

Review Article

Nursing review of spinal meningiomas

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Abstract

Background: Spinal meningiomas are found in patients typically between the ages of 75 and 84: some report the average age to be 50. They occur with an incidence of approximately 1000 patients per year in the US, are mostly single (90%) rather than multiple (10%), and arise from the spinal meninges (arachnoid/dura). Tumors are typically posterior/posterolateral (70%) in location, leaving the remaining 30% in the anterior/anterolateral spinal canal. They produce symptoms and signs of radiculopathy (nerve root) and/or myelopathy (cord compression) depending on their site of origin.

Methods: Meningiomas may be single/sporadic (90%) or multifocal. They may arise primarily/spontaneously, can be radiation-induced, or associated with neurofibromatosis. They are found most frequently in females vs. males in up to a 3.4:1 ratio, occur predominantly in the thoracic spine. They are found in decreasing order in the cervical and lumbar spinal canals. The diagnosis of a meningioma is based on magnetic resonance (MR) studies, where tumors are isointense on T1 weighted MR, and hyperintense on T2-weighted MR images; they also typically uniformly enhance with Gd-DTPA. On computed tomography (CT) examinations, they are usually characterized as calcified/hyperdense.

Results: The neurological deficits resulting from meningiomas and the rapidity of symptom/sign progression dictate whether they are treated surgically or nonsurgically. Management choices include; stereotactic radiation therapy only, and/or in combination with varied surgical resection techniques.

Conclusions: The majority of benign spinal cord tumors are meningiomas (40%) that are predominantly found in the thoracic spine in middle-aged females. Tumor levels (e.g. in descending order cervical, thoracic, lumbar), and their location (e.g. anterior/anterolateral 30%; dorsal/dorsolateral 70%) best determine whether nonoperative, operative, and/or operative intervention combined with routine vs. stereotactic radiosurgery are warranted.

Key Words: CT, Diagnostic studies, locations, MR, prognosis, spinal meningiomas, surgical techniques, tumors, stereotactic radiosurgery/Cyberknife, routine radiation

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INTRODUCTION

There are approximately 1,000 spinal meningiomas treated per year in the USA.^[1-6] Although they typically occur in the older ages groups of 75–84, some studies reported an average age of just 50. They are much more commonly encountered in females in the thoracic region, followed by the cervical and lumbar spine [Figures 1-10].

Location

Most spinal meningiomas are intradural (inside the dura) and extramedullary (outside the spinal cord) [Figures 1-10].^[1-6] They typically involve an average of 3.2 segments (range 2–5 levels). Most meningiomas (nearly 60%) are located in the thoracic spine, with up to 14-27% found in the cervical region and 7.5–12.7% of cases located in the lumbar spine. Very few arise in the sacral canal.

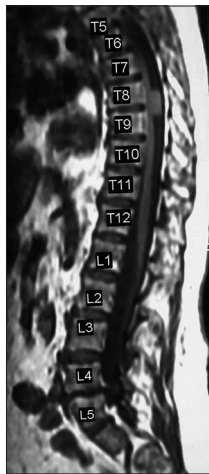


Figure 1: Midline sagittal T1-weighted localizing MR scan documenting a meningioma filling the spinal canal at the T8 level. Note the lesion is isointense when compared with the cord



Figure 3: Axial bone window thoracic axial CT demonstrating an ossified/calcified meningioma filling two-thirds of the dorsolateral spinal canal centrally and toward the left. Note the homogeneous hyperdense structure of the tumor

Epidemiology

Spinal meningiomas comprise 40% of all benign spinal tumors; the remainder consist predominantly of neurofibromas/schwannomas [Figures 1-10].^[1-6] Most are located in the thoracic spine in females vs. males (2.5 to 3.4 times more frequent in females), especially postmenopausal females. Although some reports state these lesions most often occur in patients averaging 50 years of age, others cite more tumors occurring in those 75 to 84 years old. They typically originate from the arachnoid cap cells located within the dural root sleeves, but others simply note the pia and/or dura as the sites of origin. They occur in up to 0.33 persons per 100,000 in the overall population per year, and demonstrate an average yearly growth of 0.34–0.46 cm.

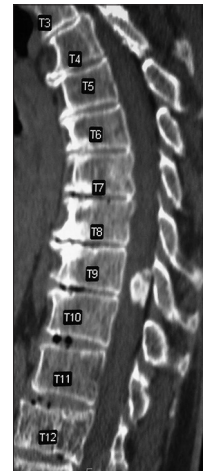


Figure 2: Midline sagittal 2D-CT bone window demonstrating a calcified meningioma with classical “tail” (*en-plaque*) sign indicating extension along the posterior dura. Note the tumor nearly fills the spinal canal at the T9 level and extends inferiorly to the T9/T10 interspace

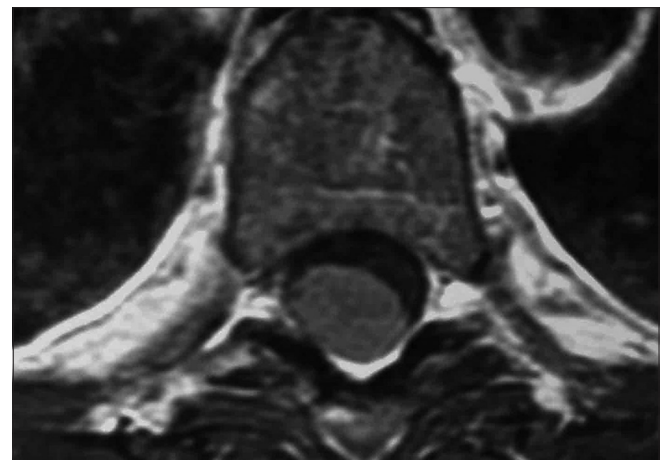


Figure 4: Axial thoracic T1 MR without contrast shows an isointense meningioma filling 5/6 of the dorsolateral spinal canal centrally/ toward the right side. This results in the cord being compressed ventrally and toward the left side of the canal

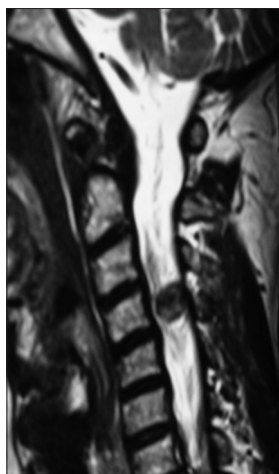


Figure 5: Midline sagittal T2-weighted cervical MR scan showing a homogeneous, hypointense lesion filling the spinal canal opposite the C4 vertebral level

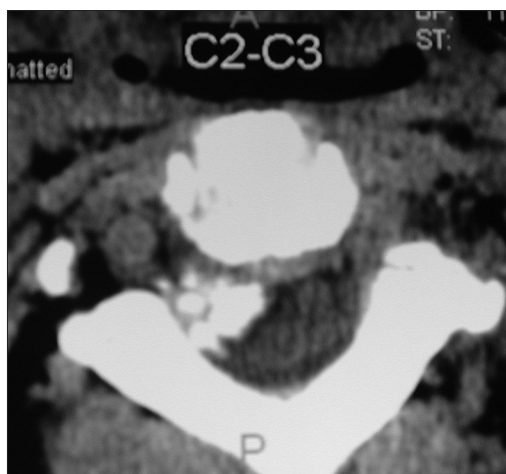


Figure 6: Axial soft tissue window CT scan at the C2-C3 level demonstrating inhomogeneous ossification/calcification of a meningioma (combined with some soft tissue/hypointense elements) filling the anterolateral and dorsolateral right side of the spinal canal. There is further central and right foraminal extension. Note the lesions appear to extend all the way from the lamina posteriorly to the disc space ventrally

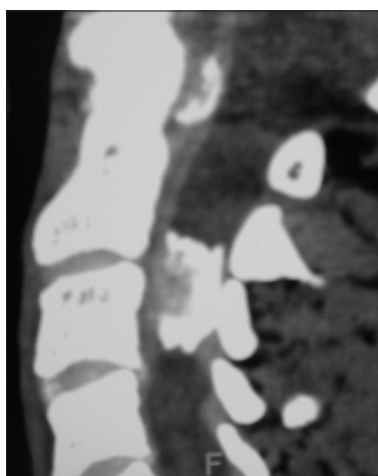


Figure 7: For the same patient depicted in Figure 6, the right-parasagittal soft tissue window 2D-CT shows the inhomogeneous nature (hyperdense calcification/isodense-soft tissue) of the right central-lateral/foraminal meningioma

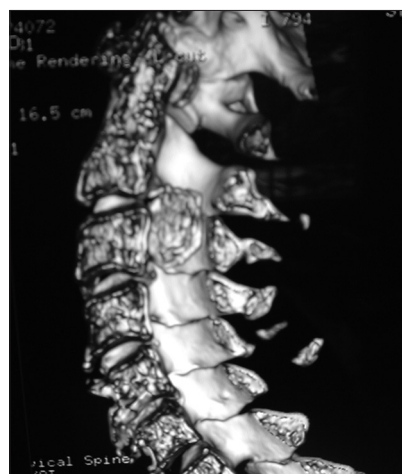


Figure 8: Parasagittal 3D-CT taken from the same patient depicted in Figures 6 and 7, demonstrates the right-sided central-foraminal location of the inhomogeneous meningioma, indicating ossification/calcification (hyperdense)

FACTORS CONTRIBUTING TO MENINGIOMAS

Estrogen may contribute to the more aggressive presentation and higher recurrence rates for meningiomas in females. Their occurrence may also be attributed/linked to spinal trauma (e.g., involving the bony elements/meninges). Other etiologies include prior radiation exposure, or a history of neurofibromatosis (e.g., heterozygosity of the NF2 gene).

Diagnostic studies

Magnetic resonance examinations

MR studies are best at defining the location and extent of meningiomas. These lesions are isointense on T1-weighted, and hyperintense on T2-weighted studies; they typically uniformly enhance with gadolinium DPTA.

Classically, meningiomas demonstrate a clear dural base with the “dural tail” or “en-plaque” signs seen in up to 93% of cases. This finding does not, however, necessarily indicate dural penetration.

Computed tomography studies

On CT examinations, meningiomas may demonstrate varying degrees of calcification. Sometimes they are uniformly calcified (57%), while at other times, there are only inhomogeneous areas of punctate ossification. CT may also signal whether there is dural penetration. Furthermore, MR and CT studies together may reveal foraminal extension (71%), adherence to the underlying nerve roots (79%), and/or intradural invasion (57%).



Figure 9: Coronal 3D CT taken from the same patient depicted in Figures 6–8 demonstrates the right-sided central-foraminal location of the inhomogeneous signal within the right-sided, dorsolateral/foraminal meningioma indicating ossification/calcification (hyperdense) with additional soft tissue elements (isodense)

CLINICAL DEFICITS CORRELATING WITH MENINGIOMAS

The clinical symptoms/signs of meningiomas correlate with their location in the spinal column. Their neurological deficits may reflect root compression (radiculopathy) and/or cord compression (myelopathy-diffuse weakness, hyperactive reflexes, loss of sensation including pin, position, and vibratory appreciation). Patients with spinal meningiomas may uniquely complain of increased pain at night that is relieved when sitting/standing typically during the day. Depending on their location, anterior/anterolateral lesions may contribute to weakness without pain (myelopathy), whereas dorsolateral tumors (behind) may produce a loss of vibration/position sensation before exhibiting motor deficits.

UTILITY OF PREOPERATIVE SPINAL ANGIOGRAMS

As spinal meningiomas are typically very vascular lesions, a preoperative spinal angiogram with embolization of major vascular feeders may decrease the risk of intraoperative bleeding. Nevertheless, the risks of spinal angiography, that includes the potential for a stroke to the artery of Adamkiewicz (located T8-L3 if directly injected resulting in paraparesis/paraplegia), must be weighed against the benefits of less intraoperative hemorrhaging.

Surgery

Many types of spinal operations may be performed to resect spinal meningiomas. Lesions that are posterior/posterolateral (70%) are more readily resected utilizing a routine laminectomy. For the more anterior/anterolateral (30%) cervical/thoracic tumors, a costotransversectomy (removal of a part of the rib), extracavitary (very lateral)

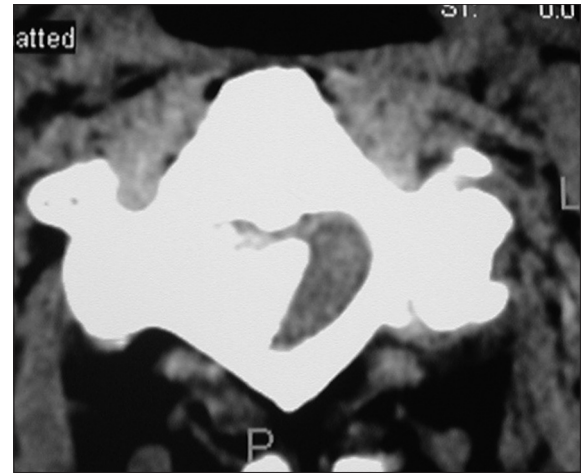


Figure 10: This axial soft-tissue CT demonstrates a uniformly ossified meningioma occupying the entire right side of the cervical spinal canal at the C3-C4 level

approach, and/or anterior approaches may be warranted to achieve tumor resection without cord manipulation. Depending upon the extent and location of tumor removal (e.g. cervicothoracic junction and thoracolumbar junction), an additional fusion may be required.

DURAL CLOSURE TECHNIQUES FOR RESECTION OF INTRADURAL LESIONS

Advantages of dorsal/dorsolateral approaches to cervical, thoracic, or lumbar meningiomas include the avoidance of a persistent cerebrospinal fluid leak. Here, in most cases, the dura, following tumor removal, may be clearly elevated/everted, allowing for clear placement of 7-0 Gortex sutures (note the needle is smaller than the suture that is nonresorbable). If the edges cannot be brought together without tension or if the tumor extends to and through the dura requiring dural resection, then a dural patch graft may be needed. One may use bovine pericardium or a fascial autograft to close the dura in some of these latter cases. Closure is then enhanced with microdural staples, a fibrin sealant, and microfibrillar collagen.

Dural penetrance vs. dural-sparing meningiomas

Some meningiomas will extend to/through the dura whereas others will involve the inner dural membrane while sparing the external sheath. If possible, preserving the dura and obtaining a primary closure is preferable to placing a dural patch graft as the latter carries a higher risk of persistent CSF fistula.

Pathology

There are several pathologic types of meningiomas; 70% psammomatous, 15% meningothelial, 7% angiomatous, 7% transitional, and 1% may be cancerous/infiltrative/malignant (e.g., meningiopericytomas, clear cell meningiomas) [Figures 1-10].^[1-6] They can also demonstrate several

growth patterns characterized by initial thickening of the dura, calcification, and dural invasion.

RADIATION THERAPY AND RADIOSURGERY

Increasingly, stereotactic radiosurgery may be added to the resection of spinal meningiomas or may indeed supplant the need for surgery. This may be particularly true for the most complex craniocervical lesions. Although surgical resection is often considered optimal by most surgeons, the size/location of the lesion, pattern of growth, and age/comorbidities of the patient may dictate the utilization of nonoperative/stereotactic radiosurgical treatment. In addition, radiosurgery may be the treatment of choice for recurrent/residual tumors (e.g., difficult to resect). At present, sophisticated stereotactic radiosurgery techniques may be used as the primary radiosurgery treatment, or in other cases, to supplement where prior conventional fractionated radiotherapy was delivered.

Radiation-induced myelopathy

Patients who have undergone radiation therapy for spinal meningiomas may develop the late onset (6 months to 2 years later) or radiation-induced myelopathy (0.2–5%). This is typically dose dependent, and may be best diagnosed on T2-weighted MR studies. Treatment options include steroids and/or nerve transmitter medications.

CONCLUSION

Spinal meningiomas are most frequently found in the thoracic, followed by the cervical and lumbar spine, and constitute approximately 40% of all benign spinal tumors [Figures 1-10].^[1-6] Patients may average 50 years of age, but a preponderance is found between the ages of 75 and 84. Symptoms and signs of radiculopathy (root

compression) and myelopathy (cord compression) reflect the location of the tumors. These lesions on MR studies are isointense on T1 and hyperintense on T2 examinations; they also typically homogeneously enhance with contrast (Gd-DTPA). CT studies further confirm the extent of ossification/calcification. Seventy percent of the tumors located dorsally/dorsolaterally are often readily excised utilizing laminectomies alone unless located at the cervicothoracic or thoracolumbar junctions where additional fusion may be warranted. However, the remaining 30% found ventrally/ventrolaterally are typically more difficult to resect. Although many tumors are completely removed, others may have microscopic and/or macroscopic remnants warranting secondary adjuvant stereotactic radiosurgery.

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Conflicts of interest

There are no conflicts of interest.

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