Cervicogenic headache: Techniques of diagnostic nerve blocks

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ABSTRACT

The term cervicogenic headache (CEH) was introduced by Sjaastad and co-workers in 1983. In 1990 Sjaastad et al. published diagnostic criteria for CEH. In 1998 refinements of these criteria were published, emphasising the use of diagnostic nerve blocks in patients with CEH as important confirmatory evidence. However, the standardisation of diagnostic nerve blocks in the diagnosis of CEH remains to be defined. Herein we present an overview of diagnostic nerve blocks in the cervical area. Suggestions as to their role in the diagnosis of CEH are given.

Introduction

Cervicogenic headache (CEH) is a clinically defined headache syndrome which is hypothesised to originate from nociceptive structures in the cervical spine. Early publications of this concept were offered by Barré, Bärtschi-Rochaix and Hunter and Mayfield (1-3). In 1983 Sjaastad and colleagues introduced the term cervicogenic headache (CEH) to describe a headache arising from the neck and radiating to the ipsilateral frontotemporal and orbital regions (4). CEH is, in principle, a unilateral headache without sideshift but it may also be bilateral. A diffuse ipsilateral neck, shoulder or arm pain of a non-radicular nature may occur. Symptoms and signs referable to the cervical spine are essential. In 1990 Sjaastad *et al.* published the first diagnostic criteria for CEH (5). In these criteria, diagnostic nerve blocks with the use of a local anaesthetic solution were not mandatory. Recently refinements of these criteria were published, adding the use of diagnostic nerve blocks as important confirmatory evidence in diagnosing CEH (6). Moreover, a positive response to a diagnostic nerve block is an obligatory point for CEH in scientific work.

A possible neuro-anatomical basis for CEH is convergence in the trigeminocervical nucleus between nociceptive afferents from the field of the trigeminal nerve and the receptive fields of the first three cervical nerve roots (7-11). This may imply that CEH mainly emanates from structures innervated by the first three cervical nerve roots, whereby the C2 cord segment provides an important relay of afferent fibres (12,13). However, other observations suggest that headache may also arise from structures in the lower cervical spine (14-16). Various structures in the cervical spine are capable of causing neck pain and headache such as the zygapophyseal joints, segmental nerves, dorsal root ganglia, intervertebral discs, muscles and ligaments (11, 15, 17-19). Other authors have reported the existence of venous vascular and non-vascular compression of the upper cervical roots in patients with CEH (20, 21).

Although diagnostic nerve blocks are an obligatory point in establishing the diagnosis of CEH, a description of the techniques is lacking. The aim of this paper is to summarise the existing literature on techniques of diagnostic nerve blocks in the cervical area.

Diagnostic nerve blocks

A diagnostic block is a temporary reversible block with a local anaesthetic solution directed to a target nervous structure with the intention of relieving the (head)pain. Not every anatomical structure in the cervical spine which is innervated, e.g. the dura mater and vertebral artery, can be blocked reliably. This may be due to: 1) problems in approaching the anatomical structure safely; or 2) a multi-segmental innervation of the structure.

Diagnostic blocks should be directed to the nerve(s) or structure(s) suspected of mediating or causing CEH. Appropriate blocks in the cervical spine should include structures capable of causing CEH such as: the greater occipital nerve (GON), minor occipital nerve (MON), zygapophyseal joints (facet joints), segmental nerves and intervertebral discs (6,

13, 16). Sometimes additional information may be obtained by combining diagnostic nerve blocks. Diagnostic blocks aimed at deeper anatomical structures should be done using fluoroscopic control to enhance reliability (22-24). It is also recommended to use a contrast medium (Iohexol, Omnipaque 300®) to check the position of the needle in relation to the target and to prevent intravascular or intrathecal injection. The quantity of the local anaesthetic solution should be as small as possible to prevent overflow to other structures. Severe coagulation disturbances are a contraindication to the performance of the more invasive diagnostic blocks. Pain relief after diagnostic nerve block is generally assessed 30 minutes after the procedure by means of a 4-point Verbal Rating Scale and a Visual Analogue Scale (VAS).

Techniques of diagnostic nerve blocks

Diagnostic block of the greater occipital nerve

Block of the greater occipital nerve (GON), the medial branch of the C2 dorsal ramus, is technically easy to perform (18, 25-27). A 22G needle is placed approximately 2 cm lateral and 2 cm inferior to the external occipital protuberance. After contact with the periosteum of the occipital bone, the needle is retracted a distance of approximately 0.5 cm. Then 1.0 - 2.0 ml of a local anaesthetic solution, e.g. Lidocaine 2%, is injected. Assessment of the sensory deficit of the ipsilateral scalp is performed to confirm the accuracy of the injection near the GON. Fluoroscopy is not necessary for this peripheral nerve block.

Diagnostic block of the minor occipital nerve

The minor occipital nerve (MON) arises from the ventral ramus of C2 with a variable contribution of the ventral ramus of C3 (28). The sensory innervation area is behind the ear. A diagnostic block of this nerve is performed with a 22 G needle inserted at the mastoid process posterior to the ear. The injected volume is 1-2 ml Lidocaine 2%. Sensory loss is assessed to determine whether the injection has been correctly administered near the MON. Fluoroscopy is not indicated.

Diagnostic block of the zygapophyseal joints

The zygapophyseal joints are innervated by the medial branches of the dorsal rami of the segmental nerves (29, 30). Each zygapophyseal joint is ipsilaterally and bisegmentally supplied by branches from the dorsal ramus of its own segment and from one level cephalad. As a consequence, a diagnostic block of one zygapophyseal joint involves a block of the two adjacent medial branches of the dorsal rami.

Fig. 1. Diagnostic nerve block of the medial branches of the dorsal rami C3, C4 and C5. The needles are positioned at the base of the superior articular processes and make contact with the bone. C-arm in the 20°- 30° oblique and 10° caudocranial projections.

There are two reliable techniques to perform a diagnostic block of the zygapophyseal joints: a) the dorsal-lateral approach (31); and b) the lateral approach (32).

In the dorsal-lateral approach, the patient is positioned supine on the operating table. The C-arm of the fluoroscope is positioned slightly obliquely so that the X-rays are parallel to the axis of the intervertebral foramen which is positioned upwards and slightly caudally (24, 31). The dorsal ramus in this projection runs over the base of the superior articular process (Fig. 1). The entry points of the needles are marked posterior to the posterior border of the bony column of the zygapophyseal joints and slightly caudal to the target point. A 22 gauge 50 mm Neurography® needle (Radionics) is introduced and carefully advanced anteriorly and cranially until contact is made with the base of the processus articularis superior. The position of the C-arm is changed to the anterior-posterior (AP) direction. This should confirm the position of the tip of the needle adjacent to the "waist" of the articular pillars of the cervical spine at the corresponding level (Fig. 2). To avoid an intravascular injection, 0.2 - 0.3 ml of contrast medium (Iohexol, Omnipaque 300®) is injected. The injected volume of local anaesthetic solution is 0.5 ml. Lidocaine 2%.

In the lateral approach the patient is positioned supine on the operating table. The C-arm of the image intensifier is positioned in a lateral projection. The target point is the centroid of the articular pillar. Entry points are marked over the centroid and 22 G Neurography® needles are advanced in a lateral projection until contact is made with bone of the articular pillar (32). After the injection of 0.2 - 0.3 ml contrast medium, 0.5 ml of Lidocaine 2% is administered.

Diagnostic segmental nerve block

A diagnostic segmental nerve block at the C3, C4 and C5 levels is performed using the C-arm fluoroscope positioned so that the X-rays are parallel to the axis of the intervertebral foramen (23, 24, 31). This axis points 25-35° anteriorly and 10° caudally. With the C-arm in this position, the entry point is found by pro-

Fig. 2. Diagnostic nerve block of the medial branches of dorsal the rami C3, C4 and C5. The needles are positioned in the "waist" of the articular pillars. The C-arm is in the AP projection.

jecting a metal ruler over the caudal part of the foramen. A 50 mm 22G Neurography® needle is introduced in the direction of the X-rays. If necessary the direction is corrected while the tip is still in the superficial layers, until the needle is projected on the monitor screen as a dot ("tunnel vision" technique). In practise this dot should lie directly over the dorsal wall of the caudal part of the intervertebral foramen. The direction of the C-arm is then changed to AP and the canula is further introduced until the tip is projected just lateral from the bony column of the zygapophyseal joints. After the segmental nerve has been identified with 0.2-0.3 ml Iohexol contrast medium, 0.5 ml Lidocaine 2% is slowly injected (Fig. 3). During the injection the resultant radio-opaque mixture is observed to avoid accidental overflow into the epidural space. Relief of headache will be assessed 30 minutes after the procedure.

At the C2 level the diagnostic nerve block is performed differently since the anatomy at that level is different. The foramina start at the C3 level. The C2 nerve exits from the arch of the atlas (C1) and the lamina of the axis (C2). The C-arm is positioned in a lateral view and the arch is visualised. A 50 mm 22G Neurography® needle is introduced in a lateral approach in the direction of the X-rays and advanced using the "tunnel vision" technique (Fig. 4). The direction of the C-arm is changed to AP and the canula is further introduced until the tip is projected just laterally from the imaginary extended line of the bony column of the zygapophyseal joints. After the injection of 0.2-0.3 ml Iohexol showing the outline of the C2 segmental nerve, 0.5 ml Lidocaine 2% is slowly injected. Assessment of headache relief is done 30 minutes after the procedure.

Fig. 3. Diagnostic segmental nerve block C3. C-arm in the AP projection after the injection of 0.2 - 0.3 ml of contrast medium (Iohexol, Omnipaque 300®).

Diagnostic disc block

A diagnostic cervical disc block is performed with the patient in a supine position on the operating table. We use the analgesic discography technique to assess adequate headache relief. Using radiological control, the C-arm is positioned in a 50° oblique projection (24, 33). Projection of the disc without double contours is achieved by changing the projection along the horizontal axis. At the selected disc level an entry point is marked, the carotid vessels are displaced laterally and a SMK-C5 (Sluijter-Metha Kit, Insulated Cannula 5 cm) needle is introduced at the right side approaching from anterior.

The needle passes the vessels medially and is carefully advanced under "tunnel vision" fluoroscopy until the tip is close to the disc. After entering the disc the needle is advanced slightly further until the tip lies in the middle of the disc on both the lateral and AP projections (Figs. 5 and 6). When the needle is in the correct position, 0.5 - 1.0 ml of a mixture of two parts Lidocaine 2% and one part Iohexol is injected. During the injection of this mixture continuous fluoroscopy is performed to prevent leakage from the disc to the epidural space. Assessment of headache relief is performed after 30 minutes.

A diagnostic block of the cervical intervertebral disc is routinely performed from the right side to prevent perfora-

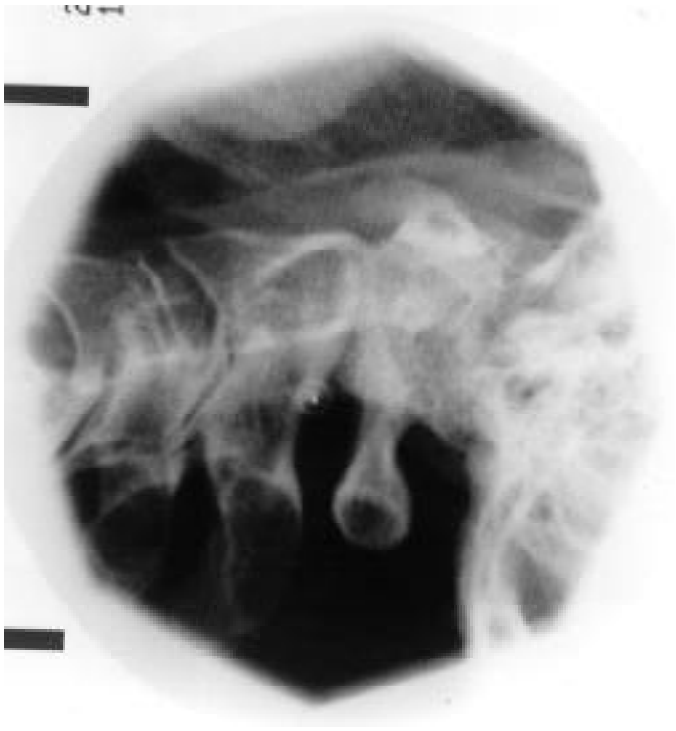

Fig. 4. Diagnostic segmental nerve block C2. C-arm in lateral projection. The needle is projected as a dot in "tunnel vision" technique.

tion of the oesophagus, since the oesophagus is situated to the left of the median line (34). There is an increased risk of discitis when a perforation of the oesophagus or pharynx occurs.

The anterior approach is not suitable for the upper two levels, since it carries the risk of puncturing the pharynx (24). The approach of choice for the levels C2-C3 and C3-C4 is to introduce the needle from the posterior to the carotid vessels in a slightly oblique projection. The procedure is continued as described above. The posterior-lateral approach for the higher disc levels has, on occasion, been found to be technically impossible due to the presence of a large uncinate process.

Fig. 5. Diagnostic disc block C5-C6. Needle in the centre of the disc with the C-arm in lateral projection.

Discussion

Diagnostic blocks are included in the recently published criteria to diagnose CEH. At first sight diagnostic block seems to be the obvious method to confirm the diagnosis of CEH. However, there are some practical problems which limit its usefulness. These problems may lead to false-positive and false-negative diagnostic blocks. Reliable evaluation of diagnostic blocks implies that, apart from considerations such as the importance of administering small volumes of local anaesthetic solution and contrast dye to prevent overflow to adjacent structures, the patient's report of pain reduction must be unequivocal (22,23,35). Furthermore, lack of communication between the doctor and the patient, patient involvement in litigation procedures, psychological factors, coexisting social problems and placebo responses may be other sources of false-positive blocks (36, 37). A false-negative block may also result after incorrect needle placement, such as inadvertent injection too far away from the target structure or intra-vascular injection of the local anaesthetic solution.

A positive diagnostic block is an important criterion to establish the diagnosis of CEH, but it may also be an indicator for the advisability of therapeutic modalities such as radiofrequency lesions (RF-lesions) or other surgical procedures. In a recently published prospective study it was demonstrated that radiofrequency cervical zygapophyseal joint neurotomy for patients with CEH could be a beneficial treatment (38). Van Kleef *et al.* demonstrated in a prospective double-blind randomised study that RF-lesions induced adjacent to the dorsal root ganglion resulted in a significant reduction of the pain in patients with cervicobrachial pain (39). A definite conclusion regarding the value of RF-lesions in the cervical area will only be possible when randomised clinical trials on patients with CEH have been conducted.

According to Bovim *et al.*, a diagnostic block of the GON, which is the medial branch of the C2 dorsal ramus, is easier to perform and has fewer side effects than a diagnostic C2 block (18). In his study the complete effect obtained with GON block in 4 of the 5 patients who

Fig. 6. Diagnostic disc block C5-C6. Needle in the centre of the disc with the C-arm in AP projection.

responded to C2 block, suggests that the simpler GON block may be sufficient in many patients with CEH. Bovim *et al*. performed diagnostic blocks of the cervical segmental nerves following the technique of Moore, using anatomic landmarks and the elicitation of paresthesias, without fluoroscopy or contrast dye (40). The disadvantage of this "blind" technique is that one is not assured of the correct position of the needle and overflow to adjacent nervous structures with 1.5 ml of local anaesthetic solution is not imaginary. A positive relationship between the GON and the diagnostic segmental block of C2 using the technique described above has not been established yet.

Like Bovim *et al.*, we routinely perform diagnostic blocks of segmental nerves C2 and C3 in order to confirm the diagnosis of CEH (23). Only when both diagnostic nerve blocks are negative will the segmental nerves C4 and C5 be tested as well. To evaluate the effect of a diagnostic block it is important not only to assess the headache relief reported by the patients, but also to evaluate the sensory deficit in the particular dermatome that was blocked in order to correlate both responses (22). The results of Bovim *et al*. demonstrated that the diagnostic block of the segmental nerve C2 is the most informative procedure, which is in line with our clinical experience.

In analgesic discography a local anaesthetic solution is injected into a putatively symptomatic disc in an effort to relieve patient's (head)pain by anaesthetising its source (41). However, analgesic discography is still not considered a golden standard to establish the presence of discogenic pain. Speaking in absolute terms, we do not exactly know what a positive analgesic discography means. Does it mean that the disc is actively the source of the headache? Is it possible that the pain arises from other structures in the same motion segment which is innervated by the same dorsal root ganglion and afferent nerve? Analgesic discography may be difficult to achieve because it relies on the diffusion of the local anaesthetic solution from the nucleus pulposus to the outer innervated portion of the annulus fibrosis (42). False-positive results can be obtained from uncontrolled leakage into the epidural space. Some authors consider analgesic discography useful in diagnosing the "pathological" source (24, 43). Other authors have abandonned analgesic discography as a diagnostic block (44). Patients who are prone to infectious complications of the intervertebral disc, e.g. chronic corticosteroid medication, diabetes mellitus etc., should be excluded from this procedure.

Although epidural anaesthesia is not considered to be a diagnostic block for CEH, it is used by some neurosurgeons to assess the degree of headache relief in patients with severe hemicranial pain. They emphasise that surgery in the cervical region is justified only in the case of a positive outcome of the epidural block. In their opinion this epidural block is helpful in diagnosing and localising the origin of the headache (20). However, with an epidural block it is difficult to block only one selected level at a time. To select the "pathological" level a diagnostic segmental nerve block, using fluoroscopy and contrast dye, is a more reliable procedure. A segmental nerve block is more convenient for the patient, as well as being much more secure. Because life-threatening situations can occur with a cervical epidural block, e.g. myelum puncture, epidural haematoma, intravascular injection etc., an intravenous canula, cardiovascular monitoring and equipment to intubate the patient should be available on site. In our opinion the diagnostic cervical epidural block should not be used in the standard diagnostic work-up for CEH.

In summary, numerous nerve blocks may be used in the diagnostic work-up of CEH. Since exact data on the sensitivity and specificity of most of these procedures do not exist, it is recommended to use the less complex ones first, before moving to the more invasive techniques. Careful assessment of each diagnostic nerve block is essential.

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