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Authors: A. M. Quiles Granado, E. Gómez Roselló, G. Laguillo Sala, R. García, J.-L. Caro, F. Pérez, S. Pedraza; Girona/ES
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Learning objectives

-To analyze the patterns of intraspinal tumours based on their location and histological type.

-To describe their radiological features and pathological correlation.

-To evaluate clinical data, treatment options, and clinical outcome.

-To illustrate different practical cases.

Fig. 1: Type of Tumours according to location.

References: Servicio de Radiología (IDI), Hospital Universitario Dr. Josep Trueta - Girona/ES
Background

**INTRODUCTION:**

An intraspinal tumour is an abnormal mass of tissue within or surrounding the spinal cord and spinal column. Intraspinal tumours may originate from the spinal cord, filum terminale, nerve roots, meninges, intraspinal vessels, sympathetic chain, or vertebrae. They can be benign or malignant, primary or secondary, and may result in serious morbidity.

Intraspinal tumours are relatively uncommon lesions accounting for approximately 15% of craniospinal tumours. However, these lesions can cause significant morbidity and can be associated with mortality as well. In establishing the differential diagnosis for a spinal lesion, location is the most important feature.

Spinal tumours may be referred to by the area of the spine in which they occur. The basic areas are cervical, thoracic, lumbar, and sacral. Additionally, they are also classified into 3 main categories according to the their location with respect to the dural sac and spinal cord: extradural; intradural-extramedullary; or intramedullary (Fig. 1 on page 7). Lesions can occasionally compromise more than one compartment.

**Extradural** (55%-60% of all spinal tumours): They originate outside the dural sac. They may derive from the cells covering the nerve roots, from the vertebrae (most extradural lesions), or from the epidural tissues. Occasionally, an extradural tumour extends through the intervertebral foramina, lying partially inside and partially outside the spinal canal. **Metastases** are the most frequent extradural lesions.

**Intradural-extramedullary** (30%-40%): These tumours develop in the spinal cord's arachnoid membrane (*meningiomas*), in the nerve roots that extend out from the spinal cord (*schwannomas and neurofibromas*), or at the base of the spinal cord (*filum terminale ependymomas*). Most of these lesions are primary. Drop metastases can be also observed at this location.

**Intramedullary** (5%-10%): These tumours grow inside the spinal cord, most frequently in the cervical region. They typically derive from glial or ependymal cells that are found throughout the interstitium of the cord. Most (90%-95%) are malignant. **Ependymomas** and **astrocytomas** are the two most common types. Ependymomas are the most frequent in adults and astrocytomas are the most frequent in children.
ETIOLOGY:

The cause of most primary spinal tumours is unknown. Some may be attributed to exposure to cancer-causing agents. Spinal lymphomas are more common in people with compromised immune systems. Some are related to a genetic component. In a small number of cases, primary tumours may result from these genetic diseases: Neurofibromatosis (type 1 or 2) and Von Hippel-Lindau (VHL) disease.

- NF2>NF1
- NF2: Ependymomas, schwannomas, meningiomas
- NF1: Astrocytomas, neurofibromas
- VHL: Hemangioblastomas

SYMPTOMS:

Intraspinal tumours often present with nonspecific symptoms. Non-mechanical back pain is the most frequent symptom. Pain may spread beyond the back to the hips, legs, feet, or arms, and it may worsen over time. Depending on the location and type of tumour, other signs and symptoms can develop, especially as a tumour grows and compresses on the spinal cord, the nerve roots, blood vessels, or bone of the spine. Impingement of the tumour on the spinal cord can be life-threatening in itself.

Additional symptoms can include:

- Loss of sensation or muscle weakness in the legs, arms, or chest.
- Difficulty walking, which may cause falls.
- Loss of bowel or bladder function.
- Paralysis in different parts of the body, depending on which nerves are compressed.
- Scoliosis or other spinal deformity resulting from a large but benign tumour.

DIAGNOSIS:

Magnetic resonance imaging (MRI) is the most important diagnostic tool for intraspinal tumours, playing an integral role in their evaluation and improving their anatomic delineation and early diagnosis. MRI can show the spinal cord, nerve roots, and surrounding areas. One should always obtain sagittal and axial unenhanced T1- and T2-weighted images and contrast-enhanced T1-weighted images. Contrast-enhanced images can be important for tumour detection, delineation, characterization, and grading.
They help differentiate the tumour from the spinal cord, nerve roots, or thecal sac as well as from peritumour edema or cysts. They are also crucial to ensure correct staging and treatment planning. MRI also plays an important role in follow-up.

**Computed tomography** remains the best modality to assess the osseous structures. Sometimes CT shows typical patterns of bone destruction, sclerosis, and/or remodeling. CT is especially important in planning instrumentation, although this is usually not required for intradural tumours, as the vertebral bodies are nearly always essentially unaffected.

**Plain Film Radiography** provide information about osseous anatomy: alignement, bone matrix, bone destruction, sclerosis and demineralization.

**Bone scintigraphy** is useful in detecting multiple spinal bone lesions and distant metastases.

**Angiography** is useful in a select group of patients who have vascular lesions (both vascular malformations and vascular tumours), and in some instances endovascular treatment may also be useful.

**Ultrasound**, except in infants, does not have a role, as it is unable to image the intradural compartment due to the overlying posterior spinal elements.

After radiological confirmation of the tumour, the only way to determine whether the tumor is benign or malignant is to examine a small tissue sample (**Biopsy**).

**TREATMENT:**

Surgery is the most common treatment, and in most cases the neurological symptoms improve postoperatively. Primary spinal tumours may be removed through complete en bloc resection for a possible cure. In patients with metastatic tumours, surgical treatment is primarily palliative, with the goal of restoring or preserving neurological function, stabilizing the spine, and alleviating pain. Indications for surgery include intractable pain, spinal cord compression, and the need for stabilization of pathological fractures.

Nonsurgical treatment options include observation, chemotherapy, and radiation therapy. Watchful waiting with regular MRI monitoring can be an option in tumours that are asymptomatic or mildly symptomatic and do not appear to be changing/progressing.
OUTCOME:

Outcome depends greatly on whether the spinal tumour is benign or malignant, primary or metastatic, on the histologic grade of tumour and on the age and overall health of the patient. The extent of surgical resection is also a predictor of outcome.

In the case of primary tumours, the goal is to remove the tumour completely, leading to potential cure. In the case of metastatic tumours, the goal is almost always palliative. At best, palliative treatment may provide the patient with an improved quality of life and prolonged life expectancy.
Fig. 1: Type of Tumours according to location.

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MATERIALS, METHODS AND RESULTS:

We retrospectively reviewed cases of intraspinal tumours treated at our institution from January 2008 to December 2011 (n = 67; 36 women, 31 men, median age at diagnosis 53 years [range 18-83]). In this period, 344 craniospinal tumours were treated in our centre, thus representing a prevalence of 19% of intraspinal tumours (similar to published data).

We evaluated clinical data, location, histological type, radiological features, type of treatment, and outcome.

Clinical symptoms were variable and determined by location and tumour size.

Pain was the most frequent clinical presentation (n=29), associated in some cases with a motor deficit (n=12). In 17 cases, isolated motor deficit was the first clinical presentation and in 14 cases the tumour was an incidental finding with no valuable clinical data.

Location:

We classified intraspinal tumours by the area of the spine in which they occur: cervical (n=14; 20.9%), cervico-thoracic (n=2; 3%), thoracic (n=26; 38.8%), thoraco-lumbar (n=7; 10.4%), lumbar (n=12; 17.9%), lumbo-sacral (n=1; 1.5%), sacral (n=2; 3%), and whole-spine (n=3; 4.5%). (Fig. 2 on page 19)

Additionally, we classified them by their anatomic relations with vertebrae, dural sac, and spinal cord: (Fig. 3 on page 20)

1, 2: Extradural (n= 21; 31%)
3: Intradural extramedullary (n=30; 45%)
4: Intradural-extradural (dumbbell) (n=5; 7%)
5: Intramedullary (n=9; 14%)
6: Intradural extramedullary with minimal intramedullary extension (n=2; 3%)

The most frequent histological type was schwannoma (n=16; 24%), followed by metastases (n=14; 21%) and meningioma (n=11; 16.5%). Other, less frequent tumours were: ependymoma (n=5; 7%), lymphoma (n=4; 6 %), plasmocytoma (n=3; 4.5%),...
hemangioblastoma (n=3; 4.5%), astrocytoma (n=3; 4.5%), lipoma-angiolipoma (n=2; 3%), primary osseous tumours [chordoma (n=1; 1.5%), hemangioma (n=1; 1.5%)], neurofibroma (n=1; 1.5%), primitive neuroectodermal tumour-PNET (n=1; 1.5%), glioblastoma multiforme (n=1; 1.5%), and solitary fibrous tumour (n=1; 1.5%). (Fig. 4 on page 21)

Radiological findings:

In 19 patients, MRI was not available for evaluation; therefore, these cases were excluded from the analysis. The 48 remaining cases were analysed:

- On T1-weighted TSE sequences, 23 lesions were isointense (48%), 22 were hypointense (45.8%), 2 were hyperintense (4.2%), and 1 had a heterogeneous mixed signal (2%).

- On T2-weighted TSE sequences, most lesions were hyperintense (n=34, 70.8%), 7 were isointense (14.6%), 5 were hypointense (10.4%), and 2 had a heterogeneous mixed signal (4.2%).

- STIR sequences were done in 38 patients: Most lesions were hyperintense (n=31, 81.6%), 4 were hypointense (10.5%), one was isointense (2.6%), and 2 had a heterogeneous mixed signal (5.2%).

- Gadolinium-enhanced sequences were obtained in 35 patients: 33 lesions showed contrast enhancement (enhancement was homogeneous in 20, heterogeneous in 8, and peripheral in 5) and two lesions did not enhance.

- Evidence of cord compression was present in 69% of cases, and associated intramedullary lesions (oedema or syringomyelia) were present in 45%.

Treatment and outcome:

58 cases were treated with surgery (total or partial resection) and in 8 cases radiotherapy or chemotherapy was done. One case was clinically observed without treatment.

48 patients showed clinical improvement after treatment; 10 achieved clinical stabilisation, and 9 worsened despite treatment (5 of these died).

CLINICAL CASES WITH RADIO-PATHOLOGIC CORRELATION:

EXTRADURAL LESIONS:
CASE 1: **OSSEOUS METASTASES** *(Fig. 5 on page 22)*

67-year-old woman with recent chest pain associated with progressive loss of sensation and muscle weakness in the legs. MRI and CT detected an isolated lytic lesion in a thoracic vertebra (T9) with an associated extradural soft-tissue mass in an anterior and posterior location that compressed the spinal cord. Tumour extension studies detected a breast neoplasm. She underwent T9 vertebrectomy with vertebral prosthesis and spinal fixation system.

*Teaching points:*

- Metastases are the most frequent extradural tumours.
- Solitary vertebral lesions are less frequent than tumours with multiple locations.
- Metastases are most frequent in the thoracic spine followed by the lumbar spine.
- The most common primary tumours giving rise to metastatic spinal tumours are lung, breast, and prostate tumours.
- Most lesions are osteolytic; osteoblastic metastases occur frequently with metastases from prostate and breast cancer.
- In elderly patients, the differential diagnosis with plasmocytoma/myeloma must be done.

CASE 2: **MULTIPLE MYELOMA** *(Fig. 6 on page 23)*

66-year-old man with a three-week history of low back muscular pain with lower limb paresthesias, with pain increasing in the last 2 to 3 days despite treatment. He was diagnosed with IgG-kappa multiple myeloma with multiple lesions in the spine, ribs, pelvis, cranial vault, and sternum.

*Teaching points:*

- Myeloma is the most frequent primary malignant tumour of the spine.
- The peak incidence is in the sixth to seventh decade.
- The spine and especially the vertebral bodies are the most common sites; epidural extension is common.

CASE 3: **VERTEBRAL HAEMANGIOMA** *(Fig. 7 on page 24; Fig. 8 on page 25)*
77-year-old man with chest pain. MRI detected an osseous vertebral lesion at T5-T6 with an epidural component that extends to the vertebral canal and foramina, compressing the spinal cord and nerve roots.

**Teaching points:**

- **Vertebral hemangioma is the most common benign spinal tumour.**
- **Most occur in the vertebral body and about 10% extend into the posterior elements.**
- **The thoracic region is the most frequent.**
- **There are two different types: 1- asymptomatic; 2-aggressive, symptomatic types with intraspinal tumour extension and cord compression.**
- **Lesions with high T1 signal are considered benign. Low signal on both T1- and T2-weighted sequences represents degenerative change/involution of the lesion. Low T1 signal together with high T2 signal may represent an atypical hemangioma.**

**CASE 4: CHORDOMA (Fig. 9 on page 26)**

53-year-old man with a history of chronic low back pain radiating to the lower limbs, associated with dysesthesia over the last 2 months. MRI detected an osseous tumour at L2 that was diagnosed as a chordoma at histologic study. He showed good clinical recovery after partial posterior vertebrectomy and postsurgical radiotherapy.

**Teaching points:**

- **Chordomas are malignant tumours that arise from remnants of the notochord, show local invasion, and can produce distant metastases.**
- **Chordomas are destructive, lytic (or mixed lytic/sclerotic) lesions with an associated mass.**
- **Amorphous calcification may be seen (50%-70% cases).**
- **On MRI, most are isointense or hypointense on T1-weighted images and hyperintense on T2-weighted images compared to muscle. The internal fibrous septa that divide the gelatinous components of the tumour have low signal intensity on T2-weighted images and are a characteristic feature.**
- **Half of these tumours are found in the sacrum, 35% in the clivus, and the rest in the vertebrae.**
-They are usually located along the midline.

CASE 5: ANGIOLIPOMA (Fig. 10 on page 27)

52-year-old woman with lower limb paraparesis. A posterior intraspinal extradural mass, corresponding to an angiolipoma, was detected at T6-T7. MRI showed signs of compressive myelopathy. She showed good recovery after complete resection of the lesion.

Teaching points:

-Angiolipomas are common benign lesions that are almost always located subcutaneously. However, spinal angiolipoma is a specific but uncommon clinico-pathological entity that should be considered in the differential diagnosis of long-standing, slowly progressive paraparesis.

-They are composed of varying proportions of mature fat cells and abnormal vascular elements. The variability of the vascular and adipose elements of the tumor results in significant heterogeneity in imaging studies.

-Most are located in the thoracic region. Almost all noninfiltrating epidural angiolipomas are posterior or posterolateral in location.

INTRADURAL-EXTRAMEDULLARY LESIONS

CASES 6 and 7: MENINGIOMA

Case 6: 51-year-old man presented with Brown-Séquard syndrome. CT and MRI showed a well-delimited oval lesion with intense contrast enhancement in the intradural extramedullary space at the level of C1 causing compressive myelopathy (Fig. 11 on page 28).

Outcome after complete resection of the lesion (see video- Fig. 12 on page 29) was very good. Histologic study diagnosed meningothelial meningioma (Fig. 13 on page 30).

Case 7: 40-year-old man with a four-year history of progressive left back pain radiating to the waist and progressive gait disturbances (lower limb paraparesis without associated sensory deficit). MRI detected an intradural extramedullary lesion compressing the thoracic spinal cord and causing secondary myelopathy (Fig. 14 on page 31). The
lesion was excised (Fig. 15 on page 32), and histology diagnosed **psammomatous meningioma** (Fig. 16 on page 33). He developed paraplegia as a postsurgical complication.

**Teaching points:**

- Spinal meningiomas are the second most frequent intradural extramedullary tumor after nerve sheath tumours.
- They are slow-growing, usually benign tumours.
- They are most frequent in thoracic region (80%), followed by the cervical region (15%).
- They are usually located posterolateral in the thoracic region and anteriorly in the cervical region.
- Broad dural based. A dural tail may be seen.
- They may be calcified.
- They enhance avidly and homogenously with contrast.
- Female predominance. They usually present after the fourth decade.
- Keep in mind that multiple meningiomas may be present in NF-2.

**CASE 8: SOLITARY FIBROUS TUMOR**

71-year-old man presenting with Brown-Sequard syndrome. An intradural extramedullary lesion compressing the cervical cord was detected (Fig. 17 on page 34). Preoperative MRI suggested meningioma. After laminectomy with tumor resection, pathologic examination revealed a solitary fibrous tumour (Fig. 18 on page 35). The patient died of a postsurgical respiratory complication.

**Teaching files:**

- Solitary fibrous tumours are uncommon mesenchymal tumours that involve the pleural cavity and numerous extrathoracic sites, including the prostate, kidney, thyroid, and rarely the intraspinal compartment.
- This rare entity should be included in the differential diagnosis of intradural extramedullary spinal neoplasms.
CASES 9 and 10: **FILUM TERMINALE EPENDYMOMA**

Case 9: 21-year-old woman with low back pain, impaired ambulation, lower limb paresis, and sphincter incontinence. MRI detected a huge intradural lesion at the filum terminale and cauda equina (T12-L5), producing bone remodeling and syringomyelia (Fig. 19 on page 36). Subtotal resection resulted in good outcome. Pathologic examination ruled out a grade I myxopapillary ependymoma (Fig. 20 on page 37).

Case 10: 54-year-old man with long-standing symptoms of sphincter incontinency, hypoesthesia in the left L5-S1 territory, and minimal lower limb motor deficit. MRI detected an intradural extramedullary tumour at L1-L2 (Fig. 21 on page 38). The lesion was excised (see intraoperative video- Fig. 22 on page 39). Pathologic examination of the specimen revealed a grade I myxopapillary ependymoma of the filum terminale

**Teaching points:**

- **Myxopapillary ependymomas are relatively common in the conus medullaris and the filum terminale; they are by far the most common tumours in those locations.**

- **They are slow-growing tumours that arise from ependymal glia of the filum terminale or conus medullaris or rarely from ependymal remnants in sacral regions.**

- **They are usually well circumscribed and do not infiltrate adjacent cord tissue.**

- **They have a tendency to bleed** (myxopapillary ependymomas are the subtype of ependymomas that are most prone to haemorrhage), **which may lead to subarachnoid haemorrhage.**

- **They may calcify or undergo cystic degeneration.**

- **They tend to have an earlier clinical presentation than other spinal ependymomas, with a mean age of presentation of 35 years.**

- **If they become large, myxopapillary ependymomas may expand the spinal canal, cause scalloping of the vertebral bodies, and they may protrude through the neural exit foramina.**

CASES 11 and 12: **SCHWANNOMA**

Case 11: 45-year-old man, asymptomatic. Routine follow-up MRI for discectomy detected an intradural extramedullary tumour at T12-L1 compressing the conus medullaris and nerve roots of the cauda equina. Benign schwannoma was diagnosed at pathologic examination after surgical excision (Fig. 23 on page 40).
CASE 12: 66-year-old man with a several-month history of predominantly distal left upper limb paresis and predominantly proximal lower limb paresis affecting his gait. He slowly developed quadriplegia. MRI detected a left-sided spinal lesion at C3-C4 with an intraspinal part (that has both intradural extramedullary component and extradural component and causes compressive myelopathy) and an extraspinal part (extending to the left foramen and paravertebral soft tissues). A dumbbell-shaped Schwannoma was diagnosed (Fig. 24 on page 41, Fig. 25 on page 42).

Teaching points:

- Schwannomas are considered benign tumors (>90% cases); they are the most common intradural extramedullary spinal lesions, followed by meningiomas.
- Schwannomas are the most frequent type of nerve sheath tumors, followed by neurofibromas.
- 70% are intradural extramedullary, 25% extradural, and <1% intramedullary.
- They often show cystic degeneration and haemorrhage.
- They usually present as solitary tumors. If multiple spinal root tumors are present, think of NF1 (neurofibromas) or NF2 (schwannomas). Neurofibromatosis is present in 35%-45% of all patients with spinal nerve sheath tumours.
- Both neurofibromas and schwannomas may have an extradural component, and extension through the foramina may be seen, which potentially results in widening of the foramina (see Fig. 24).

CASE 13: LEPTOMENINGEAL METASTASES

18-year-old man with diplopia and radicular pain. Brain MRI ruled out pineal and hypothalamic lesions and multiple intradural extramedullary lumbo-sacral lesions (Fig. 26 on page 43). One leptomeningeal lumbar lesion was surgically biopsied and histologic study diagnosed germinoma with leptomeningeal spread at the cauda equina (Fig. 27 on page 44).

Teaching points:

- Intradural extramedullary metastases result from CSF spread from primary neoplasms.
- Primary tumors include:
*Central nervous system (Drop Metastases): Cerebral glioblastoma, anaplastic astrocytoma, ependymoma, medulloblastoma, PNET, pineal tumors (germinoma, pineoblastoma), choroid plexus neoplasms).

*Non-CNS: lung cancer, breast cancer, melanoma, lymphoma, leukaemia.

- The lumbo-sacral region is the most common location.

**INTRAMEDULLARY LESIONS**

**CASE 14: ASTROCYTOMA**

51-year-old woman with lower limb paresthesias and mild motor deficit. MRI detected an intramedullary lesion (Fig. 28 on page 45). Pathology diagnosed a grade II astrocytoma after surgical biopsy (Fig. 29 on page 46), and posterior subtotal tumour resection was done. At follow-up, the rest of the tumour was upgraded to a grade IV glioblastoma.

*Teaching points:*

- Astrocytoma is the most common intramedullary tumour in children and the second most common in adults.

- Most (75%) are low grade.

- They most frequently occur in the cervical and thoracic region.

- Astrocytomas diffusely invade the spinal cord and are difficult to delineate; they are more infiltrative than ependymomas and therefore complete resection of astrocytomas is rare.

- Eccentric location within the posterior spinal cord is typical.

- Several spine segments are involved at the time of diagnosis.

- Fusiform expansion of the cord is common.

- Cystic components are present in 30%.

- Despite the low grade, nearly all enhance after contrast administration.

- The incidence of spinal astrocytomas is higher in patients with NF-1.

**CASES 15 and 16: EPENDYMOMA**
Case 15: 46-year-old man with cervical and thoracic back pain, hypoesthesia in hands and feet, motor deficit in hands, and mild instability. MRI detected a relatively well-defined intramedullary mass extending from C3 to C6, with a widened cervical and thoracic cord and syringomyelia. Grade II ependymoma was diagnosed after excision (Fig. 30 on page 47).

Case 16: 73-year-old woman with a several-month history of neck pain, upper limb sensory loss, and motor deficit in her hands. Typical MRI findings enabled the diagnosis of an intramedullary cervical ependymoma. (Fig. 31 on page 48).

Teaching points:

-Ependymomas are the most common intramedullary tumors in adults.

-Cellular ependymomas most frequently occur in the cervical spine (unlike myxopapillary types, which occur in the filum terminale and cauda equina).

-These slow-growing tumors are usually well circumscribed.

-They tend to be centrally located in the cord, unlike astrocytomas, which tend to be eccentric and more infiltrative.

-Cyst formation and haemorrhage are common, especially at the tumour margins (hemosiderin deposits-"dark caps" are sometimes seen rostral and caudal to the tumour) (see Fig 29-different patient with a grade II cervical ependymoma).

-Intense, homogeneous or heterogeneous enhancement after contrast is the rule.

-Syringohydromyelia may be associated, especially with cervical ependymomas.

-They often can be surgically resected.

CASE 16: HEMANGIOBLASTOMA (Fig. 32 on page 49)

31-year-old woman with cervical pain and Von Hippel-Lindau disease. She recently had a cerebellar hemangioblastoma removed.

An intramedullary lesion consistent with hemangioblastoma was detected at C6. Outcome was very good after excision of the cervical lesion.

Teaching points:
- Hemangioblastoma is the third most frequent intramedullary tumour.

- These tumors occur more commonly as sporadic isolated lesions (70%-80% of cases) rather than as multiple lesions, as part of the dominantly inherited familial cancer syndrome, von Hippel-Lindau disease (16%-25% of cases).

- Most (75%) spinal hemangioblastomas are intramedullary, mainly located in the dorsal surface of the cord.

- MRI typically shows a large intramedullary cyst with a mural nodule.

- Symptomatic hemangioblastomas usually have relatively large associated syringes, whereas asymptomatic lesions often do not.
Fig. 1: Type of Tumours according to location.

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Fig. 2: Location by area of the spine.

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Fig. 3: Tumour classification by their anatomic relations.

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Fig. 4: Histological types of intraspinal tumours.

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Fig. 5: Sagittal T2-weighted (A), sagittal T1-weighted (B), sagittal STIR (C), and axial T2-weighted (E). MRI images showing a bone metastasis in the T9 vertebra with intraspinal extradural extension (arrows) that causes compressive myelopathy. The lytic changes are noted in the sagittal reformatted CT image (D). A breast neoplasm (arrowhead) was detected in the chest CT extension study (F).

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Fig. 6: Multiple Myeloma

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Sagittal T2-weighted and T1-weighted images (A, B) demonstrating multiple bone lesions, some with associated soft-tissue masses. Note the cord compression at multiple levels (long arrows). Axial T1-weighted images before (C) and after gadolinium injection (D) show a huge soft-tissue mass with both intraspinal extradural (short arrows) and extraspinal components (arrowheads).
Fig. 7: Vertebral Haemangioma

Axial T2-weighted (A) and T1-weighted (B) and sagittal STIR images demonstrating a T2-hyperintense and T1-hypointense lesion in the vertebral body and left posterior elements in the thoracic spine (T5-T6). The lesion is associated with an intraspinal extradural component that enhances after gadolinium administration (arrows in C and E).

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Fig. 8: Microscopic examination of the specimen (HE x 10) shows a benign lesion composed of a proliferation of vascular structures without atypia, some with luminal thrombi. HAEMANGIOMA

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Fig. 9: Axial T2- and T1-weighted MRI (A, B) and CT scan (C) show a lytic bone tumour in the L2 vertebra with a large soft-tissue mass extending to the paravertebral regions, bilateral foramina, and intraspinal extradural compartment (arrows). Histologic examination of the biopsy specimen diagnosed a chordoma. Microscopically, (D) chordoma is composed of epithelioid cells with vacuolated cytoplasm arranged in solid nests and cords immersed in a weakly basophilic myxoid stroma.

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**Fig. 10:** Extradural Angiolipoma

Sagittal T2-weighted (A) and T1-weighted (B) images of the thoracic spine show a posterior extradural lesion of signal intensity similar to fat, corresponding to an angiolipoma. (C) Hematoxylin-eosin stain shows a lesion composed of adipocytes without atypia and abundant vascular structures with characteristic hyaline thrombi.

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Fig. 11: Intradural cervical Meningioma

MRI and CT images. Intradural extramedullary lesion at C1 (blue arrows) corresponding to a meningioma. The lesion compresses the cord (arrowheads) and contacts with the left vertebral artery (orange arrows).

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Fig. 12: Intraoperative images of a cervical meningothelial meningioma. Complete resection of the lesion was performed.

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Fig. 13: Photomicrograph (H & E stain) showing a meningothelial proliferation in solid clusters of cells with round or oval nuclei and ill-defined eosinophilic cytoplasm. Meningothelial Meningioma.

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**Fig. 14: Intradural thoracic Meningioma**

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Fig. 15: Intraoperative images obtained before (A) and after (b) resection of the thoracic meningioma.

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Fig. 16: Psammomatous meningioma (H & E stain). Elongated cells in a hyaline stroma with abundant psammoma bodies.

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Fig. 17: Solitary Fibrous Tumour

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Intraoperative images obtained before (A) and after (B) resection of an intradural extramedullary tumour at C1-C3 level. C, HE stain showing fusiform cells arranged in bundles of collagenous stroma. Immunohistochemistry was positive for CD34 (D) and BCL2 (E). **Solitary fibrous tumour** was diagnosed.

**Fig. 18:** Solitary Fibrous Tumours. Intraoperative photographs and Photomicrographs.

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Fig. 19: Filum Terminale Ependymoma

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**Fig. 20:** A, Intraoperative photographs of the giant myxopapillary ependymoma obtained before (upper) and after (lower) durotomy. B, Microscopic specimen. Hematoxylin-Eosin stain. Cuboidal cellularity with multiple microcystic spaces with myxoid material.

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Fig. 21: Sagittal T2-weighted (A), T1-weighted (B), and postgadolinium T1-weighted (C) images show an intradural extramedullary lesion near the conus medullaris that enhances after contrast administration. Corresponding HE stain (x40) of the resection specimen (D) showed the proliferation of cuboidal cells with oval nuclei and scant atypia within myxoid stroma. (E) Immunohistochemical study of the same specimen (AB x 20). The Alcian blue (AB) stain highlights the stromal mucoid deposit. Myxopapillary ependymoma was diagnosed.

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Fig. 22: Intraoperative video. Myxopapillary ependymoma removed.

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Fig. 23: Schwannoma

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Fig. 24: Sagittal and axial T2- (A and B) and T1- (C and D) weighted images show a "dumbbell" tumour with an intradural and extradural component and a extraspinal extension. Note the remodelling in the adjacent vertebral body.

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Fig. 25: SCHWANNOMA: A, Photomicrograph H&E (x40): Tumour consisting of fusiform cells with abundant ill-defined eosinophilic cytoplasm and elongated or ovoid nuclei without pleomorphism. B, H&E stain (x20): Areas with the "Antoni A" pattern where you can see the palisade arrangement of nuclei.

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**Fig. 26: Leptomeningeal Metastases**

Sagittal T2-weighted (A) and postgadolinium T1-weighted (B) MRI show multiple intradural extramedullary enhancing lesions in the lumbar region. Brain MRI (C) detected pineal and suprasellar masses. Germinoma with leptomeningeal metastases was diagnosed.

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Fig. 27: Microscopic analysis of the biopsy specimen: A, HEx40: Neoplasm composed of undifferentiated tumor cells, with vesicular nuclei containing prominent nucleoli and with abundant ill-defined vacuolated cytoplasm, arranged in nests or loose in a stroma with marked lymphocyte infiltration. B, At immunohistochemistry, tumour cells were positive for D2-40.

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**Fig. 28: Low grade intramedullary Astrocytoma**

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Fig. 29: Micrograph image (H&E stain) shows a neoplastic lesion composed of fibrillar or gemistocytic astrocytes with scant atypia (low grade astrocytoma).

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**Fig. 30:** Intramedullary cervical mass (long arrows), with mildly heterogeneous signal at T2 (A) and T1 (B) and with intense contrast enhancement demarcating tumor margins (C). An associated syrinx widens the cord (short arrows), predominantly below the mass. Peripheral tumour cysts are seen above and below the mass (arrowheads). D, Micrograph (HE stain x40) shows a richly cellular ependymal neoplastic lesion with oval nuclei and pinkish cytoplasm and scant mitotic activity (cellular ependymoma).

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**Fig. 31: Intramedullary Ependymoma**

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Fig. 32: Intramedullary Hemangioblastoma

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Conclusion

Intraspinal tumours may be difficult to distinguish, and imaging findings together with information about symptoms, age, gender, and location are helpful in the final diagnosis. Accurate radiological description of these lesions is essential to ensure timely appropriate treatment. Pathological correlation may help radiologists to better understand the radiological features.
References


Personal Information

Ana Mª Quiles Granado

Department of Radiology (IDI), Girona Biomedical Research Institute, Hospital Universitari de Girona, Dr Josep Trueta. Girona, Spain

amquiles.girona.ics@gencat.cat