**METHODS**

All lambs underwent a 24 h esophageal Multichannel Intraluminal Impedance-pH monitoring (MII-pH) (MMS®, Enschede, Holland). The 2-mm diameter MII-pH catheter (Unisensor, Attikon®, Switzerland) is equipped with a pH-measuring electrode positioned at 2 cm from the probe's distal tip as well as 7 impedance sensors. Following calibration, the catheter was introduced into the esophagus via the nose by pulling it through a 10 Fr suction catheter, to prevent coiling of the catheter in the nasopharynx. The probe was anchored to the head skin with 2 stitches. Positioning of the catheter 3 cm above the cardio-esophageal junction was confirmed by X-ray and verified at necropsy. The signals from the impedance and pH channels were sampled at 50 and 8 Hz, respectively, stored in the battery-powered data logger and downloaded into a personal computer. MII-pH recordings were analyzed with Database Software® (version 8.9a; MMS, Enschede, Holland) and visually verified.

Multichannel intraluminal impedance allows the detection of refluxes and definition of their chemical (acid, weakly acid [WA] and alkaline) and physical composition (liquid, mixed or gas). MII-pH also defines the proximal extent of the refluxate and bolus presence time in the esophagus (bolus clearance time) (Francavilla R, et al., 2010).

The impedance and pH recordings were analyzed independently for GER. GER was detected by impedance and defined as a sequential, orally-progressing drop in impedance to < 50% of baseline values starting distally in the esophageal body and propagating retrogradely to at least the next 2 proximal measuring segments. According to the corresponding pH change, impedance-detected reflux was classified as acid when pH fell below 4 for at least 4 seconds or decreased by at least one pH unit for more than 4 seconds if pH was already below 4. Weakly acid reflux was defined as a pH drop of at least 1 pH unit sustained for > 4 seconds with the basal pH remaining between 7 and 4. Reflux was considered alkaline when there was impedance evidence of reflux but the pH did not drop below 7. Gas reflux was defined as a rapid increase in impedance to a value > 5000 Ω that occurred simultaneously or retrogradely in at least 2 esophageal measuring segments. For each reflux episode as determined by impedance-pH, the associated gas-liquid pattern was classified as (1) mixed reflux of liquid and gas or (2) liquid reflux. The proximal extent of each reflux event was evaluated from the impedance tracings. For each lamb, the total number of reflux events (acid, weakly acid and alkaline), the acid exposure and bolus exposure index (total percentage of reflux detected with impedance), and average proximal extent of reflux were calculated. The bolus exposure index was measured from the most distal impedance segment in the esophageal body. Each of these periods was limited from liquid bolus entry (impedance drop to < 50% of baseline) to liquid bolus clearance (impedance return to > 50% of baseline). Acid clearance and volume clearance were defined as acid exposure and bolus exposure index, respectively, divided by the total number of reflux episodes (Salvatore S et al., 2009).

**RESULTS**

The relationship between rump-muzzle length [X, 49 cm (2)] and pH sensor insertion length [Y, 25 cm (1)] could be described by a linear regression equation: Y = 0.4 X + 4.8 (R² = 0.44).

The proximal esophagus was reached in 35% (26), 23% (41) and 28% (40) of refluxes during whole, preprandial and postprandial periods respectively (no significant difference, Friedman test). While 30% (45) of liquid refluxes reached the proximal esophagus in preprandial periods versus 50% (58) in postprandial periods, 20% (45) of mixed refluxes reached the proximal esophagus in preprandial periods versus 5% (10) in postprandial periods (no significant differences, Wilcoxon signed-rank test).

**REFERENCES**

1. Francavilla R, Magistà AM, Bucci N, et al. Comparison of esophageal pH and multichannel intraluminal impedance testing in pediatric patients with suspected gastroesophageal reflux. J Pediatr Gastroenterol Nutr. 2010;50(2):154-60.
2. Salvatore S, Hauser B, Devreker T, et al. Esophageal impedance and esophagitis in children: any correlation? J Pediatr Gastroenterol Nutr. 2009;49(5):566-70.