PLACENTAL PROTEINS IN RUMINANTS:

Biochemical, physiological and zootechnical aspects

SOUZA N.M., FIGUEIREDO J.R. AND BECKERS J.F.*
Faculty of Veterinary Medicine, Federal University of Santa Maria, Brazil and *Physiology of Reproduction, Faculty of Veterinary Medicine, Liège, Belgium.

Abstract

During the last decade, investigations were carried out by several research groups in order to characterize proteins or glycoproteins synthesized in the ruminant placenta. Recently, as results of this research, a large family of pregnancy-associated glycoproteins (PAGs) was discovered. Using molecular biology techniques, they were found to be members of the superfamily of the aspartic proteinases which also contains pepsinogen, chymosin, renin, beta-secretase, cathepsin D and E etc. Synthesized in the mono and/or binucleate cells of the trophoblast, some forms of PAG seem to lack of proteinase activity. It is likely they are synthesized together with molecules involved in the tissue remodeling of the placenta. Their release in large quantities into the maternal blood circulation results in measurable plasma concentrations.

Thanks to international collaborative studies, we have shown that PAG levels are a good indicator of feto-placental well-being and that sharp decreases in PAG levels occur just before pregnancy failure in cows and in goats. In some countries, the PAG assay is available for veterinarians in the regional laboratories responsible for animal health including immunodiagnosis for brucellosis, IBR, BVD, CAEV, VISNA-MEDI etc.

1. Introduction

Placenta is a polyvalent organic system with a vital biological role for the perpetuation of the eutherian mammals. Fetal development is related to that of the placenta from the anatomical, genetic and metabolic points of view. As far as metabolism is concerned, endocrine function is particularly important. The endocrine function of the mammalian
placenta includes various hormones: progesterone, oestrogens, chorionic gonadotropins, placental lactogens, also designed “chorionic somatomammotropins”, prolactins, growth hormones and a series of growth factors, proteins and glycoproteins interfering with the establishment of pregnancy, corpus luteum maintenance, immunotolerance of the conceptus by the mother, intermediate maternal metabolism, fetal growth and mammary growth.

The study of the endocrine function of the ruminant placenta will be discussed below. Emphasis will be given to pregnancy-associated (specific) proteins, but information related to other polypeptide hormones will be freely utilized in order to develop our comparative understanding of the structure, function and release in maternal circulation of the placental proteins.

2. The Placenta

The placenta plays an essential role in both establishment and maintenance of pregnancy as well as in fetal development, working as a respiratory, nutritional, epurative, endocrine and immunological organ. The placenta is not only a barrier, as it was thought before, but it has a real active and selective exchanger role which is developed in harmony with other systems.

The topography and structure of the placenta vary according to the species and depend on the behavior of the egg which, at the time of its attachment, either remains in the uterine lumen or implants interstitially in the uterine mucosa. Various classifications have been proposed though the most widely used, despite some imperfections, is the classification based on the histological structure, or, more precisely, the number of histological layers separating the maternal and fetal blood. Four types of placenta may be distinguished histologically: the epitheliochorial placenta (Equidae, Suidae), the synepitheliochorial placenta (ruminants), the endotheliochorial placenta (carnivores) and the haemochorial placenta (human, primates and rodents).

The uterine connective tissue is modified in both endothelial and haemochorial placentas and tearing of the uterine tissues accompanied by bleeding occurs during parturition. The uterine regions shed in this way are said to be deciduous and the species with these types of placenta are called deciduates.

The mature ruminant placenta is neither entirely syndesmochorial with no uterine epithelium, nor epitheliochorial with two apposed cell layers whose the only anatomical interaction observed is the presence of interdigitated microvilli. The uterine epithelium persists but is modified to a variable degree into a hybrid fetomaternal syncytium formed by the migration and fusion of the fetal chorionic binucleate cells with those of the uterine epithelium (Wooding, 1992).

2.1. BINUCLEATE CELLS

The most characteristic element of the ruminant placenta is the presence of binucleate cells or diplokaryocytes in the trophectoderm (Wimsatt, 1951). First described by Assheton in 1906, these cells have been the subject of numerous investigations over the