

Evolution

Back to [Evolution](#)

Is it true that in earlier times humans were all O blood type (in ABO blood group) and that A, B and AB blood type occurred later by mutation of the O blood type gene?

-A curious adult from Thailand

January 13, 2010

No this probably isn't the way it happened. Most likely A came first. And then mutations in the original A gene caused B and O to appear.

One way scientists figured this out was by using something called [coalescence analysis](#). Basically, this is where you compare DNAs and figure out when they used to be the same. From this kind of analysis scientists concluded that A came first. Then, about 3.5 million years ago, the A gene mutated in someone and blood type B was born. The same thing happened about a million years ago for O blood type. So O is actually the most recent blood type.

At first this might seem weird since O is the most common blood type, but these kinds of things happen all the time. Different traits can become more common over time for [lots of different reasons](#).

For example, if a trait gives some sort of advantage, it can quickly become the norm. How quickly this happens depends on how big an advantage the trait gives.

So what's the use of having O blood? One theory is that it makes people suffer less severe symptoms from malaria.

As I said earlier, humans probably started with mostly A type blood. In areas with lots of malaria, these A folks lived shorter lives and had fewer babies than the O ones. Over time, the O folks slowly came to dominate.

This is one way that O might have become the most common human blood type. And there are [many others possible ways](#), some of which don't even require an advantage. What I'll do for the rest of the answer is talk a bit about how genes get changes in them to create new traits. In other words, for our discussion here, how did O and B spring from A? I'll also talk a bit about why having an O blood type can make you suffer less from malaria.

Blood type B and O came from A

If humans started out as A blood type, where did O and B come from? They came from small changes in the A gene.

To understand how this happened, we need to step back a bit and discuss genes and DNA. Because A, B, and O are all the result of one of our genes.

Each of our thousands of genes has the instructions for one small part of us. The gene we're interested in is called ABO. This gene comes in three different versions -- A, B, and O. The four common blood types all come from [different combinations of these versions](#) (or alleles as scientists like to call them).

The instructions in genes are written in DNA. The alphabet of this language has just four letters -- A, G, C, and T. The ABO gene has around 20,000 of these letters all arranged in a certain order.

The differences between the three different ABO alleles are actually very small. There is only a single difference between O and A and just four between A and B.

These kinds of differences originally came from things like environmental damage or mistakes our own cells made copying DNA. DNA changes like these are surprisingly common.

Given that many of these mutations are not good for us, we're lucky that our cells are nearly perfect at fixing them. But our cells don't catch all mutations--some are missed.

Sometimes one of these missed mistakes can cause problems like cancer or cystic fibrosis. But sometimes they can be helpful too. Like when they change A to O and this happens to give some protection against malaria.

Malarial Protection

So how does a single letter change protect someone from malaria? It does this by affecting the protein that gets made.

In order for a gene to perform its function, its instructions must be read and a protein made. It is the protein that goes off and does the work.

To get from DNA to protein, a cell needs to read a gene's instructions. Remember when I said that the genetic language has only four letters? Well, it also only has 64 three-letter words. This is called the genetic code.

Each combination of 3 letters makes up an amino acid and proteins are made up of these amino acids. So, a gene is really just a long string of three letter words that tells a cell to connect amino acids in a certain order.

Now imagine what would happen if you were to change (mutate) one of the letters that codes for an amino acid.

Let's take as an example the amino acid leucine.

There are six different words that mean leucine. We'll just focus on one -- UUA.

		Second letter				
		U	C	A	G	
First letter U	U	UUU } Phe UUC } UUA } Leu UUG }	UCU } UCC } Ser UCA } UCG }	UAU } Tyr UAC } UAA } Stop UAG } Stop	UGU } Cys UGC } UGA } Stop UGG } Trp	U C A G
	C	CUU } CUC } Leu CUA } CUG }	CCU } CCC } Pro CCA } CCG }	CAU } His CAC } CAA } Gln CAG }	CGU } Arg CGC } CGA } CGG }	U C A G
	A	AUU } Ile AUC } AUA } AUG } Met	ACU } ACC } Thr ACA } ACG }	AAU } Asn AAC } AAA } Lys AAG }	AGU } Ser AGC } AGA } Arg AGG }	U C A G
	G	GUU } GUC } Val GUA } GUG }	GCU } GCC } Ala GCA } GCG }	GAU } Asp GAC } GAA } Glu GAG }	GGU } GGC } Gly GGA } GGG }	U C A G

If one of the letters were changed (or mutated), then you might get

Genes are written in a four letter alphabet with these three letter words.

UUU. Now instead of leucine, you have phenylalanine. It is like putting the wrong word in the middle of a sentence. It's as if you wanted to write CAR but instead you wrote CAT.

This is exactly the difference between allele A and B except that there are four differences like this instead of one. These differences that make up the B allele result in a different blood protein. This protein still works like it should.

What about the O allele? Well, as we said before, the O allele differs at only one location from the A allele. But what a big difference it is!

Instead of changing a letter, the O allele is actually missing one. What happens is that every "word" after this change is wrong. Which means that a bunch of gibberish gets made.

To see what I mean, imagine the sentence:

The old man had one new hat.

Now imagine what happens when you get rid of the first e. Because of the way a cell reads a gene, it only "sees" three letter words. Which means the new sentence is:

Tho ldm anh ado nen ewh at.

So you end up with a protein getting made that can't do much of anything. For the O allele, very shortly after the missing letter, one of the new three letter words that gets made is a stop codon.

Stop codons are sort of like a period in a sentence -- they tell a cell when to stop reading a gene. Ultimately this means that for the O allele, we end up with half a protein that has a lot of the wrong amino acids.

Our cells can't use these kinds of proteins so it is like the protein isn't even there. And apparently for a malaria infection to really take hold, it needs an A or B protein.

Malaria is caused by a parasite that is transmitted from mosquitoes to men. Once this parasite enters your body it lives in your red blood cells. The parasite doesn't seem to have any trouble getting into an O blood cell. But it does have trouble quickly spreading from cell to cell.

Malaria symptoms come from these parasites destroying lots of red blood cells. If they can't infect as many, the symptoms will be less severe. This is one possible reason why O blood type came to dominate.

So we all started out with A blood type. Some lucky person developed a mutation that caused the A to convert to O. Now that person (and his or her offspring) was more resistant to malaria and so lived longer and had more babies. After a while, O came to dominate human blood types. That's one theory anyway.

Mara Damian, [Stanford University](#)