A comparison *in vitro* of the responses of the mesenteric arterial vasculature from duckling and chicken to nervous stimulation and noradrenaline

B.A. GOODEN
(introduced by A.T. BIRMINGHAM)

Department of Physiology and Pharmacology, Medical School, Queen's Medical Centre, Clifton Boulevard, Nottingham NG7 2UH

It is well documented that ducks can survive underwater asphyxia for about five times as long as hens (Andersen, 1966). Intense vasoconstriction in peripheral vascular beds, including the mesentery, has been shown to act as an oxygen-conserving mechanism in ducks during diving (Butler & Jones, 1971). However, the literature is virtually devoid of information concerning the relative responsiveness of isolated vascular beds from diving and non-diving animals.

The vascular responses of isolated mesenteric arterial beds from 2–5 week old domestic ducks (*Anas platyrhynchos*) and domestic chickens (*Gallus domesticus*) were compared. The anterior mesenteric artery was cannulated and the mesentery cut away at its border with the gut (McGregor, 1965). The tissues were perfused at either constant flow rate (2 ml/min) or constant pressure (50 mm Hg). Periarterial nerve stimulation was produced over a logarithmic range of frequencies from 1.25 to 80 Hz at a pulse width of 200 μs, supramaximal voltage of 56 V and a duration of stimulation of 20 seconds. (−)-Noradrenaline bitartrate was administered into the perfusion line adjacent to the tissue as 0.1 ml doses over a logarithmic range of concentrations of 1×10^{-6} to 8×10^{-3} M. At a constant flow rate the maximum pressure response evoked by nervous stimulation in the ducklings (137 ± 62 mm Hg; mean ± standard deviation; $n = 35$) was significantly greater than that produced in the chickens (46 ± 29 mm Hg; $n = 39$; $P < 0.001$). When perfused at a constant pressure, nervous stimulation at 20 Hz arrested flow in 4 out of 8 ducklings and at 40 Hz in 7 out of 8. Flow was not arrested in any chicken at any frequency used. The mean minimum flow rate in the ducklings was $2 \pm 6\%$ of the control level and in the chickens $38 \pm 17\%$ ($n = 10$; $P < 0.001$). In the constant flow experiments the maximum pressure response produced by intravascular noradrenaline in the ducklings (170 ± 27 mm Hg; $n = 13$) was also significantly greater than that produced in the chickens (92 ± 32 mm Hg; $n = 16$; $P < 0.001$). When perfused at a constant pressure the mean minimum flow rate in the ducklings was $1 \pm 1\%$ ($n = 8$) of the control level and in the chickens $23 \pm 22\%$ ($n = 9$; $P < 0.01$). Thus the duckling arterial bed produced significantly greater maximum vasoconstrictor responses to nervous stimulation and intravascular noradrenaline regardless of whether the tissues were perfused at constant flow or constant pressure. A quantitative histological examination of the mesenteric arterial vasculature in the two species suggests that these differences may be ascribed, at least partially, to greater wall thickness to lumen diameter ratios and greater densities of noradrenergic innervation in the duckling arteries. The present findings indicate that the mesenteric arterial bed in the duckling is well adapted to play its rôle in oxygen conservation during diving.

References

ANDERSEN, H.T. (1966). Physiological adaptations in diving vertebrates. *Physiol. Rev.*, **46**, 212–243.

BUTLER, P.J. & JONES, D.R. (1971). The effect of variations in heart rate and regional distribution of blood flow on the normal pressor response to diving in ducks. *J. Physiol. Lond.*, **214**, 457–479.

McGREGOR, D.D. (1965). The effect of sympathetic nerve stimulation on vasoconstrictor responses in perfused mesenteric blood vessels in the rat. *J. Physiol. Lond.*, **177**, 21–30.