

Spirometry in full-term and premature lambs

F. Bovino, DVM, MSc; E.M. Panelli, Undergraduate Student; D.G. Camargo, DVM, MSc; M. Deschk, DVM, MSc; P.S.P. Santos, DVM, MSc, PhD; L.C.N. Mendes, DVM, MSc, PhD
Univ Estadual Paulista Julio de Mesquita Filho, FMV, Unesp, Aracatuba, Sao Paulo, Brazil 01049-010

Introduction

Premature lambs are those born before day 137 of gestation. Animals born with premature lungs have multiple causes for developing respiratory distress syndrome (RDS) and respiratory failure. Surfactant treatment for infants with RDS is used routinely and results in beneficial clinical responses. Prenatal glucocorticoid treatment of fetal sheep results in improvements in oxygenation, gas exchange, lung mechanics, and lung volume after pre-term delivery. Spirometry is a physiological test that measures how an individual inhales or exhales volumes of air as a function of time. The primary signal measured in spirometry may be volume or flow. The minute volume is the amount of air a person or animal breaths in a minute. The minute volume is calculated by the multiplication of the tidal volume (Vt) and the respiratory rate (RR).

The aim of this study was to evaluate respiratory capacity by spirometry in neonatal lambs, and to compare full-term and premature responses.

Materials and Methods

We evaluated 36 lambs divided into 5 groups. In the NORMAL group (n = 9) lambs were born by normal delivery, and 4 different premature groups (PRE, DEX, SURF, and SURF+DEX), were delivered by c-section (137 days of gestation). Lambs in each group received a different treatment: PRE (n = 6) were not treated; DEX (n = 9) whose dams received dexamethasone (16 mg/IM) 36 hours before surgery; SURF (n = 6) lambs that received surfactant immediately after birth by intratracheal instillation (45.4 mg/lb; 100 mg/kg); and SURF+DEX (n = 6), where the dam received dexamethasone and the lamb received surfactant. The spirometric assessments were made immediately at birth (M0), 15 minutes (M15), 1 hour (M1), 6 hours (M6), 12 hours (M12), 24 hours (M24), and 48 hours (M48) after birth, using the monitor Dixtal 2020. Data obtained by spirometry, tidal volume (Vt), minute volume (Vm), respiratory rate (RR) in movements per minute (mpm), and end-tidal carbon dioxide (EtCO₂) were compared to determine if there were significant differences between moments and between groups. ANOVA was used followed by Tukey's test. Significance level was set at $P \leq 0.05$ in all analyses.

Results

For RR (mpm), in the DEX group there was a significant difference between M0 and M15, and M24 and M48, and in the SURF+DEX group there was a difference between M0 and M1, and M12 and M24.

In the SURF+DEX group there was a significant difference in Vt between M48 and M0 and M15.

For Vm (mL), the DEX group there was a significant difference between M0 and M6, M12, M24, and M48; M15 differed from M12, M24, and M48; and M1 differed between M24, and in the group SURF+DEX M0 with M1, M6, M12, M24, and M48; and M15 with M6, M12, M24, M48. For EtCO₂, there was a significant difference in the NORMAL group between M0, M15 and M1 with M6, M12, M24, and M48, and in the SURF+DEX group there was a difference between M0 and M1, M6, M12, M24 and M48.

When comparing groups, the RR was a difference in M0 (SURF was lower than NORMAL, PRE, DEX, and SURF+DEX) and at M15 (SURF was lower than NORMAL, PRE and SURF+DEX).

In Vm, the NORMAL values observed in the 3 first initial moments was higher than the other 4 groups.

Vt was verified in M60 the NORMAL was higher than the other 4 groups, and at M24 and at M48 the NORMAL differed only from the DEX and SURF+DEX groups.

For EtCO₂, the only difference between groups was observed at M0, where the value of SURF is higher than NORMAL and PRE.

All deaths occurred before 24 hours of life. Two lambs died in PRE and in DEX, 6 (100%) in the SURF group, and 1 in the SURF+DEX group.

Significance

We conclude that 48 hours was not sufficient time for all lambs to establish adequate ventilation. However, NORMAL lambs showed better adaptive capacity of respiratory function than premature lambs. Animals that received only surfactant (SURF) had the highest mortality rate (100%) before 6 hours, and were considered the poorest-outcome group. The other 3 premature groups had similar clinical evolution among groups.