

NARRATIVE REVIEW A quick and comprehensive guide to differential diagnosis of neck and back pain: a narrative review

Elisha Krasin¹, Haggai Schermann¹, Nimrod Snir¹, Adrian Tudor¹, and Eyal Behrbalk²

¹Tel Aviv Sourasky Medical Center

²Hillel Yaffe Medical Center

March 07, 2024

Abstract

The list of possible differential diagnoses for complaints of back and neck pain is enormously long. Many proposed diagnostic workups trying to avoid the challenge of considering all possible etiologies by early commitment to a specific area of the spine (i.e., neck or lower back). Others limit the differential diagnoses by pursuing a rational but limited goal, like ruling out conditions that may result in disability or death in the setting of an emergency department. We have briefly described a long list of medical conditions, each of which may present as back or neck pain, and whose prevalence ranges from common to very rare. We then showed that they all can be assigned to one of 7 groups according to judicious history taking, physical examination and simple imaging and laboratory tests: (1) pain that radiates from the cranium, chest or abdomen; (2) pain with signs of infection; (3) pain with signs of nerve root compression; (4) pain with signs of cord or cauda compression; (5) mechanical pain; (6) rheumatic pain; (7) pain with other characteristics, with or without local tenderness. Further referral to diagnostic tests and specialist consultations after initial assignment to one of these seven categories would save the patient time and unnecessary tests. We believe that this review and the proposed diagnostic algorithm may be valuable for medical education and for application in the primary care setting for the purpose of conducting a diagnostic workup of any type of back or neck pain in all patient groups and may be possibly used for development of diagnostic software and machine learning.

Introduction

Neck and back pain are extremely common complaints in orthopedic, pediatric, emergency room, and general medical practice.¹⁻³ The range of differential diagnosis of neck and back pain is vast and even an experienced physician will often struggle to achieve the correct diagnosis without a systematic approach. While common diagnoses like a laterally herniated lumbar disc, that is easily recognizable on the basis of history and physical examination and can be differentiated from a tumor or a gout tophus, or other pathologies that can compress the nerve root, by magnetic resonance imaging, diagnosis of rarer disorders is more difficult. For example, fungal infections of the spine are almost always diagnosed with a delay that invariably diminishes the chances of a good outcome.⁴ A method of differential diagnosis that enables the diagnostician to shorten the list of possible diagnoses and decrease the number of diagnostic tests and the time to final diagnosis is highly desirable.⁵

This paper describes a useful method for sorting the possible etiologic causes according to a short list of simple clinical criteria. Our intention is to create a kind of map to facilitate the navigation between the long lists of diagnoses and the appropriate standard tests and imaging studies for their verification or exclusion with the least amount of waste in time and resources.

Several recent publications were concerned with the issue of diagnostic workup for low back pain. The often recommended approaches include its classification into acute versus chronic pain and consideration of red flags suggesting more severe pathology.^{1,6} However, the reliability and predictive value of red flags in the

diagnosis of severe back pain etiologies has recently been questioned.^{7,8} An approach to cervical and thoracic spine pain is covered in separate publications, but it is largely extrapolated from literature on low back pain.⁹ Such tendency to evaluate different parts of the spine separately may bear a certain level of risk, because focusing on one anatomical part may mislead physicians and cause them to neglect other parts. This review describes a comprehensive and practical systematic approach to the diagnosis of a patient with axial spinal complaints.

Literature review

Referred pain

It is of utmost importance to bear in mind that neck and back pain can originate from a pathologic process that is not located in the spinal column.^{6,10,11} For example, acute myocardial infarction or ischemia of the posterior wall of the myocardium can cause thoracic interscapular pain that can be accompanied by dyspnea, sweating, and palpitations.¹² Dissection of an aortic aneurism can cause thoracic or lumbar pain that develops suddenly or gradually.^{13,14} Signs of ischemic shock or tachycardia will not always appear immediately, and weak or absent pulses in the upper or lower extremities may be the first early sign.¹⁴ A pulmonary embolism can cause the sudden appearance of thoracic back pain as well as pulmonary bulla, pleuritis, pneumothorax, and empyema.¹⁴ Lung cancer especially that expands to the posterior thorax can cause back pain.¹⁵ Intra-abdominal pathologies, such as pancreatic cancer⁶ with or without bone metastases, can cause lumbar back pain that typically radiates to the abdomen in a "belt-like" manner. Posterior perforation of a peptic ulcer can cause the sudden appearance of back pain and the gradual development of signs of sepsis.¹⁴ Renal pathologies^{6,14} may cause back and flank pain that radiates to the groin and that may be accompanied by urinary symptoms, fever, chills, nausea, and headaches. Various gynecological problems and menstrual cramps can also cause back pain. Brain stem tumors can present as neck pain with or without neurological abnormalities or gait abnormalities.¹⁶ Inflammation of the sacroiliac joint can cause poorly localized buttock pain that can be confused with lumbar pain¹⁷ and sometimes even be accompanied by radiating pain to the thigh and leg with neurological manifestations due to involvement of the lumbosacral plexus.¹⁸

Trauma and overuse

In cases of a traumatic fracture, dislocation, or ligamentous tear, a history of a traumatic injury is not always apparent when the patient is unconscious, demented, psychotic, under the influence of alcohol or drugs, or a nonverbal child.³ On the contrary, a history of injury does not necessarily mean that the pain has a traumatic etiology, and it may be a "red herring" that distracts from the real cause. Strains and sprains of the spine are defined as low-energy injury, overuse, or stretching of muscles or tendons and ligaments.¹⁹ Whiplash injury is well described and can lead to neck and back pain.²⁰ A "clay shoveler's fracture" is an avulsion injury of the spinous processes of the cervical-thoracic junction that can appear after injury or overuse.²¹ SCIWORA (spinal cord injury without radiographic abnormality) is a syndrome of traumatic injury/myelopathy without radiological findings that was described in the 1970s,²² was revealed as being a contusion of the spinal cord by magnetic resonance imaging (MRI) scanning. Central cord syndrome is defined by muscle weakness that is greater in the upper extremities, as well as by urinary retention and various sensory abnormalities.²³ It is caused by hyperextension of the neck that compresses the spinal cord, and can appear without predeceasing spondylosis and narrowing of the spinal canal.²³ Pathological fractures due to osteoporosis, infection, or a tumor can appear without injury or after only a minor trauma.⁶ Stress fractures of the pars-interarticularis (spondylolysis) are typical to adolescents that are physically active, they appear more often in volleyball players and weightlifters, and the pain is typically "mechanical"²⁴. Stress fractures of the sacrum appear in osteoporotic patients and may be responsible for low back pain.²⁵ Apophysitis of the vertebrae (Scheuermann's disease/osteochondrosis) will appear in the thoracic spine (75%) or in the lumbar spine in adolescents without apparent history of overuse. Only 20-60% will have pain, and the rest will develop a painless kyphotic deformity.²⁴ Neurological abnormalities are rare. Brown-Sequard syndrome is caused by injury to a hemicord that can be traumatic or due to a tumor: ipsilateral paralysis with loss of proprioception will typically be observed, with contralateral loss of pain and temperature sensation.²⁶

Infection

Osteomyelitis and/or discitis will cause sudden or gradual appearance of back pain that can be on different levels and of various severities, and may be accompanied by fever and chills. The pain will be constant and include night pain, and it might worsen over time without treatment.²⁷ In children, spondylodiscitis can present with gait abnormalities or abdominal pain without back pain.²⁸ An epidural abscess will cause a turbulent illness with severe pain, fever, chills, and progressive neurological deficiency caused by cord or cauda compression. If the patient is partially treated the clinical picture may be deceptively less severe.²⁹ A paraspinal abscess can cause prolonged fever even without pain, or pain that radiates to the groin along the psoas muscle.⁶ Fungal infections of the spine appear most often in immunosuppressed patients, and will cause back pain with various neurological abnormalities because of cord or nerve root compression.⁴ Brucellosis causes a systemic illness with fever and muscle and bone pain, including spinal involvement with micro abscesses of the vertebra.²⁹ Gonorrhea can cause meningitis of the cord, especially in immunosuppressed individuals.³⁰ Syphilis causes Charcot arthropathy of the spine and (rarely) a gumma in the spinal canal that can compress the cord or the nerve roots.³¹ Tuberculosis of the spine causes a slowly progressing illness, back pains, and deformity with various neurological abnormalities.²⁹ Spinal hydatid disease (*Echinococcus granulosus*) is rare: its manifestations are radiculopathy, myelopathy, and/or local pain due to bony destructive lesions, pathological fracture, and consequent cord compression.²⁹ Herpes zoster causes suddenly appearing back pain that radiates to the chest or the abdomen 2 or 3 days before the appearance of the typical herpetic vesicles (the rash will not appear at all in some cases [zoster sine herpete]).¹⁴ Various viral diseases, such as influenza, can cause back and bone pain that might appear before the fever and other systemic signs.¹⁴ A Coxsackie-B virus infection causes severe chest and back pain ("devil's grip").³² Poliomyelitis, tetanus, and rabies can also cause back pain and should be considered.^{33,34} Acute flaccid myelitis causes fever, neck and back pain with flaccid motor paralysis of various severities, with minimal sensory symptoms, cranial nerve involvement is possible.³⁵

Tumor

Benign tumors of the spine, such as osteoid osteoma or osteoblastoma, will cause back pain that may gradually worsen over time. The pain is not dependent upon activity, and the characteristic night pain may be present.³⁶ Eosinophilic granuloma and Langerhans histiocytosis may cause back pain with "vertebra plana" findings on imaging studies.³⁷ Tumors of neural tissue, such as schwannomas, can cause radiculopathic pain.³⁸ Calcifying-pseudo-neoplasm of the spine ("CAPNON") is a benign slow growing tumor that can produce mass effect³⁹ causing weakness and gait problems. Chordoma is the most common tumor of the sacrococcygeal region.^{36,40} Malignant tumors, such as Ewing's sarcoma, are quite rare. Metastases of epithelial tumors (lung, breast, prostate) are common in the lumbar and sacral spine in older age.⁴¹ Tumors of hematopoietic tissue, such as lymphoma or multiple myeloma, are not rare.³⁶

Degenerative, rheumatic, and autoimmune

Degeneration and herniation of the intervertebral disc can cause back or neck pain with radiculopathic pain along the extremity, sometimes without any axial pain whatsoever.⁶ Piriformis syndrome, which causes sciatic symptoms without back pain, should be excluded.⁶ Nociceptive nerve fibers in the disc that become sensitized by the cytokines in the degenerative disk cause "pure discogenic" pain.⁴² In adolescents disc herniation can be associated with separation of the apophyseal ring.²⁸ Non-specific back pain that worsens on standing is related to Modic I changes in the end plate ("active discopathy").⁴³ Pediatric disc calcification causes a self-limiting neck or back pain.⁴⁴ Symmetrical buttock pain with perianal hypoesthesia, with or without sphincter weakness, suggests a cauda equina syndrome and requires urgent intervention.¹¹ Stenosis of the lumbar spinal canal will cause back and buttock pain during ambulation that may worsen and cause claudication.⁶ Stenosis of the cervical spinal canal can cause cervical myelopathy with typical ataxia.⁴⁵ Degeneration of the facet joints will cause "mechanical" pain on standing, walking, and physical effort. An "active" osteophyte can appear on every vertebral level, but most typically at the lumbar area, and it will

cause pain in the flank that worsens upon movement and is aggravated by nighttime movement. It may be easily diagnosed on a technetium bone scan.⁶ Spondylolisthesis and spinal instability will cause mechanical back pain.⁶ Costovertebral joint problems (most often osteoarthritis) will cause localized pain that worsens with movement, coughing, and deep breathing.⁴⁶ Baastrup syndrome is caused by friction between adjacent spinal processes that produce local inflammation and growth of a bursa. Midline pain and tenderness that improves on flexion and worsens on extension is typically found.⁴⁷ Diffuse idiopathic skeletal hyperostosis can be asymptomatic or cause back and neck pain.⁴⁸ Spondyloarthropathies, such as ankylosing spondylitis or psoriatic arthritis, will cause axial back or neck pain often involving the sacroiliac joints as well.⁵ There is typical night pain with prolonged morning stiffness that is relieved by non-steroidal anti-inflammatory drugs.⁶ Reactive arthritis tends to less involve the spine but it can cause inflammation of the vertebrae and intervertebral joints.³¹ Bechet's disease rarely involves the spine and can cause myelitis and vasculitis of the cord.¹⁴ Other rheumatic diseases, such as systemic lupus erythematosus (SLE) or rheumatoid arthritis (RA) can affect the spine. RA typically involves the upper cervical vertebra and the craniocervical junction, causing atlantoaxial subluxation, superior odontoid migration, or subaxial subluxation.⁴⁹ SLE can cause myelitis and vasculitis of the cord as well as atlantoaxial subluxation/dislocation.¹⁴ Gout can affect the spine at any level, destroying the facet joints and causing hypointense lesions of the gout tophi that are seen in the extradural space on T1-weighted MRIs.³¹ Clinically, lumbar pain with radiculopathy will most often be observed as in a laterally herniated disc or spinal claudication as seen in spinal stenosis. In levator scapula syndrome, periscapular bursitis of the supraserratus bursa with involvement of the levator scapula will cause pain and local tenderness at the upper medial corner of the scapula.⁵⁰ Inflammation or strain of the rhomboids may cause thoracic back pain, and may be diagnosed by pain and tenderness in the rhomboids. It is important to rule out spontaneous pneumothorax or bulla that can present with a similar type of pain. Fibromyalgia can cause back pain without any physical or laboratory findings except for local tenderness at the known trigger points.¹⁴ Myofascial pain syndrome resembles fibromyalgia, but palpable tender and stiff trigger points are found in the muscles and fasciae.⁵¹ Polymyalgia rheumatica will cause neck, shoulder girdle, and hip pain, especially in the morning, accompanied by low fever, fatigue, and feeling of illness. Elevated erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels can be observed, unlike in fibromyalgia.¹⁴ Transverse myelitis is an inflammation of the spinal cord, mostly thoracic, that is related to autoimmune or infectious diseases or the use of certain drugs. It affects one or two adjacent segments and causes back or neck pain with motor weakness and complete paraplegia with sphincter paralysis that develops over hours or days.⁵² Arachnoiditis is chronic inflammation of the arachnoid that is caused by misplaced subdural injection of steroids or contrast medium after spinal operations and various infectious agents. It can be asymptomatic and discovered incidentally on MRI, but it can also cause severe chronic back pain on standing and sitting with various neurological abnormalities related to nerve root or cauda compression.⁵³ Synovitis, Acne, Pustulosis, Hyperostosis and Osteitis (SAPHO) syndrome can affect the vertebra and discs, and cause thickening of the paravertebral tissues.⁵⁴

Vascular

Obstruction of the artery of Adamkiewicz that feeds the anterior spinal artery (usually due to atherosclerosis) will cause an infarction of the cord. Typically, severe back pain and flaccid paralysis with pain and deficiency in temperature sensation will develop within minutes or hours.⁵⁵ Level D₂₋₄ will usually be the affected sensory level. Vibration and proprioception will be relatively preserved due to a different blood supply to the posterior cord. Arteriovenous malformations can be small or large, and either asymptomatic or cause radicular symptoms or sudden pain with various neurological problems due to bleeding.⁵⁶ An aggressive spinal hemangioma can grow out of the vertebral body into the spinal canal, compress the cord and spinal roots, and cause symptoms accordingly. It typically appears in young adults and worsens during pregnancy.⁵⁷ An epidural or subdural hematoma of the spine appears after trauma, epidural injection, coagulation abnormalities, and thrombolytic therapy and causes the sudden appearance of pain with various neurological problems up to complete paraplegia within minutes or hours.⁵⁸ Wegener granulomatosis is a systemic necrotizing granulomatous vasculitis. Neurologic symptoms mostly include peripheral neuropathy and mononeuritis multiplex, with rare cases of meningeal involvement. Cervical spinal cord compression

leading to myelopathy has also been reported.⁵⁹

Congenital/developmental

Congenital malformations, such as hemivertebra, and block vertebra, can cause deformation of the spine with or without pain.⁶⁰ If pain is present, it is usually mechanical pain due to degenerative changes in adjacent segments. Syringomyelia is caused by partial obstruction of the CSF flow from various causes, and it is usually painless. Neurologically, it presents as a kind of central cord syndrome, with upper extremity weakness and diminished pain and temperature sensation in a "mantle-like" shape, is observed and develops gradually in years. Vibration and proprioception sensations remain relatively intact.⁶¹ Chiari malformations can cause headaches and neck pain with various neurological problems (myelopathy, cerebellar symptoms, and central cord syndrome) due to pressure on the brain stem and cervical cord and development of a syrinx.⁶¹ Bertolotti syndrome (lumbosacral transitional vertebra) is a congenital pseudoarthrosis of a transverse process of L5 with the ileum or the sacrum.⁶² Mechanical low back pain is typical in young adults.

Psychogenic

Complaints of neck and back pain are common in somatoform disorders, conversion disorders, and malingering.⁶³ Diagnosis is by exclusion.

Metabolic/endocrine

Paget's disease is asymptomatic in 70-90% of cases but it can affect the axial skeleton and cause back and pelvic pain. Enlargement of vertebral bodies can cause compression of nerve roots, the cord, and the cauda equina. Paget's sarcoma is rare, but any prolonged change in pain in a Paget's disease patient demands investigation.⁶⁴ Hyperparathyroidism and renal osteodystrophy can cause pain due to spinal involvement, pathological fractures, and development of a "brown tumor".¹⁴ Osteomalacia causes generalized skeletal pain, especially of the back and pelvis

⁶⁵ Ochronosis causes disc calcifications and herniation with generalized and advanced arthritic changes.⁶⁶

Iatrogenic

Failed back syndrome is a syndrome of chronic back pain after surgery that was intended to treat back pain caused by different reasons, but did not succeed in bringing about any improvement.⁶⁷ It can be caused by disc remnants, recurrent disc herniation, damage to nerves during surgery, operation on the wrong segment, spinal stenosis or instability, epidural fibrosis, arachnoiditis, and infection. The clinical picture depends upon etiology.⁶⁷ Several medications can cause back pain, for example: statins, bisphosphonates (especially resins), aromatase inhibitors, isotretinoin and carvedilol.⁶⁸

Idiopathic

Sarcoidosis of the spine is rare and can involve the cord, meninges, and bone. Clinically, neck or back pain with various neurological problems is observed. Cervical involvement is more common than thoracic or lumbar involvement.⁶⁹ Torticollis is involuntary contraction of neck muscles (dystonia), usually the sternocleidomastoid. It is mostly idiopathic, but it can be secondary to trauma, muscle inflammation, infection, antipsychotic drugs, or a tumor. Hereditary cases have also been described. It can be a sign of atlanto-axial rotatory subluxation in children. It needs to be differentiated from congenital torticollis due to obstetric trauma to the sternocleidomastoid.⁷⁰

Back pain in pregnancy

Back pain in pregnancy can be caused by all of the above disorders, and some tumors are known to progress and become symptomatic during pregnancy, including giant cell tumors.³⁶ and hemangiomas.⁵⁷ However, majority of pregnant women experience either the pelvic girdle pain or the pregnancy-related low-back pain.⁷¹

It is characterized by mechanical back and pelvic pain that is relieved at rest. Any pain that is not relieved by rest, occurs at night, or is progressive requires investigation.⁵⁷

Method

We suggest sorting the above disorders that cause neck and back pain into 7 clinical groups according to several simple clinical, laboratory, and imaging criteria that will enable us to improve and speed up the diagnostic process and direct further investigative studies aimed at arriving at the correct final diagnosis (Table 1):

1. *Referred pain from the cranium, chest, or abdomen.* Each disorder has individualized symptomatology and should be differentiated by appropriate symptoms and signs. A high index of suspicion is required. For example, a 66-year-old diabetic smoker who complains of interscapular back pain with sudden onset should be cleared for a cardiac or vascular event before proceeding to an orthopedic workup.
2. *Pain with signs of infection.* Fever, chills, hyperhidrosis, leukocytosis, and increased acute phase reactants (CRP, ESR, ferritin) should all point to an infectious etiology. The clinical picture can be less clear in chronic or partially treated infections. Further investigation involves computerized tomographic and/or MRI studies, cultures, antibody levels (brucellosis, syphilis) and tissue diagnosis when indicated.
3. *Pain with signs of nerve root compression.* This category includes any process that compresses the nerve root and causes pain that is referred to the extremity with relevant segmental sensory, motor and reflex abnormalities. It can be investigated by CT or MRI scanning.
4. *Pain with signs of cord or cauda compression.* This category includes sensory level, paraplegia or paraparesis and signs of myelopathy. It always requires imaging, preferably gadolinium-enhanced MRI. Tissue diagnosis of any existing tumors is required.
5. *Mechanical pain.* This refers to pain that depends upon movement and effort and is relieved by rest and recumbence. A precise diagnosis can be usually be achieved by careful history taking, physical examination, and plain films. A CT scan may sometimes be needed to improve detail.
6. *Rheumatic pain.* This refers to pain that is not relieved by rest and even increases at night, with prolonged morning stiffness, good response to NSAIDs, and accompanied by pain or inflammation of other joints. Diagnosis is by fulfilling the diagnostic criteria for each disorder. Plain films of the hands can often differentiate between various rheumatologic disorders, such as RA, osteoarthritis, and gout arthropathy.
7. *Pain with other characteristics, with or without local tenderness.* A precise diagnosis of the source of this pain can be achieved by careful history taking and physical examination, and plain films. A CT scan may sometimes be needed to improve detail. Specific studies for metabolic/endocrine disorders may also be needed.

Discussion

The need for a systematic approach to back pain has long been acknowledged in the field of primary care.^{8,72} Underwood has discussed the poor performance of the red flags approach due to the high prevalence of at least one red flag in back pain patients and the rarity of severe pathology. Instead, he proposed focusing upon a select number of disorders that need to be diagnosed early: cauda equina syndrome, major intra-abdominal pathology, focal infections, and fractures. For other causes of back pain, he proposed that diagnosis can be made over a period of time and with several observations, because reasonable delay would not endanger the patient and it would not affect the initial treatment in many cases.⁷

Singleton and Edlow have also suggested a systematic approach for risk stratification and diagnosis of severe spinal pathology in emergency departments.¹ Our approach is somewhat similar to theirs by adopting a mental framework that includes benign self-limited musculoskeletal pathologies, spinal pathologies that cause neurologic disability due to cord or cauda damage, and non-spinal (abdominal or retroperitoneal) causes of low back pain.

Bardin et al proposed a “diagnostic triage” for low back pain, starting with exclusion of non-spinal causes

and continuing with allocation of patients to one of 3 broad categories: specific spinal pathology (<1% of cases), radicular syndrome (5–10% of cases), and non-specific low back pain (90–95% of cases), with the latter being diagnosed by exclusion of the former two.¹¹

We find the above diagnostic approaches to back pain useful and effective guides for the workup of low back pain. They are focused upon not missing an important pathology in a patient with low back pain. The originality and the relative advantage of this article is an inclusive overview of spinal pathologic conditions from the cervical to the sacral spine. This, as previously stated, would educate the reader to have a more wide view of the spinal pathology. Extending the number of pain syndromes (7 instead of 3 or 4^{1,11}) makes this review useful for non-emergency settings. We believe that using the list of the above 7 syndromes will guide any physician that is concerned with diagnosis of axial pain to wisely and cost-effectively diagnose the underlying pathology with the minimum number of diagnostic tests and referrals.

References

1. Singleton J, Edlow JA. Acute Nontraumatic Back Pain. *Emerg Med Clin North Am* . 2016;34(4):743-757. doi:10.1016/j.emc.2016.06.015
2. Vanwye WR. Nonspecific low back pain: evaluation and treatment tips. *J Fam Pract* . 2010;59(8):445-448.
3. Altaf F, Heran MKS, Wilson LF. Back pain in children and adolescents. *Bone Jt J* . 2014;96-B(6):717-723. doi:10.1302/0301-620X.96B6.33075
4. Ganesh D, Gottlieb J, Chan S, Martinez O, Eismont F. Fungal Infections of the Spine: *Spine* . 2015;40(12):E719-E728. doi:10.1097/BRS.0000000000000903
5. Lurie JD. What diagnostic tests are useful for low back pain? *Best Pract Res Clin Rheumatol* . 2005;19(4):557-575. doi:10.1016/j.berh.2005.03.004
6. Hooten WM, Cohen SP. Evaluation and Treatment of Low Back Pain. *Mayo Clin Proc* . 2015;90(12):1699-1718. doi:10.1016/j.mayocp.2015.10.009
7. Underwood M. Diagnosing acute nonspecific low back pain: Time to lower the red flags? *Arthritis Rheum* . 2009;60(10):2855-2857. doi:10.1002/art.24858
8. Galliker G, Scherer DE, Trippolini MA, Rasmussen-Barr E, LoMartire R, Wertli MM. Low Back Pain in the Emergency Department: Prevalence of Serious Spinal Pathologies and Diagnostic Accuracy of Red Flags. *Am J Med* . 2020;133(1):60-72.e14. doi:10.1016/j.amjmed.2019.06.005
9. Teichtahl AJ, McColl G. An approach to neck pain for the family physician. *Aust Fam Physician* . 2013;42(11):774-777.
10. Kelsey JR. Backache from intra-abdominal causes. *Am J Orthop* . 1962;4:64-66.
11. Bardin LD, King P, Maher CG. Diagnostic triage for low back pain: a practical approach for primary care. *Med J Aust* . 2017;206(6):268-273. doi:10.5694/mja16.00828
12. Ferry AV, Anand A, Strachan FE, et al. Presenting Symptoms in Men and Women Diagnosed With Myocardial Infarction Using Sex-Specific Criteria. *J Am Heart Assoc* . 2019;8(17). doi:10.1161/JAHA.119.012307
13. McConaghy JR, Oza RS. Outpatient diagnosis of acute chest pain in adults. *Am Fam Physician* . 2013;87(3):177-182.
14. Jameson JL, ed. *Harrison's Principles of Internal Medicine* . Twentieth edition. McGraw-Hill Education; 2018.
15. Mabry LM, Ross MD, Tonarelli JM. Metastatic cancer mimicking mechanical low back pain: a case report. *J Man Manip Ther* . 2014;22(3):162-169. doi:10.1179/2042618613Y.0000000056

16. Li D, Hao S-Y, Wu Z, Zhang L-W, Zhang J-T. Primary medulla oblongata teratomas: Report of 2 cases. *J Neurosurg Pediatr* . 2014;14(3):296-300. doi:10.3171/2014.6.PEDS1423
17. Sembrano JN, Polly DW. How Often Is Low Back Pain Not Coming From the Back?: *Spine* . 2009;34(1):E27-E32. doi:10.1097/BRS.0b013e31818b8882
18. Dyck PJB, Thaisetthawatkul P. Lumbosacral Plexopathy: *Contin Lifelong Learn Neurol* . 2014;20:1343-1358. doi:10.1212/01.CON.0000455877.60932.d3
19. Ayloo A, Cvengros T, Marella S. Evaluation and Treatment of Musculoskeletal Chest Pain. *Prim Care Clin Off Pract* . 2013;40(4):863-887. doi:10.1016/j.pop.2013.08.007
20. Bannister G, Amirfeyz R, Kelley S, Gargan M. Whiplash injury. *J Bone Joint Surg Br* . 2009;91(7):845-850. doi:10.1302/0301-620X.91B7.22639
21. Posthuma de Boer J, van Wulfften Palthe AFY, Stadhouder A, Bloemers FW. The Clay Shoveler's Fracture: A Case Report and Review of the Literature. *J Emerg Med* . 2016;51(3):292-297. doi:10.1016/j.jemermed.2016.03.020
22. Wyndaele JJ. SCIWORA. *Spinal Cord* . 2016;54(10):755-755. doi:10.1038/sc.2016.141
23. Segal DN, Grabel ZJ, Heller JG, et al. Epidemiology and treatment of central cord syndrome in the United States. *J Spine Surg* . 2018;4(4):712-716. doi:10.21037/jss.2018.11.02
24. Patel DR, Kinsella E. Evaluation and management of lower back pain in young athletes. *Transl Pediatr* . 2017;6(3):225-235. doi:10.21037/tp.2017.06.01
25. Longhino V, Bonora C, Sansone V. The management of sacral stress fractures: current concepts. *Clin Cases Miner Bone Metab* . 2011;8(3):19-23.
26. Kunam VK, Velayudhan V, Chaudhry ZA, Bobinski M, Smoker WRK, Reede DL. Incomplete Cord Syndromes: Clinical and Imaging Review. *RadioGraphics* . 2018;38(4):1201-1222. doi:10.1148/rq.2018170178
27. Nickerson EK, Sinha R. Vertebral osteomyelitis in adults: an update. *Br Med Bull* . 2016;117(1):121-138. doi:10.1093/bmb/ldw003
28. Shah SA, Saller J. Evaluation and Diagnosis of Back Pain in Children and Adolescents. *J Am Acad Orthop Surg* . 2016;24(1):37-45. doi:10.5435/JAAOS-D-14-00130
29. Babic M, Simpfendorfer CS. Infections of the Spine. *Infect Dis Clin North Am* . 2017;31(2):279-297. doi:10.1016/j.idc.2017.01.003
30. Low SY, Ong CWM, Hsueh P-R, Tambyah PA, Yeo TT. Neisseria gonorrhoeae paravertebral abscess: Case report. *J Neurosurg Spine* . 2012;17(1):93-97. doi:10.3171/2012.4.SPINE11914
31. Dodson SC, Koontz NA. Spinal Manifestations of Systemic Disease. *Radiol Clin North Am* . 2019;57(2):281-306. doi:10.1016/j.rcl.2018.10.005
32. Kenzaka T, Hida Y, Matsumoto M, Akita H. A case of epidemic myalgia with symptoms resembling acute purulent spondylitis and discitis. *BMC Musculoskelet Disord* . 2016;17(1):323. doi:10.1186/s12891-016-1181-x
33. Santos A, Cale E, Dacheux L, Bourhy H, Gouveia J, Vasconcelos P. Fatal case of imported human rabies in Amadora, Portugal, August 2011. *Euro Surveill Bull Eur Sur Mal Transm Eur Commun Dis Bull* . 2012;17(12).
34. Ibe U, Rehmani S, Jiwa N, Gega A. Return of the old guard: a case of tetanus in an unvaccinated patient. *BMJ Case Rep* . 2019;12(6):e229502. doi:10.1136/bcr-2019-229502
35. Messacar K, Schreiner TL, Van Haren K, et al. Acute flaccid myelitis: A clinical review of US cases 2012-2015. *Ann Neurol* . 2016;80(3):326-338. doi:10.1002/ana.24730

36. Orguc S, Arkun R. Primary Tumors of the Spine. *Semin Musculoskelet Radiol* . 2014;18(03):280-299. doi:10.1055/s-0034-1375570
37. Di Felice F, Zaina F, Donzelli S, Negrini S. Spontaneous and complete regeneration of a vertebra plana after surgical curettage of an eosinophilic granuloma. *Eur Spine J* . 2017;26(S1):225-228. doi:10.1007/s00586-017-5063-1
38. Camacho JE, Usmani MF, Ho C-Y, Sansur CA, Ludwig SC. Perineal and Radicular Pain Caused by Contralateral Sacral Nerve Root Schwannoma: Case Report and Review of Literature. *World Neurosurg* . 2019;129:210-215. doi:10.1016/j.wneu.2019.06.012
39. Saha A, Arevalo-Perez J, Peck KK, et al. Calcifying pseudoneoplasm of the spine: imaging and pathological features. *Neuroradiol J* . 2018;31(4):440-444. doi:10.1177/1971400916682511
40. Krasin E, Nirkin A, Issakov J, Rabau M, Meller I. Carcinoid Tumor of the Coccyx: Case Report and Review of the Literature. *Spine* . 2001;26(19):2165-2167.
41. Smith JK, Lury K, Castillo M. Imaging of Spinal and Spinal Cord Tumors. *Semin Roentgenol* . 2006;41(4):274-293. doi:10.1053/j.ro.2006.07.002
42. Theodore N. Degenerative Cervical Spondylosis. *N Engl J Med* . 2020;383(2):159-168. doi:10.1056/NEJMra2003558
43. Splendiani A, Bruno F, Marsecano C, et al. Modic I changes size increase from supine to standing MRI correlates with increase in pain intensity in standing position: uncovering the “biomechanical stress” and “active discopathy” theories in low back pain. *Eur Spine J Off Publ Eur Spine Soc Eur Spinal Deform Soc Eur Sect Cerv Spine Res Soc* . 2019;28(5):983-992. doi:10.1007/s00586-019-05974-7
44. Bagatur AE, Zorer G, Centel T. Natural history of paediatric intervertebral disc calcification. *Arch Orthop Trauma Surg* . 2001;121(10):601-603. doi:10.1007/s004020100297
45. Cohen SP. Epidemiology, Diagnosis, and Treatment of Neck Pain. *Mayo Clin Proc* . 2015;90(2):284-299. doi:10.1016/j.mayocp.2014.09.008
46. Erwin WM, Jackson PC, Homonko DA. Innervation of the human costovertebral joint: Implications for clinical back pain syndromes. *J Manipulative Physiol Ther* . 2000;23(6):395-403. doi:10.1067/mmt.2000.108144
47. Alonso F, Bryant E, Iwanaga J, Chapman JR, Oskouian RJ, Tubbs RS. Bastrup’s Disease: A Comprehensive Review of the Extant Literature. *World Neurosurg* . 2017;101:331-334. doi:10.1016/j.wneu.2017.02.004
48. Tripathi M, Rajmohan D, Quirk C, et al. Diffuse Idiopathic Skeletal Hyperostosis, Associated Morbidity, and Healthcare Utilization: A University Hospital Experience. *JCR J Clin Rheumatol* . 2020;26(3):104-108. doi:10.1097/RHU.0000000000000965
49. Cha TD, An HS. Cervical spine manifestations in patients with inflammatory arthritides. *Nat Rev Rheumatol* . 2013;9(7):423-432. doi:10.1038/nrrheum.2013.40
50. Estwanik JJ. Levator Scapulae Syndrome. *Phys Sportsmed* . 1989;17(10):57-68. doi:10.1080/00913847.1989.11709889
51. Saxena A, Chansoria M, Tomar G, Kumar A. Myofascial Pain Syndrome: An Overview. *J Pain Palliat Care Pharmacother* . 2015;29(1):16-21. doi:10.3109/15360288.2014.997853
52. Hammerstedt HS, Edlow JA, Cusick S. Emergency Department Presentations of Transverse Myelitis: Two Case Reports. *Ann Emerg Med* . 2005;46(3):256-259. doi:10.1016/j.annemergmed.2005.05.006

53. Kochany JZ, Tran ND, Sarria JE. Increasing Back and Radicular Pain 2 Years Following Intrathecal Pump Implantation with Review of Arachnoiditis. *Pain Med* . 2013;14(11):1658-1663. doi:10.1111/pme.12188
54. Firinu D, Garcia-Larsen V, Manconi PE, Del Giacco SR. SAPHO Syndrome: Current Developments and Approaches to Clinical Treatment. *Curr Rheumatol Rep* . 2016;18(6):35. doi:10.1007/s11926-016-0583-y
55. Pai V, Rochlani Y, Sahaya K. Back pain—an ominous harbinger of spinal cord infarction. *J Ark Med Soc* . 2014;111(7):134-135.
56. Peckham ME, Hutchins TA. Imaging of Vascular Disorders of the Spine. *Radiol Clin North Am* . 2019;57(2):307-318. doi:10.1016/j.rcl.2018.09.005
57. Han I-H. Pregnancy and spinal problems. *Curr Opin Obstet Gynecol* . 2010;22(6):477-481. doi:10.1097/GCO.0b013e3283404ea1
58. Okazaki T, Nakagawa H, Hayase H, et al. Idiopathic and Chronic Epidural Hematoma in the Lumbar Spine: A Case Report and Review of Literatures. *Neurol Med Chir (Tokyo)* . 2018;58(3):138-144. doi:10.2176/nmc.cr.2017-0052
59. Mentzel H-J, Neumann T, Fitzek C, Sauner D, Reichenbach JR, Kaiser WA. MR Imaging in Wegener granulomatosis of the spinal cord. *AJNR Am J Neuroradiol* . 2003;24(1):18-21.
60. Passias PG, Poorman GW, Jalai CM, et al. Incidence of Congenital Spinal Abnormalities Among Pediatric Patients and Their Association With Scoliosis and Systemic Anomalies. *J Pediatr Orthop* . 2019;39(8):e608. doi:10.1097/BPO.0000000000001066
61. Kahn EN, Muraszko KM, Maher CO. Prevalence of Chiari I Malformation and Syringomyelia. *Neurosurg Clin N Am* . 2015;26(4):501-507. doi:10.1016/j.nec.2015.06.006
62. Yousif S, Wood M. Minimally invasive resection of lumbosacral pseudojoint resulting in complete resolution of a lower back pain – A case report and review of Bertolotti syndrome. *J Clin Neurosci* . 2018;51:67-68. doi:10.1016/j.jocn.2018.02.006
63. Edmond SL, Werneke MW, Hart DL. Association Between Centralization, Depression, Somatization, and Disability Among Patients With Nonspecific Low Back Pain. *J Orthop Sports Phys Ther* . 2010;40(12):801-810. doi:10.2519/jospt.2010.3334
64. Mangham DC, Davie MW, Grimer RJ. Sarcoma arising in Paget's disease of bone: Declining incidence and increasing age at presentation. *Bone* . 2009;44(3):431-436. doi:10.1016/j.bone.2008.11.002
65. Oh H-M, Oh J, Kim K-T, Lee J. Osteomalacia as a Cause of Chronic Low Back and Buttock Pain. *Am J Phys Med Rehabil* . 2015;94(10). doi:10.1097/PHM.0000000000000343
66. Gil JA, Wawrzynski J, Waryasz GR. Orthopedic Manifestations of Ochronosis: Pathophysiology, Presentation, Diagnosis, and Management. *Am J Med* . 2016;129(5):536.e1-6. doi:10.1016/j.amjmed.2016.01.010
67. Baber Z, Erdek MA. Failed back surgery syndrome: current perspectives. *Journal of Pain Research*. doi:10.2147/JPR.S92776
68. Conforti A, Chiamulera C, Moretti U, Colcera S, Fumagalli G, Leone R. Musculoskeletal Adverse Drug Reactions: A Review of Literature and Data from ADR Spontaneous Reporting Databases. *Curr Drug Saf* . 2007;2(1):47-63. doi:10.2174/157488607779315516
69. Radwan W, Lucke-Wold B, Robadi IA, Gyure K, Roberts T, Bhatia S. Neurosarcoidosis: unusual presentations and considerations for diagnosis and management. *Postgrad Med J* . 2017;93(1101):401-405. doi:10.1136/postgradmedj-2016-134475
70. Gray GM, Tasso KH. Differential Diagnosis of Torticollis: A Case Report. *Pediatr Phys Ther* . 2009;21(4):369-374. doi:10.1097/PEP.0b013e3181beca44

71. Vermani E, Mittal R, Weeks A. Pelvic Girdle Pain and Low Back Pain in Pregnancy: A Review. *Pain Pract* . 2010;10(1):60-71. doi:10.1111/j.1533-2500.2009.00327.x
72. Ferreira GE, Machado GC, Oliver M, Maher CG. Limited evidence for screening for serious pathologies using red flags in patients with low back pain presenting to the emergency department. *Emerg Med Australas* . 2018;30(3):436-437. doi:10.1111/1742-6723.12984

Hosted file

table1.docx available at <https://authorea.com/users/404950/articles/709788-narrative-review-a-quick-and-comprehensive-guide-to-differential-diagnosis-of-neck-and-back-pain-a-narrative-review>