Cervical radiculopathy: diagnostic aspects and non-surgical treatment
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CHAPTER 2

Degenerative cervical radiculopathy: diagnosis and conservative treatment. A review

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Chapter 2

Abstract

Objectives
To provide a state-of-the-art assessment of diagnosis and non-surgical treatment of degenerative cervical radiculopathy

Methods
A literature search for studies on epidemiology, diagnosis including electrophysiological examination and imaging studies, and different types of conservative treatment was undertaken.

Results
The most common causes of cervical root compression are spondylarthrosis and disc herniation. Diagnosis is made mainly on clinical grounds, although there are no well-defined criteria. Provocative tests like the foraminal compression test are widely used but not properly evaluated. The clinical diagnosis of degenerative cervical radiculopathy can be confirmed by magnetic resonance imaging. The role of electromyography is mainly to rule out other conditions. Cervical radiculopathy is initially treated conservatively, although no treatment modality has been evaluated in a randomised controlled trial.
Degenerative cervical radiculopathy: a review

Introduction

Cervical radiculopathy because of root compression by spondylosis or disc herniation is a common cause of pain in neck and arm, with a considerable impact on overall health status. Yet, many controversies exist regarding diagnostic procedures and mode of treatment. This paper reviews current knowledge of pathophysiology, diagnosis and non-surgical treatment.

Methods

For this literature review, articles were obtained through a comprehensive Medline search with the terms: ‘cervical’ or ‘neck’ AND ‘radiculopathy’, ‘root compression’, ‘spondylosis’, ‘disc’ without limitation of year of publication; the earliest dated from 1953. Articles were also identified from reference-lists of the articles found in the Medline search. Original articles on epidemiology, pathophysiology, diagnosis and non-surgical therapy were selected; review articles were only included in this review if they offered new insights or opinions. Papers not written in English were exluded. Finally 77 articles were reviewed in this paper.

Epidemiology

Epidemiological data on cervical radiculopathy are sparse. Radhakrishnan et al performed a large retrospective population-based study and found an annual age-adjusted incidence rate of 83.2 per 100 000 in total (107.3 for males and 63.5 for females). Male predominance has been confirmed by others. There was a clear peak incidence in the fourth and fifth decade. In a door-to-door survey in Sicily a prevalence of 3.5 per 1000, with the same age-distribution was found. Spondylarthrosis as a cause of cervical radiculopathy tends to occur more in higher age, whereas disc herniation is more common in younger patients. Not much is known about risk factors. There have been several studies suggesting that smoking is a risk factor (relative risk 2.9). Smoking is thought to have an adverse effect on vertebral blood supply leading to decreased nutrition of the disc.
Pathophysiology

The most common cause of root compression at the cervical level is narrowing of the foraminal space secondary to spondylarthrosis. The intervertebral foramina are shaped like a funnel: the entrance zone is the most narrow part. As root sleeves are conical, with their origin in the central dural sac being the largest part, the nerve root is vulnerable for compression mainly in the entrance zone of the intervertebral foramen. Laterally herniated discs are the second cause of root compression in the cervical spine. Differentiation between these two is clinically cumbersome, although neurological deficits, especially weakness, seem to occur more often in patients with soft disc prolaps.

The most common level of root compression is C7, followed by C6. Compression of roots C5 and C8 are less frequent. One possible explanation is that intervertebral foramina are largest in the upper cervical region and progressively decrease in size in the middle and lower cervical areas, with an exception of the C7-Th1 foramen, which is larger than the other cervical intervertebral foramina. The middle and lower cervical regions are most susceptible for mobility and stress. Simultaneous disc herniation at more than one level is uncommon, whereas spondylarthrosis often occurs at multiple levels. Patients who had undergone cervical fusion show accelerated degeneration at adjacent levels, which is probably partly because of the underlying tendency towards spondylarthrosis and partly because of the cervical fusion.

There is increasing evidence that inflammation in itself and/or in association with root compression is the main cause of the symptoms and signs. This is corroborated by the presence of interleukins and prostaglandin in herniated discs and the spontaneous recovery within weeks or months in the majority of patients.

Clinical diagnosis

Clinical features
Cervical radiculopathy is largely a clinical diagnosis, albeit that there is a lack of well-defined clinical criteria. The classic clinical picture includes neck pain with irradiation to the arm and fingers corresponding to the dermatomes involved, paraesthesias in arm and hand in conjunction with diminished muscle tendon reflexes, sensory disturbances and/or motor weakness with dermatomal/myotomal distribution.
Two major studies including 100 and 561 patients, respectively, report that paraesthesias were present in 91% and 89.7%, respectively, sensory loss was found in 24% and 33.0%, respectively, symptoms of weakness in 34% and 15.3%, signs of weakness in 70% and 64.2%, respectively, and hypoactive tendon reflexes in 72% and 84.1%, respectively.

Patients often report that neck movements and manoeuvres causing increased intraspinal pressure like coughing and sneezing worsen the pain or tingling in the arm. Neck pain itself is not necessarily present or minor compared with the arm pain. Atypical clinical symptoms as chest, breast and jaw pain are described; in a retrospective study of 241 patients with a C7 radiculopathy, 16% had 'atypical' symptoms as subscapular pain and chest pain. Also pain along the medial border of the scapula is quite common.

Prognostic tests
Prognostic tests elicit or worsen symptoms in the affected arm and are indicative of cervical radiculopathy. A recent systematic review showed that only six studies evaluating the diagnostic accuracy of prognostic tests could be included. A meta-analysis was not performed due to several methodological flaws. Although no firm conclusions could be drawn, the review suggested that, when consistent with the history and other physical findings, the foraminal compression test, described by Spurling in 1953, and Valsalva’s manoeuvre might be indicative of a cervical radiculopathy, while a negative upper limb tension test (ULTT) might be used to rule it out. In cases of extradural cervical root compression, shoulder abduction often causes relief of radicular symptoms. This ‘shoulder abduction relief sign’ is also called the shoulder abduction test.

Imaging
The clinical diagnosis cervical radiculopathy can be confirmed by demonstration of root compression using MRI which is the method of choice to detect disc protrusions, whereas thin slices spiral CT is possibly superior in showing foraminal stenosis by bony
Table 1. Causes of arm pain mimicking degenerative cervical radiculopathy

<table>
<thead>
<tr>
<th>With paraesthesias and neck pain</th>
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<tbody>
<tr>
<td>Cervical root compression</td>
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<tr>
<td>Tumors</td>
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<tr>
<td>Cysts</td>
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<tr>
<td>Trauma</td>
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<td>Cervical root inflammation</td>
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<tr>
<td>Lyme borreliosis</td>
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<td>Herpes zoster</td>
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<tr>
<th>With paraesthesias without neck pain</th>
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<tbody>
<tr>
<td>Brachial plexus</td>
</tr>
<tr>
<td>Parsonage-Turner syndrome or neuralgic amyotrophy</td>
</tr>
<tr>
<td>Tumors</td>
</tr>
<tr>
<td>Radiation-induced brachial plexopathy</td>
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<tr>
<td>Thoracic outlet syndrome</td>
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<tr>
<td>Nerve</td>
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<tr>
<td>Carpal tunnel syndrome</td>
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<tr>
<td>Ulnar nerve entrapment at the elbow</td>
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<table>
<thead>
<tr>
<th>With neck pain, and sometimes referred pain</th>
</tr>
</thead>
<tbody>
<tr>
<td>Facet-joint pain, ligamentous pain</td>
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</table>

<table>
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<tr>
<th>Without paraesthesias and without neck pain</th>
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<tbody>
<tr>
<td>Shoulder</td>
</tr>
<tr>
<td>Rotator cuff injury</td>
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<tr>
<td>Arthritis</td>
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<tr>
<td>Bursitis</td>
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<td>Elbow</td>
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<tr>
<td>Epicondylitis</td>
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<tr>
<td>Arthritis</td>
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<tr>
<td>Heart</td>
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<td>Myocardial ischaemic pain</td>
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</table>

Compression. No data are available on the diagnostic accuracy of both methods. MR-myelography and CT-myelography are reported to achieve higher sensitivity rates. The imaging data should always be interpreted in the clinical context as particularly MRI.
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often yields false positive results showing abnormalities in asymptomatic patients. This also holds true for plain X-ray studies that exhibit ‘degenerative’ changes increasing with age unrelated to clinical signs and symptoms and may therefore be considered obsolete in the regular diagnostic work-up of a patient with cervical radiculopathy.

Electrophysiologic studies

The diagnostic value of conventional needle myography (EMG) is still a matter of debate. Reported sensitivities from unblinded studies vary from 30 to 95%. EMG results were compared with data on root compression verified during surgery, or obtained by MRI or clinical examination. A standard screening program of 6 to 8 limb and paraspinal muscles representing the different myotomes was recommended. As most C6 muscles are also innervated by C5 or C7 identifying a C6 radiculopathy by EMG alone will be difficult. Paraspinal muscle examination seems to be more sensitive but technically more challenging with often false-positive results in elderly patients. Needle electromyography can also be used to determine the stage and severity of the root compression. Abnormal spontaneous activity may appear in severe cases three weeks after onset of symptoms as a sign of axon loss. In cases of chronic radiculopathy neurogenic recruitment patterns can be seen as a result of collateral sprouting. Flexor carpi radialis H-reflexes were delayed or absent in 21 of 25 patients with C6 or C7 compression and normal with C5 and C8 radiculopathies. F-waves did not contribute much to diagnosing cervical radiculopathy. Probably the most important role of neurophysiologic examination is to rule out other conditions like median or ulnar nerve entrapment with nerve conduction studies.

Non-surgical treatment

The natural course of spondylotic and discogenic cervical radiculopathy is generally favourable. Disc herniations often resolve spontaneously. Surgery is only indicated for patients with intractable or long lasting pain. Usually there is a wait and see policy in which the patient is treated with analgesics. Although one might expect a positive effect of anti-inflammatory drugs like non-steroidal anti-inflammatory drugs (NSAIDs) because of the supposedly inflammatory component in radiculopathy no evidence for that was found. It is equally unknown if oral corticosteroids have a beneficial effect on
Well-designed trials on conservative treatment of cervical radiculopathy are not available. Persson et al have conducted the only randomised clinical trial (RCT) comparing three modes of treatment. Patients with long-lasting (more than 3 months) cervical radiculopathy were randomised for surgery, physiotherapy or cervical collar. Surgery was superior for pain relief at 4 months follow-up (p<0.05). At 16 months follow-up there was no difference between the three groups regarding pain, muscular strength or sensory loss. In 1966 the British Association of Physical Medicine conducted a randomised clinical trial including 493 patients with cervical root symptoms, treated with traction, placebo traction, collar, placebo tablets or placebo heat treatment. No significant difference in pain and in ability to work was found between the five treatment groups. Seventy-five percent of patients reported pain relief at four weeks follow-up in all treatment arms. Although the methodology of this trial does not fulfil current criteria of RCTs, it demonstrates the favourable spontaneous course of cervical radiculopathy.

**Exercise therapy**

A recent systematic review on exercise for patients with neck pain (with or without radicular arm pain) concluded that specific exercises may be effective for the treatment of mechanical neck disorders. Four studies were included encompassing patients with neck pain and at least some radicular findings. One of these is the study of Persson et al, described above. In the other three studies, it remained unclear how many patients had cervical radiculopathy and what the effect of exercise was in this subgroup. Yet, exercise therapy is probably one of the most widely used interventions for cervical radiculopathy.

**Manipulation**

A systematic review studying the effect of manipulation and mobilisation techniques in patients with mechanical neck disorders showed that manual therapy probably results in more short-term pain-relief than does exercise therapy or usual medical care in atypical neck pain without radiculopathy. However, there was insufficient evidence for the effect of manipulative techniques in the subgroup with cervical radiculopathy. Moreover, cervical spine manipulation carries a risk of complications like vertebral dissection and spinal cord compression due to massive disc herniation. Therefore, this intervention should be discouraged in cervical radiculopathy, especially if imaging of the spine has not yet been performed.
Cervical collar

The effectiveness of treatment with a cervical collar has not been settled. Many authors state that the use of a collar reduces pain by minimizing motion and nerve root irritation. 12 22 41 69-71 In the previously mentioned study of Persson et al. no benefit was found of a cervical hard collar, surgery or physiotherapy in patients with cervical radiculopathy lasting more than 3 months. 57 58 A collar is usually prescribed in the acute or subacute stage. Longer use might cause adverse effects due to immobilisation such as atrophy of the paraspinal muscles. 18 22 No clear evidence about the different types of cervical collars used as an intervention in cervical radiculopathy is available. Hard collars are uncomfortable, soft collars do not give enough support. Semi-hard collars might be a good compromise.

Nerve root blocks

Selective diagnostic nerve root blocks have been reported as a diagnostic tool in multilevel radiculopathy as well as a therapeutic tool. 72 A cohort study by Bush and Hiller showed favourable results of foraminal steroid injections. 53 73 Sixty eight patients with cervical radiculopathy were treated with serial periradicular/epidural corticosteroid injections. All patients made a satisfactory recovery without the need for surgical intervention. A control group was not available, hampering a robust conclusion about its effectiveness. Recently, the first randomised study on transforaminal steroid injections has been published, which failed to show any positive effect. 72 Forty patients with cervical radiculopathy were randomised for injections with steroids/local anaesthetics or saline/local anaesthetics. At follow-up, no difference was found in subjective symptom reduction. Foraminal injections can cause minor complications like injection-induced pain. 74 75 Serious vascular complications causing anterior spinal artery syndrome and cerebellar strokes have been described as a rare complication. 74-77 As long as there are no well controlled, positive studies, this treatment with potential serious complications 74-77 should not be advocated.

Conclusion

It is truly amazing that there is lack of evidence with regard to diagnostic procedures and treatment interventions in such a frequent condition as degenerative cervical radiculopathy. The diagnosis, mainly made on clinical grounds, is not considered as difficult, but establishing the exact level of root compression is problematic due to the poor localising
value of the clinical symptoms and signs. The foraminal compression test and Valsalva’s manoeuvre are the best known tests on physical examination. The clinical diagnosis cervical radiculopathy can be confirmed by demonstration of root compression using MRI. Electromyography can be useful in identifying severe cases, but its main value it to rule out other conditions. Cervical radiculopathy is initially treated conservatively, although no treatment modality has been evaluated in a randomised controlled trial and therefore the superiority of conservative interventions to the spontaneous recovery is unknown.
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