REVIEW

Low back pain investigations and prognosis: a review

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Br J Sports Med 2006;**40**:494–498. doi: 10.1136/bjsm.2004.016659

Low back pain is reviewed in terms of when investigations are useful and its clinical course. Despite the extensive evaluation of the accuracy of investigations such as radiography, magnetic resonance imaging, and myelography, there is a surprising dearth of research to inform their use in primary care. There is no clear evidence on which to base judgments for selection of appropriate tests to confirm or exclude low back pain pathology. It appears that investigations are rarely necessary for low back pain. Specific investigations should be ordered to identify a particular pathology but should not be ordered routinely for general screening. In the absence of pathology, low back pain and its associated disability improve rapidly in the first weeks after onset, but, in contradiction to all guidelines, both commonly persist and the best evidence suggests that recurrences are common.

Low back pain (LBP) is one of the most common symptoms in the developed world,[1] yet it is one of the most elusive. It can be extremely disabling, and the social and economic burden is enormous.[1] Costs arise from treatment, investigations, compensation for pain and suffering, and lost work time. Ironically, it is likely that part of the burden of LBP arises from unnecessary and ineffective investigations and from incomplete understanding of its clinical course.

CAUSES OF LBP

The cause of the vast majority of LBP is unknown; current tests cannot identify a pathological cause for the pain in at least 85% of cases.[2] That is, in 85% of cases, even when the most extensive testing is conducted, no apparent cause can be established. For this reason, such LBP is now usually termed non-specific low back pain. Our inability to reliably identify pathology has given rise to numerous hypotheses concerning the cause of LBP, including reduced trunk extensor endurance,[3] psychological distress,[4] hamstring inflexibility,[5] poor muscle control of the trunk,[6] poor posture,[7] and low body mass.[7] However, at best, there is only preliminary evidence to support an association between such impairments and the presence of LBP, and most of the causal hypotheses lack convincing evidence. Given our poor ability to identify the cause of most cases of LBP, invasive and expensive investigations should only be used when findings from the clinical examination indicate the likely existence of serious pathology. It should be noted, however, that the clinical signs and symptoms of LBP can be treated successfully without a pathological diagnosis.

To identify serious pathology, all guidelines for management of LBP recommend use of a diagnostic triage. Based on the findings from the history and physical examination, LBP is classified into one of three diagnostic categories: non-specific low back pain or simple backache, nerve root/spinal nerve compromise, or potential cases of serious spinal pathology (including infection, cancer, fracture, inflammatory disorders, and cauda equina syndrome).

Because non-specific LBP currently cannot be further classified, it is often referred to according to its duration: acute LBP (duration less than six weeks); sub-acute LBP (duration more than six weeks and less than three months); and chronic LBP (duration more than three months). Although probably simplistic, this classification makes some sense because evidence to date suggests that different treatments are effective in different phases of LBP,[8] and different factors, such as psychosocial factors, appear to take on greater importance with increasing chronicity.[9] Non-specific LBP does not benefit from extensive investigations, and in some cases, further examinations have been shown to be harmful.[10]

WHEN ARE FURTHER INVESTIGATIONS OF LBP PRUDENT?

Investigations additional to the clinical examination are required when a patient's signs or symptoms (red flags) raise the index of suspicion that there is serious pathology. Relevant investigations include blood tests, nerve conduction tests, imaging such as radiography, magnetic resonance imaging (MRI), computed tomography, and dual energy *x* ray absorptiometry, and rarely myelography. However, invasive tests should be ordered judiciously, such as when identification of pathology necessitates specific treatment or, more importantly, if the pathology renders a treatment harmful. It is also likely that early detection of certain serious pathologies is vital because delayed treatment leads to poorer outcome.[11 12] The goal is to identify all, or most, cases of serious pathology with a minimum of unnecessary diagnostic testing.

These invasive investigations should rarely be required for patients with LBP because serious pathology presenting as LBP is rare. The few studies that have investigated the incidence of serious pathology presenting as LBP found that <5% of cases can be classified as serious pathology. For example, in the United States, Deyo and colleagues[13] found, in a retrospective

Abbreviations: LBP, low pack pain; MRI, magnetic resonance imaging

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Accepted 7 January 2006

study of acute LBP presenting to primary or secondary healthcare practitioners, that 4% had compression fracture and 1% had cancer, infection, inflammatory disorders, or cauda equina syndrome. An even smaller proportion of serious pathology (1.4% of cases) was found in Australia[14] from a survival cohort of patients with LBP of any duration presenting to primary or tertiary care.

All clinical practice guidelines advise detection of serious spinal pathology from features in the clinical assessment such as age over 50 or under 20 years, fever, widespread neurological symptoms, or unexplained weight loss—for example, National Health and Medical Research Council guidelines.[15] However, the accuracy of these clinical features for diagnosis of serious pathology, particularly in primary care, has rarely been explored. The validity of the information from the few available studies is likely to be poor, because most studies have serious design problems such as patient selection bias and verification bias.

In the few cases of LBP for which further diagnostic work up is required, investigations should be ordered specific to the suspected pathology. Investigations should not be ordered routinely or to screen broadly for a range of pathologies because asymptomatic anomalies exist in the normal population. The practice of routine investigation is in danger of leading to management of benign abnormalities seen on images, such as disc bulge, despite the evidence that these anomalies are rarely related to LBP.[2]

Taken together, this information suggests that thoughtful referral for further investigation relies on accurate diagnosis from the clinical examination, but accuracy of individual components of the clinical examination is not known. As there is so little evidence, the conservative recommendation should be that clinicians use the clinical practice guidelines for management of acute LBP until better evidence becomes available.

SPECIFIC PATHOLOGIES REQUIRING FURTHER INVESTIGATION

Spinal fracture

It is interesting to note that most guidelines reference diagnostic accuracy of the clinical examination for fracture to unpublished data originating from observations reported in a single review.[13] The methods used in the review were not detailed, precluding assessment of validity of the findings.

We are currently conducting a systematic review of diagnosis of fracture. Three studies[16–18] investigated diagnosis of fracture in a mix of primary and secondary care settings, and nine studies[19–27] investigated detection of fracture after blunt trauma in emergency departments. The diagnostic accuracy of features conventionally thought to be associated with fracture, such as age >55 years, use of corticosteroids, and trauma, was low and/or inconsistent across the studies.

Given the lack of evidence on which to base referral, adherence to the guidelines is necessary, in addition to clinical judgment. For young people, fractures are rare unless major trauma is involved. Stress fracture should be suspected among gymnasts[28] and fast bowlers in cricket.[29] For older people (≥75 years), particularly older women, a compression fracture should be suspected if pain results from minor trauma and osteoporosis is either confirmed or is suspected from hormonal status or steroid use. These clinical judgments should be regularly reviewed as more information becomes available. It is now a public health imperative to identify osteoporosis. When one fracture has occurred, the risk of subsequent fracture is greatly increased,[30] and so the person should be placed on an osteoporosis management programme to slow bone loss, prevent falls, and decrease risk of further fractures.

Cancer

The red flags presented in most clinical guidelines for the diagnosis of cancer in patients presenting with LBP in primary care are based on a single study.[31] In this study, however, Deyo and Diel[31] identified cases of cancer retrospectively from the hospital's tumour register and not from following patients prospectively. A consequence of this is that those patients who developed cancer but presented elsewhere would not be identified as cancer cases, thereby potentially biasing the findings. Nevertheless, Deyo and Diel[31] found that four clinical findings strongly predicted cancer in patients with LBP: previous history of cancer, age ≥50 years, failure to improve with conservative treatment, and unexplained weight loss (>4.5 kg (10 lb) in six months).[31]

Although the diagnostic evidence available for primary care practitioners is scant, the need to identify cancer early is urgent to ensure early and effective intervention and prevent complications. Joines and colleagues[11] evaluated a decision analysis paradigm using data from the original study of Deyo and Diel,[31] and determined sensitivity and specificity of a range of diagnostic strategies to identify cancer. They also conducted a rudimentary cost-effectiveness analysis on these same data. They recommend that, for patients with any positive finding among the four predictors originally identified, the most appropriate diagnostic work up is to order erythrocyte sedimentation rate (ESR) tests or radiographs. For those with ESR ≥50 mm/h or positive radiograph, an MRI should be ordered. For any patient with a previous history of cancer, particularly breast or prostate cancer, an MRI should be ordered. If the MRI is positive, the patient should be referred for a vertebral biopsy. However, the study was conducted in a hypothetical setting. Because prevalence of cancer in the population presenting for care can dramatically alter the findings, clinicians should be alert to new knowledge in settings relevant to their patients.

Infection

The red flags for clinical diagnosis of infection are also based on a single study that focused on spinal osteomyelitis.[32] The authors retrospectively surveyed patients with spinal infection to determine an association between reported intravenous drug use, urinary tract infection, or skin infection. In the absence of clear evidence, best practice would currently recommend that, when infection is suspected because of fever and sudden onset of severe pain, particularly in the case of intravenous drug use, it should be confirmed by blood tests or aspiration of the relevant tissue.

Inflammatory disorders

Although there are studies of patients with inflammatory disorders presenting with LBP in tertiary care[33–35] and non-consulting participants identified in an epidemiological survey,[36] there are no studies of diagnostic accuracy of clinical features for inflammatory disorders presenting as LBP in primary care. The design problems in the available studies, such as using pain-free participants as controls,[33 35] potentially inflate estimates of diagnostic accuracy.[37]

From the body of literature on inflammatory arthritides,[33–36] the cardinal signs include morning stiffness lasting more than 30 minutes, symmetrical peripheral joint involvement, associated signs and symptoms of systemic involvement, and non-mechanical pain—for example, pain and stiffness that decreases with movement and increases with rest. These signs and symptoms have not been evaluated for patients presenting primarily with LBP in primary care. However, it is prudent to use them as raising the index of suspicion and request confirmatory blood tests if they are present, and be alert when patients do not improve rapidly even when these symptoms are absent.

Cauda equina syndrome

There are no studies of diagnostic accuracy for cauda equina syndrome. Clinical observations suggest that cauda equina syndrome should be suspected when leg pain that includes several spinal nerve levels is accompanied by widespread motor and/or sensory weakness and importantly when there is associated urinary and/or faecal incontinence or retention. When a patient presents with this cluster of symptoms, further tests such as radiography, myelography, and, rarely, lumbar puncture should be requested immediately. The earlier the diagnosis is made, the better the outcome.[38]

Other abnormalities

Many abnormalities can be visualised, particularly as modern imaging techniques have become more powerful. However, most of these abnormalities do not constitute pain provoking or serious pathology. For example, spondylitis and general spinal degeneration are often found on scans of older people, but are generally regarded as benign and are rarely associated with symptoms. Images are therefore not useful in non-specific LBP, particularly because it is tempting to attribute symptoms to abnormal findings, and this practice can be harmful, prolonging episodes of LBP.[10]

As the accuracy of clinical diagnosis of serious pathology is largely unknown, we have little evidence to support clinical judgments made from the history and physical examination, the basis of referral for further assessment. Until such evidence becomes available, the signs and symptoms recommended for clinical diagnosis in all guidelines should be used to alert clinicians to the possible presence of serious pathology. Clinicians should also be alert to atypical progress in their patients with LBP, however, because serious pathology may exist in the absence of signs and symptoms.

PROGNOSIS OF LBP

Non-specific LBP is generally considered as a single entity despite the possibility that there are distinct and separate subgroups within this population that may recover at different rates and with different outcomes and may respond differently to the variety of available treatments. There has been some attempt to identify factors that predict rate of recovery. However, most of these studies have serious methodological problems, such as not using inception cohorts or not providing data to support the conclusions.[39–42] Despite these problems, most guidelines for acute LBP recommend that indicators of poor prognosis be identified and report that factors such as fear avoidance behaviours, presence of leg pain, or low job satisfaction are likely to prolong the episode of LBP.

Prognosis for chronic LBP has rarely been studied and is therefore largely unknown. The few studies that addressed this issue included participants with subacute LBP, had high drop out rates, and those lost to follow up differed significantly from the cohort remaining in the study. Consequently, once a person has persisting LBP, the course of the problem cannot be accurately predicted.

The prognosis for acute LBP has been investigated and has been confidently reported as excellent in all current clinical practice guidelines for the management of acute LBP.[43] All guidelines consistently report that acute LBP typically has an excellent prognosis because most cases (up to 90%) recover within six weeks.[44]

Our group found reason to question the guidelines and to hypothesise that the prognosis of acute non-specific LBP might not be so optimistic. In Australia, the prevalence of chronic pain in general was found to be much higher in the population than previously thought,[45 46] particularly as the majority (>55%) do not seek care for their LBP[47 48] and recovery from acute LBP was not necessarily complete.[49] In addition, there was conflicting evidence about prognosis, varying between recovery in >90% of patients within two weeks[50] and recovery in only 41% of patients by one month.[51] The longer term prognosis also varied appreciably, from recovery in 98% of patients by three months[50] to recovery in only 54% of patients by 12 months.[51] These two studies provide very different predictions of risk of developing chronic LBP. These clear contradictions led us to believe that the current view of acute LBP as benign and self-limiting should be reconsidered.

We therefore conducted a rigorous systematic review of studies of the prognosis of acute LBP[52] and of the factors that increase the risk of poor prognosis. We included prospective studies that used a clearly described inception cohort of participants with acute LBP who were followed for at least three months. Reporting of patient relevant outcomes such as disability, quality of life, and return to work was required, with follow up of at least 80% at each follow up measurement occasion.

Fifteen relevant studies (reported in 20 papers)[50 51 53–70] were located, one of which specifically investigated sciatica.[70] A consistent finding across these studies was that pain decreased rapidly by 12–84% of initial pain levels (pooled mean 58%) within the first month, and thereafter decreased more slowly for the next two months. Only two studies[53 56] investigated longer term outcome, both finding that pain levels remained unchanged at the 12 month follow up. The pooled mean level of pain was 22/100 at one month and 15/100 at 3–12 months.

The findings for disability outcomes were similar to the pain outcomes. Disability decreased by 33–83% of initial levels (pooled mean 58%) within one month. Only one study[53] reported longer term (six months) follow up data. The pooled mean level of disability was 24/100 at one month and 14/100 at three to six months.

A particularly interesting finding was that most participants (68–86%) who were off work because of LBP at the start of the study returned to work within one month (pooled estimate 82%; 95% confidence interval (CI) 73% to 91%). By six months, nearly all participants had returned to work (pooled estimate 93%; 95% CI 91% to 96%). Taken together, these findings from different studies suggest that people return to work despite continuing pain and disability. This effect is seen in the trial of Hagen *et al*[71 72] of advice as a treatment for workers sick listed because of LBP: at follow up 61% of the intervention group had returned to work yet 95% where still in pain.

Recurrence was found to be common. More than a quarter of participants had at least one recurrence within three months, with a cumulative risk of 26% (95% CI 19% to 34%). At 12 months the pooled cumulative risk of at least one recurrence within 12 months varied from 66% to 84% (pooled estimate 73%; 95% CI 59% to 88%), and after three years it was 84%.

In the single study that included patients with sciatica,[70] both back and leg pain decreased by a mean of 69% of initial scores within one month. Disability decreased by 57% of initial scores within one month. Long term pain and disability data were not available.

Prognostic factors

There is a wealth of information on clinical features that predict poor prognosis from an episode of non-specific LBP. However, few reports are from rigorous prospective studies. Factors commonly thought to predict outcome of an episode of LBP include psychological factors[9] (such as psychological distress, depression), clinical factors[59] (such as previous back pain), and work related factors[59] (such as job satisfaction). In our recent review,[52] we located three studies that reported on

What is already known on this topic

- Although low back pain (LBP) is highly prevalent and has been extensively researched, the pathological diagnosis remains a puzzle
- All 11 clinical guidelines consistently recommend that investigations should rarely be used except when serious pathology is suspected. Finally, non-specific LBP was thought to be a benign, self limiting condition

What this study adds

- Conventional investigations are unrewarding for at least 85% of patients with LBP
- There is little evidence to support the signs and symptoms (red flags) used to identify serious pathology, and prognosis has been shown to be poor

prognostic factors for at least 80% of the population studied.[50 51 59] The only predictor of outcome was score on the Vermont disability prediction questionnaire: a lower score predicted earlier return to work.[59] However, as most people return to work by three months (pooled estimate of 6% not returned to work), the ability to predict this outcome probably has limited clinical utility.

CONCLUSIONS

LBP has proved to be an enigma for health professionals for decades. It is not possible to identify the cause in most cases, although serious pathology can present as LBP and health practitioners are required to recognise such presentations. However, a review of the diagnostic accuracy of the red flags shows that none have sufficient evidence of accuracy when used in primary care for patients presenting with LBP. This is a major problem, given the imperative to identify serious pathology so that appropriate management can be instituted as early as possible. The most prudent recommendation would be that clinicians treating patients with LBP re-evaluate any patients who do not respond rapidly to treatment. It is clear that LBP should markedly improve in the first weeks after onset. If the clinical course appears aberrant, further investigation may be required.

At the end of the last century, it seemed clear that LBP was a benign self limiting condition. Recent work shows that this is not true. Non-specific LBP is often not self limiting; a large proportion of patients experience persistent low intensity pain and disability, but are able to return to work.

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Competing interests: none declared

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