How not to miss major spinal pathology in neck pain

Neck pain is a common complaint in primary and secondary care with up to 39% of adults experiencing neck pain in their life (Fejer et al, 2006). Although major spinal pathology is rare, delayed or missed diagnosis can lead to secondary neurological sequelae causing severe morbidity, mortality and serious medicolegal consequences.

This article provides an overview of clinical assessment, differential diagnoses and key management steps in patients with atraumatic disease related to the cervical spine.

For the purpose of this article, common atraumatic spinal pathology has been divided into:

1. Infective causes
2. Malignant causes
3. Degenerative causes
4. Complications of rheumatoid arthritis.

Table 1. Red flags for major spinal pathology

Age <20 years or >50 years
Night sweats, fevers, chills
Non-mechanical pain
Night pain
Thoracic pain
Immunosuppression
Severe neurological deficit or progressive neurological deficit
Sphincter disturbance (bladder or bowels)
History of malignancy
High energy trauma or spinal deformity (not discussed in this article)
Significant trauma or deformity (not discussed in this article)

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History and examination

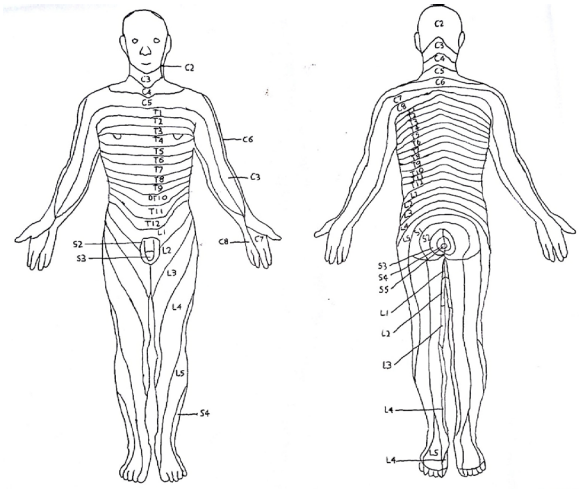
A thorough history and physical examination of patients presenting with neck pain is vital in identifying serious pathology. A focused history is critical in eliciting 'red flag' symptoms and signs which may indicate major spinal pathology (*Table 1*).

When examining the spine, the clinician should use a 'look, feel, move and special test' system as for any joint examination. A comprehensive spinal examination must include a thorough neurological and per rectal examination.

The neurological exam should follow an approach of 'tone, power, reflexes, coordination and sensation'. Light touch and pin prick (most sensitive) must be assessed in all dermatomes with power tested in a myotomal distribution and graded using the MRC (Medical Research Council) scale (*Figure 1*).

The rectal examination is critical in identifying a patient who may have cord compromise. Clinicians must assess for peri-anal sensation with pin prick and assess both resting and active external anal sphincter tone.

Hoffman's reflex is a special test to identify cervical spinal cord compression, performed by flicking the nail of the middle finger. A



MRC (Medical Research Council) scale for muscle power
0 – no movement
1 – flicker of activity
2 – active movement with gravity removed
3 – active movement that can overcome gravity
4 – active movement against resistance
5 – normal muscle strength

Upper limb myotomes	
Shoulder abduction	C5
Elbow flexion	C5–6
Elbow extension	C7
Wrist flexion	C8
Wrist extension	C7
Finger flexion	C8
Finger extension	C7
Finger abduction	T1

Lower limb myotomes	
Hip flexion	L1–2
Hip extension	L5–S1
Knee flexion	L5–S1
Knee extension	L3–4
Ankle plantarflexion	S1–2
Ankle dorsiflexion	L5
Toe extension	L5

Reflexes	
Biceps	C5
Supinator	C6
Triceps	C7
Knee	L3–4
Ankle	S1–2

Figure 1. Dermatomes, myotomes and Medical Research Council (MRC) grading system for power. From Bowden (2013).

reflex contraction of the ipsilateral thumb and/or index finger is considered positive for cervical cord impingement. Hoffman's reflex is 58% sensitive and 78% specific, thus a negative test does not rule out cord compromise (Glaser et al, 2001).

In secondary care clinicians are advised to complete an American Spinal Injury Association chart with all of the information obtained from the examination, providing a reference for any change in neurological deficit (www.asia-spinalinjury.org).

Infective causes

Although infections of the spine are uncommon, their destructive nature means that they must be diagnosed and treated expeditiously to prevent sepsis, spinal instability and neurological compromise. Pyogenic spondylitis covers a range of infectious processes including spondylodiscitis, vertebral osteomyelitis and epidural abscess (Cheung and Luk, 2012).

Discitis is an infection of the intervertebral disc commonly caused by haematogenous spread from the head and neck, respiratory, gastrointestinal or genitourinary tracts. Typically the disc and the adjacent vertebra are affected as a result of their shared segmental arterial supply. Around 50% of infections are caused by staphylococcal or streptococcal infections. In intravenous drug users Gram-negative bacilli are more frequent causes (Cheung and Luk, 2012).

Infections can spread into adjacent bone causing osteomyelitis and bony destruction. Infection may also travel posteriorly into the spinal canal causing an epidural abscess which may compress the spinal cord with associated neurological signs. Soft tissue collections can also occur anteriorly and are classical for tuberculous vertebral osteomyelitis which should be considered in at-risk patients (*Figure 2*).

Risk factors to elicit in the history include recent spinal instrumentation, recent infections, immunosuppression such as HIV or long-term steroid use, diabetes mellitus, intravenous drug use and age >50 years old.

Symptoms

- Insidious onset
- Localized spinal pain
- Pyrexia
- Night pain
- Weight loss, fatigue.

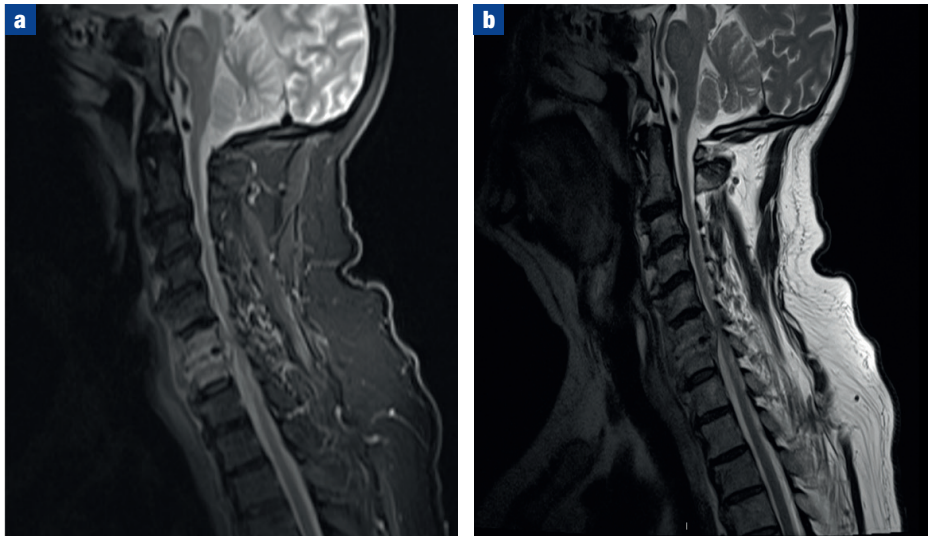


Figure 2. Magnetic resonance imaging sequences revealing C6/7 discitis, vertebral osteomyelitis and anterior epidural abscess. **a.** Sagittal STIR sequence. **b.** Sagittal T2-weighted image.

Signs

- Spinal tenderness on palpation
- Neurological signs (by bony compression following destruction or epidural abscess formation).

Investigations

Laboratory tests

Erythrocyte sedimentation rate and C-reactive protein are sensitive indicators of bacterial infection and are positive in over 90% of spinal infections (Cheung and Luk, 2012).

Full tests should include white cell count, erythrocyte sedimentation rate, C-reactive protein and blood cultures (positive 25–59% of the time) (Cheung and Luk, 2012).

Imaging

Plain radiographs should be performed to identify bony destruction and mal-alignment. Early changes of osteomyelitis include loss of disc height and blurring of vertebral end plates, but these changes may only manifest on radiographs 2–8 weeks later.

Magnetic resonance imaging is the gold standard imaging modality for spinal infections, allowing early identification of infectious changes and soft tissue collections (Hopkinson and Patel, 2016). Magnetic resonance imaging should be performed urgently to expedite treatment.

Given that the likely cause is haematogenous spread, the source should be identified. Further investigation may require urinalysis and culture, sputum culture, a chest radiograph and occasionally echocardiography.

Treatment

Antibiotics form the mainstay of treatment in spinal infections without neurological deficit.

Where there is a strong clinical diagnosis of spinal infection with a suitable history, positive blood cultures and compatible laboratory results, parenteral antibiotics can be initiated.

A definitive diagnosis can only be made with histological and bacterial culture of infected tissues. In patients where the clinical diagnosis is in doubt, an image-guided biopsy should be considered before starting antibiotic therapy to confirm diagnosis and allow more focussed antibiotic therapy (Hopkinson and Patel, 2016). Delay in treatment must be considered against the risk of sepsis on an individual basis. Close liaison with microbiologists is vital since the optimum duration and route of administration of antibiotics remains unclear.

In a patient presenting with neurological deficit secondary to spinal cord infections, expedited surgical intervention is warranted. The type of surgery undertaken will depend on the cause of cord compression – either bony compression or abscess formation. Surgery aims to relieve pressure on the spinal cord and obtain tissue samples for microbiology allowing targeted antimicrobial therapy.

Metastatic spinal cord compression and cancer

Metastatic disease is the most common neoplasia of the spine; primary spinal malignancies are rare. The cervical spine is

involved in between 8 and 20% of metastases to the spine (Molina et al, 2012). The age at presentation is generally between 40 and 60 years old.

Common metastasizing cancers to the cervical spine include breast, prostate, non-small cell lung and renal cancer. It has been suggested that infiltration is mainly the result of direct invasion, haematogenous spread or CSF seeding (Molina et al, 2012).

Direct invasion of the tumour or surrounding oedema may lead to metastatic spinal cord compression with neurological signs (*Figure 3*). This is an oncological emergency and requires prompt diagnosis and treatment to reduce morbidity and mortality.

Symptoms

- Localized non-mechanical pain
- Spinal pain exacerbated by straining, for example coughing
- Night pain
- Weight loss.

Signs

- Neurological dysfunction
- Localized spinal tenderness.

Investigation

Laboratory tests

- Oncological markers should be tested: prostate-specific antigen, Ca125, Ca 15-3, TTF-1, myeloma screen and bone profile
- Magnetic resonance imaging of the whole spine for metastatic cord compression should be performed within 24 hours as per National Institute for Health and Care Excellence (2008) guidelines.
- Magnetic resonance imaging of the whole spine should be performed within 1 week for spinal pain suggestive of spinal metastases with no neurology (National Institute for Health and Care Excellence, 2008).
- A computed tomography scan of the chest, abdomen, pelvis and spine should be performed to identify a primary malignancy, if unknown, and to assess bony stability.

Treatment

Early recognition and treatment of neurological dysfunction caused by metastatic spinal cord compression is vital, as preoperative function is the most important prognostic factor in recovery of neurological deficit. Administration of corticosteroids such as dexamethasone reduces intramedullary oedema and compression of the spinal cord. High dose steroids (96 mg) do not significantly change outcomes compared to low dose (16 mg) (Molina et al, 2012). National Institute for Health and Care Excellence (2008) recommends doses of 16 mg daily with regular blood glucose monitoring and gastric protection. Urgent discussion should also be undertaken with a metastatic spinal cord compression spinal service for consideration of spinal decompression or debulking of tumour. Radiotherapy is often used as an adjunctive therapy to help with debulking. If vertebral instability or collapse occurs vertebroplasty, kyphoplasty or fusion may be required.

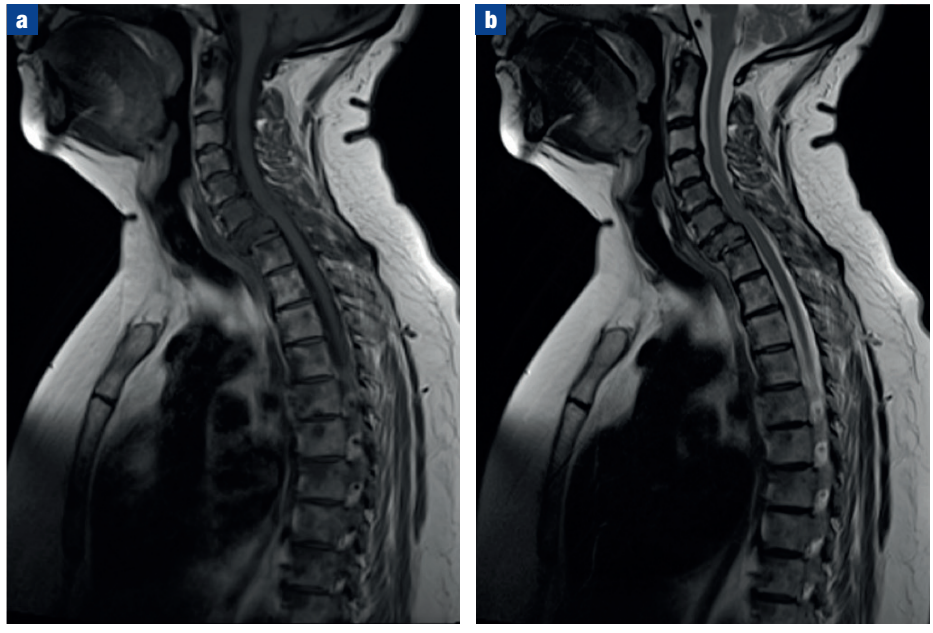


Figure 3. Magnetic resonance imaging showing widespread bony metastases from breast cancer in both cervical and thoracic spine with collapse and infiltration of C7 along with cord compression. **a.** Sagittal T1-weighted. **b.** Sagittal T2-weighted.

Degenerative cervical disease

Cervical spondylosis is the degeneration of cervical vertebrae and associated discs. In the UK 90% of 60-year-olds will have some degree of cervical spondylosis with varying severity of symptoms (NHS Choices, 2017).

Several risk factors have been implicated in the development of cervical spondylosis including age, previous trauma to the neck, genetics, smoking, lack of exercise, obesity and occupational risk, e.g. overhead work (Felson et al, 2000).

Severe cervical spondylosis can affect the vertebra, intervertebral discs, facet joints and associated ligaments. Degeneration of these structures along with osteophyte production, ligamentous hypertrophy and disc herniation may cause impingement of nerves. This may manifest as radiculopathy (compression of a nerve root) or even myelopathy (compression of the spinal cord).

The normal diameter of the cervical spinal canal is between 17 and 18 mm. When this diameter falls below 12–14 mm myelopathic symptoms may present. Myelopathy is more common in men and is often multi-level, commonly occurring at C5–C6 (Ayub and Anwar, 2015).

Symptoms

- Insidious onset
- Progressive symptoms
- Neck stiffness
- Headaches (pain radiating from back of the head to the forehead)
- Neurological symptoms: paraesthesia and/or weakness in upper limbs, reduced grasping power and loss of fine motor skills.

Signs

- Decreased range of movement in neck
- Atrophic musculature
- Hyper-reflexia
- Reduced power and sensation in upper limbs.

Imaging

It is important to note that radiological changes may not strongly correlate with clinical findings (Singh et al, 2014).

Plain radiographs enable assessment of bony congruity, osteophyte production and loss of disc height, but provide little information on encroachment of spinal cord.

If a patient presents with neurological deficit, further imaging (magnetic resonance imaging) is warranted. The North American Spine Society recommends magnetic resonance imaging as the first-line investigation in patients with objective neurological signs (Bono et al, 2011).

Nerve conduction studies or electromyography are useful if a peripheral nerve lesion or disease is suspected.

Treatment

Conservative management forms the main treatment of simple spondylosis (National Institute for Health and Care Excellence, 2015). Analgesics and anti-inflammatories can be used in accordance with the World Health Organization pain ladder. Additionally, neuropathic analgesics such as gabapentin may help along with specialist referral to a pain clinic. Activity modification is also beneficial along with avoiding aggravating movements. Patients can be referred to physiotherapy for strengthening and stretching of neck muscles. Long-term use of neck collars or braces should be avoided as symptoms can be exacerbated. Epidural steroid injections containing methylprednisolone produce short-term relief of symptoms and are a useful adjunct in conservative management (Caridi et al, 2011).

Surgery is reserved for patients (8–33%) who have persistent pain combined with objective neurological deficit (Williams and Hoving, 2004) and should be referred early to a spinal surgeon. Compression is often progressive and delayed intervention can lead to irreversible spinal cord injury with permanent loss of function. Surgical options include cervical discectomy, laminectomy and laminoplasty with newer techniques including prosthetic intervertebral disc replacement.

Complications of rheumatoid arthritis of the cervical spine

The cervical spine can be affected in up to 80% of patients with rheumatoid arthritis (Nguyen et al, 2004). Destructive synovitis of the cervical joints leads to ligamentous laxity and bony destruction causing instability. Atlanto-axial instability, subluxation of the C1 vertebrae on C2, is the most common. Instabilities may present as neck pain with or without neurological signs and rarely sudden death as a result of severe compression of the spinal cord or vertebral vasculature (Nguyen et al, 2004). Thus a high index of suspicion is required for cervical pathology in rheumatoid patients presenting with neck pain.

Symptoms

- Neck pain
- Decreased range of motion in neck
- Upper and/or lower limb weakness or paraesthesia
- Bladder and bowel dysfunction
- Headaches
- Dizziness
- Dysarthria.

Signs

- Hyper-reflexia
- Ataxic gait
- Reduced power or sensation in upper and lower limbs.

Investigations

Check for multi-organ effects of rheumatoid arthritis and medication: white cell count, haemoglobin, C-reactive protein, erythrocyte sedimentation rate, urea and electrolytes, liver function tests, rheumatoid factor, anti-CCP antibodies.

Plain radiographs allow evaluation of the rheumatoid cervical spine. Standard anteroposterior and lateral radiographs should be obtained as well as flexion and extension views to demonstrate instability.

Magnetic resonance imaging should be obtained in all patients exhibiting neurological signs and allows visualization of the spinal cord and destructive pannus (*Figure 4*).

Treatment

Patients exhibiting mild instability or no neurological symptoms may be managed conservatively with rigorous control of rheumatoid disease using anti-inflammatories, steroids and disease-modifying agents. Early therapy with disease-modifying agents can reduce the rate of early instability and overall prevalence of instabilities (Silber et al, 2006), meaning that patients nowadays rarely progress to advanced spinal disease. Physiotherapy helps to maintain strength of neck muscles and facet joint injections can be used selectively.

Figure 4. Sagittal T2-weighted magnetic resonance imaging showing cervical myelopathy as a result of spondylitis at C3–5 levels. Previous anterior cervical discectomy and fusion can be noted at levels C6/7.

Patients demonstrating significant instability or objective cord compression should be considered for urgent surgery to prevent progression. Surgical options include odontoidectomy and posterior cervical fusion with spinal cord decompression.

If a rheumatoid patient is to undergo surgery of any kind requiring intubation, the responsible anaesthetist must be informed in advance to allow adequate time for pre-assessment because of the risk of instability and rarely death on positioning of the neck. Plain cervical radiographs should be considered for all rheumatoid patients to act as a screening tool if there is no previous diagnosis of cervical spine involvement or to assess progression of known cervical spine disease.

Conclusions

Timely and accurate diagnosis of major cervical spine pathology is critical in preventing patient morbidity and mortality related to irreversible secondary neurological sequelae. Completing a focussed yet thorough history and examination will enable clinicians to identify red flag signs and symptoms to ensure serious pathology is not missed. Appropriate imaging and investigations should be undertaken promptly to aid diagnosis. Patients with major cervical spine pathology must be referred urgently to specialist spinal centres, through agreed local and national pathways, to ensure early treatment of pathology. BJHM

KEY POINTS

- Neck pain is commonly caused by cervical spondylosis. Major pathology in neck pain in rare.
- A thorough history and examination including neurological and per rectal examinations is key in identifying 'red flag' symptoms and signs which may indicate serious pathology.
- Early identification and treatment of major spinal pathology is key in preventing irreversible neurological compromise.
- The cervical spine is commonly affected in rheumatoid patients. This should be imaged before any type of surgery, with the anaesthetist involved early in the care of these patients.
- Urgent referral of patients with major spinal pathology to specialist spinal centres through agreed local and national pathways is critical in preserving function and reducing morbidity and mortality.

Conflict of interest: none.

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