INDUCTION OF PARTURITION AND EVALUATION OF POSTPARTUM FERTILITY IN CROSSBRED COWS

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DECLARATION

I hereby declare that the thesis entitled **"INDUCTION OF PARTURITION AND EVALUATION OF POSTPARTUM FERTILITY IN CROSSBRED CATTLE "** is a bonafide record of research work done by me during the course of research and that this thesis has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

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CERTIFICATE

Certified that the thesis, entitled **"INDUCTION 'OF PARTURITION AND EVALUATION OF POSTPARTUM FERTILITY IN CROSSBRED CATTLE"** is a record of research work done independently by **Dr. Sheeja. S.**, under my guidance and supervision and that it has not previously formed the basis for the award of any degree, associateship or fellowship to her.

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We, the undersigned members of the Advisory Committee of **Dr. S. Sheeja**, a candidate for the degree of Master of Veterinary Science in Animal Reproduction, Gynaecology and Obstetrics, agree that the thesis entitled **"INDUCTION OF PARTURITION AND EVALUATION OF POSTPARTUM FERTILTY IN CROSSBRED CATTLE"** may be submitted by Dr. S. Sheeja , in partial fulfillment of the requirement of the degree.

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Introduction

1. INTRODUCTION

Cattle rearing is an integral part of agriculture in all parts of the world. They provide human population with products such as milk, meat, hide, fertilizer and fuel as well as draught power. India is a vast pastoral country where domestic animals are synonymous to wealth. Dairying is one of the principal occupations of the rural based life. With the increase in human population, grazing land is being progressively brought under the plough, leading to a decline in animal population. Hence the need to meet the maximum production potential from each individual animal arises. Reproductive management plays a crucial role in meeting the increasing demand.

Kerala being an agricultural state, dairying and allied occupations contribute a major share of subsidiary income. The total cattle population of Kerala as per 2003 livestock census was 21,22,453 out of which crossbred cattle around 17, 35 271 and local breeds constitute 3, 87 182 .

Reproduction is a vital factor in determining efficiency of animal production and is not only a complex process but also a crucial commercial necessity for the livestock farmer. From a biological point of view calving rate is perhaps the most appropriate measure of fertility.

Parturition is one of the most fascinating biological processes in the life of a breeding cow. It may be defined as the process of giving birth and expulsion of mature foetus from the secure intra uterine environment into the harsher outside world. Reproduction is successfully completed when a healthy live calf is at its mother's side. The time of parturition is one of the most critical stages in the life of any animal and the periods of highest death rates in foetus and the dam occurs during parturition. This period is of vital concern to the farmer who has a large economic

investment in his animals. Parturition is accompanied by the onset of milk production and these two processes are controlled by endocrine mechanisms.

Research in animals and humans has strongly implicated the importance of the foetus in determining its own time of delivery. This concept was first suggested by Hippocrates in 400 BC. As parturition approaches, there is activation of the foetal hypothalamic – pituitary – adrenal axis resulting in increased levels of foetal cortisols. Cortisol stimulates the placenta to convert progesterone to oestrogen. The elevated levels of oestrogen stimulate the secretion of prostaglandin and the development of oxytocin receptors. In corpus luteum dependent species, cortisol in addition to the synthesis of oestrogen causes a release of prostaglandin from the endometrium. As a result of alterations in steroid patterns, there is an increased uterine sensitivity to oxytocin and production of prostaglandin. Smooth muscle activation is associated with oxytocin and $PGF_2\alpha$ that augments the force of contraction and expulsion of foetus.

Prolonged gestation occurred as a result of some compromise of the pituitary adrenal axis of the foetus, which was no longer able to initiate parturition. Genetic, infectious, toxic, and unknown reasons had been associated with this problem. In a normal gestation, the foetus gained 0.45 to 0.68 kg/day in the final weeks in utero and as much as 1 kg per day when gestation is one to two weeks overdue. It had become common practice to induce parturition after 285 days of gestation rather than allow gestation to be prolonged to prevent dystocia due to foetal oversize.

The first published report of premature induction was by Adams (1969) in cows. The induction of parturition in cattle presents great economic incentives and significant economic benefits and advantages as a management tool in animal husbandry (Mansell *et al.*, 2006). Various treatments to induce parturition have been found applicable for this purpose.

The main indication for induction of calving is the shortening of gestation length with reduced birth weight of the calf. Another indication is to prevent mastitis due to excessive odema of the udder in advanced stages of parturition. In diseased animals, we alleviate the condition by induction and sometimes a live calf may be obtained by this way. In the advanced stages of parturition induction can be used to schedule calving to occur during daylight hours on known dates, to facilitate availability of personnel to manage calving. In addition, parturition can be induced to coincide with the availability of pasture for increased milk production and ensuring assistance at predetermined time.

The main limitations of induction of parturition are the requirements for known breeding dates and a high incidence of retained placentas.

The ability of synthetic corticosteroids to induce parturition in cattle has been found applicable to synchronize calving for better and convenient calving management. Various types and combinations of hormone treatments have been studied for efficacy and safety in parturition induction. Corticosteroids or prostaglandins are used in combination with various oestrogen preparations and oxytocin. Dimenhydrate and relaxin in combination with dexamethasone have been reported to reduce retention of foetal membranes. Prostaglandins and its analogues have been successfully used from 275 days of gestation with a latent period of two to three days. Good results have been obtained by using a combination of corticosteroid and prostaglandins. Mifipristone (RU 486), potent antiprogesterone, used alone or in combination with relaxin also had given varying results.

Hence the present study was undertaken to develop a suitable protocol for inducing parturition in cows with prolonged gestation and also to assess the safety of the protocol in the management of reproductive health and production.

Review of Literature

2. REVIEW OF LITERATURE

2.1 GESTATION LENGTH

Sane *et al.* (1994) stated that the gestation period of Gir cows was 281±19 days and for Sindhi cows it was 287 days. Craig (2000) reported that average period of pregnancy in cow was 283 days. Iype and Venkadachalapathy (2001) reported that local breeds of Kerala like Vechur had gestation length of 278 days. Sastry and Thomas (2005) reported that the gestation period of Indian dairy cattle varied from 286 to 289 days, but exotic breeds like Jersey and Holstein Friesian had a mean gestation length of 279 days whereas for Brown Swiss it was 290 days. The mean gestation length in cattle varied from 280 to 285 days (Suleyman and Mehmet, 2005; Barth, 2006).

Norman and Younguist (2007) observed that normal gestation period in cattle was 280 days and beyond that resulted in increased birthweight of the calf. Reports on gestation length of cross bred cattle of Kerala were scanty.

2.1.1 Factors affecting gestation length

Gestation was the period from conception to parturition, which represents the duration required for the formation of fully formed young ones (Bearden *et al.* 2004). The below mentioned factors were reported to affect gestation length in cattle.

2.1.1.1 Hereditary factors

Foote (1981) reported that dams and sires of the cows affected gestation length significantly. Cundiff *et al.* (1986) reported mainly the sire effect on gestation length of cattle. Marshell *et al.* (1993) recorded that gestation length

was highly heritable trait especially in beef cattle and they suggested that selection for reduced gestation length could be a useful move to reduce dystocia.

Deshpande *et al.* (1994) reported that the genetic constitution of the foetus had a vital role in the length of gestation. Sane *et al.* (1994) also reported that gestation length was controlled by hereditary influence and genotype of the dam and foetus.

According to Ball and Peters (2004) the variation in gestation length was mainly due to genetic influences of both the dam and sire. The length of gestation had been found to be heritable and problems associated with prolonged gestation could be changed by selection (Norman and Younguist, 2007).

Norman *et al.* (2009) reported that genetic correlations between effects of service sire and cow sire were 0.70 to 0.85 for Brown Swiss, Holstein and Jersey which indicated that those traits were controlled by many of the same genes.

2.1.1.2 Breed

Roberts (1986) reported that length of gestation period differed between certain breeds and certain hybrids. The gestation length of Jersey varied from 277 to 280 days, whereas for Holstein it was 278 to 282 and for Brown Swiss 288 to 291. The Indian breed Brahman had a mean gestation length of 292 days ranging from 271 to 310.

Deshpande *et al.* (1994) reported that larger the size of the animals longer was the gestation period, differences between breeds were also observed. Within breeds small variation was due to seasonal influence, mating time, managemental and feeding practices and individual variations. They also reported that there was significant correlation between body weight of the dam and gestation period, heavier the cow longer the duration of gestation.

Craig (2000) reported that in the improved breeds of Indian cattle the gestation length was shorter than local breeds. Bearden *et al.* (2004) also reported that both individual and breed differences exist among cattle. The difference in breed characters in adult animals were determined during foetal development itself (Mao *et al.*, 2008).

Nasser *et al.* (2008) reported that Bos *indicus* cattle had longer gestation than *Bos taurus* cattle. Similarly Camergo *et al.* (2009) also stated that *Bos indicus* dairy breeds had longer gestation length and lighter offspring than *Bos taurus* animals.

2.1.1.3 Sex and Weight of the Calf

Roberts (1986) reported that in cattle, male fetuses were carried one to two days longer than female foetus and weigh more than the female foetus. It was also reported that body weight of the calf was closely associated with gestation length and sire had significant effect on birth weight of the calf .Calves born to mature cows were heavier than from heifers. In general longer a foetus was carried, heavier was the birth weight.

Usmani *et al.* (1987) reported that gestation length changed quadratically with calf birth weight and concluded that lower calf birth weight had the longer gestation length than heavier weight. They also observed that heavier dams produced heavier calves and body weight of the dam increased with age of the dam at calving.

Bellows *et al.* (1994) reported that gestation length of male calves averaged two days longer than those of females. Deshpande *et al.* (1994) reported that irrespective of breed difference sex of the calf had significant effect on the gestation length, duration was longer in the case of male foetuses. But Sane *et al.* (1994) observed that there was positive correlation between the size of the foetus

and length of gestation. Gestation was little longer when a cow carrying male foetus than a female (Bearden *et al.*, 2004).

Camergo *et al.* (2009) reported that *in vitro* embryo production resulted in increased percentage of male calves (76.9 per cent) with increased weight and resulted in prolonged gestation.

2.1.1.4 Season

Sane *et al.* (1994) reported that in Indian breeds gestation period was lower at the end of winter, beginning of summer and end of rainy season, when climatic conditions were favourable but the gestation length was longer in June and December .

Sastry and Thomas (2005) reported that season had profound influence on reproduction in cattle. The purpose of seasonality was to have young ones taking birth at the most appropriate season of the year favouring better survival of new born.

Suleyman and Mehmet (2005) reported the influence of season on gestation length in exotic breeds that the gestation length was longer in winter, when daylight was short and the shortest in summer, when daylight was long. Similarly it was reported that length of gestation increased by 1.3 days for every one hour decrease in day length from September to December.

2.1.1.5 Age and Parity of the Dam

Sane *et al.* (1994) stated that the average duration of pregnancy in primipara was shorter than the pluriparous animals. The length of gestation was slightly variable and there was no consistency from calving to calving denoting that the age of the dam had apparently little or no effect on the duration of pregnancy.

Primiparous cows with lower bodyweight had shorter gestation length and they might often require assistance during birth (Olson *et al.*, 2009).

2.1.1.6 Twinning

Deshpande *et al.* (1994) reported that multiple pregnancy led to shorter gestation length when compared to single pregnancy. Echternkamp and Gregory (1999) also reported that twin pregnancies had shorter gestation length (275.6days) than single pregnancies (281.3 days.)

Similarly Craig (2000) reported that twinning led to shorter gestation length than singletons. Olson *et al.* (2009) also reported that twins had shorter gestation length and lower birth weight than single births.

2.1.2 Prolonged gestation

Barth (2006) reported that during terminal stages of gestation foetus often gained weight 450 g to 680 g per day and hence prolongation of gestation resulted in foetal oversize which finally ended up in complications during parturition.

Norman and Younguist (2007) stated that gestation period longer than 280 days resulted in increased calving difficulty primarily as a result of increased birth weight of the calf.

2.1.2.1 Factors affecting prolonged gestation

Prolonged gestation was observed in congenital defects of the calf such as hydrocephalus, cerebral hernia, reduced size of cranial cavity and these animals had abnormal or hypoplastic pituitary and adrenals (Roberts, 1986).

Hafner *et al.* (1991) reported prolonged gestation in a cow with gestation length of 469 days and postmortem lesions of the calf were suggestive of hypoplasia of adenohypophysis and bilateral agenesis of the adrenal cortex.

Noakes *et al.* (2001) reported that prolonged gestation was associated with abnormalities of foetal brain like in anencephalic calves in which due to the absence of foetal pituitary normal parturition could not be initiated, foetus continued to grow and resulted in foetal oversize and subsequent dystocia. They also reported that when haematic mummification occurred between three to eight months of gestation, there was persistent corpus luteum and no foetal signal for initiation of parturition and pregnancy maintained for an unpredictable time.

Similarly Yeruham *et al.* (2001) reported congenital malformation of calf as a sequelae of Bovine Viral Diarrhoea Virus infection which resulted in prolonged gestation with an oversized foetus lacking the pituitary gland and had cyclopia, cleft palate and generalized alopecia.

Mastorakos and Ilias (2003) reported that abnormalities of foetal adrenal gland such as increased level of receptors for antagonist of corticotropic releasing hormone would significantly prolong the gestation length.

Cornillie *et al.* (2007) reported the prolonged gestation in two Belgian blue cows due to inherited adenohypophyseal hypoplasia of fetuses.

2.2 INDUCTION OF PARTURITION

Bellows *et al.* (1988) stated that induced parturition was useful for predicting and scheduling parturitions and it helped in detection and correction of dystocias which reduced perinatal calf death.

Mansell *et al.* (2006) reported that the practice of induction of parturition in cows was a reliable way of shortening the gestation period of cows.

Nasser *et al.* (2008) developed a protocol for induction of parturition with long acting corticosteroids, short acting corticosteroids and $PGF_2\alpha$ and this protocol was recommended to minimise prolonged gestation to reduce birth weight of the calf.

2.2.1 Indication for Induction

Noakes et *al.* (2001) reported that during the last week of gestation the growth rate of the calf was rapid and therefore induction of parturition could reduce dystocia due to foeto maternal disproportion.

In dairy herds, parturition might be induced one to two weeks early to prevent excessive udder oedema and distension that might predispose to mastitis and difficulty in milking (Barth, 2006).

Krishnaswamy (2006) stated that induction of parturition was indicated for critically ill pregnant cows at an advanced stage of gestation those suffering from downer cow syndrome, hydroallantois, hydramnios or even third degree vaginal prolapse.

Buczinski *et al.* (2007) stated that prolonged gestation was commonly associated with foetal adenohypophyseal aplasia, hydronephrosis, hydrocephaly, holocephaly and teratology of fallot and induction was strongly recommended in such pathological conditions.

Norman and Younguist (2007) reported that in some dairy cows during the last weeks of pregnancy there was extensive oedema of the mammary gland and the condition indicated induction of parturition.

2.2.2 Drugs used for induction

Corticosteroids, prostaglandins and their combinations were widely used with varying results by different researchers. Most induction protocols employed a combination of prostaglandins and a potent short acting corticosteroid which resulted in a predictable interval from induction to calving, with no detrimental effect on calf viability (Barth, 2006; Nasser *et al.* 2008).

2.2.2.1 Corticosteroids

2.2.2.1.1 Long acting corticosteroids

MacDiarmid (1983) reported that the use of long acting corticosteroids was a more reliable method of induction in earlier stages of gestation than short acting corticosteroids

On contrary, Diskin and Sreenan (1984) induced parturition with long acting corticosteroid betamethasone on day 280 of gestation in 19 animals. Three cows calved within five days of treatment but rest of the animals required further treatment with short acting corticosteroid and prostaglandin.

Peters and Poole (1992) also induced parturition with another long acting corticosteroid dexamethasone trioxa undecanoate at a dose rate of 7.5 mg /kg 14 days prior to the predicted date of calving. The induction was safe for the dam and calf though the calves had 3.2 kg lower than control.

Barth (2006) administered dexamethasone trimethyl acetate (25 mg) intramuscularly one month prior to actual date of parturition and calving occurred within 4 to 26 days.

2.2.2.1.2 Short acting corticosteroids

Beardsley *et al.* (1976) induced parturition with dexamethasone 4.4mg/ 100 kg body weight at day 273 of gestation in 29 animals and 84 per cent of the treated group calved within 31 and 60 hours with an average of 45.1±11.1 hrs.

MacDiamird (1980) induced parturition in 553 pregnant animals with betamethasone at the dose rate of 20 mg and 103 animals that were closer to the term calved within seven days and rest of the animals responded to second dose of betamethasone . Calf mortality, retention of foetal membranes was high but the incidence of dystocia, mastitis and other illnesses was low.

Diskin and Sreenan (1984) reported that a short acting corticosteroid was used to terminate prolonged gestation in beef heifers and often led to dystocia due to poor birth canal relaxation.

Bellows *et al.* (1988) reported that induction of parturition was successful with 10 mg of flumethasone on day 272 of gestation and 95.3 per cent of animals calved within 60 hours.

The protocol employed by Diskin *et al.* (1989) involved treatment with a long acting corticosteroid on day 274, followed by five days later with a short acting corticosteroid . Calving was recorded in 90 percent of cattle within 80 hours of second injection and concluded that the treatment resulted in satisfactory maternal preparation for delivery and acceptable udder development.

Kamimura *et al.* (1992) induced parturition with short acting corticosteroid (dexamethasone 20 mg) in three animals each with gestation length of 293 to 352 and 255 to 277 days , all the cows in both groups calved within three days.

Prakash and Madan (1993) used induction one month prior to the expected date of calving with short acting corticosteroid dexamethasone and they concluded that the induction treatment had no deleterious effect on subsequent reproductive performance despite the high rate of retention of foetal membranes.

Bellows *et al.* (1994) reported that successful induction occurred in 91.2 per cent of animals with treated with 10mg of flumethasone on 269 days of gestation with an average induction interval of 46.6 hrs .

Barth (2006) induced parturition with 90 per cent efficacy when dexamethasone was given as single intramuscular injection within two weeks of normal term. The interval from injection to parturition was 24 to 72 hours, with an average of 48 hours.

2.2.2.2 Prostaglandins

Prostaglandins and its analogues had been successfully used from 275 days of gestation with a latent period of two to three days (Kordts and Jochle, 1975; Day, 1977)

Kask *et al.* (2000) reported that the average interval from administration of PG $F_2\alpha$ to parturition was shorter (2.7 days) compared to dexamethasone injection (5.3 days).

Arthur *et al.* (2001) successfully induced parturition with prostaglandins and obtained a more rapid response than dexamethasone but postpartum complications were more.

Kask *et al.* (2001) induced parturition in five cows, two weeks before term using two injections prostaglandin with a dose of 25mg at an interval of 24 hours. All the animals responded to the treatment and calved within 5days with an average of 2.7 days.

Kornmatitsuk *et al.* (2001) reported that prostaglandins had been successfully used in the induction of parturition in 12 dairy heifers about two weeks before the expected calving and the induction time was 59±70 hours.

Jenkins *et al.* (1981) treated two cases of bovine foetal mummification with 500µg of cloprostenol and mummies were delivered at 104 and 120 hours post treatment. Similarly Memon *et al.* (1986) also successfully treated two cows of hydroallantois with single intramuscular injection of prostaglandin $F_2\alpha$ (30mg), after 82 hours most of the fluids and dead foetuses were expelled.

2.2.2.3 Combination of Dexamethasone and Prostaglandin

Horta *et al.* (1978) reported that half the dose or even ¼th of the total dose of prostaglandin (500 µg) resulted in luteolysis in cyclic animals with varying time intervals.

Bo *et al.* (1984) successfully induced parturition with dexamethasone plus cloprostenol combination which resulted in a predictable calving time, high calf viability and low incidence of placental retention

Lewing *et al.* (1985) reported that simultaneous administration of cloprostenol and dexamethasone in combination was a safe, reliable and effective method of inducing parturition in cows. The protocol induced a local and general decrease in progesterone which resulted in inducing parturition.

Nasser *et al.* (1994) reported that pretreatment with triamcinolone acetonide (1mg/30 Kg body weight) seven days prior to induction of parturition with combination of dexamethasone and cloprostenol on day 270 of gestation. All the cows calved within 48 hours with reduced incidence of retained placenta.

Davis and Macmillan (2001) observed that cows treated with a combination of prostaglandin and dexamethasone calved earlier ie, 25 to 42 hours

after treatment and the interval from injection to calving was less variable than dexamethasone alone (29 to 65 hours) or cloprostenol alone (37 to 57 hours).

Barth (2006) also reported that the interval from treatment to calving was shorter in cows treated with the combination of dexamethasone and cloprostenol than when dexamethasone or cloprostenol was used alone.

Nasser *et al.* (2008) reported that cows which received 25 mg dexamethasone and 500µg of cloprostenol in combination calved earlier than the animals which received dexamethasone or cloprostenol alone.

Sukle *et al.* (2008) concluded that dexamethasone in combination with $PGF_2\alpha$ was used successfully for emergency induction of parturition in buffaloes but there was higher incidence of retained placenta and mortality of calves.

2.2.2.4 Others

2.2.2.4.1 Mifepristone and Relaxin

Dlamini *et al.* (1995) induced parturition in crossbred heifers at 277 day of gestation with mifipristone, a potent antiprogesterone (RU 486) and combination of mifipristone and relaxin and all the animals in the first group calved within 43 hours but in combination it had taken 52 hours .The incidence of dystocia was low in treated groups than in control but retention of foetal membranes was high in treated animals.

Similarly Barth (2006) also reported that mifipristone was used alone or in combination with relaxin and administered on day 277 or 278 of gestation and found that basal levels of progesterone by 48 hours and calving at 53 to 55 hours after injection. There were no complications at calving and no retained placentas.

2.2.2.4.2. Misoprostol

Yildiz (2009) reported the the intravaginal use of misoprostol, a synthetic analogue of prostaglandin E_1 for the induction of parturition in cows with gestation length of 270 days. The experimental animals received two doses of the hormone i.e., 200µg and 400 µg at six hour intervals and recorded the mean induction time as 38.44 ± 2.78 and 36.22 ± 3.07 hours respectively. They also reported that the rate of placental retention, birth weights, calving difficulty and calf viability did not differ among groups and suggested that misoprostol was a cost effective and safe alternative for induction of parturition.

2.2.3 Time Taken for Induction

Lewing *et al.* (1985) reported the mean interval from treatment to calving was 34.6 ± 1.4 hours for prostaglandin with dexamethasone induced groups , 43.3± 2.4 hours for dexamethasone alone treated groups and 44.9 ±2.1 hours for prostaglandin alone treated groups. They also observed that cows with gestation length of 290 days calved after induction with cloprostenol and dexamethasone combination with a mean interval of 29.4 ± 2.3 hours while in cows with gestation length of 280 days there was a further delay of five hours more. All the cows in the cloprostenol plus dexamethasone group calved within 48 hrs after induction where as only 63 per cent of the dexamethasone group and 44 per cent of the cloprostenol had calved by this time. They further reported that time intervals from treatment to completion of delivery was not significantly related to the gestation length. The appearance of the chorioallantois until completion of delivery was significantly longer for the cloprostenol group than for all other groups.

Bellows *et al.* (1988) reported that parturition was induced in 106 pregnant animals on the 272 day of gestation with 10 mg of flumethasone intramuscularly and average induction time was 39.6 hours. Majority of the

treated dams (95.3 per cent) responded within 60 hours and gestation was shortened by 2.9 days.

In a later report, Bellows *et al.* (1994) reported that induction of parturition was done using 10 mg of flumethasone in 56 cows with gestation length of 269 days and the average interval from treatment to calving was 46.6 hours and 91.2 per cent of animals responded within 60 hours.

Nasser *et al.* (1994) reported that 94 per cent of the induced animals calved within 48 hours after the treatment of 25mg dexamethasone in combination with 500 µg of cloprostenol on 270 day of gestation.

In Japaneese Black beef cows parturition was induced in late pregnancy with a combination of 20 mg of $PGF_2\alpha$ with 5 mg dexamethasone and 90 per cent of the animals calved within 28 hours of treatment (Kozo *et al.*, 2005).

Mansell *et al.* (2006) reported that the mean interval from induction to calving for long acting corticosteroid dexamethasone trimethyl acetate was 11 days whereas for prostaglandin group it was 48 hours and 97 per cent of the animals calved within 72 hours.

Sukle *et al.* (2008) induced parturition in 17 buffaloes and grouped into two, first group less than 300days of gestation treated with a combination of dexamethasone 20 mg and $PGF_2\alpha$ 25 mg and the second group with gestation length of more than 300 days with dexamethasone 20mg alone. The induction time was recorded for the combination group was 37.83± 2.61 hours and for dexamethasone it was 20.45± 2.06.

2.2.3.1 Failure of Induction

Lewing *et al.* (1985) reported that in the cloprostenol plus dexamethasone group all cows calved within 72 hours after injection, where as

in dexamethasone or cloprostenol treatments resulted in induction failures 11 per cent and 13 per cent respectively . These induction failures calved within 48 hours after repeated treatment.

2.2.4 Udder Changes and Milk Production

Beardsley *et al.* (1974) reported that after induction with dexamethasone there was reduction in milk yield in the second and third week of gestation with an average daily production of 24.8 and 27.8 kg for treated and control animals. They explained that the mammary gland of the induced groups did not have the same period of preparation for lactation as the control animals.

Kadu and Kaikini (1975) recorded intense, medium and normal type of udder changes during the last trimester of pregnancy in Sahiwal cows.

Chew *et al.* (1978) reported induction of parturition with dexamethasone 25 mg on day of 280 day of gestation had no effect on total milk yield and contents of fat, protein, total solids in milk during the first twelve weeks of lactation.

Field *et al.* (1989) induced parturitions in 34 pregnant cows with dexamethasone and prostaglandin and found that colostrum production from dexamethasone group was lower compared to prostaglandin group. They also reported that calves born from normal calving had significantly more IgG at 24 hour than from induced animals and they stated that induced calves might be at an increased risk of failure of passive transfer of immunoglobulins and low disease resistance.

At the onset of parturition the mammary glands became hypertrophied, voluminous, hard and tender. Serous fluid oozed out and the milk cisterns get distended with colostrum, yellow turbid, opaque and honey like cellular

secretion. These changes were particularly observed in primiparous animals (Sane *et al.* 1994)

Mortan and Butler (1995) compared the milk production in animals using dexamethasone with that of control and found that milk production during the lactation was 9 per cent less in induced groups but fat and protein concentrations were not affected.

Hayes *et al* .(1998) reported that lowered milk yield for entire lactation was 1.2 ±0.2 liters /cow/day in induced cows , with greatest difference noted as 2.5 ± 0.4 liters /day /cow in early lactation .

Reported similar milk production losses associated with the use of calving induction ranging from 4 to 5 per cent (Malmo and Beggs, 2000; Stevens *et al.* 2000).

Mansell *et al.* (2006) reported that failure of lactation or poor production in induced groups by 1.9 per cent and total milk production of induced cows was approximately 4 per cent lower than untreated ones.

Although udder filling might not be complete at the time of calving with the induction of corticosteroids, colostral immunoglobulins and total milk production for the lactation period were very close to normal (Nasser *et al.*, 2008).

2.2.5 Problems Associated With Induced Parturition

Beardsley *et al.* (1976) induced parturition with dexamethasone 4.4mg/100 kg body weight at day of 273 of gestation in 29 animals and observed that in induced group calving difficulty was more, the retention of foetal membranes were high and reduced milk production.

MacDiarmid (1983a, b) indicated that early induction of parturition resulted in increased rate of retention of foetal membranes, higher calf mortality, decreased calf vigour and reduced calf gains and weight, all of which were dependent on stage of prematurity of the calf.

However, Ottobre and Inskeep (1983) reported that differences between calving difficulty scores, proportion of dead calves and incidence of retained placentas were not significant in induction of parturition with long acting and short acting corticosteroids.

Cows with retained placenta subsequently had more uterine infections, foot problems and mastitis than cows without retained placenta (Larson *et al.*, 1984).

Lewing *et al.* (1985) reported that both corticosteroids and prostaglandins induced cows had high incidence of retained placenta when compared to controls.

Echternkamp (1992) stated that duration of labour, calving difficulty and calf viability did not differ between calves born at an induced or spontaneous parturition.

Too early induction of parturition prior to completion of normal gestation period often resulted in a number of problems such as decreased calf viability, increased occurrence of retained placenta, photosensitization , infections and cow mortality were reported by few researchers (Mortan and Butler, 1995;1995b).

Barth (2006) reported that the length of second stage of labour, calving difficulty were not different between groups of short acting corticosteroids, long acting corticosteroids and combination of short acting and cloprostenol and no premature calves were born in the experiment.

Sukle *et al.* (2008) concluded that induction of parturition with dexamethasone or in combination with $PGF_2\alpha$ was used successfully for emergency induction of parturition in buffaloes, but there was higher incidence of dystocia, retention of foetal membranes and mortality of calves.

2.2.5.1 Dystocia

Lewing *et al.* (1985) reported that calving difficulty scores following induction of parturition were similar to natural calving.

Bellows *et al.* (1988) induced parturition in 100 animals with flumethasone and reported that four abnormal presentations in treated group and six in control group. These values were interpreted to indicate that induced parturition did not increase the incidence of abnormal presentation and dystocia problems.

On contrary, Knight *et al.* (2001) stated that there was high incidence (52 per cent) of assistance at parturition in induced groups.

Kornmatitsuk *et al.* (2001) stated that there was high incidence of calving difficulty, stillbirths and retained placenta in induced groups but retained placenta did not affect subsequent reproductive performance.

2.2.5.2 Retention of Foetal Membranes

Premature induction of parturition one to two weeks of normal gestation often resulted in high incidence of retention of foetal membranes.

MacDiarmird (1983) concluded that incidence of retention of foetal membranes increased with degree of prematurity of the calf resulting from induced parturition.

LaVoie *et al.* (1984) induced parturition with dexamethasone in different doses and most of cows responded to the treatment and reported 23 to 78 per cent incidence of retained placenta whereas in control group it was only 6 per cent.

Peter and Poole (1992) also reported the high incidence of retained placenta with induction of long acting corticosteroid.

Bellows *et al.* (1994) reported 60.3 per cent of retained placenta after induction of parturition with long acting corticosteroid flumethasone 10mg on 269 day of gestation.

Nasser *et al.* (1994) reported that there was high incidence (11 to 23 per cent) of retained placenta when cows induced with dexamethasone and prostaglandin combination even after pretreatment with triamcinolone acetonide

Knight *et al.* (2001) reported higher incidence of retained placenta (70 per cent) after induction with prostaglandin and dexamethasone along with pretreatment of opticortinol.

Konigsson *et al.* (2001) showed that cortisol profiles at parturition might be altered after induction of parturition with dexamethasone leading to retention of foetal membranes.

Barth (2006) reported the incidence of retained placentas with different combinations of long acting corticosteroids was quite low (9 to 22 per cent) compared with short acting corticosteroids.

Mansell *et al.* (2006) reported that the incidence of retention of foetal membranes was 16.4 per cent, 18.8 and 23.2 per cent for prostaglandins, dexamethasone trimethyl acetate and combination of dexamethasone and PG respectively, while for control animals it was only 4.6.

2.2.6 Birth Weight and Weight Gain of Calves

Hanie (2006) reported that after parturition calves typically achieved sternal recumbency within several minutes and try to stand within 15 to 30 minutes. It was also stated that the maintenance and growth energy requirements were 50 kcal/kg/day and 300kcal/100g body weight gain. An average calf needed three liters of milk for maintenance and four to five additional liters to gain 1kg of body weight.

2.2.6.1 Birth Weight

Beardsley *et al.* (1976) reported that birth weight of the calf in parturition induced cows was significantly lower when compared to control group. Lewing *et al.* (1985) reported that the birth weight of control calves were 4.2 kg heavier than induced calves. Roberts (1986) reported that birth weight of the calves was higher when the gestation was prolonged.

Poncelet and Moody (1987) reported that there were no significant differences among actual weights for the induced groups and control groups .

Bellows *et al.* (1988) induced parturition with 10 mg of flumethasone and reported 0.5 kg decrease in birth weight of calves from induced than normal parturition. They also reported that the decreased weight did not result in calf mortality and calf vigour.

Later, Bellows et *al.* (1994) reported that induction of parturition in cows with gestation length of 269 days and the birth weights of calves reduced by 2.4 kg. The lower birth weights were due to the 8 day shorter gestation length as a result of induced parturition. They also observed that calves born from older cows were heavier at birth than heifer dams.

Barth (2006) observed that birth weights and calf viability were not different between groups and no premature calves were born after induction of parturition with dexamethasone, prostaglandin and combination of these drugs. However, Mansell *et al.* (2006) reported lower calf viability when parturition was induced at earlier stages of pregnancy.

2.2.6.2 Growth of Calf

Muller *et al.* (1975) reported that weight gains of calves after induction of parturition with dexamethasone did not differ with that of control group. They also observed that no major differences were found in chest depth, shoulder width, head circumference, hip width, or height of calves at birth to two months of age from induced and control animals.

Bellows *et al.* (1994) reported that weight gain of induced calves up to two months of age was low (0.87kg/day) compared to non induced group (0.95 kg/day).

2.3 FERTILITY IN PARTURITION INDUCED ANIMALS

According to Arthur *et al.* (2001) it was important that there should be a normal puerperium for the cow, because farmer's intention was to reduce the calving to conception interval. Any extension of the period could have detrimental effect on the future reproductive performance of the individual animal.

2.3.1 Nature of lochia

Sane *et al.* (1994) reported that within 48 hours after parturition the amount of lochial discharge voided was the greatest (1400 to 1600 ml) and eighth day after parturition it was decreased to 500 ml and by 14 to 18 days it was almost cleared. The discharge was amber to red colour and odourless. By about 9 to 10 days postpartum increased amount of blood in the lochial discharge.

Lochia, the uterine discharge that occurred during puerperium and composed of mucus, blood, shreds of foetal membranes, maternal tissue and foetal fluids. Lochia caesed by the first week after parturition. The expulsion of lochia and reduction of uterine size were caused by myometrial contractions (Jainudeen and Hafez , 2000).

Kask *et al.* (2000a) reported that after induction of parturition with dexamethasone vaginal discharge observed for seven weeks postpartum and found that animals with retained placentas had more vaginal discharge during the first 11 days than the non retained cases and control animals. They also observed that between days 20 and 30 the uterus contained more fluid than nonretained and normal animals.

Kask *et al.* (2001) reported that the highest uterine bacterial count was recorded during first three weeks postpartum and there were no visible vaginal discharge after 28 days postpartum.

Kask *et al.* (2000 a,b,c) reported that pathological uterine discharge was seen in induced animals which had retention foetal membranes

2.3.2 Uterine involution

After normal parturition, the expanded uterine bag was expected to attain its normal position and size within specified time. This reposition is physiological and termed as involution of uterus (Sane *et al.*, 1994).

Uterine involution was the restoration of the uterus to its normal non pregnant size and function after parturition (Jainudeen and Hafez, 2000)

Kask *et al.* (2001) reported that the time required for completed uterine involution was 27 days postpartum. They further stated that there was no difference in the involution of uterus between induced and normal animals. The highest bacterial content was recorded during first three weeks postpartum in retention of foetal membranes and two weeks postpartum in cows with out retained placenta and the most dominant bacteria were *E.coli*, *Arcanobacterium . pyogenus* and *Fusobacterium. Necrophorum.*

The uterus had more specific effects on postpartum ovarian activity. High level of bacterial contamination could depress follicle stimulation and subsequent oestrous behaviour (Sheldon *et al.*, 2000; Sheldon *et al .*, 2002).

The uterus of primiparous cows usually involutes more rapidly than those of multiparous ones and suckling appeared to stimulate involution and being completed about 30 day in the suckling cow (Ball and peters, 2004)

2.3.3 First postpartum oestrus

Frederickson *et al.* (1985) reported that in normal parturitions the non infected animals ovulated as early as 16 days postpartum and in infected animals it was around 31 days.

According to Ginther *et al.* (1989) in the dairy cow after normal parturition one dominant follicle was selected and became dominant and ovulated at the earliest between 10 to15 days postpartum, while others had undergone atresia. They also observed that approximately 60 per cent of the animals had ovulated before 25 days.

Bellows *et al* .(1994) reported that length of postpartum interval from calving to first oestrus in induced animals was 7.6 day longer than normal parturitions.

Nasser *et al.* (1994) reported that cows with retained placentas after induction with dexamethasone in combination with prostaglandin had long intervals from calving to first ovulation.

Kask *et al.* (2001) observed the ovaries by ultrasonography on 8th day postpartum after induction with prostaglandin and found the first dominant follicle of diameter of 0.8 cm. They also observed that total of three follicular waves seen with emergence and regression of dominant follicles during 32 day utrasonographic evaluation.

The average length of these waves was 9.1 days and the average size of the dominant follicle was recorded as 1.1.cm. The non infected animals ovulated on an average of 16 days postpartum as compared to infected animals which ovulated 31 days after parturition. The longer the release of $PGF_2\alpha$ was the indication of the infection in the uterus and the reason for delayed ovulation.

Shrestha *et al.* (2004) reported that period of time from parturition to first postpartum oestrus was found to be as short as 15 days or longer than 100 days and usual postpartum interval being 60 to 90 days.

2.3.4 Calving to conception interval

Claydon (1984) reported that irrespective of placental retention after induction of parturition there was no difference among treatments in the subsequent calving to conception interval and a mean value of 84 days was recorded.

Lewing *et al.* (1985) reported that the cows after induction of parturition with dexamethasone, cloprostenol and combinations had normal uterine involutions and later successfully used as recipients of embryo transfer.

Bellows *et al.* (1988) reported that after parturition in induced group with flumethasone the service per conception was lower than control group.

Nasser *et al.* (1994) reported that cows with retained placentas after induction with dexamethasone in combination with prostaglandin had long intervals from calving to conception.

Mortan and Butler (1995) reported the reproductive performance of induced and untreated groups did not differ significantly and the percentage of non pregnant cows in induced group and control was 9 and 7.2 per cent respectively.

Barth (2006) reported that the first service conception rates and pregnancy rates did not differ between groups however first service conception rates and overall pregnancy rates were lower which had retained placenta. Mean services per conception in animals which had retained placenta and which did not have retained placenta was 1.23 and 1.35 respectively. The calving interval was 365 days following the induced parturition

Mansell *et al.* (2006) reported that the mean inter calving interval for induced group was 348 days whereas for untreated animals it was 351 days.

2.3.5 Conception rate

Moller and MacDiamird (1981) reported that non pregnancy rate of induced group and control group was 16.7 and 6.1 per cent respectively. However, MacDiamird (1983b) and Bellows *et al.* (1988) observed no adverse effect of overall conception rate in induced animals. A later report by Bellows *et al.* (1994) concluded that induced parturition resulted in an 18.4 per cent reduction in pregnancy rate.

Nasser *et al.* (1994) reported that the first service pregnancy rates and final pregnancy rates were lower in induced cows with retained placenta (43 and 63.6 per cent) than non retained group (76 and 87.7 per cent)

Hayes *et al.* (1998) reported that the over all pregnancy rates for induced and normal calvings were 91.40 ± 2.10 and 93.60 ± 1.70 per cent respectively which was significantly less for induced calvings.

But Mortan (2000) reported that no effects on first service conception rates between induced and untreated groups.

McDougall (2001a) reported that induction of parturition or animals that are late to calve had significantly lower pregnancy rates and took longer times to conceive than normal parturitions.

McDougall (2001b) concluded that calving induction reduced the pregnancy rate by 8.3, extended the mean interval from planned mating time to conception by 4 days.

Materials and Methods

3. MATERIALS AND METHODS

A preliminary study was conducted by collecting data regarding gestation length and details of calving in crossbred cattle of the University Livestock Farm, Mannuthy and local breeds belonging to " ICAR Scheme on Conservation of Germplasm of Vechur Cattle ".The main experiment part comprised of developing a suitable protocol for inducing parturition in cows with prolonged gestation and to assess the safety of protocol in reproductive management. Premature induction of parturition was done in downer cows in which medical treatment had failed and its efficiency to manage the diseased animal and new born was tried.

3.1 GESTATION LENGTH AND DETAILS OF CALVING

Data on gestation length, birth weight, sex of the calf and postpartum complications occurring in crossbred cattle of the University Livestock Farm, Mannuthy and animals of Vechur scheme for the period from January 2008 to February 2010 were collected and analysed.

3.2 INDUCTION OF PARTURITION

Pregnant cows belonging to the ULF and private farms nearby during the period from December 2008 to February 2010 were closely monitored for signs of approaching parturition. Twenty four pregnant cows which had a prolongation of gestation up to 286 days were selected at random and allotted to four groups of six each viz, Group I, Group II, Group III and Group IV (Control).

Detailed data regarding breeding, age, parity, general condition, feeding habits were collected. They were further subjected to detailed clinico-

gynaecological examination to assess the position of foetus, foetal viability, fremitus, cervical dilatation and vaginal discharge.

3.2.1 Therapeutic regime adopted

Parturition was induced on day 286 of gestation in all the experimental animals (group I to III) using the following treatment regime and group IV acted as control.

Group I

Induction of parturition was done by administering *dexamethasone 24 mg (Dexona vet 6 ml) intramuscularly .

Group II

Parturition was induced by administering $PGF_2\alpha$ analogue 500µg ** (Inj. Cyclix 2 ml) intramuscularly .

Group III

A combination of dexamethasone 12 mg and 250 µg of prostaglandin analogue were administered intramuscularly .

Group IV

Cows with gestation length over 286 days were regularly followed up for normal parturition.

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* Dexona vet, dexamethasone sodium phosphate equivalent to dexamethasone phosphate 4 mg/ ml, Zydus Animal Health Limited

** Cyclix 2ml vial, cloprostenol sodium 263 µg/ml, synthetic prostaglandin analogue, Intervet

3.2.2 Response to Induction of Parturition

3.2.2.1 Time taken for Induction

All experimental animals were closely observed for signs of parturition. The interval from administration of drug to the actual expulsion of the foetus was recorded as time taken for induction of parturition.

3.2.2.2 Duration of Various Stages of Parturition

Duration of parturition in all animals was monitored by close observation of clinical signs. The duration of first stage was recorded based on presence of mucus discharge, bellowing, restlessness, reduced feed intake, onset of uterine contractions, straining, cervical dilatation, appearance of water bag and foetal parts. The duration of second stage labour ie, actual expulsion of foetus and duration of third stage of labour ie, the expulsion of foetal membranes were recorded. In addition weight of placenta and number of cotyledons were also recorded.

3.2.2.3 Complications during Parturition and Postpartum

All experimental and control animals were closely observed for dystocia, retention of foetal membranes, prolapse of genital organs, metritis, mastitis, postpartum laminitis and metabolic diseases recorded.

3.2.2.4 Birth Weight and Sex of the Calf

The birth weight and sex of the calves were recorded in all experimental and control animals. Further the body weight of calves in all groups was taken at weekly intervals to monitor the growth rate.

3.2.2.5 Udder Changes, Lactational Yield and Day of Peak Yield

Udder changes prior to and after calving were assessed by degree of enlargement of udder, oedema of teats, appearance of colostrum and shining

appearance of udder and were classified as mild, moderate and marked. The lactational yield and day of peak yield of experimental and control animals were recorded.

3.2.3 Postpartum fertility

3.2.3.1 Onset of first postpartum oestrus

The animals in all groups were closely observed periodically for uterine involution, disappearance of lochial discharge and onset of postpartum oestrus. They were subjected to further detailed clinico- gynaecological examination on the day of oestrus for assessing the status of tubular genitalia and ovarian changes.

3.2.3.2 Conception rate

All the animals were inseminated with good quality semen during second postpartum oestrus. Those animals failing to conceive were reinseminated in the subsequent two oestrus and pregnancy diagnosis was done at 60 th day after AI.

3.2.3.3 Calving to conception interval

The interval from calving to conception in all groups was recorded.

3.3. MANAGEMENT OF DOWNER COWS IN ADVANCED PREGNANCY

Four downer cows presented at Veterinary College Hospital,Mannuthy were treated with the same induction protocols using dexamethasone and prostaglandins. These animals had gestation length of 253, 285, 270 and 275 days respectively. The fetal viability and general condition of the diseased animals were assessed. Prostaglandin at the dose of 500µg was administered in two animals while another animal was given 24 mg dexamethasone alone. A combination of dexamethasone 12 mg and prostaglandin 250 µg was given in the last animal. The induction time, calf survivability and general condition of the parturition induced animals were recorded.

3.4 STATISTICAL ANALYSIS

The data collected were compiled and subjected to statistical analysis as per Snedecor and Cochran (1994).

Results

4. RESULTS

The mean gestation length and details of calving of the crossbred cattle of the University Livestock Farm, Mannuthy and local breed of "ICAR Scheme on Conservation of Germplasm of Vechur Cattle" were analysed and presented. The results of the induction of parturition in crossbred cattle with prolonged gestation and management of downer cows by the premature induction of parturition were also presented.

4.1GESTATION LENGTH AND CALVING

Detailed data of 192 crossbred cattle of the University Livestock Farm Mannuthy and 100 animals of Vechur Scheme regarding gestation length, sex of calf, birth weight of calf and postpartum complications during the period from January 2008 to February 2010 were analysed and presented (Table 1). The mean gestation length of crossbred cattle of ULF was 274 ± 0.48 days and that of Vechur scheme was 282 ± 0.98 days. The average birth weight of new born calf at ULF was 26.52 ± 0.39 kg and that of Vechur was 10.43 ± 0.12 kg. The sex ratio of male and female was 1: 0.9 and 1: 1.2 for ULF and Vechur scheme respectively. The postpartum complications recorded were 9 and 4.5 per cent respectively.

The animals of ULF and Vechur farm were classified based on their gestational age (Table 2). The per cent of animals that had the mean gestation length of 274 days and below was 46.88 and above the mean gestation length was 53.13. The corresponding birth weights of new born calves were 26.04 ± 0.69 and 29.79 ± 0.42 respectively. Similarly in the Vechur scheme the per cent of animals that had the mean gestation length of 282 days was 30 and above the mean gestation length was 70 respectively. The mean birth weight of new born calves at Vechur scheme was 9.50 ± 0.15 and 10.40 ± 0.21 kg respectively. The

postpartum complications were three and 15 per cent for ULF and three and six per cent for Vechur respectively.

4.2 INDUCTION OF PARTURITION

Details of age, parity, fetal viability, fremitus, day of induction of parturition, time taken for induction and per cent of animals responded to the treatment were presented in Table 3. The mean age in years for groups I to IV was 5.0 0± 0.63, 5.50 ± 0.76, 4.17 ± 0.86 and 4.58 ± 0.71 respectively. The parity of the animals for these groups was 1.80± 0.54, 2.50 ± 0.54, 1.33 ± 0.66 and 1.50 ± 0.50 respectively. The foetal viability and fremitus for all the groups were recorded as healthy. The statistical analysis of the data revealed that the gestation length had no significant correlation with age and parity of the dam.

All the experimental animals were induced on 286 th day of gestation and the mean time taken in hours for induction of parturition in group I to III were 39.50 ± 1.26, 30.50 ± 2.17 and 26.9± 1.81 respectively (Table 3 and Fig.1). The appearance of animals prior to induction of parturition, induction response and post treatment are illustrated in Plates 1 to 7. All the animals in the experimental groups responded to treatment indicating an efficiency of 100 per cent. Analysis of data revealed that there was significant difference in the time taken for induction between three groups and the least time was recorded in group III. The control animals were followed up for normal delivery and obtained a mean gestation length of 296 ± 0.92 days

4.2.1 Duration of Various Stages of Parturition

The mean duration for first stage of labour in group I to IV was 4.00 ±0.16, 3.12 ± 0.15, 3.24 ± 0.02, 4.49 ± 0.12 hours and for second stage was 1.27 ± 0.02, 1.12 ± 0.14, 1.21 ± 0.12, 1.53 ± 0.10 respectively (Table 4 and Fig .2) The per cent of animals that expelled placenta normally for the experimental and control animals was 50, 66.66, 83.33, 83.33 and the mean time for the

expulsion was 6.67 ± 0.33, 6.35 ±1.87, 3.02 ± 0.13, 2.74 ±0.14 hours respectively

The mean weight of the placenta in experimental and control groups was 2.87 ±0.43, 3.50 ± 0.54, 3.00± 0.28, 3.60 ± 0.25 kg respectively. The mean number of cotyledons in Group I to IV was 89.50 ± 0.76, 91.20 ± 0.60, 90.50 ± 0.84, 91.50 ± 0.76 respectively. Analysis of data revealed no significant variation between groups in terms of duration of stages of labour, time of expulsion of the placenta, weight and number of cotyledons.

4.2.2 Complications during Parturition and Postpartum Period

4.2.2.1 Dystocia

The incidence of dystocia in experimental and control animals were 50, 0, 33.33 and 50 per cent respectively (Table 5 and Fig.3). In group I, out of three dystocia cases recorded, two were due to improper cervical dilatation and one was due to postural defects of foetus. Of the two cases of dystocia recorded in group III, one was due to absolute foetal oversize and the other was due to postural defect. In the control group two cases were due to absolute foetal oversize and one was due to postural defect. No incidence of dystocia was recorded in group II.

4.2.2.2 Reproductive Problems during Postpartum Period

The incidence of retention of foetal membranes in groups I to IV was 50, 33.33, 16.66 and 16.66 per cent respectively (Table 6). Plate 8 shows an animal with retention of foetal membranes after 12 hours of parturition.

In group I, the incidence of postpartum prolapse of genital organs, downer cow syndrome and mastitis was recorded as 16.66 per cent respectively.

4.2.3 Sex and Birth Weight of the Calf

The sex ratio of new born calves of experimental and control groups was 1:1, 0.57: 1, 1:1 and 1:1 respectively (Table 7 and Fig. 4). The average birth weight in kg for the male calves was 29.33 ± 1.20, 26.65 ±6.50, 31.51 ± 3.40, 34.66 ±2.03 respectively. Similarly the birth weight of female calves was 30.00 ± 1.15, 27.25 ± 1.97, 23.33 ± 2.40, 32.33 ± 1.20 kg respectively. Plate 9 shows the procedure of taking weight of the newly born calf. Analysis of data revealed that in control animals the birth weight of calves was higher than experimental groups. The body weight of calves at weekly intervals up to two months of age in treated and control groups were tabulated in Table 8 and Fig.5. There was steady increase in body weight of calves as age advanced in experimental and control groups, however there was no significant difference between groups in mean body weight.

4.2.4 Udder Changes, Milk Yield and Day of Peak Yield

During induction of parturition prominent udder changes were obtained in group II, III and control groups whereas in group I the udder changes were less prominent (Table 9 and Fig .5). The mean peak yield for the groups I to IV in the present lactation was 9.57 ± 0.58, 11.33 ±1.17, 11.67 ±1.54 and 13.17 ± 0.75 liters respectively. The corresponding values in previous lactation for the experimental and control groups were 11.48 ± 0.48, 11.60 ± 0.75, 12.70 ± 0.47 and 13.50 ± 0.65 liters respectively. The day of peak yield in the present lactation was 25 ±0.63, 21.66 ± 0.61, 22.33 ± 1.05 and 19.16 ± 0.79 days and the corresponding values in previous lactation were 19.80 ± 0.95, 18.7 ±0.67, 20.3±1.28 and 19.3± 0.63 days respectively. Analysis of the data revealed that the milk yield of the entire treated group was slightly lower when compared to their previous lactational yield and the day of peak yield was also slightly extended.

4.2.5 Postpartum fertility

The data regarding post partum fertility in experimental and control animals were presented in Table 10 and Fig. 6. The disappearance of lochial discharge for the experimental and control groups was 20.16 ± 1.04, 17.31 ± 1.13, 17.17 ± 0.87, 21.00 ± 1.26 days respectively. The first postpartum oestrus was observed at 33.20 ± 1.25, 30.70 ± 0.88, 29.50 ± 0.76 and 31.6 ± 0.76 days respectively. Similarly, the second postpartum oestrus was on 59.00 ± 1.22, 51.83 ± 0.83, 48.33 ± 1.99 and 53.83 ± 0.94 days respectively.

Conception rate for the first AI in group I to IV was 0, 50, 50, and 33.33 respectively where as the overall conception rate for these animals was 16.66, 66.66, 83.33, 66.66 per cent respectively. The highest conception rate was obtained in group III. The mean calving to conception interval for the experimental and control animals were 91.50 ± 15.00, 77.66 ± 9.38, 74.00 ± 7.00, and 82.00 ± 13.97 days respectively.

4.3MANAGEMENT OF DOWNER COWS IN ADVANCED PREGNANCY

Parturition was induced in four downer cows presented at Veterinary College Hospital, Mannuthy which failed with routine medical treatment. These four animals had gestation length of 253, 285, 270 and 275 days respectively (Table 11). In the first two animals parturition was induced with prostaglandin and the time taken for induction was 48.30 and 31.20 hours respectively. In dexamethasone treated third animal calving occurred at 51.00 hours after administration of drug. Similarly the time taken for induction in animal which was treated with combination of dexamethasone and prostaglandin was 29.45 hours. All the three animals which were treated with prostaglandin and its combination with dexamethasone recovered from recumbent stage after delivery and had regained normal feeding habits. The images of one of the animal before and after treatment of the syndrome are presented in Plate 11. The animal treated

with dexamethasone failed to regain its the normal condition and was advised disposal. But all the four calves survived in this experiment.

The drugs used for induction of parturition in this study are presented in Plate 10.

Table 1. Mean Gestation length, birth weight, sex ratio of new born calves and post partum complications of the University Livestock Farm, Mannuthy and "ICAR Scheme on Conservation of Germplasm of Vechur Cattle."

FARM	Number of calvings	Gestation length (Mean ±SE days)	Mean Birth weight (kg)	Sex ratio M:F	Post partum complications (%)
ULF, Mannuthy	192	274 ± 0.48	26.52± 0.39	1: 0.9	9
Vechur scheme	100	282 ± 0.98	10.43± 0.12	1: 1.2	4.5

Table 2. Details of gestational age, birthweight and postpartum complications at ULF, Mannuthy and Vechur farm

Gestational age (days)	ULF, Mannuthy			Gestational age (days)	Vechur scheme		
	No. and per cent of calving	Birth weight of new born calf(kg)	Post partum complications (%)		No. and per cent of calvings	Birth weight of new born calf (kg)	Post partum complications (%)
Mean Gestation length of 274 days and below	90 (46.88)	26.04 ± 0.69	3	Mean gestation length of 282 and below	30(30)	9.5 ±0.15	3
Mean Gestation length above 274 days	102(53.13)	29.79±0.42	1 5	Mean gestation length above 282 days	70 (70)	10.40 ± 0.21	6

Table 3. Data regarding gestational status and induction of parturition in experimental and control animals

Group (n=6)	Parameters					
	Mean age in years	Parity	Foetal viability and fremitus	Day of induction of parturition	No. and per cent of animals responded	Time taken for induction (mean ±SE hours)
Group I Dexamethasone	5.00±0.63	1.80±0.54	Healthy	286	6 (100)	39.00 ± 1.26^{a}
Group II Prostaglandin	5.50±0.76	2.50±0.54	Healthy	286	6 (100)	30.50 ± 2.17^{b}
Group III Dexamethasone + prostaglandin	4.17±0.86	1.33±0.66	Healthy	286	6 (100)	26.90 ± 1.81^{b}
Group IV Control	4.58±0.71	1.50±0.50	-	Calving at mean gestation length of 296±0.92 days	-	-

Superscripts with different letters differs significantly ($p \leq 0.01$)

Table 4. Duration of various stages of parturition in hours and details of placental expulsion in experimental and control animals

Group (n=6)	Mean first stage of labour	Mean second stage of labour	No. and per cent of animals with normal placental expulsion.	Time taken for normal expulsion of placenta	Mean weight of the placenta (kg)	Mean No. of cotyledons
Group I	4.00 ±0.16	1.27 ± 0.02	3(50)	6.67 ± 0.33	2.87±0.43	89.50±0.76
Group II	3.12 ± 0.15	1.12 ± 0.14	4(66.66)	6.35 ±1.87	3.50±0.54	91.20±0.60
Group III	3.24 ± 0 .02	1.21± 0.12	5(83.33)	3.02 ± 0.13	3.00±0.28	90.50±0.84
Group IV	4.49 ± 0.12	1.53 ±0.10	5 (83.33)	2.74 ±0.14	3.60±0.25	91.50 ±0.76

Table 5. Incidence and causes of dystocia during calving in experimental and control animals

Group (n=6)	Dystocia (%)	Causes		
		Improper cervical dilatation	Absolute foetal oversize	Postural defects of foetus
Group I	3(50)	2	-	1
Group II	-	-	-	
Group III	(2) 33.33	-	1	1
Group IV	(3) 50	-	2	1

Table 6. Reproductive problems encountered during post partum period in experimental and control animals

Group (n=6)	Complications (Number and per cent)			
	Retention of foetal membranes	Postpartum prolapse of genital organs	Downer cow syndrome	Mastitis
Group I	3 (50)	1 (16.66)	1(16.66)	1(16.66)
Group II	2 (33.33)	-	-	-
Group III	1 (16.66)	-	-	-
Group IV	1 (16.66)	-	-	-

Table 7. Mean birth weight and sex ratio of the calf in experimental and control animals

Group (n=6)	Sex ratio M:F	Birth weight of calf(kg)	
		Male	Female
Group I	1:1	29.33 ± 1.20	30 ±1.15
Group II	0.57:1	26.65 ±6.50	27.25±1.97
Group III	1:1	31.51 ± 3.40	23.33 ± 2.40
Group IV	1:1	34.66± 2.03	32.33± 1.20

Table 8. Mean body weight (kg) of calves at weekly intervals of experimental and control animals

Age of calf (days)	Mean body weight (kg)			
	Group I	Group II	Group III	Group IV
0	29.67 ± 0.76	27.00 ± 2.03	27.42 ± 2.61	33.50 ±1.18
8	31.33 ±1.73	32.67 ± 2.47	31.67 ± 2.99	36.50 ±1.15
15	33.83 ± 1.40	37.42 ±2.25	35.17 ± 3.43	39.50 ±1.31
21	36.33 ±1.23	39.83 ±2.87	38.33 ± 3.59	43.83 ±1.40
28	38.33 ±0.95	43.17 ± 2.99	41.17± 3.86	45.00 ±1.37
35	40.50 ±1.02	46.17 ± 3.00	44.00 ± 3.99	44.83 ±1.42
42	42.33 ± 0.95	48.83 ± 3.26	46.33 ± 4.04	46.67 ±1.41
49	44.67 ±0.76	51.83 ± 3.16	48.50 ± 4.19	48.50 ±1.36
56	46.67 ±0.71	54.50 ± 3.21	51.17 ± 4.45	50.50 ±1.36

Table 9. Udder changes, milk yield and day of peak yield in experimental and control animals

Group (n=6)	Udder changes	Peak yield in previous lactation (litres)	Peak yield in induced calving (litres)	Day of peak yield in previous lactation	Day of peak yield after induced calving
Group I	Medium	11.48 ±0.48	9.57 ± 0.58	19.8±0.95	25 ±0.63
Group II	Marked	11.60 ±0.75	11.33 ± 1.17	18.7±0.67	21.66±0.61
Group III	Marked	12.70 ± 0.47	11.67 ±1.54	20.3±1.28	22.33±1.05
Group IV	marked	13.50 ±0.65	13.17 ± 0.75	19.3± 0.63	19.16±0.79

Table 10. Post partum onset of oestrus and fertility observed in experimental and control animals

Group	Disappearance of lochial discharge (days)	First post partum oestrus (days)	Observed second postpartum oestrus (days)	Number percent of animals conceived during first AI	Over all conception rate for three consecutive AI Number and percent	Calving to conception interval (Mean ±SE days)
Group I	20.16±1.04	33.20±1.25	59.00±1.22	-	1(16.66)	91.5 ±15
Group II	17.31±1.13	30.70±0.88	51.83±0.83	3(50)	4(66.66)	77.66±9.38
Group III	17.17±0.87	29.50±0.76	48.33±1.99	3(50)	5(83.33)	74.00±7.00
Group IV	21.00±1.26	31.60±0.76	53.83±0.94	2(33.33)	4(66.66)	82.00±13.97

Table 11. Data regarding management of downer cows in advanced pregnancy.

Sl . No.	Day of induction of parturition	General condition of the animal	Foetal viability	Protocol used	Time taken for induction (hours)	Birth weight of calves (Kg)	Calf survivability	General condition of cow after induction
1	253	Poor	Viable	Prostaglandin	48.30	18	Survived	Good
2	285	Good	Viable	Prostaglandin	31 .20	30	Survived	Good
3	270	Poor	Viable	Dexamethasone	51 .00	20	Survived	Culled
4	275	Poor	Viable	Dexamethasone +Prostaglandin	29.45	26	Survived	Good

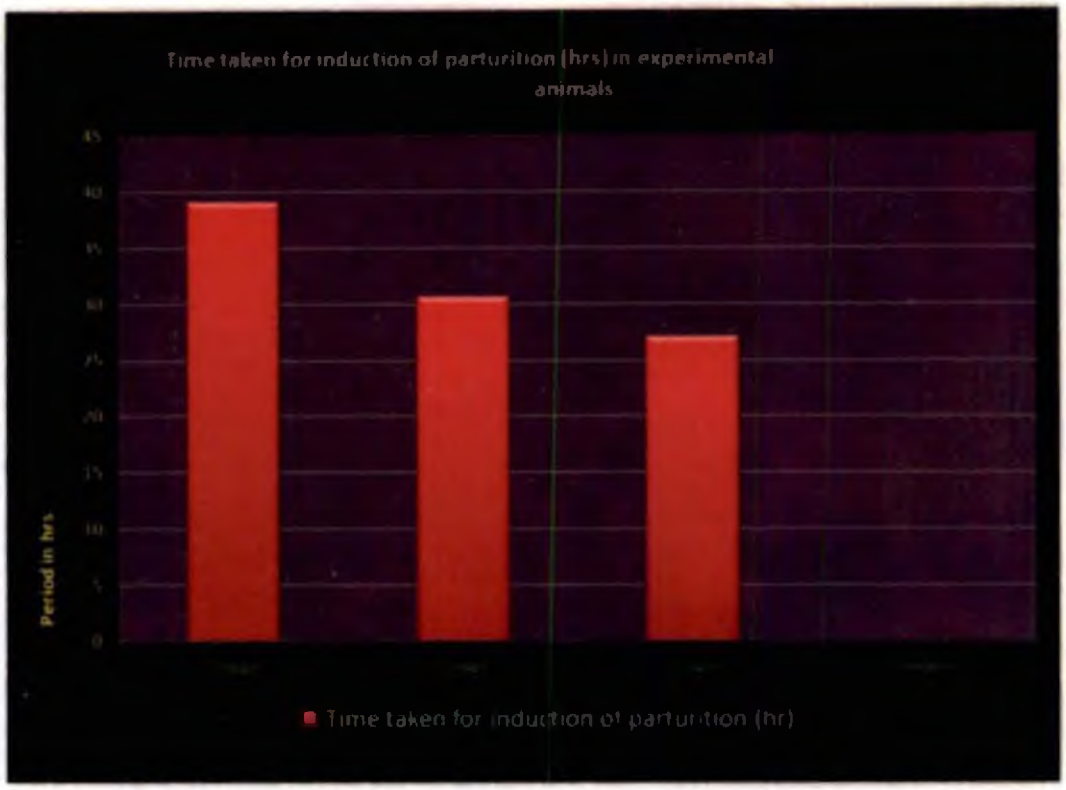
Time taken for induction of parturition (hrs) in experimental animals
Period in hrs
Time taken for induction of parturition (hr)

Fig. 1

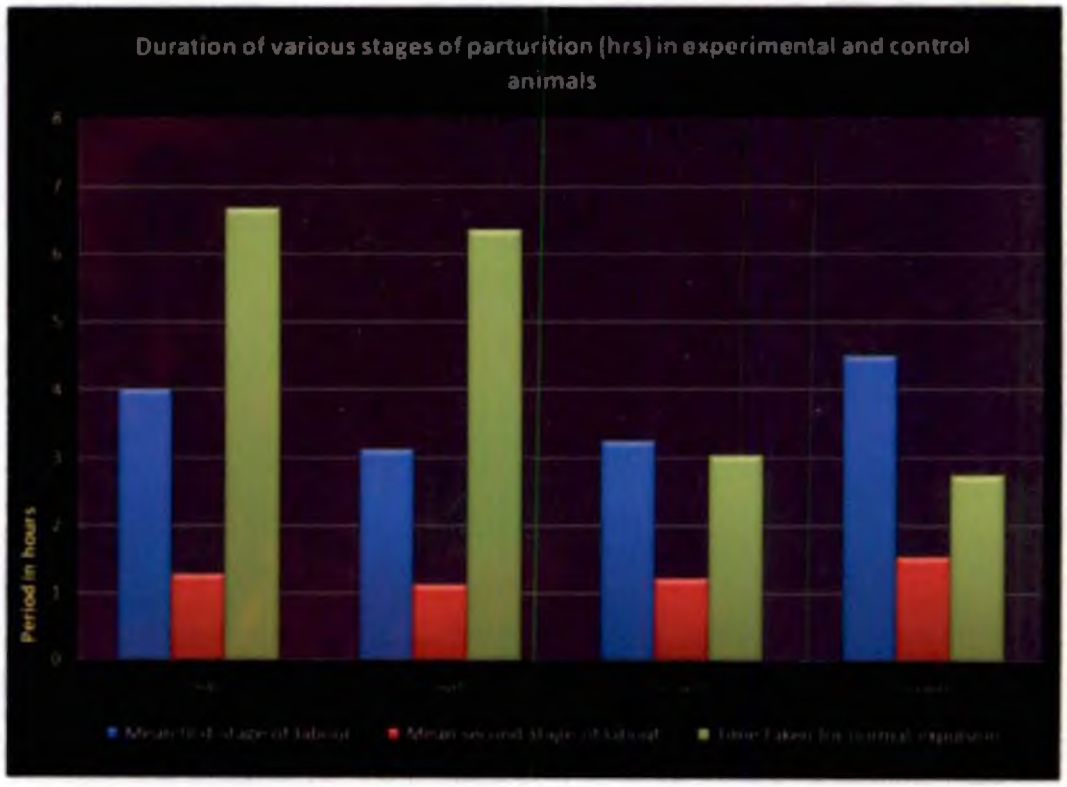
Duration of various stages of parturition (hrs) in experimental and control animals
Period in hours

Fig. 2

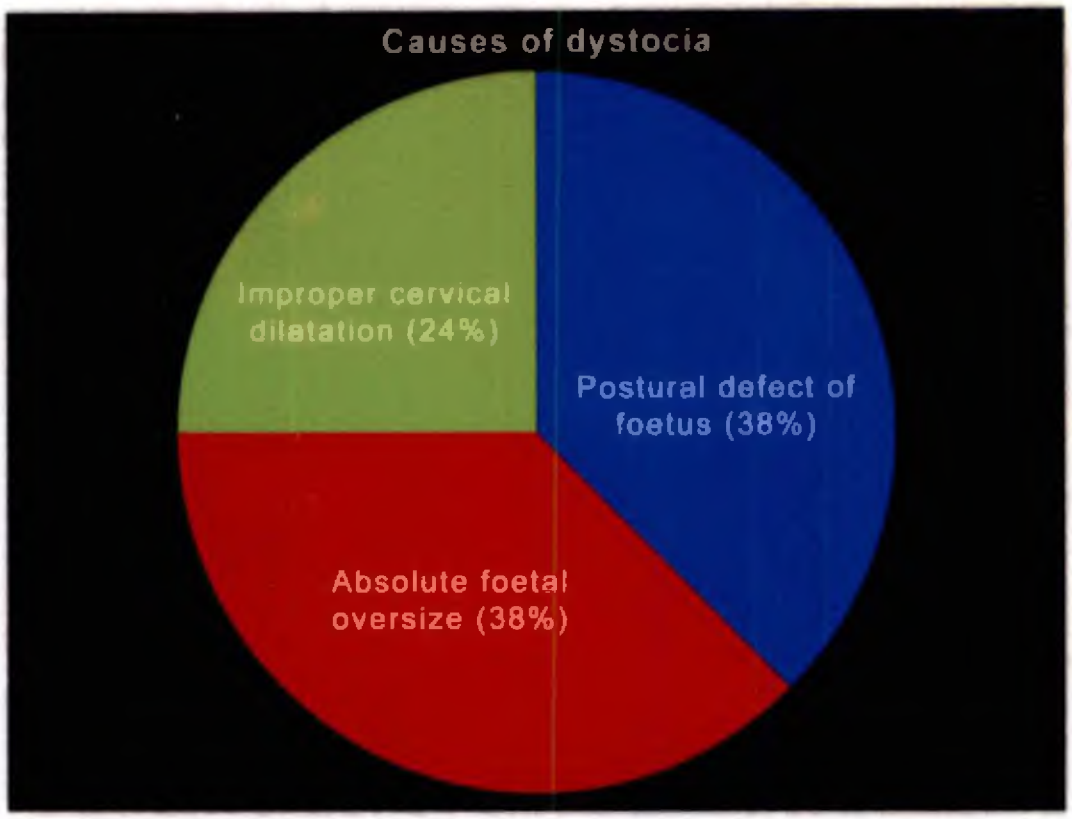
Causes of dystocia
Improper cervical dilatation (24%)
Postural defect of foetus (38%)
Absolute foetal oversize (38%)

Fig. 3

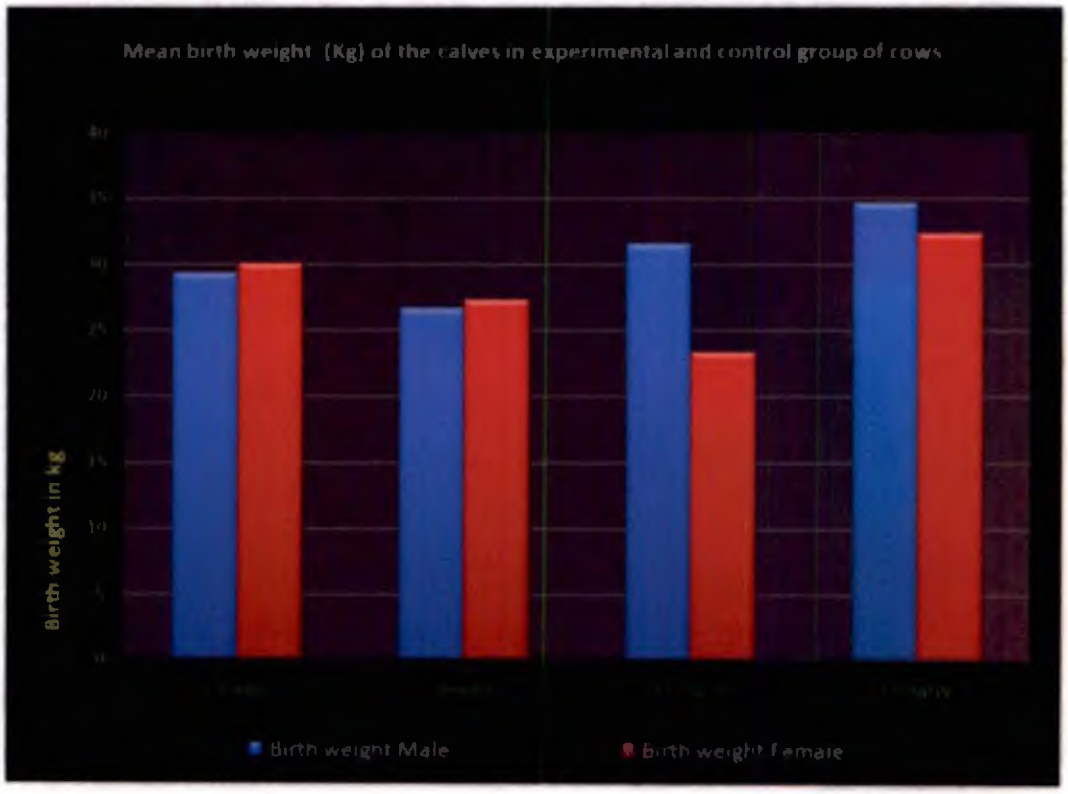
Mean birth weight (Kg) of the calves in experimental and control group of cows
Birth weight in kg
Birth weight Male
Birth weight Female

Fig. 4

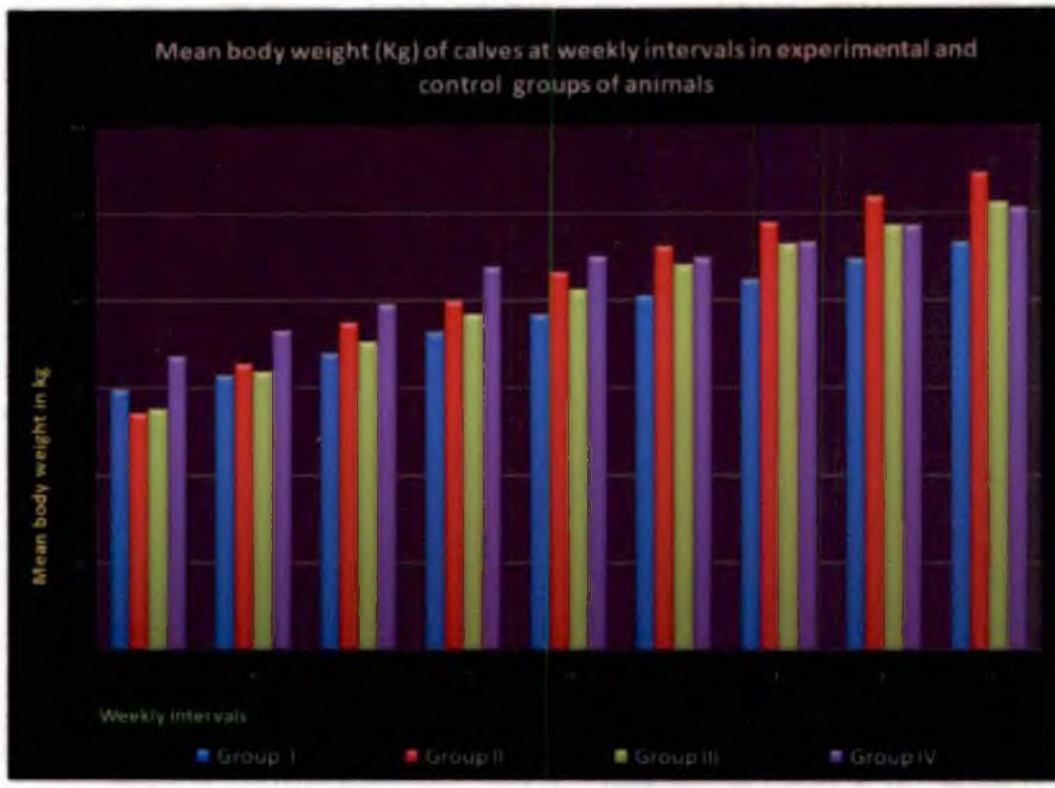
Mean body weight (Kg) of calves at weekly intervals in experimental and control groups of animals
Mean body weight in kg
Weekly intervals
Group I
Group II
Group III
Group IV

Fig. 5

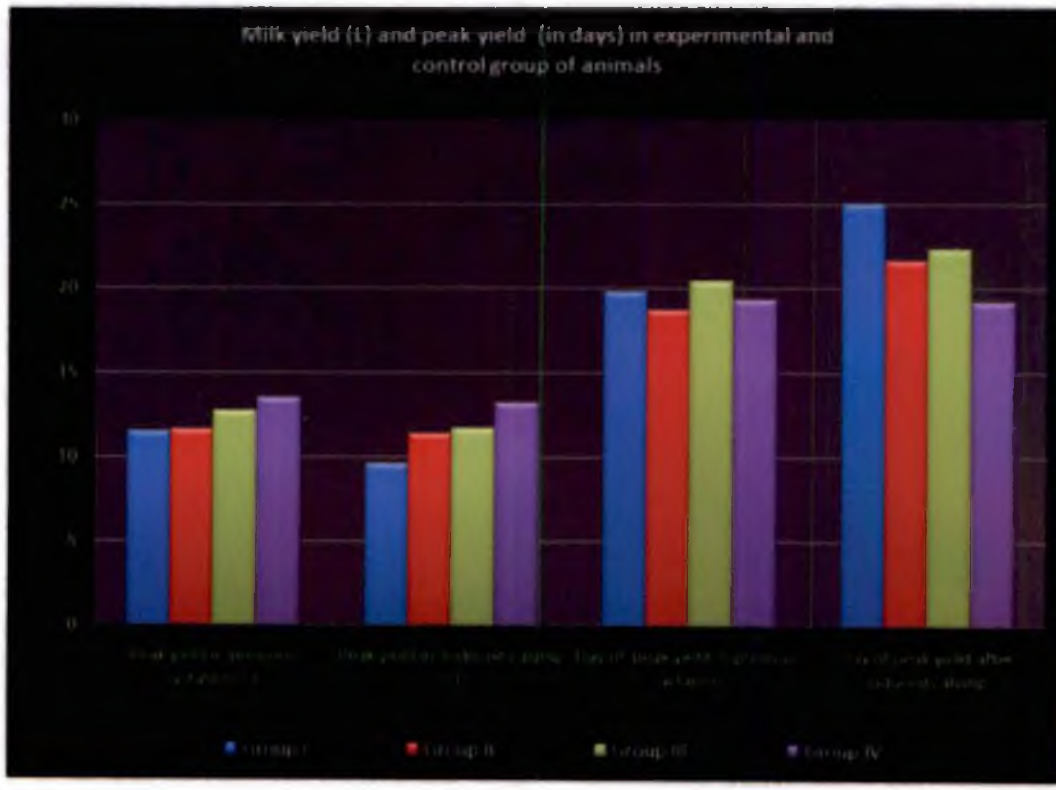
Milk yield (L) and peak yield (in days) in experimental and control group of animals
30
25
20
15
10
5
0
Group I
Group II
Group III
Group IV

Fig. 6

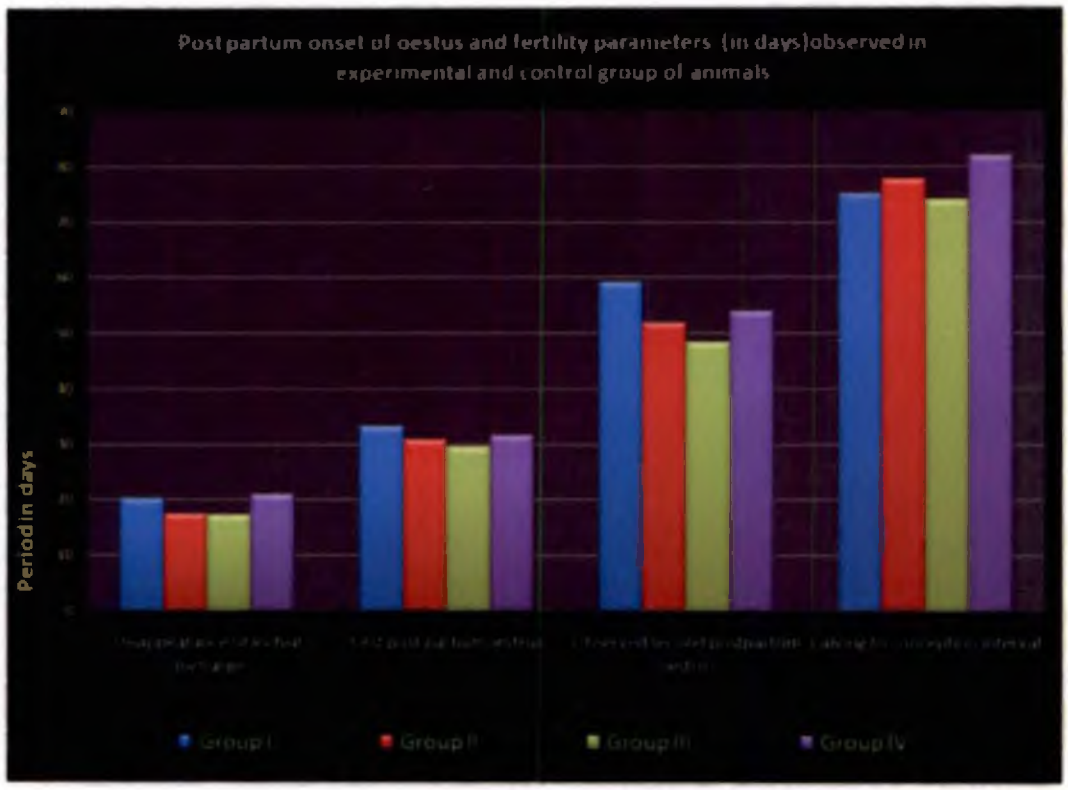
Post partum onset of oestus and fertility parameters (in days)observed in experimental and control group of animals
Period in days
Group I
Group II
Group III
Group IV

Fig. 7

Plate 1. Before induction of parturition (286th day of gestation)

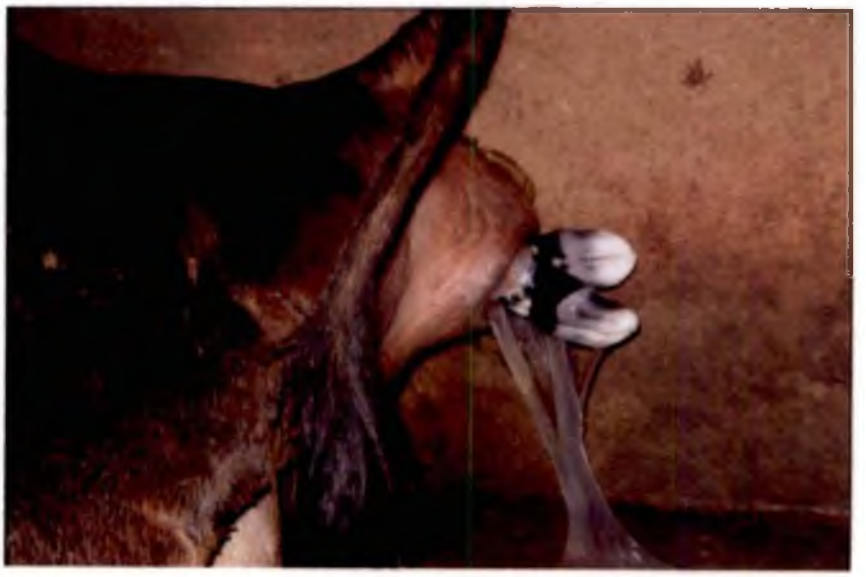

Plate 2. Second stage of labour – protrusion of forelimbs

Plate 3. Second stage of labour - expulsion of foetal head

Plate 4. Foetal head and both forelimbs completely expelled

Plate 5. New born calf

Plate 6. Part of foetal membranes immediately after expulsion of foetus

Plate 7. Dam with its new born calf

Plate 8 Retention of foetal membranes
12 hours after parturition

Plate 9. Weighing of new born calf

Plate 10. Drugs used

1. Inj. Dexamethasone
2. Inj. Cloprostenol

Plate 11. Downer cow syndrome

11A. Downer stage (before induction of parturition)

11B. Cow with its calf (after induction of parturition)

11C. Fifth day after calving

Discussion

5. DISCUSSION

The present research work was undertaken (1) To find the mean gestation length and details of calving in crossbred cattle of the University Livestock Farm and local breed of " ICAR Scheme on Conservation of Germplasm of Vechur Cattle " (2) To develop a suitable protocol for inducing parturition in prolonged gestation cases and (3) To tackle the downer cow syndrome in cattle by premature induction of parturition to save the life of mother and new born.

5.1 GESTATION LENGTH AND DETAILS OF CALVING

Perusal of data in Table 1 shows that the average gestation length in crossbred cattle of the University Livestock Farm, Mannuthy was 274 ± 0.48 days, but the local breed of Kerala, Vechur had a higher gestation length of 282 ± 0.98days. The average birth weight of new born calf at ULF was 26.52 ± 0.39 kg and that of Vechur scheme was 10.43 ± 0.12 kg. The sex ratio at ULF was 1: 0.9 and that in vechur scheme was 1:1.2. The postpartum complications were 9 and 4.5 per cent respectively.

The analysis of the data revealed that local breeds had longer gestation length and these findings were in agreement with the observation of Sane *et al.* (1994) and Craig (2000). Similarly Nasser *et al.* (2008) and Camergo *et al.*(2009) also reported that *Bos indicus* dairy breeds had longer gestation length and lighter offspring than *Bos taurus* animals.

The data revealed that a higher proportion of male calves were born in ULF whereas in vechur higher proportion of female calves were born. The sex of the calf had no significant correlation with gestation length, agreeing with the findings of Rajagopalan (1976) and Madhavan *et al.* (1979).

The per cent of animals that had the mean gestation length of 274 days was 46.88 and that above the mean gestation length was 53.13. The corresponding mean birth weights of new born calves were 26.04 ± 0.69 and 29.79 ± 0.42 kg respectively. Similarly in the Vechur scheme the per cent of animals that had the mean gestation length of 282 days was 30 and above the mean gestation length was 70 respectively. The mean birth weights of new born calves were 9.5 ± 0.23 kg, 10.4 ± 0.21 kg respectively. The postpartum complications were three and 15 per cent for ULF and three and six for vechur respectively.

The data on birth weight of new born calf at ULF revealed that the mean body weight was higher in prolonged gestation cases when compared to normal gestation. Higher incidence of postpartum complications reported in prolonged gestation cases and it was mostly due to absolute foetal oversize resulting in dystocia and other complications. The observation was in agreement with Noakes *et al.* (2001) and Barth (2006) that during terminal stages of gestation foetus often gained weight 450 g to 680 g per day and hence prolongation of gestation beyond 280 days resulted in foetal oversize which finally ended up in complications during parturition.

5.2 INDUCTION OF PARTURITION

Parturition was induced in experimental animals (Group I to III) on 286 th day of gestation and control animals (Group IV) were followed up for normal calving. The mean age in years for experimental and control animals was 5.00 ± 0.63, 5.50 ± 0.76, 4.17 ± 0.86 and 4.58 ± 0.71 respectively. The parity of these animals was 1.80± 0.54, 2.5 ± 0.54, 1.33 ± 0.66 and 1.50 ± 0.50 respectively.

The data revealed that gestation length had no significant correlation with age and parity of the dam. It was reported that gestation length was not influenced by parity but influenced by age of the dam (Hedge and Swamy, 1980).

Sane *et al.* (1994) stated that as age advanced gestation length also increased. Similarly Olson *et al.* (2009) also reported that primiparous cows with lower bodyweight had shorter gestation length. The present study it was revealed that age and parity of the dam had no significant effect on gestation length.

All the animals in the experimental group in the present study responded to the treatment with an efficiency of 100 per cent. But in the majority of works by several researchers related to induction the response was not fully effective (Beardsley *et al.*, 1976; Diskin *et al.*, 1984; Bellows *et al.*, 1988). On contrary, Lewing *et al.* (1985) reported that all the animals in the experimental group responded to the treatment with a combination of dexamethasone and prostaglandin and Kornmatitsuk *et al.* (2001) also successfilly induced parturition with prostaglandin and obtained 100 per cent efficacy.

The time taken for induction of parturition for groups I to III was 39.50 ± 1.26, 30.5 ± 2.17 and 26.9 ± 1.8 hours respectively (Table 3 and Fig.1). Analysis of data revealed that there was significant difference between groups and the time taken for dexamethasone plus prostaglandin group was less compared to prostaglandin or dexamethasone alone.

In the present study it could be established that prostaglandin and dexamethasone alone or in combination would remove both ovarian and placental source of progesterone resulting in induction of parturition. In addition, induction time was short when combination of prostaglandin and dexamethasone at a lower dose was used. This could be due to synchronization of prostaglandin and dexamethasone in bringing the initiation of labour at a shorter interval. The finding from the present study was in agreement with the observations of Lewing *et al.* (1985), Nasser *et al.* (1994), and Kozo *et al.* (2005). A combination of the two hormones would remove both ovarian and placental sources of progesterone and resulted in shorter induction time (Barth, 2006).

5.2.1 Duration of Various Stages of Parturition

The duration for first stage in group I to IV was 4.00 ± 0.16, 3.12 ± 0.15, 3.24 ± 0.02, 4.49 ± 0.12 hours and for second stage was 1.27 ± 0.02, 1.12 ± 0.14, 1.21 ± 0.12, 1.53 ± 0.10 hours respectively (Table 4)

Analysis of data revealed no significant variation between groups in terms of duration of stages of labour. This finding was in agreement with the observation of Lewing *et al.* (1985), Nasser *et al.* (1994), Wiltbank *et al.* (1990) and Barth (2006).

The per cent of animals that expelled placenta normally was 50, 66.66, 83.33, and 83.33 respectively and the mean time for the expulsion was 6.67 ± 0.33, 6.35 ± 1.87, 3.02 ± 0.13, 2.74 ± 0.14 hours respectively . The mean weight of the placenta in kg for the group I to IV was 2.87 ±0.43, 3.50 ± 0.54, 3.00 ± 0.28, 3.6 ± 0.25 kg respectively and mean number of cotyledons was 89.50 ± 0.76, 91.2 ± 0.60, 90.50 ± 0.84, and 91.50 ± 0.76 respectively.

Analysis of data revealed no significant difference in the time of expulsion of foetal membranes after delivery between experimental and control groups. The result showed that the induction of parturition did not interfere with the normal expulsion of placenta. Nasser *et al.* (1994) reported that the mean interval from calving to placental release was not different from the induced and control group and the observation was in agreement with that of present study. Nasser *et al.* (2008) recorded that pre-treatment with long acting corticosteroid induced placental maturation and greatly reduce the incidence of retained placenta in induction protocols with dexamethasone and prostaglandin.

In the present study placenta was expelled within normal limits probably due to placental maturation due to prolongation of gestation. The weight of placenta and number of cotyledons were within the normal range and correlates

with the observation of Jose (1981) and Athman (1995). Analysis revealed that weight or number of cotyledons had no effect on prolonging the gestation length.

5.2.2 Complications during Calving and Postpartum Period

The incidence of dystocia in treated and control animals was 50, 0, 33 and 50 per cent respectively. In the present study the incidence of dystocia in control animals was more due to absolute foetal oversize and postural defects. The observation was in agreement with Noakes *et al.* (2001) and Norman and Younguist (2007) who reported that when gestation prolonged beyond the average, the birth weight of the calf also increased and resulted in complications at delivery.

Perusal of data in the table 6 shows that the incidence of retained placenta in each group was 50, 33.33, 16.66 and 16.66 per cent respectively. This was in agreement with the observation of several researchers that induction of parturition would result in retention of foetal membranes. LaVoie *et al.* (1984), Bellows *et al.* (1994) and Nasser *et al.* (1994) induced parturition with dexamethasone at different doses and reported 11 to 23 per cent of retained placenta. Mansell *et al.* (2006) reported that the incidence of retention of foetal membranes was 16.4, 18.8 and 23.2 per cent for prostaglandins, dexamethasone trimethyl acetate and combination of dexamethasone and PG respectively, while for control animals it was only 4.6. The findings by several researchers coincided with the result of present study that there was high incidence of retained placenta in the dexamethasone group. Placental retention with induction of parturition has been postulated to be due to placental immaturity or the hormonal imbalance that may occur with synthetic hormone treatments (Arthur, 1979; Grunert, 1984).

In dexamethasone treated animals the incidence of uterine prolapse (16.66), downer cow syndrome (16.66) and mastitis (16.66) per cent were observed. Beardsley *et al.* (1976) suggested that glucocorticoid treatment had

lowered the blood serum calcium which might had precipitated hypocalcaemia. Hence in this present study it could be inferred that in dexamethasone treated animal hypocalcaemia might have attributed for postpartum uterine prolapse and occurrence of downer cow syndrome.

Mastitis was reported in one animal after dexamethasone treatment which was successfully treated with antibiotic enrofloxacin. Higher dose of dexamethasone might have suppressed the immune system which finally resulted in occurrence of mastitis.

5.2.3 Birth Weight and Sex of the Calf

The sex ratio of new born calves of experimental and control groups was 1:1, 0.57 : 1, 1:1 and 1:1 respectively. The average birth weight in kg for the male calves was 29.33 ± 1.20, 26.65 ± 6.50, 31.50 ± 3.40, 34.66 ± 2.03 respectively. Similarly the birth weight of female calves were 30 ± 1.15, 27.25 ± 1.97, 23.33 ± 2.40, 32.33 ± 1.20 kg respectively (Table 7).

Analysis of data revealed that in control animals the birth weight of calves was higher than experimental group that was in agreement with Roberts (1986) that birth weight of the calves was higher when the gestation was prolonged. The birth weight of male and female calves did not differ significantly but several reports indicated the higher birth weight for male calves (Roberts, 1986; Camergo *et al,* 2009). Beardsley *et al.* (1976) and Lewing *et al.* (1985) reported that birth weight of the calf from induced cows was significantly lower when compared to control group. But Poncelet and Moody (1987), Nasser *et al.* (1994) and Barth (2006) reported that there were no significant difference in body weight for induced and control groups and similar observation were found in the present study.

The body weight of calves at weekly intervals up to two months in treated and control animals were tabulated in Table 8 and Fig.5. There was steady increase in body weight of calves as age advanced in experimental and control groups. Statistical analysis of the data revealed that there was no significant variation among the treatment groups and control animals in terms of weight gain of calves. These results agree with the observations of researchers like Barth (2006) and Nasser *et al.* (2008). On contrary, Bellows *et al.* (1994) reported that daily weight gain of calves born in induced parturition was 0.87 kg and for normal parturition it was 0.95 kg.

5.2.4 Udder Changes, Milk Yield and Day of Peak Yield

During induction of parturition prominent udder changes were obtained in group II, III and control groups whereas in group I the udder changes were less prominent. The mean peak yield for the groups I to IV in the present lactation was 9.57 ± 0.58, 11.33 ± 1.17, 11.67 ± 1.54 and 13.17 ± 0.75 liters respectively. The corresponding values in previous lactation for the experimental and control groups were 11.48 ± 0.48, 11.60 ± 0.75, 12.70 ± 0.47 and 13.50 ± 0.65 liters respectively. The day of peak yield in the present lactation was 25 ± 0.63, 21.66 ± 0.61, 22.33 ± 1.05 and 19.16 ± 0.79 days and the corresponding values in previous lactation were 19.80 ± 0.95, 18.70 ± 0.67, 20.30 ± 1.28 and 19.30 ± 0.63 days respectively (Table 9).

Analysis of the data revealed that the milk yield of the entire treated group was slightly lower when compared to their previous lactational yield and day of peak yield also extended in all experimental animals. The reduction in milk yield was reported by several researchers. Beardsley *et al.* (1974) explained that the mammary gland of the induced groups did not have the same period of preparation for lactation as the control animals. Similarly Mortan and Butler (1995) and Mansell *et al.* (2006) also reported reduction in milk yield. Contrary observations were reported by Chew *et al.* (1978), Barth (2006) and Nasser *et al.*

(2008) who claimed that induction of parturition did not affect milk production. Ayoob (2009) stated that peak yield was normally achieved before completing one month of lactation in normal calvings, similar observations were found in the present study also.

5.2.5 Postpartum fertility

The disappearance of lochial discharge for experimental and control groups was 20.16 ± 1.04, 17.31 ± 1.13, 17.17 ± 0.87, 21.00 ± 1.26 days respectively. This observation was in agreement with the statement of Sane *et al.* (1994) who reported that during 14 to 18 days postpartum there was almost complete disappearance of lochial discharge. In the present study the disappearance of lochial discharge was within normal limits but slight extension was noticed in dexamethasone group and control animals because of increased incidence of dystocia and retention of foetal membranes. Kask *et al.* (2000a) reported that after induction of parturition with dexamethasone, vaginal discharge was observed for seven weeks postpartum. They were also reported that animals with retained placentas had more vaginal discharge during the first 11 days than the non retained cases and control animals. Similar observations were found in the present study.

The onset of first postpartum oestrus was noticed in groups at 33.20 ±1.25, 30.70 ± 0.88, 29.50 ± 0.76, and 31.6 ± 0.76 days after parturition. In normal parturitions the non infected animals ovulated as early as 16 days postpartum and infected animals around 31 days (Frederickson *et al.*, 1985; Ginther *et al.* 1989.) but in most of the cases first postpartum oestrus would be silent due to the refractoriness of the brain induced by high levels of oestradiol during late gestation and observed heat signs around 30 days (Roche *et al*, 2000).

The second postpartum oestrus was observed at 59.00 ± 1.22, 51.83 ± 0.83, 48.33 ± 1.99, and 53.83 ± 0.94 days respectively and all the animals were

inseminated. The overall conception rate for the groups I to IV was 16.66, 66.66, 83.33, 66.66 per cent respectively. The highest conception rate obtained in group III. The mean calving to conception interval for the experimental and control animals was 91.50 ± 15.00, 77.66 ± 9.38, 74.00 ± 7.00, and 82.00 ± 13.97 days respectively.

The highest conception rate for the group III might be due to early uterine involution and occurrence of less postpartum complications. Conflicting results on postpartum fertility in cows that retained placentas after induction have been reported by several researchers. The overall conception rate was found highly varying among groups because of postpartum complications especially high incidence of retention of foetal membranes. Claydon (1984) reported that irrespective of placental retention after induction there was no difference among treatments in the subsequent calving to conception interval and a mean value of 84 days was recorded. But Nasser *et al.* (1994) reported that cows with retained placentas after induction with dexamethasone in combination with prostaglandin had long intervals from calving to conception. Mansell *et al.* (2006) reported that the mean inter calving interval for induced group was slightly longer than control groups.

In the present study a higher conception rate obtained in prostaglandin and combination of prostaglandin with dexamethasone groups , might be due to less complications at delivery and postpartum period. Similarly, in dexamethasone treated animals the overall conception rate was less due to postpartum complications like retention of foetal membranes, delayed involution of uterus and delayed onset of oestrus.

5.3 MANAGEMENT OF DOWNER COWS IN ADVANCED PREGNANCY

Parturition was induced in four cows presented at Veterinary College Hospital, Mannuthy which failed with routine medical treatment for downer cow syndrome. These four animals had gestation length of 253, 285, 270 and 275 days respectively (Table 11).

The time taken for induction in prostaglandin treated group was 48.30 and 31.20 hours respectively. The dexamethasone induced animal had taken 51.00 hours for parturition while in combination of dexamethasone and prostaglandin it was 29.45 hours. All the three animals in which prostaglandin and its combination with dexamethasone was used, recovered from recumbent stage after delivery and had regained normal feeding habits. The animal treated with dexamethasone had not regained the normal condition and was advised disposal. But all the four calves survived in this experiment. Dexamethasone treatment in downer cow might have suppressed the immune system resulting in further weakening of the general condition of the animal. Noakes *et al.* (2001) and Krishnaswamy (2006) indicated the induction of parturition in downer cows to alleviate the downer cow condition.

Conclusion

It was concluded that prostaglandin alone and its combination with dexamethasone could be used successfully to induce parturition in cows with prolonged gestation to reduce the complications during parturition and postpartum. In addition, premature induction of parturition with same protocol developed from the present study could also be used to tackle the downer cow syndrome in cattle to save the life of dam and new born.

Summary

6. SUMMARY

A preliminary study was conducted by collecting data regarding gestation length and details of calving in crossbred cattle of the University Livestock Farm, Mannuthy and local breeds belonging to "ICAR Scheme on Conservation of Germplasm of Vechur Cattle". The main experiment was designed to develop a suitable protocol for induction of parturition in prolonged gestation and to assess the safety of protocol in the management of reproductive health and production.

Twenty four pregnant cows belonging to the University Livestock Farm, Mannuthy and private farms nearby having a gestation length over 280 days were selected and allotted at random to four groups of six animals each (Group I, II, III and IV as control). Parturition was induced on 286th day of gestation in all experimental animals. The control animals were followed up regularly for normal parturition.

In all the animals of experimental group I, II and III the drug was administered for inducing parturition on 286th day of gestation. In group 1, 24 mg of dexamethasone, in group II 500µg of prostaglandin analogue (cloprostenol) and in group III a combination of 12 mg of dexamethsone and 250 µg cloprostenol was administered intramuscularly.

The mean time taken in hours for induction of parturition in group I to III was 39.50 ± 1.26, 30.50 ± 2.17 and 26.90 ± 1.80 respectively and the least time was recorded in combination group. This shows that prostaglandin along with dexamethasone at a lower dose could induce parturition at an early period.

The duration for first stage of labour in group I to IV was 4.00±0.16, 3.12 ± 0.15, 3.24 ± 0.02, 4.49 ± 0.12 hours respectively and for second stage was 1.27 ± 0.02, 1.12 ± 0.14, 1.21 ± 0.12, 1.53 ± 0.10 hours respectively. The mean time for the expulsion of placenta in experimental and control animals were

6.67 ± 0.33, 6.35 ± 1.87, 3.02 ± 0.13 2.74 ±0.14 hours. There was no significant variation in the duration of first stage, second stage and third stage of labour between groups. This suggests that in all experimental animals drug administration was effective in inducing parturition within normal period.

The incidence of dystocia in groups I to IV was 50, 0, 33.33 and 50 per cent respectively. The incidence of retention of foetal membranes in groups I to IV was 50, 33.33, 16.66 and 16.66 per cent respectively. Higher incidence of dystocia was observed in dexamethasone treated and control animals. In dexamethasone treated animals (group I) improper cervical dilatation and in control group absolute foetal oversize were attributed as the reasons for occurrence of dystocia. Further it was observed that incidence of retention of foetal membranes were more in dexamethasone treated animals when compared to prostaglandin treated animals.

The mean birth weight in kg for the male calves for the experimental and control groups was 29.33 ± 1.20, 26.65 ± 6.50, 31.50 ± 3.40, 34.66 ±2.03 respectively. Similarly the birth weight of female calves were 30.00 ± 1.15, 27.25 ± 1.97, 23.33 ± 2.40, 32.33 ± 1.20 kg respectively. The mean birth weight in control animals was found to be higher which was attributed as a reason for higher incidence of dystocia. However, in all calves of the experimental and control groups there was no significant difference in mean body weight gain.

The mean peak yield and day of peak yield did not vary much in all groups except dexamethasone treated animals. In dexamethasone treated animals there was significant reduction in the present lactation compared to previous yields.

The disappearance of lochial discharge and the first postpartum oestrus observed was within normal limits in all animals except dexamethasone treated

animals. Similarly over all conception rate was also the least in dexamethasone treated animals.

Four downer cows in poor state presented at Veterinary College Hospital, Mannuthy having a gestation length of 253, 285, 270 and 275 days and were induced parturition by using prostaglandin, dexamethasone and its combination. All the three cows had uneventful recovery but the dexamethasone treated animal had not regained its general condition and it was later disposed. However, all the four calves born could be saved.

Hence from the present study it could be established that prostaglandin or its analogues alone or in combination with small dose of dexamethasone could be used efficiently to induce parturition in cows with history of prolonged gestation. Dexamethasone treatment alone at high dose may result in improper cervical dilatation, higher incidence of dystocia, postpartum complications, reduction in milk yield, delayed uterine involution, delayed postpartum oestrus and lowered fertility. Further the safe protocol developed in this study could be used for premature induction in downer cows which have failed to respond to routine medical treatment to save the life of mother and new born calf.

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INDUCTION OF PARTURITION AND EVALUATION OF POSTPARTUM FERTILITY IN CROSSBRED COWS

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ABSTRACT

A preliminary study was conducted by collecting data regarding gestation length and details of calving among crossbred cattle of the University Livestock Farm and local breeds belonging to "ICAR Scheme on Conservation of Germplasm of Vechur Cattle". The mean gestation length of crossbred cattle of ULF was 274 ± 0.48 days and that of Vechur scheme was 282 ± 0.98 days. The average birth weight of new born calf at ULF was 26.52 ± 0.39 kg and that of Vechur was 10.43 ± 0.12 kg. The sex ratio of male and female was 1: 0.9 and 1: 1.2 for ULF and Vechur scheme respectively

The main experiment was undertaken to develop a suitable protocol for induction of parturition in crossbred cattle with prolonged gestation and to assess the postpartum fertility of these animals. The study was performed in 24 pregnant animals of the University Livestock Farm and private farms near by Mannuthy during the period from December 2008 to February 2010.

In all animals in group I, II and III, the drug was administered for inducing parturition on 286th day of gestation. In group 1, 24 mg of dexamethsone, in group II 500µg of prostaglandin analogue (cloprostenol) and in group III, a combination of 12 mg of dexamehasone and 250 µg cloprostenol was administered intramuscularly and group IV acted as control.

The mean time taken in hours for induction of parturition in group I to III was 39.50 ± 1.26, 30.50 ± 2.17 and 26.90 ± 1.80 respectively and the least time was recorded in combination group.

The duration for first stage of labour in groups I to IV was 4.00 ± 0.16, 3.12 ± 0.15, 3.24 ± 0.02, 4.49 ± 0.12 hours respectively and for second stage was 1.27 ± 0.02, 1.12 ± 0.14, 1.21 ± 0.12, 1.53 ± 0.10 hours respectively. The

mean time for the expulsion of placenta was 6.67 ± 0.33, 6.35 ± 1.87, 3.02 ± 0.13 2.74 ± 0.14 hours respectively.

The mean weight of the placenta for the groups was 2.87 ± 0.43, 3.50 ± 0.54, 3.00 ± 0.28, 3.60 ± 0.25 kg and the mean number of cotyledons were 89.50 ± 0.76, 91.20 ± 0.60, 90.5 ± 0.84, and 91.50 ± 0.76 respectively.

The incidence of dystocia in groups I to IV was 50, 0, 33.33 and 50 per cent respectively. The incidence of retention of foetal membranes in groups I to IV was 50, 33.33, 16.66 and 16.66 per cent respectively. In group I, the incidence of postpartum prolapse of genital organs, downer cow and mastitis were recorded as 16.66 per cent each.

The sex ratio for the groups I to IV was 1:1, 0.57: 1, 1:1 and 1:1. The mean birth weight in kg for the male calves was 29.33 ± 1.2, 26.65 ±6.5, 31.5 ± 3.40, 34.66 ± 2.03 respectively. Similarly the birth weight of female calves were 30.00 ± 1.15, 27.25 ± 1.97, 23.33 ± 2.40, 32.33 ± 1.20 kg respectively. There was steady increase in body weight of calves as age advanced in experimental and control groups, however there was no significant difference between groups in mean body weight gain.

The mean peak yield in the present lactation for the experimental and control animals was 9.57 ± 0.58, 11.33 ±1.17, 11.67 ±1.54 and 13.17± 0.75 liters respectively. The corresponding values in the previous lactation for the experimental and control groups were 11.48 ± 0.48, 11.60 ± 0.75, 12.70 ± 0.47 and 13.50 ± 0.65 liters respectively. The day of peak yield in the present lactation was 25.00 ± 0.63, 21.66 ± 0.61, 22.33 ± 1.05 and 19.16 ± 0.79 days and the corresponding values in previous lactation were 19.80 ± 0.95, 18.70 ± 0.67, 20.30 ± 1.28 and 19.30 ± 0.63 days respectively.

The disappearance of lochial discharge for the experimental and control groups was 20.16 ± 1.04, 17.31 ± 1.13, 17.17 ± 0.87, 21.00 ± 1.26 days respectively. The first postpartum oestrus was observed at 33.20 ± 1.25, 30.70 ± 0.88, 29.50 ± 0.76 days for experimental animals and for control animals it was 31.60 ± 0.76 days. Similarly, the second postpartum oestrus was on 59.00 ± 1.22, 51.83 ± 0.83, 48.33 ± 1.99, 53.83 ± 0.94 days respectively.

Conception rate for the first AI in group I to IV was 0, 50, 50, and 33.33 respectively where as the overall conception rate for these animals was 16.66, 66.66, 83.33, 66.66 per cent respectively. The highest conception rate was obtained in group III. The mean calving to conception interval for the experimental and control animals was 91.50 ± 15, 77.66 ± 9.38, 74.00 ± 7.00 and 82.00 ± 13.97 days respectively

Premature induction of parturition was carried out in four downer cows presented at Veterinary College Hospital, Mannuthy which failed with routine medical treatment and having the gestation length of 253, 285, 270 and 275 days. In the first two animals parturition was induced with prostaglandin and the time taken for induction was 48.30 and 31.20 hours respectively. In dexamethasone treated animal calving occurred at 51 hours after administration of drug. Similarly the time taken for induction in animal which treated with combination of dexamethasone and prostaglandin was 29.45 hours. All the three animals in which prostaglandin and its combination with dexamethasone, recovered from recumbent stage after delivery and had regained normal feeding habits. The animal treated with dexamethasone had not regained the normal condition and was advised disposal. But all the four calves survived in this experiment.

The present study revealed that induction of parturition with prostaglandin alone in normal dose and its combination with dexamethasone at a lower dose were equally useful for successful induction of parturition in animals with prolonged gestation with least reproductive complications. When parturition

was induced with dexamethasone milk yield was found to be reduced during early stages of lactation while when prostaglandin and its combination with dexamethasone were used reduction in milk yield was negligible. In animals in which parturition was induced with prostaglandin and its combination had normal disappearance of lochial discharge, early involution of uterus and had early normal postpartum oestrus and had fairly good overall conception rate. Further it is recommended that premature induction of parturition in downer cows when all other medical treatments have failed, prostaglandin or its combination with dexamethasone could ideally be used to induce premature induction of parturition to save the life of mother and new born.