GIRAFFES · PHYSIOLOGY

Giraffes and the Blood Pressure Problem

How the world's tallest animal pumps blood all the way up its neck to its brain — and bends down to drink without fainting.

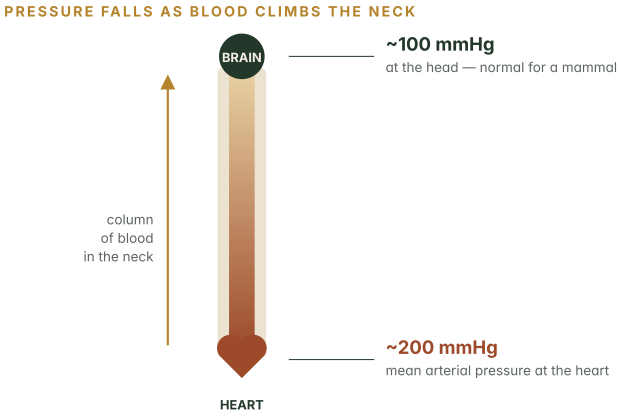
SERIES **SAFARI NOTES** FORMAT **FIELD & GUIDING NOTES** PUBLISHED BY **THE SAFARI SHOW**

> A giraffe's brain sits a long way above its heart. Getting blood up there takes a blood pressure that would be dangerous in us — and then the giraffe lowers its head to drink and lifts it again 5–6 metres in one sweep. Its body is built to cope with every part of that.

01 The problem: gravity

Blood has weight. The higher the brain sits above the heart, the harder the heart must push to get blood up there at a useful pressure. Physiologists have been fascinated by giraffes for centuries for exactly this reason: gravity affects every tall animal, and the giraffe is the tallest of all.

Several studies have measured a **mean arterial blood pressure of about 200 mmHg** at the level of the giraffe's heart. That appears to be what's needed to deliver a pressure of **around 100 mmHg at the head** — about the same as in other mammals.



Simplified: roughly half of the pressure produced at the heart is used up lifting blood up the neck (Aalkjaer & Wang 2021; Mitchell & Skinner 2009).

~200 mmHg

PRESSURE AT THE HEART

Published measurements average around 200 mmHg — almost twice what's predicted for a mammal of its size (~117 mmHg).

~100 mmHg

PRESSURE AT THE HEAD

Similar to other mammals, so the brain receives a normal pressure.

up to 8 cm

LEFT VENTRICLE WALL

The wall of the main pumping chamber gets thicker almost in step with neck length.

5–6 m

HEAD LIFT

The distance a drinking giraffe raises its head in one movement.

02 The heart: thick walls, not a giant heart

A popular myth says giraffes have enormous hearts. In fact, the giraffe's heart is about the **size you'd expect for its body** — roughly 0.5% of body mass, the same as other mammals.

What's different is its shape. The wall of the **left ventricle** (the chamber that pumps blood to the body) is very thick — up to about 8 cm in large animals — and its thickness rises almost in step with the length of the neck. A study of nine giraffes found the heart has a **small left ventricular cavity** and pumps a **small volume per beat**. A thick wall around a small chamber lets the heart produce very high pressures while keeping the stress on the muscle wall at normal mammal levels.

At rest, a giraffe's heart typically beats around **60–90 times a minute**, rising to about 175 during exercise.

MYTH CHECK

"Giraffes have the biggest hearts relative to their size." Not true — heart mass relative to body mass is ordinary. It's the *thickness* of the wall that's exceptional.

03 The legs: a built-in support stocking

High pressure is useful for the brain but a problem for the legs. Below the heart, gravity adds even more pressure, which should force fluid out of the blood vessels and make the lower legs swell (**oedema**). Giraffes don't get swollen legs, and research has found several reasons why:

TIGHT WRAPPING

A natural "anti-gravity suit"

Tight skin and dense connective tissue (fascia) around the lower legs resist fluid leaking out. In one study, injecting saline caused a pressure rise about 5.5 times larger in the legs than in the neck — the leg tissue barely stretches.

NARROWED ARTERIES

Built-in pressure reducers

The main foreleg artery thickens and narrows sharply just below the elbow, with dense nerve supply. It can constrict, producing a pressure drop along the artery before blood reaches the small vessels.

MUSCULAR SMALL ARTERIES

Strong vessel walls

Small arteries in the legs have thicker muscular walls for their size than those in the neck, and can contract much more forcefully.

LESS LEAKY CAPILLARIES

Holding proteins in

Capillaries in the legs are poorly permeable to plasma proteins, which helps keep fluid inside the blood vessels.

These findings come from pressure recordings in walking giraffes (by radiotelemetry), studies on anaesthetised giraffes, and tissue samples.

04 Bending down to drink

When a giraffe lowers its head to drink, its brain drops from far above the heart to below it. You'd expect a surge of pressure in the head, and a sudden drop when it stands back up — enough to make a person faint. Measurements on anaesthetised giraffes showed what happens:

1. **Head goes down.** Blood stops flowing out of the head and pools in the big jugular veins of the neck — about **1.2 litres** in one study.
2. **Less blood returns to the heart,** so cardiac output fell by about 30% and mean arterial pressure dropped from about 193 to 131 mmHg — which may help offset the extra pressure in the lowered head.
3. **Head comes up.** The jugular veins collapse and the stored blood rushes back to the heart.
4. **Output recovers** as the head is raised again, when the brain needs that pressure most.

Valves in the jugular veins also stop blood flowing backwards into the head when it's lowered. Researchers caution that the pooling mechanism has been shown in anaesthetised animals; it hasn't yet been confirmed in awake, free-moving giraffes.

MYTH CHECK

"The neck works like a siphon." An old idea held that blood flowing down the jugular veins helps pull blood up the arteries. Model experiments and measurements on giraffes do not support this: blood reaches the brain because the heart generates enough arterial pressure, not through a siphon.

05 Kidneys under pressure

Very high blood pressure normally damages the kidneys. A study of 14 giraffes found the giraffe kidney protects itself with a **very strong outer capsule** (calculated to burst only at about 600 mmHg) and a **high pressure inside the kidney tissue** — more than ten times that of other mammals. This counteracts the high arterial pressure, and the kidneys filter blood at a lower rate than expected for an animal of that size.

06 Clues in the genes

A 2021 study in *Science Advances* sequenced a high-quality giraffe genome and found giraffe-specific changes in genes linked to the cardiovascular system and bone growth. One gene, **FGFRL1**, carries seven amino-acid changes not found in any other ruminant. Laboratory mice engineered with the giraffe version

showed **exceptional resistance to hypertension (high blood pressure)** and **higher bone density**. The authors suggest this may one day help research into human hypertension.

07 Giraffes in Zimbabwe

Giraffe numbers across Africa fell by an estimated 36–40% in 30 years, from roughly 152,000–163,000 in 1985 to about 97,500 in 2015, and in 2016 the IUCN moved the giraffe from Least Concern to **Vulnerable**. In 2025 the IUCN recognised four giraffe species; Zimbabwe's giraffes belong to the southern giraffe (*Giraffa giraffa*), and new Red List assessments for the separate species are still to come. The Giraffe Conservation Foundation lists **Hwange National Park** among Zimbabwe's main southern giraffe populations, alongside Gonarezhou, Savé Valley, Bubye Valley, Malilangwe, Nuanetsi and the Matetsi complex — and notes that numbers have continued to decline in Hwange.

AT THE SIGHTING — HOW TO SAY IT

"To get blood up to that brain, a giraffe runs a blood pressure about twice ours — around 200 at the heart. Its heart isn't especially big; the wall is just incredibly thick. Look at those lower legs: the skin is so tight it works like a compression stocking, so they don't swell."

IF ONE COMES DOWN TO DRINK

"Watch it lower its head. Experiments on sedated giraffes found blood pooling in the neck veins — over a litre — which lowers the pressure going to its head. When it lifts up again, that blood flows back to the heart, which probably helps it avoid blacking out."

08 Key terms

Mean arterial pressure	The average pressure in the arteries over one heartbeat, measured in millimetres of mercury (mmHg).
Left ventricle	The heart chamber that pumps blood out to the body.
Oedema	Swelling caused by fluid leaking out of blood vessels into the surrounding tissue.
Fascia	Sheets of dense connective tissue wrapping muscles and other structures.
Jugular veins	The large veins that carry blood from the head back down to the heart.
Cardiac output	The volume of blood the heart pumps per minute.
FGFRL1	A gene with giraffe-specific changes linked in mice to resistance to high blood pressure and denser bones.

In summary

- Giraffes run a mean arterial pressure of **about 200 mmHg** at the heart to get **about 100 mmHg** to the brain.
- The heart is normal-sized for the body; its **left ventricle wall is extremely thick** around a small chamber.
- **Tight skin and fascia, narrowed leg arteries and muscular vessel walls** protect the legs from swelling.
- In anaesthetised giraffes, lowering the head made **blood pool in the jugular veins**, lowering pressure; it returned when the head came up.
- A strong kidney capsule and high internal kidney pressure protect the kidneys.
- The giraffe was listed as **Vulnerable** in 2016; Hwange is one of Zimbabwe's key giraffe areas.

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