the heart must contract more forcefully to prevent a reduction in stroke volume. As previously explained (p. 392), initially the heart is unable to do this, and therefore the stroke volume of the left ventricle temporarily declines. However, the venous return of blood to the right side of the heart remains unaltered during the subsequent heartbeats. Consequently, the left ventricle receives more blood than it pumps into the arteries. The end-diastolic volume therefore increases sufficiently for the stroke volume to be normalized, despite the increased arteriolar resistance.

- *Blood volume*. The blood volume affects the arterial blood pressure, primarily because it affects the venous pressure, the end-diastolic volume, the stroke volume, and thus the cardiac output. Thus, an acute increase in blood volume increases the arterial blood pressure. However, the blood volume is well-regulated and normal variations are negligible. Moreover, the blood vessels, particularly the veins, expand when the blood volume increases, and therefore the increase in blood pressure will be moderate. Even so, adjustment of the blood volume is important for the long-term regulation of the arterial pressure (p. 503). Changes in arterial pressure as a result of altered salt intake are due to the fact that blood volume is dependent on the Na^+ content of the body (p. 500)
- Normal changes in *emotional status*, *digestive activity*, and not least, *physical activity*, all affect cardiac output or TPR, and consequently, the arterial blood pressure.

Table 11.3 gives the arterial pressures at rest for some animal species. There is no clear correlation between the size of an animal and its arterial blood pressure, but mammals with a large vertical distance between the heart and the brain exhibit the highest pressures. Giraffes have a particularly high arterial blood pressure (Fig. 11.43). This is necessary in order to ensure that the brain is supplied with sufficient amounts of blood when the head is raised. Birds also have relatively high arterial blood pressures (Table 11.3). This is advantageous, since it reduces the impact on the circulation exerted by the rapid accelerations that occur during flying.

Table 11.3 Arterial blood pressures in domestic mammals, some rodents, birds, and giraffes.

Animals	Systolic pressure (mmHg)	Diastolic pressure (mmHg)	Mean Pressure (mmHg)
Domestic mammals	125–145	80–95	100–110
Rats, mice, guinea pigs	100–120	70–80	85–100
Birds	175–250	150–170	160–200
Giraffe	280–350	200–300	300

The Arterioles and Regulation of Arteriolar Diameter

The smallest arteries are, as noted, called arterioles. The diameter of each arteriole is less than 50 µm (0.05 mm), and the pressure decrease along the arterioles is considerable (Fig. 11.40). About 60 % of the total resistance to flow (TPR) in the systemic circulation resides in the arterioles. While the pressure drop in the arteries is quite small, the pressure at the junction between the arterioles and the capillaries has decreased to about 35 mmHg in most organs. Moreover, the pulsatile blood pressure and blood flow in the arteries are converted to an even pressure and a smooth flow in the capillaries and the veins. These changes are primarily due to the distensibility of the arterioles.

The walls of the arterioles are less elastic and more muscular than the walls of the ar-

?

90 Describe the direct and indirect methods for measuring arterial blood pressure.

91 Why is it difficult to measure arterial blood pressure by non-invasive methods in domestic animals?

92 How does gravity influence measurements of blood pressure?

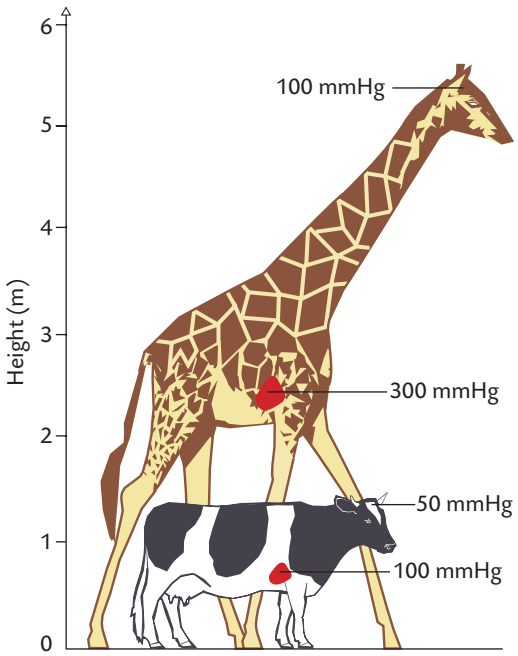

Figure 11.43 Blood pressure in giraffes. In order to obtain a sufficiently high arterial pressure at the level of the brain, the giraffe must have a mean arterial pressure as high as 300 mmHg at the level of the heart. For comparison, the situation in a shorter mammal is also shown. Modified from Engelhardt and Breves, 2000.