

“...the trouble with my back”

Musculoskeletal Block

Case 1, Year 1

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Key Concepts

- Anatomy of the back.
- Function of the different anatomical structures of the back.
- Pathology and pathogenesis of back pain.
- Principle of dermatomes and myotomes.
- Application of knowledge learnt from anatomy.
- Use of basic sciences in interpreting patient's symptoms and signs.
- Differences between X-rays, CT scans, and MRI scans.
- Pharmacology and mechanisms of action of NSAIDs and paracetamol.

Learning Objectives:

This PBL package (Tutorials One and Two) targets the following objectives:

- Discuss the anatomy and function of the musculoskeletal system of the back.
- Use knowledge learnt from anatomy to discuss the possible causes of back pain.
- Discuss the pathophysiological consequences of disc injury and the mechanism of pain in these patients.
- Use basic sciences to explain the patient's symptoms and signs.
- Discuss the principle of myotomes and dermatomes of the trunk and lower limbs.
- Discuss main differences between X-rays, CT scans, and MRI scans.
- Discuss the Pharmacology and the mechanisms by which NSAIDs and paracetamol work as analgesics.

Trigger

(40 Minutes)

Salem Kumar, a 38-year-old construction builder comes in with his wife to see a local general practitioner, Dr Ayman Alam, because of back pain in the lower part of his back for the last 5-6 days. Salem's wife is worried about her husband as his pain hasn't gone away, although Salem has been taking paracetamol tablets for the last 2 days.

Discussion Questions:

- Are there any difficult words you do not understand?
- List the key information about Salem.
- Identify Salem's presenting problems.
- For each problem make a list of how it may be caused (generate hypotheses).
- What further information would you like to know to help you differentiate between your hypotheses? (What questions would you like to ask Salem and his wife?)

Trigger

(40 Minutes)

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New Terms

Paracetamol:

Also known as **acetaminophen** is a widely used over-the-counter analgesic (pain reliever) and antipyretic (to reduce temperature in patients with fever). It is commonly used for the relief of back pain, joint pains and headaches as well as other minor aches. It is also a major ingredient in numerous cold and flu remedies.

Hypotheses

1. **Lower back pain**
 - Muscles: muscle tear, muscle strain.
 - Ligaments: tear, rupture.
 - Vertebrae: fracture, primary bone tumour, metastasis from a primary.
 - Joints: joint dysfunction, facet joint injury, degenerative disease, inflammation.
 - Disc: disc injury, disc prolapse.
 - Osteophytes: secondary to degenerative diseases.
 - Infection of vertebrae.
 - Infection the spinal cord.
 - Blood collection (haematoma).

Hypotheses

2. Worried wife:

- The pain is severe.
- Pain is causing her husband unable to move, go to work.
- Pain continued for 5-6 days.
- Lack of information.
- Not sure about outcomes.
- Previous bad experience with family members or friends.
- Afraid lest he has cancer.

Hypotheses

3. Pain did not go away (despite paracetamol):

- Paracetamol is not the appropriate medication for his condition (diagnosis).
- Paracetamol is not taken in the correct dose (drug dose).
- Paracetamol is given only once (frequency).
- Paracetamol is not strong analgesics (efficacy).
- Compared to NSAIDs, paracetamol is not a strong anti-inflammatory drug (actions).

Facilitation Questions

What are the anatomical structures forming the back?

- Skin.
- Muscles of the back.
- Bones of the back (vertebrae).
- Intervertebral discs.
- Joints.
- Ligaments.
- Arteries.
- Veins.
- Nerves and spinal cord.

Facilitation Questions

What could possibly go wrong to each of these structures and produce pain?

- Skin and subcutaneous tissue → infection/ inflammation/ cancer.
- Skeletal muscles → Injury/tear/inflammation/infection.
- Bones (vertebrae) → Fracture/tumour/infection/ inflammation.
- Joints → injury/tear ligaments/ tear meniscus/dislocation.
- Nerves/normal connections → nerve injury/nerve tear/ nerve inflammation/ pressure on spinal nerve..
- Arterial blood supply → arterial insufficiency,
- Venous drainage → thrombosis/blockage

Facilitation Questions

When we are handling a sudden health problem what are the sources (causes) or our worries?

- The sudden onset of the news.
- Not knowing what to do.
- Not knowing the outcomes.
- Thinking about bad outcomes/losses.
- Lack of enough information.
- Fears.
- How the problem will affect people around you as well.
- Not sure about costs.
- Not sure about consequences on long term.
- Worries about death.
- Worries about loss of function.
- Difficulties in making decisions.

Facilitation Questions

What do you know about paracetamol?

What is the mechanism by which paracetamol works?

To date, the mechanism of action of paracetamol is not completely understood. The main mechanism proposed is the inhibition of cyclooxygenase (COX), and recent findings suggest that it is highly selective for COX-2 (Hinze et al 2008; <http://www.fasebj.org/content/22/2/383>).

Do you know any other drugs that can provide a stronger analgesic effects?

NSAIDs

COX-2 inhibitors

Opiates and morphinomimetics.

Facilitation Questions

In what way is paracetamol different from NSAIDs?

Paracetamol:

- As an analgesic: paracetamol is less potent compared to NSAIDs.
- Side effects: it does not cause increased acidity, peptic ulcer etc.
- Action: it is considered as COX-2 inhibitor.
- Toxicity: if taken in large doses, acute liver failure is the main complication.

Facilitation Questions

What are the factors that can increase the risk of developing low back pain?

- Smoking.
- Obesity.
- Old age.
- Osteoporosis of bone.
- Physical strenuous work.
- Sedentary work.
- Stressful work.
- Anxiety.
- Depression.

Further Questions

- Any history of fall or trauma.
- Any history of lifting heavy objects.
- Past history of similar pain.
- History of investigations, hospital treatment or surgery for back pain.
- Any history of referred pain to the thighs, buttocks?
- Activities and any limitations of movement.
- Smoking and alcohol intake.
- Medications and allergy.
- Family history.
- Social history

**Please Read
The History**

History

Salem likes his work and he has been enjoying good health; he rarely gets ill. Over the last 5-8 days he experienced pain in his lower back. The pain is localized in the lower part of his back and interferes with his daily activity. He grades the pain severity as 5-6 out of 10. He describes his pain as a constant dull ache pain in the lower back which is increased by sudden movement of his trunk. Also coughing, sneezing make his back pain worse. Two days ago he noticed pain in his left buttock, back of thigh, and calf muscles. The pain is associated sometimes with numbness in the outer area below the left knee, and outer toes.

He noticed no changes in his urination or bowel habits. He was able to sleep at night after taking 2 paracetamol tablets but in the morning the pain returned again. He remembers carrying a few heavy objects at work the day he experienced the back pain. He gives no history of fever or rigor and no changes to his appetite.

History (continue)

Past Medical History

No past history of investigations or surgery.

No past history of chronic illness or hospital admission.

Tobacco & Alcohol

Nil.

Allergy and Medication

Nil

Family History

Nothing significant

Social History

Salem has been working in Saudi Arabia for the last 5 years and has been married for 10 years and has 3 children (8, 5, and 2 years old). His family is living with him in Riyadh. He has some stress at work but no financial problems.

Discussion Questions

- Are there any difficult words you do not understand?
- List the key information in this progress.
- Identify any new problems and add to your list.
- For each new problem make a list of how it may be caused (generate hypotheses).
- What body system would you like to examine to help you in refining your hypotheses?

New Words/Terms

Calf muscles: The calf muscle group is made up of three muscles superficial in the posterior compartment of the lower leg, with gastrocnemius and soleus being the main ones.

- gastrocnemius.

- soleus.

- plantaris.

New Problems

- Salem likes his work and has always been in good health.
- Experienced lower back pain about 5-8 days ago.
- He grades his pain as 5-6 out of 10. The pain is a constant dull ache pain.
- Pain increases on coughing, or sneezing .
- Pain is felt in his left buttocks, back of thigh and calf muscle.
- There is numbness in the outer area below the left knee and outer toes.
- No changes in his urination or bowel habits.
- He sleeps at night after taking 2 paracetamol tablets.
- No history of fever or rigor or changes in appetite.
- No past history of similar pain or investigations.
- Has been working in Saudi Arabia for the last 5 years. Has 3 children.

Hypotheses

1. Lower back pain

- Muscles: muscle tear, muscle strain. 0/+
- Ligaments: tear, rupture. ?/0
- Vertebrae: fracture, primary bone tumour, metastasis from a primary. ?
- Joints: joint dysfunction, facet joint injury, degenerative disease, inflammation. ?
- Disc: disc injury, disc prolapse. ++/+++
- Osteophytes: secondary to degenerative diseases. ?/0
- Infection of vertebrae. ?
- Infection the spinal cord. ?/0
- Blood collection (haematoma). ?

Hypotheses

2. Worried wife:

- The pain is severe. ++
- Pain is causing her husband unable to move, go to work. +++
- Pain continued for 5-6 days. +++
- Lack of information. +++
- Not sure about outcomes. +++
- Previous bad experience with family members or friends. ?/o
- Afraid lest he has cancer. ?/+

Hypotheses

3. Pain did not go away (despite paracetamol):

- Paracetamol is not the appropriate medication for his condition (diagnosis).?/++
- Paracetamol is not taken in the correct dose (drug dose).++
- Paracetamol is given only once (frequency). ++
- Paracetamol is not strong analgesics (potency) +++/+++.

**Please Read
The Clinical
Examination**

Clinical Examination

Clinical Examination

Salem looks unwell. He leans to the right. His vital signs are summarized in the table below:

Vital signs	Salem	Normal range
Pulse rate	82	60-100/min
Blood pressure	120/80	100/60 – 135/80 mmHg
Temperature	37.1 °C	36.6-37.2 °C
Respiratory rate	15	12-16/min

Clinical Examination (continue)

Musculoskeletal Examination:

- He puts his weight on the right leg.
- He is unable to flex his trunk forward. Lateral flexion is fine.

Neurological Examination:

- Examination of both upper limbs: Normal
- Straight leg-raising is restricted to only 30 degrees on the left side. Normal (up to 90 degrees) on the right side.
- Sensations: impaired sensation on the outer aspect of the left leg below the knee, lateral side of the dorsum of foot, and lateral 3 toes. Normal sensations on the right side.
- Reflexes: normal except for left ankle is lost (the ankle is supplied by S1).
- Examination on the right leg is normal.
-

Cardiovascular and Respiratory Examinations:

- Normal

Discussion Questions

- List the key information in this progress.
- Identify any new problems and add to your list.
- For each new problem make a list of how it may be caused (generate hypotheses).
- What are your learning issues?

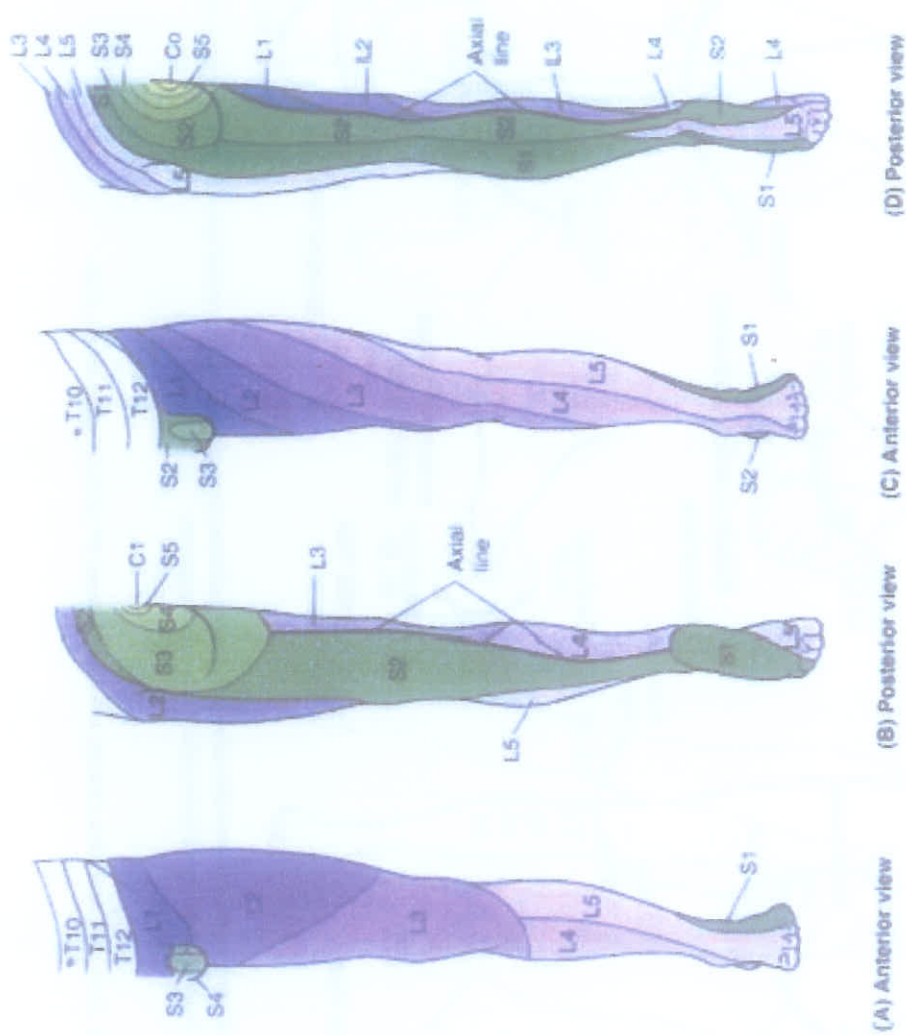


FIGURE 5.17. Dermatomes of lower limb. The dermatomal or segmental pattern of distribution of sensory nerve fibers persists despite the merging of spinal nerves in plexus formation during development. Two different dermatome maps are commonly used: **A and B.** The dermatome pattern of the lower limb according to Foerster (1933) is preferred by many because of its correlation with clinical findings. **C and D.** The dermatome pattern of the lower limb according to Keegan and Garrett (1948) is preferred by others for its aesthetic uniformity and obvious correlation with development. Although depicted as distinct zones, adjacent dermatomes overlap considerably, except along the axial line.

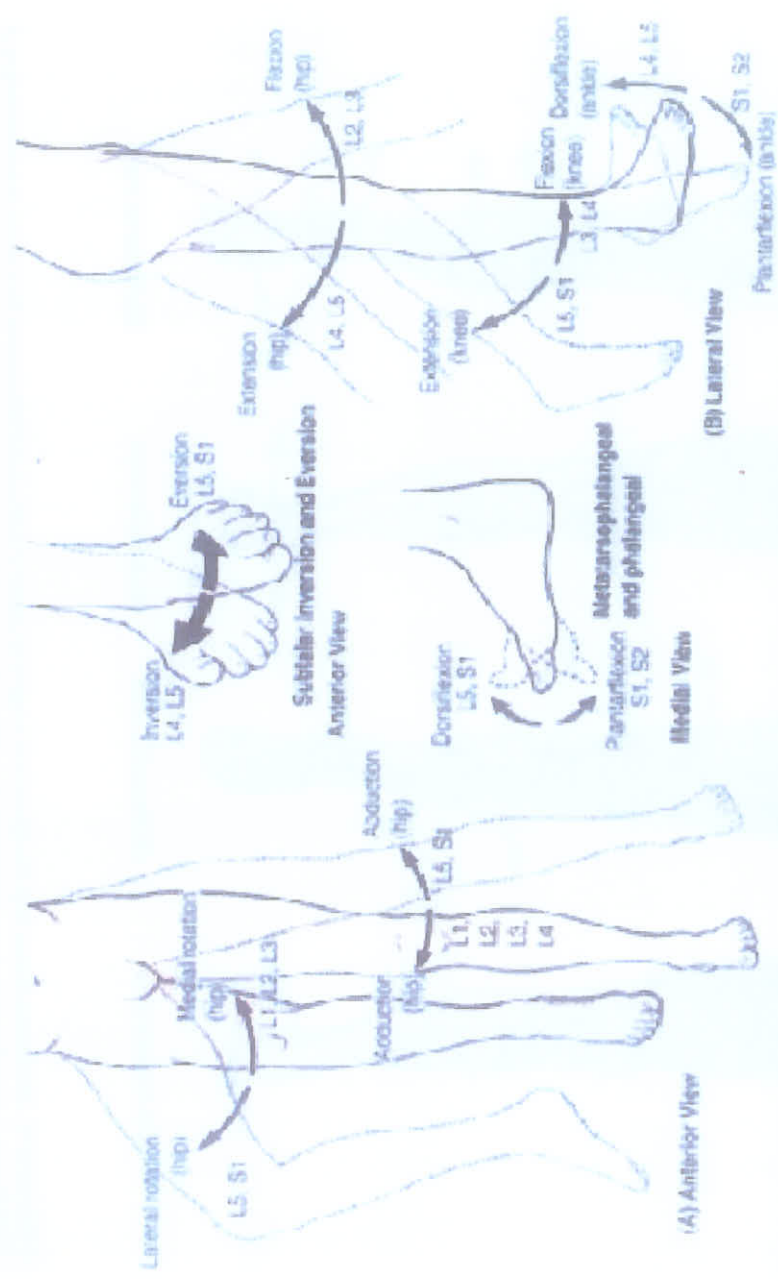


FIGURE 5.18. Myotomes: segmental innervation of muscle groups and movements of lower limb. The level of spinal cord injury or nerve impingement may be determined by the strength and ability to perform particular movements.

Source : Moore KL , Dalley AF , Agur AMR, Clinically Oriented Anatomy. 6th edition. Wolters |Kluwer 2010.

Hypotheses

- Lower back pain**
 - Muscles: muscle tear, muscle strain. 0/0
 - Ligaments: tear, rupture. /0
 - Vertebrae: fracture, primary bone tumour, metastasis from a primary. ?
 - Joints: joint dysfunction, facet joint injury, degenerative disease, inflammation. ?/0
 - Disc: disc injury, disc prolapse. ++/+ +++
 - Osteophytes: secondary to degenerative diseases. ?/0
 - Infection of vertebrae. /0
 - Infection the spinal cord. ?/0
 - Blood collection (haematoma). ?/+

Hypotheses

2. Worried wife:

- The pain is severe. ++
- Pain is causing her husband unable to move, go to work. +++
- Pain continued for 5-6 days. +++
- Lack of information. +++
- Not sure about outcomes. +++
- Previous bad experience with family members or friends. ?/0
- Afraid lest he has cancer. ?/+

Hypotheses

3. Pain did not go away (despite paracetamol):

- Paracetamol is not the appropriate medication for his condition (diagnosis).?/++
- Paracetamol is not taken in the correct dose (drug dose).++
- Paracetamol is given only once (frequency). ++
- Paracetamol is not strong analgesics (potency) +++/+++.

Facilitation Questions

Where do you think the level of the Salem's problem? (one answer). Justify your views.

- Cervical vertebrae.
- Thoracic vertebrae.
- Lumbar vertebrae.
- Sacral vertebrae.

Justification:

- Presented with lower acute back pain.
- Pain radiates to buttocks and back of left thigh.
- Sensory changes in his legs and
- Loss of ankle reflex.

Facilitation Questions

How would you explain the changes in his left lower limb?

1. Neurological condition:

- Spinal nerve compression by a prolapsed disc.
- Inflammation of spinal nerves supplying the muscles of his left lower limb.
- Interference with the sensory nerve fibers carrying sensations in from the left lower limb.
- Interference with the blood supply to the left lower limb.

2. Muscle disease like myositis (less likely).

3. Generalized muscle disease e.g., myopathy (less likely).

Refining Hypotheses

Most likely:

- Intervertebral disc prolapse.
- Zygapophyseal (facet joint) injury.

Less likely:

- Infection.
- Inflammation.
- Degenerative disease.
- Trauma.
- Metastasis.
- Muscle tear.
- Primary cancer

Learning Issues

Learning Issues

- Anatomy of the back? What are the anatomical structures forming the back?
- Functions of the muscles, joints, ligaments, discs, and vertebrae of the back.
- Pathology and pathogenesis of back pain?
- Spinal nerves and distribution to lower limbs.
- Principles of dermatomes and myotomes.
- What is paracetamol? Pharmacology and mechanisms of action of paracetamol. How paracetamol is different from NSAIDs?

Tutorial Two

TUTORIAL TWO

Students will discuss their learning issues for 50 minutes. Then:

- What is your refined hypothesis? Justify your views.
- Discuss the mechanisms underlying Salem's back pain.
- What do you think the doctor will do at this stage?

**Please Read
Progress 1**

Progress 1

Salem is very stressed because he does not know the nature of his illness and whether he will need a surgery or not. He is also worried lest he loses his job and how he will be able to look after his family. He asks a number of questions and tries to find out answers for his questions. Dr Alam assures him that there is a need for some investigations before making a final diagnosis.

Dr. Alam arranges for Salem to have X-ray and CT scan of the lower back. Because of the changes seen in the CT-scan, Salem is recommended for an MRI-scan of the lower back. The results of his investigations are shown below:

Progress 1 (continue)

- **Plain X-ray of the lumbar spine:**
Nothing significant was found.
- **CT- scan of the lower back:**
Sagittal section CT scan shows mild bulge of the disc at L5/S1. There is no bony abnormality.
- **MRI- scan of the lower back:**
Sagittal section shows some prolapse of the disc at the level of L5/S1.

Discussion Questions

- Are there any terms that you do not understand?
- Summarise the key information that you have obtained from this progress.
- What are the sources of Salem's stress?
- Use the results of these investigations to refine your hypothesis.
- How would you explain the failure of the plain X-ray to show pathological changes? What are the main differences between an MRI-scan and a CT-scan?
- What are your management goals and management options?

New Words/Terms

- Plain X-ray
- CT scan.
- MRI scan

New Words/Terms

(Oxford Concise Colour Medical Dictionary)

Plain X-ray– Electromagnetic radiation of extremely short wavelength (beyond the ultraviolet), which pass through matter to varying degrees depending on its density. X-rays are produced when high energy beams of electrons strike matter. Great care is needed to avoid unnecessary exposure.

CT scan- A form of x-ray examination in which the x-ray source and source of detector (CT scanner) rotate. Patients undergoing CT scan examination are exposed to a higher X-ray dose than in conventional plain X-ray. However, the information gained from CT scan images are useful in making a diagnosis. Ct scans are particularly useful in examination of Head, Chest and Abdomen. They provide more information compared to plain x-ray.

New Words/Terms

(Oxford Concise Colour Medical Dictionary)

MRI scan– No risk of X-ray exposure or radiation is expected by using MRI scan. The imaging technique here is based on the emission of electromagnetic waves from the body when the patient is placed in a strong magnetic field and exposed to radiofrequency radiation. Most images relay on the signals from hydrogen in water resulting in different grades (white, grey to black) in the imaging. MRI scan can give good images showing soft organs such as the liver, intestine, spleen etc and any pathological changes.

Facilitation Questions

- What are the changes you have noticed in the CT and MRI scans?
- Are these changes consistent with the clinical examination findings? Justify your views.
- How can you explain Salem's back pain on the basis of the MRI scan findings?

**Please Read the
Closure**

Case Closure

Dr Alam discusses the results of the investigations with Salem and his wife. He explains that it is possible that the heavy load Salem carried a few days ago at his work has caused a severe pressure on the discs located between the bones of the back (also known as vertebrae). The pressure caused a part of one of the discs between the vertebrae to protrude from its place causing a little pressure on one of the spinal nerve. The little pressure (touch) on the spinal nerve explains the tingling and numbness experienced by Salem on his left leg. It also explains how the back pain was precipitated by coughing, sneezing or moving his trunk forward.

He explains that there is no need for surgery. He prescribes NSAIDs for three weeks, three times daily, after meals. He also prescribes a muscle relaxant. He asks him to keep active and walking. Over the next 4 weeks Salem gradually feels much better. His pains gradually disappeared and he is able to resume his daily activities.