SEMPI Priority clinical area: Low Back Pain

INTRODUCTION

Low back pain is very common. It ranks second among reasons for physician office visits each year (Edwards et al., 2017). Up to 84% of the population experience low back pain at some time in their lives (Deyo et al., 2006; Walker, 2000). In 1998, total U.S. health care expenditures for low back pain were estimated at $90 billion, and costs have risen substantially since then, at a rate higher than observed for other health conditions (Gore et al., 2012; Vos et al., 2016; Yang et al., 2016). Contributing to the high costs are radiographic imaging, diagnosis and treatment (Chou et al., 2011; Deyo et al., 2009; Ivanova et al., 2011). Low back pain is also one of the most common reasons for missed work or reduced productivity while at work, resulting in high indirect costs (Vos et al., 2016; Yang et al., 2016).

Low back pain has a wide variety of causes, and a precise diagnosis often cannot be made (Chou et al., 2007; Deyo et al., 2014; Srinivas et al., 2012). Although disc herniation, disc degeneration, facet joint arthritis, and other degenerative abnormalities are common and increase in prevalence with age, these imaging findings correlate poorly with the presence of or severity of low back pain, and they are generally considered non-specific findings (Chou et al., 2007; Chou et al., 2011; Srinivas et al., 2012). Other causes of back pain include spinal malignancies, spinal infections, compression fractures, and ankylosing spondylitis (Jarvik & Deyo, 2002). Back pain with signs of nerve root compression (leg pain, numbness/tingling/loss of sensation, or weakness in a nerve root distribution) can occur due to herniated disc or spinal stenosis. Back pain can also be a symptom of systemic disease or regional, non-spine related disease. Non-spine related causes of low back pain include such conditions as endometriosis, kidney infection, abdominal aortic aneurysm, and pelvic inflammatory disease. Abdominal and retroperitoneal tumors such as lymphomas and sarcomas can also present with back pain.

The great majority of patients, about 75%-90%, recover within 4 weeks after onset of low back pain. Diagnostic imaging for low back pain is not recommended within the first 4-6 weeks unless there are other associated factors which could indicate a potentially serious condition (Chou et al., 2007; Chou et al., 2011; Jarvik & Deyo, 2002). These factors include but may not be limited to: history of cancer (especially lung, breast, or prostate cancer), symptoms suggestive of cauda equina syndrome (such as urinary retention or saddle anesthesia), progressive or severe neurological deficit, bowel or bladder dysfunction, trauma in the elderly patient, persistent radicular pain, and unexplained fever or chills. Age and mild constitutional symptoms are weakly associated with increased risk of cancer and in the absence of other risk factors, imaging is usually not required in the first 4-6 weeks (Chou et al., 2011; Jarvik et al., 2015). Chronic low back pain in younger persons that improves with activity may indicate ankylosing spondylitis.

Evaluating a patient with low back pain requires a thorough, problem-focused medical history and physical examination. Diagnostic imaging studies should be reserved for evaluation of patients with risk factors for serious disease and conditions that require surgery or other specific treatments and, in some cases, to evaluate chronic unexplained pain. Routine imaging does not improve patient outcomes, does not change initial management, can expose patients to potential harm related to radiation exposure, and increases the use of invasive procedures and surgeries that may be unnecessary ((Chou et al., 2007; Chou et al., 2011; Wnuk et al., 2018).

RADIOLOGICAL EVALUATION OF LOW BACK PAIN

Radiological modalities for evaluating low back pain include plain radiographs, computerized tomography (CT), magnetic resonance imaging (MR), myelography, nuclear medicine studies. Advanced imaging techniques such as MR and CT provide more detail than plain radiographs but are also more costly. Myelography and nuclear medicine studies are generally reserved for specific situations in which standard imaging (radiographs, CT, or MR) are inappropriate. These situations include, patient allergy to contrast media, MR contraindicated due to metallic implants or claustrophobia, or when findings on standard imaging are unclear or inconsistent with the clinical presentation. As described below, the role of discography is controversial.

Plain Radiography (X-ray)

Plain radiographs mainly allow visualization of bony structures in the spine and are useful in cases involving acute trauma. They are also useful in showing the degree of spondylosis, scoliosis, spinal stenosis or dislocation. This information can then guide the choice of imaging for further evaluation (Ahmed & Modic, 2007; Jarvik & Deyo, 2002). Plain radiographs are often used as the first step in the diagnostic workup for persistent low back pain (Chou et al., 2007). Plain radiographs, however, lack sensitivity for early detection of a destructive process such as a tumor, infection, or for soft tissue abnormalities (Ahmed & Modic, 2007; Chou et al., 2007). Further, imaging may not improve clinical outcomes and may lead to further Imaging or treatment interventions of limited or questionable value (Wnuk et al., 2018).

Computerized Tomography (CT)

CT is useful for evaluating the cross-sectional anatomy of the lumbar spine and is considered superior to MR for visualizing bony processes that occur in degenerative arthritis, or for bony alterations associated with malignant tumors, spinal stenosis, ankylosing spondylitis, or trauma (Jarvik & Deyo, 2002; Ahmed & Modic, 2007). CT imaging is highly accurate in detecting bone marrow edema in vertebral compression fractures (Yang et al., 2018). CT is also used for unstable patients who need extensive monitoring and for patients who are unable to have an MR due to claustrophobia or contraindications (e.g., presence of certain implanted metallic devices). Of note, abdominal CT imaging done for **non**-low back

pain purposes (e.g. abdominal pain) can accurately identify lumbar spine pathology, (e.g. fractures, herniated discs, infection, bone tumors, spinal cord/nerve root impingement, foraminal stenosis) when compared to a magnetic resonance (MR) reference standard, with greater than 92% diagnostic accuracy (Klein, 2017).

Magnetic Resonance Imaging (MR)

Like CT, MR provides visualization of the cross-sectional anatomy of the spine and also provides the most accurate and detailed images when one is looking for soft tissue pathology. MR is also not associated with radiation exposure and is usually the preferred advanced imaging method, when advanced imaging is required (Ahmed & Modic, 2007; Bartynski & Petropoulou, 2007; Jarvik et al., 2015). MR has a greater sensitivity than other imaging studies for evaluating disc degeneration and paraspinal soft tissue abnormalities. It can clearly show the anatomy of discs, spinal nerves, and the dural sac (Bartynski & Petropoulou, 2007). Injuries of the spinal cord, such as cord compression, cauda equina or spinal cord lesions, can be seen well on an MR (Petrasic et al., 2017; Stolper et al., 2017). MR is very useful in the evaluation of spinal tumors, infection, and spinal deformities (Lazzeri et al., 2019; O'Sullivan et al., 2015; Park et al., 2018). MR is the scan of choice for evaluation of spinal stenosis or radiculopathy thought due to a herniated disc (Chou et al., 2007). In most cases MR would be the scan of choice for patients with continued low back pain following spinal surgery (Thakkar et al., 2012). An advantage of MR over other imaging modalities is that it shows the pathology in the spinal canal as well as the pathology in adjacent organs and soft tissue.

Myelography

Myelography demonstrates the anatomy of the subarachnoid space and can be useful in diagnosing spinal canal stenosis but is now uncommonly obtained because it is invasive and associated with potential side effects such as headache, seizures, and infection. A myelogram followed by a CT-Myelogram may be useful for evaluation of persistent postoperative back pain if the patient is unable to have an MR or when symptoms are not explained by MR or conventional CT imaging in patients with degenerative scoliosis (McKay et al., 2017).

Nuclear Medicine

Radionuclide bone scans are uncommonly used for evaluation of low back pain. Bone scans are more sensitive for detecting occult infection or a neoplasm than plain radiographs, but MR is more sensitive and specific (Lazzeri et al., 2019; O'Sullivan et al., 2015; Park et al., 2018). Bone scans may be useful in the identification of benign bone and joint conditions such as stress fractures, articular facet osteoarthritis, and osteoid osteoma, when standard imaging tests are not definitive.

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