

# A history of non-drug treatment in migraine

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## Introduction

In most historical reviews of migraine, medicinal treatments are considered while non-drug treatments are hardly addressed. In this paper, I will review the history of these non-drug treatments. I have analysed texts by physicians known to have written on headache and migraine during the main historical periods up to 1900. Additionally, some mainstream neurological textbooks of the 20th century have been studied to review contemporary non-drug treatments. The periods covered are listed in Table 1.

**Table 1.**

*Historical epochs in migraine*

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Ancient Egypt

- magic treatments, external, catfish ashes

Antiquity

- Greco-Roman period: bloodletting, head veins, cupping, sneezing, bleeding from nose

Middle Ages

- Byzantine period: purging, bleeding, oil in the ear, bleeding (opposite side of the head from the nose)
- Arabic: red hot iron, subcutaneous garlic, bloodletting (arterial)

Renaissance – scientific revolution:

- Water, leeches, cupping, bleeding

Enlightenment

- Cupping, blistering, blood letting, water, cauterisation
- Electrical treatment
- Magnets

19th century

- Water (on the feet), mustard plaster, cold water treatment
- Electricity, galvanisation of the sympathetic
- Carotid and vagal compression
- Vibration treatment

20th century treatments

- Diet, health regimens, water cure
  - Psychotherapy, massage, hydrotherapy, hot air
  - X-rays (pituitary)
  - Tonsillectomy
  - Lumbar puncture
  - Trepanation (dates from pre-history although continues to this day in primitive cultures and in the early 20<sup>th</sup> century it was also applied in civilised countries)
  - Sympathectomy
  - Blood vessel ligation (carotid and middle meningeal)
  - Afferent sensory surgery (mainly trigeminal)
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## Ancient Egypt

In Egyptian medicine, there was no sharp distinction between ‘magical’ and ‘medical’ explanations of health and disease. We had to wait until the Hippocratic period before naturally observable phenomena were held responsible. Hemicranial headache was treated using the skull of a catfish, which was heated until it turned to ashes and then boiled with oil. The sufferer’s head was rubbed with the material for four days. In the remedy we recognise the magical principle of *similia similibus* (like will be cured by like). The catfish was the symbol of a demon belonging to the ‘sphere of the night’, which once afflicted the god Horus with headaches of such intensity that they forced him to live in the dark. By killing and burning the catfish, the physician may have intended to diminish the demon's power and to restore the patient's health (1).

## Areteaus of Cappadocia (2nd century)

With respect to headache, knowledge from the Greco-Roman period is epitomised by the work of Areteaus. His concepts are considered to be the basis for our knowledge of the matter over the past twenty centuries and his books were still referred to up to the early 1800s. Only two of his books have survived: *De causis et signis acutorum et chronicorum morborum* and *De therapia acutorum et chronicorum morborum*. His classification of headache can still be recognised in our present diagnostic criteria, and included cephalea (chronic type of headache), cephalgia (short-lasting but up to several days) and heterocrania, which evolved to ‘hemicrania’ in the writings of Galen, and from which the French word ‘migraine’ is derived,. The books follow the well-known sequence ‘*a capite ad calcem*’ (from head to heel). I quote below descriptions of several of his non-medicinal therapies for headache, many of which were referred to in subsequent ages. The quotes are taken from a recent translation (2,3).

*“If the pains have been present for a certain period (as complaints of a more serious nature come along), incise the vein at the elbow. First, have the patient drink wine for two days. Do take into account what the patient is able to bear when you bleed him. The best is not to bleed him all at once, so that the patient bears the quantity that is taken and the disease is driven back by repeating the same action several times”.*

Blood letting was a regular treatment for many diseases, including headache, and should be considered from the perspective of humoral medicine, in which a balance of the four humours (blood, phlegm, yellow and black bile) determine health and disease. Blood was not only taken from veins in the arm, however.

*“Then, incise the vein that runs upward in the middle of the forehead, as bleeding here is very important. The quantity should be one cotula or a little more. Do not take more. After all, you do not need to empty the vessels”.*

A cotula was a cup, the smallest capacity unit in the Greek liquid measure system (16.5 cubic inches; 0.475 pint; 270 cubic centimeters). If this was not successful, the physician would continue cupping.

*“Next, shave off his hair and place a cup at the crown of the head. Put a second cup between the shoulder blades without bleeding there and carry out a good-sized incision at the crown in order to draw a large quantity of blood and to incise the deep layer. Incisions that get to the bone are beneficial for headache”.*

By placing heated glass tubes on the skin, blisters were drawn and this again was thought to restore the balance of the humours. The treatments became more invasive if previous attempts were ineffective.

*“If one does not carry these, then take the shaft of a thick goose feather, scrape off a bit from the outer layer and make notches into the fibres so that it results in teeth like on a saw. Subsequently, push the shaft inside the nose up to the ethmoid bones, move it with both hands in order to create scratches at that site. In this way, a lot of blood will be discharged in a short time, as many small veins end there, and the site is soft and easy to injure”.*

And finally, the red hot iron was taken:

*“Consequently, you have to shave off the hair (which yet on its own is good for the head) and cauterise superficially down to the muscles. If you wish to cauterise down to the bone, carry it out at a site where there are no muscles. For if you burn muscles, you will provoke cramps. Some physicians incise down to the bone on the forehead along the border of the hair. They abrade or chisel the bone down to the diploe and let flesh grow over the place. Others perforate the bone down to the meninges. These are hazardous treatments. You have to apply them when the headache persists after all that has been done; the patient keeps courage and the body is vigorous”.*

## Galen of Pergamon

As noted, Galen adopted the word ‘hemicrania’, from which ‘migraine’ was later derived, for Areteus’ condition of heterocrania. Galen’s treatments also included purging and blood letting (Figure 1a and b) (4).

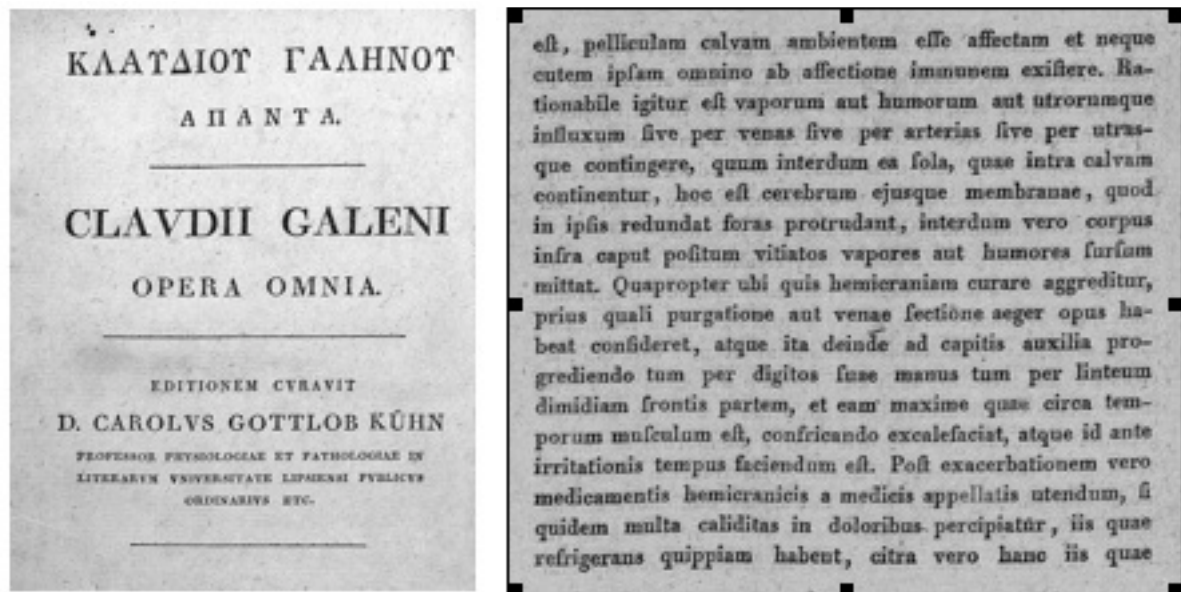


Figure 1 – a) Title page and b) text concerning the treatment of hemicrania, including ‘purgatione’ and ‘venae sectione’. From Galenus’, *Opera omnia* vol. 12, *De compositione medicamentorum* secundum locum liber III, p. 591-3

## Byzantine period

I will discuss three physicians from the Byzantine period: Oribasius of Pergamon, Alexander of Tralles and Paul of Aegina. Oribasius (325-403) was the personal physician of emperor Julianus Apostata, who ordered him to write a collection of medical treatises, summarising Greek medicine. It culminated in the *Collectiones medicae*, comprising 72 books. For hemicrania, he advised purging and blood letting; but also the injection of soft oil into the ear. Alexander van Tralles (525-605), who had a great reputation in Rome, Spain, Gaul and Italy, advised blood letting from the side opposite to the side of the headache. Paul of Aegina (625-690) the famous obstetrician, advised among other treatments, to open the veins of the nose.



Figure 2. Title pages of 19<sup>th</sup> century works by a) Oribasius, b) Alexander of Tralles, and c) Paul of Aegina

### Arabic medicine

One of the ways by which the Greco-Roman medical tradition returned to Europe, in particular to the 11<sup>th</sup> century medical schools of southern Italy (including the Salerno school), was through Arabic medicine. As an example, I would mention Abulcasis (936-1013), who was born in the Córdoba area and became surgeon to king Al-Hakam II of Spain. A popular method in his days was the red hot iron, and if this did not succeed, he advised to take garlic, peel and cut it at the two ends, make an incision at the patient's temples with a large scalpel and make space underneath the skin enough to completely hide the garlic (5).

In the 11<sup>th</sup> century we find information on headache in the *Regimen sanitatis Salernitanum*, a didactic poem known by heart by many physicians (Fig. 3a). The first version was probably written by Johannes Afflacijs. Salerno was a well-known medical school, where Arabic, Hebrew and Greek texts were translated, independent from the Benedictine monastery of the nearby Monte Cassino. These poems have been translated into several languages for centuries, including Dutch (6). Treatments for headache included drinking water and using the leaves of nightshade that were to be brushed and applied the forehead.

### The Renaissance and 17<sup>th</sup> century

It is no coincidence that we come across the old Greek remedies in the Renaissance period. As an example, I mention the 'Dutch Hippocrates' Forestus (1521-1597), doctor medicinae in Alkmaar and Delft, who generally advised just to help nature, but in one incurable case he

ultimately applied the trepan and found a 'black worm' on the dura (a chronic subdural?). For hemicrania, he advised leeches among other treatments (Fig. 3b) (7)



Figure 3. Title pages of a) one of the many translations of the Salernitan *Regimen sanitatis* and b) Forestus' *Observationum et curationum medicinalium*.

Areteaus' work on headache was still referred to in the 17<sup>th</sup> century, for example by the Amsterdam physician Nicolaas Tulp (1593-1674), who cited him in several cases he described, mentioning Arateus' distinction between cephalaea and cephalalgia (8). For example, Tulp described a carpenter's wife suffering from headache for considerable period. It was accompanied by a warm feeling ascending from a foot to the head and vice versa, to the big toe. Tulp ordered a cup to be set, inducing a sore, by which he believed a volatile spirit could drain from the body. The patient soon recovered. The pathophysiological concepts of the period were still based on humoral theory. Another case from Tulp's book was a merchant from the south with intense "squinting headache" that occurred every Spring. He could hardly open his eyes or speak, although he was normally quite talkative. He was treated by 'cupping' or blistering plasters to the occiput.

### The Enlightenment

In the work by the Dutch pupil of Boerhaave, Gerard van Swieten (1700-1772), who emigrated to Vienna to become court physician to the Queen, we find an accurate description of what we now recognise as cluster headache. In a chapter on intermittent fever (!), we find the case of a young man, suffering from headache every day, at the same hour, localised above left eye, accompanied by reddening of the eye and tearing. The pain was so severe that he nearly went mad. Several treatments were tried, including blood letting, anti-inflammatory purges, cups to the neck and blistering plasters, but all in vain. Finally he applied quinine (9).



Figure 4. a) Pieter van Foreest (1521-1597) and b) Nicolaas Tulp (1593-1674)

In the same period we find descriptions of the case of the Swedish naturalist Carl Linnaeus, a well-known migraine sufferer. In the treatises of the ‘Hollandsche Maatschappye der Weetenschappen in Haarlem’ (Dutch Society of Sciences, founded much later than the Royal Society and the Académie des Sciences), we read that he was cured from hemicrania by drinking “half a pound of water every morning”!

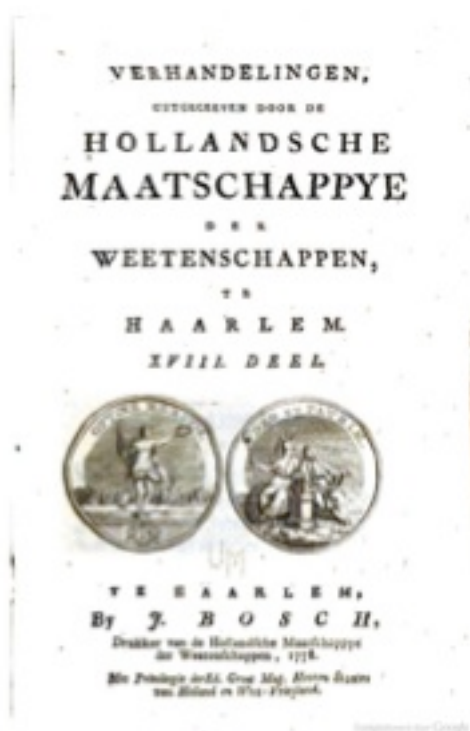


Figure 5. Title page of one of the volume of Treatises published by the Dutch Society of Sciences (Haarlem), in which the migraine of Linnaeus was described, and also the electric shocks of eels from South-America, which were recognised because they resembled the effects of a Leyden jar.

Blistering plasters and cauterisation were also applied by Claude Pouteau (1725-1775), a French surgeon at the Hôtel-Dieu de Lyon, as described in his *Mélanges de chirurgie* (10).

*N'eût-il pas été plus expédient de donner une issue à cette humeur, en appliquant sur la tête des vésicatoires, ou en ouvrant un cautère ?*

[Isn't there a better solution than to give way to that humor by applying blistering plasters to the head or using a cauterising iron]

Samuel-Auguste Tissot (1728-1797), working in Lausanne, wrote an influential book (*Traité des nerfs*) that was used up to as far into the 19th century (11). In the book we find an important chapter on migraine, summarising many cases from medical literature, including those by Wepfer, Willis, Cornelis Stalpart van der Wiel, Van der Linden and Van Swieten. The book was often referred to during the 19th century. Among other descriptions we find an interesting one on migraine aura. Tissot emphasised the nervous character of migraine: [migraine] “*a aussi des caractères nerveux très-marqués*” (11, p 103) [migraine also has a very pronounced nervous character]. For instance, an officer in Austrian service, aged 32 years, reported

*J'ai, dès l'âge de neuf ans, ce sont ses termes, une migraine qui, dans les commencemens, me prenait environ tous les deux mois, quelquefois plus souvent : j'ai aussi été plus d'une année sans l'avoir. Elle commence par les yeux ; lorsque je m'y attends le moins, je vois tout-à-coup tout trouble, mais plus d'un côté que de l'autre, comme une personne qui a fixé le soleil. Cela dure environ une dizaine de minutes ; ensuite un bras et une jambe du même côté, et un jour d'un côté et un jour de l'autre, s'endorment. Je sens des frissons, comme s'il y avait des fourmis ; je sens la même chose à la bouche et à la langue, et même pendant ce tems-là, j'ai bien de la peine à parler. Cela dure environ un demi-quart d'heure ; ensuite les douleurs de tête commencent, mais seulement aux tempes, où elles se soutiennent très-fortes pendant sept à huit heures : quand je puis vomir, cela me soulage. La migraine m'attaque en tout saison et à toute heure ; la saignée ne me soulage que peu* (11, p 103-4).

[Since the age of nine years (those are his words), I have a migraine that in the beginning took me approximately every two months, sometimes more often: I have also been more than a year without it. It begins in the eyes; at the most unexpected moments, I suddenly see unclear, but more on one side than on the other, like a person who has looked in the sun. This lasts approximately ten minutes; subsequently an arm



and a leg on the same side fall asleep, one day on one side and then on the other. I shiver, like if there were ants; I have the same sensations in the mouth and the tongue, and even during this time I experience quite some trouble to talk. This lasts about half an hour; subsequently the headache starts, but only at the temples, where it remains for seven or eight hours very severe: if I am able to vomit, it provides relief. The migraine may attack me in every season and at every hour; bleeding only gives little relief...]

(12).

Next to blood letting, Tissot applied the magnetic bar, but realised that with respect to the attacks “there is scarcely anything to be done... Baths to the legs, enemas, applications to the forehead, do no good and only worry the patient”.

### **Introduction of electricity into medicine**

In the middle of the 18<sup>th</sup> century, electricity was introduced into medicine. Among the early treatments was the application of electric fish, e.g. the strong currents of the electric eel, that was found in the northern parts of South-America and gave off more powerful shocks than the European and African fish that had been known for ages. (Catfish are capable of delivering shocks up to 300 volts and the shocks of common torpedoes are only about 50 volts; electric eels however, may produce shocks of 600 volts). In one of the letters in the Treatises of the Haarlem Society of Sciences we find the following observation on a surgeon who described the effects of the eel (13)

*He likewise threw a slave boy, who suffered from a bad Fever into a tub with a Conger-eel. The boy was shocked in such a way that the gentleman was compelled to help him out of the water. But a few minutes afterwards, the Fever disappeared and did not recur.*

The second concerned an Indian boy, who had suffered badly from several episodes of a fever and had himself shocked with a Conger-eel. The result was the same as in the previous case.

*The gentleman also says (the author continues) that when a slave complains of a bad headache, he has them put one of their hands on their head and the other on the fish, and that they will be helped immediately, without exception.*

Although the numbing effect of electric fish had been known since centuries, it was in particular Dutch scientists, who had experienced the effects of the Leyden jar in 1745 (with its discoverer Pieter van Musschenbroek 1692-1761), working in the Dutch West Indies in the

1750s, who realised that this was a similar sensation. Electricity from these fish, but more often electrical machines, became widely applied for headache and other afflictions (14). In a book on medical electricity, we read about a man who experienced intolerable pains above one of the eyes. He was relieved after drawing sparks from that site within 15 minutes (15) (Figure 6).

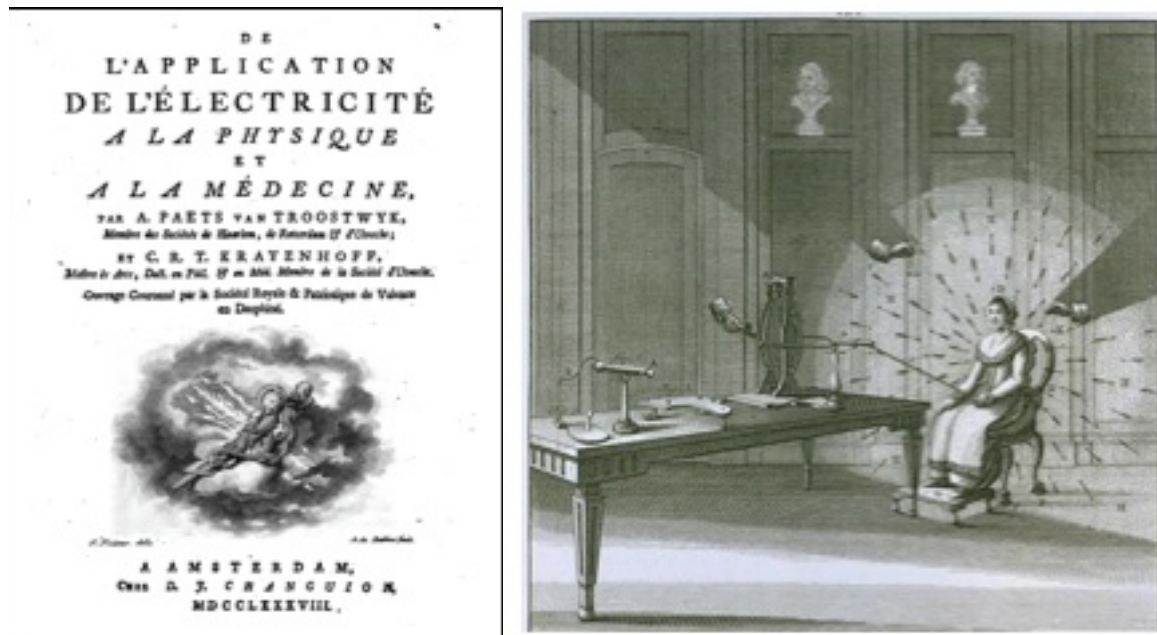


Figure 6. Title page of and picture from a book on medical electricity in which also headache cases are described

The French physician Pierre Bertholon (1742-1800), a friend of Benjamin Franklin, was among the many physicians of the time who applied electricity. He wrote about it in his book *Electricité du corps humain dans l'état de santé et de maladie* (16).

*Quelquefois la céphalalgie, la migraine, la céphalée exigent, pour guérison, une électricité en moins ; parce que cet état dépend d'une influence trop grande de fluide nerveux dans la tête. Je me suis guéri plusieurs fois de différens maux de tête en employant l'électricité négative, principalement dirigée vers la région des tempes....*

[sometimes cephalalgia, migraine, cephalaea, demand for its curing a negative electricity; because that condition depends on a too great influence of nervous fluid on the head. I have cure myself several times from various headaches by applying negative electricity, mainly directed to the temporal region].

It is interesting to see that Bertholon is still using Aretaeus' classification of cephalalgia, cephalaea and migraine.

## The 19<sup>th</sup> century – vasomotor theories

Pierre-Adolphe Piorry (1794-1879), successor to Trousseau at the Hôtel Dieu in Paris, wrote a treatise on hemicrania (1831), in which he advised stimulation of the feet by warm water (17).

*Une vive stimulation des pieds par l'eau chaud ou par la proximité d'un brâsier, a quelques fois arrêté brusquement la migraine*

[a quick stimulation of the feet by warm water or the firelight has sometimes suddenly stopped the migraine].

In this period, however, science found its introduction into medicine and humoral medicine was disappearing. Experimental physiology became an important source for new medical knowledge. Experimental observations that elucidated the mechanism and function of the vasomotor nerves were carried out in the 1850s. In November 1852, the French physiologist Claude Bernard (1813-1878) found that section of the cervical sympathetic resulted in increased blood flow, rise of temperature in the face, and constriction of the pupil (18). At first, he did not understand the observed phenomena, as in his concept the sympathetic was considered the producer of the *chaleur animale* (animal warmth) and therefore he expected the contrary, notably cooling of the face. In the same year (August 1852), the physician and physiologist Charles Edouard Brown-Séquard (1817-1894) published the results of his animal experiments during his stay in Philadelphia (19). He had 'galvanised' (probably he meant faradised, since he used an induction coil, invented by Emil du Bois-Reymond) the cervical sympathetic in several animals and noticed constriction of the blood vessels in the ear and diminishing temperature of the skin of the face. Brown-Séquard is considered the first to provide a description of a vasomotor reflex. In contrast to Bernard, he interpreted the effects of section as well as of stimulation correctly. Bernard did not acknowledge that Brown-Séquard preceded him in this and only started to use the term vasomotricity in 1862 (20).

In the subsequent years, a debate arose on whether migraine was a sympathicolytic or sympathicotonic affliction; the first theory was defended by Brown-Séquard, the latter was adhered to by Dubois-Reymond, a migraine sufferer himself (21). Brown-Séquard was supported by several other physicians, including Möllendorff, who referred to him and used the term "angioparalytic" migraine (22). In his paper, Möllendorff wanted to prove that migraine was a unilateral disturbance of the vasomotor nerves resulting in relaxation of the arteries and increased flux to the brain. He provided several arguments to demonstrate that migraine was a disease of the sympathetic nerves.

*Comprimirt man während des hemikraniellen Anfalles die Art. Carotis communis der schmerzenden Seite in der Höhe des Schildknorpels, ungefähr so stark, dass der Puls in der Art. Temporalis zu verschwinden anfängt, so hört, wie durch Zauber, der Kopfschmerz auf. Das Auge wird lebhaft aufgeschlagen, das gedrückte, schmerzleidende Antlitz klärt sich auf und fragt freudestrahlend: wo ist der Schmerz geblieben? ... umgekehrt steigert die Compression der Art. Carotis der anderen Seite ... den Schmerz, wenn er noch nicht seine volle Höhe erreicht hat...(22)*

[If during a hemicranial attack, the common carotid artery on the painful side is compressed at the level of the thyroid cartilage, so much that the pulse of the temporal artery starts to disappear, the head pain wears off as if by magic. The eye will be lifted, the dejected face brightens up and happily asks: where is the pain? ... the other way round, the pain, if not yet reached its full climax, increases by compression of the carotid artery on the other side...]

In the meantime, electric therapy had not been abandoned, as can be demonstrated by Rudolf Lewandowski's book *Elektrodiagnostik und Elektrotherapie einschliesslich der physikalischen Propädeutik* (1887) (23).

Another author of this period who advised electrical therapy was Elizabeth Garrett Anderson (1836-1917), an astonishing woman who became England's first female physician in 1870. She was unable to study medicine in Britain as medical schools refused to accept female students, but she was accepted at the University of Paris. She chose headache as the subject on which to base her doctoral thesis *Sur la migraine*. In her thesis on migraine, Garrett Anderson wrote (24)

*Il y a lieu de supposer que dans la migraine, ainsi que cela arrive dans d'autres cas de douleur forte et récurrente, la lésion centrale consiste dans la nutrition imparfaite des tissus nerveux. Le résultat immédiat en est une trop rapide décharge de l'électricité inhérente aux molécules nerveux.*

[there are reasons to suppose that in migraine, as well as in other cases of severe and recurrent pain, that the central lesion consists of imperfect nutrition of nervous tissues. The immediate result of it is a too rapid discharge of electricity inherent to nervous molecules]

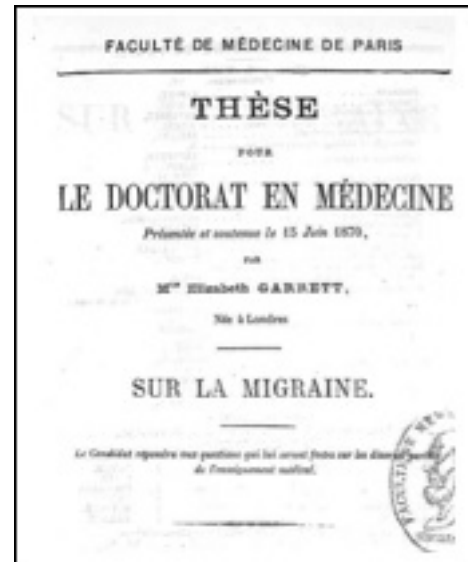
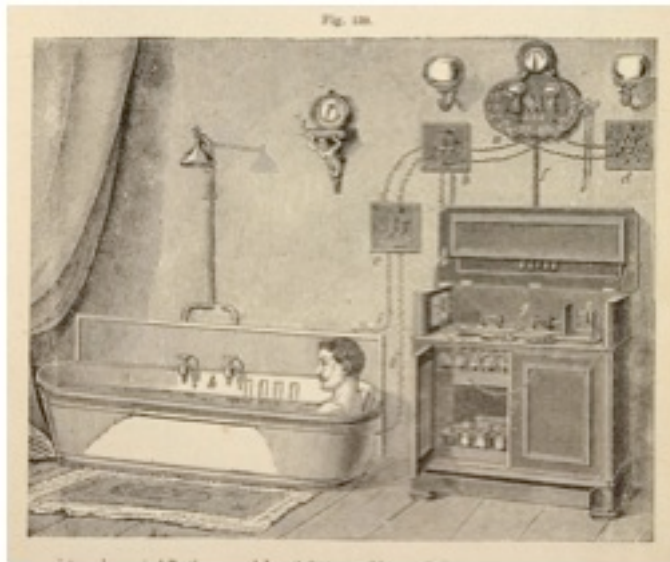


Figure 7 a) The hydro-electric bath was used amongst others for headache by Rudolf Lewandowski b) title page of Garrett Anderson's thesis; she also advised electrical therapy.

She believed that Voltaic electricity, next to air and exercise, was the most effective treatment. The current, she advised, should be “stronger than that of 10 elements” and that “*chaque application dure environ quarante secondes*” [each application lasts about forty seconds].

As would be expected, Edward Liveing also provided information on non-medicinal therapy when he reviewed the literature in 1873 (25). With respect to the vasomotor theories, he mentioned compression of the carotid artery in the neck, referring to Parry and Möllendorff, and also to the combined compression of the carotid artery and vagus nerve as described by Romberg and Schroeder van der Kolk. The sympathetic was galvanised by Eulenburg and Benedict. But Liveing also mentioned mustard plaster (in the neck as used by Lebert), cold affusion (by the Lausanne physician Dufour, during the ‘blind stage’, probably referring to the aura phase), hot water on the feet (Piorry, as mentioned above) and electrical therapy. Liveing was critical about what he had found in medical literature and concluded that “*with the exception of perfect repose... they often completely fail in the severer forms of seizure*” (25, p.471).

At the end of the C19th, several monographs on migraine were written, including one by Paul Möbius (1853-1907). He reviewed physical treatments, including water therapy, massage and electrotherapy (galvanisation of the sympathetic, faradisation of the head, the electrical bath), being quite clear on the effects (26)

*Es bleibt kein anderer Ausweg, hier wie bei den Wundern der Massage handelt es sich um Suggestion. Ich habe schon gelegentlich darauf hingewiesen, dass bei leichteren Migräneanfällen psychischen Einflüsse von großer Bedeutung sind. Es ist also verständlich, dass bei einem solchen Anfall die elektrischen Manipulationen, besonders wenn sie von einer geeigneten Persönlichkeit ausgeführt werden, „sofortiges Wohlbehagen“ bringen.*

[There is no other way out, here as with the miracles of massage, it concerns suggestion. I have occasionally pointed to the fact that in mild migraine attacks, psychic influences are important. Therefore, it is obvious that in such type of attack, electric manipulations will bring immediate well-being, in particular if it is carried out by an appropriate personality]

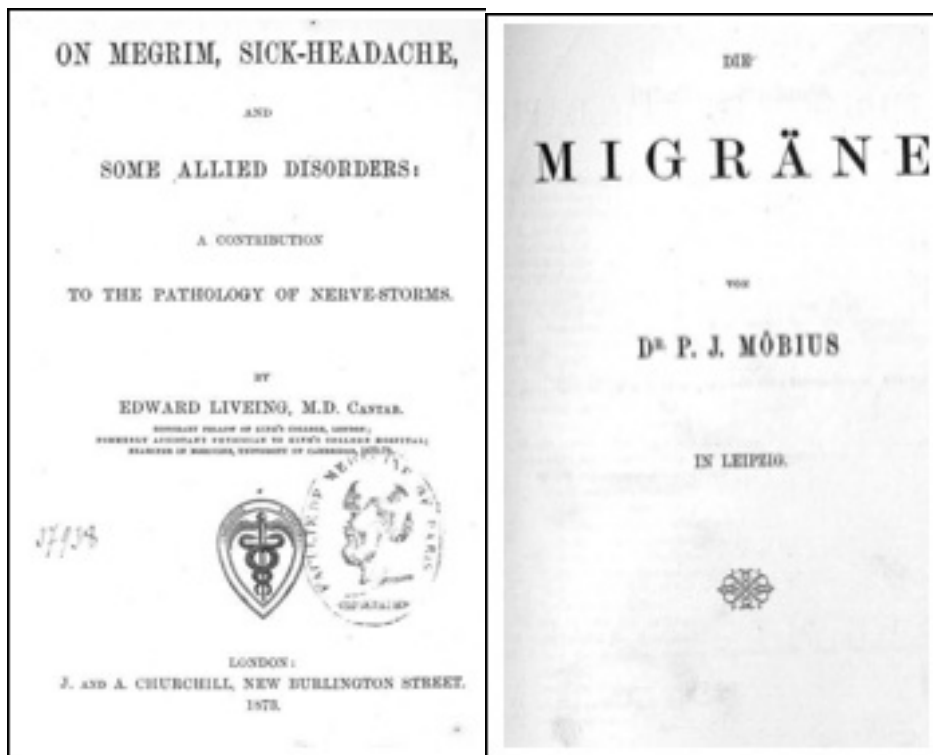


Figure 8 - Title pages of A Liveing's thesis and B Möbius' monograph

Another physical method applied at the end of the 19<sup>th</sup> century was vibration therapy. It was used by Jean-Martin Charcot (1825-1993) and later by Georges Gilles de la Tourette (1857-1904) for Parkinson's disease, after it had been noticed that journeys in post-coaches and trains could relieve the symptoms. Special 'chaires trépidantes' were designed for this purpose (27). It was also applied for headache and migraine. In a book on vibration therapy of the period we find the following text (28) (Figure 9).

*Cases of headache are generally best treated by percussion with the disc over the meatus of the ear, or with the flat-headed hammer... over the superior cervical nerves*

and plexuses. Parietal headache may often be relieved by percussion over the transverse root of the zygoma; and occipital by percussion about an inch behind the posterior margin of the base of the mastoid process, on the superior curved ridge of the occipital bone, or the percuteur may be moved along the ridge two or three times... Hemicranial headache is best treated with the brush, applied very lightly on the scalp, and moved from below upwards and from before backwards, a few times in an orderly manner

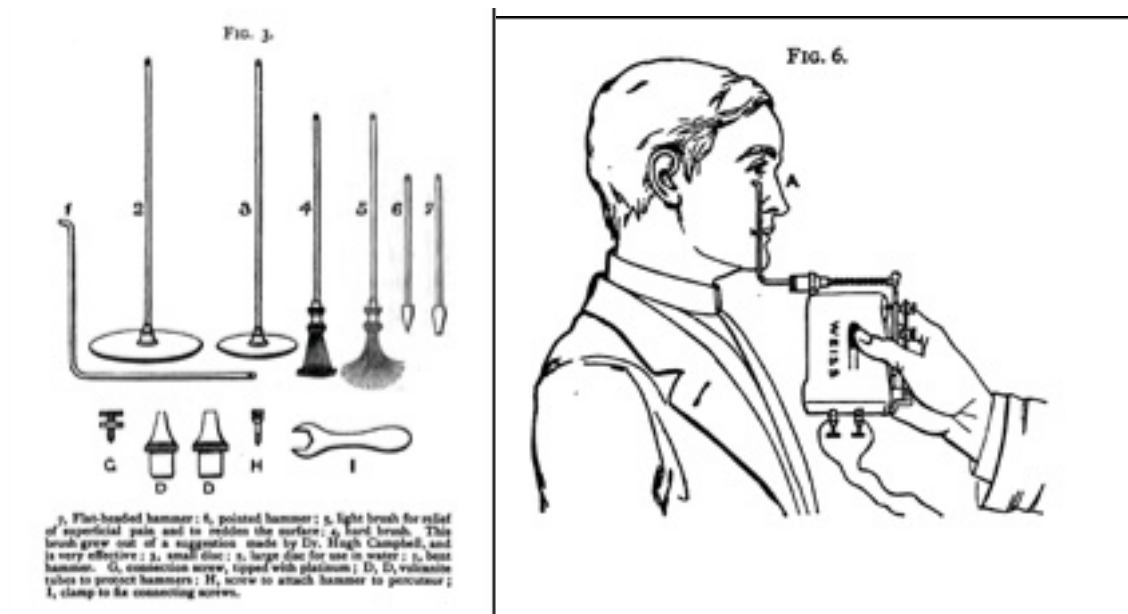


Figure 9 - From Mortimer Granville's book *Nerve vibration and excitation. Agents in the treatment of functional disorder and organic disease* (1883)

## The 20<sup>th</sup> century – more invasive treatments

In the early 20<sup>th</sup> century, surgery of the tonsils was applied and several other surgical procedures would follow. The German neurologist Hermann Oppenheim (1858-1919), in the English translation of the second edition of his well-known textbook, wrote about ‘the treatment of chronic nasal diseases’ that ‘partly relieved and even cured the attacks in some of his cases’ (29). He still advised to try hydrotherapeutic measures, general massage, gymnastics, galvanic, faradic or static currents, “that should be used in every case, though the results are not brilliant”.

Edward Flatau’s well-known review on migraine (1912) can be used to put together a list of non-medicinal treatments in vogue at the time (Table 2) (30). He had classified the pathophysiological models of migraine as follows:

- (a) Reflex theories of among others: Carolus Piso, Tissot (stomach), Calmeil, Vander Linden (menstruation).
- (b) Vasomotor theories of: Parry, Hall, Du Bois-Réymond, Möllendorff, and others.
- (c) Central theories: various pathogenetic mechanisms proposed by, among others, Wernicke (sensitive dura mater), Moebius (aura as primary event and hyperaemia of the meninges being secondary), Von Krafft-Ebing (cortical theory), Liveing, Quincke (cerebrospinal fluid) and Spitzer (foramen of Monro).
- (d) Theories on toxicity: Trousseau, Ebstein, Hertoghe, and others.

**Table 2**

***Non-medicinal treatments of migraine as can be put together from reference (30)***

- 
- Portable shock apparatus
  - Vibrator therapy
  - Cold water therapy
  - Hot air therapy (in particular with gout phenomena)
  - Electrotherapy (transverse galvanisation of the head, galv. of the cervical sympathetic)
  - Hypnosis
  - Lumbar puncture (Quincke's angioneurotic hydrocephalus theory)
  - Trepanation, craniotomy, palliative trepanation of sella with 3rd ventricle puncture (enlarged pituitary theory)
  - Sympathectomy
- 

### **Surgical treatment of migraine in the 20<sup>th</sup> century**

In this section I will discuss various surgical therapies that were applied in the 20<sup>th</sup> century.

Two approaches can be found, notably

1. Operations on the sympathetic nervous system
  - surgical procedures
  - ligation of blood vessels
2. Operations on the afferent sensory pathways

#### *Operations on the sympathetic nervous system*

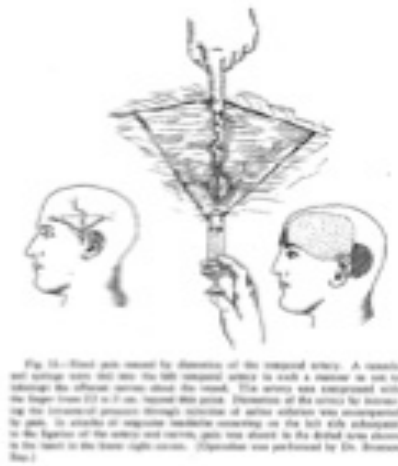
Bumke's and Foerster's *Handbuch der Neurologie*, consisting of 17 volumes (18 books), was considered a successor to Max Lewandowski's handbook of the 1910s and a predecessor of



Vinken & Bruyn's post-war *Handbook of Clinical Neurology* (31). In a review by Hugo Richter (1935), several surgical treatments are mentioned (32). At the time, migraine was still considered a vasospastic disorder, not a disorder of abnormal vasodilatation, and therefore a vasodilatory treatment was thought to be necessary. This resulted in procedures on the cervical sympathetic, including upper ganglion and periarterial sympathectomy, with the aim of dilating the pertinent arteries. Several authors had applied and described these procedures. The French physicians Lermoyez and Jean Athanase Sicard (1872-1929) carried out periarterial sympathectomy of the temporal artery. The American neurosurgeon Walter Dandy (1886-1946) operated on the cervical and first thoracic ganglion (reporting two cases that were painfree for 7 and 4 months). Dickerson wrote about excision of part of middle meningeal artery (trepanation).(32).

The English neurosurgeon Geoffrey Knight wrote a review on surgical treatment of migraine in Vinken's and Bruyn's *Handbook of Clinical Neurology* in the late 1960s (33). In this period, the vasospastic theory of migraine was still used as a basis to carry out surgical procedures that included cervical sympathectomy bilaterally; inferior cervical and 1st thoracic ganglionectomy; stellate ganglion excision; and cervicothoracic ganglionectomy. In the latter paper, 126 cases are mentioned, including eighteen headache patients, twelve of which reporting 'partial or complete relief', and Knight's conclusion was that 'no doubt ... stellate ganglionectomy could produce a favourable influence on migraine'.(33) Other treatments based on the vasospastic theory were periarterial sympathectomy of carotid bifurcation (sometimes accompanied by stellate ganglionectomy and division of the external carotid) and cervical sympathectomy (periarterial carotid bifurcation and stellate ganglionectomy). In the latter paper, cases of what we today would call migraine with aura and hemiplegic migraine were included. Cluster headache did not respond to these therapies.(33)

Following the vasospastic theories of the early 1900s, John Graham and Harold Wolff showed that migraine should be considered a problem of abnormal vasodilatation (Figure 10).(34,35,36,37) Therefore, not sympathicolytic procedures, but ligation of vessels were brought into vogue. Middle meningeal vessel procedures were carried out by the Swedish neurosurgeon Herbert Olivecrona (1891-1980; reported in 1947) and common carotid artery procedures by Geoffrey Knight (1968). He warned that it should only be done in carefully selected cases and that the only indication was 'relief of localized retro-orbital pain which can be consistently relieved by carotid compression'.



*Figure 10* - One of the investigations by which John Graham and Harold Wolff demonstrated their theory that migraine is caused by abnormal vasodilatation.

### *Operations on the afferent sensory pathways*

In his review on surgical procedures in migraine, Knight also reviewed procedures carried out on the afferent pathways since the early 20<sup>th</sup> century. The following neurosurgical procedures were mentioned, including those by the American neurosurgeon Harvey Cushing (1869-1939), who warned not to spare the ophthalmic division of the trigeminal nerve (1904), the Canadian neurosurgeon Wilder Penfield (1891-1976), who treated the ophthalmic fibres (1932), Harris, who injected around the Gasserian ganglion (1936), Rowbotham, treating the supraorbital and supratrochlear nerves (1942), Olivecrona, who performed intramedullary tractotomy (1947) and Knight himself, who stated that ‘sensory root section is justified when the pain is repeated and severe and ... ergot leads to toxic features..’(1968). But also other nerves have been used as a target for neurosurgical procedures, including occipital, post auricular, and the auriculotemporal.

This long list of procedures continues into the present day. A new series of non-medicinal treatments has emerged, including deep brain stimulation (mainly of the hypothalamus for cluster headache), occipital nerve stimulation (for chronic migraine and cluster headache), nucleus caudalis dorsal root entry zone surgery, patent foramen ovale procedures and transcranial magnetic stimulation. Their scope and application remain to be defined.

## Conclusion

Non-drug treatments for headache, in particular migraine, from the ancient Egyptian period up to the second half of the 20th century have been discussed. The main changes in non-medicinal treatments are summarised in Table 3. A large variety of treatments have been tried based mainly on contemporary pathophysiological models that were applied not only in connection with headache but in medicine in general. Invasive procedures for the more severe types of headache have been applied for centuries and returned in the physician's therapeutic palette in the 20<sup>th</sup> century following the introduction of new ideas on pathophysiology.

'Electrical therapy' has been applied since the 18<sup>th</sup> century and is enjoying a resurgence in the modern era and several other new methods that were discovered in medicine (including X-rays and lumbar puncture) have been tried for the treatment of migraine. Even today, new physical procedures are emerging and will no doubt continue to do so.

**Table 3**

*Overview of non-medicinal treatments in relation to pathophysiological theories of the period*

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Pre-1800 period:

- Based on *humoral* theories
- Often referred to Galen and Aretaeus
- Electricity added in 18th century

Modern period

- Based on new *solid* (organ-based) theories
- Scientific method introduced into medicine
- Vasogenic theories led to vascular procedures (carotid, sympathetic)

20th century

- Vasospastic -> vasodilatation theory of migraine (new surgical procedures)
  - Old still used (at least in alternative medicine)
  - Application of new methods (including x-rays of the pituitary for supposed endocrine origin of migraine, lumbar puncture)
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