Headache Platform

Surgical treatment of vascular headaches

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Introduction

The pathogenesis of migraine pain has not yet been adequately explained and remains the subject of vigorous debate. In the 1940s, Harold Wolff and his associates postulated that migraine pain emanates from dilated extracranial arteries, and they were able to provide compelling experimental evidence in support of their theories.[1-6] Since 1958, however, when Milner[7] proposed that the visual aura of migraine may be caused by the "spreading depression" of Leão[8], migraine research has focused almost exclusively on the central neurovascular changes, to the exclusion of Wolff's postulates. Current theories implicate changes in the trigeminovascular system, which is, by definition, made up of the trigeminal subnucleus caudalis, the trigeminal nerve, and the intracranial arteries.[9] In spite of a plethora of hard experimental, clinical, and pharmacological evidence linking the extracranial terminal branches of the external carotid artery to migraine pain, this aspect of migraine has been largely ignored by the headache community!

There have been a number of reports of successful treatment of vascular headache by ligation, cryotherapy, or cauterization of the extracranial branches of the external carotid artery.[10-20] In spite of these positive reports, however, this form of treatment has not been widely adopted. This is possibly because most headache specialists do not have a surgical background. Non-surgeons often view even the most minor surgical procedure, such as this, as unnecessarily invasive. Others would argue that a minor surgical procedure with an exceedingly low morbidity is far less invasive than ongoing long-term use of rescue and prophylactic medication, with the attendant poor results and side effects. Most patients, in the experience of the author, opt for the surgical option, particularly those who have had poor results or unpleasant side effects from prophylactic medication, and those whose quality of life has been materially compromised by their headaches.

Diagnosis

The Classification Committee of the International Headache society has classified headache into 13 sections, running to 76 pages, but approximately 99% of headache sufferers have Primary Headache, and fall into the first three categories, namely Migraine, Tension-Type Headache, and the relatively uncommon Cluster Headache.[21] Most primary headaches are classified as one of these three types, but there is considerable overlap between them, making accurate diagnosis and treatment difficult.

There is a growing body of headache specialists who recognize that these conditions, instead of being completely different entities, form part of a continuum. At one end of the continuum is pure vascular pain, and on the other end is pure muscle pain *(Figure 1)*. Most primary headache sufferers have a combination of vascular and muscle pain, in varying proportions.[22] To label patients as having either one or the other hampers one's understanding of the underlying pathophysiological process, and adversely affects diagnosis and treatment. Patients who fit into the 'migraine' pigeonhole are automatically treated with 'migraine' drugs, even though they may have a combination of muscular, vascular, and neural pain. Patients who fit into the tension-type headache pigeonhole are certainly never treated with vasoactive drugs, even though they may well have an element of vascular pain!

The more rational approach to the diagnosis of primary headache is to carry out a systematic assessment of those structures most commonly involved in migraine pain, regardless of the IHS Classification category of the headache.

Carry out a systematic assessment of structures involved in migraine pain

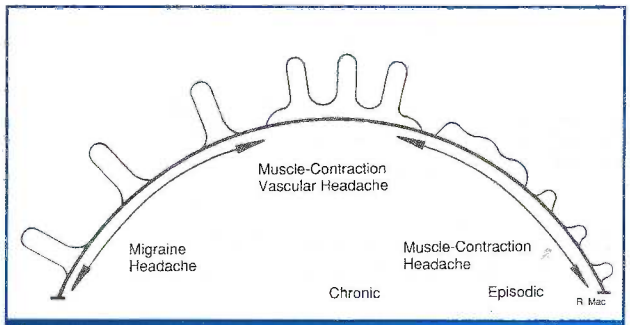

Figure 1. The migraine – tension headache continuum

These are:

- The craniomandibular and craniocervical muscles
- The superficial branches of the internal and external carotid arteries
- The supra-orbital and the greater and lesser occipital nerves.

Diagnosing whether all or some of the headache pain originates in the extracranial arteries is complicated by the fact that arterial pain can only be diagnosed by examining the patient while the headache is present. This is done by systematically digitally compressing the superficial extracranial arteries, and ascertaining whether this results in a diminution of the pain. When the pressure is removed, the pain returns, usually within a few seconds. Only if the pain lessens or disappears with arterial occlusion, can the examiner be certain that the compressed arteries are involved in the pain. The diagnosis may be complicated by the presence of cutaneous allodynia. When cutaneous allodynia is present, the arterial component of the headache may be masked by the allodynic pain. If there is allodynia present, the affected nerves may first have to be blocked before an accurate assessment of the arteries can be carried out.

Arterial examination

If the pain is exacerbated by any of the following, it is suggestive of a vascular component (these tests do not distinguish between intracranial and extracranial pain):

- Coughing
- Putting the head between the legs
- Rapid side to side movement of the head, or
- During the initial stage of the Valsalva manoeuvre.

There is a network of interconnecting arteries supplying the scalp. In vascular headache, sections of this network are painfully dilated – occlusion of the arteries supplying blood to the painful area reduces the blood flow, and the local blood pressure is lowered. If the pressure is lowered sufficiently, the pain is relieved. The blood supply of the scalp is derived from the superficial temporal, occipital, angular, and posterior auricular branches of the external carotid artery, and the supratrochlear and supraorbital branches of the internal carotid artery. An important anatomical feature is that there are extensive anastomoses, both homolateral and heterolateral, between these vessels.

These anastomoses are not constant, and vary not only from patient to patient, but at times from left to right in the same patient. Crossing the midline is a communicating vessel between left and right approximately every 5-7 mm.[23] The presence of this anastomotic network complicates the diagnosis, as sometimes the pain improves only when a distant or contralateral vessel is occluded, or when a number of vessels are blocked simultaneously. Consequently, each patient has to be carefully assessed to determine exactly which vessels are involved. Only if a positive diagnosis can be made of exactly which vessels are involved, does surgical cauterization of the relevant vessels become an option.

The branches of the external carotid artery most frequently involved in headache pain are the superficial temporal (and in particular its frontal branch), the posterior auricular, and the occipital. Other superficial vessels, such as the angular artery, or the superficial branches of the internal carotid artery, the supra-orbital and supratrochlear arteries are far less frequently involved. There are extensive anastomoses between these arteries, that vary from patient to patient, and from left to right in the same patient.[23]

Cutaneous allodynia

In some patients suffering with severe pain, and in whom the arterial assessment is negative, the more severe pain may be caused by cutaneous allodynia. The pain arises from the skin and subdermal tissues, and can be so severe that it masks pain arising from other structures, such as the arteries. In patients with severe pain, who do not respond positively to compression of the arteries, the cutaneous allodynia must first be eliminated by means of nerve blocks of the supraorbital and/or occipital arteries. Once the nerve blocks have been administered and the pain levels reduced, the arterial assessment is carried out again, and is often positive, where it was negative before the nerve blocks.

Surgical technique

An Ultrasonic Doppler Flow Detector model 811-BL (Parks Medical Electronics Inc.) is used to locate the relevant vessels. In most patients, multiple vessels are involved in the pain process, and must be cauterized.

Superficial temporal artery (main trunk).

The main trunk of the superficial temporal artery is approached through a vertical incision just anterior to the pinna, where it crosses superficial to the temporal root of the zygomatic arch. The level at which the main trunk divides into its three terminal branches is not constant. If it divides below the level of the arch, the branches must be cauterized individually.

Superficial temporal artery (frontal branch).

The frontal branch of the superficial temporal artery runs a tortuous course subcutaneously, crossing the temple in an antero-superior direction. It is often visible, particularly during a migraine attack. It is approached via an incision approximately 1 cm long, at right angles to the course of the vessel.

Posterior auricular artery.

The posterior auricular artery emerges from the deep tissues in the groove between the cartilage of the ear and the mastoid process, and curves up between the pinna and the skull. It is accessible through a 1 cm incision as it curves round the upper attachment of the pinna. At this level it is distant from the facial nerve.

Occipital artery.

The occipital artery emerges at the level of the superior nuchal line from the deeper tissues of the neck between the attachments of the trapezius and sternomastoid muscles. It is approached via a horizontal incision approximately 2 cm long.

Discussion

Abu al-Quasim Al-Zahrawi (936 AD), in his treatise, At-Tasrif, was the first to describe the exposure and division of the temporal artery for the relief of certain types of headache. The next record of this procedure was 500 years later, by Ambroise Pare, one of the great surgeons of the Renaissance, who sectioned his own temporal artery for migraine. Since then this method of treating vascular headaches has been reported a number of times.[10-20] Unfortunately, in spite of its low morbidity, this treatment modality is not widely used, possibly because most primary headache sufferers are treated by non-surgeons, who often view even the most minor of surgical procedures, such as this one, as unnecessarily invasive. Others would argue, though, that a once-off minor surgical procedure is far less invasive than the long-term use of rescue and prophylactic medication. In the author's experience, given the choice, most patients prefer the surgical option.

A once-off minor surgical procedure may be less invasive than long-term medication

With regard to the possibility of post-operative morbidity due to insufficient blood supply to the scalp, Abul-Hassan wrote "It is, of course, well-known that the whole scalp will survive on one superficial temporal artery and vein".[24] Confirmation of this statement is provided by the results of surgical re-implantation of the traumatically avulsed scalp.[25-30] Experimental confirmation was provided by Marty, who, by measuring transcutaneous oxygen pressure, concluded that one superficial temporal artery can easily ensure the survival of the entire scalp.[23]

Conclusion

In selected primary headache patients with a severely compromised quality of life, and particularly those that do not derive adequate relief from pharmacotherapy, surgical cauterization of positively diagnosed superficial scalp arteries can be a life-changing experience.

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