Back pain in children and adolescents

The causes of back pain in childhood and adolescence vary from the trivial to the life threatening. A thorough history and examination – along with the use of appropriate investigations – will elucidate the cause in most situations.

ANGUS J. GRAY
MB BS, FRACS(Orth)

Dr Gray is Head, Department of Orthopaedics, Sydney Children's Hospital, and a Visiting Medical Officer, Prince of Wales Private and Mater Misericordiae Hospitals, Sydney, NSW.

Back pain is rare in children under the age of 10 years, but up to 60% of teenagers report having back pain at some stage. Most do not seek medical attention because symptoms are rarely severe enough, and those who do present are frequently found to not have an identifiable cause.

Back pain in children (or adults) may be classified simply as 'evil' or 'innocent'. Evil pain is caused by conditions that, if not diagnosed and treated, progress to cause significant disability, morbidity or even death (e.g. tumours, infection, processes causing spinal cord or nerve root compression) and need to be considered during the evaluation of any patient. Innocent back pain includes the nonspecific ache or sprain, spondylolysis and Scheuermann's kyphosis, as well as idiopathic back pain. These are benign, occasionally chronic conditions that can trouble children or, more usually, adolescents, for months or even years. Investigations show no abnormalities, which can be frustrating for the child, parents and clinician alike.

History

The history should elicit the duration of symptoms, the character and site of the pain, its frequency, and exacerbating and relieving factors. The types of pain that should generate concern are

IN SUMMARY

- **Discerning innocent from evil back pain requires a thorough history and examination of the patient, along with appropriate investigations.**
- **Back pain that is wakening patients from sleep, interfering with normal activities, or worsening should generate concern.**
- **Bed wetting in a previously continent child requires early and comprehensive investigation.**
- **Every child with back pain that cannot confidently be classified as innocent should have, at least, standing anterior–posterior and lateral radiographs of the spine.**
- **Reassurance, physiotherapy and a fitness program are effective for idiopathic back pain, with review after a few months of treatment.**
- **Disc herniation tends to occur in teenagers, but has been reported in children as young as 5 years.**
- **Discitis is characterised by delayed diagnosis. Initial signs may be nonspecific and early plain radiographs may be normal.**
- **Although rare, tumours should always be considered in children or adolescents presenting with back pain.**
- **Early specialist referral is warranted in cases of infection, tumour, spondylolisthesis and neurological abnormality. It is also indicated if the diagnosis remains obscure or symptoms persist.**

continued

Figure 1. A patient with a list to one side secondary to a disc prolapse.

those that wake patients from sleep, interfere with normal activities, or are worsening. Generalised pain is more common for innocent causes. Localised pain tends to occur with conditions such as spondylolysis and tumours. Pain that is worse with particular movements, such as bending or twisting, brings to mind conditions such as spondylolysis.

Pain that radiates to the legs, especially if associated with weakness or paraesthesia, suggests spinal cord or nerve root compression. It is important to enquire about a change in bladder or bowel habit, which can also herald neural compression. Bed wetting in a previously continent child is a cause for concern. These symptoms all require early and comprehensive investigation.

A systems review should be performed. Weight loss, fever, arthralgias or lethargy may point to infection or a generalised condition.

Examination

The physical examination must be thorough. The patient should wear underpants only (and, if necessary, a hospital gown). For young children, a formal examination is often difficult, but much information can be elicited initially by watching them play or interact with their parents.

First, make a general inspection. Look for wasting in the upper and lower limbs, and observe the profile of the spine, looking for muscle spasm, masses, pits or hairy patches of skin. Midline skin defects or cysts can indicate underlying neural tube defects.

Watch the patient walk. Is there a limp? Can he or she walk on toes and heels? Ask the child to bend forward with the knees straight. Observe how a toy on the floor is picked up – does he or she flex the spine and hips to reach it, or keep the back straight and bend at the hips and knees? An abnormal forward bend test is almost always the sign of significant pathology. Look for thoracic or lumbar asymmetry, a list to one side (Figure 1) or limited range of movement. Pain on lumbar extension suggests spondylolysis.

A neurological test must be performed. This may not be easy in small children – in such cases, it should be possible at least to test the reflexes and for the presence of clonus. A limited or asymmetrical straight leg raise is commonly associated with radiculopathy.

Palpation should be performed, being mindful of what structures lie below – spinous processes, facet joints, transverse processes, ribs, and associated soft tissues. Localised pain is more likely to have an identifiable cause. The presence of a step between spinous processes may indicate a spondylolisthesis.

Investigation: the next step

Discerning innocent from evil back pain depends on a thorough history, detailed examination and appropriate investigations. One of the difficulties in the assessment of patients with back pain is deciding how far to pursue investigations in the search.

At the end of the examination, it should be possible to have a reasonable idea of whether the patient's pain is evil or innocent. For example, consider a 14-year-old girl with a two-year history of a generalised ache in the back that is worse when carrying a schoolbag but not interfering with sport or sleep. On examination, the only positive finding is tenderness along the entire thoracolumbar spine, which is maximal at the lumbosacral junction. This is strongly suggestive of innocent, and indeed idiopathic, back pain. It is very unlikely that radiographs or other investigations will add anything to the diagnosis or treatment.

Now, consider a 7-year-old boy who presents with a three-month history of aching lower back pain that is slowly worsening. For the last week, coughing and walking have caused sharp exacerbations, and he has been woken from sleep on a few occasions. His spine is stiff and he walks in flexed posture. Straight leg raise is limited and palpation over the L3/4 spinous processes causes agony. This is clearly a worrying presentation, with infection or tumour being distinct possibilities. The child needs to be investigated until a diagnosis is made.

Lumbar x-rays

Every child who presents with back pain that cannot confidently be classified as innocent should have, at least, standing anterior–posterior and lateral radiographs of the spine; oblique radiographs of the lumbar spine should also be performed if spondylolysis is suspected. However, it is worthwhile remembering that the radiation from these tests is not insignificant. A lumbar spine series gives the effective radiation dose equivalent of 2.2 mSv – slightly more than the average amount that an individual receives in one year from natural background radiation.[1] In comparison, a chest x-ray dose is 0.05 mSv.[1] All tests involving ionising radiation should be ordered judiciously.

Other imaging

CT scans are useful in investigating fractures, tumours and disc herniations. A reverse gantry CT, in which the beam is directed in the plane of the pars, is the most useful in diagnosing spondylolysis. Bone scan is a sensitive test for discitis, tumour and spondylolysis. SPECT (single photon emission computed tomography) can give good detail of stress fractures or focal tumours, such as osteoid osteomas.

MRI is extremely useful in investigating back pain because it provides good delineation of soft tissue masses, bone infiltration, infection, disc prolapse, nerve root compression and cord pathologies. Due to expense and inconvenience, it is usually requested only when other imaging modalities cannot provide sufficient information. In a patient under 5 years of age, general anaesthesia is needed to ensure that the child remains still during the scan.

Blood tests

Blood tests are needed when conditions such as discitis, inflammatory processes or malignancies are suspected. Useful baseline screening tests are:

- a full blood count
- erythrocyte sedimentation rate (ESR)
- C-reactive protein (CRP) level
- electrolytes, urea and creatinine levels
- liver function tests.

Measurements of HLA-B27, rheumatoid factor and antinuclear antibodies are baseline investigations for possible rheumatological conditions.

Causes of back pain

Causes of back pain in children and adolescents are listed in the Table, and their presentation and management are discussed below.

Idiopathic pain

Idiopathic pain is usually described as a nonspecific, dull ache in the thoracic or lumbar spine. It may be constant or may occur with certain activities, such as sitting or standing for long periods; carrying a heavy schoolbag may also give rise to discomfort. The pain is relieved by a change in position or activity and does not interfere with sporting activities or wake patients at night. Occasionally, poor posture or overactivity can be identified as a factor, particularly in teenagers. On examination, there is usually mild tenderness in the paravertebral muscles, and the patient may have a postural kyphosis and tight hamstrings. Radiographs are normal.

Simple measures such as reassurance, physiotherapy and a fitness program are effective. Changing the child's schoolbag to a properly worn backpack and modifying his or her seat and desk at home may also be considered. In all cases, it is important to exclude more serious conditions if symptoms remain after a reasonable trial of appropriate treatment, and therefore patients should always be reviewed a few months later.

Spondylolysis and spondylolisthesis

Spondylolysis and spondylolisthesis are the most common cause of back pain in patients between 9 and 16 years of age (ranked second after idiopathic back pain).[2] Up to 5% of 6-year-old children and 6% of adults have a lytic lumbar spondylolysis, most commonly at L5. Lytic spondylolysis is thought to be secondary to a stress fracture in the pars interarticularis (the 'bridge' located between the superior and inferior facet joints of a vertebra), and can lead to a spondylolisthesis that is usually small and asymptomatic. It should be differentiated from the dysplastic form of spondylolisthesis, which is congenital and secondary to malformation of the vertebral bodies and posterior elements. These slips are far more likely to be progressive and symptomatic.

Trauma or overuse may lead to symptoms in patients with spondylolysis and spondylolisthesis. Children who participate in activities such as gymnastics, dancing and contact sports are at higher risk. The pain is usually an ache in the lower back that occurs with sport and is relieved by rest; radicular pain can occur in cases of spondylolisthesis. In

Table. Causes of back pain in children and adolescents

'Innocent'
Idiopathic pain
Spondylolysis and spondylolisthesis
Scheuermann's kyphosis
Conversion reaction
Adolescent idiopathic scoliosis
'Evil'
Discitis
Inflammatory conditions
Tumours (benign or malignant)
Disc herniation
Tuberculosis
Atypical spinal infections
Epidural abscess
Processes causing spinal cord or nerve root compression
Spinal cord tethering
Some fractures

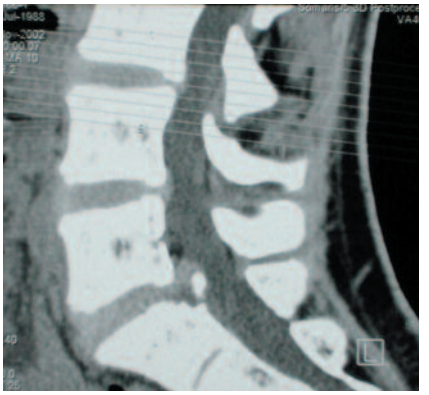


Figure 2 (left). Spondyolisthesis at L5. Note the anterior translation of L5 on S1 (arrow).
Figure 3 (above). CT scan showing a disc prolapse at L5/S1 in association with a bony avulsion (ring apophysis fracture).

spondylolysis, there may not be much to find on clinical examination apart from local tenderness. In higher grade spondylolisthesis, a step in the spinous processes will be palpable. There is a lumbosacral kyphosis and the lumbar lordosis is increased. Restricted straight leg raise due to hamstring spasm is also usual.

Plain radiographs of the lumbar spine should include oblique views. Spondylolisthesis is easily seen on the lateral plain radiograph, but spondylolysis may not be visible, even on the oblique films (Figure 2). Bone scan with SPECT or reverse gantry CT should be arranged if clinical suspicion remains.

These conditions normally respond well to activity modification and physiotherapy. Some children may require a lumbar brace for six to 12 weeks if the symptoms are severe. They may return to normal activities when they become asymptomatic, and should be followed up on a regular basis to ensure that a progressive slip is not occurring. For those with ongoing pain or a progressive slip, pars repair or spinal fusion may be necessary. Dysplastic spondylolisthesis is more likely to require surgical management.

Disc herniation

Disc herniation tends to occur in teenagers, but has been reported in children as young as 5 years.[3] Trauma is a common precipitating factor. The herniation may be simply of the nucleus pulposus alone or in association with a fracture of the endplate of the vertebra (ring apophysis). It is a rare condition.

The presentation in children and adolescents differs from that in adults as there may be no back pain, and even leg pain may not always be present. It may mimic a muscle strain. On examination, there is marked back stiffness and a very restricted straight leg raise. The child may stand with an antalgic scoliosis or list. Neurological signs such as diminished reflexes are uncommon.

The differential diagnoses of disc herniation are discitis, spondylolisthesis, neoplasms and spinal cord tethering. Plain radiographs are usually normal, but may reveal underlying congenital abnormalities such as transitional lumbar vertebra or spina bifida occulta. Congenital anomalies are seen in up to 30% of young patients with disc herniations. CT scans will clearly reveal whether a ring apophysis avulsion is present with the prolapse (Figure 3). MRI is better for delineating the disc and nerve roots.

Nonoperative treatment of disc prolapse in children and adolescents is not as effective as it is in the adult population, but it should be the first line of treatment unless there is a neurological deficit. Rest, analgesics, anti-inflammatories and physiotherapy are indicated. Corticosteroid injections under CT guidance may have a role in patients who have significant radicular symptoms. Discectomy is reserved for those who have debilitating symptoms after a reasonable trial of conservative measures.

Idiopathic scoliosis

Scoliosis is a relatively common condition, with a prevalence of 3% in adolescents. It is almost always associated with a low grade backache, which usually occurs at the apex of the scoliosis and typically is noted after activities or when sitting for long periods. It normally responds well to rest or stretching and rarely interferes with activities.

Flank asymmetry or uneven shoulders or pelvis may be the first clinical sign of scoliosis. However, it is the forward bend test that indicates the presence of a true (that is, structural) scoliosis. On forward flexion, chest wall asymmetry will be seen as a consequence of the rotation that occurs in the spine with a structural scoliosis. Postural scoliosis is not associated with vertebral body rotation.

The symptoms of scoliosis normally respond well to a stretching and strengthening exercise regimen. Specialist review is recommended for child and adolescent patients.

Scheuermann's kyphosis

The aetiology of Scheuermann's kyphosis remains obscure. It is thought that a disruption of the enchondral ossification in the endplate of the vertebra during the growth spurt leads to irregularity, Schmorls' nodes, and wedging of the vertebral body and narrowing of the disc.[4] It tends to affect teenage boys.

There are two forms of Scheuermann's kyphosis: thoracic and lumbar. Thoracic Scheuermann's is the more common form, and is typified by a rigid kyphotic deformity and a mild to moderate aching pain around the apex of the deformity. Clinically, it can be distinguished from postural kyphosis by the lack of correctability of the deformity. Radiologically, the endplates are irregular, the disc spaces narrow and the apical vertebrae wedged. The kyphosis measures greater than 40 degrees. Lumbar Scheuermann's kyphosis has little deformity but more troublesome pain, and radiographs reveal marked endplate irregularity (Figure 4).

Mild or early cases respond well to physiotherapy aimed at improving posture, stretching hamstrings and strengthening the paravertebral musculature. Aerobic sports should be encouraged. Some patients with progressive thoracic Scheuermann's kyphosis may require bracing or occasionally spinal fusion, mainly for cosmetic reasons. This group of patients is also at increased risk of cord compression from a thoracic disc prolapse because the spinal cord, as a result of the kyphosis, lies directly against the anterior border of the canal.

Discitis

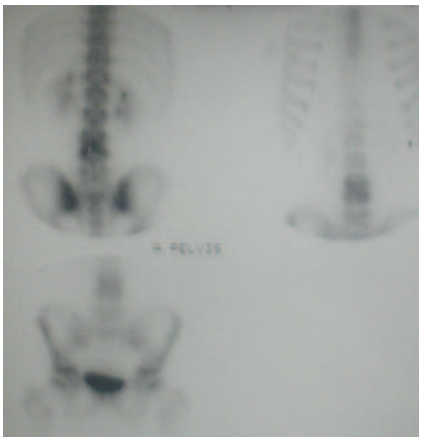
Discitis (infection of the disc space) begins in the adjacent vertebral endplate and then spreads into the disc space and opposite vertebra. The cause is usually haematogenous seeding of pyogenic bacteria – commonly *Staphylococcus aureus*. It is characterised by delayed diagnosis because the initial signs may be nonspecific and early plain radiographs may be normal. (Discitis in children and adults has been covered in a previous article in *Medicine Today*.[5])

Generally, the child is well and there is no fever. Children under 3 years of age may present as a sudden refusal to walk. This may raise concerns of a lower limb problem or neurological process, but on examination these are normal. Usually the only finding is marked back stiffness and restricted straight leg raise. Children between 3 and 9 years of age can complain of abdominal pain – particularly if the discitis is in the lower thoracic region – and there have been cases where unnecessary laparotomy has been performed for this condition. The presence of back spasm and restricted straight leg raise should alert the doctor to possible discitis. For older individuals, the symptoms become more localised to the back, with discomfort radiating to the legs.

Differential diagnoses include Scheuermann's kyphosis, tuberculosis and atypical spinal infections, epidural abscess, vertebra plana, osteoid osteoma or malignancy. If discitis is suspected, plain radiographs and blood tests, including blood cultures, should be performed. The full blood count is usually normal, but the ESR and CRP are elevated. Blood cultures are positive in only 50% of cases. Plain radiographs may be normal for a week or more, but later the endplates become eroded and the disc space narrows (Figure 5a). A bone scan is a sensitive investigation in cases of suspected early discitis (Figure 5b). MRI is only necessary if the diagnosis remains in doubt or neurological symptoms develop.

Figure 4. X-ray of thoracic Scheuermann's kyphosis showing marked endplate irregularity, narrowing of the disc spaces and wedging of the vertebrae.

Treatment is appropriate intravenous antibiotics until symptoms resolve, followed by oral antibiotics for four to six weeks. Occasionally, bracing is required



Figures 5a and b. Discitis. a (left). Plain radiograph showing narrowing of the L3/4 disc space and endpate erosion.
b (above). Bone scan showing increased uptake in two adjacent vertebral bodies, consistent with discitis.

Figure 6. MRI showing an aneurysmal bone cyst (benign but aggressive tumour) at L5.

for comfort. Surgical drainage is needed for patients who do not respond to therapy or develop an epidural abscess.

Inflammatory conditions

Inflammatory conditions of the spine are rare. Juvenile chronic arthritis usually affects the cervical spine and is not commonly implicated in back pain. Diagnosis of spondyloarthropathies, including ankylosing spondylitis, is rare in patients under 16 years of age.

Often the symptoms of spondyloarthropathies are nonspecific. Back stiffness in the morning, pain in the region of the sacroiliac joints and other joint involvement are suggestive. Radiographs will usually be normal in early or mild cases. The full blood count may indicate anaemia of chronic disease, and the ESR and CRP are elevated. Measurement of HLA-B27 should be performed. Negative results do not exclude an inflammatory condition. Treatment of spondylo-arthropathies includes physiotherapy and anti-inflammatory medication. A rheumatological opinion is recommended.

Intervertebral disc space calcification is a rare disorder of unknown cause that usually involves the cervical spine. It can occur in the thoracic spine and manifest as acute localised pain, stiffness and, in some cases, fever. Radiographs reveal calcific deposits outlining the nucleus pulposus. Usually the symptoms are short lived, and treatment is limited to analgesia and rest.

Tumours

Although rare, tumours should always be considered in patients with back pain. Their presentation is often nonspecific, and complaints of night pain or pain unrelated to any activity must be taken seriously. Clinical examination may reveal a list or an atypical scoliosis. The neurological examination needs to be thorough – symptoms are rare, but even subtle findings, such as asymmetry of abdominal reflexes, are significant. Patients who have these symptoms or signs require a full work up, including MRI (Figure 6). Suspicious lesions on plain radiography also warrant investigations sufficient to make a confident diagnosis.

Conversion reaction

Conversion reaction is a diagnosis of exclusion. It may be considered in individuals who present with severe pain, report significant disruption to normal daily activities but have no or minimal physical signs. Often minor trauma is related to the beginning of symptoms.

Time should be taken to ascertain whether there are factors at home or school that may trigger the complaint. Children who have unreasonable expectations put upon them or live in an otherwise stressful environment may develop back symptoms or other somatic complaints as a result.

It is important not to apply this diagnosis too readily, and to apply it only when a physical condition has been confidently ruled out. Referral to a specialist or paediatric multidisciplinary clinic is recommended.

Conclusions

Back pain in children covers a broad spectrum of conditions, and the subdivision into innocent and evil helps rationalise the approach to diagnosis and management. It is critical to ensure that serious diseases are not overlooked and that all patients receive appropriate treatment. A thorough history and examination – along with the use of appropriate investigations – will elucidate the cause in most situations. Early specialist referral is warranted in cases of infection, tumour, spondylolisthesis and neurological abnormality, and also when diagnosis remains obscure or symptoms persist. MT

References

1. George S, Dewey P, McGrath J, Beh H. Radiation safety for orthopaedic surgeons. Sydney: Australian Orthopaedic Association; 2002.
2. Turner PG, Green JH, Galasko CS. Back pain in childhood. Spine 1989; 14: 812-814.
3. Bunnell WA. Back pain in children. Orthop Clin North Am 1982; 6: 587-604.
4. Weinstein S. The pediatric spine. Principles and practice. 2nd ed. Philadelphia: Lippincott, Williams & Wilkins; 2001.
5. Gray AJ. Recognising and treating discitis. Med Today 2003; 4(5): 107-108.

DECLARATION OF INTEREST: None.