

Nonspecific back pain: approach and management

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Back pain is a debilitating condition that affects many people. The work environment, the overall health status and one's psychosocial state may predispose an individual to back pain. Back pain may be the result of osteoporotic or traumatic bone fractures, degenerative joint disease, neurological compromise, inflammation, infection or muscle spasms. Nonsteroidal anti-inflammatory drugs are the first-line medication for back pain, but opioids and muscle relaxants are also effective. Surgical intervention is rarely indicated for patients with back pain alone, but may be helpful for patients with leg pain secondary to spinal stenosis and/or degenerative spondylolisthesis, who have failed conservative management.

Back pain continues to be an ubiquitous and chronic condition that affects as many as 5.6% of adults daily [1] and over 26 million adults annually [2,3]. Over 60–70% of people will have at least one episode of lumbar pain in their lifetime and 30–40% will require continuous medical care due to recurrent disease [2–5]. Back pain starts as early as 14 years of age and worsens with time [6]. Symptoms are considered acute if they last less than 4 weeks, subacute if lasting 1–3 months and chronic if symptom duration extends beyond 4–6 months [7]. The chronic condition may lead to extensive disability and pain, and has a major impact on the healthcare economics of working adults [8]. In fact, acute low back pain is the first most common reason for work absenteeism, the second most common cause for physician visits and the third most common diagnosis for surgical procedures [9,10]. Each year, patients with back pain utilize over US\$90 billion in healthcare expenditures alone, and those costs are predicted to rise rapidly due to the complexity associated with newer advanced procedures and increased demand [11]. A short period of bed rest is no longer recommended for an initial acute episode; instead, management involves advanced rehabilitation techniques and innovative interventional procedures.

The approach to back pain is complicated by the vast differential diagnosis involved. Although, back pain in the primary-care setting carries an oversimplified definition that consolidates musculoskeletal, neurological and/or even vascular components into a single diagnosis, the condition is typically multifaceted and often involves life-critical situations [12]. Imaging modalities, including MRI, are neither cost effective, nor specific enough to be used independently [13–15].

Over 35% of patients under 40 years of age and over 93% of patients over 60 years of age will show false-positive MRI findings irrelevant to their condition [16]. Therefore, optimal decision algorithms must combine anatomical, physiological, functional and even psychosocial variables into a unified diagnostic scheme. Ultimately, 80–90% of people will report relief with rest alone and will show complete resolution of symptoms by 3 months [8,9].

The spine

The spine is both a conduction pathway for the nervous system and a leverage mechanism for musculoskeletal stabilization, protection and movement. The chain of seven cervical, 12 thoracic and five lumbar vertebra provide enough rigidity to support the axial skeleton and enough flexibility to allow for complex axial movement. The intervertebral interactions take place at the two zygapophyseal joints (ZJs) and the intervertebral discs that form the functional spinal unit at each level. Despite the apparent simplicity of the ZJ, this is a true synovial joint that guides directional motion at each level by anatomical variations in the facet plane [17]. For example, facets oriented parallel to the sagittal plane allow motion in the same plane but resist axial rotation, while those oriented in the coronal plane resist shearing motion, while allowing axial rotation [18]. Each ZJ is innervated by the medial branches of the posterior primary rami at both the level of the joint and the level above. However, the intrinsic role of the ZJ in back pain is still debated and the presence of joint arthropathy on imaging does not guarantee the source of the back pain [19]. Nonetheless, these joints are certainly subject to degenerative changes

Keywords

arthrodesis ■ arthroplasty
■ artificial disc ■ back pain
■ fusion ■ spine

and local inflammation (as evidenced by MRI studies) [20]. The subsequent enlargement of the joint space may produce direct impingement of nerves and result in neurogenic pain, owing to the development of an associated degenerative spondylolisthesis that causes spinal stenosis [17].

Since all three joints function as a unit, any change in one of the joints affects the other two. As a result, changes in the ZJ affect the disc and changes in the disc reflect on the ZJ [18]. The disc provides a direct cartilaginous articulating surface with motion derived from its internal elastic properties. Each disc contains a central gelatinous structure, termed the nucleus pulposus, surrounded by circular lamellar collagen fibers forming the annulus fibrosus. The nucleus pulposus contains large amounts of aggrecan, which is responsible for maintaining disc hydration and, therefore, the shock-absorbing capacity of the structure. Alterations in the aggrecan gene may also be responsible for the genetic predisposition for disc degeneration. Variable numbers of repeats in the aggrecan gene determine the chondroitin sulfate content of the proteoglycan and, therefore, the inherent capability of the disc to osmotically retain water [21]. In addition, when intermixing polymorphisms or mutations in collagen, matrix metalloproteinase or interleukin genes, certain individuals are genetically susceptible to early disc degeneration, disc bulging and herniation [22]. For example, polymorphisms in *COL9A2* and *COL9A3* replace normally hydrophilic amino acids with tryptophan, which then disrupts the triple helix and cross-link formation [23]. The lamellar structure of the disc is therefore weakened and predisposes the individual to disc instability [24,25]. In a cross-sectional study of patients with chronic low back pain, as many as 39% of the study population showed internal disc disruption, with the highest prevalence at the L5–S1 and L4–L5 levels [26]. Nevertheless, other studies failed to find a significant correlation between radiographic disc disruption and lower back pain [27,28].

Muscular and ligamentous structures may be responsible for some cases of back pain in the primary-care setting [29,30]. Multiple layers of superficial and deep intrinsic muscles provide a complex scheme of vectors that stabilize the vertebral column. However, in the setting of a dysfunctional pivot axis as a result of joint disease, the same muscle groups may destabilize the spine and produce pain symptoms. An acute event like trauma or forceful physical activity may push the limits of flexibility and cause strain or even sprain. In the setting of bulging discs or

a stenotic spinal canal, the event can also aggravate underlying conditions and produce radicular symptoms. Finally, when no clear etiology of back pain is identified, as many as 85% of patients may suffer from nonspecific myofascial pain or fibromyalgia [30,31].

Risk factors for back pain

Back pain has been linked to both a genetic predisposition and lifestyle influences. In a study of 4501 adults, individual health status was one of the stronger predictors of back pain [32]. People who rated their health as poor were twice as likely to have a first episode of back pain in the following year, compared with people rating their health as excellent. Back pain had the highest incidence between 45 and 59 years of age, with a Gaussian curve distribution around those ages [32]. Patients with back pain often report multiple comorbid conditions, including cardiac, pulmonary and gastrointestinal disorders, or other bone and joint disease [33]. Obesity, as defined by a BMI of more than 30, is an independent risk factor for developing back pain [6]. Smoking may also be a risk factor, although available evidence is inconsistent [6]. Individuals with depression were at increased risk for back pain [28]. Depression was a predictor, rather than a consequence, even though patients with back pain were six-times more likely to develop depression [34,35].

Physical labor may be the cause of up to 37% of lower back pain worldwide [36]. This condition accounts for 149 million lost workdays per year in the USA alone, adding to a combined total of US\$70–100 billion in worker compensation and loss of productivity [4,37]. People involved in professions that require heavy lifting, moving, carrying, bending, or those that require long periods in one position, are more likely to develop back pain [6]. These professions include individuals who do clerical work, repair, service and transportation. Workplace dissatisfaction alone was associated with an increased risk of back pain. In a prospective study of 3020 aircraft employees, subjects who did not enjoy their jobs were 2.5-times more likely to report back injuries compared with satisfied workers [38].

Red flags

Although 85% of patients with back pain will leave the physician's office without a clear diagnosis [29,30], 30–60% will recover in less than 1 week, 60–90% are symptom free by 6 weeks and over 95% show resolution of symptoms by 3 months [1]. Despite the positive outlook,

a missed diagnosis of spinal cord compression, malignancy or infection may result in severe morbidity or even mortality. Vascular emergencies such as ruptured abdominal aortic aneurism or aortic dissection often present with acute back pain in the absence of any other physical findings. Approximately 1% of patients presenting with back pain to a primary-care physician have metastatic cancer [39], most commonly from the breast, prostate, lung, kidney or thyroid [40]. Metastases are also responsible for over 90% of cases of epidural spinal cord compression [40,41]. Disc herniation, infections or bleeding comprise other important causes of spinal cord compression. Osteomyelitis due to *Staphylococcus aureus* can migrate to adjacent vertebral bodies and intervertebral joints producing spondylodiscitis [42–44]. If untreated, the infection can result in spinal epidural abscesses, in approximately two cases per 10,000 admissions, and may produce neurological symptoms and paralysis [45].

Most of these emergency diagnoses can be identified at an early stage through a thorough history and physical exam. Although vertebral compression fractures account for less than 5% of back pain cases, this is always a working diagnosis – especially in older individuals with osteoporosis [46–48]. Findings associated with malignancy include a history of unintentional weight loss in patients older than 50 years of age with unrelenting pain despite analgesics. Any vascular history should be ruled out when hypotension is found in the presence of a pulsatile abdominal mass or pulse amplitude differentials. Fever and chills in an immunosuppressed individual with intravenous drug use should always prompt an infection workup. Even in the absence of specific findings, back pain warrants a broad differential and precautionous treatment.

Management of back pain

Nonoperative approaches

In the absence of any red flags, conservative management is indicated. However, most trials attempting to standardize back pain management are still lacking, and additional research data continue to slowly filter into practice. NSAIDs comprise the first-line medication recommended for back pain and have shown significant symptomatic relief in over 65 clinical trials [49,50]. Nevertheless, at least two to three patients need to be treated in order to see one patient show a 50% improvement in pain symptoms [1]. NSAIDs were shown to be equally, or possibly slightly more, effective than

paracetamol or acetaminophen when compared with other drugs, even though NSAIDs had more side effects [49]. By comparison, selective cyclooxygenase-2 inhibitors had fewer side effects, but several studies questioned their cardiovascular risks. No statistical differences were seen between NSAIDs and narcotic analgesics or muscle relaxants [50]. Despite this, narcotics should be considered only after other options have been unsuccessful.

Multiple alternative non-medical treatments have been evaluated for the management of back pain, with many of them failing to show a significant improvement in symptoms. Nevertheless, a review of over 15 studies suggested that multidisciplinary therapy incorporating physical therapy, training in relaxation techniques, psychological group therapy and neurophysiology education may be superior to no treatment or standard medical treatment alone [51]. Spinal manipulation showed a significant improvement in pain and symptom duration when compared with placebo [52]. Prior recommendations for bed rest have been abandoned in favor of modified activity regimens [53]. Aerobic conditioning may improve muscle tone and, psychosocial well-being, and therefore decrease the severity of back pain [54]. Active physical therapy shortens disability, lowers pain scores and decreases healthcare utilization [55].

Surgical intervention

Surgery is a viable option in patients who fail to improve after conservative therapy. First, plain radiographs are taken to assess structural abnormalities, fractures, spondylolisthesis or scoliosis [56,57]. MRI allows imaging of canal stenosis or inflammatory changes in the facet joints, disc, or vertebral body; nevertheless, imaging for spinal pathology is highly nonspecific [13–15]. The decision to proceed to surgery must take into account the entire clinical picture and patient motivation in order to improve outcomes. One of the most commonly performed lumbar spine operations is microdiscectomy. This procedure is indicated in the setting of leg pain owing to a herniated disc, which has failed to improve with nonoperative treatment. However, both operative and nonoperative patients showed significant improvement in symptoms after 2 years, according to the recent Spine Patient Outcomes Research Trial [58]. Nevertheless, in the analysis of outcomes based upon the treatments actually received (the so-called ‘as treated’ analysis), a substantial advantage was seen for operative compared with nonoperative treatment [59].

Spinal decompression via laminectomy is a widely used technique for neurogenic claudication due to canal stenosis and involves the partial removal of the lamina, the spinous process and ligamentum flavum [60]. The excision of other structures or the disc may be necessary in order to achieve complete decompression of the nerve roots. However, such extensive resection may destabilize the spine and the patient may require an arthrodesis. A partial or unilateral decompression is sometimes a better choice in order to minimize destabilization. In a study of 100 patients, Amundsen *et al.* described significant improvement in the operative groups compared with conservative treatment at both 4 and 10 years postoperatively [61]. More than 80% of the operative group population showed improvement at 4 years, compared with 50% in the nonoperative group. Similar results were subsequently reproduced by Atlas *et al.* in later work [56]. Despite such success, most experts suggest initial conservative attempts owing to significant improvement in many patients even without surgery [62,63].

Arthrodesis versus arthroplasty & adjacent segment disease

Many approaches have been described for accomplishing lumbar fusion in the setting of instability, including the direct posterior fusion and posterolateral (intertransverse) fusion, the posterior lumbar interbody fusion, the tranforaminal lumbar interbody fusion, and the extreme lateral transpsoas interbody fusion [64,65]. Posterior lumbar interbody fusion uses incisions at the fusion level, followed by bilateral hemilaminectomies and medial facetectomies. The nerve roots are retracted, which allows enough access to also perform a discectomy. After decorticating the endplates, an interbody device with graft material is placed and the fusion is then instrumented. Transforaminal lumbar interbody diffusion is similar to posterior lumbar interbody diffusion, but requires less nerve retraction at the expense of sacrificing a facet joint [66]. Combined, these techniques allow for highly successful fusion procedures in 90–95% of cases, yet symptom improvement lags far behind [67]. The indications for fusion are controversial, and long-term outcome data are lacking. In a study of 289 patients, Fritzell *et al.* found significant improvement in patients after fusion procedures [68]. In similar work, Brox *et al.* described no significant differences between operative and nonoperative groups, while the operative group experienced an 18% complication rate [69].

Spinal fusion or arthrodesis remains the mainstay of treatment for spinal instability, yet the procedure is not ideal. The spine is designed to modulate very high loads, so any alteration in the input force may subsequently transduce the load across multiple adjacent levels [70–73]. Several studies have shown that arthrodesis at one level increases intradiscal pressures of adjacent levels, and the magnitude of increase correlates with the extent of fusion [74]. Adjacent segment disease (ASD) is a clinical, rather than a radiologic, diagnosis that includes return of back pain, radiculopathy or myelopathy at spinal levels adjacent to a surgically fused or manipulated intervertebral level. One of the most quoted studies on ASD by Hilibrand *et al.* predicted that approximately 25% of patients undergoing cervical fusion developed ASD within 10 years [75,76], with several studies reporting reoperations in 7–15% of patients [75]. Similar statistics have been reported for lumbar or thoracolumbar procedures, whereas Cheh *et al.* describe a 24% prevalence of clinical ASD at approximately 8 years after surgery [77]. When ASD is diagnosed, subsequent surgeries have worse outcomes compared with the index procedure, and repeat decompression with fusion is recommended only in cases of evolving instability and new symptoms refractory to nonoperative treatments [78,79].

Spinal arthroplasty is a contemporary attempt at removing the disease condition at the affected level, while maintaining the original anatomic biomechanics. Nevertheless, the vertebral unit is perhaps one of the most complicated joints in the body. Several attempts at replicating the nucleus pulposus have been made [80]. The total disc-replacement system is even more complicated and current results show lots of potential. Griffith *et al.* reported significant improvement in the functional status of 93 patients at 1 year follow-up, with device failure seen in only 6.5% of cases [81]; three patients required reoperation. Therefore, spinal arthroplasty is only in its infancy and remains unproven as to its advantages over fusion, but continues to be carefully studied.

Conclusion

Back pain can be incapacitating and may severely impact one's quality of life. Despite the advancement of modern surgical techniques, approximately 20% of back surgeries fail, requiring chronic treatment and repeat interventions [82]. The issue is further complicated by the lack of clear outcome measures [83].

Results are often controversial and the findings are difficult to generalize.

Back pain management requires a thorough medical evaluation, and an exhaustive history and physical exam are crucial. Certain risk factors, including the patient's psychosocial and environmental state may provide diagnostic clues or red flags that require follow-up. Rarely, symptoms of back pain, may represent a medical emergency, such as an aortic dissection. Conversely, a significant portion of back pain complaints are nonspecific and will resolve without any intervention.

Acute-to-subacute back pain can be managed with conservative watchful waiting and NSAIDs. Alternative treatments, including education, spinal manipulation or physical therapy, can be helpful, and the condition may require the joint effort of multiple specialists. Surgery is a valuable option only when other treatments have not provided sufficient relief. The patient should be involved in the surgical decision and should understand the relative success and risk of the surgery. Less invasive procedures are preferred when appropriate, and the intervention should minimize bone loss in order to prevent instability. If instability is present, fusion will be necessary. However, in the case of fusion, ASD is a serious complication that may require the progressive extension of the fusion to multiple levels. Such a

decision, like all surgical decision-making with regards to the spine, is ultimately dependent on communication between the surgeon and the patient.

Future perspective

The spine is one of the more complicated musculoskeletal structures in the body, with a complex interplay between muscles, cartilaginous joints and the bony vertebra. Current approaches are successful, but often have unexpected long-term consequences, such as ASD. The advancement of technology is leading to changes in the practice of spinal surgery, including introduction minimally-invasive techniques and disc arthroplasty procedures. Long-term follow-up of these procedures in comparison with traditional forms of decompression and stabilization is needed to fully define their role in the surgical treatment of spinal degenerative disease.

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Executive summary

Back pain affects 5.6% of adults daily

- Acute low back pain is the first most common reason for work absenteeism, the second most common cause for physician visits and the third most common diagnosis for surgical procedures.
- Each year, patients with back pain utilize over US\$90 billion in healthcare expenditures and US\$70–100 billion in worker compensation and loss of productivity.

Spine anatomy

- Zygapophyseal arthropathy may be responsible for local mechanical or radicular symptoms from either the joint nociceptive stimuli or the impingement of adjacent nerves.
- The intervertebral disc, composed of the nucleus pulposus and annulus fibrosus, is a highly complex structure that is responsible for the flexibility of the motion segment.

Red flags

- Back pain may be the result of osteoporotic or pathologic bone fractures, degenerative joint disease and neurological compromise, including claudication, nerve impingement, cauda equina syndrome, inflammation infection or muscle spasms.

Management

- Nonsteroidal anti-inflammatory drugs comprise the first-line medication recommended for back pain.
- A surgical approach should be considered only when conservative treatments showed no improvement.
- Spinal arthroplasty shows promise in specific cases of discogenic low back pain, and multiple clinical trials are underway to further delineate its role in treating back pain.

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