INVITED ARTICLE

DIAGNOSING LOW BACK PAIN

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ABSTRACT

The approach to the diagnosis of low back pain must include a knowledge of the pathology and the natural history of the common disease processes that affect the spine. A detailed history and physical examination are essential, and in most instances will serve as the most helpful guides to the diagnosis and treatment of the patient. The common differential diagnoses and the clinical evaluation of low back pain are discussed in this paper.

Keywords: Backache, Sciatica, prolapsed intervertebral disc, degenerative disk disease, spinal stenosis

SINGAPORE MED J 1992; Vol 33: 74-78

INTRODUCTION

Low back pain is a very common disability. Epidemiological studies from Sweden and the U.S. had estimated that between 60% and 80% of the general population suffer from low back pain some time in their life and that between 20% and 30% would be suffering from it at any given time. Contrary to popular belief, it is not an affliction of the elderly, being most common after the age of 35, remaining high until the late fifties, and becoming less frequent thereafter.

PATHOLOGICAL ANATOMY

The spinal column is an articulated multi-segmental structure. The vertebrae are connected by the intervertebral discs anteriorly at the vertebral bodies; and by the facet joints posteriorly. Bony projections like the spinous and transverse processes give attachment to strong muscles that support and provide movement to the spine. The vertebral body consists of bony trabeculae sandwiched between two cortical endplates and is designed for weight bearing. In osteoporosis, the loss of bony trabeculae reduces the capacity of the vertebrae to withstand normal physiological loads.

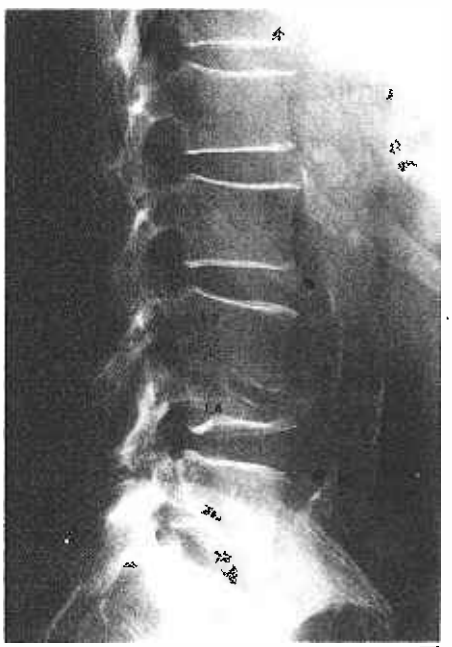
Micro-fractures of the trabeculae occur, in addition to the well recognised compression fractures, and are commonest causes of back pain in the elderly. Metastatic tumours and myeloma may replace the bony trabeculae, weakening it and causing pathological fractures. Other structural lesions like spondylolysis with or without spondylolisthesis may cause back pain as a result of spinal instability.

The intervertebral disc has a strong fibrous outer layer, the annulus fibrosus; and a gelatinous inner core, the nucleus pulposus. The annulus fibrosus is a very strong, laminated structure which is firmly attached to the cortical rim of the vertebral bodies. Together, the annulus and the nucleus pulposus act as a constrained roller bearing between adjacent vertebral bodies; while posteriorly the facet joints guide and steady the movement. The facet joints are synovial joints; the articular surfaces lined by hyaline cartilage and joined by lax capsules lined with synovium. These joints allow simple gliding movements. The intervertebral disc and two facet joints function together and any disease or structural change that affects one joint will inevitably affect the other two joints of the complex.

Degenerative changes affect both the intervertebral as well as the facet joints. Tears in the annulus fibrosus, herniation of the nucleus pulposus, disc narrowing and osteophyte (more accurately syndesmophyte) formation are typical features of degeneration at the intervertebral disc. In the facet joints, cartilage degeneration, osteophyte formation, joint laxity and subluxation occur. The annulus fibrosus and the capsule of the facet joints are richly innervated with pain receptors, and are common sources of back pain.

The joints in the spinal column are susceptible to inflammatory conditions like ankylosing spondylitis and rheumatoid arthritis. In ankylosing spondylitis, the inflammatory process may end with spontaneous fusion of the sacro-iliac, intervertebral and facet joints. Spinal infections, both pyogenic and tuberculous, commonly begin at the anterior vertebral endplates adjacent to the discs and rapidly destroy the disc ending up with spontaneous fusion between two or more vertebrae (Fig 1). In contrast, metastatic tumours cause destruction of the vertebral bodies leaving the discs largely intact.

Fig 1 - Osteomyelitis of the spine. There is loss of the intervertebral disc, collapse of the adjacent vertebrae and a large prevertebral abscess (arrowed). The infective organism was *Staph.* aureus.



One of the important anatomical features of the spinal column is the relationship the neural elements bear to the

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bony skeleton and the intervertebral discs. The spinal cord ends at L1, and caudal to that, the lumbar, sacral and coccygeal roots run together in the dural sac to exit at their respective levels at the neural foramina. The nerve root is vulnerable to compression anywhere along its course. At the level of its exit from the dural sac, it is commonly compressed from anteriorly by an interverterbral disc herniation. Where the disc polapse is large and central in location, it may compress all the nerve roots of the cauda equina at the same vertebral level. In spinal stenosis secondary to degenerative disease, compression of the neural elements is caused by hypertrophied facet joints and ligamentum flavum posteriorly, and a bulging degenerated disc anteriorly (Fig 2). Spinal stenosis may also occur in spondylolisthesis due to compression of the nerve roots from forward displacement of the vertebrae and associated posterior bulging of the intervertebral disc (Fig 3).

Fig 2 - The anatomy of spinal stenosis secondary to degenerative disease. The site of stenosis may be central, causing narrowing of the dural sac; and/or lateral, causing compression of the spinal nerve root in the "lateral recess"

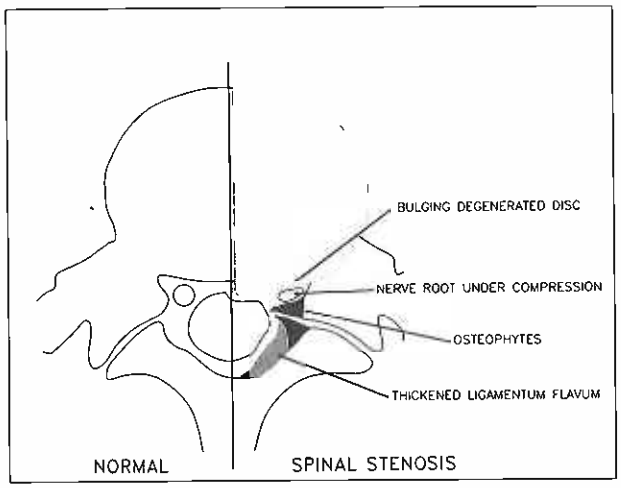
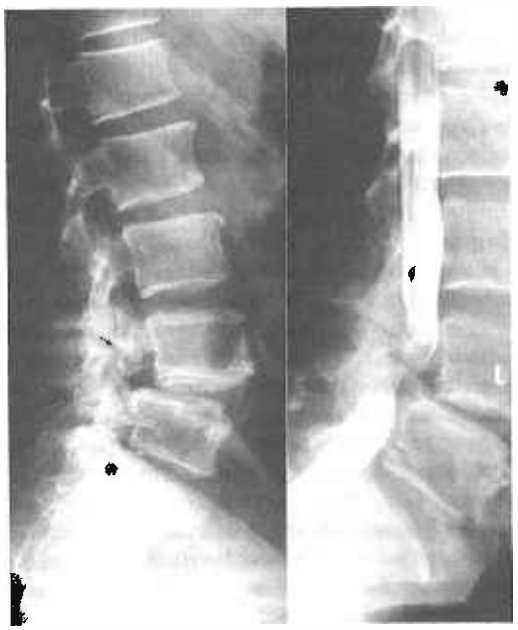


Fig 3 - L4 spondylolysis (arrowed) with L4 L5 spondylolisthesis causing spinal stenosis. There is almost complete block of the contrast column at the level of spondylolisthesis. This patient presented with back pain radiating to his leg and neurogenic claudication.



Although the presence of pain or neurological deficits in the lower limb may indicate nerve root compression, they do not necessarily localise the pathology to the same vertebral levels. This is particularly so with spinal nerve tumours. A neurolemmoma, ependymoma or cyst may selectively involve the L5 or S1 roots at the level of conus medullaris and give rise to considerable confusion in diagnosis.

Finally, it must not be forgotten that closely related to the spinal column are the retroperitoneal structures like the kidneys, the pancreas, the abdominal aorta and the uterus in the female. Pain from renal and pancreatic carcinomas; lymphomas, abdominal aneurysms, have on many occasions been mistaken for spinal pain.

DIFFERENTIAL DIAGNOSIS

Extra-spinal causes of back pain

Backache is a symptom and not a disease. Many lesions can cause back pain and sometimes the lesion may not be in the spine itself. Macnab's[1] classification of back pain into 5 categories viz viscerogenic, neurogenic, vascular, psychogenic and spondylogenic is useful. As long as one thinks of back pain in this way, the chances of missing a more serious cause for degenerative disease is reduced (Table I). The clinical syndromes associated with non-spinal causes of back pain can usually be differentiated after a careful history and physical examination.

Back pain of spinal origin

A classification of back pain of spinal origin is shown in Table II. Infection, fractures, neoplasms and inflammatory condi-

Table I - Important and often missed causes of back pain

Viscerogenic	
	Carcinoma of the pancreas
Vascular	
	Abdominal aortic aneurysm
Neurogenic	
	Nerve root tumours eg neurofibromas
	Spinal cord tumours
	Diabetic neuropathy
Spondylogenic (Spinal)	
	Multiple myeloma
	Metastases
	Osteoid osteoma
	Vertebral osteomyelitis
	Ankylosing spondylitis
	Sacro-iliac joint infection

Table II - A classification of back pain of spinal origin

Aetiology	examples
Degenerative	Disc, facet arthritis, spondylolisthesis
Congenital/ Developmental	Dysplastic spondylolisthesis, spondylolysis
Infection	Discitis, osteomyelitis - Staphylococcus, M tuberculosis, Brucella, etc.
Neoplasia	Osteoid osteoma, myeloma, metastatic tumours
Inflammatory	Ankylosing spondylitis, Reiter's syndrome, rheumatoid arthritis
Metabolic	Osteoporosis, Paget's disease
Traumatic	Compression fracture, stress fracture,
Iatrogenic	Post-laminectomy syndrome, post-operative instability/spondylolisthesis

tions of the spine must always be excluded and the diagnosis is usually not difficult as long as these conditions are kept in mind. However, these lesions together account for only a very small percentage of patients presenting with back pain. The majority has pain from degenerative disease, predominantly affecting the disc and facet joints. In this group of patients, making a specific anatomical diagnosis of back pain can be difficult. Localisation of pain in the spine is poor and it is difficult to be certain whether the source of pain is in the intervertebral disc, the facet joint capsule, ligaments, the paraspinal muscles or the bone. Standard spine X-rays are of limited value as the changes secondary to degeneration correlate poorly with the clinical picture. Special investigations are necessary to diagnose specific disc or nerve root lesions.

The recognition of some common back pain syndromes has allowed a more rational approach to clinical diagnosis in this group of patients [2,3] (Table III). These syndromes do not imply a specific diagnosis, but focus on the likely location of the lesion. The familiar clinical features in the "facet syndrome" point to the facet joints as the likely source of pain although the pathological processes causing it are not well understood. The presence of root irritation in the radicular syndrome points to compression of the segmental nerve root(s). The actual pathology may be a prolapsed intervertebral disc, spinal stenosis, an abscess or a neurofibroma. Nevertheless, the presence of root irritation allows more specific definition of the pathology when compared to presentation with back pain alone.

Table III - Some common back pain syndromes

Facet Pain

Pain is of spontaneous onset or may follow a minor incident. It is felt in the low back or buttock with radiation to the back of the thigh. It is worse in the morning and after prolonged sitting or standing. Patients may need some time to straighten their back on getting up but gets better with activity in the day. The physical examination reveals pain on extension; forward flexion is unrestricted. Straight leg raising is normal and there are no neurologic abnormalities.

Disc Pain

Pain may follow an unexpected lift, or a period of unusual physical activity. However, it is common not to have any preceding history, the patient noticing gradual increasing low back or buttock pain. Pain is increased on prolonged sitting or standing, particularly in a forward flexed position. The physical examination reveals pain and limitation of forward flexion, with little discomfort on extension. The trunk may be listed to one side and stooped forward. Straight leg raising is full or produces back pain only, and the neurologic examination is normal.

Radicular pain

In this category, leg pain is the dominant feature, and in some cases, no back pain may be present. The patient complains of pain radiating from the buttocks to below the knee, frequently in the distribution of a dermatome. Signs of nerve irritation with or without neurologic deficits are present on physical examination.

Neurogenic claudication

The patient is usually older and may have a history of chronic back pain. The main symptom is leg pain brought on after walking a distance and relieved by sitting. Paresthesia in the affected root dermatome is commonly present and symptoms may appear with prolonged standing. Physical examination is often normal, but positive neurologic signs may appear on provocation by walking. The peripheral circulation is normal.

Some aspects of the history and physical examination which are helpful in the differential diagnosis are discussed below.

HISTORY

Age

Age can be a good indicator of the nature of the likely pathology. Disc degeneration and facet joint syndromes are the commonest causes of back pain in the 35 to 50 age group with the peak incidence at 45 years. Disc prolapse is uncommon under the age of 20 and over the age of 60. Spinal stenosis and neurogenic claudication is unusual below the age of 40. Spondylolysis and spondylolisthesis may be symptomatic at any age, but they tend to cause back pain under the age of 40 and neurogenic symptoms in older patients. In the older patient, particularly over the age of 60, multiple myeloma, senile osteoporosis and secondary metastatic disease must be considered in the differential diagnosis.

Infections of the spine occur at all ages but in the very young and in the elderly, there may be atypical presentation without the usual clinical signs of sepsis[4].

Pain Patterns

Most back pain is variable in intensity, duration, and frequency of attacks. Discogenic pain is often severe, regardless of the position adopted, although lying prone may reduce the pain. Pain on extension is classically associated with facet pain; it is exacerbated by prolonged sitting or standing, and relieved by walking. Pain from fractures, infections and tumours may be continuous, unremitting and is frequently worse at night. Night pain is classically related to benign spinal tumours like osteoid osteoma. Radicular symptoms from spinal canal stenosis may be worse at night. Morning stiffness is a common symptom in ankylosing spondylitis and in other types of arthropathy.

Radiation of pain

Spread of pain to the leg is an important symptom and the patient should be asked to demonstrate the distribution of pain. It is important to know this when trying to determine whether one is dealing with referred pain or pain due to nerve root irritation (radicular pain), and if so, which root.

Referred pain is commonly felt in the buttock and thigh, and rarely beyond the knee. When severe, it may radiate farther down the leg. Referred pain is believed to arise most commonly from the facet and the sacro-iliac joints[5]. Pain in the buttock is often mistaken for local hip or pelvic pathology. Pain from as high as the thoraco-lumbar junction can be referred to the low back and buttocks as is commonly seen in osteoporotic compression fractures. X-rays taken of the pelvis and the lumbosacral spine in this condition will miss the fracture unless one is aware of the pattern of referred pain.

Radicular pain usually follows a dermatomal distribution and is most commonly present in disc herniation and spinal canal stenosis[5]. Pain due to compression of the L4 nerve root usually radiates down the front of the thigh, whereas L5 root pain usually radiates to the dorso-medial aspect of the foot. S1 root pain spreads to the lateral side and sole of the foot but occasionally may involve only the posterior thigh. Lesions in the spine affecting the higher lumbar roots and the thoraco-lumbar junction may present with pain radiating from the back spreading anteriorly around the trunk like a "girdle". Infections and neoplasms of the upper lumbar spine, including direct infiltration from carcinomas of the pancreas and the kidney frequently present with symptoms of girdle pain. Radicular pain is commonly associated with paresthesia. This may be described by the patient as numbness, tingling, or burning in the distribution of the affected dermatome. When present, paresthesia is of great significance in differentiating radicular from referred pain.

Radicular pain may be brought on by walking, a condition called neurogenic claudication, typically seen in spinal stenosis. The patient complains of pain and/or numbness in the dermatomal distribution, commonly of L5 or S1, coming on after walking a distance, and is relieved only by sitting down. It differs from intermittent vascular claudication by its pattern of radiation in the buttock towards the leg, accompanying paresthesia and being relieved by sitting and not by standing.

Where the stenosis is severe, radicular symptoms may come on after standing for a few minutes.

Systemic Enquiry

The patient should be asked about weight loss and appetite, disturbance of bladder and bowel function, night sweats and drugs. Peripheral neuropathy from diabetes mellitus may cause weakness and paresthesia in the lower limbs similar to root irritation[6].

Physical Examination

The patient's general state of health should be assessed. Undue lethargy, weight loss, and general debility should alert the clinician that he may be dealing with chronic inflammatory or neoplastic conditions. Pallor, lymphadenopathy, bone tenderness and joint swelling should be routinely look for. The peripheral pulses are examined. In appropriate cases, attention may be directed to extra-spinal mainfestations of systemic conditions like ankylosing spondylitis; or to the thyroid, breast, lungs, kidney or prostate, these being common primary tumours that metastasise to the spine.

Back Examination

The patient must be undressed and the gait, standing posture, and spinal mobility are examined.

Shuffling, spasticity or foot drop should be looked for. Marginal weakness of the dorsi-flexors and plantar-flexors of the ankle may be revealed by asking the patient to walk on his heels and then his toes. The patient with muscle spasm from disc herniation or inflammatory lesions often stands stooped forward with flattening out of the normal lumber lordosis. There may be listing of the trunk to one side. In spondylolisthesis, a "step" in the alignment of the spinal processes may be palpable. Angular kyphosis may be present as a result of osteoporotic compression fractures, or spinal infections.

The range and character of spinal movement are observed. Flexion at the hip joint should not be mistaken for spinal movement. Spinal mobility can be easily appreciated by the examiner placing one finger tip on the spinous process of an upper lumbar vertebra and another on the sacrum, and noting the separation of the processes on flexion. Flexion of the spine is typically limited in disc herniation while extension is unrestricted. In contrast, patients with facet joint syndrome have limitation and pain on extension with flexion unaffected. In painful inflammatory conditions of the spine movements are limited and painful in all directions. The rigidity of the whole spine in the later stages of ankylosing spondylitis is characteristic.

In the supine position the hips and the sacro-iliac joints are routinely assessed.

Neurological examination

The aim of the neurological examination is to confirm the presence of neurological signs as suggested by the symptoms in the history. The potential neurological deficits related to common spinal nerve root levels involved are shown in Table IV. Depending on the degree and duration of nerve compression, there may be no physical signs on neurological examination, a situation not uncommonly found in spinal stenosis.

The straight leg raising test (SLR) evaluates the presence of nerve root tension and is typically positive in prolapsed intervertebral disc. It is negative in spinal stenosis, and unreliable in the presence of acute back with muscle spasm. Since the femoral nerve receives the major contribution of L4 in the lumbosacral plexus, tension on the L4 nerve root is tested using the femoral stretch test. This is performed by extending the hip with the knee flexed while the patient is prone. In a positive test, pain is elicited running down the front of the thigh.

Table IV - Neurological deficits related to common spinal nerve root levels

	Root		
	L4	L5	S1
Motor Weakness	Knee extension	EHL, Ankle dorsiflexion	FHL, Ankle plantarflexion
Sensory loss	Medial side of the leg	Lateral side of the leg and dorsum of foot	Sole and lateral border of the foot
Reflex depression	Knee	-	Ankle
Muscle Wasting	Quadriceps	Anterior compartment of the leg	Calf

EHL = Extensor hallucis longus

FHL = Flexor hallucis longus

INVESTIGATIONS

The investigations may be divided into three main groups.

1. **Laboratory tests** are done to exclude inflammatory, infective and neoplastic causes of back pain. The full blood count, erythrocyte sedimentation rate (ESR), serum protein, calcium, and alkaline phosphatase are basic screening tests. Anaemia and a markedly elevated ESR should alert one to consider myeloma and spinal infections. Additional investigations like serum protein electrophoresis, HLA - B27, and bone scans should be done when the basic screening tests are abnormal; in patients who have atypical pain patterns, and in those who do not respond to the usual conservative treatment. Bone scanning is helpful in confirming the diagnosis of early infection and ankylosing spondylitis. An osteoid osteoma may remain undiagnosed for years, to be revealed as an intense "hot spot" after bone scanning.
2. **Plain X-rays** of the lumbo-sacral spine are the most common investigation performed. X-rays have a limited role in the diagnosis and treatment of a patient with back pain. It is used to identify structural spinal lesions eg. spondylolysis, spondylolisthesis, and to exclude serious disease eg infections and tumours. Attention should be paid to the bony as well as the soft tissue shadows eg the pedicles (replacement by metastatic tumours, interpedicular widening in neurofibroma); the vertebral end-plates ("fuzziness" and scalloping in infection); and the presence of a paravertebral or enlarged psoas shadow (spinal infections). The pars defect in spondylolysis may be more clearly seen on oblique views; and in some instances, lateral views with the spine in flexion and extension may be ordered to exclude instability.

   In the majority of cases, plain X-rays will not show any abnormal features. The presence of disc space narrowing and syndesmophytes adjacent to the intervertebral disc may suggest the presence of degenerative disc disease but does not necessarily mean that segment is the cause of pain. Similarly, the presence of spondylolysis or spondylolisthesis on X-ray may be incidental in some instances. Correlation with the clinical presentation is essential. Treatment is determined by clinical assessment and not by X-ray findings.
3. **Special imaging procedures** like myelography, CT scanning and MRI provide more precise anatomical definition of a lesion. They are used to confirm the clinical diagnosis and to provide a "road map" for planning the surgical approach to the problem. CT scanning is often combined with myelography to allow better differentiation of the nerve elements from the soft tissues of the vertebral canal. MRI is increasingly used and is an excel-

lent technique for looking at disc degeneration and herniation, neoplasms and spinal cord pathology. The drawback of these special tests, particularly for CT and MRI is that they are so sensitive that it is possible to show pathology in almost all patients. Unless careful clinical correlation is done, over-interpretation of the findings and inappropriate treatment may result.

SUMMARY

Extra-spinal causes of back pain must must always be considered and excluded. Pain from specific spinal pathology like infections, tumours, trauma and metabolic diseases have clearly defined clinical syndromes and their investigative and treatment modalities are well established. In contrast, "mechanical" pain from degenerative processes in the spine are poorly understood and difficult to localise. Pain radiating down the leg should always be asked for and when it is due to spinal nerve root irritations, will usually lead to a more specific diagnosis. Investigations of varying sophistication can bring one closer to defining or confirming the specific pathology, but one must always be wary of over-interpretation, particularly with the newer, more sensitive imaging procedures.

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