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Transuterine embryo migration, distribution of sexes within uterine horns, and fetometry in Nellore (*Bos indicus*) cattle

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ABSTRACT

There is no consensus about the occurrence of transuterine embryo migration under natural breeding circumstances, neither data related to this phenomenon for zebu cattle. In this study, 5431 reproductive tracts of Nellore cows and heifers were evaluated in an abattoir in the state of Mato Grosso do Sul. A total of 1030 animals (19.0%) were pregnant at the time of slaughter (including 2 twin pregnancies). Regarding singleton pregnancies (n = 1028), 39.5% of them, the fetus was located in the left uterine horn and the remaining 60.5% in the right. These frequencies differed statistically from parity. In all 1028 (100.0%) cases, the presence of a single CL was perceived in the ovary ipsilateral (whether right or left) to the pregnant uterine horn, indicating the absence of transuterine embryo migration of the conceptus. The overall sex ratio found was 51.5%, considering only pregnancies with sex identified, not differing significantly between the number of males and the number of females. The sex frequencies obtained from the total number of singleton pregnancies were 46.5% males, 43.9% females, and the remaining 9.6% corresponding to unknown sex fetuses. The supposed sex predilection for uterine horns was not observed because the difference between the numbers of males and females for the same uterine horn was not statistically significant. The crown-rump (CR) and crown-nose (CN) measures, for the conceptus with CR length 2.00 cm to 15.00 cm, showed a high linear correlation coefficient ($r = 0.990865$), being $CN = (0.3027 \times CR) + 0.4491$, $r^2 = 0.9818$, the equation that describes the behavior between the variables for this length interval. In conclusion, in Nellore cattle, the transuterine migration of conceptus may not exist, or consists of a rare event. In addition, the sex ratio and predilection are not distinguished from the symmetrical distribution, and regarding fetometry, an equation that involves CR and CN, could be useful for the veterinary field routine, especially in reproductive evaluation.

1. Introduction

Transuterine embryo migration is well documented in farm animal species such as sheep [1], horses [2], goats [3], and swine [4], and despite the relatively great amount of knowledge concerning the migration and mobility of the embryo through the uterine horns in cattle [5–8], there is no consensus about its occurrence under natural breeding circumstances, neither data related to this phenomenon for Zebu breeds. In multiparous species, transuterine embryo migration is a way to ensure the spatial distribution of fetuses during pregnancy, becoming a reproductive strategy because the fetal development should be deficient in smaller compartments [9], which would imply a larger mortality in early stages of pregnancy or at birth. In addition, another proposition involves the embryo migration as a mechanism to equalize the potential of the gonads, in those cases in which ovary inequalities occur [10].

The distribution of the sexes between the uterine compartments, demonstrating a larger number of male or female in a specific uterine horn evidencing such sexual segregation has been described by a couple of authors for some

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laboratory rodent animals [11,12], whereas some works failed to detect it for the same species [13]. In farm animals, this event was recently described for horses [14], indicating a proportion of males different from parity when ovulation occurs in left ovary. Hylan et al. [15] working with bovine embryos in several experiments found a lower sex ratio when oocytes were derived from left ovaries when compared with contralateral ones; however, such phenomenon was not observed when embryo transfer was performed resulting pregnancies in the left uterine horns of recipients, assuming so that ovarian factors might play a more significant role in sex ratio than does the uterine horn itself.

Concerning the fetal morphology and morphometry, the advent of ultrasonography contributed to pregnancy diagnosis, besides allowing noninvasive observations of prenatal development in cattle since the early 80s [16] and its evolution in the following decades [17], but few studies were conducted for zebu cattle [18]. Fetometry by direct means using disposal abattoir material, that is, discarded fetuses, still consists of a valuable finding, due to enormous amount sampled and its association what occurs in commercial herds in regard to reproductive physiology, thus avoiding the loss of important information useful for scientific research [19–23].

Since limited information is available related to the occurrence of transuterine embryo migration in cattle under natural breeding, the main objective of the present study was to verify the event regarding Nellore breed (*Bos indicus*), besides to determine the sex ratio of fetuses within the uterine horns and the establishment of equation describing the behavior of two commonly used fetal lengths in fetometry.

2. Material and methods

2.1. Animals

During the period from May 2015 to October, reproductive tracts were collected from 5431 cows and heifers at an abattoir located in the state of Mato Grosso do Sul, Brazil, at 20°05′S, 51°05′W. All animals were of Nellore breed (*Bos indicus*), and all tracts were transported to a room located in the same slaughterhouse and were examined within 1 hour of collection.

2.2. Gravid uterine horn verification

All work was conducted by a single technician that using plastic containers for transport, collect all the material just after the official veterinary health inspection table, and directed it to a specific room where the reproductive tracts were individually examined onto a table to determine the uterine horn of gestation. Appropriate orientation of the tracts was ensured based on the greater curvature of the uterine horn and the correct alignment of the external genitalia. The uterine horn of gestation (Fig. 1) was recorded after the pregnancy assumptions (presence of a CL in the ovaries, or pronounced asymmetry between them; asymmetry between the uterine horns and palpation findings like liquids and embryonic vesicles, or even structures with dimensions and texture compatible with a fetus) were confirmed by direct visualization of conceptus, that was dissected from its membranes and placenta by an incision made along the length of the uterine horn, thus allowing its removal. Longitudinal incisions were made in both the ovaries intending in this way to find a CL, thus relating its laterality (i.e., ipsilateral or contralateral) to the gravid uterine horn, and when an embryo or fetus were located in contralateral uterine horn to the site of ovulation, it was considered the occurrence of transuterine migration [10]. Assumed pregnant reproductive tracts in which the conceptus was unnoticeable to the naked eye due to its size, or incomplete tracts were not used in this study.

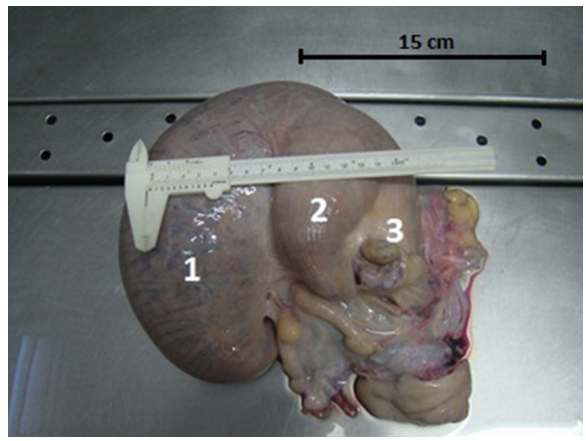

Fig. 1. Gravid right uterine horn (1), left uterine horn (2) smaller in size but also filled with fetal wraps and liquid. Left ovary before longitudinal incision (3).

2.3. Sex determination

The sex of the fetus was determined by visual inspection of the external genitalia or the genital tubercle [24–26]. Any fetus in which the sex could not be determined due to short gestational length was attributed as unknown sex.

2.4. Fetometry

Crown-rump (CR) and crown-nose (CN) measures were taken, using a plastic caliper (precision of 0.05 mm), as suggested by Lyne [27] who used the terms “crown-rump length (straight)” and “head length (straight) for CR and CN, respectively (Fig. 2). The sizes of the fetuses were divided into four groups: G1, fetuses with CR $<$2.00 cm (in which CN length was not taken); G2, fetuses with 2.00 cm $\leq$ CR $\leq$ 15.00 cm (were also taken CN length to establishment of correlation between the two variables); G3, fetuses with CR $>$15.00 cm, and CN $\leq$15.00 cm (registered only the CN length); and G4, fetuses with CN $\geq$15.00 cm (none of them was registered, simply was counted the number of individuals in this class).

2.5. Standardized terminology

The sex ratio and parity terms are used as presented by Giraldo et al. [25].