# DISCUSSION

A review of the embryology of the cranial arteries demonstrates that many channels exist between future normal adult vessels, and these usually regress during development. During the regression period of the anastomotic channels, the primitive otic is the first to disappear, followed by the hypoglossal and trigeminal artery.<sup>1</sup> Of the presegmental arteries, the otic is the least important for blood supply and also the first to disappear, thus leading to its extremely low incidence.<sup>2,3</sup> To date, only one case with persistent otic artery variant has been reported.<sup>4</sup> Although persistent arteries are usually incidental findings on angiography, several clinical entities such as cerebral aneurysm have been described in association with persistent arteries. Some investigators have suggested that structural defects in the wall of these abnormal vessels could make them more prone to cerebral aneurysm development.5 The aneurysm in this case was located apart from the otic artery, and the etiology of this combination seems coincidental. However, this is the first documented case of cerebral aneurysm associated with a persistent primitive otic artery.

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# Totally thrombosed giant P2 aneurysm: a case report and review of literature

# Uğur Türe мд, Ilhan Elmaci мд, Gazanfer Ekinci мд, M. Necmettin Pamir мд

Department of Neurosurgery and Radiology, Marmara University School of Medicine, İstanbul, Turkey

**Summary** The diagnosis and treatment of intracranial saccular giant aneurysms is still difficult despite developments in neuroradiology, neuroanesthesiology and micro-neurosurgery. These aneurysms are usually located on major intracranial arteries and are rarely on distal branches of these arteries. An extra-axial  $4 \times 5$  cm mass lesion in the left mediobasal temporal region was detected on the CT and MRI examinations of a 37 year old male patient who was admitted to our institution with headache and slight right-sided hemiparesis lasting for 2 months. The lesion was avascular on angiography. Surgery proved that the lesion was a totally thrombosed giant aneurysm of the P2 segment of posterior cerebral artery (PCA). The P2 segment was clipped proximal to the aneurysm with pterional-transsylvian approach and the aneurysm was totally excised. Giant aneurysms of the P2 segment are rare and 15 cases have been reported in the literature. This report presents a rarely seen totally thrombosed giant P2 aneurysm and discusses the difficulties in diagnosis and treatment.

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Journal of Clinical Neuroscience (2003) 10(1), 115–120 © 2002 Elsevier Science Ltd. All rights reserved. DOI:10.1016/S0967-5868(02)00276-X

Keywords: thrombosed aneurysm, giant, posterior cerebral artery, P2

Received 24 October 2001 Accepted 19 February 2002

*Correspondence to:* Uğur Türe MD, Associate Professor of Neurosurgery, Marmara University School of Medicine, Mihrabad cad. Yazici Tasocagi Yolu, No. 16, Ruzgarlibahce Sitesi, D-1 Blok, Daire: 6, Kavacik, Beykoz, 81610, İstanbul, Turkey. Tel.: +90-216-425-4371; E-mail: ugurture@turk.net

### INTRODUCTION

Aneurysms with the largest diameter of 25 mm or more are termed as "giant aneurysm" and comprise 3–13% of all intracranial aneurysms.<sup>1–12</sup> The giant aneurysms are generally located on major arteries and are very rare on the distal branches of these arteries.<sup>10,13–15</sup> Aneurysms of the PCA account for 1.4% of all intracranial aneurysms.<sup>15</sup> They can be located on P1, P1–P2 junction, P2, and P3 segments. P2 segment is the part that is distal to the junction of PCA with the posterior communicating artery, and is localised in the ambient cistern with proximity to the optic tract and pulvinar.<sup>15</sup> Giant aneurysms of P2 segment are rare and 15 cases have been previously reported.<sup>3,9,15–18</sup>

Although giant aneurysms cause symptoms due to their mass effect, 14-35% of cases presents with subarachnoid haemorrhage (SAH).<sup>15,19</sup> They are thrombosed in 40% of cases.<sup>13</sup> The incidence of SAH increases if the aneurysm is not thrombosed, and the neurological findings are grave.<sup>8,9</sup> The recent developments in CT and MRI have provided high-resolution images and helped the differentiation of these aneurysms from other mass lesions.<sup>20-24</sup> Selective DSA plays an important role in the diagnosis of these aneurysms. With the improvements in microsurgical techniques, it has become possible to successfully clip these aneurysms or excise them after various anastomosis techniques. 1-3,5,8,9,13-15,17,18,25,26 The embolisations of giant aneurysms are being performed with the help of developments in interventional neuroradiology.<sup>17,25</sup> The developments in neuroanesthesiology, pharmacological brain sparing, hypothermia, and cardiac arrest techniques too, have made great contributions to surgery, causing the morbidity and mortality rates to decrease.<sup>2,5,27</sup> However, all these developments in various medical disciplines, giant aneurysm surgery is still one of the most challenging procedures in neurosurgery practice.

# **CASE REPORT**

A thirty-seven year old male patient was admitted with headache and ongoing symptoms of mild weakness on the right side of his body for 2 months. His neurological examination revealed mild hemiparesis on the right side. Cranial CT examination was obtained and a slightly hyperdense mass lesion with well-defined margins that measured  $4 \times 5$  cm was detected in the left mediobasal region. CT scan showed the lesion to have a calcified regular rim and amorphous calcific content. The rim enhanced faintly following i.v. contrast (Fig. 1A). The MRI demonstrated a  $4 \times 5$ cm extra-axial mass lesion in the left mediobasal temporal region, extending from the supraclinoid internal carotid artery along the PCA. This oval shaped lesion displayed a hypointense rim with

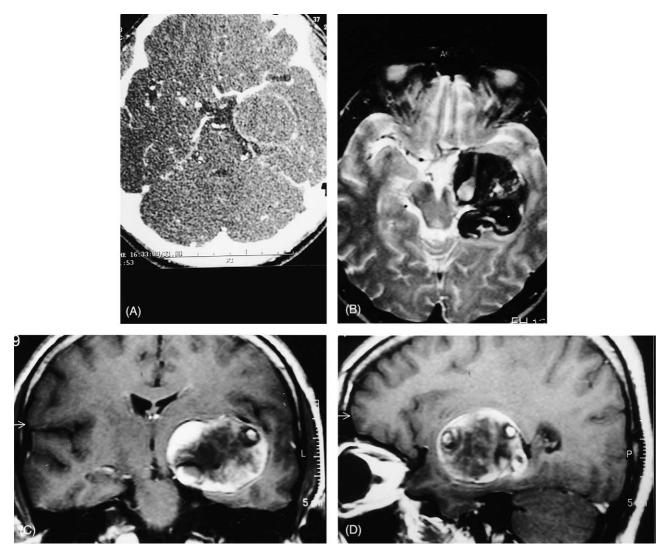


Fig. 1 (A) Enhanced CT scan shows the mass extends from the supraclinoid internal carotid artery along the PCA in the left mediobasal temporal region. A faint capsular opacity is evident. An axial T2 weighted (B), a coronal T1 weighted (C), and a sagittal T1 weighted (D) MR images demonstrate an extra-axial mass in the left mediobasal temporal region with thin hypointense rim and hyperintense–hypointense content.

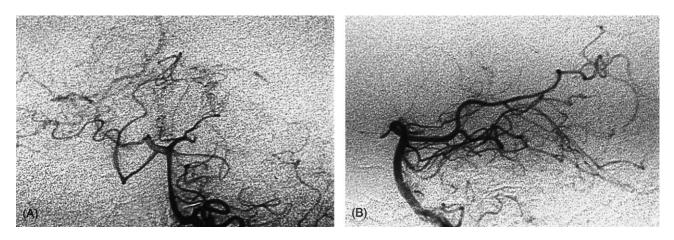


Fig. 2 On anteroposterior (A) and lateral (B) vertebral angiography, left P1 and proximal P2 are shifted, elongated and tenuous with no contrast material in P3 segment.

hypointense-hyperintense central structures in both T1 and T2 weighted images. The hypo and hyperintense signals were considered to present calcification and blood products (Fig. 1B–D). DSA of left internal carotid artery and vertebral artery displayed the posterior communicating artery, P1, and proximal P2 to be

elongated, shifted and P3 showed no contrast filling (Fig. 2). Radiological examinations failed to demonstrate an aneurysm directly. CT findings of a mass with peripheral mild enhancement and calcific rim content, calcification around P2 segment and the viscidity of the lesion to P2 and supraclinoid cerebral arteries were in favour of a totally thrombosed and calcified aneurysm. On MRI the hypointense rim and the heterogenous signal intensity on T1 and T2 weighted images supported the diagnoses of a thrombosed aneurysm. Although no blood flow could be detected in the lesion. A calcific granuloma (tbc) and less probably non-enhancing meningioma of the tentorial edge were considered in the differential diagnosis.

Left pterional approach was performed under endotracheal general anaesthesia. Sylvian fissure was opened wide with microdissection technique to expose left M2 and M1 segments of the middle cerebral artery, left internal carotid artery, left A1 segment of the anterior cerebral artery, and both optic nerves. Left anterior choroidal artery, posterior communicating artery, and oculomotor nerve were also seen. Posterior communicating artery was followed to reach the P1-P2 junction. The lesion was reached following the P2, and it was found to be hard in substance with a smooth contour. The first impression was that the lesion was a thrombosed aneurysm. The wall of the aneurysm was detected and the thrombus was subtotally dissected with the help of an ultrasonic aspirator and use of forceps. The wall of the aneurysm was separated from PCA, parahippocampal gyrus, cerebral peduncle, and the basal vein. The lesion was a saccular aneurysm with a broad base on the P2 and P2 was thrombosed distal to the aneurysm. Proximal P2 was clipped and the aneurysm was excised. After bleeding from the distal part of the P2 was ruled out, coagulation was performed. Postoperative period was uneventful. Pathology report confirmed the diagnosis of thrombosed giant aneurysm. Postoperative CT and MRI examinations showed that the lesion was totally excised (Fig. 3). The mild right-sided hemiparesis was still present in the late post-operative period.

# DISCUSSION

Giant intracranial saccular aneurysms usually present with clinical symptoms associated with their mass effect at their localisations.<sup>2,3,9,15</sup> SAH is less frequent with the giant aneurysms of the posterior circulation.<sup>3,15</sup> The aneurysms of the posterior circulation develop mass effects faster secondary to their close proximity to the brain stem and the cranial nerves. Clinical findings secondary to obstructive hydrocephalus can also be observed. It has been reported that platelet aggregation can take place in giant aneurysms, and either the degradation products or the thrombi can cause embolism to the distal segments of the artery to cause symptoms secondary to ischaemia.<sup>10,19</sup>

DSA examination is the most valuable neuroradiological technique in the diagnosis and surgical planning of giant aneurysms. The detailed anatomy of the neck and the orientation of the

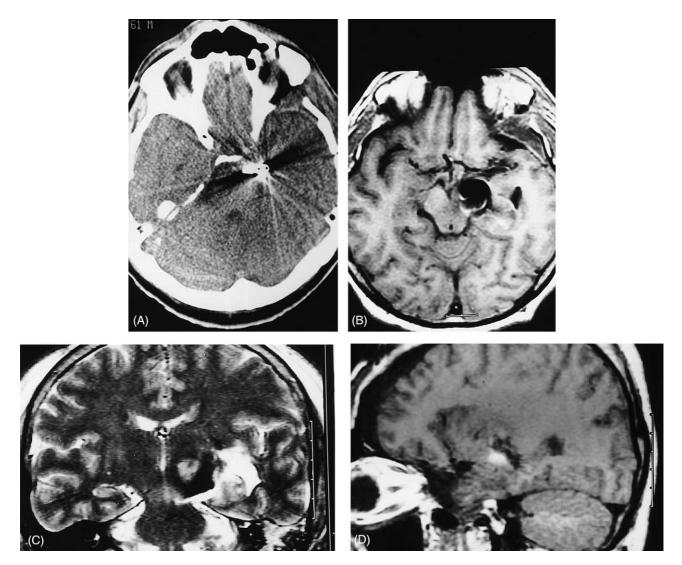


Fig. 3 Postoperative CT scan (A) and axial T1 weighted (B), coronal T2 weighted (C), and sagittal T1 weighted (D) MR images demonstrates the total excision of the giant P2 aneurysm and clip artifact.

aneurysm can be demonstrated in several planes. DSA also demonstrates the details of the collateral circulation. On CT images, giant aneurysms are seen as mass lesions with well-defined margins. There can be "ring enhancement" in the wall of the aneurysm, non-enhancing mural thrombus, and central enhancement secondary to residual blood flow.<sup>2,20,23</sup> The relationship of the parent artery with the aneurysm can be better demonstrated with high-resolution thin section CT. The visualisation of the thrombus is important since it is often difficult to clip the aneurysm before dissecting the thrombus. It is also important that the presence of the thrombus warns the surgeon that the manipulation of the aneurysm can cause distal embolism. The calcification of the aneurysm wall is the most important factor in unsuccessful clipping of the aneurysm and it can be best demonstrated with thin section CT.14 Thin section CT and three-dimensional reconstructions can show the anatomical relationship of the aneurysm with the bony structure of the skull base. This information is very important for the surgeon using a drill. CT is also important in demonstrating the changes in the size of the thrombus of the aneurysms that "trapping" was performed. MRI is important to differentiate the aneurysms from tumoural lesions. MRI demonstrates the blood flow inside the aneurysm as well as the "age" of blood elements. Deoxyhemoglobin, methaemoglobin, and hemosiderin causes low signal intensity on T2 weighted images. Free and binded methaemoglobin causes high signal intensity on T1 weighted images. Fresh blood is hyperintense on T1 and T2 weighted images.<sup>16,21,24</sup> MRI can also be helpful in demonstrating the relationship of the aneurysm with the vessels and brain parenchyma. The recent developments in MR angiography have somewhat reduced the need for DSA. Although there are many developments in neuroradiology, it can still be difficult to differentiate giant P2 aneurysms from tentorial meningiomas. Good et al.,<sup>16</sup> have reported a case of giant P2 aneurysm with a "dural tail" on MRI that received a prediagnosis of a meningioma. In our case, the aneurysm was totally thrombosed so the differential diagnosis included meningioma, and the definite diagnosis was reached in surgery.

The most suitable treatment for a giant aneurysm can be selected by carefully examining all the information collected from CT, MRI, and DSA examinations. The treatment includes direct clipping, proximal occlusion, trapping, anastomosis surgery, and embolisation.<sup>1–3,5,9,14,15,17,18,25,27–29</sup> Treatment strategy is closely related to the location of the aneurysm, collateral blood flow, and patient age. The aim of treatment is the prevention of rupture, removal of the mass effect, and continuation of normal cerebral blood flow without damaging the brain parenchyma and the cranial nerves. The proximal occlusion of the parent artery reduces the chance of rupture by decreasing the pressure of the blood reaching the aneurysm. Extracranial-intracranial anastomosis surgery can be performed using superficial temporal artery, radial artery, and the saphenous vein to prevent the ischaemic complications that can be caused by proximal occlusion.<sup>6,9,15,18,27</sup> There is usually a broad base in giant aneurysms and this fact makes direct clipping tough to perform. In this situation, proximal ligation or trapping is advised with or without anastomosis surgery to prevent further disruption of nearby brain parenchyma, cranial nerves and vascular structures.<sup>6</sup> Giant aneurysms however, usually do not collapse with trapping alone. The blood inside the aneurysm should be evacuated by direct aspiration. In case of thrombosed aneurysm, this procedure may not be sufficient to clip the neck of the aneurysm. The clip usually slips from the neck of the aneurysm, narrowing the parent artery. For this reason, excision of the thrombus is recommended.<sup>6,9,15</sup> It requires great care during this procedure not to cause the thrombus to enter the systemic circulation. One of the most important complications in giant aneurysm surgery is cerebral ischaemia due to the occlusion of perforating arteries. The disruptions of venous circulation and cranial nerve deficits are also reported.<sup>2</sup>

Giant P2 aneurysms are rare and they are not included in many large series.<sup>1,4,6,7,10,11</sup> Fifteen cases have been reported so far in the literature.<sup>3,9,15–18</sup> These aneurysms are located in the crural and ambient cisterns, in close proximity with the choroidal fissure, and surrounded by the parahippocampal gyrus. The relationship of the aneurysm with the fourth cranial nerve should be carefully examined.

Subtemporal approach is the most frequently used technique for P2 aneurysms.<sup>2,3,9,14,15,26,28,30</sup> The main disadvantage of this technique is the risk of injury to the vein of Labbé and the basal temporal veins due to the need for major temporal lobe retraction.<sup>2</sup> Injury to these veins may cause postoperative oedema or even infarction in the temporal lobe. Sindou and Fobe<sup>29</sup> reported that drilling the ceiling of the external auditory canal decreases the need for temporal lobe retraction. Seoane et al.,<sup>18</sup> in a series of 8 cases with P1 and P2 aneurysms, have reported that they have used pterional or pretemporal approaches for surgery. In our case, we have used pterional approach with the consideration that the use of subtemporal approach would cause too much retraction and therefore injury to the temporal lobe. With this technique, the aneurysm was totally excised without major brain retraction using the space provided by separating the sylvian fissure and the space created by the aneurysm itself. We think that the pterional approach should be preferred to the subtemporal alternative for anterior portion of P2 aneurysms.

Drake has reported 7 of 15 giant P2 aneurysms found in the literature.<sup>3</sup> Drake has stated that due to the location of P2 aneurysms, the growth is tolerated better and no neurological symptoms are detected for a long time. He also stated that the closure of P2 distal to the inferior temporal branches is well tolerated by the patient. Peerless et al.,<sup>26</sup> in a series of 27 cases that P1 and P2 occlusions were performed, have reported only 2 cases with infarction in the occipital lobe. The rich collateral system of the PCA has been documented in various anatomical and clinical studies.<sup>3,14,15,26,31,32</sup> Anterior choroidal artery has anastomoses with medial and lateral posterior choroidal arteries. The medial posterior choroidal arteries on either side have anastomoses on the roof of the third ventricle. The cortical branches of the anterior and middle cerebral arteries have anastomoses with the cortical branches of PCA. The posterior pericallosal artery has a strong anastomosis with the pericallosal artery in the splenium region.<sup>31</sup> Because of all these anastomoses, trapping of the P2 segment is well tolerated by the patients.

Subtemporal approach is used in 11 of 15 cases with giant P2 aneurysms in the literature (see Table 1).<sup>3,9,15–18,33</sup> Drake placed clips at the aneurysm neck in 5 cases, but angiography showed that 2 of them had no flow in P2 after the operation.<sup>3</sup> Ligation of the aneurysm neck was performed in 1 case to prevent PCA occlusion and postoperative angiography demonstrated normal flow in PCA.9 Trapping and excision were performed in 3 cases, but 1 patient could not tolerate the procedure.<sup>3,15</sup> The aneurysm was excised with the closure of P2 in 1 case and the distal part of the aneurysm was anastomosed to the superior cerebral artery.<sup>9</sup> The aneurysm was excised and end-to-end anastomosis was performed on P2 in 1 case, but the patient died 3 months after the operation.<sup>18</sup> In 1 case, a balloon was placed in P2 after unsuccessful surgery.<sup>17</sup> Surgery was not performed in 1 case, and 1 case had no information on whether surgery was performed or not.<sup>30</sup> Among the 12 cases reported to be operated, 1 patient died and 1 patient was disabled after the operation.<sup>15,18</sup> Our case is the 16th giant P2 aneurysm to be reported and has the greatest diameter. It is also

٩ N	Authors, year	Age, sex	Localisation, size	Sign and symptoms	Diagnosis	Treatment approach	Thrombus	Result
-	Drake 1979 (7 cases)			4, SAH 2, headache 1, facial pain	Angiography	Subtemporal 5 clip	Partially thrombosed	Good and moderate 1
ωd	Yasargil, 1984 Scott of al 1088	35, M	Left P2, 6 cm multilob	SAH, right hemiparesis, hemianopsia	CT, angiography	<ul> <li>Subtemporal, trapping, excision</li> </ul>	Partially thrombosed	visual rielu delicit Poor
10	Sundt 1990	48, F	Right P2	Headache		Subtemporal, trapping, excision,	I	Good
1	Sundt 1990	13, M	Left P2, 3 cm	Headache	CT, angiography	Subtemporal, ligation of neck	Partially thrombosed	Good
12	Hodes et al., 1991	49, M	Right P2	SAH, hemiparesis, hemianopsia, memory deficit	CT, angiography	or aneurysm Unsuccessful surgery, proximal P2 halloon occlusion	Calcified, thrombosed	Mild memory deficit
1 13 13	Sakata et al., 1993 Seoane et al., 1997				MRI, DSA	Subtemporal excision,		Dead
15 16	Good et al., 1997 Türe et al., 2001	37, M	Right P2 Left P2, 5 cm	Headache, mild hemiparesis	MRI, DSA CT, MRI, DSA	anasiomosis with FZ and F3 No surgery Excision	Totally thrombosed	Mild hemiparesis

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Table 1 Giant P2 aneurysms in the literature

remarkable by being totally thrombosed and being excised by pterional-transsylvian approach.

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# Solitary tuberculoma of the cerebellopontine angle: a rare presentation

# Satish Sathyanarayana<sup>1</sup> мо мсн, Mustafa K. Baskaya<sup>1</sup> мо, Marjorie Fowler<sup>2</sup> мо, Richard Roberts<sup>1</sup> мо, Anil Nanda<sup>1</sup> мо ғасs

<sup>1</sup>Department of Neurosurgery, Louisiana State University Health Sciences Center, Shreveport, LA 71130-3932, USA, <sup>2</sup>Department of Pathology, Louisiana State University Health Sciences Center, Shreveport, LA 71130-3932, USA

**Summary** Central nervous system tuberculoma presenting as a solitary mass in an extrinsic location is rare. Due to the increase in incidence of tuberculosis in the western world, there is a corresponding increase in CNS tuberculosis. Cerebellopontine angle tumours are most commonly acoustic schwannomas or meningiomas. Radiosurgery as a primary modality of treatment for many CNS masses without prior pathological diagnosis is increasing in popularity. This report shows that a mass in the CP angle can closely mimic a tumour radiologically and inappropriate radiation treatment was avoided after surgery. Histopathological examination proved it to be a tuberculoma. Awareness of this rare presentation of a solitary tuberculoma in the CP angle is emphasised.

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Journal of Clinical Neuroscience (2003) **10**(1), 120–122 © 2002 Elsevier Science Ltd. All rights reserved. DOI:10.1016/S0967-5868(02)00269-2

**Keywords:** CNS tuberculosis, solitary tuberculoma, cerebellopontine angle, CP angle

Received 30 October 2001 Accepted 14 February 2002

*Correspondence to:* Anil Nanda MD, FACS, Professor and Chairman, Department of Neurosurgery, Louisiana State University Health Sciences Center, 1501 Kings Highway, P.O. Box 33932, Shreveport, LA 71130-3932, USA. Tel.: 1-318-675-7352; Fax: 1-318-675-4615; E-mail: ananda@lsuhsc.edu

# INTRODUCTION

Tuberculomas have been increasingly encountered in the western world.<sup>1</sup> They commonly occur as solitary or multiple intrinsic brain masses, and only rarely in extrinsic sites where they can closely mimic a neoplasm.<sup>2</sup> This patient had an isolated mass in the cerebellopontine angle (CP angle) without evidence of involvement of other areas of the central nervous system. Diagnosis was established after surgery, and antitubercular therapy was instituted.

# **CASE REPORT**

A 47-year-old male was admitted to the hospital with a 2-week history of unstable gait, slurred speech and occipital headache. His past medical history was significant for diabetes, which was diagnosed 2 months previously and was being treated with an oral antidiabetic drug (Glucotrol 100 mg/day). Neurological examination revealed an alert individual with no gross dysfunction of higher mental function or language. He had no papilloedema, but did have bilateral horizontal nystagmus, bilateral terminal gaze restriction and a lower motor neuron type of facial palsy on the right. Other cranial nerve functions including hearing were normal. He had gait and appendicular ataxia, as evidenced by poor finger-to-nose and heel-to-shin tests, which was worse on the right side. Examination revealed mild grip weakness on the left side with increased deep tendon reflexes, as well as an extensor plantar reflex, also on the left side.

Computerised tomographic (CT) scan of the brain showed a 3-cm mass in the right cerebellopontine angle with an irregular ring-like enhancement and compression of the brainstem. Magnetic resonance imaging (MRI) of the brain confirmed the extrinsic location of the mass in the CP angle (Figs. 1A and B). The preliminary differential diagnosis was a solitary metastasis with central necrosis or an inflammatory lesion. The patient also underwent positron emission tomographic (PET) scanning of the brain, which yielded the same differential diagnosis.

Blood chemistry panels were normal with the exception of slightly elevated levels of glucose (126 mg/dl) and BUN (24 mg/dl). Blood count revealed an elevated white blood cell count of 12.2 K/UL and a decreased red blood cell count of 4.46 M/mm<sup>3</sup>, but was otherwise normal. Differential WBC count showed elevated neutrophils at 83.3% and a decreased lymphocyte count at 12.6%. Sedimentation rate was elevated at 34 mm/h. CD4 counts were within normal range. The patient had negative human immunodeficiency virus (HIV) 1 and 2 tests, a negative toxoplasma panel, and a negative hepatitis serology panel.

The patient underwent a retromastoid suboccipital craniotomy and microsurgical exploration of the CP angle. A 5-cm lateral suboccipital bone flap was raised, the dura was opened, and the cerebellum was gently retracted, revealing an encapsulated whitish mass. The capsule was opened, exposing a yellowish-white caseation-like material. The capsule was biopsied and the material sent for histopathological examination and cultures. The frozen section pathological examination revealed necrosis and chronic inflammatory cells. A partial excision of the mass was done to ensure adequate brainstem decompression. The patient tolerated the procedure well. Final histopathological examination was suggestive of tuberculoma (Figs. 1A and B). There were numerous confluent caseating granulomas with scattered giant cells. The culture of the specimen grew Mycobacterium tuberculosis complex sensitive to routine primary antitubercular agents. Postoperative CT scan of the brain (Fig. 1C) confirmed the extent of excision of the mass. A few days later he developed a deteriorating level of sensorium due to hydrocephalus. A ventriculoperitoneal shunt was placed, and he was discharged to a rehabilitation facility on an antitubercular regimen.

# DISCUSSION

Although intracranial tuberculomas are rare in the western world, they are increasingly being encountered due to multiple factors such as immunocompromised status, HIV infection and the growing immigration rate from countries with higher incidences.<sup>3</sup> While CNS tuberculosis accounts for 0.53% of all systemic tuberculosis in the United States, tubercular meningitis is the most common manifestation, comprising 15–30% of all CNS tubercu-