

Medical and Surgical Management of Spinal Infections

Cesar A. Serrano-Almeida
June 14, 2007

- Infections along the spinal axis are characterized by an insidious onset, and the resulting delays in diagnosis are associated with serious neurological consequences and death.
- Various anatomical locations:
 - * Vertebral bone.
 - * Intervertebral disc space.
 - * Epidural or intradural space.
 - * Adjacent soft tissues.

➤ Laminectomy:

- * First attempt surgical management.
- * Failure to address the anterior component of the disease.
- * Frequent postoperative spinal stability.
- * It is now used less often.

➤ Hodgson and Stock described an anterior approach to treat spinal infections.

- Advances in imaging, pharmaceutical treatment and surgical technologies have reduced the death rate to 20 %.
- The nature of the disease has evolved:
 - * Resistant organisms
 - * Immunocompromised patients.
 - * Intravenous drug abusers.

CLASSIFICATION, PATHOGENESIS, AND PRESENTATION.

- ✓ Infections of the spine are classified by the anatomical location: VB, intervertebral disc space, spinal canal, and adjacent soft tissues.
- ✓ Focal pain and fever should raise suspicion.
- ✓ Pain:
 - * 92 % of patients.
 - * Localized at the level involved.
 - * Relieved by recumbency.
 - * Aggravate by activity.
- ✓ 2 of 3 patients are afebrile
- ✓ Neurological symptoms:
 - * Suppuration within the spinal canal.
 - * Compression by abscess or fractured and displaced bone.

☀ Mean time from onset of symptoms to diagnosis: 8 weeks to 3 months

☀ Predisposing conditions:

- * Advanced age
- * Immunosuppression
- * Alcoholism
- * Long term steroid use
- * Concomitant infections
- * Malignant Tumor
- * Severe multisystemic trauma.
- * DM
- * RA
- * Previous surgery
- * Drug abuse

SPINAL CANAL INFECTIONS

- ☀ Classified according to the relationship of the abscess to the meninges.

a) Spinal epidural abscess

- * Most common

- * Incidence: 0.2 – 2.0 cases / 10,000 hosp admi./year

b) Subdural abscess

c) Intramedullary abscess

- ☀ Clinical presentation: Heusner Clinical Stages

☞ Spinal ache

☞ Root pain

☞ Weakness

☞ Paralysis

VERTEBRAL OSTEOMYELITIS

- ☞ Most common spinal infection
- ☞ Affects primarily ant. elements of vertebra and adjacent discs.
- ☞ Source of infection:

Usually hematogenous

- * Arterial origin: → segmental arteries
 - involvement of two vertebra and the intervening disc.
- * Venous origin: → Batson plexus

Other sources of infection

- * Abscess in contiguous structures
- * Iatrogenic (post-surgical)

☞ Pyogenic vertebral osteomyelitis:

- * Has become more common than TB
- * Lumbar spine (48%)
- * Thoracic spine (35%)

☞ Pott disease:

- * More indolent course
- * Propensity to infect thoracic spine
- * Intervertebral disc is not involved initially
- * Neurological deficit: 40% of patients
- * Paraplegia: more common because involvement of posterior elements
- * Paravertebral soft-tissue abscesses: 70 – 75%

INTERVERTEBRAL DISC SPACE INFECTION

→ Primary infection of disc space

→ Categories:

a) Adult hematogenous (spontaneous)

In conjunction with VB infection

b) Childhood (discitis)

Incidence: 0.3 – 0.6 / 10,000 cases/year.

Younger children have vascular channels perfusing the cartilaginous regions of the disc space.

Controversial origin: traumatic condition

Results from a partial dislocation of the epiphysis –
flexion injury

c) Postoperative

Incidence: 2 – 4 % of patients undergoing spinal procedures.

Mean time to onset one month.

Different quality of pain.

ADJACENT SOFT-TISSUE INFECTION

- ↪ Includes cervical and thoracic paraspinal abscesses and lumbar psoas muscle abscesses.
- ↪ Soft tissue abscesses affect younger patients and are relatively rare in the elderly population.
- ↪ Destruction of the cortical bone may be seen.
- ↪ Psoas abscesses: Infection may extend inferiorly as far as the groin and thigh.
- ↪ Symptoms are nonspecific: flank pain, abdominal pain, or limp.

CAUSATIVE ORGANISMS

- **Pyogenic organisms:**

- * *S. aureus*: 60%

- * Gram - negative species:

- E. coli*.

- More common in immunocompromised patients.

- * IV drug abusers: *Pseudomonas*.

- * Infective endocarditis: *Strep. viridans*.



- Granulomatous infection

- * Mycobacterium species

- M. tuberculosis: emergence of multiple drug-resistance

- M. avium-intracellulare: Immunocompromised patients

- * Fungal infections:

- Coccidiomycosis

- Blastomycosis

- Histoplasmosis

- Sporotrichosis.

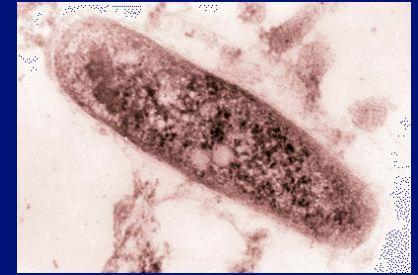
- Criptococcosis

- * Parasitic infections:

- Bartonella henselae:

- catscratch disease

- Feline exposure



DIAGNOSIS

- Delayed diagnosis is not uncommon:
Mean duration of symptoms from onset to dx = 1 month.
- Laboratory tests:
 - Acute-phase proteins (ESR and CRP)
 - * Monitoring of treatment efficacy
 - * Detection of post-op infection when back pain persists
 - Blood cultures
 - * Ideally obtained during fever spikes
 - * Positive in 1/3 of patients.
 - Purified protein derivative skin test
 - * Positive in 95% of cases.
 - * Immunosuppressed patients: false-negative results
 - Polymerase chain reaction
- Lumbar puncture is contraindicated
- CT guided biopsy:
Useful to identify the organism



Imaging studies

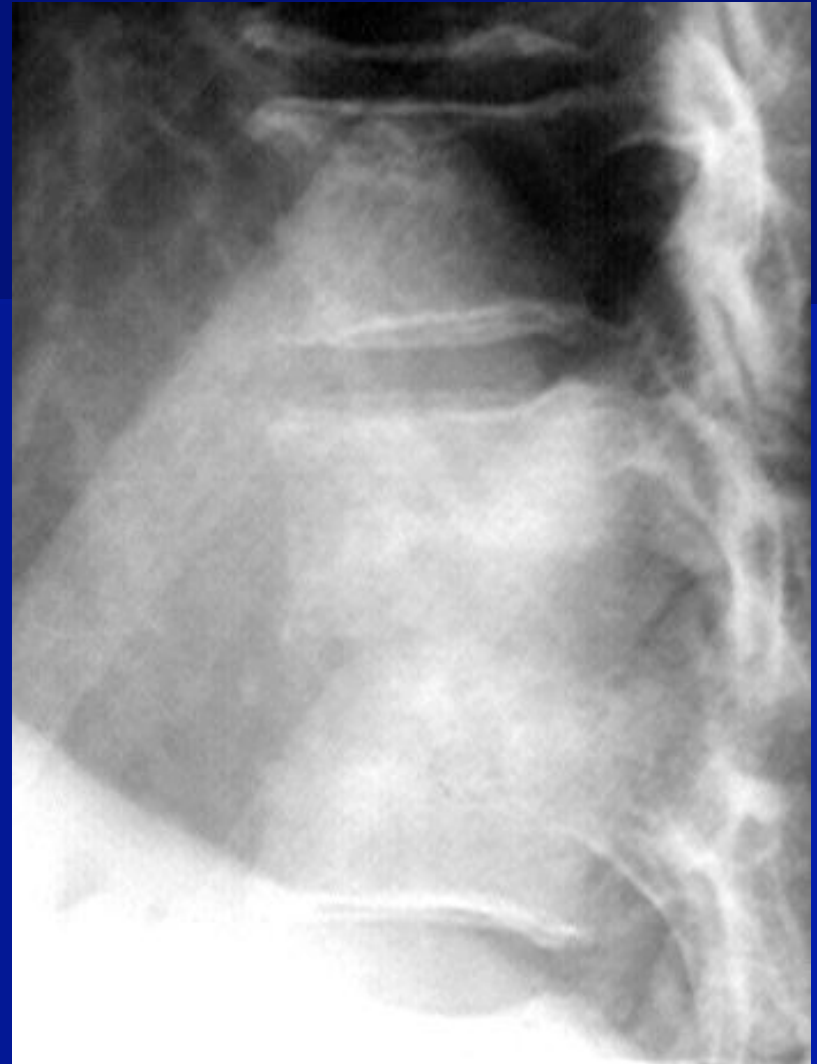
- Vertebral osteomyelitis

Plain X-rays

- * Initial findings appear within 2-3 weeks of infection
- * Narrowing of disc space.
- * Blurring and destruction of vertebral endplates.

^{99m}Tc bone scans and ¹¹¹In leukocyte studies:

- * Sensitive tools
- * Difficult interpretation in older patients because of degenerative spinal abnormalities.



- CT scans

Demonstrate the extent
of bone destruction

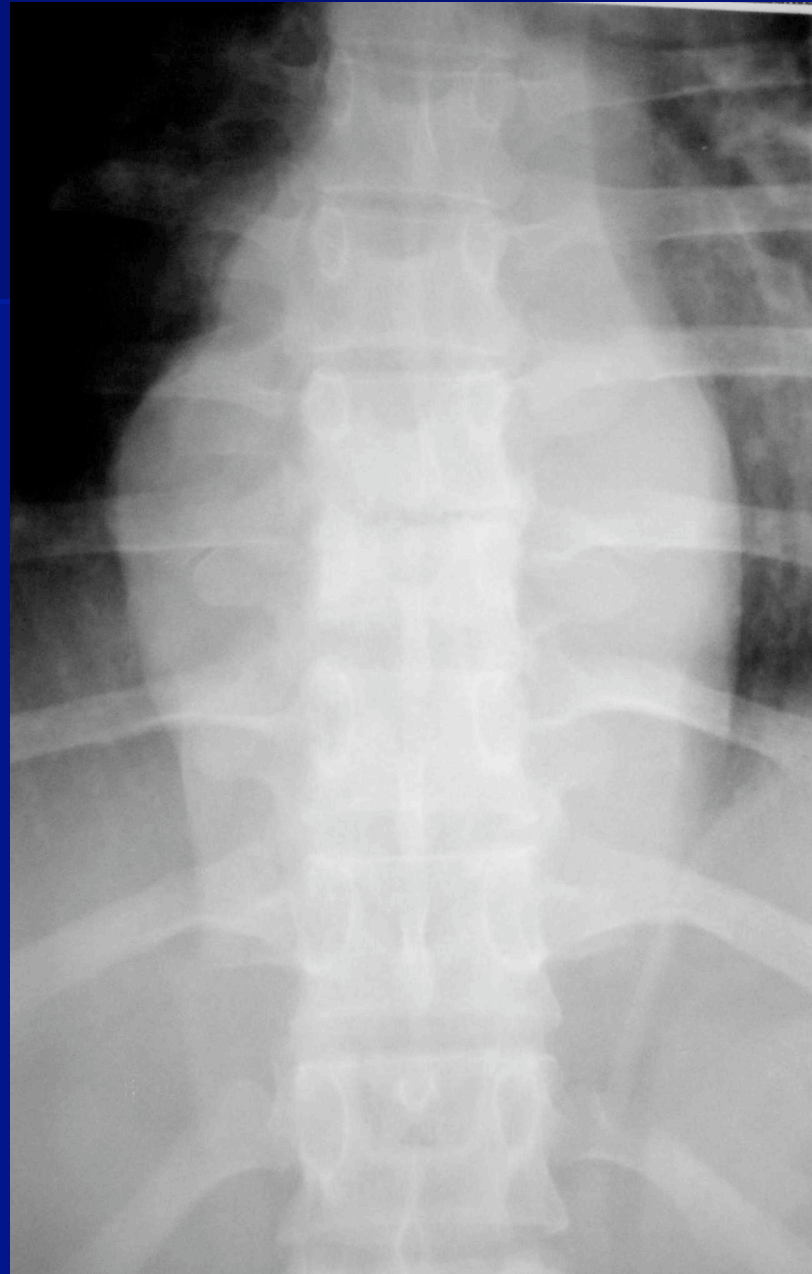


- MRI

Extent of soft-tissue
involvement.



POTT DISEASE



- ❖ Involvement of the posterior bone elements.
- ❖ Calcification
- ❖ Disc destruction occurs later
- ❖ Paraspinal and epidural involvement is common
- ❖ Thoracic spine is more commonly affected



Tuberculous osteomyelitis of spine (Pott's disease) with angulation and compression of spinal cord



DISC SPACE INFECTION

✓ Childhood discitis

X-rays:

narrowing of the disc space
erosion of adjacent vertebral
end plates

MRI:

edema and purulent material in
the marrow or disc space is
hypointense on T1 and
hyperintense on T2.



A



B

✓ Postoperative disc space infection.

MRI: best investigational tool.

Inflamed areas have contrast enhancement.

T1: hypointensity of disc and end plates.

T2: Hyperintensity of disc and end plates.

SPINAL CANAL INFECTIONS



MRI * with Gad is the gold standard

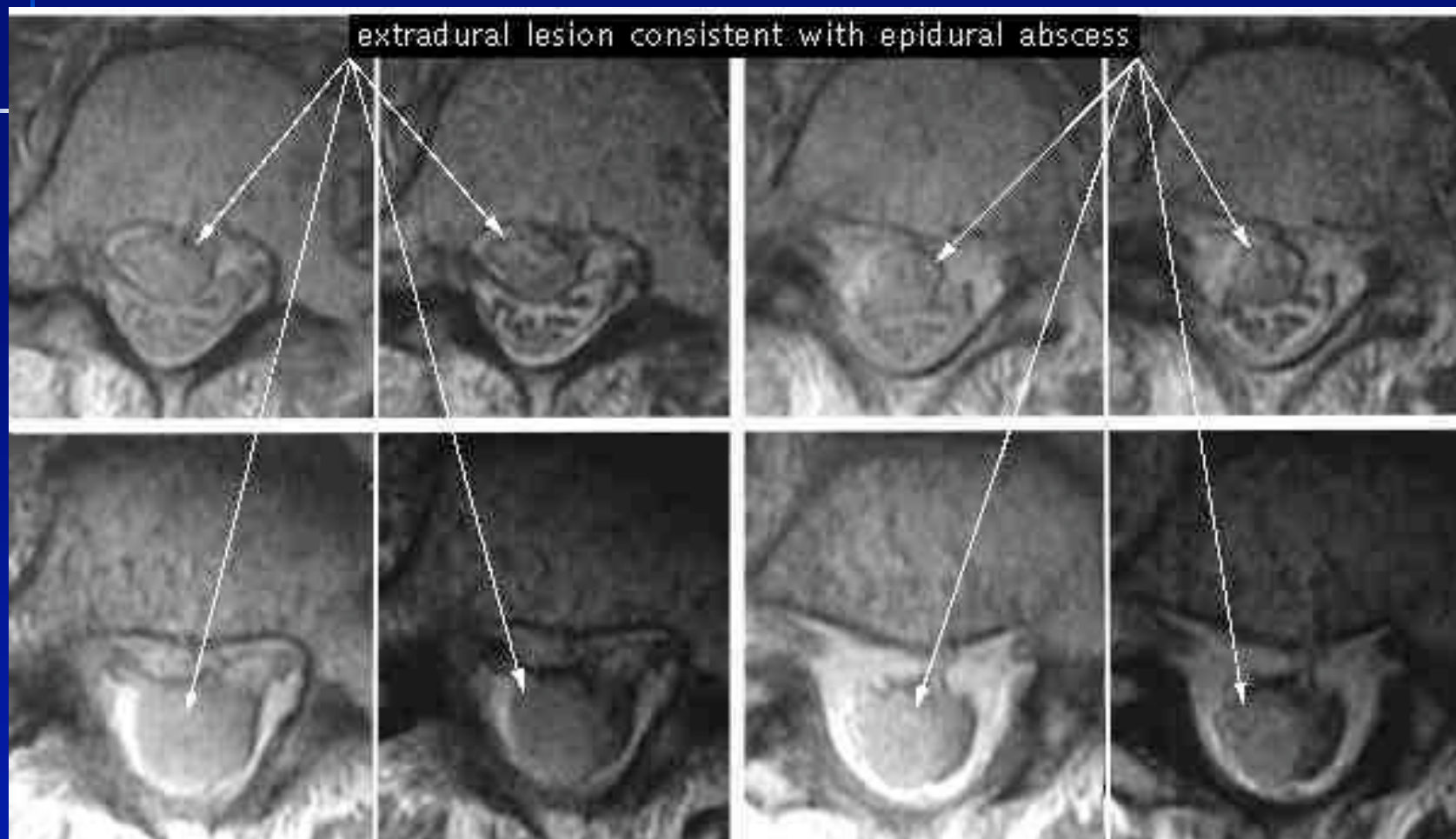
* abscesses are hypointense or Isointense on T1 and isointense or hyperintense on T2.

* Differentiation b/w epidural and subdural abscess may be difficult:

accompanying osteomyelitis or discitis → epidural process.

abscess spanning many levels → subdural process.

SPINAL CANAL INFECTIONS



MANAGEMENT

Basic goals:

- Eradication of infection
- Prevention or reversal of neurological deficit
- Relief of pain.

Nonsurgical management:

- Indicated in patients with no neurological deficit and no significant kyphotic deformity or pathological fracture.
- **Medical treatment:** Abx and rest.
- **Immobilization**
 - * T&L spine: TLSO
 - * C spine: hard collar.
- **Identification of specific causative agent**
 - * CT guided biopsy
 - * Blood cultures
 - * Repeat CT guided biopsy and blood cultures if prior results negative
 - * Open biopsy if again negative results.
- **Duration of Abx**
 - * Pyogenic osteomyelitis: 6-8 weeks
 - * POTT disease: 12 months
- **Failure of medical management:** if symptoms persist or increase after:
 - * 1 month → pyogenic infection
 - * 3 months → Pott disease.

□ Abx in childhood discitis:

- * Controversial because the benign course.
- * Abx if positive cultures are obtained, recurrences of back pain + systemic signs (↑ ESR, ↑ CRP, ↑ WBC count, or ↑ temperature), or clinical progression despite immobilization

□ Medical management of spinal canal infection

* Controversial

* Candidates:

High-risk surgical patients

Neurologically intact and stable patients

Complete motor deficit > 72 h

Extensive diffuse abscess formation

* Abx course: more prolonged than in cases of surgical drainage.

Surgical management:

- The optimal method of surgical management remains controversial.
- General principles:
 - * Thorough debridement of infected tissue.
 - * Adequate perfusion of the infected area to allow tissue healing.
 - * Maintaining or restoration of spinal stability.
- Image guided bx has low mortality and morbidity rates in thoracic and lumbar spine
 - * C-spine: Higher risk because of the surrounding complex anatomical structures.
 - * Presence or progression of neurological deficit is indicator for Sx.

Abscess Drainage

- **Cervical Spine:**
 - * Abscesses may be present in the anterior or posterior triangle or in the supraclavicular area. Extension to the mediastinum and prevertebral fascia is possible.
 - * If airway is compromised: immediate surgical drainage.
- **Thoracic spine:**
 - * Costotransversectomy is commonly used.
- **Lumbar spine:**
 - * Paravertebral abscess: posterior paramedian approach.
 - * Psoas abscess: may be drained through the Petit triangle (latissimus dorsi, external oblique abdominal muscle, and crest of the ilium)

Posterior Decompression

- **Laminectomy:**

- * Indication: isolated posterior epidural collection without involvement of anterior vertebral elements.

- * Not advised for infections involving anterior elements. Risks of deformity, instability, and neurological deterioration.

- **Costotransversectomy:**

- * Posterior epidural abscess extending from an anterior focus in a medically unstable patient.

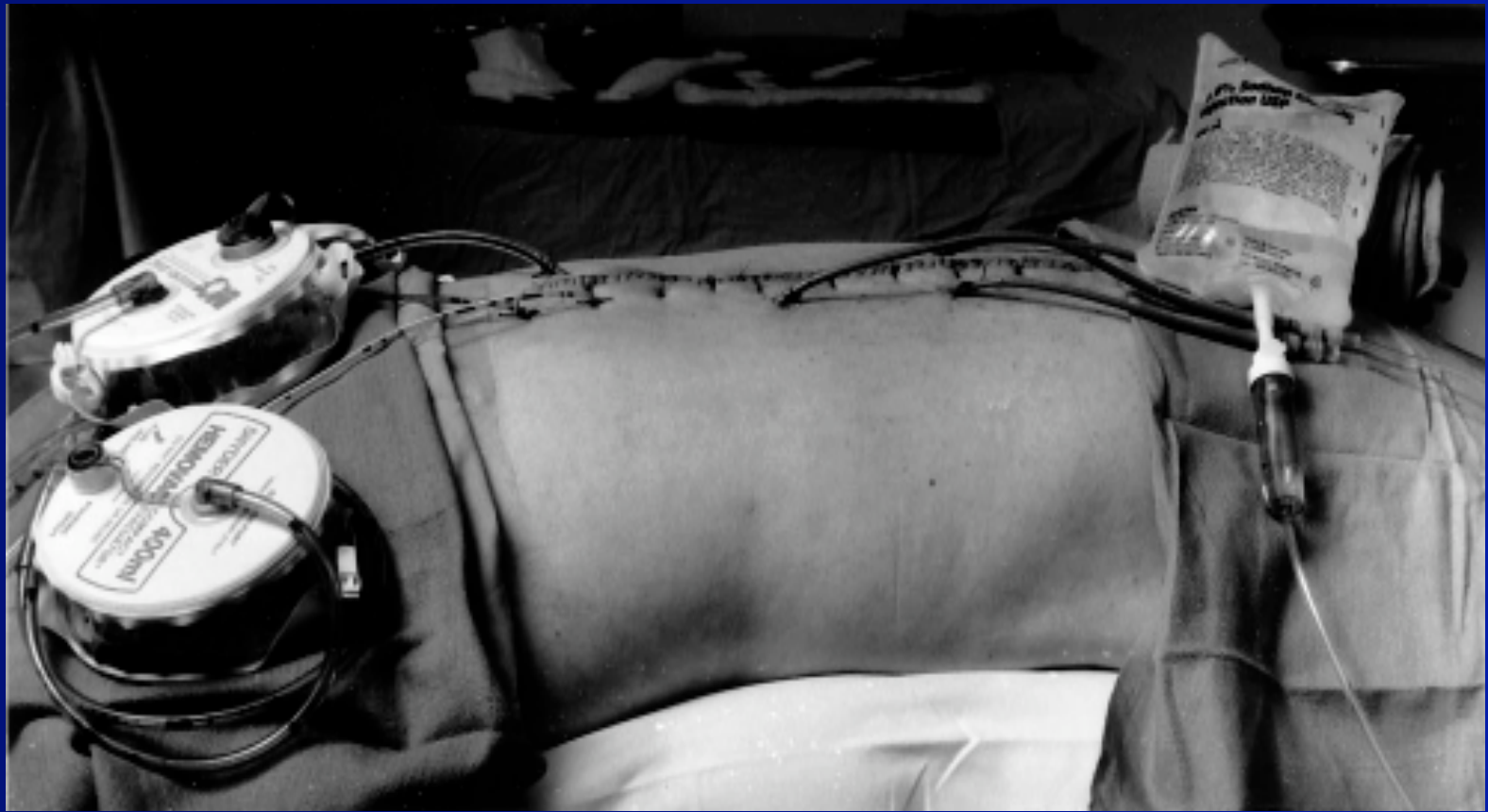
Anterior Decompression

- **Modalities:**

- 1) Anterior decompression with and without autologous bone graft.
- 2) Anterior decompression and fusion with posterior stabilization.
- 3) Anterior decompression and fusion with anterior instrumentation.

Postoperative Spinal Infections After Placement of Instrumentation.

- Incidence of spinal infection after laminectomy or discectomy: 1%
- Incidence of spinal infection after instrumentation: 2.1 - 8.5 %
- Strategies:
 - * Multiple surgical debridements with removal of hardware.
 - * Antibiotic-impregnated beads with multiple reoperations.
 - * Surgical debridement and insertion of an antibiotic delivery irrigation-suction system for 5 days. Instrumentation is not removed.



RHEUMATOID ARTHRITIS:

- RA is a debilitating polyarthropatic degenerative condition.
- 86% of patients have C-spine involvement.
- If left untreated a large percentage of patients progress toward complex instability patterns.
- Once myelopathy occurs, prognosis for neurologic recovery and long term survival is poor.



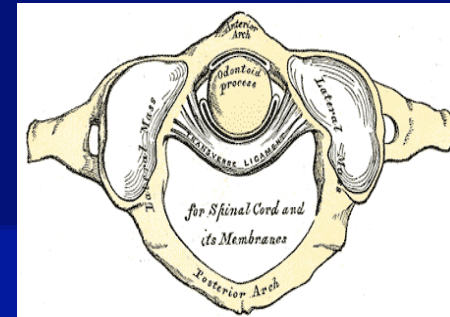
- RA is a progressive inflammatory condition exhibiting polyarthropathic degeneration and systemic manifestations resulting from both the disease process and management-associated medication.
- Clinical manifestations of the disease are the result of an autoimmune process that attacks the joint synovium, resulting in the release of cytokines that stimulate inflammatory reaction eventually leading to joint destruction and periarticular erosions.

PATHOPHYSIOLOGY

- The T-lymphocyte-mediated process results in an inflammatory synovitis and rheumatoid pannus that can damage:
 - * ligaments
 - * bones
 - * synovial joints in the cervical spine
 - * potentially resulting in subluxation
 - * instability and brainstem or cord compression.
- Because the large number of synovial articulations present and the increase range of motion required in the upper C-spine the occipito-atlantoaxial joints are the greatest risk for pathological involvement.

- Most common patterns of instability:

- * Atlanto axial subluxation (AAS)
- * Cranial settling
- * Subaxial subluxation (SAS)



- Atlanto-axial joint is most commonly affected because:

- * The consistent involvement of the synovial-lined bursa found b/w the odontoid and the transverse ligament.
- * Subsequent weakening and rupture of the transverse, alar, and apical ligaments combined with erosions of the atlantoaxial joint can lead to anterior AAS.
- * The increased atlantoaxial motion + periodontoid rheumatoid pannus can result in catastrophic spinal cord and/or brain stem injury.

- Posterior AAS

- * Represents 6.7% of all AAS
- * Results from either C1 ant. Arch defects or from odontoid erosions/fractures.

- Lateral AAS:

- * Secondary to a combination of rotational deformities.

- Frequency of AAS

- * anterior > lateral (20%) > Posterior (10%)

- Craneal settling:

- * AKA: Basilar settling, basilar invagination, atlantoaxial invagination, atlantoaxial impaction and sup. migration of the dens.

- * Occurs as result of bone and cartilage destruction at the occipito-atlantal and atlantoaxial joints.

- * Typically there is a destruction of the lateral masses of the atlas. Less commonly the lateral masses of the axis and the occipital condyles may be involved.

- * Bilateral destruction and collapse results in settling of the skull onto the cervical spine with subsequent relative superior migration of the odontoid into the foramen magnum.

- * Cranial setting is almost always preceded by AAS.

■ Subaxial Subluxation:

- * The least common of the rheumatoid cervical deformities
- * Develops late in the course of the disease.
- * Occurs secondary to destruction of the facet joints, interspinous ligament, and discovertebral junction.
- * Multiple levels are affected: classic “stepladder” deformity on lateral radiographs.

NATURAL HISTORY

- C-spine involvement is frequent, and potentially devastating
- C-spine involvement occurs in up to 86% of patients with R.A.
- Half of patients develop some degree of AAS within 5 years of the serologic diagnosis for R.A.
- Several factors have been associated to more aggressive disease o process:
 - * Disease duration
 - * Elevated c- reactive protein levels
 - * Seropositivity
 - * Severe peripheral joint involvement
 - * Rapid erosiveness
 - * Arthritis mutilans.

- Once C-spine is affected its instability is often progressive
- Non-operative treatment does not prevent progression of existing cervical disease.
- Some evidence suggests that early atlanto-axial fusion may prevent cranial settling.
- If left untreated a large percentage of patients with AAS progress toward more complex instability patterns in particular cranial settling.
- Prognosis is negatively affected once myelopathy manifests
 - * Sudden death rate: 10% of rheumatic cases with AAS.
 - * Crockard reported that of patients with RA who became myelopathic half will be dead in a year.

CLINICAL MANIFESTATIONS

- **Suboccipital pain:** One of the most complaints (40% to 85%) but nonspecific.

When pain is associated to subluxation:

- * Aggravates with neck motion
 - * Clunking sensation
 - * Feeling that the head is falling forward with flexion
-
- **L' hermitte sign:**
 - * Can be elicited with either head flexion or extension.
 - * Indicates possible spinal cord involvement.
 - Severe peripheral rheumatoid disease can mask subtle findings of brainstem or spinal cord involvement.

- First signs of early myelopathy:
 - * Clumsiness of the hand
 - * Gait disturbances
 - * Sensation of heaviness or fatigability in the legs.
- Cervical spine involvement should be suspected in patients who were previously ambulatory even if with crutches or a walker who became wheelchair dependent.
- PE:
 - * Weakness
 - * Spasticity
 - * Clumsiness
 - * Pathologic reflexes: hyperreflexia and positive Babinski and Hoffman sign
 - * Urinary and rectal disturbances: are unusual and occur late in the disease progress.
- Patients with C-spine involvement may present with findings consistent with verteobasilar insufficiency:
 - * vertigo
 - * vomiting
 - * dysarthria
 - * nausea
 - * dysphagia or cerebellar signs.

IMAGING

Plain Radiographs

■ Screening x-rays include:

- * AP
- * Lateral
- * Open mouth odontoid
- * Dynamic flexion and extension lateral views.

□ Particular attention should be paid to:

- * Anterior atlantodental interval (AADI)
- * Posterior atlantodental interval (PADI)
- * Superior migration of the tip of the odontoid
- * Degree of subaxial subluxation.

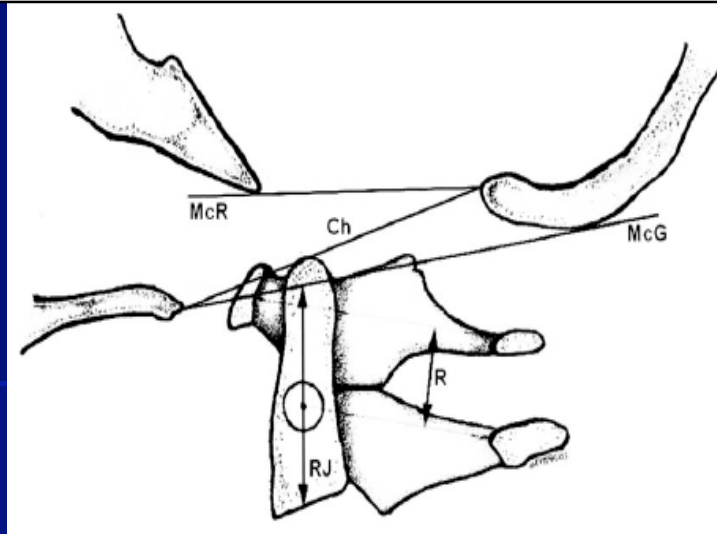
Lateral radiograph demonstrating the anterior (black arrows) and posterior (white arrows) atlantodental intervals.



- **Atlanto-axial complex integrity:**
 - * Evaluated by lateral flexion-extension radiographs.
 - * The amount of dynamic motion present during flexion-extension radiographs is more relevant than values obtained from single neutral lateral radiograph.

- Cranial settling describes intrusion of the tip of the odontoid into the foramen magnum.
- Saggital tomography demonstrating cranial settling.





- **Abnormal measures:**

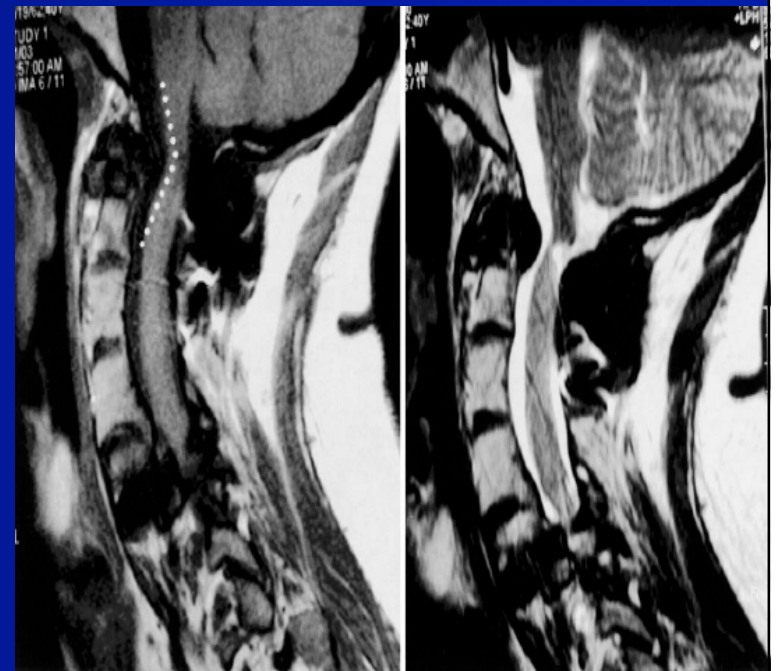
- * Odontoid tip 3 mm above Chamberlain's line.
- * Odontoid tip above McRae's line.
- * Ranawat's line < 13 mm
- * Redlund-Johnell's occipitoatlantoaxial index < 33 mm (men) and 27 mm (women)

Computed Tomography

- Provides valuable information about bony detail and osseous destruction.
- Use of CT with and without contrast provides information about inflammatory soft tissue changes differentiating b/w effusions and hypervascular pannus.

MRI

- Study of choice.
- Provides visualization of the periodontoid soft tissue pannus (increased signal intensity on T2).
- The cervicomedullary angle correlates with the clinical presence of myelopathy and paralysis. **CMA < 135 degrees.**
- Normal CMA: 135 – 175 degrees.
- Dynamic flexion-extension MRI



Indications for Surgery

- Intractable pain.
- Neurologic involvement:
 - * Cervical collars do not prevent progression of subluxation.
 - * Once myelopathy develops the prognosis is poor.
- Cervical instability with “impending” neurologic involvement:
 - * Most challenging group: patients with cervical subluxation without neurologic deficit and minimal pain.
 - * Classical criteria for atlanto-axial and sub-axial instability should not be extrapolated to RA patients.
 - * Cut off for surgery: AADI > 10 mm, PADI < 14 mm, Space available for the cord (SAC) < 13 mm

Surgical Management

- **Main goals:**
 - * Preserve or restore neurologic function.
 - * Management of cervical instability and deformity should focus on restoring alignment and obtaining solid arthrodesis.
- **AAS surgical techniques:**
 - * Modified Gallie graft.
 - * Brooks-Jenkins fusion.
 - * Magerl C1-C2 transarticular screw technique.
- **SAS surgical techniques:**
 - * Interspinous wiring.
 - * Lateral mass screw fixation.
 - * Pedicle screw fixation.