

Oncologic Imaging Spine and Spinal Cord Tumors

Heung Sik Kang
Joon Woo Lee
Eugene Lee

 Springer

Oncologic Imaging: Spine and Spinal Cord Tumors

Heung Sik Kang
Joon Woo Lee • Eugene Lee

Oncologic Imaging: Spine and Spinal Cord Tumors

 Springer

Heung Sik Kang, MD
Department of Radiology
Seoul National University College
of Medicine
Seoul National University Bundang
Hospital
Seongnam
South Korea

Eugene Lee, MD
Department of Radiology
Seoul National University Bundang
Hospital
Seongnam
South Korea

Joon Woo Lee, MD
Department of Radiology
Seoul National University College
of Medicine
Seoul National University Bundang
Hospital
Seongnam
South Korea

ISBN 978-981-287-699-7 ISBN 978-981-287-700-0 (eBook)
DOI 10.1007/978-981-287-700-0

Library of Congress Control Number: 2017931640

© Springer Science+Business Media Singapore 2017

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, express or implied, with respect to the material contained herein or for any errors or omissions that may have been made.

Printed on acid-free paper

This Springer imprint is published by Springer Nature
The registered company is Springer Nature Singapore Pte Ltd.
The registered company address is: 152 Beach Road, #22-06/08 Gateway East, Singapore 189721, Singapore

*To my co-authors, Joon Woo Lee and Eugene Lee, who
proved their excellence and hard work through the
publishing process of this book.*

Heung Sik Kang

*To God, for his eternal love and support.
To my wife, Cho, for her love and support.*

Joon Woo Lee

*To my parents, Lee and Chun, whom I love and respect
most in the world.*

*Thanks to the two respected teachers, Kang and Lee, for
their warm heart and understanding.*

Eugene Lee

Preface

Tumors of the spine and spinal cord can be neurologically and systemically devastating, and can manifest as nonspecific back pain, making their correct diagnosis crucial for effective prognosis.

However, only a limited number of textbooks are available for clinicians and radiology trainees who are interested in embarking upon a self-learning course in imaging interpretations of spine and spinal cord tumors. With this point in mind, this book consists of three sections: warm-up part of basic concepts, tumor details, and practical tips for differential diagnosis. To enhance the readers' understanding, a total of 538 illustrations have been included.

There are several characteristic features of *Oncologic Imaging: Spine and Spinal Cord Tumors*. First, we describe the compartmental approach and histological basis of imaging appearances and then suggest the systemic approach to image interpretation for spine and spinal cord tumors in Part I. This section will be very useful for trainees in understanding the basic concepts of imaging interpretation for spine and spinal cord tumors. Second, we show the top three tumors for each compartment (e.g., intramedullary) or special condition (e.g., childhood), based on their incidence and clinical impact. For these top three tumors, we provide several cases for the readers to fully understand the imaging characters. Third, we attempt to cover all spine and spinal cord tumors that have been reported until recently according to Google search results, and we present these tumors in an alphabetical order with representative cases. This section will be useful as a quick reference when encountering difficult cases during routine practice. Finally, this book presents common confusing tumors with practical tips for differential diagnoses and case illustrations.

This book is intended for physicians and radiologists caring for patients with spine and spinal cord tumors. We hope that the readers will find this self-learning journey as richly rewarding as it has been for the authors over the course of its preparation.

Finally, we would like to thank Dr. Le Roy Chong for his assistance in editing the manuscript and our clinical fellows (Hoseok Lee, Yun Hee Cho, Yeon Jee Ko, Jiwoon Seo, Chi Young Park, and Yeon Hong Yoon) for their assistance in case preparation.

Seongnam, South Korea

Heung Sik Kang
Joon Woo Lee
Eugene Lee

Contents

Part I Warm-Up: Basic Concepts

1	Compartmental Approach to Spinal Tumors	3
1.1	Extradural Versus Intradural Tumor.....	3
1.2	Intradural Extradural Versus Intramedullary Tumor.....	4
1.3	Illustrations: Compartmental Approach to Spinal Tumors.....	5
1.3.1	Four Compartments of the Spine.....	5
1.3.2	Extradural Versus Intradural Tumor.....	6
1.3.3	Intradural Extradural Versus Intramedullary Tumor.....	8
	Bibliography.....	10
2	Histologic Basis for Imaging Appearances of Spinal Tumors	11
2.1	Tumors with Fatty Component.....	11
2.2	Red Marrow Component.....	12
2.3	Tumors with Vascular Component.....	12
2.4	Tumors with High Cellularity.....	12
2.5	Tumors with Hemorrhagic Component.....	12
2.6	Tumors with Calcification/Ossification.....	12
2.7	Illustrations: Histologic Basis for Imaging Appearances of Spinal Tumors.....	13
2.7.1	Tumors with Fatty Component.....	13
2.7.2	Red Marrow Component.....	15
2.7.3	Tumors with Vascular Component.....	17
2.7.4	Tumors with High Cellularity.....	20
2.7.5	Tumors with Hemorrhagic Component.....	22
2.7.6	Tumors with Calcification/Ossification.....	23
	Bibliography.....	24
3	Systematic Approach for Image Interpretation of Spinal Tumors	25
3.1	Intraosseous Tumors.....	25
3.1.1	Incidence-Based Approach for Intraosseous Tumors.....	26
3.1.2	Age-Based Approach for Intraosseous Tumors.....	26

3.1.3	Location-Based Approach for Intraosseous Tumors	26
3.1.4	Imaging Pattern-Based Approach for Intraosseous Tumors	26
3.2	Extradural Non-osseous Spinal Tumors.	26
3.2.1	Incidence-Based Approach for Extradural Non-osseous Tumors	26
3.2.2	Imaging Pattern-Based Approach for Extradural Non-osseous Tumors	26
3.3	Intradural Extramedullary (IDEM) Tumors.	27
3.3.1	Incidence-Based Approach for IDEM Tumors	27
3.3.2	Age-Based Approach for IDEM Tumors.	27
3.3.3	Location-Based Approach for IDEM Tumors	27
3.3.4	Imaging Pattern-Based Approach for IDEM Tumors	27
3.4	Intramedullary (IM) Tumors	27
3.4.1	Incidence-Based Approach of IM Tumors.	27
3.4.2	Age-Based Approach for IM Tumors	27
3.4.3	Location-Based Approach for IM Tumors.	27
3.4.4	Imaging Pattern-Based Approach for IM Tumors	27
3.4.5	IM Tumors Versus Non-tumorous Myelopathy	28
3.5	Infant/Childhood Spinal Tumors	28
	Bibliography	28

Part II Advanced Steps: Tumor Details

4	Top 3 Spinal Tumors of Each Compartment	31
4.1	Intraosseous Tumors	31
4.1.1	Hemangioma	31
4.1.1.1	Illustrations: Hemangioma	33
4.1.2	Metastasis.	35
4.1.2.1	Illustrations: Metastasis	36
4.1.3	Multiple Myeloma	40
4.1.3.1	Illustrations: Multiple Myeloma	41
4.2	Extradural Non-osseous Tumors or Tumorlike Lesions	43
4.2.1	Schwannoma	43
4.2.1.1	Illustrations: Schwannoma	44
4.2.2	Neurofibroma.	47
4.2.2.1	Illustrations: Neurofibroma.	48
4.2.3	Herniated Intervertebral Disc (HIVD) (Sequestration).	51
4.2.3.1	Illustrations: HIVD (Sequestration)	52
4.3	Intradural Extramedullary (IDEM) Tumors.	55
4.3.1	Schwannoma	55
4.3.1.1	Illustrations: Schwannoma	56
4.3.2	Meningioma.	59
4.3.2.1	Illustrations: Meningioma.	60
4.3.3	Myxopapillary Ependymoma.	62
4.3.3.1	Illustrations: Myxopapillary Ependymoma	63

- 4.4 Intramedullary (IM) Tumors 66
 - 4.4.1 Ependymoma 66
 - 4.4.1.1 Illustrations: Ependymoma 67
 - 4.4.2 Astrocytoma 70
 - 4.4.2.1 Illustrations: Astrocytoma 71
 - 4.4.3 Hemangioblastoma 74
 - 4.4.3.1 Illustrations: Hemangioblastoma 75
- 4.5 Multi-compartment Tumors 77
 - 4.5.1 Lymphoma 77
 - 4.5.1.1 Illustrations: Lymphoma 78
 - 4.5.2 Leukemia 80
 - 4.5.2.1 Illustrations: Leukemia 81
 - 4.5.3 Hemangioma 84
 - 4.5.3.1 Illustrations: Hemangioma 85
- 4.6 Infant/Childhood Spinal Tumors 86
 - 4.6.1 Sacrococcygeal Teratoma 86
 - 4.6.1.1 Illustrations: Sacrococcygeal Teratoma 87
 - 4.6.2 Langerhans Cell Histiocytosis 89
 - 4.6.2.1 Illustrations: Langerhans
Cell Histiocytosis 90
 - 4.6.3 Ewing’s Sarcoma 93
 - 4.6.3.1 Illustrations: Ewing’s Sarcoma 94
- Bibliography 96

**5 Common Spinal Tumors Outside the Top 3 Lists
(in Alphabetical Order) 99**

- 5.1 Aneurysmal Bone Cyst (ABC) 99
 - 5.1.1 Illustrations: Aneurysmal Bone Cyst (ABC) 100
- 5.2 Benign Notochordal Cell Tumor (BNCT) 101
 - 5.2.1 Illustrations: Benign Notochordal Cell Tumor
(BNCT) 102
- 5.3 Bone Island 105
 - 5.3.1 Illustrations: Bone Island 106
- 5.4 Cavernous Malformation (Intramedullary Cavernous
Hemangioma, Cavernoma) 109
 - 5.4.1 Illustrations: Cavernous Malformation 110
- 5.5 Chondrosarcoma 114
 - 5.5.1 Illustrations: Chondrosarcoma 115
- 5.6 Chordoma 119
 - 5.6.1 Illustrations: Chordoma 120
- 5.7 Giant Cell Tumor 123
 - 5.7.1 Illustrations: Giant Cell Tumor 124
- 5.8 Lipoma 128
 - 5.8.1 Illustrations: Lipoma 129
- 5.9 Osteoblastoma 132
 - 5.9.1 Illustrations: Osteoblastoma 133
- 5.10 Osteochondroma 136
 - 5.10.1 Illustrations: Osteochondroma 137

5.11	Osteoid Osteoma	140
5.11.1	Illustrations: Osteoid Osteoma	141
5.12	Osteosarcoma	144
5.12.1	Illustrations: Osteosarcoma	145
5.13	Plasmacytoma	147
5.13.1	Illustrations: Plasmacytoma	148
	Bibliography	151
6	Rare But Interesting Spinal Tumors	
	(in Alphabetical Order)	153
6.1	Angiolipoma	153
6.1.1	Illustrations: Angiolipoma	154
6.2	Atypical Teratoid/Rhabdoid Tumor (ATRT)	155
6.2.1	Illustrations: Atypical Teratoid/Rhabdoid Tumor (ATRT)	156
6.3	Chondroblastoma	157
6.3.1	Illustrations: Chondroblastoma	158
6.4	Epidural Hemangioma	159
6.4.1	Illustrations: Epidural Hemangioma	160
6.5	Epithelioid Angiosarcoma	163
6.5.1	Illustrations: Epithelioid Angiosarcoma	164
6.6	Epithelioid Hemangioendothelioma	166
6.6.1	Illustrations: Epithelioid Hemangioendothelioma	167
6.7	Ganglioglioma	168
6.7.1	Illustrations: Ganglioglioma	169
6.8	Ganglioneuroma	170
6.8.1	Illustrations: Ganglioneuroma	171
6.9	Undifferentiated Pleomorphic Sarcoma	172
6.9.1	Illustrations: Undifferentiated Pleomorphic Sarcoma	173
6.10	Malignant Peripheral Nerve Sheath Tumor	175
6.10.1	Illustrations: Malignant Peripheral Nerve Sheath Tumor	176
6.11	Oligodendroglioma	177
6.11.1	Illustrations: Oligodendroglioma	178
6.12	Paraganglioma	179
6.12.1	Illustrations: Paraganglioma	180
6.13	Primitive Neuroectodermal Tumor (PNET)	181
6.13.1	Illustrations: Primitive Neuroectodermal Tumor (PNET)	182
6.14	Solitary Fibrous Tumor (Hemangiopericytoma)	183
6.14.1	Illustrations: Solitary Fibrous Tumor (Hemangiopericytoma)	184
6.15	Teratoma	186
6.15.1	Illustrations: Teratoma	187
	Bibliography	188

7	Other Tumor-like Lesions	191
7.1	Epidural Abscess	191
7.1.1	Illustrations: Epidural Abscess	193
7.2	Arachnoid Cyst	195
7.2.1	Illustrations: Arachnoid Cyst.....	196
7.3	Arachnoiditis	198
7.3.1	Illustrations: Arachnoiditis.....	199
7.4	Cysticercosis	200
7.4.1	Illustrations: Cysticercosis.....	201
7.5	Discal Cyst.....	202
7.5.1	Illustrations: Discal Cyst	203
7.6	Echinococcosis.....	204
7.7	Extramedullary Hematopoiesis	204
7.7.1	Illustrations: Extramedullary Hematopoiesis.....	205
7.8	(Vertebral Tophaceous) Gout.....	207
7.8.1	Illustrations: (Vertebral Tophaceous) Gout	208
7.9	Idiopathic Hypertrophic Pachymeningitis	209
7.9.1	Illustrations: Idiopathic Hypertrophic Pachymeningitis	210
7.10	Perineural (Root Sleeve) Cyst	212
7.10.1	Illustrations: Perineural (Root Sleeve) Cyst.....	213
7.11	Pigmented Villonodular Synovitis (PVNS).....	214
7.11.1	Illustrations: Pigmented Villonodular Synovitis (PVNS).....	215
7.12	(Focal) Red Marrow (Hematopoietic Marrow)	216
7.12.1	Illustrations: (Focal) Red Marrow (Hematopoietic Marrow)	217
7.13	Retro-odontoid (Periodontoid) Pseudotumor.....	218
7.13.1	Illustrations: Retro-odontoid (Periodontoid) Pseudotumor	219
7.14	Facet Synovial Cyst	220
7.14.1	Illustrations: Facet Synovial Cyst	221
7.15	Tuberculosis.....	223
7.15.1	Illustrations: Tuberculosis	224
7.16	Ventriculus Terminalis	225
7.16.1	Illustrations: Ventriculus Terminalis	226
	Bibliography	227

Part III Final Steps: Differential Diagnosis

8	Practical Tips for Differential Diagnosis	231
8.1	Focal Red Marrow Versus Metastasis	232
8.2	Hemangioma Versus Benign Notochordal Cell Tumor (BNCT).....	233
8.3	Aggressive Hemangioma Versus Metastasis	234
8.4	Hemangioma Versus Focal Fat Deposition	235

8.5	Metastasis Versus Schmorl's Node	236
8.6	Osteoblastic Metastasis Versus Bone Island	237
8.7	Ependymoma Versus Astrocytoma	238
8.8	Multiple Myeloma Versus Lymphoma.	239
8.9	Intramedullary Metastasis Versus Ependymoma.	240
8.10	Hemangioblastoma Versus Vascular Malformation.	241
8.11	Schwannoma Versus Meningioma.	242
8.12	Herniated Intervertebral Disc (Sequestration) Versus Schwannoma.	243
8.13	Sacral Tumors: Chordoma Versus Giant Cell Tumor	244
8.14	Spinal Cord Tumor Versus Non-tumorous Myelopathy	245
8.15	Osteoblastoma Versus Osteosarcoma	246
8.16	Chondrosarcoma Versus Osteosarcoma.	247
8.17	Primary Versus Secondary Aneurysmal Bone Cyst (ABC).	248

Part I

Warm-Up: Basic Concepts

Contents

1.1	Extradural Versus Intradural Tumor	3
1.2	Intradural Extramedullary Versus Intramedullary Tumor	4
1.3	Illustrations: Compartmental Approach to Spinal Tumors	5
1.3.1	Four Compartments of the Spine	5
1.3.2	Extradural Versus Intradural Tumor	6
1.3.3	Intradural Extramedullary Versus Intramedullary Tumor	8
	Bibliography	10

The first step in the compartmental approach to spinal tumors is to determine if the lesion is intraosseous, extradural, intradural extramedullary (IDEM), or intramedullary (IM) in location. The possible differential diagnoses and optimal surgical approaches of these tumors are different depending on their compartmental location. In most cases it is not difficult to identify the compartment in which these tumors are situated on MRI, although it can be confusing in some instances. In the chapter, we will discuss radiological clues that can be helpful in localizing the compartment to which these tumors belong.

1.1 Extradural Versus Intradural Tumor

The main clues favoring an extradural tumor are extrinsic dural sac compression and tumor extension into the neural foramen. With severe tumor compression of the dural sac, however, it can be difficult to tell if the dural/cord compression is extrinsic (by an extradural tumor) or due to a space occupying lesion within the dura (by an intradural tumor). The clue that points toward an extradural tumor lies in the appearance of the subarachnoid space at the margin of the tumor; due to extrinsic compression of the dura, the subarachnoid space between the dura and spinal cord is obliterated at its margin of the tumor. With an intradural tumor, the dura bulges out instead with

a convex appearance, while the cord is compressed by the tumor, resulting in widening of the subarachnoid space at the edge of the tumor.

1.2 Intradural Extramedullary Versus Intramedullary Tumor

The clue that can be used to differentiate an extramedullary from an intramedullary tumor lies in the appearance of the outer contour of the spinal cord at the margin of the tumor. With an extramedullary tumor, the outer contour of the spinal cord at the interface with the tumor is indented upon and compressed by the tumor

resulting in widening of the subarachnoid space, whereas with an intramedullary tumor the outer contour of the spinal cord has a convex bulge resulting in narrowing of the subarachnoid space.

Exophytic intramedullary tumors can occasionally be confusing and mimic appearances of extramedullary tumors, especially in the lower thoracic spinal cord and conus medullaris. In such cases, the axial images have to be reviewed carefully. With intramedullary tumors part of the tumor can be shown to be contiguous with the spinal cord, and if this can be established, it can be concluded that the tumor originates from the spinal cord.

1.3 Illustrations: Compartmental Approach to Spinal Tumors

1.3.1 Four Compartments of the Spine

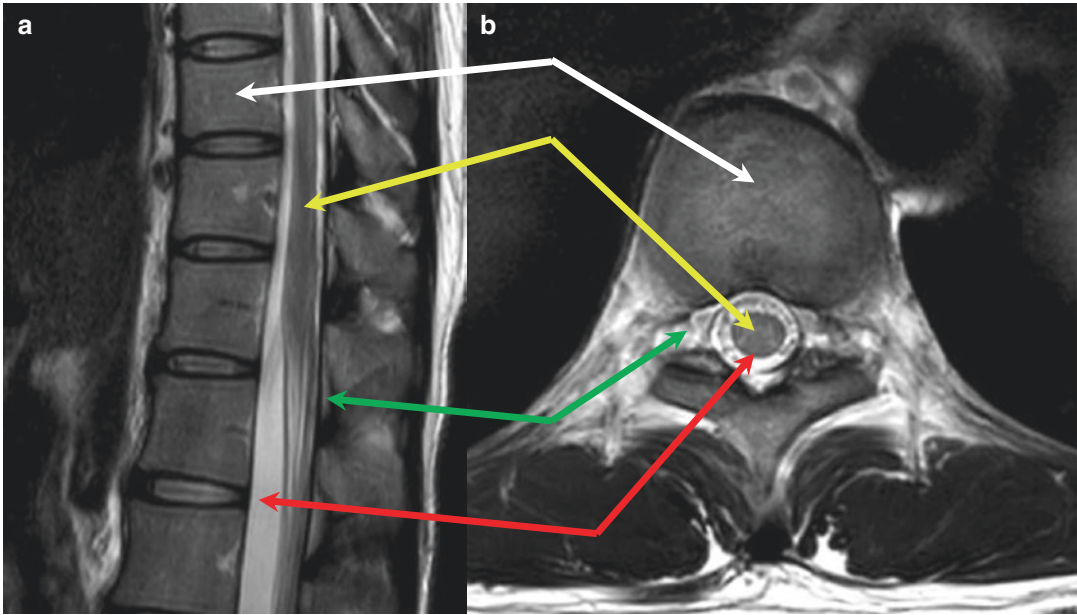


Fig. 1.1 The concept of compartmental locations of the spine on the T2-weighted magnetic resonance (MR) images, sagittal (a) and axial (b) scans. The compartments are

composed of four different locations: intraosseous (*white arrow*), intramedullary (IM, *yellow arrow*), extradural space (*green arrow*), and intradural extramedullary (*red arrow*)

1.3.2 Extradural Versus Intradural Tumor

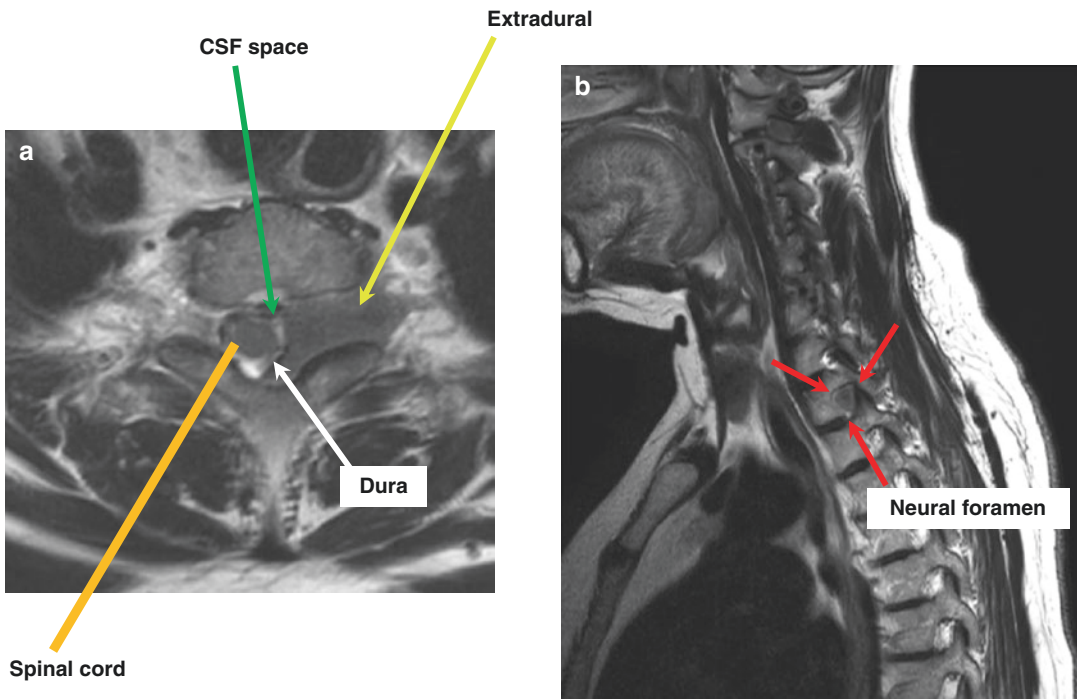


Fig. 1.2 An approximately 2 cm extradural mass encasing the left T1 nerve root in a 58-year-old female. The axial T2-weighted image (a) shows extrinsic dural sac compression (*white arrow*) and tumor extension to the neural foramen (*yellow arrow*). The subarachnoid

space between the dura and spinal cord (*green arrow*) is obliterated at the margin of the tumor due to extrinsic compression by the tumor. The sagittal T2-weighted image (b) shows widening of the neural foramen due to tumor extension

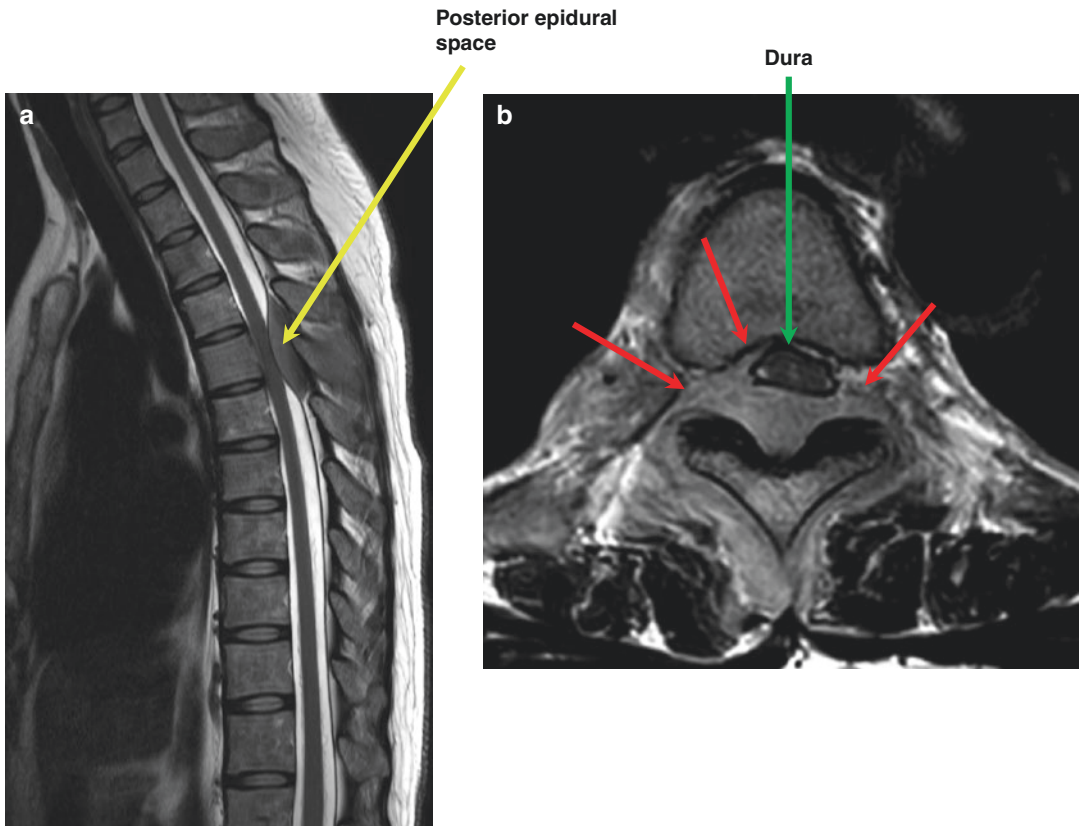


Fig. 1.3 Known B-lymphoblastic lymphoma involvement of the extradural space from T4 to T6 in a 48-year-old female. (a) Tumor is mainly located in the posterior epidural space with dural sac compression (yellow arrow). The subarachnoid space is obliterated anteroposteriorly

with mild cord compression. (b) Axial T2-weighted MR image shows severe tumor compression of the dural sac (green arrow). Tumor also extends into the bilateral neural foramen and anterior epidural space (red arrows)

1.3.3 Intradural Extramedullary Versus Intramedullary Tumor

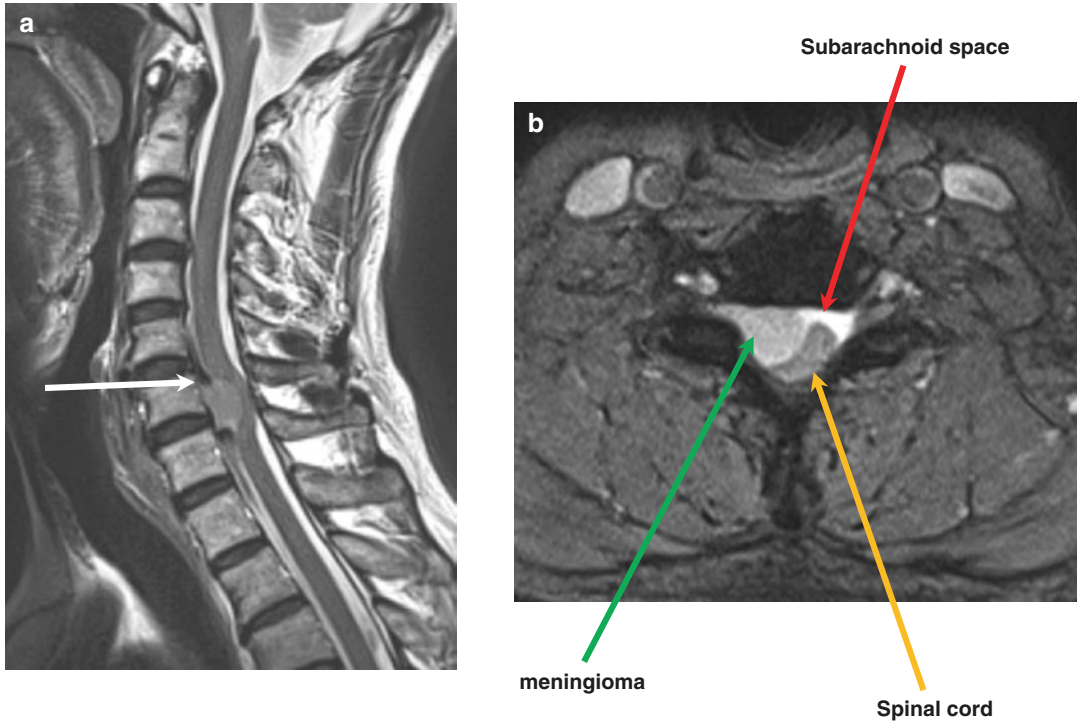


Fig. 1.4 An approximately 1.5 cm intradural extramedullary (IDEM) mass at C6–C7 spinal level in a 63-year-old female. (a) The sagittal T2-weighted image shows a high signal intensity mass with “dural tail sign” (*white arrow*) combined with craniocaudal flow artifact. There is severe cord compression by the tumor. (b) On the axial T2-weighted MR image, there is left-sided cord deviation

with signal change indicating compressive myelopathy (*yellow arrow*). The outer contour of the spinal cord at the interface with the tumor is indented and compressed by the tumor resulting in widening of the subarachnoid space (*red arrow*). All these findings (a, b) are compatible with an intradural extramedullary tumor, such as a meningioma

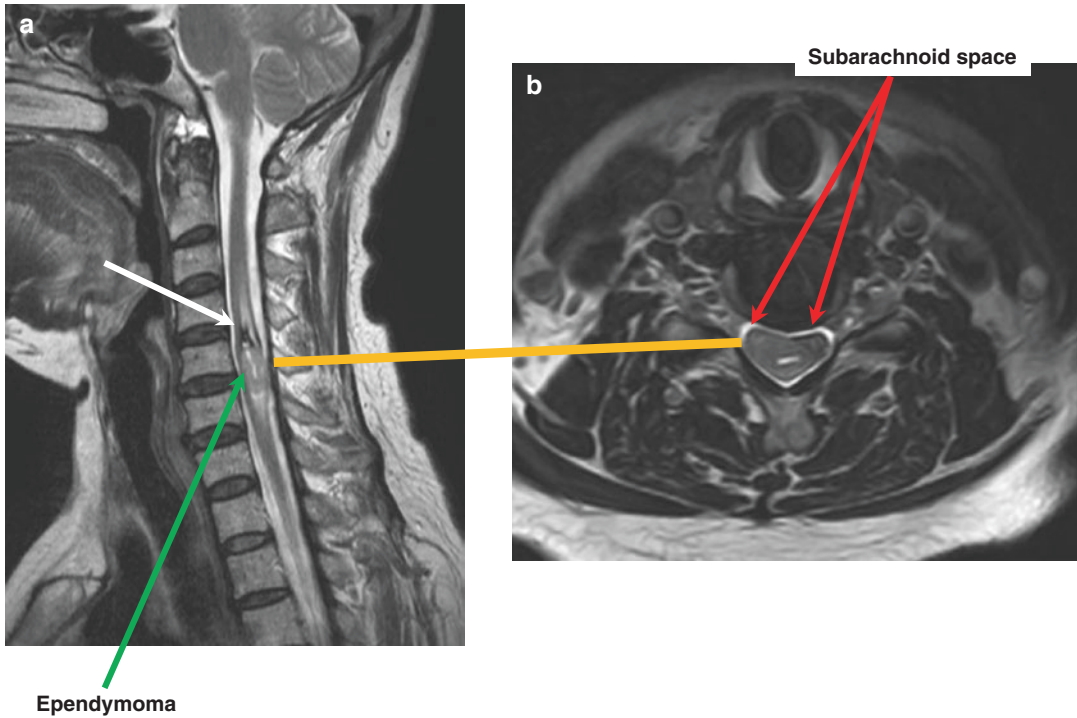


Fig. 1.5 Intraductal ependymoma at C5–C6 spinal level (*green arrow*) in a 37-year-old female. **(a)** The sagittal T2-weighted MR image shows a 1.5 cm well-defined intramedullary mass with surrounding cord edema and hemosiderin deposition (“hemosiderin cap”) at its cranial

aspect (*white arrow*). **(b)** The axial T2-weighted MR image shows that the outer contour of the spinal cord has a convex bulge resulting in narrowing of the subarachnoid space (*red arrow*)

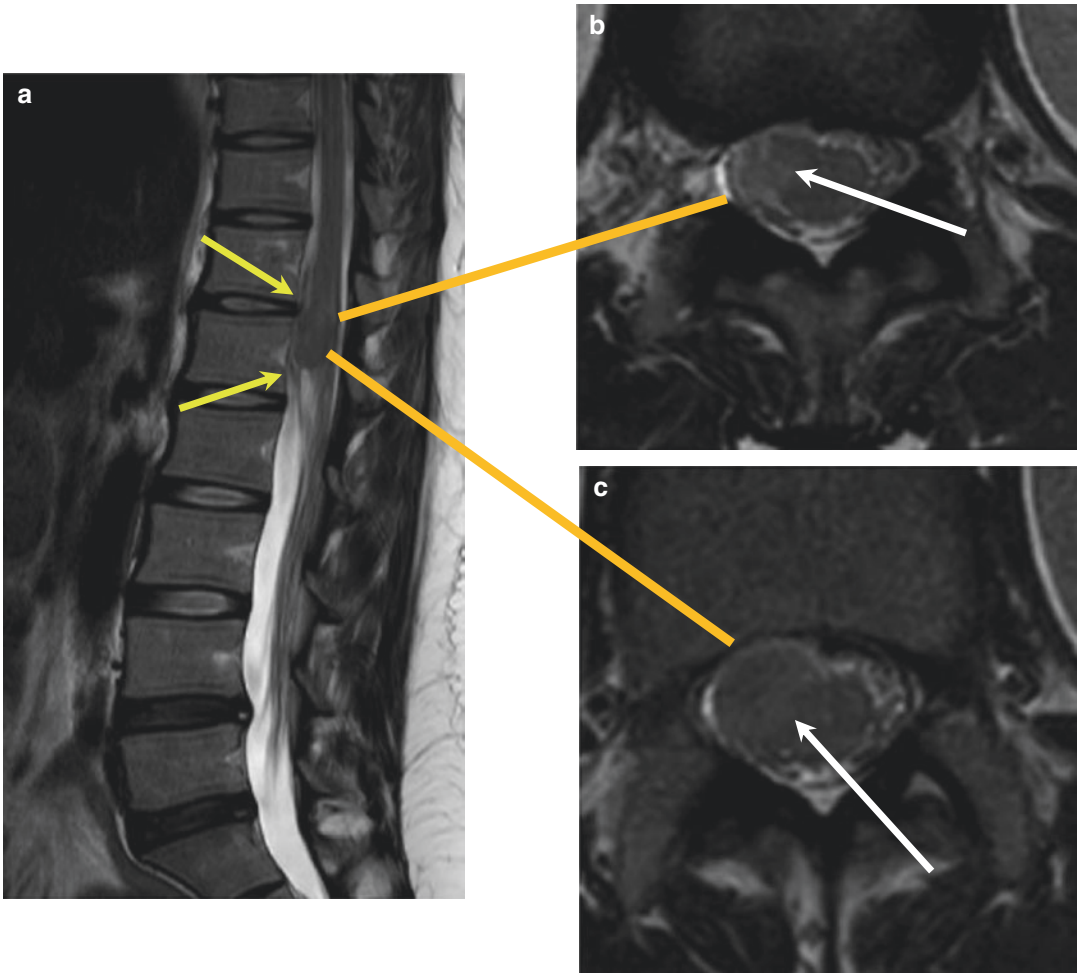


Fig. 1.6 Exophytic intramedullary tumor at the conus medullaris in a 46-year-old female. **(a)** On the sagittal T2-weighted image, the tumor mimics appearance of an intradural extramedullary tumor with cord compression

(yellow arrow). **(b, c)** The axial T2-weighted MR images show that part of the tumor is contiguous with the spinal cord (white arrows), and it can be concluded that the tumor originates from the spinal cord

Bibliography

- Kang HS, Lee JW, Kwon JW. Radiology illustrated: spine. Heidelberg: Springer Science & Business Media; 2014.
- Kim DH, Chang U-K, Kim S-H, Bilsky MH. Tumors of the spine. Philadelphia: Elsevier Health Sciences; 2008.

- Merhemic Z, Stolic-Opincal T, Thurnher MM. Neuroimaging of spinal tumors. Magn Reson Imaging Clin N Am. 2016;24(3):563–79. doi:10.1016/j.mric.2016.04.007.
- Ross JS, Moore KR. Diagnostic imaging: spine. Philadelphia: Elsevier Health Sciences; 2015.
- Cramer GD, Darby SA. Clinical anatomy of the spine, spinal cord, and ANS. Philadelphia: Elsevier Health Sciences, 2013.

Contents

2.1	Tumors with Fatty Component	11
2.2	Red Marrow Component	12
2.3	Tumors with Vascular Component	12
2.4	Tumors with High Cellularity	12
2.5	Tumors with Hemorrhagic Component	12
2.6	Tumors with Calcification/Ossification	12
2.7	Illustrations: Histologic Basis for Imaging Appearances of Spinal Tumors	13
2.7.1	Tumors with Fatty Component	13
2.7.2	Red Marrow Component	15
2.7.3	Tumors with Vascular Component	17
2.7.4	Tumors with High Cellularity	20
2.7.5	Tumors with Hemorrhagic Component	22
2.7.6	Tumors with Calcification/Ossification	23
	Bibliography	24

It is important to understand the histologic basis for the imaging appearances of spinal tumors in order to arrive at the correct diagnosis or formulate reasonable differential diagnoses. For example, hemangiomas in the vertebral bodies commonly contain fatty stroma and reveal high T1 and T2 signal on MR imaging, which is the main clue for its diagnosis. Highly cellular tumors such as lymphomas show intermediate signal intensity on T2-weighted images, which is also a clue for its diagnosis.

2.1 Tumors with Fatty Component

Fatty components within tumors show high signal on T1-weighted and T2-weighted MR images and can be suppressed with fat suppression MR techniques. The most common tumor containing fatty component is a hemangioma. If we see a fat-containing tumor in the vertebral body, the most probable diagnosis is that of a hemangioma. However, note that in contrast to vertebral hemangiomas, epidural hemangiomas do not show fatty signal in most cases. The most common fat-containing tumor in the epidural space is an angiolipoma, while the most common fat-containing tumors in the paravertebral muscles are lipomas and liposarcomas.

2.2 Red Marrow Component

Red marrow hyperplasia can mimic bony metastasis. Red marrow can show intermediate signal on T1-weighted images with patchy areas of slight enhancement. The signal of red marrow should be isointense or hyperintense to that of the intervertebral disc on T1-weighted images. Similar signal can be seen in multiple myeloma; however, multiple myelomas show strong enhancement in most cases.

2.3 Tumors with Vascular Component

Vascular components of spinal tumors show strong enhancement similar to those seen in venous structures on MRI. Usually, these vascular components show high signal intensity on T2-weighted images; however, in cases of intratumoral hemorrhage areas of low signal intensity can be seen on T2-weighted images. Common vascular tumors of the bony vertebrae include hemangiomas, telangiectatic osteosarcomas, and aneurysmal bone cysts. The common vascular tumors in the epidural space are hemangiomas and angioliipomas. The most common vascular tumor in the intradural extramedullary space is a paraganglioma, and the most common vascular tumor in the spinal cord is a hemangioblastoma.

2.4 Tumors with High Cellularity

Highly cellular components of tumors show intermediate signal intensity on T2-weighted images and demonstrate enhancement. This is often seen in lymphomas and meningiomas and can be found in some highly cellular metastases or sarcomas.

2.5 Tumors with Hemorrhagic Component

Hemorrhagic components within tumors can show variable signal intensity depending on the stage of bleeding. Chronic repetitive bleeding can result in hemosiderin deposition within or around the tumor. Hemosiderin is of dark signal on T1-weighted and T2-weighted images. Such signal change can be exaggerated on gradient echo images due to susceptibility blooming artifacts.

2.6 Tumors with Calcification/Ossification

Calcification/ossification can be more easily and reliably detected on CT compared to MR images, demonstrating high attenuation on CT images while on MRI showing low signal intensities on all sequences. Intratumoral calcifications can be seen in chondrosarcomas and meningiomas, while intratumoral ossification can be found in osteoblastomas and osteosarcomas.

2.7 Illustrations: Histologic Basis for Imaging Appearances of Spinal Tumors

2.7.1 Tumors with Fatty Component

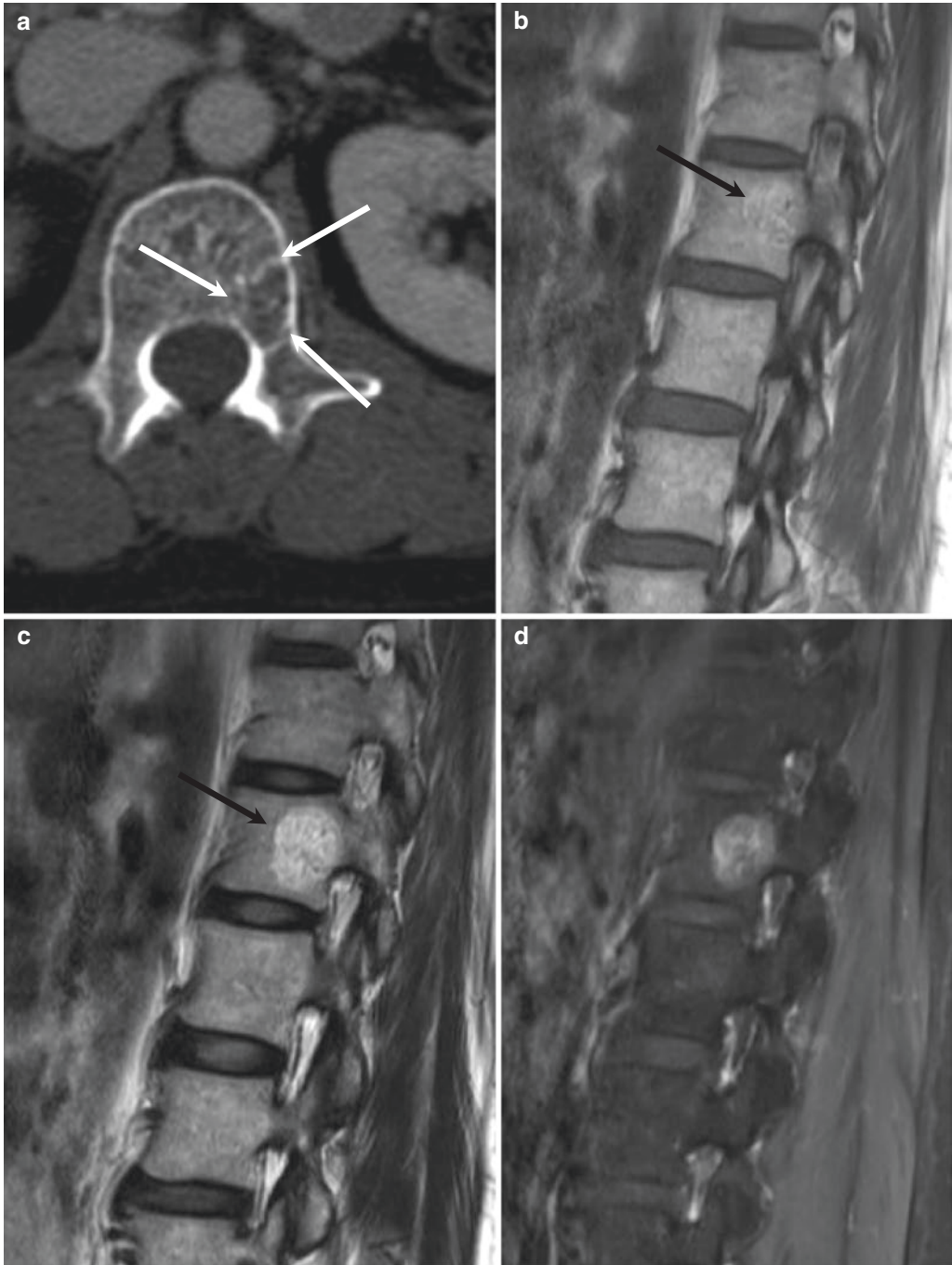


Fig. 2.1 Hemangioma at L1 vertebra in a 57-year-old woman. Axial CT scan of lumbar spine (a) shows an osteolytic lesion in the left posterior corner of the vertebral body with internal dot-like trabeculation (white arrows). T1-weighted sagittal

(b) and T2-weighted sagittal (c) MR images show high signal intensities indicating internal fat component with preserved coarse trabeculation (black arrows). Contrast-enhanced T1-weighted sagittal MR image (d) shows avid enhancement