ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Neurovascular

Editor
Kazuhiro Hongo, MD
Shinshu University, Matsumoto, Japan

SNI
Open Access

Case Report

A rare case of carotid body tumor associated with near complete cerebral sinus thrombosis and idiopathic intracranial hypertension. Management strategy and review of the literature

Toma Yuriev Spiriev[1], Milko Milev[1], Lili Laleva[1], Stoicho Stoyanov[1], Ivan Plachkov[2], Milena Staneva[3], Vladimir Nakov[1]

Departments of [1]Neurosurgery, [2]Imaging Diagnostics and [3]Angiology, Acibadem City Clinic University Hospital Tokuda, Sofia, Bulgaria.

E-mail: *Toma Yuriev Spiriev - spiriev@gmail.com; Milko Milev - milko.d.milev@gmail.com; Lili Laleva - lililaleva@gmail.com; Stoicho Stoyanov - stoichostoyanov@yahoo.com; Ivan Plachkov - Plachkov83@gmail.com; Milena Staneva - staneva_milena@abv.bg; Vladimir Nakov - vladimir_nakov@yahoo.com

***Corresponding author:**
Toma Yuriev Spiriev,
Department of Neurosurgery,
Acibadem City Clinic
University Hospital Tokuda,
Sofia, Bulgaria.

spiriev@gmail.com

Received : 16 February 2021
Accepted : 29 April 2021
Published : 07 June 2021

DOI
10.25259/SNI_170_2021

Video available on:
www.surgicalneurologyint.com

Quick Response Code:

ABSTRACT

Background: Carotid body tumors (CBTs) are rare hypervascular lesions with critical location which makes them very challenging to treat. In rare occasions, compression of the jugular vein from the tumor mass could predispose to progressive thrombosis of intracranial venous sinuses. The latter consequently leads to intracranial hypertension (pseudotumor cerebri) with the accompanying danger to the vision. Herewith, we present our management strategy for this rare presentation of CBTs.

Case Description: A 38-year-old woman, with no medical history, was admitted in the emergency unit with acute onset of headache, dizziness, and vomiting. On the diagnostic imaging studies (CT venography and MRI) a near total occlusion of all cerebral venous sinuses and a large CBT (Shambin Type II) were diagnosed. Initially, the patient was treated with anticoagulants for the thrombosis and with lumbo-peritoneal (LP) shunt for the management of pseudotumor cerebri. At a second stage, after resolution of the cerebral sinus thrombosis, the CBT was completely resected under electrophysiological monitoring, without preoperative embolization. At 1-year follow-up, the patient is neurologically intact with functioning LP shunt, patent cerebral venous sinuses, without tumor recurrence.

Conclusion: We present a rare case of CBT with intracranial complications, which was managed successfully by staged treatment. Careful study of the preoperative radiological and laboratory data, thorough preoperative planning of the tridimensional lesion anatomy, as well as meticulous microsurgical technique under intraoperative electrophysiological monitoring was essential for the successful outcome of the case.

Keywords: Carotid body tumor, Cerebral dural venous thrombosis, Idiopathic intracranial hypertension, Intraoperative electrophysiological monitoring, Pseudo tumor cerebri, Tridimensional planning, Horos software

INTRODUCTION

Carotid body tumors (CBTs) or carotid paragangliomas are complex vascular lesions, which are derived from chromaphin cells within the adventitia of the carotid bifurcation. These tumors account for 0.6% of all head and neck tumors and with incidence of 1:30,000–1:100,000 in the general population.[15] Although rare, slowly growing and rarely malignant (app. 5% of all CBT)[10]

This is an open-access article distributed under the terms of the Creative Commons Attribution-Non Commercial-Share Alike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as the author is credited and the new creations are licensed under the identical terms.
©2021 Published by Scientific Scholar on behalf of Surgical Neurology International

or familial (app. 10% of all CBT),[10] these tumors can become large before diagnosis and present with clinical symptoms ranging from local pulsating neck mass, extraglandular hormonal production (epinephrine derivatives) and elevated blood pressure, dysphagia, syncope, and, on rare occasions, venous sinus thrombosis.[7,10,21,24,25] The latter is usually occurring as a result of progressive jugular vein compression from the tumor and can be associated with intracranial venous hypertension and pseudotumor cerebri (idiopathic intracranial hypertension).[21] The risk of such complication in higher in patients with elevated probability for thrombosis.[5,8,18,21,23,27,30] Such cases can be difficult to manage, depending on the extent of the cerebral sinus thrombosis, intracranial hypertension, tumor size and its vascularity, the necessity of staged treatment, and indications for preoperative tumor embolization. Herewith, we present our treatment strategy for the management of such a rare presentation of CBT, including preoperative planning, intraoperative technical nuances and electrophysiological modalities used for minimizing potential postoperative neurological deterioration.

CASE DESCRIPTION

A 38-years-old woman was admitted in the emergency department with severe onset of headache, nausea, and vomiting. On the performed computed tomography (CT) and magnetic resonance imaging (MRI) angio- and venography, there was thrombosis of both transverse and the left sigmoid sinuses, thrombosis of sinus rectus and superior sagittal sinus, and associated brain edema [Figure 1a-d]. In the neck region, distal to the end of the thrombosis, there was a hyper-vascular mass lesion with the characteristics of left CBT (Shambin Type II lesion) [Figure 1a, b and d]. The patient was hospitalized in the neurosurgery clinic. A lumbar spinal drainage was placed in order to control the symptoms of elevated intracranial pressure. The cerebrospinal fluid opening pressure was measured at 29 cm H_2O. The patient was medicated with anticoagulation treatment with 9500 anti-Xa IU/ml 0.6 ml nadroparine calcium b.i.d. and with antiedematous treatment – dexamethasone in tapering dosage, short administration of 250 ml 10% mannitol solution (25 gr), and crystalloid solution infusions. The lumbar spinal drainage was kept for 3 days and, along with the above-mentioned therapy, allowed for a significant improvement in the neurological status with decrease of the frequency and severity of headaches and correction of vomiting and nausea. At the first stage of the operative treatment, we decided to place a lumboperitoneal (LP) shunt system to attain permanent control of the symptoms of pseudotumor cerebri and to reduce the risk of visual deterioration. We implanted a Medtronic Strata NSC adjustable LP shunt system set on performance level of 2.5 (135–147 mm H_2O opening pressure) to avoid hyperdrainage. The postoperative

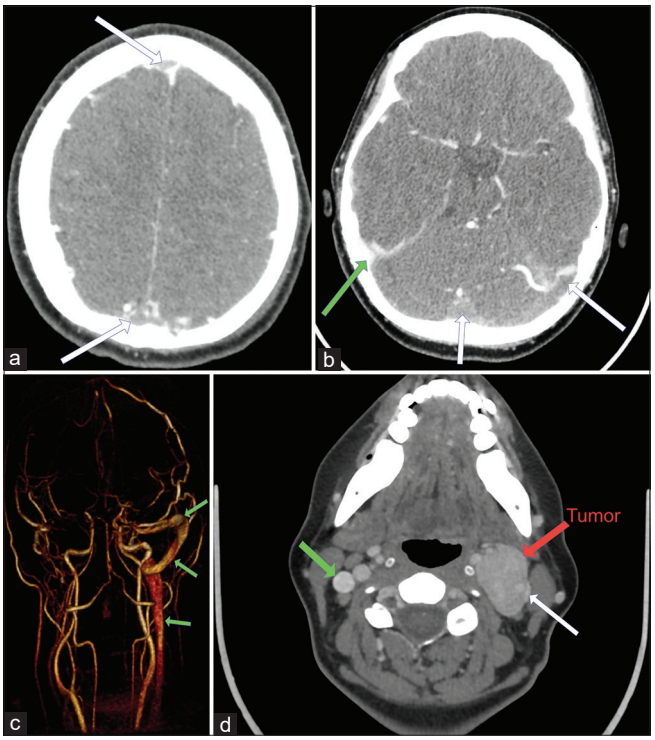

Figure 1: (a) Preoperative Computed Tomography (CT) venography indicating thrombosis of the superior sagittal sinus (white arrow) (b) preoperative CT venography indicating thrombosis of the confluens sinuum, left sigmoid and transverse sinuses (white arrow). The right sigmoid sinus is patent (green arrow). (c) Preoperative magnetic resonance imaging angiography (posterior view) indicating the extent of the intracranial thrombosis. Only the right transverse and sigmoid sinuses are patent (green arrow). (d) CT venography indicating the tumor location (left carotid bifurcation, white arrow) and the associated internal jugular vein compression. The right internal jugular vein is patent (green arrow).

course was uneventful. The patient was discharged on the 12th postoperative day with intermittent mild headaches, no visual worsening and primary healing of the surgical wound. Oral anticoagulant was continued (the factor Xa inhibitor Rivaroxaban in a daily dosage of 20 mg). Patient was sent for laboratory and genetic tests for thrombophilia, including analysis for prothrombin mutation G20210A, PAI mutation 4G/5G, Factor Leiden mutation, MTHFR C677T, A1298C mutations, protein C and protein S, antithrombin III, antiphospholipid antibody, and anticardiolipin antibody levels.

A control MRI was done 1 month after the first hospitalization indicating complete resolution of the cerebral venous thrombosis. The patient was scheduled for surgery of the CBT almost 2 months after the initial onset of symptoms. The surgery was planned on CT and MRI angiography [Figure 2a,b]. No preoperative tumor embolization was planned; therefore, no preoperative conventional

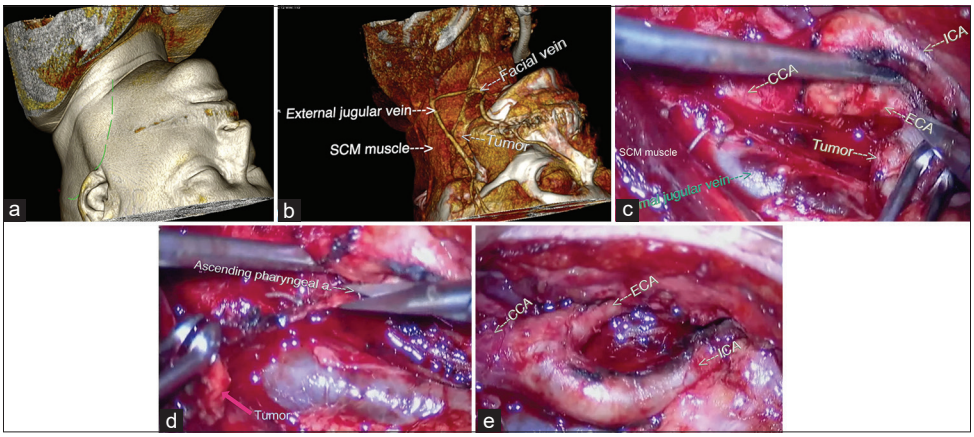

Figure 2: (a) Preoperative computed tomography based three-dimensional reconstruction with Horos™ software (an open source 64-bit medical image viewer available at: https://horosproject.org/). The skin incision is outlined in green lines, along the medial border of sternocleidomastoid (SCM) muscle. (b) Superficial muscle and venous anatomy indicating the dissection plane from the medial border of the SCM muscle. (c) Intraoperative image – the SCM muscle is detached from the mastoid process and retracted laterally, identifying and preserving the XI nerve with the help of intraoperative monopolar stimulator. The internal jugular vein is visible. The tumor is grasped with tumor forceps and the dissection plane between the tumor and the external carotid artery is visible. (d) The ascending pharyngeal artery, feeding the tumor, is identified, coagulated, and transected. (e) Surgical field after complete tumor removal presenting the carotid bifurcation.

angiography was performed, because it was assumed that this invasive examination would not give any further diagnostic data with significance to the surgical intervention planning.

The surgery was performed under intraoperative electrophysiological monitoring which included somatosensory evoked potentials (SSEP) and cortico-spinal and cortico-bulbar motor evoked potentials (MEP), direct nerve stimulation for the identification of the IX, X, XI, and XII nerves and bispectral index monitoring. The surgical protocol was as follows: the patient was in prone position on the operative table with head rotated and extended to the right side, fixed on the Mayfield head clamp. A reverse "J" incision was made starting from the middle third of the medial border of the sternocleidomastoid muscle (SCM) [Figure 2c], reaching the mastoid process and curving posteriorly [Video 1]. The dissection was kept on the medial border of the SCM, following the neck fascial planes. The muscle was detached from the mastoid process, leaving a muscle cuff for later reapproximation and preservation the greater auricular nerve. It was very important to identify the XI nerve which runs in the fat pad below the SCM. The identification of the nerve was achieved using monopolar stimulation probe with 1 mA current intensity. After the nerve was successfully identified, it was covered with a protective piece of fat and retracted laterally. This maneuver provides further space for tumor removal, especially in close proximity to the skull base. The vessel dissection in the carotid triangle was performed from proximal to distal direction, starting with identification of the internal jugular vein and the common carotid artery following them to the carotid bifurcation. The internal carotid artery (ICA) was exposed up to the point of entry into the skull base. The tumor was revealed over the carotid bifurcation, stretching the overlaying internal jugular vein [Video 1]. The IX, XII, and X nerves were anatomically identified and electrophysiologically verified with the help of monopolar probe stimulation. The tumor dissection started from the superior to the inferior tumor borders, employing microsurgical technique for the dissection of the tumor from the ICA and external carotid artery (ECA) [Figure 2d]. Bleeding was controlled using low power bipolar coagulation. No vessel clamps were necessary during tumor removal. When the dissection was performed respecting interfacial and subadventitial plane, there was no bleeding despite the nature of the tumor and the anticoagulation treatment. No changes in the MEP and SSEP were reported. The tumor was removed completely [Figure 2e]. The postoperative period was uneventful with no neurological worsening. On the postoperative, CT angiography a complete tumor excision was verified [Figure 3]. Postoperative partial thrombosis of the left internal jugular vein without intracranial extension was detected. The patient was discharged on the 4th postoperative day. The anticoagulation treatment was continued, and the patient was followed up with MRI and neck vessels Doppler ultrasound examination. The postoperative jugular vein thrombosis resolved on the 1st postoperative month, through which the patient complained form intermittent headaches. There was no data for hyperdrainage of the LP shunt and the latter was functional upon examination. The pathologic examination of the tumor tissue confirmed the diagnosis of a CBT [Figure 4].

The genetic tests for thrombophilia indicated that the patient is homozygotic for Factor V Leiden and PAI-1 4G/5G wild type allele. However, she was found to be a heterozygotic carrier of the G20210A prothrombin gene mutation, and

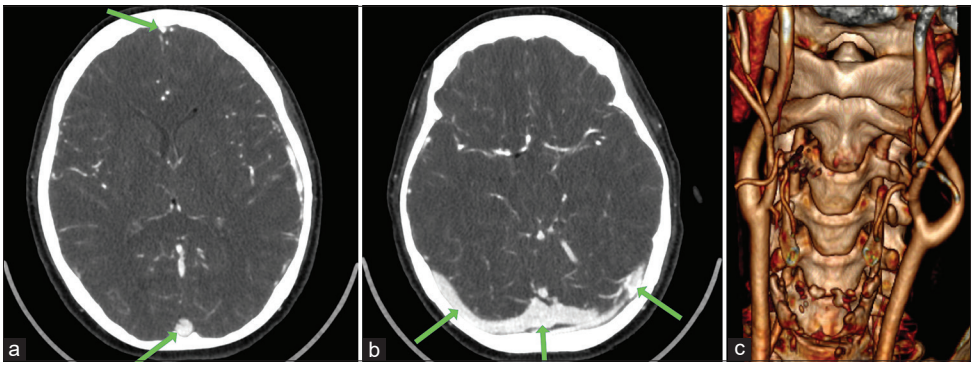

Figure 3: (a) and (b) Postoperative Computed Tomography (CT) venography indicating cerebral venous sinuses complete recanalization. (c) CT arteriography presenting complete tumor removal.

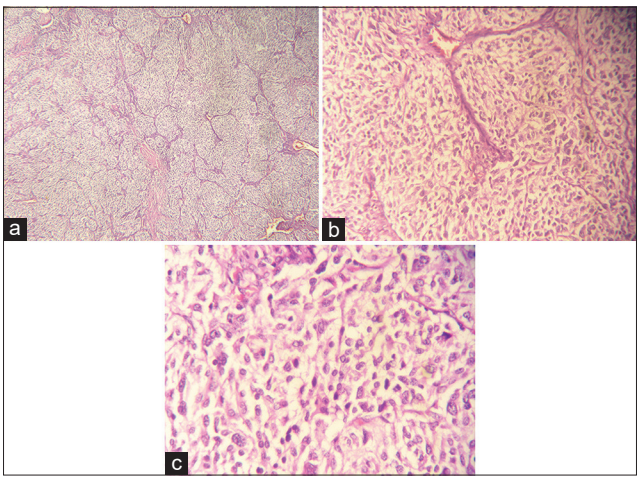

Figure 4: (a-c) Micrograph of the pathological specimen with hematoxylin and eosin stain presenting typical arrangement of the tumor cells in cell balls (Zellballen), separated by fibrotic stroma and vessels. The cells are oval or polygonal with abundant granular eosinophilic cytoplasm and nuclear atypia.

compound heterozygosity for the C677T and A1298C MTHFR mutations was further identified. Therefore, due to the high risk of future thrombotic events, the oral anticoagulant (rivaroxaban in a daily dosage of 20 mg) treatment was continued, and the patient was followed up with MRI and neck vessels Doppler ultrasound examinations.

After a 1-year follow-up the patient is neurologically intact with functioning LP shunt, without new thrombosis of the cerebral sinuses, without tumor recurrence.

DISCUSSION

Idiopathic intracranial hypertension or pseudotumor cerebri is a serious condition characterized by decreased absorption of cerebrospinal fluid due to cerebral venous outflow obstruction, which, if not managed accordingly, could lead to progressive visual loss [12,14] and can be life-threatening. The treatment strategies include cerebral spinal fluid (CSF) diversion procedures (LP or ventriculoperitoneal [VP] shunting), optic sheath fenestration in cases with progressive visual deterioration or, recently, cerebral venous sinuses stenting (in chronic cases of sinus stenosis).[2,12,14,19,20] In acute stages of cerebral venous sinus thrombosis, the increased venous pressure and the increase in intracranial pressure both have to be managed promptly to avoid further complications.[2,11,12,14,19,20] Regarding the medical management of the sinus thrombosis, clinical studies suggest better results with low-molecular-weight heparin (LMWH) treatment in the acute phase versus direct oral anticoagulants or unfractionated heparin (UFH), due to a higher risk of intracerebral hemorrhagic complications with the latter.[9,11] In our patient, as in other cases with cerebral venous sinus thrombosis, we also preferred the use of LMWH because of the ease of application (one or two dosages daily) lack of necessity for frequent measurement of International Normalized Ratio and Activated Partial Thromboplastin Time as in the cases of vitamin K antagonists or UFH use.

CSF shunting is one of the main options for treatment of the increased intracranial pressure from venous outflow obstruction and idiopathic intracranial hypertension.[2,14,19,20,26] Lumbar punctures and spinal drainage are often employed as temporary measures to determine the CSF pressure (29 cm H_2O in our case) and to relieve pressure until a long-lasting treatment option is implemented. A paper of Satti *et al.*,[26] which is meta-analysis of 17 studies of patients treated with LP or VP shunts, showed that 86% of the patients presenting with headache and 70% of the patients presenting with papilledema improved after surgery. Another study of McGirt *et al.*[20] indicated that the majority of patients experienced relief from headache 1 month after LP or VP shunt implantation, but the symptoms recurred in 19% of the cases 1 year post surgery. In the case of our patient the placement of spinal drainage and the following implantation LP shunt led to resolution of the severe preoperative headaches and the visual disturbance. However, there was a

period of intermittent headaches after tumor removal and the renewal of jugular vein thrombosis and they continued until the jugular vein thrombosis resolved, as observed on the follow-up Doppler ultrasound examinations.

There is no consensus in the literature for preference of certain type of shunting in the case of pseudotumor cerebri.[2,14,20,26] In general, the studies show similar efficacy for the LP and VP shunts, but higher rates of complications in the LP shunt patients group.[2,20,26] In our institution the sole indication for the placement of LP shunt is idiopathic intracranial hypertension or increased ICP in cases of cerebral venous sinus thrombosis. We do no place VP shunts in these patients due to the small size of the ventricles, lack of neuronavigation in our institution and the technical challenges associated with precise placement of the catheter in the lateral ventricle.

Despite our best efforts, we have found few papers in the literature related to such cases of extensive cerebral venous sinus thrombosis associated with CBT. This does not mean that this is the first case, but, most probably, that the condition is underreported. The main papers that we found are case reports and small case series for jugular paraganglioma patients presenting with increased intracranial pressure due to venous outflow obstruction by the tumor.[6,16,21,30] In comparison to these lesions, where the tumor often occludes the jugular foramen, the CBT is often associated compression of the internal jugular vein and very rarely invasion of the latter.[21] In our particular case, the symptoms occurred after the advanced compression and stenosis of jugular vein lumen leading to progressive antegrade thrombosis of the cerebral venous sinuses. The effect of this compression has been further superimposed by the patient's genetic predisposition to thrombophilia and venous thrombosis due to the combination of heterozygotic G20210A prothrombin gene mutation and compound heterozygotic C677T and A1298C MTHFR mutations.[3,13,17,28]

CBTs are very challenging to treat due to their hypervascularity, location within the carotid bifurcation and proximity to major cranial nerves (IX, X, and XII nerves). In such cases, as a part of the preoperative planning and avoidance of vascular complications, the patient was monitored for eloquent brain functions with salvage strategy for intra-extracranial bypass. Operation was performed under advanced electrophysiological monitoring, which includes SSEP and corticospinal and cortico-bulbar MEP, which would detect any form of cerebral ischemia as well as ongoing injury to the caudal group of cranial nerves. Direct nerve stimulation was also employed allowing for the identification of the IX, X, XI, and XII cranial nerves, aiding with their preservation. One of the main risks in this type of surgery is cranial nerves morbidity with estimated rate between 14% and 49% incidence of early neurological deficit and 6–23% – for persistent deficit at 1 year follow-up according to the literature.[4,10,15] The risk of stroke is <1% in more recent series.[4,10,15] Therefore, with the use of advanced intraoperative electrophysiological monitoring, in our opinion, the rate of early and late postoperative cranial nerve deficit could be reduced and more serious complications, such as cerebral ischemia, could be prevented in a timely manner. In our case, we did not had any adverse neurological events during or after surgery.

Preoperative CT and MRI angiography provided the most important information regarding the diagnosis and the choice of treatment paradigm. The protocol included CT venography, which indicated the extent of internal jugular vein and cerebral venous sinuses thrombosis. From a preoperative planning perspective, this data were used for three-dimensional (3D) reconstruction and planning with Horos™ software (an open source 64-bit medical image viewer available at: https://horosproject.org/) [Video 1]. The ability to rotate the 3D reconstruction venography and angiography image in every possible angle, overlay the arterio- and venography, adjust the intensity levels, and color maps to see skin, neck muscles, vessels, provided important preoperative understanding of the dissection plane, pathological anatomy, location and displacement of the jugular vein by the tumor mass and the course of the larger venous tributaries to the jugular vein at the level of the tumor, and defined the surgical strategy for tumor resection.[29]

Preoperative angiography was not performed just as preoperative tumor embolization was not considered after the initial imaging examinations, as we believe that this would not have added any benefit to the surgical plan in relation to blood loss or better preoperative understanding of pathological anatomy. This is also supported by other authors[1,22] and it is generally accepted that embolization should be used and adds some benefit only in large CBT. It could, however, aid the bypass planning that was performed on CT angiography in our case.

CONCLUSION

Idiopathic intracranial hypertension is a rare presentation of a CBT. In the case described, it was due to advanced thrombosis of the cerebral venous sinuses resulting from stretching and compression of the jugular vein along with genetic predisposition for thrombophilia. Prompt treatment of the venous thrombosis and intracranial hypertension followed by second stage microsurgical excision of the tumor mass without preoperative embolization under intraoperative electrophysiological monitoring prevented further neurological complications and proved to be a successful management strategy in this case.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Abu-Ghanem S, Yehuda M, Carmel NN, Abergel A, Fliss DM. Impact of preoperative embolization on the outcomes of carotid body tumor surgery: A meta-analysis and review of the literature. Head Neck 2016;38 Suppl 1:E2386-94.
2. Abubaker K, Ali Z, Raza K, Bolger C, Rawluk D, O'Brien D. Idiopathic intracranial hypertension: Lumboperitoneal shunts versus ventriculoperitoneal shunts-case series and literature review. Br J Neurosurg 2011;25:94-9.
3. Almawi WY, Tamim H, Kreidy R, Timson G, Rahal E, Nabulsi M, *et al*. A case control study on the contribution of factor V-Leiden, prothrombin G20210A, and MTHFR C677T mutations to the genetic susceptibility of deep venous thrombosis. J Thromb Thrombolysis 2005;19:189-96.
4. Amato B, Serra R, Fappiano F, Rossi R, Danzi M, Milone M, *et al*. Surgical complications of carotid body tumors surgery: A review. Int Angiol 2015;34 Suppl 6:15-22.
5. Bai C, Ding J, Da Z, Sun J, Liu C, Pan L, *et al*. Probable risk factors of internal jugular vein stenosis in Chinese patients-a real-world cohort study. Clin Neurol Neurosurg 2020;191:105678.
6. Beck DW, Kassell NF, Drake CG. Glomus jugulare tumor presenting with increased intracranial pressure. Case report. J Neurosurg 1979;50:823-5.
7. Can Sevil F, Tort M, Ali Kaygin M. Carotid body tumor resection: Long term outcome of 67 cases without preoperative embolization. Ann Vasc Surg 2020;67:200-7.
8. Chung I, Lip GY. Virchow's triad revisited: Blood constituents. Pathophysiol Haemost Thromb 2003;33:449-54.
9. Coutinho JM, Ferro JM, Canhão P, Barinagarrementeria F, Bousser MG, Stam J. Unfractionated or low-molecular weight heparin for the treatment of cerebral venous thrombosis. Stroke 2010;41:2575-80.
10. Davila VJ, Chang JM, Stone WM, Fowl RJ, Bower TC, Hinni ML, *et al*. Current surgical management of carotid body tumors. J Vasc Surg 2016;64:1703-10.
11. Ferro JM, Bousser MG, Canhão P, Coutinho JM, Crassard I, Dentali F, *et al*. European stroke organization guideline for the diagnosis and treatment of cerebral venous thrombosis-endorsed by the European academy of neurology. Eur J Neurol 2017;24:1203-13.
12. Friedman DI. The pseudotumor cerebri syndrome. Neurol Clin 2014;32:363-96.
13. Gao M, Feng N, Zhang M, Ti X, Zuo X. Meta-analysis of the relationship between methylenetetrahydrofolate reductase C677T and A1298C polymorphism and venous thromboembolism in the Caucasian and Asian. Biosci Rep 2020;40:BSR20200860.
14. Giridharan N, Patel SK, Ojugbeli A, Nouri A, Shirani P, Grossman AW, *et al*. Understanding the complex pathophysiology of idiopathic intracranial hypertension and the evolving role of venous sinus stenting: A comprehensive review of the literature. Neurosurg Focus 2018;45:E10.
15. Lamblin E, Atallah I, Reyt E, Schmerber S, Magne JL, Righini CA. Neurovascular complications following carotid body paraganglioma resection. Eur Ann Otorhinolaryngol Head Neck Dis 2016;133:319-24.
16. Lertakyamanee P, Srinivasan A, de Lott LB, Trobe JD. Papilledema and vision loss caused by jugular paragangliomas. J Neuroophthalmol 2015;35:364-70.
17. Liu F, Silva D, Malone MV, Seetharaman K. MTHFR A1298C and C677T polymorphisms are associated with increased risk of venous thromboembolism: A retrospective chart review study. Acta Haematol 2017;138:208-15.
18. Lowe GD. Virchow's triad revisited: Abnormal flow. Pathophysiol Haemost Thromb 2003;33:455-7.
19. Markey K, Mollan S, Jensen R, Sinclair A. Understanding idiopathic intracranial hypertension: Mechanisms, management, and future directions. Lancet Neurol 2016;15:78-91.
20. McGirt MJ, Woodworth G, Thomas G, Miller N, Williams M, Rigamonti D. Cerebrospinal fluid shunt placement for pseudotumor cerebri-associated intractable headache: Predictors of treatment response and an analysis of long-term outcomes. J Neurosurg 2004;101:627-32.
21. Orru E, Gursoy M, Gailloud P, Blitz AM, Carey JP, Olivi A, *et al*. Jugular vein invasion rate in surgically operated paragangliomas: A multimodality retrospective study. Clin Imaging 2014;38:815-20.
22. Power AH, Bower TC, Kasperbauer J, Link MJ, Oderich G, Cloft H, *et al*. Impact of preoperative embolization on outcomes of carotid body tumor resections. J Vasc Surg 2012;56:979-89.
23. Purvin VA, Trobe JD, Kosmorsky G. Neuro-ophthalmic features of cerebral venous obstruction. Arch Neurol 1995;52:880-5.
24. Robertson V, Poli F, Hobson B, Saratzis A, Naylor AR. A systematic review and meta-analysis of the presentation and surgical management of patients with carotid body tumours. Eur J Vasc Endovasc Surg 2019;57:477-86.
25. Sajid MS, Hamilton G, Baker DM. A multicenter review of carotid body tumour management. Eur J Vasc Endovasc Surg 2007;34:127-30.
26. Satti SR, Leishangthem L, Chaudry MI. Meta-analysis of CSF diversion procedures and dural venous sinus stenting in the setting of medically refractory idiopathic intracranial hypertension. AJNR Am J Neuroradiol 2015;36:1899-904.
27. Semenov S, Abalmasov V. Semiotics of lesions of the cerebral venous collectors on application of noninvasive techniques of X-ray diagnosis. Vestn Rentgenol Radiol 2001;5:9-15.
28. Simone B, De Stefano V, Leoncini E, Zacho J, Martinelli I, Emmerich J, *et al*. Risk of venous thromboembolism associated with single and combined effects of Factor V Leiden, Prothrombin 20210A and methylenetethraydrofolate reductase C677T: A meta-analysis involving over 11, 000 cases and 21, 000 controls. Eur J Epidemiol 2013;28:621-47.
29. Spiriev T, Nakov V, Laleva L, Tzekov C. OsiriX software as a preoperative planning tool in cranial neurosurgery: A step-

by-step guide for neurosurgical residents. Surg Neurol Int 2017;8:241.
30. Wilson M, Browne JD, Martin T, Geer C. Case report: Atypical presentation of jugular foramen mass. Am J Otolaryngol 2012;33:370-4.

How to cite this article: Spiriev T, Milev M, Laleva L, Stoyanov S, Plachkov I, Staneva M, *et al*. A rare case of carotid body tumor associated with near complete cerebral sinus thrombosis and idiopathic intracranial hypertension. Management strategy and review of the literature. Surg Neurol Int 2021;12:262.