

Heart rate variability, breathing and body movements in normoxic fetal lambs.

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Studies on physiologic variables such as fetal heart rate variability, respiratory and body movements have raised the question as to whether prenatal behavioral states exist. The purpose of our animal experiments was to examine these parameters during sleep-wake-cycles in a long term study. The experiments were performed on 13 cross bred merino sheep at a gestational age of 120-140 days (24h monitoring period).

Two types of fetal electrocortical patterns could be distinguished clearly as regularly alternating periods: High voltage slow activity (HVSA) and low voltage fast activity (LVFA). According to Ruckebusch(1), HVSA is regarded as NonREM-sleep whereas LVFA periods accompanied by eye movement activity are regarded as paradoxical or REM-sleep. However, when LVFA was not accompanied by eye movements, the state was considered to be alert wakefulness (AW). On average NREM-sleep amounted to 42.7%, REM-sleep 48.9% and AW 8.4% of total recording time (24h). This means that fetal lambs spend only about 2 hours a day in a state corresponding to wakefulness in the adult. Rapid irregular fetal breathing is found only rarely (8.6%) in NREM-phases, whereas more than 60% of the REM

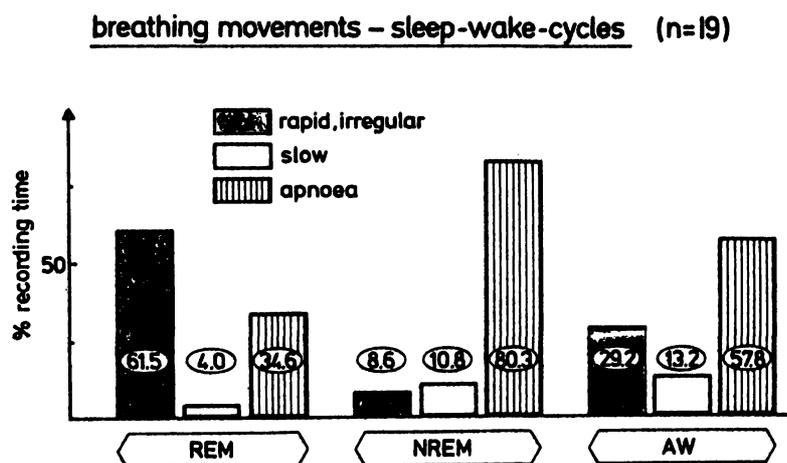


Fig. 1

time is accompanied by rapid irregular breathing (Fig. 1). Episodes of slow, relatively deep, respiratory efforts, described in the literature as gasps, are predominant in NREM-sleep. Similar to the fetal respiratory activity, the somatic movements of the fetus also display a clear dependence on the state of sleep or wakefulness. In 80% of the registration time of a NREM-phase movement activity is present. However, the fetus is moving for only half of the registration time in the REM and AW states (44.9%, 65.3% resp.). We were also interested in establishing the extend to which heart rate variability, which is known to be a good indicator of fetal

wellbeing in humans, is related to different states of the central nervous system. Heart rate variability was subdivided into four groups of beat-to-beat differences according to Hammacher and Hon. As Fig.2 demonstrates, normal heart rate variability, i.e. beat-to-beat differences of 10-25bpm, predominates. There is a dependence on the sleep-wake-cycle, but the heart rate variability is greatest in REM-sleep. Silent heart rate pattern, which is clinically regarded as a predictive value, exists overall in about 11% of the total recording time and predominated in NREM - sleep. Heart rate variability increased during episodes of rapid irregular breathing in all states of the sleep-wake-cycle. It appears that rapid irregular fetal breathing may overplay the influence of the status of the central nervous system.

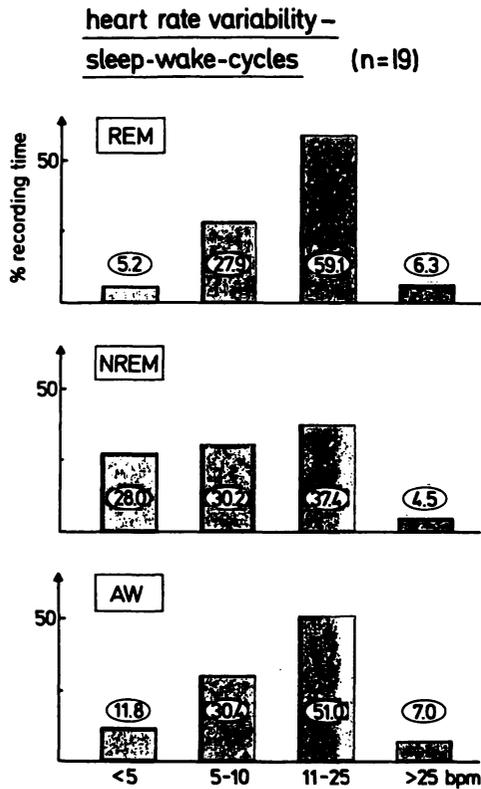


Fig.2

Reference:

- (1) Ruckebusch, Y., M. Gaujoux, B. Eghbali:
Sleep cycles and kinesis in the foetal lamb.
Electroenceph. clin. Neurophysiol. 42(1977), 226

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