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Case Report

Calcifying pseudoneoplasm of the neuraxis: A rare case involving the oculomotor nerve

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ABSTRACT

Background: Calcifying pseudoneoplasm of the neuraxis (CAPNON) is a rare entity which can occur at intracranial and spinal locations. Clinical presentation is due to local mass effect rather than tissue infiltration. Lesions causing significant symptoms or are showing radiological progression require surgical resection. Maximal surgical resection is considered curative for this non-neoplastic entity with only two cases of recurrence reported in the literature. Cranial nerve involvement is extremely rare and the presenting neurological deficit is unlikely to improve even with surgical intervention.

Case Description: We describe a case of CAPNON at the right posterior clinoid process with involvement of the right oculomotor nerve in a 38-year-old male. Computed tomography demonstrated an amorphous mass which had intermediate to low T1 and T2 signal on magnetic resonance imaging. The oculomotor nerve was compressed with sign of atrophy. The patient underwent maximal surgical debulking for progressive symptoms of worsening pain and ophthalmoplegia. Postoperatively, the patient's symptoms were stable but did not improve.

Conclusion: Preoperative diagnosis of CAPNON is difficult due to its rarity and nonspecific clinical and radiological findings. Surgical resection is considered in cases with worsening symptoms, progression on serial imaging, or uncertain diagnosis. Relatively inaccessible lesions with little or no clinical symptoms can be observed.

Keywords: Calcified pseudotumor, Calcifying pseudoneoplasm of the neuraxis, Cranial nerve palsy, Skull base tumor

INTRODUCTION

Calcifying pseudoneoplasm of the neuraxis (CAPNON) is a rare and poorly understood entity occurring at intracranial and spinal locations along the neuraxis. It was first described by Rhodes and Davis in 1978 as an unusual fibroosseous component of an atypical bony metaplasia.[17] Since then, approximately 110 cases have been reported,[9] two-third of which are intracranial. Common presenting symptoms include seizure, headache, as well as focal motor and sensory impairment.[13] Many cases remain asymptomatic, with diagnoses reported on autopsy.[17] Even though CAPNON is a non-neoplastic entity, surgical resection or open biopsy is often needed for diagnosis or to relieve mass effect.[18] The etiology of CAPNON remains unclear, though it has been proposed that it may develop as a reactive process to a number of inciting factors.[2,16]

We report a case of CAPNON occurring at the skull base with involvement of the oculomotor nerve.

PRESENTATION

A 38-year-old male presented with a 4-year history of progressive visual disturbance and severe right-sided retro-orbital pain. He described difficulty focusing on objects, blurry vision, and photophobia. On initial physical examination, the patient had an incomplete right 3rd nerve palsy, with ptosis, dysconjugate eye movements, diplopia on upward gaze, and a dilated, eccentric right pupil with no papilledema. The rest of his neurological examination was normal. Over the following 10 months, the patient reported worsening of his retro-orbital pain and deterioration of his right eye vision. There was a significant limitation in adduction of his right eye on subsequent examination. Due to the progressive nature of the patient's symptoms, the decision to undergo operative management was made after discussion with the patient.

INVESTIGATIONS

Computed tomography (CT) scan demonstrated an amorphous calcified mass arising from the enlarged right posterior clinoid process, projecting into the anterior aspect of right quadrigeminal cistern [Figure 1]. Magnetic resonance imaging (MRI) confirmed focal enlargement of the right posterior clinoid process, with minimal peripheral enhancement [Figure 1]. The lesion showed intermediate to low T1 and T2 signal and low signal on susceptibility weighted imaging [Figure 2]. The oculomotor nerve was visualized adjacent to the right posterior clinoid process and appeared thickened immediately posterior to this lesion. The diameter of the intracavernous segment was reduced, consistent with atrophy. The lesion was not fludeoxyglucose (FDG) avid on positron emission tomography (PET) scan. Based on the preoperative radiological appearance, a differential diagnosis of enchondroma, fibrous dysplasia, or a low-grade chondroid malignancy was entertained.

OPERATIVE MANAGEMENT

A standard pterional craniotomy was undertaken, with the subfrontal corridor used to access the lesion. A 5 mm lesion was identified at the posterior clinoid process and interclinoid ligament. It was rock hard, granular, and calcified and it engulfed the origin of the posterior communicating artery. The third cranial nerve ran anterolaterally from the interpeduncular cistern to be closely adherent to the mass at the roof of the cavernous sinus. The surrounding dura was erythematous and thickened. Complete resection of the lesion was not possible due to vascular encasement. Multiple biopsies were taken from the base of the calcified mass and surrounding dura without disturbing the encased posterior communicating artery. The patient made an uneventful recovery and was discharged on day 3. At 6-week follow-up, the patient reported improvement of his retro-orbital pain, however, his preoperative incomplete right oculomotor nerve palsy was unchanged.

HISTOPATHOLOGICAL ANALYSIS

Microscopically, the lesion showed typical features of CAPNON with irregular, heavily calcified chondromyxoid nodules rimmed by palisading epithelial membrane antigen (EMA)-positive, S100-negative spindled and epithelioid cells with occasional small multinucleated giant cells, surrounded by congested fibrovascular tissue containing patchy chronic inflammation with numerous CD163-positive macrophages [Figures 3 and 4]. The calcified matrix had a characteristic filigree or striated appearance, a pattern sometimes likened to chicken footprints.

DISCUSSION

CAPNON is a rare, non-neoplastic condition which can affect any parts of the neuraxis. It can occur in intra-axial or extra-axial locations and is commonly seen at the skull base adjacent to the dura or arachnoid mater.[13] Two-thirds of reported cases are intracranial and the remainder are in

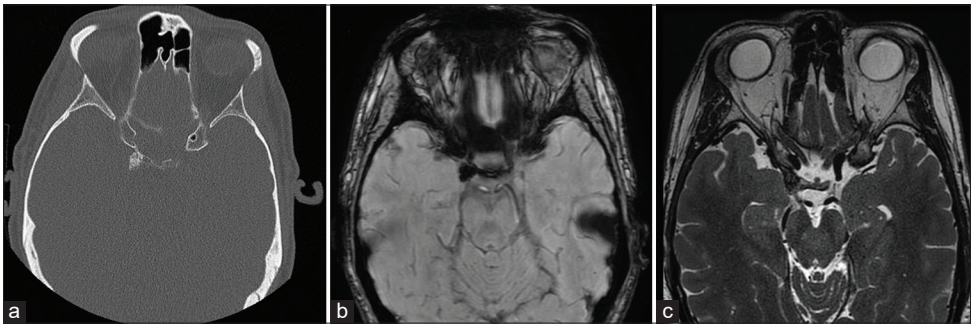

Figure 1: (a): Computed tomography (bone window, axial view) showing amorphous calcification of the right posterior clinoid process, (b): magnetic resonance imaging (MRI) susceptibility weighted imaging showing low signal within the lesion, (c): MRI T2-weighted image (axial view) showing low intensity of the lesion with oculomotor nerve entering posteriorly.

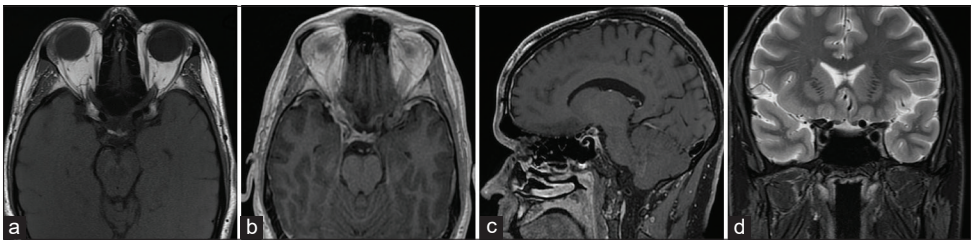

Figure 2: (a): Magnetic resonance imaging (MRI) noncontrast T1-weighted image (axial view) demonstrating heterogeneous intermediate to low intensity, (b): MRI postcontrast T1-weighted image (axial view) demonstrating minimal enhancement, (c): MRI postcontrast T1-weighted image (sagittal view) demonstrating minimal contrast enhancement, (d): MRI T2-weighted image (coronal view) showing low signal intensity and its relationship with the oculomotor nerve.

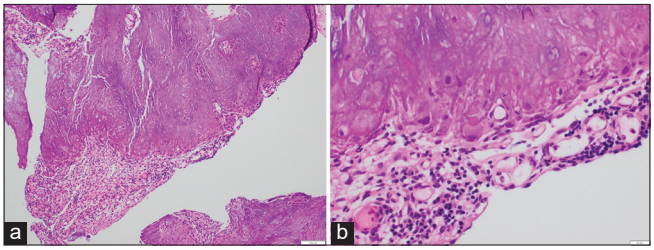

Figure 3: (a): Hematoxylin and eosin (H&E) stain showing characteristic calcified chondromyxoid nodules with surrounding fibrovascular tissue and chronic inflammation, (b): H&E staining in higher power showing edge of calcified nodule with epithelioid cells and patchy chronic inflammation.

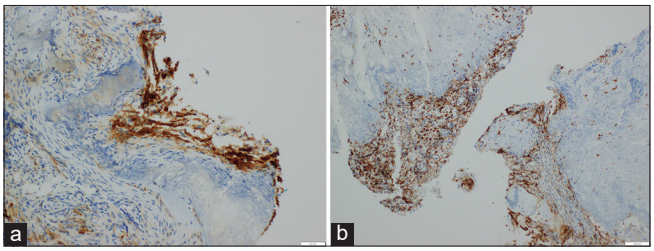

Figure 4: (a): Epithelial membrane antigen (EMA) immunostain showing peripheral EMA-positive meningothelial cells, (b): CD163 immunostain showing prominent macrophage infiltration in the surrounding fibrovascular tissue.

the spine or at the craniovertebral junction. About 34% of intracranial CAPNON are reported in the posterior fossa.[10] In the spine, the cervical region is most commonly affected (50%) followed by the lumbar (30%) and thoracic (20%) regions.[13] Nonaka noted that almost 90% of spinal CAPNON were extradural near the intervertebral disc, whereas 98% of cranial CAPNON were intradural.[13] CAPNON has been reported in patients from 6 to 83 years of age with no gender predilection.[13] In intracranial cases, the most common initial presentation is seizure (37%) followed by headache (30%) and focal neurological symptoms (10%).[11] Montibeller *et al.* reported a rare case of CAPNON adjacent to the inferior colliculus causing obstructive hydrocephalus.[12] There are approximately 110 cases in the literature.[9] Excluding the current case, only 11 cases with cranial nerve involvement have been reported[1,2,5,6] and only 1 with oculomotor involvement.[6] Symptoms result from local mass effect rather than tissue infiltration. In spinal CAPNON, patients can present with neck and/or back pain (85%) or with gait and/or sensory disturbances.[14] In many cases, these lesions are asymptomatic and are diagnosed incidentally on radiographs (X-rays, CT, and MRI) obtained for other purposes or at autopsy (approximately 20% of cases).[13]

Radiological findings are nonspecific and reflect the heavy calcification in these lesions. On CT, CAPNON presents as a well-demarcated, centrally calcified lesion resembling other hyperdense lesions such as cavernous malformation, meningioma, and certain malignancies. It is hypointense on T1- and T2-weighted images on MRI.[1,20] However, one case of CAPNON with T1 isointensity and another with T2 hyperintensity have been reported.[19] The degree of contrast enhancement can be quite variable, and perilesional edema is usually absent.[11] C-methionine PET uptake has been described in two cases and is thought to reflect the inflammation associated with CAPNON.[7,9] As in our case, Higa *et al.* also reported no FDG-PET uptake in CAPNON,[7] possibly reflecting low glucose uptake and metabolism within the lesion, low cellularity, or the size of the lesion.

Histologically, CAPNON is a fibroosseous lesion containing varying amounts of amorphous calcification and ossification in a chondromyxoid matrix, often bordered by palisaded mono- or multinucleated spindled to epithelioid cells.[14,15] Lesions may also contain fibrous stroma, multinucleated foreign body-type giant cells, lamellar bone, and psammoma bodies although no one feature is pathognomonic.[6] The spindled cells are immunoreactive for vimentin and some are also EMA positive. They are negative for S-100 and glial fibrillary acidic protein.[1,8,10] Macrophage markers, including CD68, IBA1, and CD 163, are useful to investigate the inflammatory component of CAPNON.[9] In our case, CD163-positive macrophages are found in the surrounding fibrovascular tissue, reflecting the presence of chronic inflammation.

Due to the nonspecific clinical and radiological features of CAPNON, the initial differential diagnosis is broad, including neoplasms with calcification (e.g., meningioma, oligodendroglioma, astrocytoma, or metastasis)[4,18] and other non-neoplastic lesions including cerebral calculi, fibrous dysplasia, hematoma with focal mineralization, and calcified aneurysms or arteriovenous malformations. Treatment of CAPNON is based on location and clinical presentation. Relatively inaccessible lesions with little or no clinical symptoms can be observed. Lesions causing significant symptoms or those showing growth on serial imaging warrant surgical intervention for mass effect. Another indication for surgical intervention is to establish diagnosis, which is difficult in many cases due to the rarity of the lesion and the variable and somewhat nonspecific radiological appearance. Stereotactic biopsy may be difficult sue to the dense calcification[11] and total resection can be challenging if adjacent neurological or vascular structures are involved, as in our case. While there is no standard treatment for CAPNON, maximal safe debulking alone is considered curative[12] with 95% of patients remaining disease free after maximal resection. Only two cases of recurrence have been reported.[3] The degree of recovery with cranial nerve involvement is unclear and will be influenced by the duration of symptoms, any potential atrophy of the nerve fibers, and intraoperative injury during resection. In a recent review in 2019, Yang *et al*. identified 25 skull base CAPNON in the literature, 11 (45.8%) of which presented with cranial neuropathy.[21] Of the six patients with reported postoperative outcomes, only one experienced resolution of facial pain after gross total resection of a Meckel's cave CAPNON.[5] In the remaining five, neurological deficits (hypoglossal palsy, hearing loss, and dysphagia) and neuropathic pain were stable. Among these six cases, one recurred after subtotal resection of an extensive lesion involving multiple bones of the skull base, the posterior wall of the nasopharynx the left cerebellopontine angle, and the left jugular foramen.[2]

Oculomotor nerve involvement was reported in one other case of CAPNON involving the free edge of tentorium.[6] This patient presented with headache, diplopia and had a partial left oculomotor nerve palsy on examination. On MRI, the lesion was located between the P1 segment of the left posterior cerebral and the left superior cerebellar arteries, adjacent to the proximal part of left oculomotor nerve. Unlike our case, complete resection of this lesion was possible as the lesion arose from the tentorium and was not adherent to the brainstem or blood vessels. However, postoperative neurological status and follow-up information were not reported. Cranial neuropathy in CAPNON could be related to compression by the mass, especially around narrow neural foramina or the CAPNON associated inflammation and fibrosis.[21]

CONCLUSION

CAPNON is a rare non-neoplastic lesion which can occur at intracranial and spinal locations. Its etiology is poorly understood and its clinical presentation as well as radiological features can be nonspecific. Presenting symptoms are due to local mass effect rather than tissue infiltration. Management of CAPNON depends on its location, presenting symptoms, and progression on serial imaging. Surgery alone is considered curative with no adjuvant therapy required. Involvement of cranial nerve is uncommon. We present a rare case of CAPNON at the right posterior clinoid process involving the right oculomotor nerve.

Declaration of patient consent

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

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Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Aiken AH, Akgun H, Tihan T, Barbaro N, Glastonbury C. Calcifying pseudoneoplasms of the neuraxis: CT, MR imaging, and histologic features. AJNR Am J Neuroradiol 2009;30:1256-60.
2. Bertoni F, Unni KK, Dahlin DC, Beabout JW, Onofrio BM. Calcifying pseudoneoplasms of the neural axis. J Neurosurg 1990;72:42-8.
3. Chang H, Park JB, Kim KW. Intraosseous calcifying pseudotumor of the axis: A case report. Spine (Phila Pa 1976) 2000;25:1036-9.
4. Fletcher AM, Greenlee JJ, Chang KE, Smoker WR, Kirby PA, O'Brien EK. Endoscopic resection of calcifying pseudoneoplasm of the neuraxis (CAPNON) of the anterior skull base with sinonasal extension. J Clin Neurosci 2012;19:1048-9.
5. Garen PD, Powers JM, King JS, Perot PL Jr. Intracranial fibro-osseous lesion. Case report. J Neurosurg 1989;70:475-7.
6. Ghaemi J, Wasimi M, Siripurapu R, McKee D, Pal P, du Plessis D, *et al*. Calcifying pseudoneoplasm of the neuraxis (CaPNoN): An unusual cause of third nerve palsy in a teenager. BJR Case Rep 2016;2:20150494.
7. Higa N, Yokoo H, Hirano H, Yonezawa H, Oyoshi T, Goto Y, *et al*. Calcifying pseudoneoplasm of the neuraxis in direct continuity with a low-grade glioma: A case report and review of the literature. Neuropathology 2017;37:446-51.
8. Hodges TR, Karikari IO, Nimjee SM, Tibaleka J, Friedman AH, Cummings TJ, *et al*. Calcifying pseudoneoplasm of the cerebellopontine angle: Case report. Neurosurgery 2011;69

Suppl 1:onsE117-20.
9. Inukai M, Shibahara I, Hotta M, Miyasaka K, Sato S, Hide T, *et al*. Case of calcifying pseudoneoplasms of the neuraxis coexisting with interhemispheric lipoma and agenesis of the corpus callosum: Involvement of infiltrating macrophages. World Neurosurg 2020;134:635-40e1.
10. Kerr EE, Borys E, Bobinski M, Shahlaie K. Posterior fossa calcifying pseudoneoplasm of the central nervous system. J Neurosurg 2013;118:896-902.
11. Lyapichev K, Bregy A, Shah AH, Shah K, Desai MB, Petito C, *et al*. Occipital calcified pseudoneoplasms of the neuraxis (CAPNON): Understanding a rare pathology. BMJ Case Rep 2014;2014:bcr2014206855.
12. Montibeller GR, Stan AC, Krauss JK, Nakamura M. Calcifying pseudoneoplasm of the inferior colliculus: An unusual location for a rare tumor: Case report. Neurosurgery 2009;65:E1005-6; discussion E1006.
13. Nonaka Y, Aliabadi HR, Friedman AH, Odere FG, Fukushima T. Calcifying pseudoneoplasms of the skull base presenting with cranial neuropathies: Case report and literature review. J Neurol Surg Rep 2012;73:41-7.
14. Nussbaum ES, Hilton C, Defillo A, McDonald W, Passe T, Kallmes KM, *et al*. Extradural petromastoid calcifying pseudoneoplasm of the neuraxis (CAPNON): Case report and literature review. Clin Neurol Neurosurg 2018;166:99-106.
15. Paolini MA, Ho ML, Monahan HR, Raghunathan A. Supratentorial CAPNON associated with WHO grade II meningioma: A case report. Neuropathology 2018;38:535-8.
16. Qian J, Rubio A, Powers JM, Rosenblum MK, Pilcher WH, Shrier DA, *et al*. Fibro-osseous lesions of the central nervous system: Report of four cases and literature review. Am J Surg Pathol 1999;23:1270-5.
17. Rhodes RH, Davis RL. An unusual fibro-osseous component in intracranial lesions. Hum Pathol 1978;9:309-19.
18. Shimony N, Aizic A, Cagnano E, Margalit N, Ram Z, Constantini S, *et al*. Supratentorial calcified pseudotumour: Experience of a single institution and review of the literature. Acta Neurochir (Wien) 2014;156:1115-20.
19. Shrier DA, Melville D, Millet D, Qian J, Millet D, Nelson C, *et al*. Fibro-osseous lesions involving the brain: MRI. Neuroradiology 1999;41:18-21.
20. Stienen MN, Abdulazim A, Gautschi OP, Schneiderhan TM, Hildebrandt G, Lucke S. Calcifying pseudoneoplasms of the neuraxis (CAPNON): Clinical features and therapeutic options. Acta Neurochir (Wien) 2013;155:9-17.
21. Yang K, Reddy K, Ellenbogen Y, Wang BH, Bojanowski MW, Lu JQ. Skull base calcifying pseudoneoplasms of the neuraxis: Two case reports and a systematic review of the literature. Can J Neurol Sci 2020;47:389-97.

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