



A Quick and Comprehensive Guide to Differential Diagnosis of Neck and Back Pain: a Narrative Review

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Abstract

The list of diagnostic options when approaching a patient with axial pain is impressively complex. Many offer limited diagnostic workups, but we could not find a truly comprehensive diagnostic guide to assist in the diagnostic evaluation. In this short paper, we briefly described a long list of medical conditions, each of which can manifest as back or neck pain, and whose prevalence ranges from common to very rare. We then proposed an algorithm for classifying them into subgroups. Further referral to diagnostic tests and specialist consultations, after assignment to one of those subgroups, could save time and unnecessary tests. We believe that this review and the proposed diagnostic algorithm can be valuable for medical education and for use in the primary care setting for the diagnostic evaluation of any type of back or neck pain in all patient groups.

Keywords Back pain · Neck pain · Radiculopathy · Differential diagnosis · Workup · Diagnostic tests · Classification

Introduction

Neck and back pain is extremely common complaints in orthopedic, pediatric, emergency, and general medical practice [1]. The range of differential diagnosis for neck and back pain is enormous and even an experienced physician will often find it difficult to make a correct diagnosis without a systematic approach. While common diagnoses like a lateral lumbar disc herniation are easily recognizable based on history and physical examination and can be differentiated from a tumor or gouty tophus, or other pathologies that may compress a nerve root, with magnetic resonance imaging, the diagnosis of rarer disorders is more difficult. For example, fungal infections of the spine are almost always diagnosed

with a delay which invariably reduces the chances of a good outcome [2]. An exhaustive 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.

This article describes a useful method for sorting possible etiologic causes according to a short list of simple clinical criteria. Our goal is to create a kind of a roadmap to facilitate the navigation between long lists of diagnoses and the corresponding standard tests and imaging studies to confirm or exclude them. Brief definitions are provided for each disorder in order to provide a “bird’s-eye view,” rather than an in-depth description of multiple pathologies.

Several recent publications address 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, such as suspicion or history of cancer (spinal cancer), intravenous drug use, indwelling vascular catheter, and other infection site (epidural abscess) [3], suggesting more severe pathology [1]. However, the reliability and predictive value of red flags in the diagnosis of severe back pain etiologies has recently been questioned [3]. The approach to pain in the cervical and thoracic spine is addressed in individual publications, but it is mostly extrapolated from the literature on low back pain. This tendency to evaluate different parts of the spine in isolation may carry some risk, as focusing on one anatomical

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part may mislead physicians and cause them to neglect other parts. This review describes a comprehensive and practical systematic approach to diagnosing a patient with spinal complaints.

Literature Review

Referred Pain

Referred pain is characterized by the absence of local signs and tenderness on palpation and motion of the affected region [4, 5]. 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]. 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. *Aortic aneurysm dissection* can cause thoracic or lumbar pain that develops suddenly or gradually. Signs of ischemic shock or tachycardia are not always immediately apparent and weak or absent pulses in the upper or lower extremities may be the first early sign. A *pulmonary embolism* can cause the sudden appearance of thoracic back pain as well as *pulmonary bulla*, *pleuritis*, *pneumothorax*, and *empyema*. *Lung cancer* especially that expands to the posterior thorax can cause thoracic back pain. Intra-abdominal pathologies, such as *pancreatic cancer* with or without bone *metastases*, can cause lumbar back pain that usually radiates to the abdomen as a “belt”. *Posterior perforation of a peptic ulcer* can cause the sudden appearance of back pain and the gradual development of signs of sepsis. *Renal pathologies* 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* such as *endometriosis* and menstrual cramps can also cause back pain. *Brain stem tumors* can present as neck pain with or without neurological abnormalities or gait abnormalities. *Inflammation of the sacroiliac joint* can cause poorly localized buttock pain that can be confused with lumbar pain and sometimes even be accompanied by radiating pain to the thigh and leg with neurological manifestations due to involvement of the lumbosacral plexus.

Trauma and Overuse

In cases of *traumatic fracture*, *dislocation*, or *ligamentous tear*, the history of traumatic injury is not always obvious if the patient is unconscious, demented, psychotic, under the influence of alcohol or drugs, or is a nonverbal child. In contrast, a history of trauma does not necessarily mean that the pain has a traumatic etiology, and can be a “red herring” distracting from the true cause. *Strains* and *sprains*

of the spine are defined as low-energy injury, overuse, or stretching of muscles or tendons and ligaments. *Whiplash injury* is well described and can lead to neck and back pain [7]. 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. *SCIWORA* (spinal cord injury without radiographic abnormality) is a syndrome of traumatic injury/myelopathy without radiological findings that was described in the 1970s' [8] and was revealed as being a contusion of the spinal cord by magnetic resonance imaging (MRI). *Central cord syndrome* is caused by hyperextension of the neck which compresses the spinal cord and can occur even without prior spondylosis and narrowing of the spinal canal. It is manifested by muscle weakness that is greater in the upper extremities, as well as by urinary retention and various sensory abnormalities. *Pathological fractures* due to osteoporosis, infection, or a tumor can appear without injury or after only a minor trauma. *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.” *Stress fractures of the sacrum* appear in osteoporotic patients and may be responsible for low back pain. *Apophysitis of the vertebra* (*Scheuermann's disease/osteochondrosis*) appears 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 [9]. Neurological abnormalities are rare. *Brown-Sequard syndrome* is caused by injury to a hemicord which 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.

Infection

Osteomyelitis and/or *discitis* cause a sudden or gradual appearance of back pain which can be at different levels and vary in severity 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. In children, *spondylodiscitis* can present with gait abnormalities or abdominal pain without back pain. 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. A *paraspinal abscess* can cause prolonged fever even without pain, or pain that radiates to the groin along the psoas muscle. *Fungal infections* of the spine most often occur in immunosuppressed patients and cause back pain with various neurological abnormalities due to cord or nerve root compression [2]. *Brucellosis* causes a systemic illness with fever and

muscle and bone pain, including spinal involvement with micro abscesses of the vertebra. *Gonorrhoea* can cause meningitis of the cord, especially in immunosuppressed individuals. *Syphilis* causes *Charcot arthropathy* of the spine and (rarely) a *gumma* in the spinal canal that can compress the cord or the nerve roots [10]. *Tuberculosis* of the spine causes a slowly progressing illness, back pains, and deformity with various neurological abnormalities. *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. *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*]). Various viral diseases, such as *influenza*, can cause back and bone pain that might appear before the fever and other systemic signs. *COVID-19* can cause lumbar pain in acute and *post-covid* infection [11]. A *Coxsackie-B virus infection* causes severe chest and back pain (“devil’s grip”) [12] *Poliomyelitis*, *tetanus*, and *rabies* can also cause back pain and should be considered. *Acute flaccid myelitis* causes fever and neck and back pain with flaccid motor paralysis of various severities; with minimal sensory symptoms, cranial nerve involvement is possible [13].

Tumor

Benign tumors of the spine, such as *osteoid osteoma* or *osteoblastoma*, may cause back pain which may gradually worsen over time. The pain is not dependent upon activity, and the characteristic night pain may be present [14]. *Eosinophilic granuloma* and *Langerhans histiocytosis* may cause back pain with “*vertebra plana*” findings on imaging studies [15]. Tumors of neural tissue, such as *schwannomas*, may cause radiculopathic pain. *Calcifying-pseudoneoplasm of the spine* (“CAPNON”) is a benign slow growing tumor that can produce mass effect [16] causing weakness and gait problems. *Meningioma* can have almost similar clinical presentation and appearance on imaging. *Chordoma* is the most common tumor of the sacrococcygeal region [17]. 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. Tumors of hematopoietic tissue, such as *lymphoma* or *multiple myeloma*, are not rare.

Degenerative, Rheumatic, and Autoimmune

Intervertebral disc degeneration and *herniation* can cause back or neck pain with radiculopathic pain in the extremities, sometimes without any axial pain whatsoever. *Piriformis syndrome*, which causes sciatic symptoms without back

pain, should be excluded. Nociceptive nerve fibers in the disc which become sensitized by cytokines in the degenerative disc cause “pure discogenic” pain [18]. In adolescents disc herniation can be associated with *separation of the apophyseal ring*. [19] Non-specific back pain that worsens on standing is related to Modic I changes in the end plate (“*active discopathy*”) [20]. *Pediatric disc calcification* causes a self-limiting neck or back pain [21]. Symmetrical buttock pain with perianal hypoesthesia, with or without sphincter weakness, suggests a *cauda equina syndrome* and requires urgent intervention [6]. *Stenosis of the lumbar spinal canal* will cause back and buttock pain during ambulation that may worsen and cause claudication. *Stenosis of the cervical spinal canal* can cause *cervical myelopathy* with typical ataxia [22]. *Degeneration of the facet joints* causes “mechanical” pain on standing, walking, and physical effort. An “*active*” *osteophyte* can appear at every vertebral level, but most commonly in the lumbar spine, and it causes flank pain that increases with movement and is aggravated by nighttime movement. It may be easily diagnosed with a technetium bone scan. *Spondylolisthesis* and *spinal instability* will cause mechanical back pain. *Costovertebral joint problems* (most often osteoarthritis) will cause localized pain that worsens with movement, coughing, and deep breathing [23]. *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 [24]. *Diffuse idiopathic skeletal hyperostosis* can be asymptomatic or cause back and neck pain [25]. “*Crowned dens syndrome*” is caused by the deposition of calcium pyrophosphate dehydrate crystals around the odontoid process and is manifested by severe neck pain and stiffness [26]. *Spondyloarthropathies*, such as *ankylosing spondylitis* or *psoriatic arthritis*, will cause axial back or neck pain often involving the sacroiliac joints as well. There is typical night pain with prolonged morning stiffness that is relieved by non-steroidal anti-inflammatory drugs. *Reactive arthritis* tends to affect the spine less but can cause inflammation of the vertebrae and intervertebral joints. *Behcet’s disease* rarely involves the spine and can cause myelitis and vasculitis of the cord. 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 [27]. SLE can cause myelitis and vasculitis of the cord as well as atlantoaxial subluxation/dislocation [28]. *Gout* can affect the spine at any level, destroying the facet joints and causing hypointense lesions of the gout tophi that are visible in the extradural space on T1-weighted MRI [10]. 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 [29]. *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 other than local tenderness at known trigger points. *Myofascial pain syndrome* resembles fibromyalgia, but palpable tender and stiff trigger points are found in the muscles and fasciae. *Polymyalgia rheumatica* presents with neck, shoulder girdle, and hip pain, especially in the morning, accompanied by low fever, fatigue, and malaise. Erythrocyte sedimentation rate (ESR) and C-reactive protein (CRP) levels may be elevated, unlike in fibromyalgia. *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 [30]. *Arachnoiditis* is a chronic inflammation of the arachnoid sheath caused by misplaced subdural injection of steroids or contrast medium after spinal surgery as by various infectious agents. It can be asymptomatic and detected incidentally by MRI but can also cause severe chronic back pain when standing up and sitting down with various neurological abnormalities associated with nerve root or cauda compression [31]. *Synovitis, Acne, pustulosis, hyperostosis, and osteitis (SAPHO) syndrome* can affect the vertebrae and discs and cause the thickening of the paravertebral tissues [32].

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 [33]. 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 [34]. 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 [35]. 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 [36]. *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 [37]. Other vasculitides may also affect the spine.

Congenital/Developmental

Congenital malformations, such as *hemivertebra* and *block vertebra*, cause deformation of the spine with or without pain. If pain is present, it is usually mechanical pain caused by degenerative changes in adjacent segments. *Syrinx* 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 [38]. *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. *Bertolotti syndrome* (lumbosacral transitional vertebra) is a congenital pseudarthrosis of a transverse process of L5 with the ileum or the sacrum [39]. 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* [40]. 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. *Hyperparathyroidism* and *renal osteodystrophy* can cause pain due to spinal involvement, pathological fractures, and development of a “brown tumor.” *Osteomalacia* causes generalized skeletal pain, especially of the back and pelvis [41]. *Ochronosis* causes disc calcifications and herniation with generalized and advanced arthritic changes [42].

Iatrogenic

Failed back syndrome is a syndrome of chronic back pain after surgery that was intended to treat back pain caused by various causes but did not result in improvement [43]. 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 [43]. Several *medications* can cause back pain, for example: statins, bisphosphonates (especially resindronate), aromatase inhibitors, isotretinoin, and carvedilol [44].

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 [45]. *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 must be differentiated from *congenital torticollis* due to obstetric trauma to the sternocleidomastoid muscle [46].

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 [14] and hemangiomas [35]. However, majority of pregnant women experience either the pelvic girdle pain or the *pregnancy-related low-back pain* [47]. 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.

Method

At the first encounter with a patient in the clinic, the physician has several simple diagnostic tools at his disposal. According to our experience, based on the history, physical examination, and simple laboratory and imaging data, it is often possible to make a clear diagnosis or at least determine the direction and assign the patient to one or another category, which will facilitate further investigation. We wanted to pass on this knowledge and experience to physicians less experienced in this field, but we believe that even the experienced orthopedist or rheumatologist can

benefit from a systematic and well-organized approach. 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) These clinical groups or syndromes are often easily recognizable as early as history taking and the initial physical examination of the patient. For didactic reasons, we put the category of referred pain first because physicians tend not to think about diagnoses that are not part of their specialty:

- (i) *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.
- (ii) *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.
- (iii) *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. The presence of F-waves in neurophysiological studies can confirm the diagnosis and severity of radiculopathy and whether the radicular damage is acute or chronic. The presence of F-waves may be seen in polyneuropathies. Needle electromyography also has diagnostic utility for radiculopathy [48].
- (iv) *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.
- (v) *Mechanical pain.* This refers to pain that depends upon movement and effort and is relieved by rest and recumbency. A precise diagnosis can usually be achieved by careful history taking, physical examination, and plain films. A CT scan may sometimes be needed to improve detail.

Table 1 Division of neck and back pain into 7 groups according to clinical, laboratory, and imaging criteria

	1. Referred pain 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
MI	Osteomyelitis	Herriated disc	Fracture/dislocation	Fracture/dislocation	Fracture/dislocation	Spondyloarthropathies	Tumor
Aortic aneurysm	Discitis	Posterior apophyseal ring fracture	Pathological fracture	Pathological fracture	Strain/spRAIN	Crowned dens syndrome	Paget's disease
PE	Pediatric spondylodiscitis	Pediatric disc calcification	Herniated disc	Herniated disc	Whiplash	Rheumatoid arthritis	Herpes zoster/zoster sine herpette
Bulla	Epidural abscess	Tumor	Calcifying pseudoneoplasm	Herniated disc	Ligamentous injury	Other rheumatic diseases	Whiplash
Pleuritis	Paraspinal abscess	Facet joint disease	Spinal gout	Posterior apophyseal ring fracture	Pathological fracture	Polymyalgia rheumatica	Costo-vertebral joint disease
Pneumothorax	Failed back syndrome	AVM	Aggressive spinal hemangioma	Pediatric disc calcification	Posterior apophyseal ring fracture	DISH	Drug induced (see text)
Other lung and pleura pathologies	Fungal infection	Failed back syndrome	Arachnoiditis	Cauda equina syndrome	Pediatric disc calcification	DISH	Fibromyalgia
Perforated DU	Brucellosis	Arachnoiditis	Syphilis	Spinal stenosis	Non-specific back pain	DISH	Myofascial pain
Renal colic	Tuberculosis	Piriformis syndrome	Ochronosis	Central cord syndrome	Spinal stenosis	DISH	Psychogenic pain
Glomerulonephritis	Gonorrhea	Ochronosis		/SCIWORA	DISH	DISH	/malingering
tis/Pyelonephritis	Syphilis			Tumor	Failed back syndrome		Periscapular bursitis
Renal infarction	Influenza			Calcifying pseudoneoplasm	Failed back syndrome		/levator scapula syndrome
Carcinoma of lung	COVID-19			Spinal gout	Central cord syndrome		/rheumatoid
Carcinoma of pancreas	Acute flaccid myelitis			Transverse myelitis	SCIWORA		Failed back syndrome/
Brain stem tumor	Other infections (see text)			Infarction	Stress fracture		intraspinous fibrosis
				AVM	Aggressive spinal hemangioma		Torticollis
				Aggressive spinal hemangioma	Epidural/subdural hematoma		Renal osteodystrophy
				Epidural/subdural hematoma	Active osteophyte		/hyperparathyroidism
				Syrinx	Bertolotti syndrome		Syphilis
				Brown-Sequard syndrome	Baastrop syndrome		Arachnoiditis
				Syphilis	Torticollis		Osteomalacia
				Arachnoiditis	Syphilis		Sarcoidosis
				Chiari malformations	Pregnancy		Congenital anomalies
				Hydatid cyst	Ochronosis		Ochronosis
				Wegener granulomatosis			
				Ochronosis			
				Acute flaccid myelitis			

Table 1 (continued)

1. Referred pain 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
Diagnostic tool: Radiography of chest or abdomen; electrocardiogram, etc	Diagnostic tool: Hemogram, CRP (c reactive protein), ESR (erythrocyte sedimentation rate), cultures, serum antibodies (Brucella, tuberculosis, gonorrhea, syphilis, influenza) etc	Diagnostic tool: Radiography, MRI (magnetic resonance imaging), neurophysiology studies	Diagnostic tool: CT (computed tomography) scan, MRI (magnetic resonance imaging)	Diagnostic tool: Radiography, MRI (magnetic resonance imaging), CT (computed tomography) scan	Diagnostic tool: Rheumatic antibodies	Diagnostic tool: Radiography, CT (computed tomography) scan

DISH, diffuse idiopathic skeletal hyperostosis; *SCIWORA*, spinal cord injury without radiographic abnormality; *AVM*, arteriovenous malformation; *MI*, myocardial infarction; *PE*, pulmonary embolism; *DU*, duodenal ulcer; *COVID-19*, coronavirus disease 2019

- (vi) *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 known diagnostic criteria for each rheumatic disorder. Plain films of the hands can often differentiate between various rheumatologic disorders, such as RA, osteoarthritis, and gout arthropathy.
- (vii) *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 primary care [3, 49]. 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 selected 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 [50].

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 [6].

We find the above diagnostic approaches to back pain useful and effective guides for the workup of low back pain. They aim to avoid overlooking an important pathology in

a patient with low back pain, and useful for the work of a primary care physician which does not need to make a definitive diagnosis, but not comprehensive enough for a musculoskeletal specialist. 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, 6]) 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 diagnose the underlying pathology with the minimum number of diagnostic tests and referrals.

Author Contribution EK: conceptualization, methodology, writing; HS: methodology, writing; NS: methodology, writing; AT: methodology, writing; EB: methodology, writing.

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Declarations

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