Conceptus-related measurements during the first trimester of bovine pregnancy: Evidence for early pregnancy failure

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Introduction
Diagnostic transrectal ultrasound is a powerful and frequently used tool in the assessment of early first trimester pregnancy. While rectal palpation of the bovine uterus and identification of the developing conceptus remains the most popular and cost-effective means of pregnancy diagnosis by the clinician, the application of ultrasonography to early pregnancy diagnosis, assessment of foetal loss and estimation of foetal age and ongoing development, has been significant.

In livestock breeding, the interpretation of scans for an accurate diagnosis of early pregnancy and embryonic/foetal viability are important both commercially and in research. For the producer, embryonic and foetal wastage can be a substantial source of economic loss. The origins of wastage include embryonic/foetal abnormalities, placental anomalies, environmental insult, inadequate maternal support and incompatible feto-maternal interactions.

Background
Pivotal to the accurate ultrasonographic diagnosis of a healthy pregnancy is the availability of relevant conceptus and fetometric data collected from normal pregnancies. In the absence of mating information (particularly in beef enterprises), fetometric growth parameters (e.g. crown rump length, CRL) provide the clinician/researcher with a reasonably accurate estimate of foetal age and developmental status.

In the bovine, foetal head, thorax, abdomen, pelvis and fluid compartments are readily observable via ultrasonography during the first four months of gestation with the head accessible 80% of the time throughout pregnancy. There are conflicting reports on the correlation of head diameter and head length vs CRL to foetal age. Owing to the variability in reported ultrasonography derived data, our presentation with additional ex utero foetalometric data from slaughtered beef females is warranted. The detection of conceptus fluid and compartmental membranes is often critical in the ultrasonographic diagnosis of early bovine pregnancy and their absence an accurate indicator of non-pregnancy.

This report examines, the relationship of these measurements, as well as a comparison of amniotic compartment, corpus luteum and foetal head dimensions to accepted fetometric parameters and the value of this data set in predicting normal foetal development.

Results
A total of 103 bovine conceptuses (up to ~190 mm CRL) were collected from females from various beef breeds at the first trimester of pregnancy from the abattoir offal line. Data collected for Conceptus-related and fetometric parameters from bovine in the first trimester of pregnancy (Days 36 and 103 of gestation) included corpus luteum diameter, dimensions of allantoic and amniotic compartments, CRL (In situ), head width and length and determination of sex. The fluid content of the various compartments were
aspirated and volume and total protein concentration estimated using a bicinchoninic protein assay.

Except for one Day 50 sample – placentation appeared normal across the gestational age groups. Corpus luteum (CL) diameter appeared randomly distributed in the first trimester and no correlation was found between CL diameter and length of gestation. The measurement of conceptus fluid volume and dimensions showed the allantoic volume and dimension correlated poorly with foetal age. However, the amniotic compartment increased in volume and dimension that correlated strongly with foetal gestational age.

During this period of measurement, protein concentration of amniotic and allantoic compartments differed even between animals of the same age. Allantoic fluid concentration was higher than amniotic as the same gestational time point. Allantoic concentration increased with age between 0.181 and 0.501mg/mL. The amniotic fluid volume gradually increased from <1mL at Day 36 to 950mL at Day 103 and amniotic compartment dimensions increased predictably with foetal growth. Interestingly, amniotic fluid protein concentrations (0.181-0.50 mg/mL) were tightly osmo-regulated even though volume increased in a predictable fashion. Conversely, allantoic fluid protein concentration and volume correlated weakly with foetal age.

A significant linear correlation existed between foetal crown rump length and crown nose length confirming that either measurement can be used in the ultrasonographic estimation of foetal age. No correlation between sex of the foetus and other parameters collected was observed.

**Conclusion**

The amniotic compartment and foetometric data presented has both research and clinical value, particularly in relation to foetal development evaluation and pregnancy viability diagnosis. Application of this data can be applied to the *in vitro* evaluation of foetal development and viability in normal and assisted reproductive technology pregnancies. Of clinical note, amniotic compartment volume measurements are predictive according to foetal age and the related compartment dimensions (e.g. maximum amniotic diameter) correlate well with other reliable foetometric growth parameters. The findings here support, the highly significant correlation between cranial dimensions and CRL and suggest possible substitution where applicable in ultrasonographic examinations. On the other hand, allantoic compartment volume and CL size bear no relationship to other developmental data measured and appear poor indicators of normal foetal development.

**References**
