Cervicogenic Headache
Practical Approaches to Therapy

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Abstract

Cervicogenic headache is a relatively common and still controversial form of headache arising from structures in the neck. The estimated prevalence of the disorder varies considerably, ranging from 0.7% to 13.8%. Cervicogenic headache is a ‘side-locked’ or unilateral fixed headache characterised by a non-throbbing pain that starts in the neck and spreads to the ipsilateral oculo-frontotemporal area. In patients with this disorder, attacks or chronic fluctuating periods of neck/head pain may be provoked/worsened by sustained neck movements or stimulation of ipsilateral tender points. The pathophysiology of cervicogenic headache probably depends on the effects of various local pain-producing or eliciting factors, such as intervertebral dysfunction, cytokines and nitric oxide. Frequent coexistence of a history of head traumas suggests these also play an important role. A reliable diagnosis of cervicogenic headache can be made based on the criteria established in 1998 by the Cervicogenic Headache International
Study Group. Positive response after an appropriate nerve block is an essential diagnostic feature of the disorder. Differential diagnoses of cervicogenic headache include hemicrania continua, chronic paroxysmal hemicrania, occipital neuralgia, migraine and tension headache.

Various therapies have been used in the management of cervicogenic headache. These range from lowly invasive, drug-based therapies to highly invasive, surgical-based therapies. This review evaluates use of drug therapy with paracetamol and NSAIDs, infliximab and botulinum toxin type A; manual modalities and transcutaneous electrical nerve stimulation therapy; local injection of anaesthetic or corticosteroids; and invasive surgical therapies for the treatment of cervicogenic headache. A curative therapy for cervicogenic headache will not be developed until increased knowledge of the aetiology and pathophysiology of the condition becomes available. In the meantime, limited evidence suggests that therapy with repeated injections of botulinum toxin type A may be the most safe and efficacious approach. The surgical approach, which includes decompression and radiofrequency lesions of the involved nerve structures, may also provide physicians with further options for refractory cervicogenic headache patients. Unfortunately, the paucity of experimental models for cervicogenic headache and the relative lack of biomolecular markers for the condition mean much is still unclear about cervicogenic headache and the disorder remains inadequately treated.

Cervicogenic headache, a clinically defined headache syndrome, is thought to originate from nociceptive structures in the cervical spine or occipital area. Early publications on cervicogenic headache include works by Barré and Bárschi-Rochaix. They hypothesised that head pain could originate from structures in the neck or occipital area. Barré used the term ‘syndrome sympatique cervicale supérieur’, and Bárschi-Rochaix introduced the term ‘migraine cervicale’ for headaches that might originate from the cervical spine. In these hypotheses, the crucial feature that distinguishes cervicogenic headache from other headache syndromes is the concept that the pain originates from a structural abnormality in the cervical spine.

In 1983, Sjaastad et al. formally introduced the concept of cervicogenic headache after a clinical study involving patients with a rather uniform unilateral headache. In 1990, Sjaastad et al., on behalf of the Cervicogenic Headache International Study Group, published diagnostic criteria for cervicogenic headache, with refinements to the criteria published in 1998.

Notwithstanding a long history of evolution and the publication of many clinical studies and reports on the subject, the concept of cervicogenic headache remains controversial. This controversy is reflected in the discordant headache syndrome criteria accepted by the two international organisations concerned with head pain. The International Association for the Study of Pain classification includes cervicogenic headache as a distinct headache syndrome, whereas the 1988 International Headache Society (IHS) Classification Committee did not accept cervicogenic headache as a specific diagnostic headache category. The latter society considers the concept of cervicogenic headache, as defined by the criteria of Sjaastad et al., to be not sufficiently validated in the absence of demonstrable neck pathology. The IHS classification includes only ‘headache associated with disorder of the neck’ (cervical spine: code 11.2.1) to accommodate headaches closely associated to disorder in the neck. Furthermore, several proposals aimed at updating the criteria for cervicogenic headache in the most up to date IHS classification of headache, which has been pub-
lished in 2004, have not yet been completely accept-
ed (table I).[10]

1. Epidemiology

When Nilsson[11] used a questionnaire to estimate the prevalence of cervicogenic headache according to IHS criteria, their prevalence figure for the general population was 2.5%. Monteiro,[12] in a population study using the criteria of Sjaastad et al.,[4] reported a 1% prevalence of cervicogenic headache amongst patients experiencing headache when all six of six diagnostic criteria had to be met to make the diagnosis; the prevalence increased to 4.6% when only five of these criteria had to be met.[12] Pfaffenrath and Kaube,[13] in a hospital-based study using the criteria of Sjaastad et al.,[4] reported a prevalence of 13.8% among 5520 patients experiencing headache.[13] In another hospital-based study, D’Amico et al.,[14] also using the criteria of Sjaastad et al.,[4] reported a prevalence of 0.7% among 440 headache patients. These differences in reported prevalence could be explained by differences in patient selection. D’Amico et al.,[14] for example, selected only patients with long-lasting unilateral headaches and then performed a greater occipital nerve block to confirm the diagnosis of cervicogenic headache, an approach that would tend to underestimate the prevalence of the condition.

It is difficult to assess the true prevalence rate of cervicogenic headache from these aforementioned studies because (i) different criteria for cervicogenic headache have been used in the studies; and (ii) varying epidemiological study designs were employed, i.e. population- versus clinic-based studies.

2. Clinical Picture

Cervicogenic headache is, in principle, a ‘side-locked’ or unilateral fixed headache, but it may also be bilateral. The pain typically starts in the neck or at the occipital-nuchal area and spreads to the ipsilateral oculo-fronto-temporal region, where pain is frequently maximal. A diffuse, ipsilateral shoulder and arm pain of vague, non-radicular nature or occasionally of a radicular nature, may coexist. The headache is mostly moderate in intensity with a non-throbbing character. It is a dull, boring, dragging pain, which can fluctuate in intensity. Attacks may be provoked by particular neck movements or by external pressure applied to ipsilateral tender points in the neck or occipital area. The duration of the solitary headache attack or exacerbation may range from a few hours to several days, or in some cases several weeks. Sooner or later, the solitary attacks may be substituted by a pattern of chronic fluctuating headache. Symptoms linking this headache to the neck include reduced range of motion in the neck, precipitation of the attack by mechanical stimuli or neck movements. Associated symptoms, such as nausea, photo- and phonophobia, dizziness, ipsilateral ‘blurred’ vision and dysphagia, may be present but are generally not pronounced. Women are more frequently affected than men.

An essential diagnostic feature of cervicogenic headache is a positive response, i.e. a transient pain-free period, after an appropriate diagnostic nerve block. These diagnostic blocks should be directed to the nerve(s) or anatomical structure(s) suspected of mediating or causing cervicogenic headache. Appropriate blocks in the neck or head should include structures capable of causing cervicogenic headache, such as the greater occipital nerve, the minor occipital nerve, zygapophyseal joints (facet joints), segmental nerves and intervertebral discs.[5,15]

Table I. Cervicogenic headache: summary of minimum requirements for diagnosis[10]

<table>
<thead>
<tr>
<th>Features of headache</th>
<th>Confirmatory combination</th>
<th>Provisional combination</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. Neck involvement</td>
<td>Presence of a1 and/or a2</td>
<td></td>
</tr>
<tr>
<td>a) precipitation of attacks</td>
<td>1) subjectively</td>
<td>Present</td>
</tr>
<tr>
<td></td>
<td>2) iatrogenically</td>
<td>Present</td>
</tr>
<tr>
<td>b) reduced range of motion in neck</td>
<td>Present</td>
<td></td>
</tr>
<tr>
<td>c) ipsilateral shoulder/arm pain</td>
<td>Present</td>
<td></td>
</tr>
<tr>
<td>II. Anaesthetic block effect</td>
<td>Positive</td>
<td>Positive</td>
</tr>
<tr>
<td>III. Unilaterality without sideshift</td>
<td>Present</td>
<td>Present</td>
</tr>
</tbody>
</table>

a The provisional combination is tentative.

b In nonscientific work (i.e. work not validated with controlled studies), ‘unilaterality without sideshift’ does not need to be present.
In the past, the pain of cervicogenic headache was attributed to spondylarthrosis and osteophytes. However, radiological investigative methods such as standard x-ray of the cervical spine, functional radiographs in flexion and extension, cerebral and cervical CT scans, cerebral angiography and cervical myelography do not contribute to the diagnostic work-up of individuals with cervicogenic headache.\cite{16,17}

### 3. Pathophysiology

Most forms of pain arise from direct activation or sensitisation of primary afferent neurons, especially the C-fibre polymodal nociceptors. Strain injuries to muscles or ligaments in the neck, pathological changes at the zygapophyseal joints or discs etc., may stimulate the C-fibre nociceptors. Pain impulses from the occipital region of the head and neck enter the spinal cord through the C1–C7 roots. The spinal terminals of the small fibres enter the cord in the lateral portion of the entry zone and have collateral branches, which may ascend or descend for up to three segments (in Lissauer’s tract) before synapsing in the dorsal horn laminae.\cite{18}

The role of the trigeminal nucleus in relation to pain in the face and neck was established many years ago. The trigeminal nucleus is divided into the main sensory nucleus and the spinal tract nucleus, which is located caudally in the cervical spinal cord, extending to level C3–C4. The grey matter of the brain stem that constitutes the pars caudalis of the spinal tract nucleus of the trigeminal nerve is continuous with the grey matter of the dorsal horns of the spinal cord.\cite{19} This column of neural cells is a functional continuum formed by the pars caudalis of the spinal tract nucleus of the trigeminal nerve and the grey matter of the upper three cervical spinal cord segments and may be regarded as the trigeminocervical nucleus.

Marked convergence of primary afferents of the upper three or four cervical roots with those of the trigeminocervical nucleus has been established.\cite{20,21} Connections between the trigeminocervical nucleus and the upper four cervical roots are the neuro-anatomical substrate for the spreading of pain from the cervical area to the head.\cite{20-22} This convergence forms the neuro-anatomical basis for the concept of cervicogenic headache. The nucleus caudalis contains two classes of neurons associated with sensory processing: ‘nociceptive specific’ and ‘wide dynamic range’ neurons. Some ‘wide dynamic range’ neurons receive only Aβ and Aδ input, whereas others receive strong (polysynaptic) C-fibre input, and their responses to C-fibre activation typically ‘wind up’, meaning they increase with repetitive stimulation.\cite{23} Normally, ‘wide dynamic range’ cells do not signal pain in response to non-noxious tactile stimulus; however, if they become sensitised and hyperexcitable, a non-noxious tactile stimulus will be perceived as painful. Such mechanisms may cause normal sensory input from muscles, ligaments, zygopophyseal joints etc., to become painful.\cite{24}

The concept underlying cervicogenic headache is that nociception originates from anatomical structures in the occipital region of the head and the neck. Whether sensitisation of ‘wide dynamic range’ neurons play a role in the pathogenesis of cervicogenic headache needs to be established.

Animal studies suggest that retrograde activation of the trigeminovascular system is the final common pathway for migraine.\cite{25} The trigeminovascular system is also the major pain-signalling system of the brain and the final common pathway for other headache disorders, meningeitis and arteriovenous malformation. Blood concentrations of calcitonin gene-related peptide (CGRP), a marker of trigeminal activation, increase in patients with common, as well as classical, migraine\cite{26} and after stimulation of the superior sagittal sinus in cats.\cite{27} Stimulation of the superior sagittal sinus revealed involvement of the nucleus caudalis to the level of the dorsal horn of C2.\cite{28} However, the exact role of the trigeminovascular system in the pathophysiology of cervicogenic headache remains unclear.

Other studies showed increased levels of serum interleukin (IL)-1β and tumour necrosis factor (TNF)-α in cervicogenic headache both during periods of spontaneous fluctuating basal pain and during mechanically-induced attacks.\cite{29} Statistically significant differences in cytokine levels between the
different groups were also found. In another study, patients with cervicogenic headache had higher serum concentrations of IL-1β and TNF-α during both continuous and mechanically-induced attacks compared with migraineurs without aura and controls studied during and outside spontaneous attacks.

The origin of the pain of cervicogenic headache has not yet been defined. However, enhanced production of both IL-1β and TNF-α in cervicogenic headache could represent specific signals from the immune system that result in activation of the well-known links between immuno- and neuro-peptides. The increased concentrations of IL-1β and TNF-α measured during mechanically-induced cervicogenic headache attacks could be stress-related, but this would not account for the high concentrations of these cytokines detected during the interictal phase. Although the role of these pro-inflammatory cytokines remains to be determined, it is possible that both IL-1β and TNF-α may promote hyperalgesia in cervicogenic headache.

A pivotal role for nitric oxide (NO) was recently suggested in migraine and cluster headache. We found that cervicogenic headache patients exhibited a marked activation of the NO pathway compared with patients with migraine or cluster headache. In addition, NO release resulting from spontaneous cervicogenic headache attack and cervicogenic headache pain elicited by NO donors (NOD) was unchanged. Conversely, intravenous administration of aspirin (acetylsalicylic acid) dramatically reduced the NO levels in patients with cervicogenic headache. Furthermore, assessment of cervicogenic headache pain intensity on a visual analogue scale (VAS) was not affected by the administration of NOD but revealed a marked reduction in pain scores after the administration of acetylsalicylic acid. The hypothesis that up-regulated NO synthase activity may be related to activation of the NO-ergic vascular endothelial system is widely accepted in relation to both migraine and cluster headache, partly on the basis of the demonstrated effectiveness of agents, such as triptans or hyperbaric oxygen, that act on the cerebral vasculature.

Since cerebral blood flow velocity has been shown to be unchanged during the pain phase of cervicogenic headache and oxygen, ergotamine and sumatriptan have been proven to be ineffective in cervicogenic headache, the up-regulation of the NO-ergic system that occurs during this pain phase cannot be attributed to a cerebrovascular dysfunction. It may be possible that, within a putative cervicogenic headache pathophysiology, the observed increase in NO formation in the presence of reactive oxygen species may combine with IL-1β and TNF-α to produce deleterious, proinflammatory, pain-producing effects. Indeed, in addition to the actions of familiar inflammatory mediators, such as prostaglandins and bradykinin, potentially important pronociceptive roles have been proposed for a variety of ‘exotic’ species, including the cytokines and NO. Their activation plays a key role in the induction of neuronal sensitisation, a process that underlies prolonged painful states (and possibly cervicogenic headache).

Olesen has suggested that headache may be due to an excess of nociceptive input. In his vascular-supraspinal-myogenic concept, the neurons of the trigeminal nucleus caudalis play a central role in headache. According to this model, perceived headache intensity is the sum of nociception from cranial and extra-cranial tissues converging upon the nucleus caudalis neurons.

4. Differential Diagnosis

Despite an apparent characteristic pattern of headache arising from the neck, there are still some difficulties in the differential diagnosis of cervicogenic headache, which has symptoms that overlap with those of other common primary headache syndromes. The differential diagnosis of cervicogenic headache includes (i) hemicrania continua; (ii) occipital neuralgia; (iii) migraine; and (iv) tension-type headache. The main diagnostic problem in patients with headache appears to be distinguishing cervicogenic headache from migraine without aura and tension-type headache.
4.1 Hemicrania Continua

Hemicrania continua is a rare, indometacin-responsive headache disorder characterised by a continuous, moderately severe, unilateral headache that varies in intensity, waxing and waning without disappearing completely. While hemicrania continua is not triggered by neck movements, tender points in the neck may be present. A positive therapeutic response to indometacin can distinguish hemicrania continua from cervicogenic headache.

4.3 Tension-Type Headache

Cervicogenic headache may present as a mild, non-throbbing, episodic pain that resembles tension-type headache. However, in tension-type headache there may be a ‘weight’ or pressure-like sensation, and there is often the sensation of wearing a tight skullcap. In most cases, bilateral localisation of the headache and the absence of mechanical trigger factors allow differentiation between tension-type headache and cervicogenic headache.

Bilateral cases of cervicogenic headache can complicate attempts to distinguish the condition from tension-type headache. In a study by Vincent and Luna that used the IHS criteria, only one patient with cervicogenic headache was diagnosed as having tension-type headache.

5. Drug Treatment

5.1 Paracetamol (Acetaminophen), NSAIDs and Opioids

Patients with cervicogenic headache often take simple analgesics, such as paracetamol (acetaminophen) and NSAIDs. Clinical experience indicates that, in the majority of patients with mild cervicogenic headache, these drugs provide only transient relief of the headache. However, there are no convincing clinical studies of patients with cervicogenic headache that determine the efficacy of paracetamol and NSAIDs in this setting. Because
both paracetamol and NSAIDs are often acquired in over-the-counter preparations, exact data about the efficacy of these drugs are not available. Drugs such as morphine have only a marginal effect and are generally not indicated for cervicogenic headache.\[^{37}\]

### 5.2 Ergot Derivatives

Although ergotamine is a drug compound that is still widely used in the treatment of migraine, its use in cervicogenic headache should not be recommended because it is completely ineffective in this context.\[^{29}\]

### 5.3 Serotonin 5-HT\(_{1B/D}\) Agonists

The triptans exert their agonist effects on the 5-HT\(_{1B/D}\) receptors within the trigeminal system. The efficacy of these drugs has not been established in cervicogenic headache.

### 5.4 Infliximab

In view of the observed dramatic increase in serum TNF-\(\alpha\) concentrations in patients with cervicogenic headache,\[^{49}\] we recently conducted an open-label pilot study in six patients with severe cervicogenic headache, refractory to local repeated corticosteroid treatment.\[^{48}\] Patients in this study were given infliximab, a biological agent that acts as a cytokine monoclonal antibody against TNF-\(\alpha\). The protocol, the dosage (3 mg/kg) and the timing of infusion (weeks 0, 2, 6, 14 and then every 8 weeks) were similar to those suggested for the treatment of rheumatoid arthritis\[^{49}\] and Crohn’s disease.\[^{50}\] Not surprisingly, infliximab treatment was associated with rapid and sustained effects on cervicogenic headache pain scores and self-administered analgesic consumption.\[^{48}\] Longer-term observation of this new approach to cervicogenic headache in a larger series of patients is necessary to confirm the early results of this pilot study. However, infliximab may be cautiously considered as a future therapeutic tool for neglected patients with cervicogenic headache, in whom this agent may be as effective as has been shown for refractory rheumatoid arthritis,\[^{49}\] Crohn’s disease,\[^{50}\] and, more recently, cutaneous vasculitis,\[^{51}\] myositis,\[^{52}\] psoriasis,\[^{53}\] and ankylosing spondylitis.\[^{54}\] All these diseases, like cervicogenic headache, are sustained by increased levels of the proinflammatory cytokine TNF-\(\alpha\).\[^{29,30,48}\] However, a cautious approach is still required because this treatment is based on only a few physiopathological data that have been published on this headache form.

### 5.5 Botulinum Toxin Injection

Botulinum toxin type A (Botox\textsuperscript{®}, Allergan Corporation, Irvine, CA, USA)\[^{1}\] is a focally acting neurotoxin that inhibits release of the neurotransmitter acetylcholine from presynaptic nerve endings at the neuromuscular junction, with resultant muscle relaxation. Though its mechanism of action in headache disorders is unknown, botulinum toxin type A may have antinociceptive effects apart from its muscle-relaxing effects.\[^{55}\] Data from primary culture and animal models indicate that botulinum toxin type A inhibits the local release of glutamate and neuropeptides, such as substance P and CGRP, from nociceptive neurons.\[^{56-58}\]

Treatment with botulinum toxin type A has been shown to be safe and efficacious in patients with chronic tension headache and migraine.\[^{59-61}\] The efficacy of botulinum toxin type A in patients with cervicogenic headache has also been highlighted in several case reports and in a few studies involving small numbers of selected patients.\[^{62-64}\] We also report here our 1-year data for the treatment of 23 patients with cervicogenic headache using botulinum toxin type A (unpublished data). Our data suggested substantial benefits, in terms of number of days with headache, pain scores on VAS, and expenditure on analgesics, for patients with cervicogenic headache after the fourth session of injections using the same protocol as that used to treat patients with chronic tension headache.\[^{65}\] However, at present, this approach with botulinum toxin type A could be considered as a non-approved

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1 The use of trade names is for product identification purposes only and does not imply endorsement.
Table II. Trials of spinal manipulation in patients with cervicogenic headache (CEH)

<table>
<thead>
<tr>
<th>Study</th>
<th>No. of patients</th>
<th>Diagnosis</th>
<th>Design</th>
<th>Treatment</th>
<th>Results</th>
<th>Follow-up (wks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Whittingham et al. [72]</td>
<td>26</td>
<td>Headache* B</td>
<td>Toggle recoil adjustments in upper cervical spine</td>
<td>Significant reduction in headache frequency, duration and severity in 92% of patients</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Schoensee et al. [73]</td>
<td>10</td>
<td>Headache* B</td>
<td>Mobilisation in upper cervical spine</td>
<td>Decrease in headache frequency, duration, and intensity</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>Nilsson [74]</td>
<td>39</td>
<td>CEHb A</td>
<td>High-velocity, low-amplitude cervical manipulation</td>
<td>No significant results</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Nilsson et al. [75]</td>
<td>53</td>
<td>CEHb A</td>
<td>High-velocity, low-amplitude cervical manipulation</td>
<td>Significant reduction in headache duration, intensity, and analgesic consumption in 71% of patients</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

a Unilateral headache and neck pain, heterogeneous group of patients.
b Diagnosis of CEH according to International Headache Society classification, homogeneous group of patients.

A = double-blind, randomised, controlled trial; B = observational prospective study without control group.

6. Other Treatments

6.1 Manual Therapy (Spinal Manipulation and Mobilisation)

Spinal manipulation is used in the treatment of neck pain and headache associated with symptomatic spinal segmental joint or dysfunction.[66-71] The technique used in this form of treatment is based on the results of a detailed manual examination. This manual examination, the so-called segmental spine examination, is performed to identify the precise localisation of segmental dysfunction(s) and tenderness.

Only a small number of spinal manipulation trials have been conducted in patients with headache or cervicogenic headache (table II).[72-75] Furthermore, the results were obtained 1–4 weeks after the final therapy session and a longer follow-up period will be required to establish the efficacy of spinal manipulation in cervicogenic headache.

Although there are some risks with cervical spinal manipulation (e.g. traumatic myelopathy), their prevalence is extremely low.[76,77] Nevertheless, a very cautious approach when using this technique has been recommended.[78]

6.2 Transcutaneous Electrical Nerve Stimulation Therapy

The introduction of the ‘gate control theory of pain’ in 1965 facilitated the development of afferent stimulation techniques, such as TENS therapy, for the alleviation of pain.[79] The application of TENS therapy as a pain-relieving method is by far the most extensively used biomedical technique for relieving various painful conditions, including headache syndromes. Farina et al.[80] applied TENS therapy in ten patients with cervicogenic headache, 15 patients with occipital neuralgia and 35 patients with mixed headache. Assessments were performed before and after treatment. TENS therapy was effective in 70–80% of patients in all three groups in this study. A randomised clinical trial of TENS therapy in patients with cervicogenic headache was conducted by Tarhan and Inan.[81] They found a significant improvement in the treatment group after 3 months compared with a placebo group. However, because of the nature of the treatment method, realistic placebo and blinding are an inherent problem in TENS studies.[82,83] Therefore, the results of these studies must be interpreted with caution.
### Table III. Trials of invasive treatments in patients with cervicogenic headache (CEH)

<table>
<thead>
<tr>
<th>Study</th>
<th>Patients</th>
<th>Diagnosis</th>
<th>Design</th>
<th>Treatment</th>
<th>Results</th>
<th>Follow-up (range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jansen et al. [86]</td>
<td>11</td>
<td>CEH&lt;sup&gt;a&lt;/sup&gt;</td>
<td>B</td>
<td>Vascular decompression C2</td>
<td>77% pain free, 23% improved, 23% recurrence</td>
<td>27.0 (4–125) mos</td>
</tr>
<tr>
<td>Bovim et al. [87]</td>
<td>50</td>
<td>CEH&lt;sup&gt;b&lt;/sup&gt;</td>
<td>B</td>
<td>Neurolysis of greater occipital nerve</td>
<td>46% pain free, 36% some relief</td>
<td>1wk</td>
</tr>
<tr>
<td>Sjaastad et al. [88]</td>
<td>7</td>
<td>CEH&lt;sup&gt;b&lt;/sup&gt;</td>
<td>B</td>
<td>Radiofrequency treatment planum nuchae</td>
<td>8% pain free</td>
<td>16 mos</td>
</tr>
<tr>
<td>Pikus and Philips [89]</td>
<td>35</td>
<td>CEH&lt;sup&gt;b&lt;/sup&gt;</td>
<td>D</td>
<td>Microsurgical decompression ganglion C2 (first operation)</td>
<td>33% pain free, 46% improved</td>
<td>21 (3–70) mos</td>
</tr>
<tr>
<td>Martelletti et al. [90,91]</td>
<td>12</td>
<td>CEH&lt;sup&gt;b&lt;/sup&gt;</td>
<td>C</td>
<td>Epidural corticosteroids</td>
<td>Good improvement</td>
<td>1mo</td>
</tr>
<tr>
<td>van Suijlekom et al. [92]</td>
<td>15</td>
<td>CEH&lt;sup&gt;b&lt;/sup&gt;</td>
<td>B</td>
<td>Radiofrequency neurotomy dorsal ramus C3–C6 (facet joint)</td>
<td>64% complete/good relief</td>
<td>8.8 (4–14) mos</td>
</tr>
<tr>
<td>Jansen et al. [93]</td>
<td>8</td>
<td>CEH&lt;sup&gt;c&lt;/sup&gt;</td>
<td>B</td>
<td>Dorsal cervical laminotomy and laminoplasty</td>
<td>38% pain free, 38% improvement</td>
<td>2.5 (2–3) mos</td>
</tr>
</tbody>
</table>

<sup>a</sup> Diagnosis of CEH according to International Headache Society criteria, heterogeneous group of patients.

<sup>b</sup> Diagnosis of CEH according to Sjaastad’s et al. [4] criteria, homogeneous group of patients.

<sup>c</sup> Diagnosis of CEH descriptive, heterogeneous group of patients.

A = double-blind, randomised, controlled trial; B = observational prospective study without control group; C = observational prospective study with control group; D = observational retrospective study without control group.

### 6.3 Local Injections

Injections with a local anaesthetic around the greater occipital nerve have been used to treat cervicogenic headache. In a subgroup of patients (VAS <40mm) with cervicogenic headache, Vincent [84] reported a significant relief of headache complaints during a 7-day period following infiltration of 0.5% bupivacaine 1–2mL around the greater occipital nerve. Anthony [85] suggests that the results of repeated local injections of an anaesthetic solution around the greater occipital nerve may be more favourable by combining these with corticosteroids. Nevertheless, long-lasting headache relief has only been achieved using local injection therapy in isolated cases, and this approach cannot at present be considered a long-term treatment modality.

### 6.4 Invasive Therapy

Cervicogenic headache is hypothesised to eminate from nociceptive structures in the cervical spine. Therefore, different surgical therapies have been proposed to resolve head pain in patients with this condition (table III).

Jansen et al. [86] selected a group of 11 patients experiencing severe hemicranial attacks to undergo neurosurgery. In nine of these patients, a vascular compression due to varicose veins (n = 7) or arterial loops (n = 2) in the vicinity of the C2 root was found at operation. The aim of the operation was to release the nerve roots from vascular compression. Positive postoperative results were obtained (table III). Recurrence of head pain occurred in two patients who were further treated by a percutaneous radiofrequency lesion of the dorsal root ganglion C2; this resulted in one patient becoming pain-free.

Pikus and Philips [89] performed a similar study. They operated on 35 patients with cervicogenic headache and performed 39 decompressions of the C2 root and ganglion. Bilateral decompression was performed in four patients. Retrospective analyses yielded good results at a mean follow-up of 21 months (table III). Recurrence of symptoms was reported in 21% of patients at an average follow-up.
of 18 months. In this study, the investigators decompressed the C2 root and ganglion by removing ligamentous and venous structures. During such an operation, electrocautery of small vessels is essential because the C2 ganglion is normally situated amidst an impressive venous plexus. For this reason, Stechison[94] has suggested that traumatisation of C2 by electrocautery may explain these results.

Entrapment of the greater occipital nerve in its peripheral course is considered a possible pathogenic mechanism for cervicogenic headache.[87] Thus, Bovim et al.[87] speculated that neurolysis of the greater occipital nerve in the nuchal musculature, with special attention to the point where the greater occipital nerve penetrates the trapezius muscle, might be beneficial in patients with cervicogenic headache. Accordingly, these investigators performed this procedure in an uncontrolled trial involving 50 patients with cervicogenic headache.[87] Although positive results were attained at 1-week follow-up, head pain gradually recurred in the majority of patients over a follow-up period of 16 months (table III). The investigators concluded that this liberation operation at the greater occipital nerve should not be performed in patients with cervicogenic headache.

Martelletti et al.[90] attempted to assess the short-term efficacy of cervical epidural corticosteroids in nine patients with cervicogenic headache diagnosed according to the criteria of Sjaastad et al.[4] The control group consisted of six patients with tension-type headache who received a cervical epidural injection with methylprednisolone 40mg in 3–4mL of saline. The short-term (1 month) results revealed significantly lower scores on the Numeric Pain Intensity Scale in the cervicogenic headache group compared with the control group. However, progressive clinical worsening occurred during 6-month follow-up in the cervicogenic headache group, indicating that cervical epidural injection with corticosteroids has no place in the therapeutic arsenal.[91]

Radiofrequency lesion therapy has proved beneficial in different pain syndromes.[95-98] Radiofrequency lesions are controllable heat lesions that can reduce nociceptive input.[99-101] It has been theorised that cervicogenic headache might be the result of an aberrant nociceptive input from different sources in the neck into the CNS.[93,102] Therefore, reducing some of this input may decrease pain in patients with cervicogenic headache. Sjaastad et al.[88] selected a group of seven patients with cervicogenic headache for percutaneous radiofrequency treatment of the periosteum of the external surface of the occipital bone (planum nuchale) on the symptomatic side.[88] Use of this technique was described by Blume et al.[103] in patients with persistent myalgia-neuralgia syndrome. In the study by Sjaastad et al.[88] five of seven (71%) patients reported improvements of varying degrees over a follow-up period of 4.5 years (table III). One of the two patients who did not improve developed a local effusion in the operated area after 10 days; this effusion persisted for approximately 2 months. Van Suijlekom et al.[92] conducted an open, prospective study in 15 patients with cervicogenic headache to assess the clinical efficacy of radiofrequency cervical zygapophyseal joint neurotomy (table III). This study reported good results after long-term follow-up (mean 16.8 months). Efficacy appeared to be maximal 4–14 months (mean 8.8) after treatment, and there was a tendency for some variables to worsen gradually over the long-term follow-up period.

In 1999, Jansen[93] reported the results of dorsal decompressive laminotomy and laminoplasty in the cervical spine in eight patients with headache originating from the neck. Good results were obtained, with 76% of patients reporting at least some improvement (table III). However, the follow-up period in this study was too short (2.5 months) to determine whether this treatment is a therapy of choice in a selected group of patients. Jansen[93] suggested that the dura mater, with its nociceptive nerve fibres, might be an important trigger mechanism for cervicogenic headache in some patients.

Surgical ‘decompression’ procedures are considered to be more or less ‘causal’-related therapies, while radiofrequency lesions can be considered ‘symptomatic’ treatment modalities.[100] However, radiofrequency lesions are much less invasive than...
surgical (vascular) ‘decompression’ procedures. Review of the literature on invasive therapy, with its broad spectrum of treatment modalities, does not allow the identification of a preferable sequence of therapies. However, less invasive therapy is obviously preferable to highly invasive therapy.102

7. Conclusion

As illustrated in this article, an armamentarium of therapies, including medications, manual therapy, injections and invasive treatments, are used in the management of cervicogenic headache. Treatment has largely been surgical, especially for patients in whom conservative treatment has failed. Greater knowledge of the aetiology and pathophysiology of cervicogenic headache is needed to establish a specific, curative therapy for this condition. In the absence of this information, the aim should be to treat patients as effectively as possible without causing serious adverse effects. Therapy with repeated injections of botulinum toxin type A seems to be the most safe and efficacious approach at this time. Further double-blind controlled studies are required to assess the efficacy of this approach in a large series of patients with refractory cervicogenic headache.

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