PARAPLEGIA- TYPES, CAUSES AND DIAGNOSIS

DEFINITION:
Paraplegia is impairment in motor and or sensory functions of the lower extremities often including lower part of the trunk.
Paraplegia; total paralysis
Paraparesis: partial paralysis
The area of spinal canal affected-either thoracic or lumbar or sacral region

Most common causes of Paraplegia
Trauma
Tumor
Tuberculosis
Transverse myelitis

CLASSIFICATION OF ETIOLOGY

Figure 1. PARAPLEGIA MAJOR CAUSES
SPINAL CORD LESIONS:

COMPRESSIVE MYELOPATHY.
Destruction of spinal cord tissue caused by pressure.
(from spinal cord compression by degenerative spinal disease /neoplasms /hematoma or other masses.)

Pathogenesis of cord involvement:

1. Direct involvement of roots and cords causing dysfunction.

2. Lesions can interfere with longitudinal and radicular spinal arteries causing ischemia of the segment, which they supply.
This vascular disturbance causes local edema of the cord which results in degeneration of the white matter- areas of softening occur.( called compressive myelitis.)
3. Compression can cause pressure effect upon ascending longitudinal spinal vein, which leads to edema of the cord below the site of compression e.g. If there is compression at high cervical level edema can occur at C8T1 level resulting in small muscle wasting.

**Order of compression of the tracts:**
1st Pyramidal tract,
then Posterior column,
lastly Spinothalamic tract.
But exception can occur to this rule.

**Explanation for the above:**
- Pyramidal tract is supplied by the terminal branches of spinal arteries and hence most susceptible to compressive ischemia.
- Another explanation offered:
  Pyramidal tract is lying closest to denticulate ligament
  This ligament is subject to traction in spinal cord compression.
  So pyramidal, tract is most involved.

  Obstruction of subarachnoid space,
below the level of the tumor. causes loculation of CSF -causing the characteristic changes in its composition.

**Cause of compression of spinal cord:**

Classified as 1. *Intra* medullary and 2.*Extra* medullary

2.*Extra* medullary causes divisible into

- *Intra* dural & *Extra* dural

**2a. *Intra* dural**

arise from the dura and compress the cord and roots-typical e.g. meningioma

**2b. *Extra* dural**

i. Arising from *vertebra* invading spinal canal and compressing intra spinal structures typical e.g. *2ndries* of spine from primaries breast, lung, prostate

Disc lesions; disc prolapse /spondylosis act similarly

ii. Through *intervertebral foramina*, mass can invade spinal canal e.g. Schwanoma, neurofibroma

iii. Paravertebral masses of diverse pathologies- can compress roots, their arteries autonomic, dorsal root ganglia
Elsberg phenomenon; Order of involvement of limbs:

In cervical myelopathy first there is weakness of ipsilateral arm, then ipsilateral leg, then contralateral leg, and lastly contra lateral arm occurs. This U” shaped involvement of the limbs is called Elsberg phenomenon. Occurs in Extradural intra medullary compression.
**Differences between Extradural and Intradural lesions.**

**Extra dural {Mnemonic- (3Ps) }**
- Pain-present -(root pain and spinal tenderness)
- Pyramidal involvement –early.
- Proteins in CSF-High.(Froins syndrome)
- Asymmetrical

**Intra dural**
- Dissociated anesthesia.
- Bladder involvement early.
- Not so high.
- Symmetrical involvement
- Trophic Ulcers common

**Points, which help in determining level of lesion in spinal cord -compression:**

1. Sensory level
2. Motor level
3. Reflex level
4. Root pain-shows dermatome involved.
5. Type of bladder involvement.
6. Autonomic disturbances.

**Sensory** level:
Below that level, sensory loss or impairment.

**Motor** level:
1. Beevor's sign:- indicates T10 lesion;
   In positive Beevors sign, umbilicus moves up on raising the head,because lower abdominal muscles are weak. The upper abdominal muscles supplied by T8-T10 pull the umbilicus up.

**Reflex** level:
Inverted supinator reflex indicates C5level.
If upper abdominal reflexes are preserved & lower abdominal are lostthe level of the lesion is T10.

**Autonomic** disturbances:
Below a certain level there will be autonomic disturbances like loss of sweating or excessive sweating, loss of temperature or pilo erection.

**Differences between CORD, NERVE AND ROOT LESIONS**

**CORD**
Adjoining area involvement can affect the ascending and descending long tracts

2. Cord lesion may be partial; physical findings depend upon that particular area; and long tracts involvement below the lesion UMN paralysis occurs.
   Below the lesion long sensory tracts( like spinothalamic

**NERVE**
- Formed by many roots; supplies definite area.
- Hence sensory and /motor loss will be confined to that area

2. Can be motor ,sensory or mixed
   - In motor nerve muscles supplied by that motor nerve are wasted after 3wks.
   - In sensory nerve-all types of superficial sensations are lost

**ROOT**
- Forms apart of nerve or nerves
- Area supplied by one root ,there is considerable overlapping.Hence the loss is minimal

2. Antr.root-motor atrophy- a part of the muscle;partial wasting
   - postr.root –area of sensory loss is minimal ;most marked for pin prick
   - e.g.In S1 lesion area of
/posterior column) deficit may be seen. Over of distribution of the nerve area In mixed nerve lesion combination of both.

sensory loss is confined to lateral border of foot.

**DIAGNOSIS OF LEVEL OF THE LESION IN COMPRESSIVE MYELOPATHY**

**Upper cervical region & foramen magnum:**
1. Severe pain in the occiput & neck.
2. In hands loss of posterior column sensation is early symptom & severe tingling & numbness.
   Pain & weakness in the limbs & wasting may occur in the upper limb.
3. Movements of diaphragm reduced because of compression of phrenic nerve.
4. Lower cranial nerve involvement & medullary involvement can occur.
5. Descending tract of trigeminal can be involved.

**C5C6 segment lesion:**
1. Inverted supinator reflex
2. Wasting of muscles supplied by C5C6 namely deltoid, biceps, brachioradialis, infra & suprasinators & rhomboids
3. Paraplegia

**C8T1 Level:**
1. Wasting of small muscles of the hand.
2. Wasting of flexors of wrist & fingers.
4. DTR of upper limbs preserved.
5. Spastic paralysis of trunk & lower limbs.

*Cervical spondylosis never involves C8 & so small muscle wasting rules out cervical spondylosis.*

**Mid Thoracic region of spinal cord:**
1. Upper limb normal.
2. Wasting of intercostals muscles (those supplied by involved segments)
4. Spastic paralysis of abdominal muscles & lower limbs.
5. 

9th & 10th thoracic segments:

1. **BEEVOR’S SIGN**
   
   (when patient raises the head against resistance umbilicus is drawn upwards).

T12L1 segments:
Abdominal reflexes preserved
Cremastric lost.
Paraplegia
Wasting of internal oblique & transverse abdominal muscle.

L3 L4 segmental lesion:
1. Flexion of hip is preserved.
2. Cremastric preserved.
3. But Quadriceps & adductors of hip are wasted
4. **KNEE JERK IS LOST** or diminished.
5. **BUT ANKLE JERK IS EXAGGERATED.**
7. Foot drop

S1S2 segments;
1. Wasting & paralysis of intrinsic muscles of feet.
2. Wasting & paralysis of calf muscles Plantor flexion impaired.
3. But dorsi flexion of foot is preserved.
4. In the hip all muscles of hip are preserved except flexors & adductors.
5. In the knee flexors of knee are wasted.
6. **KNEE JERK IS PRESERVED**
7. **ANKLE JERK IS LOST.**
8. Plantar reflex is lost.
9. No foot drop.
10. Anal & Bulbocavernous reflexes are preserved.

S3S4 segments:
1. Large bowel & bladder are paralysed.
2. There is **RETENSION OF URINE & FEACES** due to unopposed action of internal sphincters.
1. The external sphincters are paralyzed.
2. **ANAL & BULBO CAVERNOUS REFLEXES ARE LOST.**
3. **SADDLE SHAPED ANESTHESIA** occurs.
4. but no paraplegia

**Calculating segments involved: from vertebral level**

For cervical vertebra   Add 1
For T1-T6 - vertebrae  Add2
For T6-T9 - vertebrae  Add3
T10 vertebra corresponds to L1-L2 segments
T11 vertebra corresponds to L3-L4 segments
T12 vertebra corresponds to L5 segment
L1 vertebra overlies Sacral and coccygeal segments

**Other conditions which produce symptoms similar to Cord compression**

Pain may be referred pain as in gastritis, angina, pleural pain, cholycystitis, renal calculus.
To avoid errors thoroughly examine CNS.; usually there will be signs implicating spinal cord; signs of other visceral involvement will be absent.

**Diagnosis of causes of Paraplegia**

I. **Vertebral Disease**: pain, rigid spine, Angular deformity
   Common cause TB osteitis (young patient, raised ESR, Evidence of Tb focus anywhereelse
II. **2ndry Carcinoma**: middle age, rapid onset, severe pain, h/o surgery for carcinoma, primary detection.
III. **Cervical Sponylosis**: detected by Xray; but can be coincidental finding
IV. **Spinal tumor**: insidious onset, slowly progressive, no evidence of vertebral disease
   Under general exam look for neurofibroma, pigmentation
   It is difficult to guess the nature of spinal tumor
V. **Meningitis**: impossible to differentiate pachy meningitis and arachnoiditis:
   Multiple levels of lesion and patchy and streky arrest of contrast medium indicates arachnoiditis
VI. **Myeloma/Pagets**: Only by investigations
VII. **Other rare causes**: lymphoma, leukemia, parasitic cyst, extra dural metastasis:
   Diagnosis on clinical grounds, evidence of disease elsewhere and investigations

**Certain special types of paraplegia**

**Pure motor paraplegia without sensory loss**
- Hereditary spastic paraplegia
- Lathyism
- Amyotrophic lateral sclerosis
- Flurosis
- Gullain Barre syndrome
Acute paraplegia : 
Trauma - fracture dislocation of vertebra 
Infection: Epidural Abscess 
Vascular: 
  - Thrombosis of Anterior spinal artery 
  - Endarteritis (tuberculous, Syphilitic) 
  - Hematomyelia (AV malformation, Angioma) 
Transverse Myelitis 

Cord Compression at multiple levels 
  - Arachnoiditis 
  - Multiple secondaries 
  - Multiple sclerosis 
  - Neurofibromatosis 
  - Spondylosis - cervical and lumbar level 

Paraplegia in flexion: 
Paralysed legs are fixed in flexed posture. Occurs in partial transaction of the spinal cord. - Extensors are more paralysed than flexors

Paraplegia in extension:
Occurs in complete transaction of spinal cord, where extra pyramidal tract also is affected and hence no voluntary movements of the limb is possible resulting in paraplegia in extension
Mass reflex
In severe injury of spinal cord, stimulation below the level of the lesion produces flexion reflexes of the lower limb, evacuation of bowel and bladder and sweating of the skin below the level of the lesion.

NON-COMPRESSIVE MYELOPATHY.

Infective Causes: Bacterial: Acute: Staphylococcal (extramural or intradural) Chronic: Tuberculous, Syphilitic. 
Parasitic: Hydatid, cysticercosis, Schistosomiasis, falciparum malaria. 
Viral: Polio, Rabies, Herpes zoster, HIV 
Rickettsial: Typhus fever, spotted fever 
Fungal: Cryptococcus, Actinomycosis, and coccidiomycosis

Immuno Allergic causes: 
Post vaccinial-Rabies, tetanus, and polio 
Post exanthematous-Chicken pox, Herpes zoster

Demyelinating:
Multiple sclerosis, Neuromyelitis optica, 
Sub acute combined degeneration.

Transverse Myelitis can be due to infective or immuno allergic or Demyelinating causes.
**Heredo familial, Degenerative:**
Spinocerebellar degeneration.
Familial spastic paraplegia
Motor neuron Disease
**Toxic myelopathy:**
Lathyism
TOCP
Arsenic
Contrast media used in radiology
Intra thecal penicillin
Spinal anesthesia
SMON-Sub acute myelo opotic neuropathy (long term enteroquinol, large dose; Myelopotic and peripheral neuropathy. Abdominal symptoms.
**Vascular** Disorder:
Arteriosclerosis-Anterior spinal artery thrombosis
Dissecting aneurysm of aorta
AV malformation in spinal cord
2ndry to surgery on aorta
**Metabolic /Nutritional;**
B12 deficiency. Pellagra, Myelopathy of chronic liver disease
**Tropical;**
Tropical spastic paraplegia
**Para Neoplastic** Syndrome:
**Physical** agents;
Irradiation
Electric shock to spinal cord
Caisson’s disease.

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**Manifestations of cord /root lesion depends upon**

1. Level of lesion
2. Speed of onset
3. Vascular involvement 4. Site

**Level of the lesion:**
Above L1 vertebra- Damage to both cord and roots.
Below L1 vertebra- only roots are involved.

**Speed of the lesion:**
A rapidly progressive cord lesion produces flaccid paralysis and absent reflexes and extensor plantar. This is similar to spinal shock in trauma.
After weeks or days tone becomes hypertonic.

**Vascular involvement:**
In cord compression damage may be due to mechanical stretching or ischemia. In certain cases clinical findings indicate cord damage well beyond the site of compression. This shows vessel compression at the site of lesion is causing distant ischemic effect.
**Site of lesion:**
Intra medullary lesion produces only segmental signs & symptoms.
Extra dural lesions on the other hand produce both signs of root lesion cord lesion.
i.e. At the site of lesion –LMN segmental lesion with segmental sensory loss & below that level-
UMN Lesion & sensory loss plus root pain.

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**Difference between Cauda equina and Conus lesion.**

Differentiation is often difficult.
Also there can be isolated conus lesion, isolated cauda lesion or a combination.

*Cauda equina* is a bundle of spinal nerve roots arising from lower end of spinal cord.

**Cauda equina lesion : produces**
Asymmetric,
Atonic,
Areflexic,
Paraparesis;
   With bladder & bowel disturbance
Plus sensory loss,
Saddle shaped anesthesia
Pain is common & is referred to perineum & thigh.

**Conus lesion**
Conus medullaris is terminal end of spinal cord which occurs at L₁L₂ level.
★ In spite of paralysis of bladder & rectum if bulbocavernous and anal reflexes are preserved and
★ If there is dissociated sensory loss (over S₂S₃S₄),
it is likely that the lesion is in conus.
★ If the lesion extends above S₁ then plantar can be extensor, which is never the case with cauda lesion.
<table>
<thead>
<tr>
<th>Features</th>
<th>Cauda lesions</th>
<th>Conus lesions(S3,S4,S5,C1)</th>
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<tbody>
<tr>
<td>Pain</td>
<td>Pain in lower limbs is characteristic.</td>
<td>Often absent or limited to</td>
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<td></td>
<td></td>
<td>buttocks &amp; perineum.</td>
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<td>Bladder and rectal symptoms.</td>
<td>Often absent Present only in the involvement of lower sacral roots-usually late.</td>
<td>Always present</td>
</tr>
<tr>
<td>Symmetry</td>
<td>Often asymmetrical or unilateral for a long time.</td>
<td>Practically always bilateral.</td>
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<tr>
<td>Sensation</td>
<td>All forms of sensation impaired.</td>
<td>May be dissociated.</td>
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</table>
DTR Both knee & ankle jerk
Lost. 
Only ankle jerk affected/or
even that may be spared.

Tone Flaccid paralysis of legs &feet
characteristic of cauda lesion.

Trophic changes Absent Present.

**Investigations in a case of paraplegia**

Plain Xray Spine
Myelogram
CT scan
CSF analysis

**Plain Xray Spine**
Lateral and oblique view:
**Signs of degeneration of spines**
Reduction of intervertebral space
Narrowing of intervertebral foramina
Osteophyte formation.
Widening of IV foramina-Neuro fibroma
Widening of inter peduncular distance:-long standing intramedullary, intradural lesion.

**Secondary,myeloma,tuberculous infection:**
Destruction of vertebra/collapse of vertebra..
AP view:
Erosion of the pedicle-extra medullary tumor
Para spinal mass: -extra medullary tumor /cold abscess.

**Myelogram** (Must specify at which level lesion is suspected.)
**A. Extradural:**
Complete block shows with ragged edge.
At times even with complete block contrast can be coaxed beyond the block to determine its
upper extent otherwise a cervical puncture may be required.
**Partial block:**
Extra dural; Dura mater is lifted away from the vertebral body.

**B. Intra dural:**
Intra medullary; contrast is splayed around dilated cord.
Extramedullary; cord displaced to one side.
**CSF Analysis:** Lumbar puncture can worsen neurological disease, because of the pressure gradient it creates. So when a compressive lesion is suspected lumbar puncture & CSF analysis can be done at the time of Myelography. CSF protein is increased often especially below the block, more so in extra medullary. **Cell count:** Increase in Leukocytes indicates infections like Abcess/TB.

**CT scan:**  
**Plain CT:** Can diagnose narrowing of disc disease of lumbar region. Can identify narrowing of lumbar canal & thickening of facet joint.

**Contrast CT** is required to show Cord compression.:  
Best done 6-12 hrs after myelography. Can show amount of compression & delineate neurofibroma like intraspinal lesions.

**MRI:**  
Sagittal views are to be taken, not axial views as in case of CT scan. Can differentiate Syringomyelia from intramedullary tumors.

**Other investigations:**  
- Xray chest: May show P.T, Lymphoma or malignancy.  
- C.S.F.-Electrophoresis to show oligoclonal bands of multiple sclerosis.  
- Serological tests for Syphilis.  
- IgG/Albumin ratio-to diagnose multiple sclerosis.  
- Routine blood test: hematological, biochemical  
- Routine urine exam, urine for culture and sensitivity

**Complications of paraplegia:**  
- Bed sores  
- Contractures  
- Urinary tract infection  
- Pneumonia  
- Deep venous thrombosis