

Back pain

Part I: causes, symptoms, immediate treatment

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Introduction

According to advocates of evolution, back pain dates back to the times when our progenitors stood upon their feet and assumed the erect position; due to the physiological curvatures shaped then in the form of cervical and lumbar lordosis as well as thoracic and sacral kyphosis, the spine is more resistant to overloads and shocks. However, various harmful factors can cause the disorders of its motor and protective functions, sometimes leading to persistent pain sensations. Such sensations, which are relatively common, increase with age; according to the available estimates, few individuals aged > 50 years have never experienced „lower back” or neck pain.

Lumbosacral pain is the second leading presenting symptom [12].

Among the major causes of the growing incidence of spine-related diseases are various facilities associated with the development of civilisation leading to static, predominantly sedentary lifestyle. This improper lifestyle induces back pain in increasingly young individuals – in the professionally active population and even amongst teenagers.

Over 60% of pain sensations affect the lumbosacral region; about 30% of them involve the neck region and a few percent the thoracic area.

Due to its widespread occurrence, which often causes absences at work or even disabilities and high costs of treatment, back pain-related problems have medical as well as social and economic consequences.

Epidemiology

In Poland, the prevalence of back pain is 60-90% in the adult population [12,42]. In the United States, the annual prevalence is estimated to be 54% while the lifetime prevalence - 70%; higher rates have been reported in Europe, i.e. up to 60% and 80%, respectively [44, 58, 59].

The majority of the affected recover within 6 weeks, albeit the condition of 5-15% of them does not improve and they suffer from chronic pain. Amongst patients whose symptoms remit after the first course of therapy, 22-36% of them have recurrences. The long-term studies have demonstrated that about 45% of patients have at least one recurrence within the subsequent four years [31].

Etiopathogenesis

Back pain is of a polyetiological nature, i.e. is caused by multiple factors [5, 8, 27, 40, 41, 42, 66, 67]. In general, patients with back pain can be divided into 3 groups:

1. with conditions induced by severe causes, which in the majority of cases require surgical interventions, such as:
 - spinal neoplasms,
 - fractures,
 - inflammatory complications,
 - prolapsed discs,
 - syringomyeliaPatients with such conditions should raise a red flag, yet they constitute only 10% of all individuals with back pain [22,24].
2. with conditions caused by compression of spinal radices – discopathies, degenerative-productive changes, spondylolisthesis (a yellow flag)

3. with pain concomitant with „a non-specific mechanical factor”.

Such patients, whose CT and MRI scans frequently do not disclose the cause of pain, constitute the most abundant and most uniform group as for the clinical picture and prognosis [2, 8, 9, 31, 41]. When their complaints persist and become chronic, they are included in the yellow flag group.

Back pain can result from systemic diseases, e.g. osteoporosis [41,47] or diseases affecting the adjacent regions, e.g. the urinary system, abdominal or genital organs. The diseases of the abdominal organs, which are associated with the spinal pain, encompass abdominal aortic aneurysm, pancreatitis, cholecystitis and ectopic pregnancy [8].

To discuss the pain of the spine and its vicinity, the structures where it develops should be firstly assessed. Back pain can be located in the bones, joints, muscles, ligaments, fascia, intervertebral discs and spinal nerve roots compressed in the spinal canal.

Myalgia is predominantly acute and is seldom experienced during the chronic stage. The likely sources of it are changes in the ligaments, e.g. interspinous ligaments.

It has been demonstrated that the nucleus pulposus of the intervertebral disc does not contain nociceptive nerves, which are however abundantly represented in the external layers of the annulus fibrosus. The pain within the disc is induced by radial tears of the annulus fibrosus penetrating the internal layers of the annulus. The dislocation of the intervertebral disc to the spinal canal can press the spinal nerve roots causing the symptoms known as sciatic or trigeminal neuralgia, depending on the level of dislocation.

Spondylolisthesis is often asymptomatic, which is more common in male patients. Instability is the term, which is frequently overused [3].

Spinal neoplasms

Spinal neoplasms can be divided into those primarily originating from the spinal structures and metastatic ones.

In the majority of cases, metastases in male patients originate from the lungs and the prostate while in female patients from the breasts and lungs. They are mainly located in the vertebral bodies and present as an increasing local pain, especially at night [4].

The tumours formed in the spinal canal can be located intra- or extra-medullary. The former are mostly malignant and impair the spinal cord functions leading to limb paresis or paralysis and sensation disorders; however, they seldom cause severe pain. The extra-medullary tumours are benign and include meningiomas presenting as limb paresis and neuromas developing mainly on the cauda equine roots and inducing their pain (often in the form of sciatic neuralgia [8,53]).

Whenever a neoplastic process is suspected, the diagnostic procedures should be promptly performed – CT, which better reveals the bone changes or MRI showing intracanal masses.

In order to detect the primary focus in the lungs, the X-ray picture is required whereas in the case of prostate, the prostate-specific antigen (PSA) test should be performed [8].

Spinal inflammations

Spinal inflammations can be primary, e.g. after surgical procedures, yet more frequently result from generalised infections affecting the respiratory and urinary systems or the skin. In recent decades, the incidence of inflammatory complications of the central nervous system has increased due to the acquired immune deficiency syndrome (AIDS) epidemic. The most common symptoms of the infection include malaise and back pain with limited spinal mobility, which are likely to be accompanied by shivers, fever and nocturnal

sweating [50]. The risk factors are the history of chemotherapy, radiotherapy, use of corticosteroids and other immunosuppressive drugs. The inflammatory process in the spinal canal can develop in the form of an epidural abscess. In such cases, the infection symptoms can also include compression of the intracanal nerve structures.

The increased osteoblastic activity observed in various inflammatory processes, such as osteomyelitis or discitis, can be used for diagnostic purposes, i.e. scintigraphy with technetium-99M radiolabelling [8].

Spinal fractures

Patients after mechanical traumas, e.g. road traffic accidents, falls from heights, suspected of spinal injuries require special attention already during transport. The cervical spine should be immobilised with a rigid collar and the stretchers stiffened. An affected patient should be carried by 4 individuals. In cases of suspected fractures, at least a lateral X-ray picture should be taken, in some cases also computed tomography. In doubtful cases, scintigraphy is likely to be useful [8].

Traumatic spinal injuries can be classified into stable, e.g. compressive fractures of the vertebral bodies, and unstable, in which the spine is deprived of its supportive and protective function. Moreover, burst fractures in which the bony fragments can injure the spinal cord or cauda equine roots, are dangerous for intracanal lesions. Similar risks are observed in dislocations of the vertebral bodies with disruption of the ligamentous apparatus.

The neurological symptoms depend on the extent of damage to intracanal nerve structures and its level. Transverse spinal cord injuries at the C1-C2 level result in an immediate death due to paralysis of all respiratory intra-vertebral muscles and the diaphragm, as the nuclei of the diaphragmatic nerves are located at the C3-C4 level.

The symptoms of spinal cord injuries are as follows:

- C3-C5 - tetraplegia
- C6-C7 – paresis of the upper limbs and spastic paraplegia,
- C8-TH11 – only paraplegia,
- TH12-L1 – terminal cone syndrome,
- below L1 – symptoms of damage to the cauda equine roots commonly accompanied by chronic root pain.

Unstable spinal fractures require emergent surgical treatment, which is to:

- prevent secondary spinal cord damage,
- decompress the nerve elements inside the spinal canal,
- restore the normal spine shape,
- provide instrumental stabilisation, which enables the affected individual to assume the erect position, as opposed to the former conservative management involving multi-month immobilisation associated with the risk of bedsores and other circulatory and respiratory complications.

Severe damage to the spinal cord immediately results in spinal shock with abolition of all voluntary and reflex activities below the level of damage. In most cases, the stage of spinal automatism develops after several weeks, in which the muscle tone is restored and spasticity is observed as well as automatisms of excretory activities [49].

The priority during the first stage of management of patients with severe spinal cord injuries, especially at high levels, is to prevent the respiratory complications in cases of expectoration disorders, bedsores (by frequent turning of the affected patients and the use of special mattresses), inflammatory complications of the urinary system and venous thrombi.

Motor rehabilitation aims at maximum social adaptation of patients (in some cases also involvement in professional life). The advances

in technical facilities enable the support or replacement of lost motor functions by mechanical or electronic devices, e.g. bladder stimulators [49].

Discopathies

The intervertebral discs (n=23) connecting the adjacent vertebrae are essential for spine biodynamics. They stabilise the spine, provide its elasticity, amortises dynamic loads and have the load-bearing function – each disc balances the pressure of the neighbouring body [48].

The elasticity depends on the functional cooperation of the annulus fibrosus and nucleus pulposus. At younger age, the nucleus pulposus contains about 90% of water, which evenly transmits the pressure in all directions on overloading, according to the Pascal's law. Under pathological conditions, the avascularised nucleus is dehydrated, which is easily visualised on MRI. As a dense mass, the nucleus is displaced according to the direction of pressure. The spine leaning pushes the nucleus backwards towards the spinal canal or laterally towards the intervertebral foramina, through which the roots and spinal nerves run. The above can result in the disc protrusion and subsequently the hernia whereas the disc disruption can lead to prolapsus nuclei pulposi.

The clinical symptoms depend on the level, extent and direction of nucleus pulposus displacement. Such displacements most commonly occur in the lumbar spine (> 60%), where the loads are the largest, predominantly at L5-S1 and L4-L5, less commonly (about 30%) in the cervical spine region; in a few percent of cases, the displacement is found in the thoracic spine, which is characterised by the lowest mobility.

In the cervical spine region, dislocations of the intervertebral discs into the canal compressing the spinal cord can cause the symptoms of myelopathy in the form of tetraplegia with sensation disorders below the level of compression. The root pains,

often with parasthesias, in the upper extremities are generally more severely experienced than the neck pains. Pain and numbness localised mainly in the hands and fingers can cause diagnostic doubts as for the differentiation from the carpal tunnel syndrome.

In such cases, electromyography can prove valuable [8].

The pressure on the roots in this segment induces the following symptoms, which depend on the level of pressure:

- C5 – biceps and deltoid muscle paresis, sensation disorders on the lateral side of the arm and abolishment of the biceps reflex,
- C6 – paresis of the biceps muscles and wrist extensors, sensation disorders on the lateral forearm, abolishment of the brachioradialis reflex,
- C7 – paresis of the triceps muscles and wrist extensors, sensation disorders in the region of triceps muscles, abolishment of the middle finger reflex,
- C8 – paresis of the hand intrinsics, sensation disorders on the medial forearm,
- TH1 – paresis of the hand intrinsics, sensation disorders affecting the medial arm.

The pressure on nerve roots in the lumbar spine region can cause the following symptoms:

- L4 – paresis of quadriceps and tibialis anterior muscles, impaired sensations in the region of the medial ankle, abolishment of the ankle jerk,
- L5 – paresis of the extensor halucis longus, sensation disorders in the foot, abolishment of the medial hamstring,
- S1 – paresis of the gastrocnemius and soleus muscles, impaired sensations in the medial ankle region, abolishment of the ankle jerk [8].

The intervertebral disc prolapse in the lumbar spine most commonly occurs after sudden spine overload, especially in the leaning position, and is

often accompanied by dramatic conditions of the affected individuals; sudden paralysing pain in the lumbar region radiating to one or both lower limbs in the form of sciatic neuralgia. In such cases, the straight leg raise test (Lasegue' sign) – the elevation of the leg straighten in the knee causes the pain in the lumbosacral region radiating along the sciatic nerve. When accompanied by neurological disorders, e.g. paresis of the lower extremity with sensation disorders or impaired function of the urinary bladder, prompt diagnosis is required – preferably using MRI to determine the indications for quick surgical interventions [1,16,23,48]. Surgical decompression of the compressed roots within 3 days gives chances for complete function recovery. After this period, the chances rapidly decrease and after two weeks, they do not exceed 50%.

In cases without paralysing symptoms, patients require immobilisation in bed on the medium-hard mattress as well as analgesics and drugs reducing muscle tone to prevent the developing contracture of the paravertebral muscles. Whenever severe pain sensations hindering the normal motor activity maintain for longer than 2 months, surgery should be considered, particularly on pain recurrence [25, 28, 33, 34, 45, 52, 54, 68].

At present, discography, associated with injection of the intervertebral space and administration of a contrast medium into the disc, is extremely rarely used for the diagnosis of discopathy. Theoretically, the test can reveal internal disc disruption yet the examination is invasive and painful, not to mention the complications that can develop [8].

Spinal degenerative disease

The degenerative changes occur mainly in the elderly; in most cases, they develop from the lesions starting in the intervertebral disc. The body „protects” against dynamic overloads, especially static ones, by forming bony thickenings that are

to strengthen the spine. They occur as osteophytes, which narrow the intervertebral foramen and press the root nerves; by narrowing the vertebral canal (stenosis), they can compress the nervous structures. The spine compression in the cervical region induces the symptoms of myelopathy or brachial neuralgia and in the lumbar region – sciatic neuralgia.

The symptoms usually develop slower than in the other compressions, such as discopathies or neoplastic tumours, and progress over many years. The degenerative-productive changes are already visible on X-ray pictures; however, they can be more accurately diagnosed on CT scans [5, 27].

The treatment of choice is surgical removal of the bony formations decompressing the affected nerve elements.

Pain, especially chronic pain, quite commonly originates from the zygapophysial joint (z-joint pain), both in the cervical and lumbar region as well as in the sacroiliac joint. According to some studies, the incidence reaches 40% of patients with chronic pain [55,56], mostly the elderly individuals in whom the degenerative-productive changes intensify and are diagnosed as osteoarthritis or chondromalacia. There are no pathognomonic symptoms enabling the diagnosis of z-joint pain. The only diagnostic measure is the blockage of the affected structures. The lesions in the upper cervical spine cause headaches in the occipital region whereas those located in the lower cervical spine induce the shoulder girdle pain. Z-joint pain is a relative common consequence of whiplash damage to the cervical spine [32,62].

Ankylosing spondylitis

The inflammatory changes in the intervertebral joint lead to ossification of the cartilages, synovial membrane and articular capsules. With time, the lesions involve the fibrous rings of intervertebral discs and spine ligaments. The disease most

commonly affects male patients; its onset is about 30 years of age and is chronically progressing.

Pain usually starts in the sacroiliac joint and subsequently involves higher spine regions. In the advanced stages, the spine bends forward (hunched forward postures) [41].

Spondylolisthesis

The essence of the disease is sliding of the vertebrae, predominantly of the 5th lumbar vertebra, in relation to the sacral bone, often at its horizontal placement. In most cases, spondylolisthesis is caused by a vertebral cleft in the vicinity of the intervertebral joint arch. Increased pain is characteristic of prolonged erect positions.

Most patients require surgical stabilisation of the sliding vertebra [6, 19, 35, 42, 53].

Neuropathic pain

Many patients experience pain even over a longer time after the underlying damage or disease irritating the ends of the sensory nerves has been cured. The pain „casts a long shadow” on the nervous system, which „remembers” the pain episode caused by the disease or injury [30,39,67]. This phenomenon was called neuropathic pain, wrongly termed as behaviour-related disorders or even hysteria. The existence of neuropathic pain can be evidenced by phantom pain – post-amputation pain when the limb was removed with the source of nociceptive pain.

Patients with neuropathic pain usually present hyperalgesia, exacerbated reactions to pain and allodynia – the pain reaction to harmless stimuli, which are not suppressed and are interpreted by the nervous system as painful experiences. Long-term pain increases the posterior sulci of the spinal cord, which are included into the mechanism of neuropathic pain development.

Neuropathic pain is not only sensory; due to increased sensory sensitivity and proneness to

reflex enhancement of the muscular tone, it can lead to impaired motor control, which in turn can hinder the recovery during rehabilitation [30].

Back pain caused by „a non-specific mechanical factor”

In this group of patients, pain is local, can extend over the adjacent regions – the iliac upper thigh area, yet do not reach below the knee. The inclusion criterion in this group is the exclusion of spinal canal compression causes, such as neoplasms, fractures, inflammatory complications, prolapse intervertebral discs (red flag).

CT and MRI do not reveal any noticeable pathology that could explain the complaints [30].

The causes of this pain are attempted to be explained by subluxation, spine fusion, myofascial trigger points or indeterminable somatic dysfunction [8].

The development of pain undetectable by imaging examinations has been interestingly explained by Liebenson [30]. Back pain can result from multiple causes: structural, psychosocial, biomechanical and neuropsychological. Contrary to expectations, the structural lesions are often undetectable during imaging examinations. Recently, it has been determined that the psychosocial factors play an important role in recovery of patients. As far as the biomechanical factors are concerned, passive mobility, active mobility, muscle strength and symmetry of spine movements have been found essential [36].

Limited spine mobility is usually a significant symptom during the acute period; in the chronic period, it can be poorly expressed. According to Mc Gregor et al. [38], spondylolisthases are associated with hypermobility whereas discopathies and degenerative changes with limited mobility.

The physical performance assessment (PPA) test has proved highly useful. The test can help to identify the specific damaging factor responsible

for mechanical overload generating the pain [26]. PPA is likely to be the best assessment test due to a strict relationship between the patient's inefficiency and specific functional disability [11].

Rissanen et al. [51] have demonstrated that non-dynamometric tests are still useful in clinical practise and are superior to accurate instrumental muscle strength measurements.

The stabilising system is important for spine biomechanics. The spine stability is defined as its ability to withstand the leaning forward on overloading. The spine is affected by various types of forces- stretching, compression, turning, etc.

According to Panjabi [43], the spine stability is maintained by 3 sub-systems: the central nervous system - control, passive osteofascial system and active nervous system. Overloading of the spine generally damages the passive ligamentous system and not the elastic muscular system, which is involved in the process of secondary overloading. Thus, the symptoms of instability observed are not caused by hypermobility of the joint but by excessive muscular agonistic-antagonistic co-activation. At good CNS control and proper motor activity, spine movements are maintained within the neutral sphere; at poor control, exceeding this sphere, they cause pain.

Impaired control of CNS is likely to cause instability of the spine even due to the lack of coordination between abdominal muscles and the diaphragm. Under normal conditions during expiration the abdominal muscles increase the activity while the diaphragm decreases it. It has been demonstrated that disorders of this interrelationship in diseases of the respiratory system or its overloading can cause spine pain [14].

The majority of pain sensations is not caused by a single huge overloading but by accumulation of multiple micro-injuries, e.g. after multiple leanings in an unfavourable position and even after long-term maintenance of improper sitting position [37].

Risk factors

Numerous risk factors of chronic spine pain syndrome have been studied and described [29,40]. The importance of low physical activity associated with poor muscle strength, endurance and elasticity, especially at the younger age, is well known.

Static overloading in long-term sitting positions has already been mentioned. Static overloading is also extremely important for inducing cervical spine pain.

Some studies evaluated the effects of socio-demographic factors; age, socioeconomic status, level of education, tobacco smoking and anthropometric conditions; e.g. height and weight.

According to their findings, the complaints most commonly started at the productive age while their incidence decreased > the age of 60 years.

Moreover, the socioeconomic status affected the development of complaints; inferior positions of workers were usually associated with harder physical work, and prolonged the period of inability to work. The level of education exerted a similar effect on inability to perform job duties [65].

The effects of tobacco smoking have been explained in the following way; decreased blood flow, hence reduced nutrition of the intervertebral discs and demineralisation of the vertebral bodies alter the fibrinolytic activity thus increasing the degenerative lesions.

As far as the anthropometric factors are concerned, height slightly affected the development of lumbar pain; otherwise, the incidence of complaints increased with higher weights, particularly among women [9].

According to the Occupational Health Guidelines (OHG) concerning Great Britain, outdoor work markedly affected the development of lumbosacral pain; lifting of weights, leaning forward, turnings of the trunk and vibrations in drivers visibly strain the lumbar spine [64].

Moreover, the correlation between back pain and lack of job satisfaction [46] and lack of social support at the workplace [17] has been observed. The lack of job satisfaction markedly affected the development of chronic pain conditions [61].

Among the risk factors of cervical spine pain, static strain, e.g. long-term looking at a computer or television screen, office work, road observation by drivers, etc, exerts the most serious effects [20,63]. The other likely risk factors are as follows: tiredness, improper head positioning during sleep, low sports activity, and psychosomatic burdens [57,60]. According to some reports [15], the prognostic risk factors of cervical spine pain include age between 51-69 years, concomitant pain in the lumbosacral region and frequent bicycle riding. Higher prevalence of cervical spine pain has been observed in women aged 30-45 years [7]. Male patients predominantly experience posttraumatic complaints – following sports accidents, road traffic accident, falls, or fights [62].

Conclusions

The above considerations demonstrate that the management of back pain has recently substantially changed, which mainly regards patients with pain caused by "non-specific mechanical factors" in whom the causes requiring immediate surgical interventions have been excluded. Such patients should be immediately qualified for multi-specialist rehabilitation.

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