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## DIFFERENT PATTERNS OF AUTONOMIC HEART RATE CONTROL DURING HYPOXIA IN FETAL AND NEWBORN LAMBS

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Autonomic nervous control of heart rate (HR) during hypoxia was studied longitudinally in nine unanaesthetised fetal lambs (109 days-term) and seven newborn lambs (2-28 days old). Lambs were chronically instrumented with carotid arterial and jugular venous catheters and ECG electrodes; experiments began after at least 2 days post operative recovery. Changes in heart rate ( $\Delta$  HR) during hypoxia were age-dependent; before 120 days gestation  $\Delta$  HR was insignificant (number of experiments,  $n=6$ ); between 120 days-term bradycardia occurred ( $\Delta$  HR= $34\pm 7$  beats/min,  $n=14$   $P<0.01$ ); the response in the newborn was marked tachycardia ( $\Delta$  HR  $77\pm 7$  beats/min,  $n=11$ ,  $P<0.001$ ).

Autonomic influences on HR were quantified using atropine (0.2-3 mg/kg) and propranolol (1 mg/kg). In fetal lambs antagonistic increases in para-sympathetic and sympathetic outflows were evident during hypoxia. For example, between 120 days-term, increased para-sympathetic outflow was evidenced by greater atropine induced  $\Delta$  HR increments in hypoxic ( $n=14$ ) than normoxic ( $n=15$ ) states ( $117\pm 11$  versus  $27\pm 5$  beats/min,  $p<0.001$ ); increased sympathetic influence on HR was shown by greater propranolol induced HR decrements in hypoxic than normoxic states ( $60\pm 10$  versus  $11\pm 3$  beats/min,  $P<0.001$ ). Thus in hypoxic lambs 120 days-term nett bradycardia reflected predominant parasympathetic cardio-deceleration. In hypoxic lambs before 120 days gestation, both parasympathetic and sympathetic outflows increased, but not nett  $\Delta$  HR occurred. Parasympathetic outflow during hypoxia in the younger fetuses was evidently less than in the older group ( $\Delta$  HR with atropine  $60\pm 2$  and  $117\pm 11$  beats/min respectively,  $P<0.001$ ).

In newborn lambs synergistic sympathetic and parasympathetic changes contributed to the nett tachycardia. Increased sympathetic influence on HR was evidenced by greater propranolol induced  $\Delta$  HR in hypoxic ( $n=11$ ) than normoxic ( $n=8$ ) states ( $71\pm 10$  versus  $28\pm 8$  beats/min,  $P<0.01$ ). Decreased parasympathetic HR restraint was shown by smaller atropine induced  $\Delta$  HR in hypoxic than normoxic states ( $22\pm 5$  versus  $38\pm 8$  beats/min,  $P<0.05$ ). Thus the pattern of autonomic control of HR during hypoxia differs in fetal and newborn lambs. Changes in sympathetic and parasympathetic influences are antagonistic in the fetus, but synergistic in the newborn.

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