How did the giraffe get its improbable neck? Genetic analysis finds clues

By Rachel Feltman, Washington Post
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A 4-day-old baby giraffe stands near her mother Denisa at Ramat Gan Safari, near Tel Aviv, Israel, in 2009. Photo:Reuters/Gil Cohen Magen

Giraffes: They're weird!

These spindly creatures have necks so long that their bodies are studies in brilliant adaptation. Their torsos are stunted to support their impossibly long necks. Their dangerously thin legs grow super straight, keeping them from bowing under pressure. Their blood pressure is twice as high as our own -- which allows them to pump blood more than 6 feet up in a straight shot so it can make it all the way to the brain.

Scientists know that these adaptations all emerged relatively quickly (on an evolutionary scale, that is) because the giraffe only separated from a common ancestor with its closest relative, the okapi, around 11 million years ago. In that time, the giraffe has become -- well, a giraffe -- while the okapi has maintained the zebra-esque appearance of their ancestors.

But the giraffe's genes suggest that these radical changes were the result of a few subtle mutations.

The first full genome sequences of the giraffe and the okapi were published Tuesday in Nature Communications.

Douglas Cavener of Penn State University, who co-led the research team with Morris Agaba of the Nelson Mandela African Institute for Science and Technology in Tanzania, told The Post that he was pleasantly surprised by all the findings. Cavener and Agaba compared the genomes of the giraffe and the okapi (along with those of 40 other mammals, including humans) to figure out what genes might give giraffes their quirks. Because the okapi and giraffe genome are so similar, any differences could be used to hunt down the genes behind long necks and hardy hearts.

Instead of completely new genes, they found 70 genes with giraffe-specific mutations.

"There's a misconception that to make something novel in evolution you must be doing something very dramatic at the DNA level, but that just isn't the case," Cavener said. "You can have these very subtle changes in DNA that create dramatic effects."

Most of the genes they found are known to help regulate physical development in other mammals, which is exciting -- it adds credence to the idea that tweaking these genes could turn a donkey-like creature into the tallest animal on land.

Some of the genes they identified, such as one called FGFRL1, simultaneously influence the skeletal and cardiovascular development of other mammals.

"And that makes sense, because it wouldn't be a case that you'd create an animal with a long neck and then say oh, we have a problem with the cardiovascular system, it can't support this, and then have that change," Cavener said. In other words, tweaks in these multitasking genes could have simultaneously created long necks and long-neck-

supporting cardiovascular systems, whereas a mutation on a skeletal gene alone might have resulted in one very dead giraffe.

More research is needed to know whether or not these genes are truly behind giraffes' long necks. For now, they're just promising candidates.

"A lot of subtle changes went into giraffe evolution, and we're just scratching the surface of what the genetic changes are," Cavener said.

Cavener plans on testing out some of these genes soon. He and his team will breed genetically modified mice, replacing their own copies of individual genes with the mutated giraffe version. With any luck, they might see some familiar looking skeletal or cardiovascular changes.

Understanding how these creatures handle such high blood pressure without injury could help develop treatments for humans, the researchers say. And the genomic analysis of the giraffe will have more immediate applications as well: The team plans to look at the genomes of possible subspecies of giraffe to determine whether they're actually distinct from one another.

"If they are, then some of those subspecies are clearly endangered," Cavener said. Populations have declined by 40 percent over the past 15 years because of poaching and habitat loss, he explained, and some estimate that there could be fewer than 10,000 giraffes left by the end of the century. But if some giraffe populations have unique genes, they could disappear even sooner.

"This could be quite useful in finding them," he said.