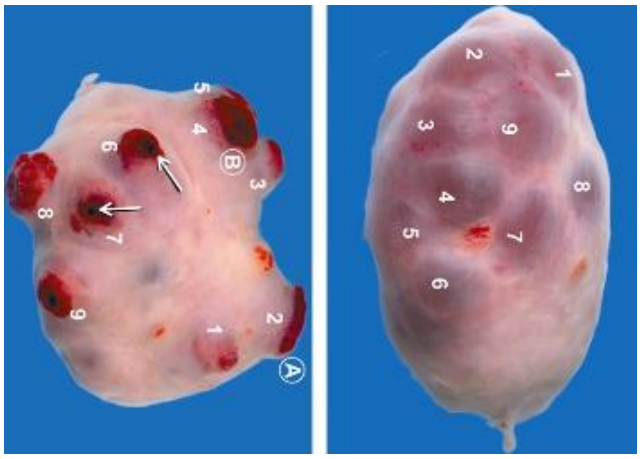
SUPEROVULATION

INTRODUCTION

The stimulation of cattle to induce additional ovulations (i.e. superovulation) has been the subject of much research during the past 50 years; the technique has always been an important consideration in the development of commercially accceptable ET technology in cattle.

Purpose:

Superovulation, also called superstimulation, is a treatment intended to increase the ovulation rate and number of available oocytes in the donor animal, without disrupting the physiological and endocrinological processes associated with oocyte maturation, ovulation, fertilization and embryonic and fetal development. Superovulation is a prerequisite for successful application of embryo transfer, particularly in species with a physiologically low ovulation rate (cattle, sheep and horses) and the description of superovulation will focus on these species. A close synchrony of oestrus between the donor and the recipient is crucial for obtaining optimal pregnancy rates, and is obviously an important part of the entire embryo transfer planning process.



Hormones

Follicular stimulation :

Two distinct groups of follicle-stimulating hormones have been used for superovulation.

1- The original hormone used for superovulation in ruminants was pregnant mare's serum gonadotrophin (PMSG), now designated equine chorionic gonadotrophin (eCG), which is a glycoprotein produced by the endometrial cups of pregnant mares. It can be purified from serum and has both a follicle-stimulating hormone (FSH)- and luteinizing hormone (LH)-Iike effect. Following injection in cattle, it has a half-life of approximately 5 days. eCG has both advantages and disadvantages.

The advantage is that the drug is relatively cheap and has to be administered only once. **The disadvantage** is a variable and unpredictable FSH : LH ratio and that the residual amount of eCG may have a continuous superstimulatory effect after ovulation and thus cause development of postovulatory oestrogen-producing follicles. The prolonged and elevated oestrogen production may disrupt fertilization and early embryonic development and, therefore, attempts have been made to reduce the allegedly adverse effects of residual amounts of circulating eCG by injecting eCG antiserum approximately at the time of oestrus. Nevertheless, other data in cattle have shown that this does not improve embryo numbers or embryo.

2- The second generation of superovulatory hormones is FSH, a pituitary gonadotrophin purified from the pituitary glands of pigs (pFSI-1), sheep (oFSH) or horses (eFSH). In contrast to eCG, pituitary gonadotrophin has a short half-life of approximately 6 hours and must be administered twice daily for 3-4 days in order to obtain the desired effect.

Compared with eCG it is expensive, but most FSH preparations have a more consistent FSH : LH ratio.

Mechanism of action:

The basis of their action is to bind to and activate FSH receptors on granulosa cells of small and medium sized follicles, and to stimulate the continued growth of these follicles, likely by inhibiting apoptosis

1- The biological half-life of FSH in the cow has been estimated to be 5 h or less so it must be injected twice a day to successfully induce superovulation.
   The usual regimen is:
   a- 4 or 5 days, twice daily treatments of FSH with a total dose of 28 to 50 mg (Armour) of a crude pituitary extract (FSH-P).
   b- Forty-eight or 72 h after initiation of the treatment, PGF is injected to induce luteolysis.
   c- Estrus occurs between 36 and 48 h, with ovulation 24 and 36 h later.
2- Equine chorionic gonadotrophin is a complex glycoprotein with both FSH and LH activity. It has been shown to have a half-life of 40 h in the cow and persists for up to 10 days in bovine circulation;
   a- injected eCG once followed by a PGF injection, 48 h later.
   b- Recommended doses of eCG range from 1500 to 3000 IU, with 2500 IU by intramuscular injection commonly chosen.