

## What is Migraine? (The scientific story) by James Cottrill

<http://headacheandmigrainenews.com/what-is-migraine-the-scientific-story/>

**We talk a lot about migraine here, but it's time to ask the basic question – *what is migraine?*** Today we're going to take a look at some cutting-edge research, and ask the question from a scientific point of view. When someone has a migraine attack, what exactly is going on? And what do we mean when we say someone has migraine?

First, a word about the **migraine causes**. Everyone wants to know what the root cause is, so that migraine can be attacked at the source. But this isn't as easy to discover as you might think. When we see something happening in the brain, there could be multiple causes, and there could be causes that our technology doesn't yet allow us to understand.

We're going to go as deep as we can, but the cause of migraine is still a matter of debate – and it's likely we still don't know nearly enough to make a judgement.

### **A genetic disease?**

When asking *what is migraine?*, migraine researchers want to know why some people get migraine and others don't. Genetics seem to be a key here – but they may not be the only key.

For example, one twin may have migraine, and one may not. That *might* indicate that migraine is not always genetic. On the other hand, it may mean that both have the disease, but for an unknown reason it's not *active* in one twin.

On the other hand, recent studies have shown a very clear correlation between genetic mutations and some types of migraine (such as familial [hemiplegic migraine](#)). It's likely that different types of migraine are rooted in different genetic abnormalities – which is another reason the link is hard to nail down.

Genetic abnormalities may, for example, cause ion channels and pumps to malfunction. **Today many researchers suspect that a combination of genetic factors are at least partially behind migraine.** If we ask what is migraine? from a genetic point of view, it has been called a **genetically based disease** or a **common complex polygenetic disorder**.

## Ion channels, the cerebral cortex and the brain stem

What is migraine? Migraine is a disease of the brain, and these three players are probably key in the start of a migraine attack.

We know that migraine brains react differently than non-migraine brains. The brain of a migraineur is hyper-excitabile. It responds differently to stimuli (in other words, we're not saying a migraine attack is *caused* by eating the wrong things or being in a stressful situation – there is something about the brain of someone with migraine disease which is fundamentally different, even when an attack is not happening). But why?

1) **Ion channels** are in all living cells, and in the membranes surrounding cells. Ion pumps are proteins that move ions. Regulating the flow of ions, they are key in the communication process of your nervous system. Malfunctions in certain types of ion channels may start the migraine chain-reaction by causing problems in the brain stem and cerebral cortex. If ion channels are to blame, we might call migraine a **channelopathy** – a type of disease related to ion channel malfunctions (*cystic fibrosis* may also be a channelopathy).

2) We know that migraine symptoms can start in these two parts of the brain, though we're not sure if ion channels are the root problem. In the **cerebral cortex**, a kind of "brain storm" happens which is called a *cortical spreading depression* (CSD). A wave of hyperexcitability – an electrical wave – spreads across the outer layer of the brain, releasing neurotransmitters. Next comes a prolonged period of *suppressed* activity. Changes in blood flow occur (first an increase of about 300%, then a decrease to normal or below normal) at this time.

As this storm crosses the brain, it hits certain areas responsible for different sensory perceptions – motor skills, language and vision, for example. **As the storm reaches these parts of the brain, migraineurs experience various types of [aura](#)**. At other times, the CSD may miss those parts of the brain, or even occur deeper in the brain, and the same person may have no aura symptoms.

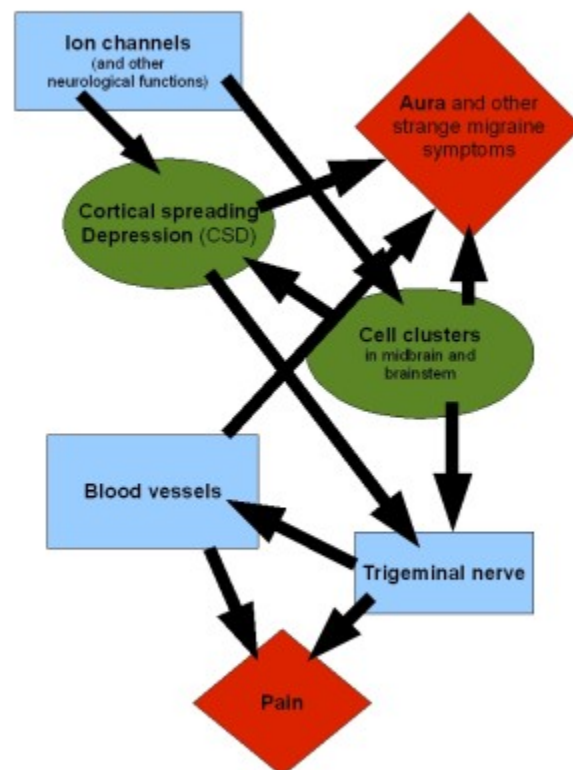
**A person who has migraine may be a person who gets these brain storms more easily than the average person.** This could be because of lower levels of chemicals in the brain, and breakdowns of communication in the neurological system (such as in [sodium channels](#)). (see [an interesting related study here](#))

3) **Deeper in the brain there are three clusters of cells that are active during migraine.** These also may be set off by ion channels or the release of serotonin and norepinephrine (two important chemicals in the brain). The *locus coeruleus* (in the brain stem), *raphe nucleus* (which releases serotonin, also in the brain stem) and *periaqueductal gray* (in the midbrain) are their names. They control things like alertness, pain sensitivity and perception of sound and light (among other things). Problems here could cause all kinds of weird migraine symptoms, including the fatigue and heaviness that accompanies migraine, and mood changes. This could also be a *cause* of a cortical spreading depression.

Emotions and behaviour can also influence the functioning of the brain stem. Though these factors alone are unlikely to "cause" migraine, it's possible that they could make a person more susceptible to an attack.

The chart to the right shows some of the complexity of migraine. These are some of the *possible* connections between various functions of the body and the symptoms of migraine. Some are more likely than others.

Many more could be listed – these are the ones we're focusing on in this article.



## What is migraine in relation to the trigeminal nerve?

The [trigeminal nerve](#) is a cranial nerve that give feeling and movement to the face and other areas such as the mouth, nasal cavity and teeth. The cell clusters we mentioned, and possibly the CSD, might set off problems in this nerve.

What if problems in the brain stem made you more sensitive to pain, then "turned on" pain in the head? Sounds like a sadistic type of torture, doesn't it? This may be what happens in a migraine attack. But notice how much we talked about before we even got to nerves and pain. The headache pain may or may not happen in a migraine attack. And it is nowhere near the start of the chain reaction.

The story may not end here. The trigeminal nerve can send signals back to the brain. Is a migraine attack an ever increasing circle of pain? These signals sent by the nerve endings may also cause changes in the blood vessels.

## Blood vessels

**The fact that we're talking about blood vessels so near the end of this article shows how far our understanding of migraine has come in 20 years!** Two or three decades ago most people thought of migraine as a vascular disease – a disorder related to the blood vessels. Today we know that changes here are the result of a long chain of events.

Dilation (expanding) of blood vessels and changes in blood flow do cause some migraine symptoms. The leaking of blood vessel walls can cause inflammation and lead to pain. It is also *possible* that changes in blood flow around the brain could cause aura symptoms. Though this was the best theory many years ago, today the most likely culprit is the CSD, as we talked about before.

**A new theory is suggesting that [blood flow itself](#) may play a greater role in neurological communication than we once thought.** If the blood flow is actually part of the process of sending messages in the body, it may play a bigger role in migraine than we now understand – though a totally different role than was believed in the 1970s.

## Triggers?

We haven't talked about [migraine triggers](#), or those things that seem to "set off" the migraine chain reaction in people with migraine. **Eating certain foods, or changing your sleep schedule, is not a cause of the disease, though it may end up in an attack.** Triggers may give us clues about what migraine is. But some people will never get an attack even with the same stimuli that is likely to cause symptoms in a migraineur. *Triggers may make an attack show up, but the attack will only happen in a person who already has the disease.*

## So what is migraine?

It's hard to summarize something as complicated as migraine. Migraine today is often called a **genetically based neurological disease**. Sometimes it's called **neurovascular**, because of the importance of both blood vessels and neurological processes in the disease. We already talked about terms like **channelopathy** and **common complex polygenetic disorder**.

Migraine is also probably more than one thing – as we learn more we may start talking about migraine *diseases* and not just migraine disease.

There is clearly something *malfunctioning* in the body of someone with migraine. Migraine is not "imaginary" (it's a biologically based disease), and it's not just a bad headache. After all, almost everyone gets headaches sometimes, but not everyone gets migraine attacks. **What happens during a migraine attack is actually very different from what is happening in the kinds of headache most people get.**

**What is migraine from a scientific point of view?** Well, a migraine attack is a neurological chain reaction that can completely disable the sufferer. The disease itself, the cause of migraine, has to do with a breakdown of communication in body. The drugs and treatments we're looking at today are often an attempt to either repair the breakdown or stop the "bad messages" from being passed on (and we'll talk about that another time).

There are pages and pages that could be written on migraine causes, the migraine chain reaction and what migraine is. There is a lot more that could be included here. But I hope this will at least give you an idea of where migraine attacks come from. In future posts we'll refer back here and expand on the topic.

*This information comes from many many sources, but I'm especially indebted to the [Scientific American](#) magazine article [Why Migraines Strike](#) by David W. Dodick and J. Jay Gargus, [Migraine and Other Headaches](#) by Drs Young and Silberstein, and [The Migraine Brain](#) by Dr Bernstein.*