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Mechanics of breathing and gas exchanges in healthy cattle : effect of somatic growth.

Growth-related changes in pulmonary function values of cattle were investigated by a cross-sectional study of forty healthy Friesians between three days and thirteen years of age. Technical and methodological procedures and body conformation and condition were standardized.

A regression analysis was done with four independent variables, the body weight, thoracic perimeter, body surface area and age, and with all pulmonary function values measured in this study.

Ventilation values, dynamic lung compliance and viscous work of breathing changed linearly with somatic growth. Respiratory frequency, total pulmonary resistance and arterial oxygen tension showed an exponential relation with all independent variables. On the other hand, intrapleural pressure values were weakly correlated with body size indexes.

Most important growth-related changes in pulmonary function occurred at approximately 1 year. Significant difference between immature and mature cattle was shown for blood gas values and specific values of the mechanics of breathing. Specific dynamic compliance was found to be lower and specific total pulmonary resistance, to be higher in cattle than in other common Mammals.

The allometric equations based on the body weight gave the best fit of the data for reference pulmonary function values in healthy cattle.

Airflow resistance partitioning was also measured in these animals. Upper airway resistance was shown to represent between 40 and 90% of total pulmonary resistance, depending on the age of the animal and the position of the head and neck.

It was concluded that (1) maximal breathing efficiency is not reached before 1 year of age in healthy Friesians, (2) concerning the respiratory physiology, cattle are disadvantaged in comparison with other species, such as man and horse; cattle appear to be predisposed to more frequent and more severe gas exchange deficiencies, (3) upper airway resistance represents the largest portion of total pulmonary resistance, specially in adult cattle, and (4) reference nomograms, proposed in this study for the prediction of normal functional values, may be used for Friesian cattle if standardization requirements for technics, methods, and body conformation and condition are met.