Radiation Oncology Emergencies: Spinal Cord Compression and The “Others”

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Overview

- Epidemiology and pathophysiology of Epidural Spinal Cord Compression (ESCC)
- Presenting symptoms and work-up
- Treatment
  - Frameworks, algorithms, guidelines
- The “Others”
- Questions

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ESCC is evidence of epidural extension of tumor with neurologic symptoms

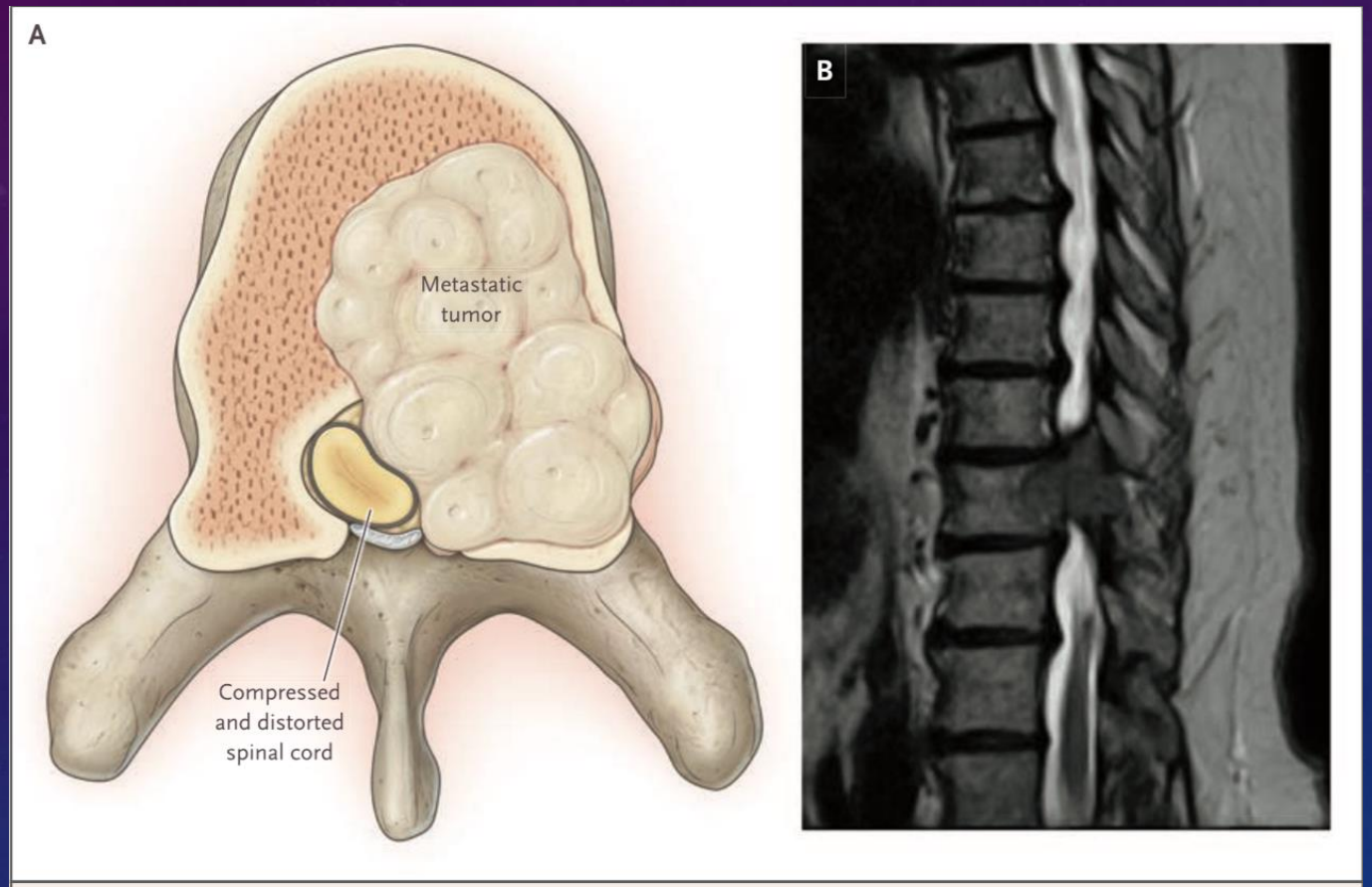
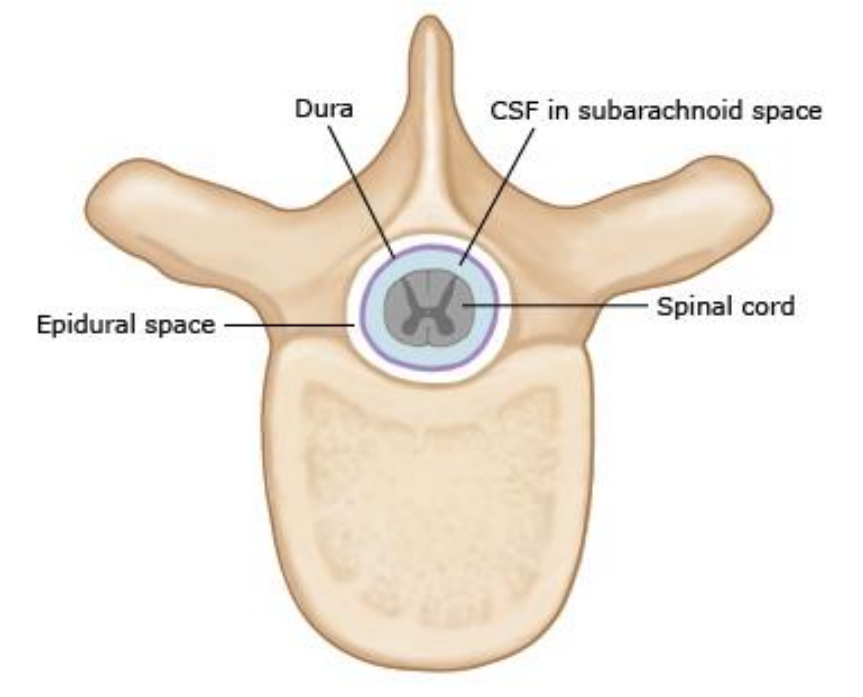


Figure 2. Acute Cord Compression Due to Metastatic Cancer to a Vertebral Body.

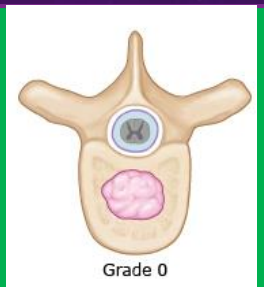
An axial view (Panel A) shows a thoracic vertebral body infiltrated by a metastatic tumor. The tumor extends from the bone and narrows the spinal canal, causing distortion and compression of the spinal cord (see the interactive graphic, available at NEJM.org). A parasagittal view of a T_2-weighted MRI (Panel B) shows metastasis of renal cancer to the T10 vertebral body and pedicle, causing severe narrowing of the spinal canal.

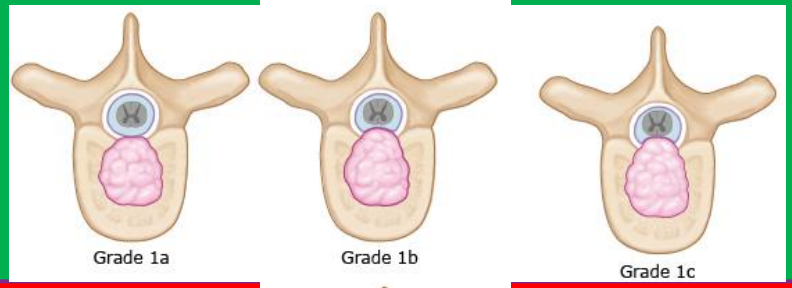
Ropper and Ropper. Acute Spinal Cord Compression. NEJM

ESCC Bilsky scale is based on how much the cord is compressed



Low grade



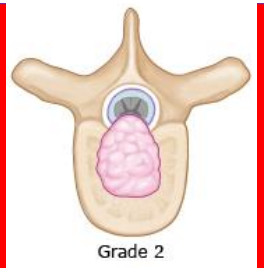


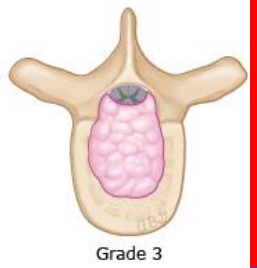
Grade 0: Only bone

Grade 1: Epidural without compression

a. Epidural extension
b. Thecal sac deformation
c. Cord abutment

High grade

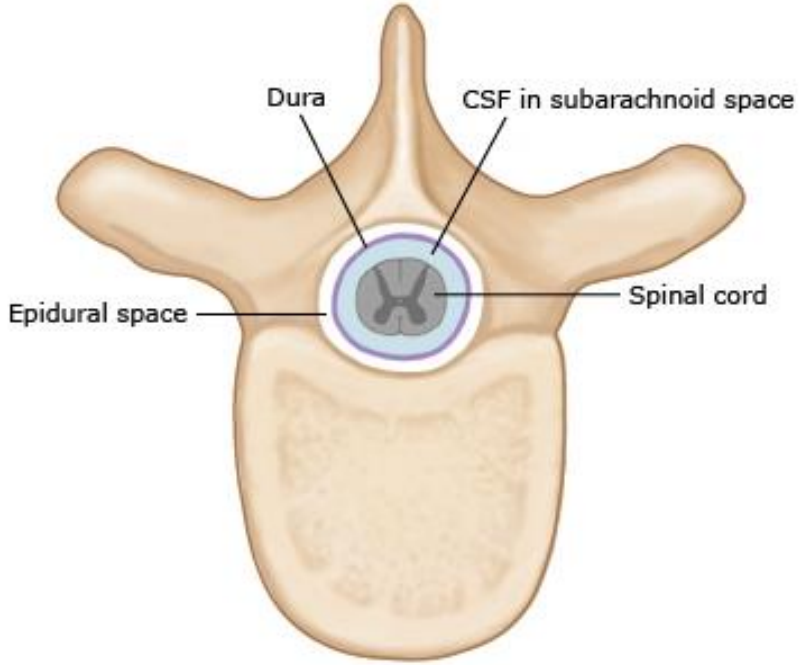




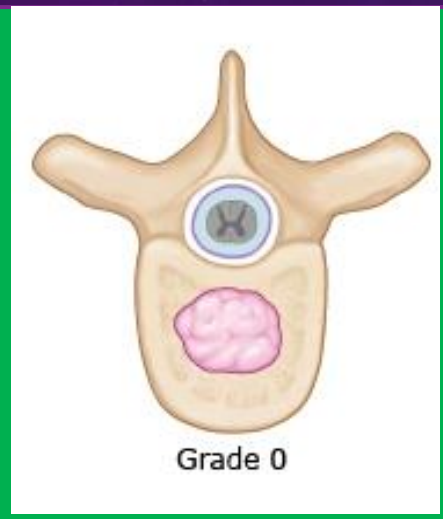
Grade 2: Compression with CSF visible around cord

Grade 3: Around cord/no visible CSF

ESCC Bilsky scale is based on how much the cord is compressed



Low grade



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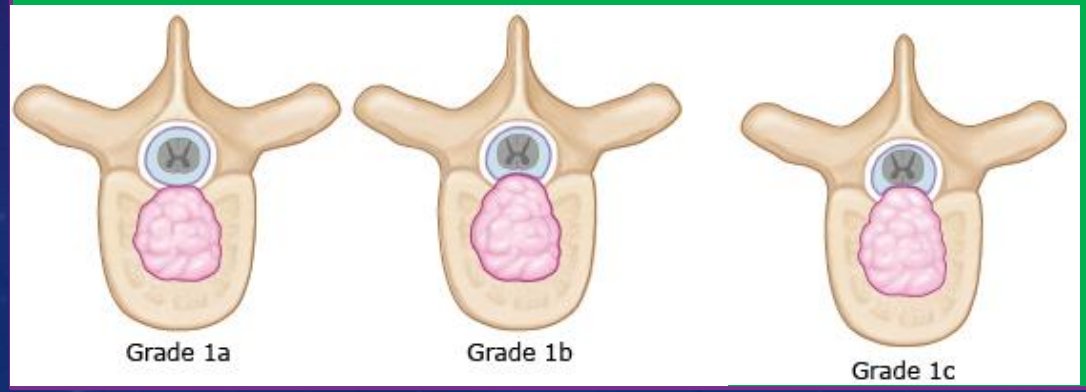

Grade 1: Epidural without compression

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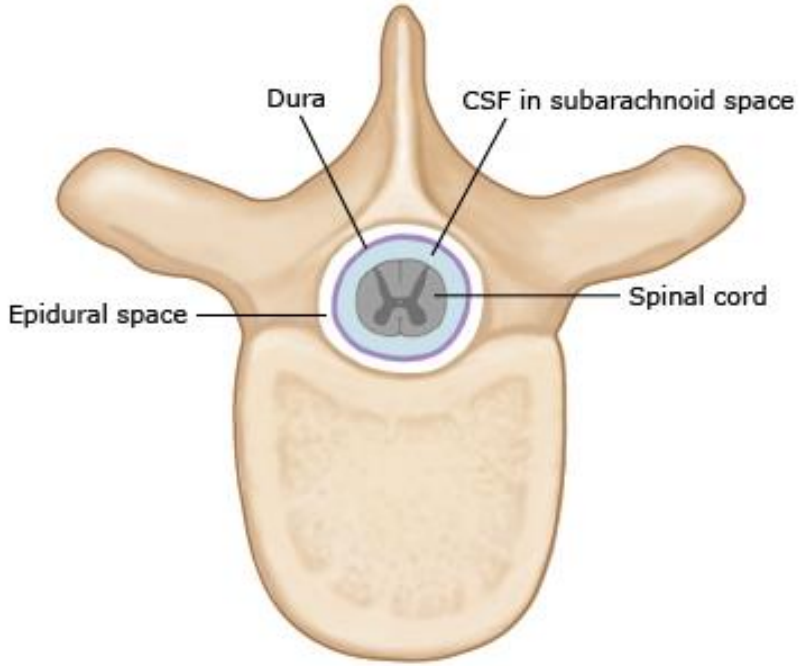
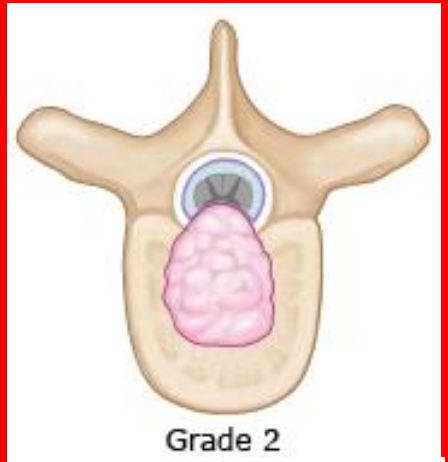
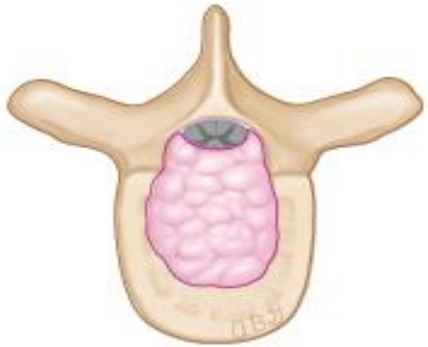


High grade


Grade 2


Grade 3

Grade 2: Compression with CSF visible around cord

Grade 3: Around cord/no visible CSF

Common cancers lead to cord compression

- From hospitalizations for ESCC from 1998-2006, the primary cancer was:
  - lung cancer (24.9%)
  - prostate cancer (16.2%)
  - multiple myeloma (11.1%)
  - breast cancer (7%)
- From people who died of each cancer, annual incidence rates of ESCC:
  - multiple myeloma (15%)
  - lymphoma (7%)
  - prostate and kidney (5%)

Mak et al 2011

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Common symptoms of cord compression

- Back pain (80-95%)
- Motor weakness (30-75%)
- Sensory deficits
- Bladder/Bowel dysfunction
- Ataxia
- Cauda Equina Syndrome (urinary retention, incontinence, saddle anesthesia, Lower extremity weakness, pain)

Lawton et al. 2018

Workup for ESCC includes:

- Physical exam
- MRI total spine with and without contrast
  - Multifocal cord involvement possible
  - Physical exam and symptoms do **not** correlate with location
  - Contrast is for delineation of leptomeningeal or intramedullary tumor
  - CT myelography if MRI is contraindicated

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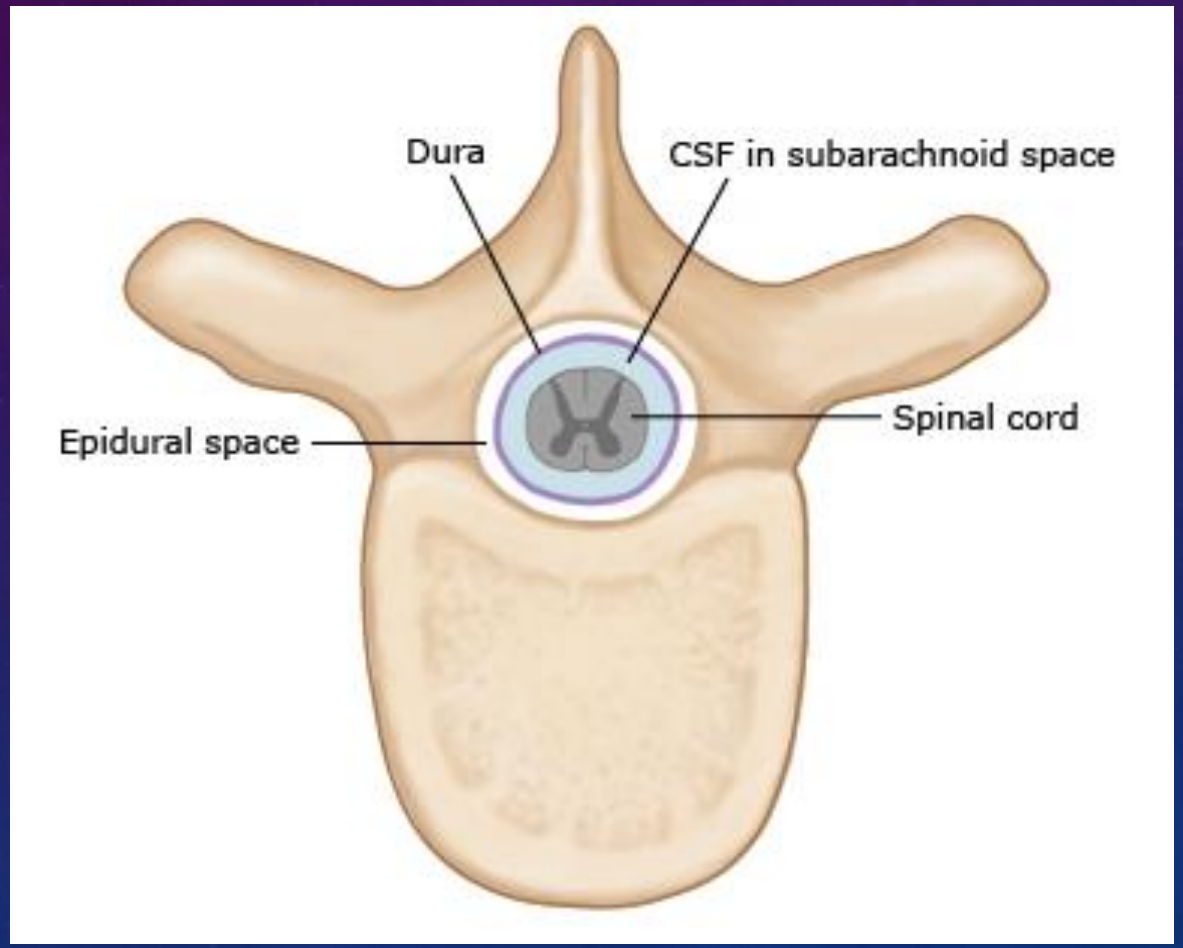
Treatment for cord compression

- Corticosteroids (Dexamethasone)
- Surgery
- Radiation
  - External beam
  - Stereotactic Body Radiotherapy (SBRT)
- Also:
  - Pain management
  - DVT prophylaxis
  - Urinary/bowel regimen

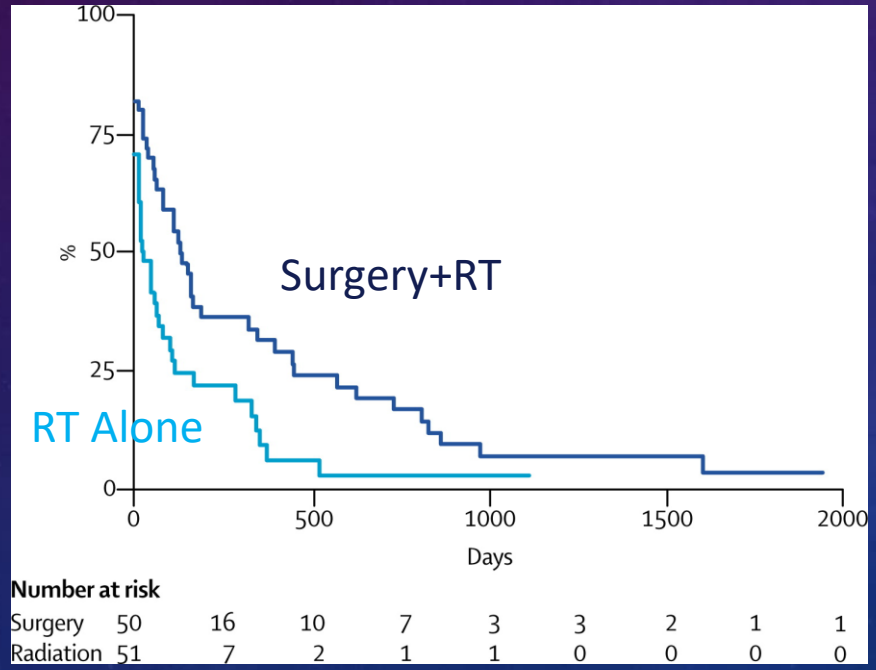
Corticosteroids reduce vascular congestion and edema



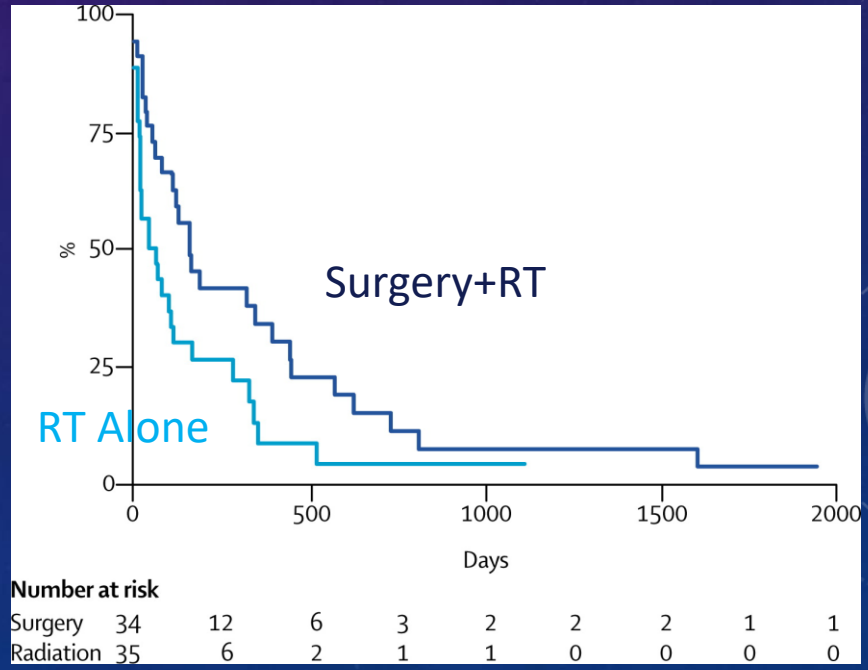
The epidural space contains fat and venous plexus

Patchell 2005 was a phase III RCT that showed surgical decompression + postop RT was superior to RT alone

% patients ambulatory (overall)



% patients ambulatory (started ambulatory)



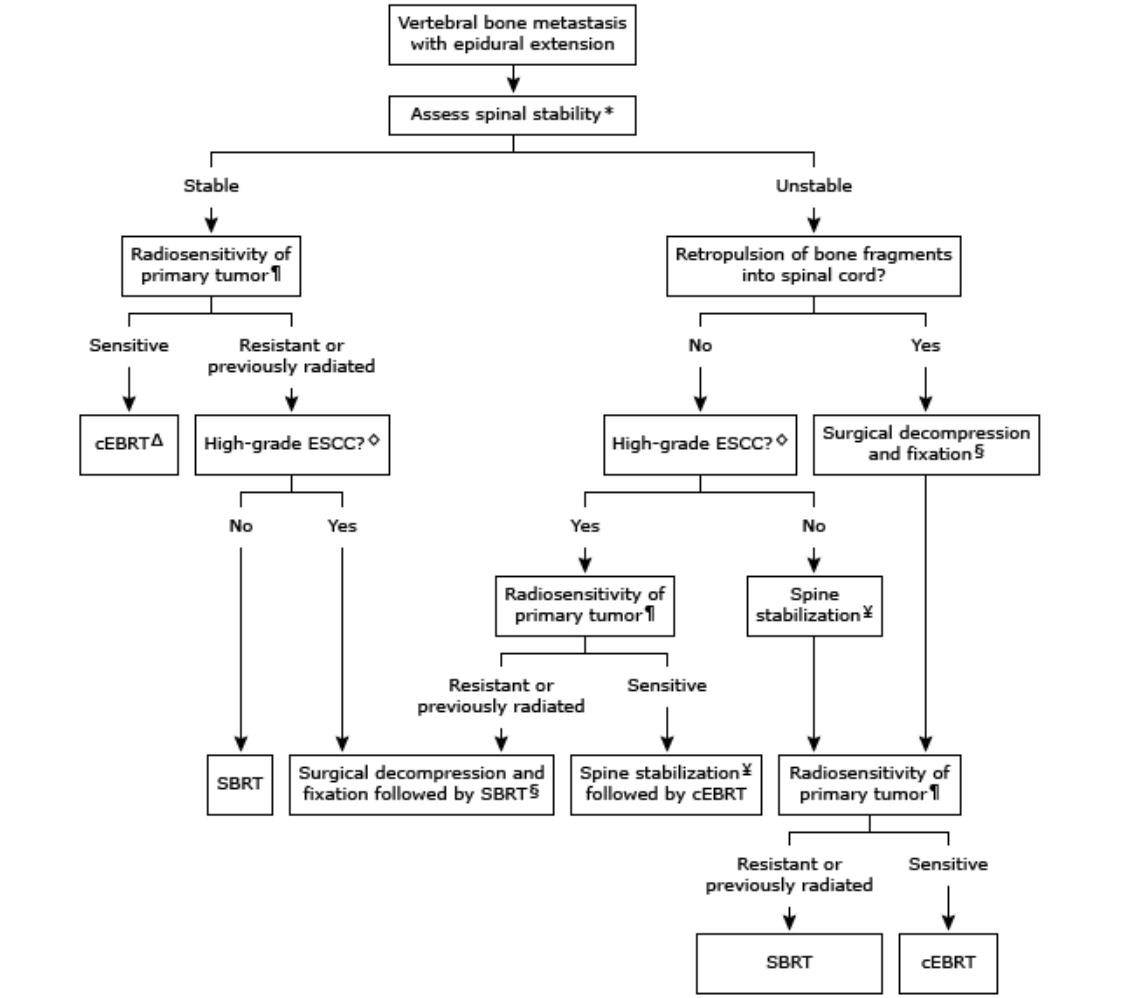
Patchell et al. Lancet. 2005 Aug 20-26;366(9486):643-8.

Framework 1: MSK/Uptodate

- Neurologic: Exam + Imaging
- Oncologic: Radioresistant vs Radiosensitive
- Mechanical: Stable vs unstable
- Systemic: Life expectancy

Radiosensitive tumors	Radioresistant tumors
▪ Lymphoma ▪ Myeloma ▪ Small cell lung cancer ▪ Germ cell tumors ▪ Prostate cancer ▪ Breast cancer ▪ Ovarian cancer	▪ Melanoma ▪ Renal cell carcinoma ▪ Non-small cell lung cancer ▪ Gastrointestinal cancers ▪ Sarcoma

Framework 2: Uptodate algorithm



SBRT if radioresistant or previously irradiated; surgery first if high grade compression or unstable

Framework 3: NCCN Guidelines

Spinal cord compression[g] → Steroids[h] →

- Surgery[k,l,m] ± stabilization followed by RT[n] (category 1)
- or
- Primary RT[n]
- or
- In the absence of clinical myelopathy, primary chemotherapy[f] if chemosensitive tumor (eg, lymphoma, germ cell tumor, myeloma)

[n]Recommend SRS if oligometastases and radioresistant. See Principles of Brain and Spinal Cord Tumor Radiation Therapy (BRAIN-C).

- **General Treatment Information**
  - Doses to vertebral body metastases will depend on patient's PS, spine stability, location in relationship to spinal cord, primary histology, presence of epidural disease, and overall treatment intent (pain relief, long-term local control, or cure).
  - Stereotactic radiation approaches (SRS/stereotactic body radiotherapy [SBRT]) for spinal cases may be preferred for patients with oligometastatic disease where tumor ablation is a goal of treatment and in tumors considered radioresistant (eg, renal cell, melanoma, sarcoma, hepatocellular, and some colorectal and NSCLC cases). Stereotactic radiation approaches may also be preferred in the setting of tumor recurrence after prior radiation as a strategy to limit radiation dose to the spinal cord or other critical structures. Careful adherence to consensus guidelines for radiosurgery planning and delivery is recommended.[31-33]

- Common recommended doses for spine SRS/SBRT may include:
  - ◊ 16–24 Gy x 1 fx;
  - ◊ 24 Gy in 2 fx;
  - ◊ 24–27 Gy in 3 fx;
  - ◊ 30–35 Gy in 5 fx

Framework 4: Consensus Guidelines

Consensus guidelines for postoperative stereotactic body radiation therapy for spinal metastases: results of an international survey

Kristin J. Redmond, MD, MPH,[1] Simon S. Lo, MD,[2] Scott G. Soltys, MD,[3] Yoshiya Yamada, MD,[4] Igor J. Barani, MD,[5] Paul D. Brown, MD,[6] Eric L. Chang, MD,[7] Peter C. Gerszten, MD,[8] Samuel T. Chao, MD,[9] Robert J. Amdur, MD,[10] Antonio A. F. De Salles, MD, PhD,[11] Matthias Guckenberger, MD,[12] Bin S. Teh, MD,[13] Jason Sheehan, MD, PhD,[14] Charles R. Kersh, MD,[15] Michael G. Fehlings, MD, PhD, FRCSC,[16] Moon-Jun Sohn, MD, PhD,[17] Ung-Kyu Chang, MD,[18] Samuel Ryu, MD,[19] Iris C. Gibbs, MD,[3] and Arjun Sahgal, MD, FRCPC[20]

Table 1

Consensus indications and contraindications for postoperative spine SBRT

Indications	Contraindications
Radio-resistant primary1–2 levels of adjacent disease Prior overlapping radiation therapy	Involvement of more than 3 contiguous vertebral bodies ASIA Grade A status (complete spinal cord injury without preservation of motor or sensory function) Postoperative Bilsky Grade 3 residual (spinal cord compression without any CSF around the spinal cord)

J Neurosurg Spine. 2017 Mar; 26(3): 299–306.

Framework 5: ASTRO 2017 Palliative Care Guidelines

Palliative radiation therapy for bone metastases: Update of an ASTRO Evidence-Based Guideline

Stephen Lutz, MD[a,*], Tracy Balboni, MD MPH[b], Joshua Jones, MD[c], Simon Lo, MB ChB[d], Joshua Petit, MD[e], Shayna E. Rich, MD PhD[f], Rebecca Wong, MB ChB[g], Carol Hahn, MD[h]

Advanced RT techniques such as SBRT as the primary treatment for painful spine bone lesions or for spinal compression should be considered in the setting of a clinical trial or with data collected in a registry given that insufficient data are available to routinely support this treatment currently.

Pract Radiat Oncol. 2017 Jan - Feb;7(1):4-12.

CLINICAL SCENARIO: SPINAL CORD COMPRESSION

- What are the symptoms?
- If there is **pain, but no neurologic compromise**, it is unlikely to be an "emergency."

- If there is neurologic change, what is the time course?
- Patients with neurologic change that has evolved over days to weeks are **less likely** to have a different outcome for emergent (hours) vs. urgent (day(s)) initiation of treatment.
- However, patients who are **ambulatory with good performance status** prior to radiation therapy have the best prognosis.
  - "The best time to treat a cord compression is before it happens."
- Has the patient responded to steroids?
- Some patients will have improvement or resolution of neurologic change and pain within hours of initiating steroids, allowing time for an urgent instead of emergent approach.

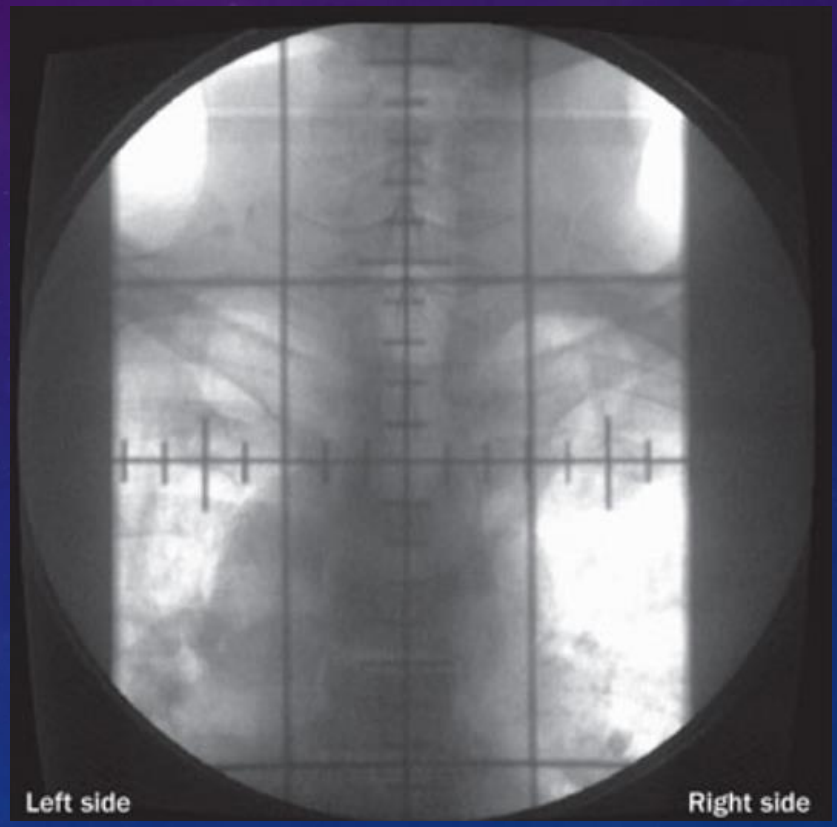
CLINICAL SCENARIO: SPINAL CORD COMPRESSION

- What **type of tumor** is involved?
- Some tumors (i.e. lymphoma, small cell) are more likely to respond within hours than others (i.e. melanoma, non small cell lung cancer).

- What **other treatment modalities** are available to the patient?
- All patients with spinal cord compression should be **evaluated by a neurosurgeon** prior to consideration of radiation therapy, as surgery is the fastest way to alleviate symptoms.

LOGISTICAL CONSIDERATIONS FOR EMERGENCY TREATMENT INITIATION

- Emergency treatment planning is less sophisticated than CT simulation process
- Physicians typically aim to plan simple fields
- I.e. single PA field or simple AP/PA field)
- Using clear normal tissue landmarks for set-up and treatment.



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CLINICAL SCENARIO: BLEEDING

- Bleeding can come from many different sites, but can include, most commonly:
- Gastrointestinal tract (esophagus, stomach, small/large bowel, rectum).
- Bladder
- Uterus/cervix
- Lung

- These cases are more nuanced.

CLINICAL SCENARIO: BLEEDING.

- Is the patient stable?
- Acute bleeding can render the patient **unstable** and unsuitable for RT.

- What is the **time course of the bleeding**?
- **Acute, brisk bleeding** is unlikely to be solved quickly with radiation, as it can come from large vessels that would take a long time to respond.
- **Chronic, low-grade bleeding** can respond well to radiation therapy, but also is not a true emergency.
- **Moderate bleeding that cannot be adequately managed with other treatment** can, rarely, be considered for emergent radiation. This category is qualitative and very much depends on clinician judgment.
- Keeping in mind: radiation usually stops bleeding **within days, not hours, which makes emergent use rare in this setting**.
- (I have never seen a case of bleeding, personally, that required true emergent treatment)

CLINICAL SCENARIO: BLEEDING

- What type of tumor is involved?
- Some tumors (i.e. lymphoma, small cell) are more likely to respond within hours than others (i.e. melanoma, renal cell carcinoma).

- What other treatment modalities are available to the patient?
- Many more options may exist for patients with bleeding, which may be combined with radiation therapy and can include, but are not limited to:
  - Embolization (vascular surgery or interventional radiology)
  - Cauterization (surgery, gastroenterology, gynecologic oncology, urology)
  - Resection
  - Modification of medical factors (elimination of blood thinners, limited transfusion)

URGENCY VS. EMERGENCY: AIRWAY OBSTRUCTION

- What can make airway obstruction an emergency?
- Rapidly declining clinical status (increasing interventions to support breathing, including ventilation).
- Limited/absent alternative treatment options (for example, if the obstruction **cannot be effectively treated with stenting**).

- Typically, treatment is **urgent, but not emergent**. However, particularly in the setting of rapid decline and radiosensitive histology, it is possible this clinical scenario could be an emergency. (New diagnosis of lung cancer on ventilator)

URGENCY VS. EMERGENCY: BRAIN METASTASES

- Brain metastases almost never present a true emergency:
- Palliate symptoms with steroids, which will be effective for most patients.
- Consultation with neurosurgery.
- Stabilize patient, and plan/execute treatment on an urgent basis, if needed.

URGENCY VS. EMERGENCY: PALLIATION OF PAIN

- Pain typically does not improve until **days, if not weeks, after initiation of radiation therapy.**

- Although radiation may be **urgent** to address a patient's pain, it will almost never be a true emergency.

SUMMARY

- Spinal cord compression is a genuine radiation oncology emergency:
- with **rapid neurologic decline,**
- that is **unresponsive to steroids,**
- with a **radiosensitive tumor,**
- in a patient who is **not a candidate for surgery, or in whom radiation may be favored over surgery**.

- Some patients with **moderate to severe bleeding** may present a clinical scenario in which treatment can be initiated emergently.

The SINS Score

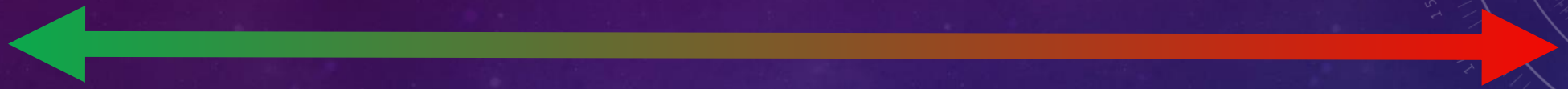
Score	Classification	Action
0 to 6	Stable spine	
7 to 12	Indeterminant	Possible impending instability, warrants surgical consultation
13 to 18	Instability	Warrants surgical consultation

High score = unstable

Component scores for clinical and radiographic findings	Score
Spine location	
Junctional (occiput-C2, C7-T2, T11-L1, L5-S1)	3
Mobile spine (C3-C6, L2-L4)	2
Semi-rigid (T3-T10)	1
Rigid (S2-S5)	0
Pain relief with recumbence (lying down) or pain with movement/loading of the spine	
Yes	3
No (occasional pain but not mechanical)	1
Pain-free lesion	0
Bone lesion quality	
Lytic	2
Mixed lytic/blastic	1
Blastic	0
Radiographic spinal alignment	
Subluxation/translation present	4
De novo deformity (kyphosis/scoliosis)	2
Normal alignment	0
Vertebral body collapse	
>50% collapse	3
<50% collapse	2
No collapse with >50% body involved	1
None of the above	0
Posterolateral involvement of spinal elements (facet, pedicle, or costovertebral joint fracture or replacement with tumor)	
Bilateral	3
Unilateral	1
None of the above	0

Framework 5: Toronto's published framework

Favor SBRT



Against SBRT

Performance status	ECOG 0-2		ECOG ≥3
Life expectancy	≥3 months		
Pain	Intractable		
Neurologic			Symptomatic cord compression or cauda equina syndrome
Oncologic			
Disease burden	Oligometastatic disease	Widespread, rapidly progressive disease	
Tumor histology	Histological proof of malignancy	Radiosensitive (eg, myeloma, lymphoma)	
Systemic therapy	Systemic therapeutic options available or indolent disease course		
Treatment			
Imaging	ESCC (Bilsky) grade 0-1	ESCC (Bilsky) grade 2	ESCC (Bilsky) grade 3 or cauda equina compressions
	Up to 3 contiguous or noncontiguous levels		>3 contiguous or noncontiguous levels
Spinal stability	SINS 0-6	SINS 7-12	SINS 13-18
Prior radiation	Previous cEBRT to affected level	Previous SBRT to affected level	Previous EBRT to affected level within 90 days or systemic radionuclide within 30 days
Positioning			Inability to tolerate near-rigid body immobilization

Global Spine J. 2017 Apr; 7(2): 179–197.

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The Controversy: SBRT or CRT?

- SBRT Pros:
  - Improved local control and pain control in reported case series
  - Fewer treatments
- Conventional RT Pros:
  - More years of safety data
  - Lower cost, planning complexity, and time

Some evidence for better local control and pain control with SBRT for spinal mets [not limited to ESCC]

Radiother Oncol. 2018 Aug;128(2):274-282. doi: 10.1016/j.radonc.2018.04.030. Epub 2018 May 26.

Randomized phase II trial evaluating pain response in patients with spinal metastases following stereotactic body radiotherapy versus three-dimensional conformal radiotherapy.

Sprave T[1], Verma V[2], Förster R[3], Schlampp I[4], Bruckner T[5], Bostel T[6], Welte SE[7], Tonndorf-Martini E[8], Nicolay NH[9], Debus J[10], Rief H[11].

- Improved pain response at 6-mo in a phase 2 RCT
- Similarly positive OS andlocal recurrence outcomes have been reported with SBRT as reirradiation tx

- 1-year local control rates 80-100% in case series of spinal SBRT (compared to historical ~50-80% for cEBRT)

Study Authors (Year)	Study Design	No. of Tumors/No. of Patients	No. of Postoperative Tumors	Histology	Total Dose (Range)/No. of Fractions (Range)	Follow-up in Months (Range)	Local Control	Overall Survival	Pain Response
Gerszten et al[52] (2007)	Prospective	156/na[a]	9	Mixed	Mean: 20 Gy (12.5-25 Gy)/1	Median: 21 (3-53)	90% (crude)	na	86% reported long-term improvement
Yamada et al[127] (2008)	Retrospective	103/93	0	Mixed	Median: 24 Gy (18-24 Gy)/1	Median: 15 (2-45)	90% (15 months)	Median: 15 months	na
Sahgal et al[59] (2009)	Retrospective	23/14	0	Mixed	Median: 24 Gy (7-40 Gy)/3 (1-5)	Median: 9 (1-26)	85% (1 year)/69% (2 years)	45% (2 years)	na
Nguyen et al[82] (2010)	Prospective	na/22[a]	0[b]	Renal cell carcinoma	Median: 27 Gy (24-30 Gy)/3 (1-5)	Median: 13.1 (3.3-54.5)	82% (1 year)[c]	72% (1 year)[c]	BPI: no pain 23% (baseline) to 52% (12 months)
Wang et al[76] (2012)	Prospective	166/149	0[d]	Mixed	27-30 Gy/3	Median: 15.9 (1.0-91.6)	80.5% (1 year)/72.4% (2 years)	68.5% (1 year)/46.4% (2 years)	BPI: no pain 26% (baseline) to 54% (6 months)
Ahmed et al[75] (2012)	Retrospective	63/46[a]	0	Mixed	Median: 24 Gy (10-40 Gy)/3 (1-5)	Mean: 8.2	91.2% (1 year)	59% (1 year)	na

- Other trials in progress(cEBRT vs SBRT pain relief)
  - RTOG 0631 Phase III pending
  - Canadian Cancer Trials Group Phase III pending

Global Spine J. 2017 Apr; 7(2): 179–197.

Some case series data suggest SBRT alone is effective for ESCC

Cancer. 2010 May 1;116(9):2250-7. doi: 10.1002/cncr.24993.

Radiosurgical decompression of metastatic epidural compression.

Ryu S[1], Rock J, Jain R, Lu M, Anderson J, Jin JY, Rosenblum M, Movsas B, Kim JH.

- n=62 patients with 85 cord compression lesions; Muscle strength at least 4/5
  - Received median of 16 Gy x1
  - 81% showed improvement in neurologic status, significant improvements in epidural tumor volume reduction and thecal sac decompression

J Exp Ther Oncol. 2009;8(1):35-41.

Single fraction spine radiosurgery for myeloma epidural spinal cord compression.

Jin R[1], Rock J, Jin JY, Janakiraman N, Kim JH, Movsas B, Ryu S.

- n=24 patients with 31 MM ESCC lesions
  - Received median of 16 Gy x1
  - Complete response in 81%, pain control 86%, 5/7 with neurological improvement
- Two clinical trials in progress:
  - NCT01256554: Phase I study at MDACC, single arm SBRT for Inoperable, Previously Irradiated ESCC
  - NCT01826058: Phase II study in Korea, single arm SBRT for ESCC

CNS Oncol. 2017 Jul; 6(3): 231–241.

Post-op case series 1 (MSKCC): ”Separation surgery” with adjuvant SBRT shows good local control

- Study design: Retrospective review of ESCC patients receiving “decompression” followed by post-op RT.
  - Surgical indications: High grade radioresistant tumors or spinal instability
- n=186; 40 received 24Gy/1, 37 received 24-30/3, 109 received 28-36Gy/5-6
- GTV: Preop tumor, CTV: not standardized, PTV: 2mm expansion of CTV - dura
- 1 year local progression 16.4%
- High dose (24-30 Gy in 3 fractions) associated with significantly less local progression (4.1% 1 year cumulative incidence) than low dose (HR 0.12, p=0.04)
- Radiation sensitivity of tumor histology, grade of ESCC, extent of surgical decompression were not associated with PFS

J Neurosurg Spine. 2013 Mar;18(3):207-14.

Post-op case series 2 (Toronto): Post-op ESCC grade predicts local recurrence after adjuvant SBRT

- Study design: Retrospective review of a prospective database of patients with spinal mets receiving surgery followed by post-op SBRT.
- n= 80
- 1-year LC: 84%, OS: 64%
- Significant predictors of local control include:
  - Post-op Bilsky grade 0/1 vs 2/3 [*P* = .003;/HR = 0.225]
  - Dose: 18–26 Gy/1–2 fractions vs 18–40 Gy/3–5 fractions [*P* = .0224;/HR = 0.322]

- A separate retrospective analysis of 60 spine mets [not necessarily ESCC] treated with SBRT : 6 of 8 local recurrences had <=1mm between tumor and thecal sac

Neuro Oncol. 2013 Oct; 15(10): 1413–1419.
Int J Radiat Oncol Biol Phys. 2009 Jul 1;74(3):723-31.

Toxicity

- Acute toxicity is rare
  - Review of 1400 patients receiving SBRT for spinal mets showed <1% risk of myelopathy
  - In both case series of post-op SBRT, no grade 3-4 toxicities were reported
- May include “Pain flare” or esophagitis
- Vertebral compression fx is a common concern after spinal SBRT (10-15%)
  - Risk factors include SBRT with ≥20 Gy/fraction, presence of a baseline VCF, spinal misalignment and lytic tumor
  - May consider prophylactic stabilization
- No evidence of increased hardware failure or wound healing delay post-op
- Based on dosimetric analysis, a maximum point dose of 10 Gy was recommended by Sahgal et al. to avoid radiation myelopathy

Int J Radiat Oncol Biol Phys. 2010 Jun 1;77(2):548-53.
Int J Radiat Oncol Biol Phys 2017;97:64-74.
Global Spine J. 2017 Apr; 7(2): 179–197.
Front Oncol. 2019; 9: 337.
Int J Surg Oncol. 2011;2011:979214. doi: 10.1155/2011/979214.

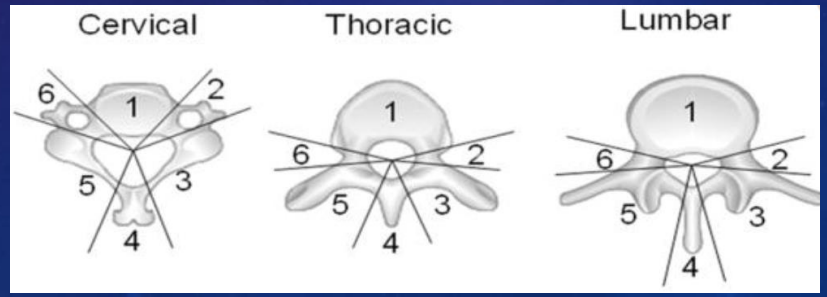
Overview

- Epidemiology and pathophysiology of ESCC
- **Presenting symptoms and work-up**
- Treatment
  - Frameworks, algorithms, guidelines
- Questions

Contouring spinal mets for SBRT (If no neurosurgery)

Target volume	Guidelines
GTV	• Contour gross tumor using all available imaging • Include epidural and paraspinal components of tumor
CTV	• Include abnormal marrow signal suspicious for microscopic invasion • Include bony CTV expansion to account for subclinical spread • Should contain GTV • Circumferential CTVs encircling the cord should be avoided except in rare instances where the vertebral body, bilateral pedicles/lamina, and spinous process are all involved or when there is extensive metastatic disease along the circumference of the epidural space without spinal cord compression
PTV	• Uniform expansion around CTV • CTV to PTV margin ≤3 mm • Modified at dural margin and adjacent critical structures to allow spacing at discretion of the treating physician unless GTV compromised • Never overlaps with cord • Should contain entire GTV and CTV

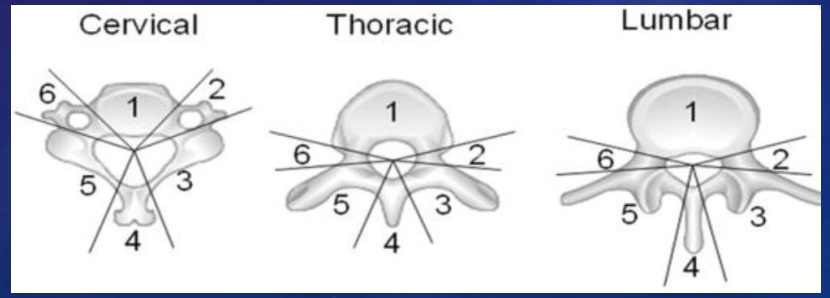
GTV involvement	ISRC GTV anatomic classification	ISRC bony CTV recommendation	CTV description
Any portion of the vertebral body	1	1	Include the entire vertebral body
Lateralized within the vertebral body	1	1, 2	Include the entire vertebral body and the ipsilateral pedicle/transverse process
Diffusely involves the vertebral body	1	1, 2, 6	Include the entire vertebral body and the bilateral pedicles/transverse processes
GTV involves vertebral body and unilateral pedicle	1, 2	1, 2, 3	Include entire vertebral body, pedicle, ipsilateral transverse process, and ipsilateral lamina
GTV involves vertebral body and bilateral pedicles/transverse processes	3	2, 3, 4	Include entire vertebral body, bilateral pedicles/transverse processes, and bilateral laminae
GTV involves unilateral pedicle	2	2, 3 ± 1	Include pedicle, ipsilateral transverse process, and ipsilateral lamina, ± vertebral body
GTV involves unilateral lamina	3	2, 3, 4	Include lamina, ipsilateral pedicle/transverse process, and spinous process
GTV involves spinous process	4	3, 4, 5	Include entire spinous process and bilateral laminae



Cox et al. International Spine Radiosurgery Consortium Consensus Guidelines for Target Volume Definition in Spinal Stereotactic Radiosurgery

Contouring spinal mets for SBRT (post-op)

- GTV: Residual tumor on CT or MRI
- CTV: GTV+Surgical bed + PRE-op tumor location + entire ISRC spine sectors containing pre-op disease +/- 5mm cranio-caudal expansion – (spinal cord and thecal sac)
- PTV: 2-2.5mm expansion of CTV, may subtract cord
- PRV (planning organ at risk): 1.5mm expansion on spinal cord [some papers suggest 5mm]



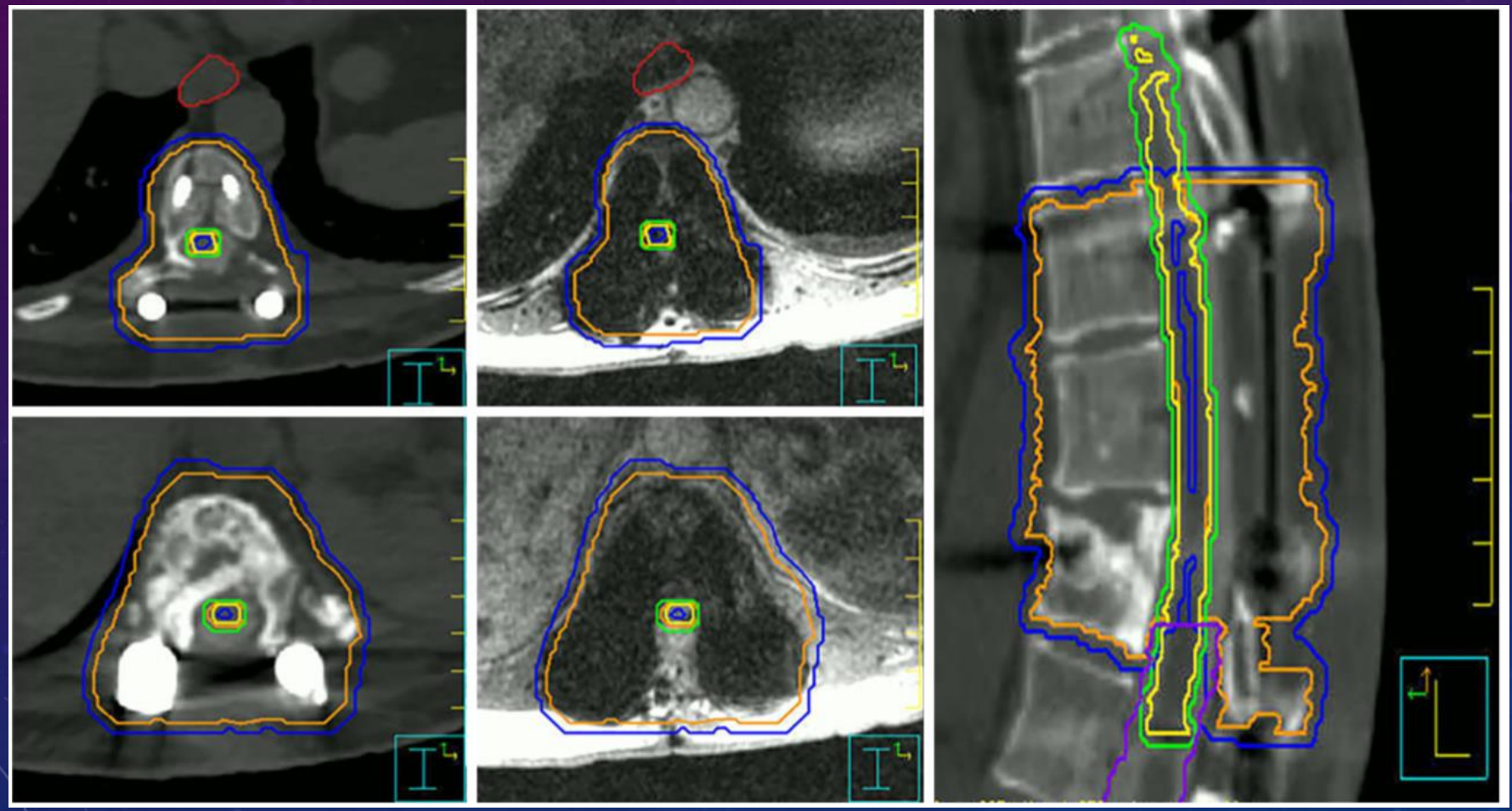
https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5600487/

Redmond KJ, Robertson S, Lo SS, et al. Consensus Contouring Guidelines for Postoperative Stereotactic Body Radiation Therapy for Metastatic Solid Tumor Malignancies to the Spine. Int J Radiat Oncol Biol Phys 2017;97:64-74.

Contouring (post-op)

- **CTV: GTV + Surgical bed + PRE-op tumor location + entire ISRC spine sectors containing pre-op disease +/- 5mm cranio-caudal expansion – (spinal cord and thecal sac)**
- **PTV: 2mm expansion of CTV vs 2.5mm , May subtract cord**
- **PRV (planning organ at risk): 1.5mm expansion on spinal cord**

Minimize weight of the beams passing through the hardware
Contour the metal hardware and assign a density



Redmond KJ, Robertson S, Lo SS, et al. Consensus Contouring Guidelines for Postoperative Stereotactic Body Radiation Therapy for Metastatic Solid Tumor Malignancies to the Spine. Int J Radiat Oncol Biol Phys 2017;97:64-74.

The Controversy: SBRT or CRT?

- SBRT Pros:
  - Improved local control and pain control in reported case series
  - Fewer treatments
- Conventional RT Pros:
  - More years of safety data
  - Lower cost, planning complexity, and time

Overview

- Epidemiology and pathophysiology of ESCC
- Presenting symptoms and work-up
- Treatment
  - Frameworks, algorithms, guidelines
  - Evidence for SBRT in cord compression
  - Contouring guidelines
- **Questions**

Acknowledgements

- Sean Maroongroge, MD, MBA
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- Marie-Adele Kress, MD

Questions:

- Is there a role for SBRT in ESCC in your practice?
- How do you address prognosis with a patient? “Will it help me walk again?”
- How long does it take from consult to treatment for SBRT? What would logistics look like post-op?

APPENDIX

Prognostic factors

- Ambulatory status before tx
  - ~90% if walk unassisted
  - ~60% if walk with assistance
  - ~10-30% if non-ambulatory
- <48 hours from start of sx to tx
  - Edema vs infarction
- >14 days from start of motor deficits to tx

ACR Case 1

- 60 yo M NSCLC with KPS 80 and known asymptomatic spinal metastasis at T7 receives first line systemic therapy, then develops severe pain from the T7 metastasis and a gradual onset of sensory changes above the umbilicus and bilateral lower extremity weakness (Str 4/5).
- MRI of the thoracic spine shows no CSF around the mildly deformed cord at T7.
- PET/CT shows stable primary tumor in the lung and lung metastases. No bony retropulsion.

ACR Case 1

- N: Rate of change? Slow
- O: Is it radiosensitive? No
- M: Is the spine stable? Yes
- S: Will they survive to recover from surgery? Yes

- Most appropriate management:
  - Steroids + Surgery + EBRT

ACR Case 2

- A 45-year-old man with known metastatic renal cell carcinoma develops increased pain in the lower back. He has received sunitinib for his systemic disease.
- KPS 80.
- Pain 8/10.
- There are no associated sensory or motor deficits in the lower extremities.
- He has a history of palliative EBRT to spinal levels T12–L2 to a dose of 30 Gy in 10 fractions one year prior to this presentation.
- MRI shows progression of spinal metastasis at L1 vertebral body, and there is no epidural extension or vertebral compression fracture.
- CT scan shows that the lungs are the only other organs with metastatic renal cell carcinoma and they have demonstrated good response to sunitinib.

ACR Case 2

- N: Rate of change? Slow
- O: Is it radiosensitive? No
- M: Is the spine stable? Unknown
- S: Will they survive to recover from surgery? Yes

- Most appropriate management:
  - SBRT +/- systemic therapy
  - Maybe surgery?

Dosing

- 24 Gy in two fractions
  - 17 Gy limit to the spinal cord/thecal sac PRV
  - 12.2 Gy limit to the spinal cord/thecal sac PRV if previously treated
- Mandatory image guidance with CBCT and/or stereoscopic imaging

Post-op SBRT results and recurrence patterns

- Most common local recurrence is epidural
  - marginal and adjacent level failures have not been commonly observed (even though we treat less vertebrae than CRT)
  - Pre-op epidural disease location predicts failure more than post-op
  - Initial anterior segment disease can recur anterolaterally, circumferential disease recurs anywhere

J Neurosurg Spine. 2007 Aug;7(2):151-60.

Other studies to consider reviewing

- https://www.ncbi.nlm.nih.gov/pubmed/28507888
- https://www.ncbi.nlm.nih.gov/pubmed/30308345
- https://www.ncbi.nlm.nih.gov/pubmed/27479724