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THE INFLUENCE OF ANESTHESIA ON THE HYPOXIC VENTILATORY RESPONSE IN SENESCENT RATS

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There are reasons to believe that the hypoxic ventilatory response (HVR) declines with advancing age, as both neural respiratory pathways and the respiratory muscle pump weaken or deteriorate. The evidence is, however, controversial. Studies show a decline, no change, or even an increase in HVR in old age. In the present study we sought to determine to what extent the states of wakefulness and anesthesia, variably used in the experimental studies on the subject, could influence changes in the hypoxic reactivity with age. The study was performed in rats divided into two extreme age groups; young – 3 months old and senescent - >24 months old. Two different experimental paradigms, each using a separate set of rats, were employed: anesthetized (α-chloralose and urethane; 10 mg and 50 mg/100 g, i.p.) and awake. In the former, minute neural respiratory output, as an index of minute ventilation (V_E), was assessed from the product of amplitude and respiratory rate components of phrenic neurogram, and in the latter, V_E was assessed from tidal volume and respiratory rate recorded in a body plethysmograph. Both age-groups in both paradigms were subjected to two levels of acute hypoxia (14% and 11% O_2 in N_2). We found that in anesthesia the profile of minute neural respiratory output over the course of hypoxia was not appreciably suppressed in the old compared with young rats. However, the hypoxic respiratory gain, which is a magnitude of the increase in the peak responses with increasing level of hypoxia, was flattened out in the old rats. By contrast, in conscious rats, both the profile of V_E and the hypoxic gain were significantly increased in the old rats. Concerning the latter, the mean peak V_E increased to 1099.1 ±105.6 and to 1463.3 ±179.2 ml/min/kg at 14% and 11% hypoxia, respectively. For comparison, the respective increases in the young rats were to 833.2 ±57.8 and to 980.1 ±5.3 ml/min/kg, which was significantly lower than those in the old rats ($P<0.05$). Thus, the study demonstrates that the ventilatory chemoreflex was well preserved in old rats, providing they had not been under anesthesia. Old rats may exhibit overcompensation of any age-related handicap in the respiratory system. We conclude that anesthesia heavily dampens hypoxic ventilatory reactivity in the aged, which may be one plausible explanation for divergent results reported in ventilatory studies.

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