Review Article

Sporadic hemangioblastoma of cauda equina: A case report and brief literature review

ABSTRACT

Background: Hemangioblastomas (HBs) are rare lesions accounting for 1%–5% of all spinal cord tumors, and are mostly associated with Von Hippel-Lindau (VHL) syndrome. Localization in the cauda equina is uncommon.

Aim: In this manuscript, we aimed to describe a rare case of sporadic intradural extramedullary HB of the cauda equina and present a literature review.

Mathods: A systematic research was performed on PubMed, MEDLINE, and Google Scholar, using the keywords "spinal HB" and "cauda equina tumors." The previous literature is integrated by the description of the present case. A 49-year-old female presented in August 2020 to our institution with a magnetic resonance imaging (MRI) which showed an intradural mass at L1/2 level and angiography that showing a nidus of serpiginous vessels inside the lesion. Symptoms were right sciatica and paresthesia in right L5 radicular dermatome for more than 3 months. Neurological examination revealed claudicatio spinalis and hypoesthesia on right L5 dermatome and weakness of right anterior tibialis muscle. Microsurgical en bloc resection of lesion was performed with adjuvant neurophysiological intraoperative monitoring. The histological examination provided the diagnosis of HB.

Results: After surgery, symptoms and neurological impairment gradually improved. Postoperative MRI showed no residual tumor.

Conclusions: Although intradural extramedullary HB of the cauda equina without VHL syndrome is a rare pathological entity, this diagnosis must be taken in consideration when a mass affects cauda equina. Preoperative embolization is an option to minimize intraoperative bleeding. Radiosurgery seems to prevent recurrences when the tumor is not completely excised. A complete surgical removal of the lesion is usually possible and it leads to a low likelihood of recurrence.

Keywords: Cauda equina, hemangioblastoma, intraoperative monitoring, spinal tumors

INTRODUCTION

Primary tumors affecting the cauda equina are uncommon and consist mainly of ependymomas and schwannomas, less commonly neurofibromas and meningiomas, and rarely hemangioblastomas (HBs).[1]

HBs are benign and capillary-rich tumors that account for about 1%–3% of all central nervous system (CNS) tumors. They mainly occur in the posterior fossa (75% of the cases) or, rarely, along the spinal cord, representing about 1.6%–2.1% of all spinal tumors.[2] These lesions may arise in isolation ("sporadic" cases) or, most commonly, associated with Von Hippel-Lindau (VHL) syndrome syndrome.[3] VHL is

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associated with several pathological conditions, including CNS tumors (HBs, retinal angiomatosis, and endolymphatic sac tumors), renal cell carcinoma/cysts, pancreatic carcinomas/cysts, pheochromocytomas, and epididymal cystadenomas.[4,5]

Spinal HBs were much more prevalent in patients with VHL syndrome (88.2%) than with sporadic disease (20.5%).[6,7]

Sporadic HBs are often isolated cases, rarely recur following a complete surgical resection, and are associated with a more severe neurological deficits.[8]

Seventy-five percent of spinal HBs are intradural/intramedullary, usually located in the posterior half of the spinal cord, and another 10%–15% have combined intramedullary- and extramedullary-intradural components.[9] Extramedullary-intradural HBs are rarer, representing only 20% of all spinal HBs.[10] In addition, spinal intramedullary or extramedullary HBs usually occur in the cervical or thoracic spine, while in the lumbosacral region is exceptional.[11] Extramedullary-intradural HBs are often attached to the dorsal spinal cord pia, and in some cases, lesions can arise solely from nerve roots.[12] Extradural tumors been rarely described.[6]

An isolated extramedullary HB of the cauda equina VHL syndrome negative is rare; indeed, only 23 cases have been reported [Table 1]. We present an additional case and elaborate a literature review.

CASE REPORT

A 49-year-old Caucasian female was admitted to our institute in August 2020. She complained of right sciatica and paresthesia in right L5 radicular dermatome for more than 3 months, which gradually worsened and resulting in severe walking difficulties. Clinical findings also included claudicatio spinalis and hypoesthesia on right L5 dermatome and weakness of anterior tibialis muscle, recorded as 3/5 in the Medical Research Council scale. The patient had no bowel or bladder deficits. The straight leg raising test was negative. The medical history was positive for hypothyroidism, rheumatoid arthritis, and arterial hypertension.

Table 1: Data of patients with spinal hemangioblastomas

Case	Reference	Age (years)/sex	Spinal level	Origin of tumor	Preoperative symptoms	Tumor origin resected	Postoperative outcome
1	Sasaki *et al*., 1978	40/male	L3	Cauda equina	Sensory and sphincter	No	Temporary sensory disturbance
2	Wolbers *et al*., 1985	36/male	L1	Filum terminale	Motor and sensory	No	Improved
3	Rohde *et al*., 1995	38/female	L3-4	Cauda equina	Sensory only	Yes	Continued sensory changes
4	Chazono *et al*., 1999	48/female	L5	Cauda equina	Motor and sensory	Yes	Continued sensory changes
5	Tibbs *et al*., 1999	35/male	L2-3	Filum terminale	Sensory only	No	Improved
6	Baker *et al*., 2000	48/female	L5-S1	Unknown	Unknown	Unknown	Unknown
7	Farneti *et al*., 2001	57/male	L4	Filum terminale	Sensory only	Yes	Improved
8	Hermier *et al*., 2002	58/male	S1	Cauda equina	Motor, sensory, and sphincter	Yes	Improved
9	Costa *et al*., 2003	40/female	L2-3	Cauda equina	Motor and sensory	No	Temporary motor changes
10	Escott *et al*., 2004	70/male	L1	Unknown	Motor only	Yes	Improved
11	Escott *et al*., 2004	45/male	L4-5	Cauda equina	Sensory only	Yes	Improved
12	Biondi *et al*., 2005	61/male	L3	Filum terminale	Motor and sensory	Unknown	Unknown
13	Biondi *et al*., 2005	Unknown/male	Unknown	Filum terminale	Sensory only	Unknown	Unknown
14	Nadkarni *et al*., 2006	52/male	L2-3	Filum terminale	Sensory and sphincter	No	Improved
15	Ortega-Martinez *et al*., 2007	41/female	L3 and S1	Filum terminale	Sensory only	Yes	Continued sensory changes
16	Ciappetta *et al*., 2007	62/female	L2-3	Filum terminale	Sensory only	No	Improved
17	Wong *et al*., 2007	64/male	L4	Filum terminale	Sensory only	Yes	Temporary urinary incontinence
18	Sergides *et al*., 2009	75/male	L3	Filum terminale	None	Yes	None
19	Kunihiro *et al*., 2011	50/male	L3-4	Cauda equina	Sensory only	Yes	Continued sensory changes
20	Wu *et al*., 2013	53/male	L1-2	Cauda equina	Sensory only	Yes	Unknown
21	Blaty, 2016	82/male	L4	Cauda equina	Sensory only	No	Improved sensory changes; temporary urinary and bowel retention
22	Brock *et al*., 2018	28/female	L2	Cauda equine	Pain	Yes	Improved
23	Martins *et al*., 2019	28/male	L2	Filum terminale	Pain	Yes	Improved

Adapted from Blaty *et al*.[1]

MR imaging displayed an intradural well-defined spinal tumor at the L1/2 levels, measuring 2 cm in length and 1.5 cm in axial diameter. The tumor appeared isointense on T1- and T2-weighted images, with bright and homogeneous enhancing of the mass and evidence tortuous vessels after gadolinium infusion [Figure a1]. The mass, filling the entire spinal canal, spreads the nerve roots of the cauda equina peripherally, and serpiginous vessels were present within the thecal sac in the dorsal and lumbar spine [Figure a2]. There was no edema within the distal thoracic cord or conus medullaris. Differential diagnoses included schwannoma, myxopapillary ependymoma, arteriovenous malformations (AVMs), cavernous malformations, and/or other highly vascular lesions (e.g., HB). Electromyography showed subacute L5 right radiculopathy.

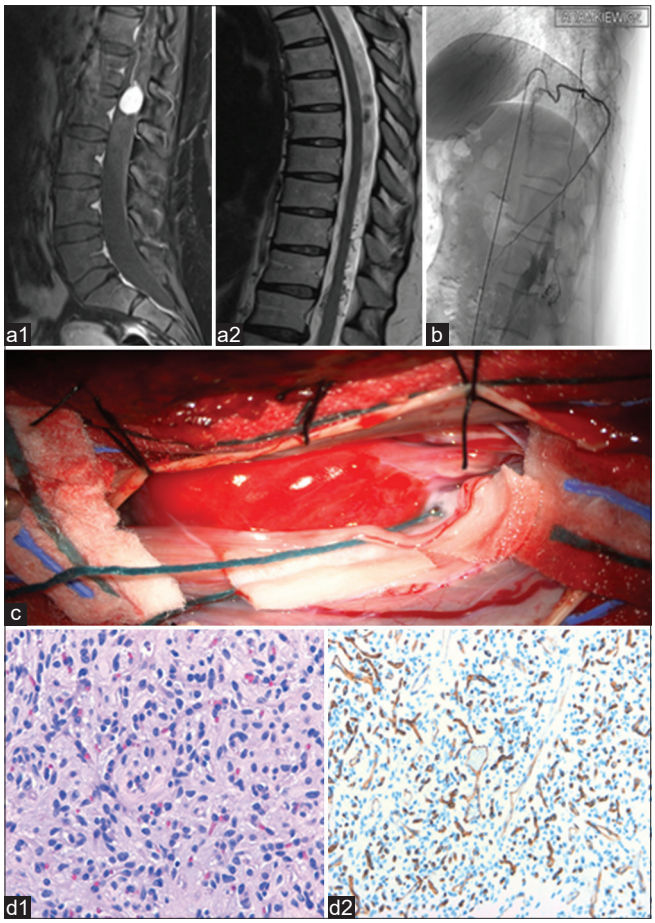

Figure 1: (a) MRI: T1-weighted sagittal lumbar image with gadolinium (a1) revealing an elliptical mass, of 2 cm x 3 cm at L1/2 levels, filling the entire spinal canal, feeded by a cranial artery, with homogeneous enhancement. Dorsal T2-weighted sagittal image (a2), demonstrating serpiginous vessels within the thecal sac. (b) spinal angiography with cannulation of right T10 revealed a lesion consistent with a vascular tumor. The major feeder was noted arising from the right T10 intercostal artery, trough anterior spinal artery. (c) Intraoperative photo showed an encapsulated tan-red mass with several nerve rootlet englobing the tumor, arising from a motor rootlet. (d) Hematoxylin and eosin stains (d1) revealed a highly vascular and cellular tumor that contained vessels of varied sizes. Endothelial cells were CD34 positive (d2)

Selective spinal angiography revealed a lesion consistent with a vascular tumor. The major feeder was noted arising from the right T10 intercostal artery, through anterior spinal artery (ASA), and venous drainage through anterior median commissural vein [Figure b].

Family history and genetic screening for VHL syndrome were negative. Brain, cervical, and thoracic magnetic resonance imaging (MRI) with and without gadolinium contrast did not reveal any lesion that may suggest VHL; an ophthalmoscopic evaluation did not reveal any ocular irregularity.

Surgery

An L1/2 laminectomy exploration with neuromonitoring was performed. Ultrasound confirmed the location of the vascular lesion. After durotomy, an encapsulated tan-red mass was evident, with several nerve rootlets englobing the tumor [Figure c]. Nerve roots were dissected away from the rootlet. Electrostimulation of the rootlet determined the contraction of anterior tibialis muscle. There was an arachnoid clear cleavage between the tumor and rootlet The artery afferent to the tumor was coagulated and cut. The mass was dissected from the root and excised en bloc.

PATHOLOGICAL EXAMINATION

The lesion was an elliptical mass with a thick capsule, and the tumor had not breached the capsule. Hematoxylin and eosin stains [Figure d1] revealed a highly vascular and cellular tumor that contained vessels of varied sizes. Foci of extramedullary hematopoiesis were noted. There was capillary proliferation and foamy epithelial stromal cells, without significant atypia or mitotic activity (Ki-67 $>1\%$), and stromal cells staining positive for actin marker of the muscle layer of vessels. Endothelial cells were CD31 and CD34 positive [Figure d2], with possible patchy immunoreactivity to stromal cells. The sample was negative for S-100, marker of neural crest, epithelial membrane antigen (EMA), and cytokeratins. On the basis of above histological findings the diagnosis was HB, WHO Grade 1.

RESULTS

The patient had resolution of radicular pain, with gradual recovery from sensory and motor dysfunctions; however, there was an initial urinary and bowel retention, which resolved within 3 days. The patient was discharged home on the 7th postoperative day without neurological deficits. Six months after surgery, he was asymptomatic and showed no neurologic deficit. Six and 12 months [Figure 2] after surgery, MRI excluded recurrence of lesion.

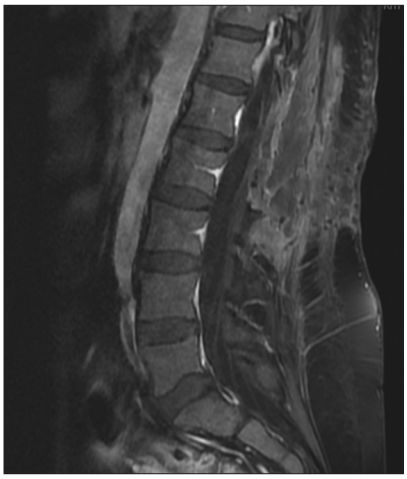

Figure 2: Post-operative MRI, T1-weighted sagittal lumbar image with gadolinium shows no recurrent or residual neoplasm

DISCUSSION

Extramedullary presentation of spinal HBs is unusual, and it is important to emphasize the findings of this lesion on MRI and the need for selective spinal angiography in the accurate preoperative diagnosis and surgical planning of a lesion with such an abnormal vasculature on the dorsum of the spinal cord.

Spinal cord tumors account for about 15% of all CNS neoplasms, and only about 10% of these are found in the cauda equina. Primary tumors of the cauda equina are rare lesions.[13,14] Most commonly, they are ependymomas and schwannomas. HBs account for 1.6%–2.1% of all spinal cord tumors.[15] Differential diagnosis included schwannoma, meningioma, ependymoma, drop metastasis, or AVM.[16,17]

However, the incidence of isolated HBs of the cauda equina is unclear. Literature review reveals 23 previously reported cases of sporadic cauda equina HB [Table 1].

Symptoms often include sensory deficits back and/or leg pain in the early stages, hyporeflexia, urinary incontinence, hypoesthesia, and extremity weakness in more advanced cases.[5] Furthermore, cauda equina syndrome had an average delay of 3.5 years from diagnosis.[18]

As shown in Table 1, in the total 23 cases of filum terminale HBs (e.g., including this case), the average age was 51 (range 28–82 years old). Notably, half of these tumors involved the cauda equina, and the other half, the filum terminale. 14 patients reported sensory impairment and five patients reported motor deficits; three patients had sphincter disorders. A total resection of the tumor was achieved in 13 patients.

In a large 10-year study of about 213 cases of HBs,[19] it was found that patients with VHL disease tend to present with neurologic symptoms at a younger age. In spinal location, multiple lesions have been reported usually in patients with VHL disease.[18] Spinal HBs are more often (50% versus 36.6%) related to VHL disease than the infratentorial ones.[18] HBs of the cauda equina are usually observed in patients with VHL disease.[20]

On MRI, spinal HBs appear usually as nodular hyperintense in T1 and isointense in T2 lesions; bright and uniform enhancing postgadolinium infusion is typical, whereas T2-weighted images, in intramedullary HBs, often reveal edema and an associated syrinx.[21] Instead, intracranial HBs usually appear as cystic lesions with enhancing intramural nodules.[22] T2 MRI provides a key finding, as it better delineates the vascular supply such as the presence of a serpentine vascular flow void shadow in or around the tumor body.[23] Usually, on T1-weighted images, this lesion can be confused with schwannoma; they often show heterogeneous hyperintensity on T2 secondary to flow void due to high vascularity. In contrast, schwannomas commonly show homogenous hyperintensity.[24] There is no difference in the MRI findings among patients with or without VHL disease except for the multiplicity and higher percentage of small tumors on VHL-positive patients.[25]

Selective spinal angiography remains the gold standard in the diagnosis of spinal vascular lesions; it allows a detailed study of the vasculature, which is determinant for planning of a microsurgical strategy, and may be used as well to perform preoperative embolization to decrease bleeding during surgery. Spinal angiography is the most sensitive and specific test to differentiate between solid tumor and vascular malformation, as spinal AVM or D-arteriovenous fistula (AVF).[15] For spinal AVFs, the angiography typically reveals a feeding artery which evolves into a cluster of smaller vessels within the dura of the root sleeve; venous drainage is usually represented by an elongated single vein on the dorsal aspect of the spinal cord, while for HBs delineates the feeding arteries and draining vein (s) of a diffuse nodular blush or stain representing the tumor itself.[26]

Histologically, HBs are benign lesions, partly cystic, and characterized by stromal cells containing foamy cytoplasm in endothelium-lined vascular channels. Common hematoxylin and eosin (H and E) and Periodic Acid-Schiff stains and additional immunohistochemical stains are often needed to make the diagnosis.[27] CD31 and CD34 are endothelial markers that lead to diagnosis of HB. The absence of S-100, EMA, and cytokeratins rules out meningioma and schwannoma. Negativity for GFAP and inhibin rules out hemangiopericytoma.[28]

Surgery is indicated in the presence of neurological impairment related to lesions or only if the tumor and/or syrinx demonstrates progression, despite patient being asymptomatic.[29] Patients with mild neurological deficits were more likely to have a better outcome than those with severe dysfunction.[30]

When spinal HBs are sporadic and isolated, a complete resection is usually resolutive with a low rate of recurrence.[23] Recurrence may occur when the tumor is suboptimally resected or if the patient has VHL syndrome. The prognosis is excellent for operated spinal HBs, with recovery rates >96%.[31] Specifically, for cauda equina Hbs, as shown in Table 1, the surgical treatment helps to improve the symptoms in most of the cases. However, a long-term follow-up is poor in the literature concerning HBs of the cauda equina, and it is unknown how many will recur or become symptomatic if subtotal resection is performed.

With improved microneurosurgical techniques, radical excision of spinal HBs can be achieved with less surgical mortality and morbidity.[32] However, surgery of HBs remains challenging and is often complicated by massive bleeding, especially in large tumors running over more than one segment and in tumors located in the lower spinal region.[18]

HBs located in the lower spinal region have a predominant vascular supply from the anterior spinal axis; in these cases, embolization can be performed through the ASA, also known as artery of Adamkiewicz. Embolization can reduce tumor vascular supply and in consequence intraoperative bleeding facilitating surgery. Reduction of intraoperative bleeding is important, because excessive bleeding might prevent a complete resection of the tumor.[33]

In our case, embolization was not performed, because the surgical team, having planned an en bloc excision, did not consider it useful; embolization of the anterior spinal axis, however, requires caution and can produce severe and irreversible neurologic damage.[34]

Recurrence of HBs has been reported after subtotal surgical resection.[18] HBs related to VHL disease exhibit higher rates of recurrence compared to sporadic HBs.[35] Patients with VHL disease have a poor prognosis postoperatively; one-third of patients develop new lesions every 2 years.[29] Recent studies demonstrated that postoperative radiotherapy, after subtotal resection, could achieve more than 90% control of global and local HBs after 4 years.[36]

CONCLUSIONS

Spinal surgeons should be aware of the presenting symptoms and differential diagnosis of HBs at the level of the cauda equina. Given the benign nature of this tumor and the 80%–90% success rate in a complete tumor removal, resection of HBs is considered the treatment of choice. A complete resection of tumor is recommended as recurrence is common with incomplete excision,[37] occasionally even after radiotherapy.[38] At surgery, intralesional debulking should not be performed, unless extremely necessary and possibly after cauterization of the main arterial feeder. These tumors should be dissected and removed en bloc. In fact, intralesional debulking, even if dealing with a small lesion, will be associated with profuse bleeding.[15] Embolization of HBs of the lower spinal region can be performed through the ASA. This procedure allows for a more avascular surgical field and is useful to achieve a complete resection of these highly vascular tumors.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the Institutional and/or National Research Committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

Informed consent

Informed consent was obtained from all the individuals included in the study.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form, the patient has given her consent for her images and other clinical information to be reported in the journal. The patient understands that name and initials will not be published, and due efforts will be made to conceal identity, but anonymity cannot be guaranteed.

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Conflicts of interest

There are no conflicts of interest.

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