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Handbook of Clinical Neurology, Vol. 136 (3rd series)
Neuroimaging, Part II
J.C. Masdeu and R.G. González, Editors

Chapter 53

Low back pain, radiculopathy

STEPHEN M. SELKIRK[1,2]* AND ROBERT RUFF[2]

[1]*Spinal Cord Injury Division, Louis Stokes Cleveland Veterans Affairs Medical Center, Cleveland, OH, USA*

[2]*Department of Neurology, Case Western Reserve University School of Medicine, Cleveland, OH, USA*

Abstract

Low back pain is a pervasive problem in the adult population. Most patients with low back pain will not require imaging as spontaneous recovery within 12 weeks is the rule. However, a small percentage of patients with low back pain will have serious underlying pathology requiring more intensive investigation. This chapter delineates the signs and symptoms related to potential serious underlying causes and discusses appropriate imaging modalities that should be utilized in patients with low back pain.

EPIDEMIOLOGY AND CLASSIFICATION

Low back pain (LBP) is an overwhelming worldwide public health problem. Prevalence rates for LBP have been estimated to be as high as 84%, chronic LBP about 23%, and those disabled from LBP make up about 10% (Airaksinen et al., 2006). In the USA about 2% of the workforce file worker's compensation claims for back pain and back-related injuries. This group produces an annual direct cost at $11.4 billion, accounting for about one-quarter of workers' compensation payments (Frymoyer, 1988). LBP accounted for 2.7 million presentations to the emergency ward in the USA per year (Licciardone, 2008). Although these data suggest that most people will experience LBP at some point in their lifetime, only 20–30% of people will actually seek medical advice because of it (Wieser et al., 2011). The most pertinent factors in determining those who seek out medical attention are poorly understood, but the patient's own perception of his or her disability level seems to be an important factor (Ferreira et al., 2010; Adamson et al., 2011).

LBP is usually divided into acute (less than 12 weeks in duration) and chronic. Nearly 90% of patients presenting with acute back pain will have complete resolution. The reasons why 10% go on to develop a chronic course is not always well understood, but chronic LBP has a poor prognosis characterized by persisting pain and disability. Obesity seems to predict progression to chronicity as well as being strongly associated with seeking medical attention for LBP (Shiri et al., 2010). Back pain can be further divided based upon the suspected underlying etiology (Table 53.1). Mechanical back pain refers to pain caused by strain or deformity of the baseline anatomic configuration of the lower back and spine. Generally speaking it is worsened by activity and improved when lying supine. It should be noted here that the role of imaging in patients with LBP is to determine if an underlying etiology exists that can be repaired or treated. However, the majority of patients who present with back pain have so-called "nonspecific" LBP. This entity refers to LBP that cannot be coupled to a detectable underlying pathophysiology. The actual pathophysiology of nonspecific LBP is usually mechanical (caused by trauma or deformity of an anatomic structure) and likely includes degenerative disc disease, resulting in disc space narrowing and intervertebral disc herniation (Cheung et al., 2009; de Schepper et al., 2010). The role of imaging for patients with nonspecific back pain is limited. Many imaging abnormalities detected in these patients may not be clinically relevant because they are commonly identified in patients without LBP. For example, it is known that in asymptomatic patients over 60 years of age, 90% will have bulging or degenerative discs detectable on magnetic resonance imaging (MRI) (Boden et al., 1990a). Thus

*Correspondence to: Stephen M. Selkirk, MD, PhD, Spinal Cord Injury Division, Louis Stokes Cleveland VA Medical Center, 10701 East Blvd, Cleveland OH 44106, USA. Tel: +1-440-552-0493, E-mail: Stephen.selkirk@va.gov

Table 53.1

Common causes of low back pain

Mechanical
Disc herniation
Spinal stenosis
Strain (sprain)
Spondylolysis
Fracture
Trauma
Inflammatory
Ankylosing spondylitis
Inflammatory arthritis
Psoriatic spondylitis
Infectious
Epidural abscess
Paraspinous abscess
Osteomyelitis
Discitis
Herpes zoster
Varicella zoster
Malignancy
Primary spinal tumor
Metastatic tumor
Multiple myeloma
Referred pain
Prostatitis
Pancreatic disease
Gallbladder disease
Aortic aneurysm
Pyelonephritis

simple identification of pathology does not directly translate to an understanding of causality.

Nonmechanical LBP in general terms refers to either a compressive mass (e.g., tumor, abscess) or inflammatory conditions of the anatomic structures of the lower back (Table 53.1). Studies have identified that about 5% of patients may have inflammatory disease, less than 1% of patients presenting with LBP have metastasis to the spine, 0.01% will have a primary central nervous system infectious process involving the spine, and only 0.04% will have cauda equina syndrome (Deyo et al., 1992; Jarvik and Deyo, 2002). When patients are stratified according to the absence or presence of risk factors for these entities (discussed later in this chapter), cases of cancer, fracture, and infection were not identified (Deyo and Diehl, 1988; Suarez-Almazor et al., 1997). Finally, LBP can be caused by primary disease in other organ systems (e.g., endometriosis, prostatitis), so-called visceral disease LBP.

LUMBAR RADICULOPATHY

Lumbar radiculopathy is defined as pain that radiates from the lower back into one or more lumbar

Table 53.2

Causes of radiculopathy and radicular pain

Disc herniation
Spinal stenosis
Lumbar facet syndrome
Piriformis syndrome
Diabetic amyotrophy
Lumbosacral plexopathy
Hip osteoarthritis
Avascular necrosis of the hip
Trochanteric bursitis

dermatomes. It is distinguished from lumbar radicular syndrome (also commonly referred to as sciatica) by the objective finding on examination of either sensory and/or motor deficits. This should not be confused with lumbar radiculitis, which indicates inflammation of the nerve roots. All of these usually occur on a continuum, as pain caused by compression likely has some degree of inflammation associated with it, and both conditions will have some degree of neurologic dysfunction that may or may not breach a threshold that can be detected by a neurologic examination. The prevalence of lumbar radicular syndrome in the USA has been documented as high as 25%, making it the most common form of neuropathic pain (Khoromi et al., 2005). Nearly two-thirds of patients will recover within 12 weeks and the most common causes identified are disc herniation and degenerative changes (Tarulli and Raynor, 2007). Lumbar radiculopathy has a prevalence rate as high as 8% (Younes et al., 2006). As with lumbar radicular syndrome, the most common cause of lumbar radiculopathy is disc herniation; other causes include degenerative changes, tumors, and diabetes (Table 53.2).

IMAGING MODALITIES

Plain film radiograph is the most commonly utilized imaging modality likely because of the low cost and high availability. The US Agency for Health Care Policy and Research (AHCPR) guidelines have recommended that spot lateral and oblique films not be performed because they do not provide any clinically relevant information, and expose the gonads to significant radiation (Biogos et al., 1994). Lateral and anteroposterior views can be useful for determining alignment, vertebral height, and other aspects of bony architecture. Plain radiography does not allow for visualization of the contents of the spinal canal or nerve roots and identifies clinically irrelevant abnormalities that occur equally in patients with back pain and asymptomatic individuals at high rates (van Tulder et al., 1997). For detecting cancer, plain film radiographs are significantly less sensitive than

MRI or computed tomography (CT) imaging. Even lytic lesions or blastic lesions are not easily detected using plain films as local lesions must be significantly advanced in order to be detected (Modic et al., 1985; Sartoris et al., 1986). Sensitivity for detection of such lesions is only 60%, with 99% specificity (Deyo and Diehl, 1988). Similarly, an infectious process must be advanced before it can be detected using plain film radiographs, and specificity is estimated to be as low as 57% for osteomyelitis (Modic et al., 1985). Disc herniation cannot be detected and the modality lacks the ability to adequately detect compromise of the spinal canal or neural foramina, making diagnosis of spinal stenosis or nerve root impingement difficult. For compression fractures, plain film radiographs are sensitive and specific but cannot delineate acuity, limiting usefulness. In contrast to these limitations, plain films can readily identify ankylosing spondylitis (Fig. 53.1) with a specificity approaching 100% (Thornbury et al., 1993).

CT imaging is nearly as accurate as MRI for detection of serious underlying pathology. The sensitivity and specificity for detection of herniated disc are about 73% and 57–64% respectively (Thornbury et al., 1993) and for spinal stenosis 70% and 80–96% (Kent et al., 1992). The addition of myelography to CT improves the sensitivity to about 76% for disc herniation, making it equivalent to the reported sensitivity and specificity of MRI (Jackson et al., 1989). In regard to detection of infection or malignancy, CT is not sensitive or specific enough to be used in place of MRI and is reserved for cases where MRI cannot be performed. In these patients CT myelography should be utilized as it increases the sensitivity for detection of clinically meaningful lesions (Jarvik and Deyo, 2002). It should be noted here that CT imaging exposes patients to low-level radiation, which promotes carcinogenesis. The use of contrasted CT has risk of hypersensitivity reaction to the dye and the risks of myelogram include widening of the anterior epidural space, epidural scar, and infection.

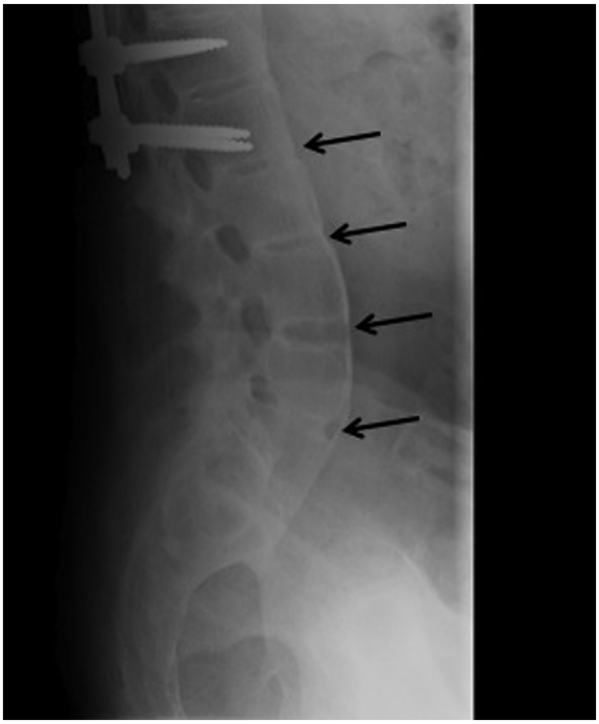

Fig. 53.1. Plain film in a patient with a diagnosis of ankylosing spondylosis. Plain films of the lumbar, thoracic, and cervical spine can demonstrate syndesmophytes (arrows) in patients with ankylosing spondylosis. Syndesmophytes represent calcified spinal ligaments and annulus fibrosus.

For all potential serious underlying etiology, MRI is the diagnostic modality of choice as it does not expose a patient to ionizing radiation and provides superior soft-tissue visualization, and detection ability for most pathologies. The specificity and sensitivity for detection of a clinically significant disc herniation (Fig. 53.2) are approximately 77% and 75% respectively (Wassenaar et al., 2012). However the sensitivity and specificity are far better in regard to detecting nerve root compression from a herniated disc, 90% and 100% respectively (Chawalparit et al., 2006). In regard to detecting spinal stenosis, the sensitivity of MRI is 87–96% (Bischoff et al., 1993; Aota et al., 2007). It turns out that CT is equally accurate for identifying disc herniation or spinal stenosis (Jarvik and Deyo, 2002), but again the advantage of MRI is that it will not contribute to the patient's aggregate radiation exposure.

The diagnosis of infection (Fig. 53.3) and malignancies requires MRI as the sensitivity is significantly better than that of CT scan alone (Jarvik and Deyo, 2002). It is superior to CT in terms of defining surrounding anatomy and routine use adds information beyond a CT, changing the parameters used in radiation therapies in 40–53% of cases (Colletti et al., 1996). In patients with known spinal metastasis sensitivity and specificity were 83 and 92% respectively (Carmody et al., 1989), but other studies have demonstrated sensitivity approaching 100% (Carroll et al., 1997). Also, studies have demonstrated MRI to be more sensitive than bone scanning (Avrahami et al., 1989) for detection of metastasis, and useful for identifying the acuity of compression fractures by examining marrow edema or hematoma formation (Yamato et al., 1998).

Finally, bone scan can be used to attempt to differentiate degenerative changes from infection, metastasis, or fracture. Sensitivity to detect metastatic disease ranges from 74 to 98% and sensitivity to detect infection is 90% (McDougall and Kriss, 1975). Utility for fracture is less for detection and more for acuity, as acute lesions are metabolically active (Yamato et al., 1998). For

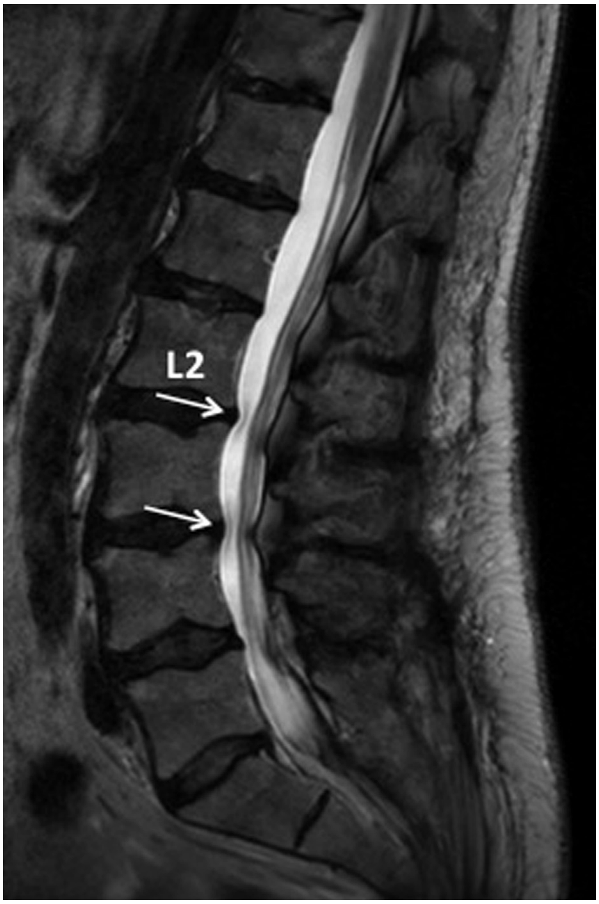

Fig. 53.2. Magnetic resonance imaging of the lumbar spine demonstrating typical age-related degenerative changes. Here, mild bulging discs impress the ventral aspect of the thecal sac (arrows) at T12–L1, L1–L2, and L2–L3. This results in mild spinal canal stenosis. This finding in asymptomatic patients can make interpretation of significance in patients with back pain difficult.

ankylosing spondylitis, the sensitivity is in the 25% range, prohibiting its usefulness when this diagnosis is suspected.

INDICATIONS FOR IMAGING

The natural history of back pain, including radicular pain, is of spontaneous resolution; therefore, most patients do not require immediate imaging. A trial of conservative management is acceptable. It should also be noted that there is a high incidence of irregular findings in asymptomatic people. For example, rates of disc herniation range from 21% in the 20–39-year age group to 37.5% in the 60–80-year age group (Boden et al., 1990b; Jensen et al., 1994). For any imaging test to be clinically useful the results must correlate with the patient presentation and physical exam findings.

About 5% of patients presenting with LBP will have a serious underlying etiology that needs to be identified (Chou et al., 2007). The goal of imaging is to identify serious pathology and guide intervention. The keys to identifying these patients for imaging studies are a thorough history and neurologic evaluation. If, through the history and physical examination, so-called "red flag" signs or symptoms are identified that increase the likelihood of having a serious underlying etiology, imaging should be ordered (Table 53.3). The concept of red flag signs or symptoms was originally put forth by the UK Clinical Standard Advisory Group in 1991 as diagnostic indicators of serious underlying etiology. The simple underlying principle of triaging LBP patients into groups that will predict outcome remains the most important concept when determining need for imaging. Shortly thereafter the AHCPR put forth similar diagnostic indicators with three significant differences (Biogos et al., 1994). First, the AHCPR lowered the red flag upper age limit to 50 years, from 55. Second, it added

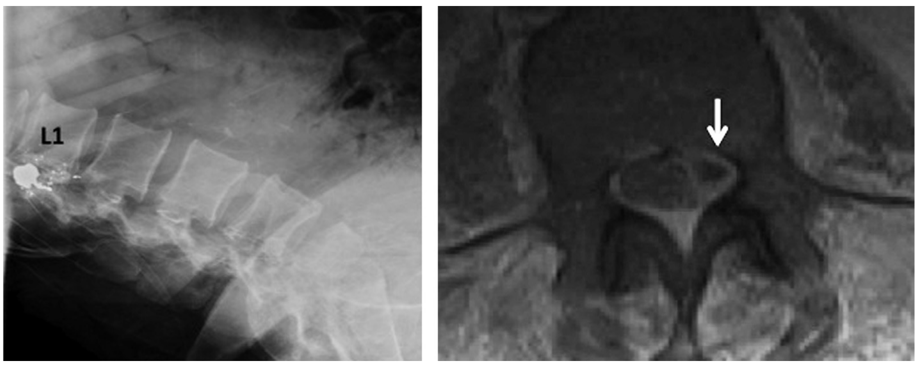

Fig. 53.3. Epidural abscess in a patient with back pain and history of gunshot trauma to the spine. The plain film (left) demonstrates the bullet fragment overlying the first lumbar vertebral body. Other than minimal hypertrophic changes, no abnormalities are identified. However the accompanying magnetic resonance imaging (right) demonstrates a large, compressive epidural abscess (arrow) extending from L4 to S2.

Table 53.3

Red flag signs and symptoms indicating serious underlying pathology

Previous history of cancer
Chronic steroid use
History of intravenous drug abuse
Immunosuppression, human immunodeficiency virus
Weight loss
Fever, chills, night sweats
Age older than 50
Abnormal neurologic examination
Pain worsening when supine
Bowel or bladder dysfunction
Thoracic pain
Saddle anesthesia

worsening pain when a patient is supine and finally, severe pain at night. Although similar guidelines have been published by other groups since, no significant changes have been made to these diagnostic indicators. The red flag signs and symptoms are listed in Table 53.3. Unfortunately very little evidence is available to support or refute the sensitivity of specificity of the list or how it impacts patient outcomes (Henschke et al., 2013). Generally speaking, however, any abnormality on neurologic examination (e.g., weakness, asymmetric reflexes, sensory loss) should suggest a serious evolving process that requires imaging. Similarly, any developing compromise to bowel or bladder function warrants immediate imaging and, when accompanied by saddle anesthesia, suggests acute cauda equina syndrome. Other examples include the presence of back pain accompanied by fever (particularly in patients with a history of diabetes mellitus, intravenous drug abuse, or immunosuppression), which suggests an infectious process such as epidural abscess or spinal osteomyelitis. A history of cancer is the strongest risk factor for tumor involving the spine (Deyo, 1989), but other symptoms such as worsening pain when supine or weight loss should alert the physician to this potential diagnosis and the need for imaging. In people with cancer, back pain that radiates in a radicular pattern, or electric-like pain traveling along the spinal column, is associated with spinal epidural cancer (Ruff and Lanska, 1989; Zaidat and Ruff, 2002).

If a patient has a normal neurologic examination but vertebral compression fracture or ankylosing spondylitis is suspected, plain films of the lumbar spine would be appropriate. However, only 30% of patients with vertebral compression fracture have a history of trauma and the predictive value of positive exam findings, such as sacroiliac joint tenderness, in patients suspected of having ankylosing spondylitis, are low (Calin et al., 1980).

In contrast to these examples, when patients have a normal neurologic examination but risk factors for spinal stenosis, vertebral compression fracture, disc herniation, or have radicular pain syndrome, it would be reasonable to delay imaging and initiate conservative therapy. The absence of resolution or the interval development of neurologic signs would warrant imaging at follow-up evaluation. So-called "yellow flags" have also been identified to denote patients who have adverse prognostic indicators. These include comorbid psychiatric dysfunction, existing injury-related litigation, pain severity out of proportion to findings, failure of multiple therapies, and substance abuse history. These yellow flags do not necessarily obviate the need for imaging, but should suggest a need for complex, multidisciplinary treatment.

THE IMPLICATIONS OF IMAGING PATIENTS WITH LOW BACK PAIN

In the age of advanced imaging and diagnostic technology, there is a strong desire among physicians to identify a cause for a patient's symptoms before initiating treatment. This may be particularly true for specialist and subspecialist, as consultations are often driven by primary care physicians who require support in explaining the patient's complaints. In regard to LBP, this drive to see the actual underlying pathology in many cases may be detrimental to the patient. Therefore, we emphasize again the need to follow evidence-based guidelines when making decisions regarding spinal imaging. Routine imaging with lumbar radiography, CT, or MRI continues to be a very common practice (Di Iorio et al., 2000; Webster et al., 2005). This practice contributes to $90 billion in total healthcare expenditures for LBP (Luo et al., 2004). Furthermore, the impact of unnecessary imaging needs to be considered in the context of subsequent diagnostic analysis, follow-up evaluations, referrals, invasive procedures, and surgical interventions. MRI has increased by over 300% between 1994 and 2005 (Deyo et al., 2009) and in worker's compensation cases MRI is now being ordered earlier and more often, or even repeatedly (Carragee et al., 2006).

A summary, in the form of a meta-analysis, of six randomized trials that have compared patients with LBP that received imaging in any form to patients who received no imaging failed to demonstrate any value to this form of diagnostic testing. Specifically, radiography of the lumbar spine, in any form, did not improve the patient's perception of his or her own improvement, quality of life, or pain (Hart et al., 1995). Routine imaging, including the use of MRI, almost never modified the patient's treatment plan when presentation was one of nonspecific LBP (Jackson et al., 1989; Hellström et al., 1990; Thornbury et al., 1993).

In contradistinction to the absence of value of routine imaging, there is evidence that routine imaging can be harmful to patients. Webster and Cifuentes (2010) reported on 3364 worker's compensation cases of LBP and compared treatment plans and outcomes for those who received early MRI (first 2 weeks) and those who did not. The early MRI group had more disability days, higher medical costs, and more lumbar surgeries than the non-MRI group. The association of increased imaging resulting in more surgical intervention is consistent with earlier studies demonstrating a relationship between imaging and spinal surgery (Hollingworth et al., 2003; Lurie et al., 2003). One last point is the contribution of routine radiography and CT imaging to a patient's aggregate radiation exposure. A lumbar CT scan exposes a patient to a radiation dose of 6 mSv and a typical plain film 1.5 mSv. Although this may seem minimal, the radiation exposure for a lumbar plain film is 75 times higher than exposure from chest radiography. It has been estimated that one single lumbar plain film series is equivalent to having a chest film every day for several years (Jarvik and Deyo, 2002).

CONCLUSION

It turns out that most episodes of LBP or radicular pain are not related to serious disease processes. It is the role of the clinician to identify this small percentage of patients without overutilizing diagnostic modalities, which can be as detrimental to patients. Imaging with MRI is the most sensitive and safest, and should be utilized whenever neurologic examination is abnormal or diagnostic indicators are identified on physical examination and patient history in accordance with set guidelines.

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