	Sex	Months	Class	Treatment	Complication	Energy Source for Dissection
1	45	M	48	II	Excision	Nil	UPD, BPD
2	52	F	36	I	Excision	Nil	UPD, BPD
3	27	F	24	III	Excision with reconstruction of ICA	Dysphagia, transient. Voice OK	UPD, BPD
4	38	M	18	III	Excision with reconstruction of ICA	Dysphagia, transient. Marginal mandibular injury	UPD, BPD and LS
5	42	F	48	II	Excision	Nil	UPD, BPD and LS
6	55	F	36	II	Excision	Nil	UPD, BPD and LS
7	48	F	72	II	Excision with excision of ECA	Nil	UPD, BPD and LS
8	34	F	36	II	Excision with excision of ECA	Nil	UPD, BPD and HS
9	32	F	18	I	Excision, with replantation of ICA (emergency)	Nil	UPD, BPD
10	22	F	48	III	Excision with ligation of internal carotid artery	Hoarseness	UPD, BPD, HS
11	32	F	60	II	Excision with ligation of External Carotid artery	Nil	UPD, BPD, HS
12	34	F	36	II	Excision with ligation of External Carotid artery	Ligation of ECA was inadvertent	UPD, BPD, HS
13	40	F	24	III	Excision with reconstruction of ICA	Nil	UPD, BPD, HS

UPD : Unipolar Diathermy, BPD : Bipolar diathermy, LS : Liga Sure TM Dolphin tip 20 cm shaft, HS : Harmonic scalpel.

Internal carotid artery was excised and both ends ligated as distal anastomosis was not possible. This patient had non-opacification of ICA on pre operative CT angiogram. There was no neurological deficit post operatively.

Bipolar diathermy was used in all cases, Ligasure TM was used in four cases and Harmonic TM Scalpel was used in five cases. In one of the patient another surgical team had started the procedure with a diagnosis of submandibular gland swelling. It was only was divided inadvertently while dissecting the tumor with harmonic scalpel. Two cases under-going type III tumor excision complained of dysphagia post operatively which resolved before discharge from hospital. One patient with type three tumors had hoarseness which improved with the passage of time. One patient with a large type-III tumor had injury to marginal mandibular branch of facial nerve which did not improve postoperatively. There was no mortality in our series.

DISCUSSION

Attempts at surgery for carotid body tumors have been made for over 100 years. The early reports described significant complications, particularly mortalities as a result of intra-operative bleeding. The earliest successful carotid body tumor resection was performed by Reigner in 1880[9]. Even into the middle of the 20th century, resection of these tumors posed problem because of the complications but modern imaging and current surgical and vascular techniques have significantly improved the safety and success of this operation.

Doppler ultrasound provides a non invasive inexpensive and sensitive diagnostic modality making it investigation of choice for screening any suspicious mass[10]. Contrast enhanced CT serves as precise and accurate investigation before embarking on surgery by providing information on relevant anatomy and ruling out the differentials.

In our series there is much more female predominance (1:5.5 compared to 1:1.9) and a younger mean age at presentation (38 yrs as compared with 55 yrs)[10]. Similar finding were observed by Darouasi *et al*, reporting the average age of patients as 35,4 years (26 to 55 years), but with a male predominance (sex-ratio: 2,33)[11]. Late presentation of patients in our series may be due to lack of awareness and access to appropriate health care facilities.

Surgery remains the mainstay of treatment. Surgery can nevertheless be challenging with risk of damage to the cranial nerves, stroke and blood loss. Surgical and anaesthetic techniques have improved but still some tumors test the nerves of the operating team. The aim of our paper is to share our experience to help those embarking upon this difficult task.

Since carotid bodies have got richest blood supply per gram of all the tissues in body, main concern in surgery is to reduce bleeding. Preoperatively, embolization of ECA have been used with good results[11,12], but it comes with a risk of stroke and needs expertise for super-selective embolization of feeding vessels[13]. In addition some of the small vessels which are not visualized during angiography remain patent and can cause bleeding. Covered stents placed in ECA have been used to overcome these problems[14]. We do not have this facility therefore they were not used in any of the cases.

Selecting energy source for haemostasis is very important. We have used bipolar diathermy in all cases and after initial few cases we have been using modern energy sources like Harmonic TM scalpel and Liga Sure TM. Although these modern energy sources are very convenient and make dissection quicker, one should be careful while using them. In one of our cases ECA was accidently divided and it was only realized when the distal end of ECA was found to be sealed and closed. It was ligated.

Some other authors have recommended 'craniocaudal dissection' of tumor i.e. dissecting cranial end of tumor, ICA and ECA and facial, vagus and hypoglossal nerves first and then excising the tumor[5]. Another technique of reducing blood loss is selective clamping of ECA just at the bifurcation and distal to the tumor[15]. This is based on the observation that all the main blood supply of CBT arises from ECA. In smaller tumors i.e. Shamblin I and some of Shamblin II we dissect the CCA first and then proceed cranially. Yet another technique named "the internal to external (INT-EX) technique", described by Rao and team is a stepwise dissection technique of carotid body tumors from the internal carotid towards the external carotid artery[16]. Our approach for dissection of large difficult tumors is a combination of craniocaudal and retrocarotid dissection as mentioned in materials and methods.

Anticipating the need of ICA resection and preparing for this situation is important so as to reduce clamping time. It has been reported that there is 30% risk of neurological deficit if internal carotid artery is resected without a shunt[16]. We therefore prepare graft (usually long saphenous vein) and pull it over Javid TM/Pruitt Inihara®

shunt before clamping and resecting ICA as already mentioned.

CBT are associated with mutation of Succinate Dehydrogenase Complex (SDHx) gene[17]. These mutations are of four types and an SDHB mutation is associated with more aggressive disease and therefore warrants early surgical intervention[18]. Unfortunately we do not have such facility here so gene analysis was not done in any case.

Mortality rate following surgery is reported to be from 0.6-13%[5], while cranial nerve palsies is found to be 10-40% in different studies and postoperative cerebro-vascular accident rate 0.5-2%[5,19]. A study conducted by Tayyab reported transient nerve palsies involving 7th and 12th cranialnerves in three out of eight patients, but all recovered spontaneously. One patient had permanent unilateral vocal cord palsy resulting in hoarseness of voice[19]. In our series there was no mortality, but the cranial nerve palsies although transient were present in 25% of cases. These were the patients with Shamblin III tumors.

The keys to successful surgery are careful preoperative planning, proximal and distal control of the vasculature with vessel loops, careful identification and preservation of neural structures if possible, dissection in the sub adventitial, white line and preparation for vascular reconstruction if necessary with suture repair, patch grafting or interposition saphenous vein graft[20].

CONCLUSION

Carotid body tumor surgery no matter how small must be considered a high risk surgery. While newer approaches to limit tumor size are utilized, but surgery remains mainstay of the treatment. Complications can be inevitable in some cases but in most cases they can be avoided by use of modern energy sources and well planned surgery.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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