THE SURGICAL TREATMENT OF HEADACHE AND ATYPICAL FACIAL NEURALGIA

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Olivier Wendell Holmes is reported to have said, "If I wished to show a student the difficulties of medical practice I should give him a headache to treat." Headache is probably the commonest discomfort of man and it has attributes that set it apart from pain that occurs in other parts of the body. Its significance is often disguised and its attending distress is out of proportion to the severity of the underlying cause.

The neurosurgeon asked to rule out intracranial disease in patients with headache is soon made aware of the need of a broad understanding of pain about the head. He must recognize that in the majority of instances there is no serious disease present and he must through clinical evaluation weigh the need for more extensive and upsetting investigations.

Perhaps the neurosurgeon’s only responsibility is to recognize and treat those whose head pain can be shown to be a symptom of an intracranial space-occupying lesion, a painful neoplasm about the head or neck, or one of the cranial nerve neuralgias. But there is a temptation often to explore the surgical possibilities for the relief of other head pain. Some surgeons are encouraged in this respect by a desire to help the patient, some wish to investigate physiological and anatomical factors, while others are deterred by a cautious or even a cynical attitude regarding the possible benefits of surgery.

It is my purpose to review the possibilities of surgical treatment of a variety of these head, face and neck pains (exclusive of neuralgias and painful neoplasms) based on others’ reports, as well as on my own experience and convictions. Put another way, it might be asked: "Is there a surgical treatment for headache?"

The basic aspects of headache can be listed under two headings: the sensitive structures of the head and neck, and their nerve supply; and the mechanisms that produce pain.

All of the tissues covering the cranium are more or less sensitive to pain, but the vascular and muscular structures about the head, face and neck together with the mucosa of the upper respiratory passages are the source of most of the headache problems.

The intracranial pain-sensitive structures include the arteries at the base of the brain, the dural arteries, parts of the dura mater in the floor of the

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skull, the venous sinuses and their venous tributaries and nerves possessing pain afferents, namely, the 5th, 7th, 9th and 10th cranial and the first two or three cervical nerves.

The common mechanisms of pain are related to traction and distention of the blood vessels; inflammation of any of the pain-sensitive structures; pressure on pain afferent nerves, and sustained contraction of muscles about the head and neck.

In prolonged vascular headache edema occurring in and about the walls of small vessels causes considerable reduction in pain threshold of these tissues. Likewise in sustained muscle contraction local metabolic changes take place that result in tender areas. Not infrequently vascular and muscular headache exist simultaneously.

HEADACHE AND DISEASES OF THE EYES AND UPPER RESPIRATORY STRUCTURES

It is relatively uncommon for headache to result directly from diseases of the eyes and upper respiratory structures. While inflammation of the mucosa of the nose and paranasal sinuses may result in a mild form of pain in the local regions of the head and face, much of the headache attributed to diseases of these structures is caused by secondary sustained contraction of muscles of the head and neck. Likewise, similar mechanisms may be involved in headache associated with diseases of the eyes and of their intra- and extra-ocular muscle functions.

MIGRAINE AND OTHER VASCULAR HEADACHES

Dilatation and distention of the arteries inside and outside the cranium give rise to numerous sensory experiences but the interest of the patient and physician is usually directed to the pain that occurs. The location, duration and intensity of the pain vary widely from person to person and in the same individual at different times. The term migraine is reserved by some for a special pattern of headache and associated phenomena, but the line of distinction with other vascular headaches is arbitrary and unimportant.

The detailed studies of migraine leave no doubt that the extracranial branches of the carotid arteries are involved principally. In addition, it seems likely that the meningeal arteries, principally the middle meningeal, take part in the production of the pain, but the intradural vessels seem to play little if any role in this type of headache. It is a common observation that obliteration of the lumen of the offending superficial arteries and even of the carotids in the neck by local pressure will give temporary relief.

Both Cushing and Gordon Holmes, remarked on the benefits sometimes observed in migraine patients after subtemporal decompression. Explanation seems to lie in the fact that in the operation both the temporal and middle meningeal arteries are usually divided. Dickerson in 1933 reported the relief of migraine in some subjects by deliberate ligation of the middle meningeal artery.
In our initial investigation of headache mechanisms at the New York Hospital\textsuperscript{33} segments of the supra-orbital, temporal, occipital and middle meningeal arteries were resected alone or in combination in a series of patients. While the intensity of the pain was diminished in most, the beneficial effects lasted no longer than 6 months. When we have occasionally been led to try this method since then for the more intractable cases of vascular pain the results have usually been disappointing. The rich anastomotic supply of small arteries, the overlapping and the regeneration of afferent nerve supply amply account for the limitations of the use of this method of treatment.

However, there are reports published and unpublished of the rather common use of resection and ligation of extracranial arteries in the treatment of migraine. Watts, Wiley and Groh\textsuperscript{41} had 5 patients relieved of migraine 16 to 24 months after resection of one or more scalp vessels, but did not say what part of their total experience was represented by these cases. Haynes\textsuperscript{24} reported 87 per cent relief of cephalalgia after resection of temporal and middle meningeal arteries and avulsion of the occipital nerve; whereas Rowbotham\textsuperscript{43} cited 76 per cent failure to relieve headache in a similar series.

About 20 years ago Dandy,\textsuperscript{11} Craig,\textsuperscript{7} and Love and Adson\textsuperscript{31} each reported a few cases of unilateral headache possibly relieved by cervicothoracic ganglionectomy, and the operation has been proposed from time to time since. While reasoning would suggest that the vascular changes in headache may somehow implicate the sympathetic system, it does not follow that cervical sympathectomy will alter the tone or interrupt afferent pain fibers of the vessels concerned in vascular headache, at least in sufficient degree to have value. Smithwick and Simeone\textsuperscript{52} disclaim any benefit from cervical sympathectomy for headache while Rowbotham\textsuperscript{44} labeled his results in 20 cases as "capricious" and largely unsatisfactory. In my experience I have not found cervical sympathectomy to be a useful procedure for relief of headache, but I have always been intrigued with the possibility that the explanation for improvement in headache in some hypertensive patients after thoracolumbar sympathectomy might be compensatory increase in the tone of cranial vessels.

The more direct approach to surgical relief of vascular headache (exclusive of the neck and lower face) would be interruption of the trigeminal nerve for frontoparietotemporal pain and of the upper cervical nerves for occipital pain since the pain fibers of both intracranial and extracranial arteries above a line from the eye to the foramen magnum traverse these nerves. In the case of occipital headache there is perhaps no objection to the interruption of the occipital and postauricular nerves, or even of the upper cervical roots, as a therapeutic trial but I suspect the results would not be very impressive in a follow-up study on a series of cases large enough to have statistical significance. Interruption of the supra-orbital nerve together with resection of the supra-orbital artery has in my hands given disappointing results.

In a few cases reported by Harris,\textsuperscript{23} Penfield and McNaughton\textsuperscript{35} and Rowbotham\textsuperscript{43} beneficial results followed partial section of the trigeminal root.
Love and Adson\textsuperscript{31} commented on occasional relief of migraine in patients having had trigeminal rhizotomy for tic douloureux. I have made similar observations in about a dozen cases but I encountered a miserable failure in the one case in which a total trigeminal rhizotomy was deliberately performed for persistent hemiplegia. There must be few patients whose headache would justify complete trigeminal rhizotomy with its attendant corneal anesthesia, possible dysesthesias and with the chance of failure to relieve the headache.

Tractotomy of the descending trigeminal fibers in 13 patients suffering from migraine was reported by Olivecrona.\textsuperscript{33} In 2 cases the headache was bilateral and the operation was performed bilaterally; one of these patients continued to have occasional headaches of less severity, while in the other there was no relief. In 3 of the unilateral cases headache developed on the opposite side. He estimated the results as satisfactory in about half of the cases, though some discomfort persisted in most, and concluded that the results of tractotomy in migraine can hardly be said to be brilliant. Perhaps one reason for indifferent results is that analgesia after tractotomy is relative and almost never absolute.

Summarily it can be said that in migraine it may be justifiable to try the effects of interruption of the various extracranial and middle meningeal arteries and their accompanying nerves in selected cases. But the expected results will fall short of what may be hoped for and good initial results will often be temporary. Other types of operation are usually unsuitable either because they are ineffective or because they may be attended by complications unacceptable in exchange for migraine.

**ATYPICAL FACIAL NEURALGIAS**

There is a variety of syndromes of face pain which, although they differ from migraine in location, timing and associated phenomena, are believed to be akin to migraine in that the mechanism of pain is principally arterial distention. Included in this group are: sphenopalatine neuralgia or Sluder's headache, vidian neuralgia, buccal neuralgia, Horton's cephalalgia, lower-half headache, atypical facial neuralgia and carotidynia. There are others with less commonly mentioned names. Each of these syndromes has some special feature which supposedly sets it apart from the other, but each borders on the other and distinguishing features are frequently spurious.

The interest in the sphenopalatine ganglion syndrome,\textsuperscript{13,45,50} as well as the opinions of its validity, have waxed and waned for years. The principal objections to the sphenopalatine as well as to the vidian neuralgia are: the lack of evidence that the implied disease of nerves actually exists; and, the similarity of these syndromes to other facial pains that are more readily identifiable as the effect of arterial distention. Lewy\textsuperscript{30} in an anatomical study of the nerves concluded that the vidian nerve has no afferent pain fibers and that in presumed transnasal cocainization of the sphenopalatine ganglion usually the maxillary nerve above is anesthetized.
Poe\textsuperscript{37} described 4 cases in which he had excised the sphenopalatine ganglion by way of a transantral approach for relief of facial pain. Since the ganglion and the maxillary nerve lie in approximation to each other the operation simultaneously removed the ganglion and a section of the maxillary nerve. Good results were reported in all patients within the limit of the longest follow-up, which was 9 months. From the description, it appears that in 2 and possibly 3 of the cases the diagnosis was trigeminal neuralgia in the maxillary region and good results, therefore, could be attributed to division of the maxillary nerve. Grant\textsuperscript{19} who has performed the operation in several cases, expressed his belief that any benefit is attributable wholly to division of the maxillary nerve. In the one case in my experience any relief of pain was overshadowed by complaints of dyesthesias in the anesthetic area.

Atypical facial neuralgia is a name employed by Frazier and Russell\textsuperscript{16} to differentiate from tic douloureux the many other kinds of facial pain. In at least one-third of patients referred to me by physicians for tic douloureux the diagnosis was erroneous. But there is some room for charity in the matter since I suspect the majority of neurosurgeons have at one time or another found to their sorrow that they had misjudged the nature of a facial pain. In a review of the cases at the University of Pennsylvania Hospital, Glaser\textsuperscript{18} reported that during a period when 1200 major trigeminal neuralgias were treated there were 245 examples of atypical pain. In these a great variety of surgical treatments, some 292 procedures in all, were unsuccessfully employed. Included in the treatment were trigeminal rhizotomy (11 cases), cervical sympathectomy, periarterial stripping, supra- and infra-orbital nerve avulsion and various ear, nose, throat and dental operations; all were declared a dismal failure.

Further consideration was given to the problem by Temple Fay,\textsuperscript{15} who performed various combinations of resection of sympathetics, cervical and cranial nerves and of vascular sheaths (19 cases). He concluded that pain pathways for blood vessels of the neck and face traversed the trigeminal and vagus nerves. But he recognized the likelihood of pathways in the 7th, 9th, 10th and possibly the 11th and 12th cranial nerves, but excluded the cervical sympathetics.

The exact sensory supply of the arteries in the neck and face is still not established but the likelihood of controlling pain from these vessels by interruption of appropriate nerves with any simple or practical operation is remote.

An occasional report has been made of beneficial results of ligation, resection or perivascular stripping of the external carotid artery or its branches for ‘‘buccal’’ pain\textsuperscript{41} and of the carotids for carotidynia. In 6 cases I found operations on the external carotid and maxillary arteries not to be helpful for facial pain while in 4 cases of carotidynia\textsuperscript{6} perivascular stripping gave partial relief in 2 and no benefit in 2 others.

A particular pain syndrome originally described as erythromelalgia of the head (by Horton, MacLean and Craig\textsuperscript{26}) but lately known as Horton’s
cephalalgia has caught the fancy of neurosurgeons. Horton\textsuperscript{27} has implied that histamine somehow plays a role, but this pain may well be one variant of vascular pain in the orbitofacial region.\textsuperscript{53}

It was suggested by Gardner and associates\textsuperscript{17} that the syndrome might be in the nature of a greater superficial petrosal neuralgia, or at least that division of this nerve might be helpful. In 13 cases of orbitofacial pain he divided the greater petrosal nerve and in 2 of these the operation was bilateral. Results were reported as excellent in 25 per cent, fair to good in 50 per cent and a failure in 25 per cent. The same operation in 13 additional patients with miscellaneous head pains produced good results in 3. The complications listed were: temporary loss of tearing, crocodile tears, Horner’s syndrome, painful keratitis and facial paralysis.

It is interesting that Gardner postulated benefit on the basis of interruption of vasodilator nerves and disregarded the possible effect of dividing afferent fibers that traverse the nerve. Sweet and White\textsuperscript{48} reported that stimulation of the central end of the divided greater superficial petrosal nerve caused pain and 3 of their patients were relieved of pain by petrosal neurectomy, while 2 were not.

The operation has been performed by others\textsuperscript{8,49} including myself but the results to me do not seem to be impressive. When it is considered that many aspects of the pain for which the operation is employed are not well understood, the incidence of early relief is less than 50 per cent, recurrences are known to take place and certain complications are not readily acceptable, there is not enough to justify enthusiasm for the procedure.

**OCCIPITAL AND SUBOCcipital PAIN**

Pain in the occipital and suboccipital regions results from three types of mechanism which may occur alone or in combination: (1) muscle tension, (2) vascular distention and (3) irritative conditions of the sensory nerves, roots or spinal ganglia in the upper cervical region.\textsuperscript{53}

A revival of interest in posterior headaches has occurred probably as a result of greater awareness of cervical disk pathology. Raney and Raney\textsuperscript{38,39} concluded that cervical disk lesions commonly result in occipital, frontal and temporal headaches. They found it impossible to determine a direct neural connection, but suggested that diffusion would explain the phenomenon. Yet they reported that head pain caused by cervical disk disease was not relieved by section of the sensory root of the 5th nerve or by trigeminal tractotomy; also that cervical sympathetic block did not affect the headache unless the procaine infiltrated the neck muscles.

It has been shown that sustained cervical muscle contraction occurs as a protective mechanism accompanying a painful lesion at any level of the cervical spine and that the muscle contraction here not only is locally painful but may induce muscle contractions and changes in vascular tone in other parts of the head and face.\textsuperscript{44} In support of this is the common experience that headaches related to tonic states of the cervical muscles can usually
be relieved by muscle-relaxing agents such as local heat, massage, curare, traction or procaine infiltration. Injection of hypertonic saline into occipital muscles consistently causes pain not only locally but in more remote regions of the head and face. Conversely, pain thus induced may be terminated by local infiltration with procaine.\textsuperscript{5,10,44} Resection of occipital and postauricular nerves is occasionally of temporary benefit, but has obvious limitations.

Hunter and Mayfield\textsuperscript{8} reviewed their experience with 11 cases of pain in the head and face attributed to upper cervical root disease, presumably secondary for the most part to trauma of the upper cervical spine. The pain was characterized by its appearance in bouts, initiated in the suboccipital region, radiating to the vertex, temple, orbit and sometimes the lower jaw; usually it was unilateral. They found that stimulation of the 2nd cervical root produced pain in the vertex and region of the eye, while stimulation of the 3rd root referred pain to the region of the ear and neck. Treatment in their 11 cases was either by (1) avulsion of the greater occipital nerve, (2) intraspinal section of the sensory root C\textsubscript{2}, or (3) section of sensory roots C\textsubscript{2} and C\textsubscript{3}. Eight of the 11 patients were benefited by the operations.

Hence, it should be recognized that pain having its origin from structures in the cervical and occipital regions may appear simultaneously in the forward part of the head and face. Operative treatment is usually not required for relief of pain of occipital origin with the possible exception of those few patients who have convincing evidence of disease of the upper cervical spine and nerve roots in which case upper cervical rhizotomy may be useful. Section or avulsion of nerves in the occipital region is technically simple and harmless, said to be useful for a variety of persistent occipital pains but initial beneficial results have frequently been temporary.

\textbf{POST-TRAUMATIC HEADACHE}

None of the problems pertaining to headache supersede those that follow head injury. The incidence is one-third to one-half in those patients with head injury sufficient to bring them to a hospital. Trauma to pain-sensitive structures of the head provides ample reason for head pain and the persistence of an extradural or a subdural hematoma may be a source of headache in the early period up to some weeks. However, in most cases there is no convincing evidence that pathologic changes of any kind occur to perpetuate head pain beyond this period.\textsuperscript{4}

In 1936 Penfield and Norcross\textsuperscript{8} concluded that a cause of chronic post-traumatic headache might be found in the formation of dura-arachnoidal adhesions and that effective therapy might be provided by introduction of subdural air. A follow-up study 8 years later by Ross and McNaughton\textsuperscript{42} concluded that there had been few patients who had remained cured after this procedure and in these few it was believed that other factors had played an important part.

Painful scars of the scalp which may be a source of noxious stimuli can sometimes be revised to advantage and in those patients with complaint of
headache accompanying cranial defects about half are relieved by cranioplasty.\textsuperscript{31} But surgeons are well acquainted with the frequently disappointing results of revising painful scars anywhere over the body.

PAINFUL DYSESTHESIAS OF CRANIAL NERVE LESIONS

Under the heading of painful dysesthesias of the cranial nerves several could be mentioned, but there are two conditions in particular that concern us. While they do not fall exactly in the category of the other types of headache under discussion there is much in common, particularly in the matter of refractoriness to surgical treatment.

One of these is the postherpetic pain which occurs particularly in the forehead region of elderly patients and which dominates their waning years of life. Any notion that the disease in these patients is limited to the Gasserian ganglion is soon dissipated when it is discovered that division of the sensory root or of the tract in the medulla provides little, if any, relief.\textsuperscript{34} I have tried rhizotomy in 2 patients and tractotomy in 2 others without the slightest benefit. Avulsion of the supra-orbital root because it is simple and safe has often been employed, but usually with disappointing results. The same is true of cervical sympathectomy and of incision for undermining and isolating the painful area, though there have been verbal reports that the latter is sometimes helpful.

The story is perhaps best told in a report by Sugar and Bucy.\textsuperscript{47} In a patient with postherpetic pain in the eye, cheek and nose the following methods were used in sequence with appropriate lapses of time to evaluate results: (1) injection of alcohol into the infra-orbital nerve, (2) roentgen radiation of the Gasserian ganglion, (3) partial division of the sensory root of the trigeminal nerve, (4) total section of the sensory root, (5) cocainization of the sphenopalatine ganglion, (6) procaine block of the stellate ganglion, (7) excision of the contralateral sensory cortex for the face, (8) excision of the ipsilateral sensory cortex for the face, (9) a series of electric shock convulsions and (10) bilateral prefrontal lobotomy. The evaluation of the result was that the patient still suffered from the pain though it was not as troublesome as it had been.

Wycis\textsuperscript{64} has informed me that mesencephalotomy in 3 cases of postherpetic pain in the face has proven satisfactory in 2 cases and failed in 1. We must hopefully wait for final confirmation of the effectiveness of this method of treatment.

The other variety of painful dysesthesia is one that particularly plagues the neurosurgeon. It occurs following trigeminal rhizotomy or tractotomy for tic douloureux. Fortunately the severe form occurs in only about 5 per cent of cases but in these it is an endless source of annoyance. Sympathectomy is of no value. A few reports of the use of lobotomy for the most part indicate failure or equivocal results. In my experience with 2 cases bilateral lobotomy was not helpful. Spiegel and Wycis' report\textsuperscript{46} of the use of mesencephalotomy in 3 cases indicates beneficial results at least in 2.
The simple fact is that the treatment of painful dysesthesias of the face is one of the most discouraging chapters in the chronicle of neurosurgery.

GENERAL COMMENT

Psychosurgery seems not to have been much employed for headache and atypical facial neuralgia; it is mentioned only briefly and without enthusiasm in a few reports that have come to my notice. An interesting comment which perhaps has an indirect bearing on the subject was made in the report of the large Boston Psychopathic Hospital series. It was suggested that in some of those with chronic postlobotomy headache the cause lay in meningo-cortical scarring resulting from the incision. Though it is very questionable whether headaches occur on this basis the fact remains that some patients do have severe headaches after lobotomy.

With regard to the useful application in various forms of head pain of thalamotomy by stereo-encephalotomy we must for the present depend on the judgment of those few who are skilled in the use of the instrument. Dr. Bailey's tacit comment on the subject is that "others had better wait until the technic is better established before attempting to make destructive lesions in this concentrated region. After several years of investigation the editor has not yet dared to attempt it."

And finally a comment on the use of anesthetic blocking or injection methods for the relief of pain is perhaps not out of order. The simple faith that most patients and many doctors have in the ability of a "skilled technician" to control pain with a well-placed injection is disturbing. Neurosurgeons in particular are exposed to this flattering confidence and some are vulnerable. But no one is in a better position than a neurosurgeon to know the limitations of the method as well as the complications that may attend it. At best, procaine or newer, longer-lasting local anesthetic agents provide but brief benefit. Alcohol blocks of the trigeminal nerve may be of use at times, but as experienced a surgeon as Grant reported a disturbing number of difficulties with the procedure even in his hands. The report of Ochsner and associates on 14 deaths and other complications from what is commonly believed to be an innocuous injection of the stellate ganglion is an occasion for considerable concern.

Neurosurgeons instead of trying to live up to the expectations of their patients and colleagues in the use of injection methods for the relief of pain can do much to clarify the matter by pronouncing its limitations and risks.

CONCLUSION

In conclusion I should hardly like to take the position that all possibilities for the surgical treatment of headache have been exhausted though the very nature of the varieties of head pain that have been discussed does not encourage hope in the solution of the problem through surgery. There is probably no harm and maybe occasional benefit in the judicious use of an operation performed as a therapeutic trial but the indiscriminate use of
operations on patients, many of whom have prominent emotional disorders, is out of keeping with the sound principles that characterize most of the rest of our neurosurgical effort.

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