PATHOLOGICAL CONDITIONS OF OVARY AND BURSA IN CROSS-BRED CATTLE

By

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THESIS

Submitted in partial fulfilment of the requirement for the degree

Master of Veterinary Science

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Kerala Agricultural University

Department of Animal Reproduction
COLLEGE OF VETERINARY AND ANIMAL SCIENCES
Mannuthy, Thrissur

1994

DECLARATION

I do hereby declare that this thesis entitled **"PATHOLOGICAL CONDITIONS OF OVARY AND BURSA IN CROSS-BRED CATTLE"** is a bonafide record of research work done by me during the course of research and that the thesis has not previously formed the basis for the award to me of any degree, diploma, associateship or other similar title, of any other University or Society.

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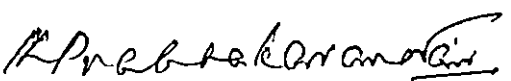
I hereby declare that this thesis entitled **"PATHOLOGICAL CONDITIONS OF OVARY AND BURSA IN CROSS-BRED CATTLE"** is a record of research work done independently by Dr. **VIJU GEROGE** under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship, or associateship to him.



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ACKNOWLEDGEMENTS

With profound gratitude I wish to place my indebtedness to Dr.K. Prabhakaran Nair, Professor, Department of Animal Reproduction and Chairman of Advisory Board for his valuable guidance, helpful suggestions, constant encouragement and advice throughout the course of this work.

I am grateful to Dr. C.P. Neelakanta Iyer, Professor and Head, Department of Animal Reproduction, College of Veterinary and Animal Sciences, Mannuthy and member of Advisory Committee for his help, constant guidance and valuable suggestions.

I am indebted to Dr.T. Sreekumaran, Associate Professor, Department of Animal Reproduction and Dr.K.R. Harshan, Associate Professor, Department of Anatomy for their help and advice at various stages of this work as members of the Advisory Committee.

I am thankful to Dr. A. Rajan, Dean, College of Veterinary and Animal Sciences for the facilities provided and timely help rendered during the study.

I would like to express my sincere thanks to Dr.K.C. George, Professor and Head, Department of Statistics and the staff.

My sincere thanks are due to Dr.V. Sudarsanan, Professor, Dr.E. Madhavan, Professor, Dr.E. Mathai, Professor, Dr.K.V. Athman, Associate Professor, Dr.S.P. Suresan Nair, Associate Professor, Dr.K.N. Aravinda Ghosh, Associate Professor and Dr.Metilda Joseph, Assistant Professor for their advice and help rendered during various stages of the study.

I am thankful to Dr.P.A.Ommer, Retired Professor and Head, Department of Anatomy for helping me during the course of my work.

I am also grateful to late Dr.G.Nirmalan, Dean in charge, College of Veterinary and Animal Sciences for the facilities provided for the study.

With great affection I appreciate my friends for their help rendered during my research work.

My sincere thanks to the Veterinary Officers of Municipal Slaughter House, Trichur for their whole-hearted co-operation.

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Introduction

INTRODUCTION

Livestock forms one of the most important productive assets of rural India. The livestock sector contributes to an estimated 8 - 9 per cent of the country's gross domestic product. Cattle and buffaloes put together account for about 90 per cent of the livestock wealth of our country. In absolute numbers the bovine population of India is 240 million, of which cattle accounts for 75 per cent.

Eventhough India could boast of a few excellent breeds of cattle especially in the western, northern and central India, Kerala and north eastern states had only local non-descript cattle which were notoriously low milk producers. Realising the potential of the livestock sector in the state's economy, in the first three five year plans community development projects and Key Village Schemes were implemented in the State of Kerala to improve the production potential of the local non-descript cattle by grading up with reputed Indian breeds such as Sindhi. Since it was felt that the pace of genetic improvement was slow with this programme, it was decided to introduce exotic breeds such as Jersey, Brown-Swiss and Holstein-friesian in the breeding programme for the state and accordingly cross breeding with exotic breeds has been going on for the last three decades.

The impact of cross breeding is significantly felt in the genetic profile of the cattle population and in the milk production of the state. The livestock census of 1987 revealed that about 50 per cent of the cattle population in the state are cross-breds. The present thrust in the breeding policy is to increase this proportion by extending Artificial Insemination facilities to more remote areas and also by using superior bulls with higher production potential. This might help in the long run to increase the average milk production per cow and also the overall production of the state which has been almost stagnant for the last 5-6 years (George and Nair, 1990).

In the process of producing high producing cross-bred cattle with exotic germplasm unexpected problems in adaptation, resistance to disease and infertility have cropped up. These cross-breds which have high production potential will naturally need higher levels of feeding and better management to enable them to adapt to the hot humid climate of the state and to express fully its production potential. Failure to provide these inputs at optimal levels, probably on account of the fact that livestock rearing in the state is the vocation of small farmers and agricultural labourers has resulted in a higher incidence of infertility due to functional reproductive disorders and

pathological conditions of ovaries. This has come to light in the course of clinico-gynaecological studies. However, these investigations alone are inadequate in providing in depth knowledge of various pathological conditions affecting ovaries and bursa which might impair fertility. This necessitates complementing the clinico-gynaecological investigations with studies based on abattoir specimens at regular intervals and hence this work.

Review of Literature

REVIEW OF LITERATURE

There are exhaustive studies on the pathology of reproductive organs of exotic cattle from different parts of the world. Eventhough there are innumerable reports on the pathological conditions of ovaries and bursa based on clinico-gynaecological studies, there is paucity of data on the pathology of ovary and bursa based on abattoir studies probably on account of a ban on cow slaughter in most of the states of India. However, there are a few published works on the pathology of ovary and bursa in cross-bred cattle (Nair and Raja, 1974a., Nair and Raja, 1974b., Kavani et al., 1986., Thakur et al., 1989).

i. Pathology of Ovary:

Lagerlof and Boyd (1953) carried out an exhaustive study on the pathology of sexual organs of 6286 cows of Swedish highland breed and reported an incidence of 13.2 per cent ovarian hypoplasia, 14.8 per cent cystic ovarian degeneration and 0.02 per cent ovarian tumours. Ovarian hypoplasia was found to affect the left ovary more frequently (9.9 per cent) than the right ovary (1.6 per cent). Both the ovaries were affected with hypoplasia in 1.69 per cent cases.

They further recorded that cystic ovarian degeneration was found to affect the right ovary, left ovary and both ovaries together in 6, 3.2 and 5.5 per cent cases respectively. The common ovarian neoplasms encountered in their study were carcinoma (3), granulosa cell tumour (2), small cystic granulosa cell tumour (1), sarcoma (1), fibrosarcoma (1) and undiagnosed (5).

Bone (1954) collected genitalia of 155 dairy cows from the abattoir which included 55 reported cases of sterility. Detailed morphological and biometrical studies were carried out using hundred normal genitalia. Those organs showing gross pathological lesions were subjected to histopathological studies. He broadly classified the ovarian pathological conditions under three categories viz., pathology of a) ovarian follicles b) corpus luteum and c) the ovarian stroma. Pathology of ovarian follicles comprised of failure of follicular development due to senility, infantility atrophy and cystic graafian follicles. Further he had given an excellent description of morphological and microscopical appearance of senile, infantile and atrophic ovaries. The most important pathological condition associated with infertility recorded in the study was cystic follicles (16 cases) which appeared as large tense fluid filled structures ranging from 5-42 mm unaccompanied by a functional corpus luteum in either ovary. The pathological conditions of

corpora lutea were cystic corpora lutea and persistant corpora lutea. The ovarian stroma in three ovaries were found to be affected with either abscess, adhesion or both.

A detailed study of one thousand reproductive tracts of cows obtained at slaughter had revealed an incidence of 2.2 per cent cystic ovaries and 4.8 per cent ovarian adhesions (Perkins et al., 1954). The significance of cystic enlargement of bovine corpus luteum was studied by Dawson (1959) who recorded 27 definite cases of cystic corpora lutea from 274 barrener discard cows slaughtered. He made a distinction between definite cases and border line cases of cystic corpora lutea by fixing up separate norms for cavity size and tissue volume. While definite cases of cystic corpora lutea had an internal cavity diameter of 1.6mm with a mean estimated tissue volume of 37 per cent of normal, borderline cases had a central cavity size of 8 mm and an average tissue volume of 70 per cent of normal.

An abattoir survey involving reproductive tracts of a random sample of 333 cows which included beef cows, Mylrea (1962) recorded macroscopic lesions of ovaries and bursa such as cystic follicles (0.6 per cent), bursitis (9.9 per cent) and cystic corpora lutea (36.9 per cent). Goswami and Choudhary (1963) studied 77 female genitalia collected from Calcutta slaughter house for their functional activity and

for gross pathological lesions and recorded non functional ovaries (23 cases), follicular cysts (1 case), ovarian abscess (1) ovarian atrophy (1) and extra ovarian cyst (2 cases). The study conducted by Rao et al. (1965) using abattoir specimens at Hyderabad revealed only an incidence of one per cent follicular cyst in the ovary. The incidence of various abnormalities in the ovaries of slaughtered heifers was recorded by Drennan and Mac Pherson (1966) who reported multiple persistent follicles (0.3 per cent) cystic corpora lutea (2.5 per cent), luteal cyst (0.6 per cent), single cystic graafian follicle (0.3 per cent) and ovarian adhesion (0.6 per cent).

Anderson and Sandison (1969) in a survey on the incidence of genital tumours in Great Britain recorded an incidence of 7 per cent in cattle of which 11 cases were ovarian neoplasms which included fibroma (1 case); granulosa cell tumour (2), teratoma (1), serous cystadenocarcinoma (3) mucinous cystadenocarcinoma (3) and adenoacanthoma (1). Dieter (1971) carried out morphological studies of ovaries of 91 Normandy cows slaughtered at Caen and Bayeux and 113 cows slaughtered at about the same time at Ried-lingen and observed that while the former group were free from follicular cysts, the latter had an incidence of 8 per cent follicular cysts. In contrast both the groups were found to be affected with cystic corpus luteum.

Of the 1097 genitalia of cows examined in a slaughter house at Athens 226 were found to be gravid (Seitaridis and Metareopoulos, 1971)). The pathological lesions encountered in ovaries were atrophy of the ovaries (10 per cent), ovarian cysts (3 per cent) cystic corpus luteum (10 per cent) and adhesions of ovarian bursa (9 cases). Cubick (1972) studied the morphology of cystic corpora lutea and the frequency of its occurrence in cattle based on abattoir studies and recorded 77 cystic corpora lutea out of a total of 444. While the right ovary was found to be affected in 60 per cent of cases, the frequency of occurrence in left ovary was only 40 per cent. Schvarc (1972) carried out detailed morphological and histopathological study of endometrium of cows affected with follicular and luteal cysts and ovarian hypofunction using biopsy materials and post-mortem samples. Based on his findings he had stressed the importance of histological and histochemical examination of samples of endometrium in case of ovarian disorders in the accurate diagnosis and hormonal therapy of condition. Scanlon (1974) examined genitalia of a total of 2093 cows and 415 heifers slaughtered at an Irish abattoir and found cystic follicles in 1.4 per cent of cows and 0.96 per cent of heifers. Adhesions of the ovaries were present in 0.7 per cent of cows and 0.24 per cent of heifers. Bilateral hypoplasia of ovary was also found during the course of study.

Nair and Raja (1974a) reported that ovarian pathological conditions were to the extent of 6.56 per cent in a total of 1250 genitalia of cross-bred cows collected from slaughter house. The various conditions recorded were hypoplasia (0.08 per cent), cystic graafian follicles (1.44 per cent), cystic corpus luteum (0.8 per cent), abscess (0.48 per cent), haematoma (0.48 per cent), infantile ovary (0.16 per cent), inactive ovary (2.24 per cent), senile atrophy (0.8 per cent) and fibropappillary growths (0.08 per cent). An overall incidence of 2.75 per cent genital pathology was reported in an abattoir study of 6741 genitalia of cows (Summers, 1974). The common conditions encountered were bilateral ovarian hypoplasia (0.12 per cent) and congenital ovarian cysts (0.15 per cent). Hypoplastic ovaries were smaller and had characteristic superficial longitudinal grooves and histological examination revealed the absence of follicles of any class, corpora albicans or corpora atretica. Congenital ovarian cysts were found to be of two types, multiple thin walled cysts upto 2 cm in diameter containing mucopurulent material and lined by stratified squamous epithelium in one type and several thin walled cysts upto 3 cm in diameter containing clear fluids in the other type. Both these types of cysts were found associated with pregnancy in a few animals.

Summers and Campbell (1974) could not find any significant difference in primordial follicle counts on

ovarian function as measured by the relative proportion of graafian follicles in a sagittal midline ovarian sections between two groups of infertile and one group of normal beef cows. They concluded that ovarian dysfunction could not be identified by histological study. The prominent lesion observed in the ovaries in a herd consisting of Brahman cattle and their crosses was a mild interstitial ovaritis (73.7 per cent) while in another herd of Santa-Gertrudis beef cow ovarian hypoplasia (18.8 per cent) and ovarian-oviduct fibrosis (43.8 per cent) were the most frequent lesions (Summers et al., 1974). Follicular cysts and bursal adhesions were reported to be the most frequent lesions among the various pathological conditions causing repeat breeding in cows (Rao et al., 1975).

Summers et al. (1975) reported a case of ovarian dysgerminoma in an aged cow. Macroscopically it was a reddish grey mass of 15 cm diameter which replaced the entire left ovary. Microscopically it was composed of sheets and foci of long polyhedral cells separated by variable amounts of connective tissue. Boitor et al. (1975), out of 483 cystic ovaries described 203 cysts as miliary, 115 as single or multiple follicular cysts of intermediate size and 50 as large or giant follicular cysts. There were also 50 cases of luteal cysts and 65 cases of cystic corpora lutea.

Erickson et al. (1976) assessed the reproductive performance of 152 graded Hereford cows which were 14-15 years of age at slaughter or death. Ovaries from 69 fertile and 78 infertile cows were serially sectioned and microscopically examined. Both the groups did not differ in total germ cell endowment and mean germ cell endowment. The mean germ cell endowment of the 147 cows were 24 $\pm$ 3 thousands. Fertile cows significantly exceeded the infertile only in number of growing follicles. Vascular hamartoma was reported by Lee and Ladds (1976) in a cow, which was a firm well described mass, 8 cm in diameter, in the right ovary. Histologically it was composed of vessels of varying size separated by thick bands of connective tissue.

In histological study of endometrium of cows with cystic degeneration of ovaries, seitaridis and Tsangaris (1976) observed only 4 out of 51 cases having a medium grade inflammation of endometrium, which could be diagnosed as endometritis.

Al-Dahash and David (1977a) examined 8071 reproductive organs of cows and recorded an incidence of 3.8 per cent cystic ovaries and 0.17 per cent ovarian tumours. Of the cystic ovaries 53.75 per cent were single and remaining 46.25 per cent multiple cysts. They further recorded that the right ovary was more frequently affected than the left.

In about 94 specimens (1.16 per cent) the cyst was found associated with a normal corpus luteum. Out of the fourteen specimens (0.17 per cent) of ovarian tumours thirteen were unilateral and one bilateral. The different ovarian neoplasms were granulosa cell tumours (2), haematoma (1) and fibromata (7). They further carried out detailed studies on the anatomical features of these cystic ovaries and also histological studies of ovaries and uteri of cows affected with cystic ovaries respectively (1977b; 1977c).

Ovarian cysts were found to be the most important cause of sterility based on the study of 1545 female genital tracts of cattle obtained from a Teheran abattoir (Ansari and Hedjazi, 1977). Rahman et al. (1977) examined the ovaries of eleven cows of Indian breeds slaughtered after 2-10 years without oestrous, contained cystic follicles (5) persistent corpus luteum (1) and intra follicular haemorrhage (1). They further remarked that ovaries were smaller and lower in weight and showed germinal epithelial abnormalities and degenerating oocytes. Donigiewicz (1978) examined the genital organs of 274 cows and 234 heifers slaughtered at an abattoir in Poland over a 7 month period and reported that the ovaries were affected with unilateral ovarian atrophy (37 cows and 5 heifers), bilateral ovarian atrophy (15 cows and 4 heifers), cystic degeneration of corpus luteum (7cows),

macrocystic ovarian degeneration (13 cows) and ovarian neoplasm (1 cow).

In a study on bovine ovarian tumours (Ito and Fujita, 1978) recorded 4 cases of granulosa cell tumour and one theca cell tumour. Of the granulosa cell tumours two were of follicular type and remaining two of parenchymatous type. In northern Nigeria Lamarde and Kumar (1978) carried out morphological study of ovaries of 236 local zebu cattle of which 189 were found to be grossly abnormal. Histological observations indicated changes due to old age.

Takushi et al. (1981) carried out post-mortem studies of 10703 genital organs at abattoirs and recorded ovarian adhesions and oophoritis in 100 cases (0.94 per cent) ovarian cysts in 25, ovarian hypofunction in 15, ovarian fibrosis in 2 and haemorrhagic atretic follicles in one case. In a study on beef cows slaughtered at Mexico City Galvan et al. (1982) recorded 1079 pregnancies out of a total of 2015 genitalia examined. They further reported that the total incidence of genital abnormalities was 9.4 per cent of which 6 per cent was follicular and luteal cysts. Shipilov and Semivolos (1983) carried out detailed histological studies of hypoactive ovaries from 8 heifers and recorded the number of follicles per section to be 43-83 of which primordial, secondary and tertiary follicles were respectively 75.9, 10.6 and 12.7 per cent. Of these follicles 68.7

per cent were found to be atretic and 25 per cent cystic. Abattoir studies revealed an incidence of 1.8 per cent of cystic ovarian degeneration for buffaloes as compared to 3.8 per cent to 5.2 per cent for cows (Dobson and Kamanpatana, 1986). Kavani et al. (1986) conducted histopathological examination of genitalia of 24 repeat-breeder cows and recorded ovarian lesions such as single or multiple cysts and ovarian hypoplasia in twelve animals.

A detailed survey of reproductive tract abnormalities of 5800 beef heifers from an Ontario abattoir revealed that there were various reproductive tract abnormalities in 1499 (27.7 per cent) of 5413 non-gravid genitalia. Of these 807 (14.9 per cent) were cystic ovaries and ovarobursal adhesions in 5.4 per cent cases (Herenda 1987). A survey on the gross pathology of 643 genital organs of Zebu cattle collected from an abattoir at Peru revealed an incidence of follicular cyst (1.4 per cent) cystic corpus luteum (0.9 per cent) and par ovarian cyst (2.7 per cent) in non-pregnant cows (Garcia, 1988). The incidence of follicular cyst and par ovarian cyst in the beifers were 1.4 and 2 per cent respectively. Okuda et al. (1988) carried out a detailed morphological and histological study of 706 bovine corpora lutea in various luteal stages to ascertain whether there was any relationship between the presence of a central cavity in the corpus luteum and infertility in cows. They recorded a

central cavity in 42.1 per cent of developing corpora lutea, 33.7 per cent of fully developed corpora lutea, 11.1 per cent of regressing corpora lutea and 5.1 per cent of corpus luteum of pregnancy. They further observed that the proportion of luteal cell type I was higher in the fully developed corpora lutea with a central cavity than without one but the reverse was found to be true with respect to luteal cell type II. This study supported by the estimation of progesterone in the luteal tissue prompted him to remark that though there were some differences in the luteal function between corpora lutea with and without a central cavity there was nothing to suggest that the presence of a central cavity in a corpus luteum was pathological.

Thakur et al. (1989) observed gross pathological lesions in 31 ovaries from 541 female genital organs collected from slaughter houses in and around Patna. The various pathological lesions were ovarobursal adhesion (5), cysts (14), ovarian atrophy (0.92 per cent) and inactive ovaries (2.2 per cent). Out of the ovaries showing presence of cysts 10 (71.4 per cent) were follicular cysts and remaining 4 (28.6 per cent) were luteal cysts. Rodriguez et al. (1990) studied the prevalence of ovarian tumours in 1489 female cattle aged from less than one year to twenty years slaughtered in Leon and recorded an incidence of 1.4 per

cent. The incidence was found to be highest in Brown-swiss (2.1 per cent) followed by Friesian and cross breds (1.2 per cent). The incidence was found to be more in cows aged eleven years and above and the most common ovarian neoplasm was granulosa cell tumour (12).

The ovaries of 74 Llamas were examined daily by transrectal ultrasonography for at least 30 days in a study of follicular dynamics to characterise the incidence, growth and regression of follicles and its effect on ovarian function. Haemorrhagic follicles were observed in 13 (18 per cent) Llamas and ultrasonically the formation of a haemorrhagic follicle was indicated by scattered free floating echogenic spots within the follicular antrum which swirled upon ballotment of ovary. It was further noticed that antral contents appeared to become organised after follicle growth ceased. It was concluded that haemorrhagic follicles were apparently anovulatory and luteinisation occurred in a few haemorrhagic follicles. Eventhough by their large size haemorrhagic follicles may be interpreted as haemorrhagic follicular cysts they were not associated with other ovarian irregularities or infertility (Adams et al., 1991). Wahid et al. (1991) studied the ovaries of 214 native cows with unknown breeding history and recorded gross lesions in 45 cases. The abnormalities were par-ovarian cysts (14), follicular cysts (9), bilateral smooth ovaries (7), corpus luteum cysts (5), luteinised cysts (5), granulosa cell tumour (2), haematoma (2) and abscess(1).

ii. Pathology of Bursa

Diseases of bursa of cattle appear to be far more common than those diagnosed clinically. Arthur (1989) stated that diagnosis of ovarobursal adhesion in life is difficult and probably only one-third to one-half of the lesions that cause infertility are diagnosed by rectal palpation. There are enough data published in the past in support of the above view (Mylrea, 1962.,Garcia, 1988).

Perkins et al. (1954) in a study of one thousand reproductive tracts obtained at slaughter found that in 4.8 per cent of tracts there were ovarian adhesion with bursa. Mylrea (1962) in a study of macroscopic lesions in 333 reproductive tracts detected bursitis to an extent of 9.9 per cent of cows under study. Bursal inflammation with adhesion, the severity of which varied from thin strands to complete envelopment of ovary by bursa was seen in 2.5 per cent of genital tracts in an abattoir survey in Hyderabad (Rao et al. 1965).

Drennan and Mac - pherson (1966) observed in 300 slaughter specimens of genital tracts from heifers in an age group of 15 to 30 months, ovarobursal adhesion in 0.3 per cent each on left and right side. Nine out of 1097 genitalia examined had ovarobursal adhesion (Seitaridis and

Metareopoulos, 1971). Adhesion of the ovaries with bursa were present in 0.7 per cent of cows and 0.24 per cent of heifers in a study conducted in an Irish abattoir (Scanlon, 1974).

Nair and Raja (1974b) reported that twenty five genitalia out of 1250 (2 per cent) showed chronic bursitis resulting in either partial or complete ovarobursal adhesion. Of these 80 per cent were partial and 20 per cent complete. In addition two cases (0.16 per cent) of bilateral hydrops bursa and 0.16 per cent of par ovarian abscess were also recorded. In a study involving 44 repeat-breeder cows slaughtered, bursal adhesion was listed along with follicular cysts to be the most frequent lesions causing repeat breeding (Rao et al. 1975).

Al-Dahash and David (1977a) in a study conducted at a local abattoir in South-Western England observed that out of 8071 genital tracts, one hundred and forty eight specimens (1.83 per cent) had ovarobursal adhesion, the severity of which ranged from mild strands of connective tissue between bursa and ovary to severe adhesion where, the ovary was completely embedded in fibrous tissue. Of these 148 specimens 119 were unilateral (65 right and 54 left) and 29 were bilateral.

Corpus luteum was enucleated manually 1 to 3 times in 40 fattening cows and cysts, when present were ruptured and the genital tracts were then subjected to examination at slaughter(Buchi, 1978). Typical cord like ovarobursal adhesion was seen in ten cases seven unilaterally and three bilaterally. One animal showed intrabursal adhesion. In a similar study (Sehneider et al. 1978) ovarian cysts of 124 cows were either ruptured manually upto four times or were left untreated. At slaughter out of the 65 untreated animals only 9 per cent showed slight intrabursal adhesion. In contrast peri-ovarian adhesion was observed in 30 per cent of ovaries of cows in which the corpora lutea were enucleated or the cysts ruptured. Ovarobursal adhesions consisted of 1-2mm thick connective tissue between ovary and meso-salpinx.

Kessy and Noakes (1985) concluded after examining 2000 bovine reproductive tracts (1000 parous and 1000 nulliparous) that the most frequently observed lesion was ovarobursal adhesion which comprised 80 per cent of all abnormalities and were identified in 6.85 per cent of all the genital tracts examined. The second most common lesion observed was ovarobursal adhesions in the reproductive tracts of slaughter beef heifers examined in an abattoir in Ontario (Herenda, 1987).

Bursal adhesion was noticed in 10.2 per cent of heifers, 7.3 per cent of non-pregnant cows and 11.2 per cent of pregnant cows (Garcia,1988). He further found bursal cysts in 3.4 per cent of heifers, 6.8 per cent of non pregnant cows and 5.8 per cent of pregnant cows and bursal abscess in 2.3 per cent of non-pregnant cows and 0.4 per cent of pregnant cows. Thakur et al. (1989) recorded from 541 female genital organs recovered at slaughter, five cases of complete adhesion of ovary with bursa and most of these ovaries were inactive. Khan (1991) revealed that ovarobursal adhesion was the most common abnormality in the abattoir specimens in his study.

iii) Biometry of ovary

There are many reports on the biometrics of the ovary, corpus luteum and follicles of both exotic and Zebu cattle. However, there seems to be paucity of information on the biometrics of ovary and the structures on it in cross-bred cattle. The size, shape and texture of the ovaries have great bearing on their functional activity. It is therefore very essential to have basic data on the size and weight of ovaries and corpora lutea and size of graafian follicles, in cross-bred cows, which will help a lot to evaluate the reproductive health status on clinico-gynaecological examination.

There are numerous reports on the biometrics of ovary and structures on it from exotic cattle. Perkins et al. (1954) in a study of thousand genitalia of parous cows reported a mean length, width and thickness of left ovary to be 3.44 cm, 2.25 cm and 1.62 cm respectively and the corresponding measurements for the right ovary were 3.60 cm, 2.40 cm and 1.75 cm.

In a biometrical study conducted on slaughter heifers Drennan and Mac pherson(1966) recorded a mean length of 3.3 cm, width of 2.42 cm and weight of 6.34 g for the right ovary and the corresponding length, width and weight of the left ovary were 3.09 cm, 2.29 cm and 5.37 g respectively. Dobson and Kamanpatana (1986) in their reveiw on cattle reproduction with special reference to comparison among exotic cattle, Zebu and buffaloes reported that the ovarian length for exotic cows came in the range of 2.8 - 3.8 cm with a weight of 5 - 9.4 g. The diameter of the biggest follicle was 1.9 to 2.2 cm against 1.7 to 3 cm for the corpus luteum.

Exhaustive reports are available in the biometrics of ovary, corpus luteum and follicle in Zebu cattle. From the observations made on 77 female genitalia recovered from slaughtered cows in Calcutta Goswami and Choudhary (1963) reported the mean length of the right and left ovary to be 18.3 $\pm$ 0.47 mm and 19.0 $\pm$ 0.45 mm. The width of the right

and left ovaries were 11.2 $\pm$ 0.26 mm and 11.,3 $\pm$ 0.27 mm respectively. Similarly, the mean length and width of the corpus luteum in the right ovary was 11.3 $\pm$ 0.89 mm and 13.70 $\pm$0.68 mm as against 14.5 $\pm$ 0.94 mm and 10.5 $\pm$ 0.47 mm for the left ovary.

Ovaries collected from 43 local non-descript cows in North West Nigeria, on macroscopic examination revealed evidence of cyclic activity in 63 per cent cows (Herbert, 1974). He further reported an arithmetic mean of 25.3 mm length, 16.0 mm breadth and 1.25 mm thickness for the ovaries. Garcia (1988) on a biometrical examination of ovaries of heifers and non pregnant Zebu cattle which included cycling and non-cycling animals in both groups, revealed the following results. Volume of ovaries in cycling heifers was 7.5 cm^3 and 9.3 cm^3 for the left and right ovaries and the corresponding values for non-cycling heifers were 5.4 cm^3 and 6.6 cm^3. In non-pregnant cows 9.2 cm^3 and 11.9 cm^3 were the volumes of left and right ovaries for cycling animals and the corresponding values for non-cycling cows were 8.2 cm^3 and 9.7 cm^3. Ovaries were larger in cyclic heifers and cows as compared with non cyclic animals ($P<0.01$). Also the ovary bearing corpus luteum was generally about double the volume of that of the non corpus luteum bearing ovary ($P<0.01$) regardless where it is the right or left side.

A biometrical study of non-pregnant genitalia of African Zebu cattle revealed that the mean weight of genitalia of heifers and cows were 0.43 ± 0.3 and 0.03 and 0.79 ± 0.02 kg respectively (Chauhan and Adamu, 1990). The mean length, breadth and thickness in centimeter and weight in gram of left ovary in heifers were 2.50 ± 0.06, 1.44 ± 0.05,0.84 ± 0.15 and 3.80 ± 0.12 respectively. The corresponding values for left ovary of cows were 2.81 ± 0.02, 1.56 ± 1.01, 10.4 ± 0.01 cm and 4.48 g respectively. The length, breadth, thickness in centimeter and weight in gram of right ovary in heifers were 2.53 ± 0.5, 1.45 ± 0.4, 0.85 ± 0.4 and 3.53 ± 0.10 respectively as against 2.84 ± 0.12, 1.63 ± 0.02, 1.05 ± 0.01 and 5.48 ± 0.04 in cows.

Materials and Methods

MATERIALS AND METHODS

Two hundred and sixty five genital organs of cross-bred cows slaughtered at municipal slaughter house, Trichur and Meat Plant, Kerala Agricultural University, Mannuthy formed the material for the study. Of these 252 were non-gravid and the remaining 13 gravid. Within half an hour of slaughter and evisceration of the organs the genitalia including the ovaries, bursa and broad ligament were excised and transported to the laboratory in separate polythene bags for detailed gross and histopathological studies. While the breeding history and clinical history of the animals slaughtered at University Meat Plant were known, those of animals slaughtered at municipal slaughter house, Trichur were not traceable.

The non-gravid genitalia were subjected to detailed gross morphological examination for pathological lesions and also to ascertain whether the ovaries indicated cyclic activity or not. The presence or absence of palpable corpus luteum in various stages of cyclic growth and regression and follicles of prematuration and maturation size were taken as a criteria for ovarian cyclic activity. Ovaries which showed evidence of cyclic activity were grouped into follicular phase and luteal phase. They were utilised for detailed

biometrical studies. Ovaries harvested from gravid genitalia, inactive ovaries and senile atrophic ovaries were also subjected to biometrical studies by standard procedures (Drennan and Mac pherson, 1966). The length, width, thickness of the ovaries and their weights were recorded. The size of corpora lutea, whether functional or regressing and the size of graafian follicles above 5 mm in diameter, which were discernible on the surface of the ovaries, were also recorded.

The ovaries and bursa which on gross examination revealed evidence of pathological lesions were subjected to detailed morphological and histopathological studies. The salpinx and uterus from the genitalia whose ovaries and bursa were affected were also subjected to gross and histopathological studies.

The ovaries were then incised at different planes for any gross lesions situated deeply, not visible on the surface. Tissue slices of 5 mm size were preserved in buffered formalin (Humason, 1979). Thin slices of the tissue 1-2 mm were taken out after a minimum period of 72 hours and were processed for detailed histopathological studies by standard procedure (Luna, 1967). Thin paraffin sections of 5 μ thickness were taken using Spencer 'AO' microtome and

were processed and stained by Harris haematoxylin and eosine method. Special staining by Van-Giessan method was done whenever there was indication (Luna, 1967). After mounting the stained sections using DPX mountant detailed histopathological examination was carried out.

The data on the weight and biometrics of the ovaries and corpora lutea from cyclic ovaries, ovaries from pregnant animals, inactive ovaries and senile atrophic ovaries were assembled and analysed by standard statistical procedure (Snedecor and Cochran, 1967).

Results

RESULTS

Results of investigation on various pathological conditions in the ovaries and bursa of cross-bred cattle obtained in the present study are presented in Table 1 to V.

A total of 265 genital tracts were examined out of which 13 were gravid, and the remaining 252 were utilised for the study. Among the 252 nongravid genitalia examined 139 (55.16 per cent) genitalia showed either one or more lesions in the ovary and bursa. In 36 genitalia there were two or more lesions affecting the ovary, bursa and the ligaments nearby.

Out of the 252 non-gravid genitalia, 99 (39.28 per cent) showed one or more lesions in the ovaries. The incidence of ovarian pathological conditions are furnished in Table I. Inactive ovaries were the most common condition and it was recorded in 59 pairs of ovaries (23.41 per cent). The other conditions encountered were cystic ovaries in 7 cases (2.78 per cent), cystic corpus luteum in 7 ovaries (2.78 per cent) haemorrhage in the ovaries in 14 cases (5.56 per cent) abscess of ovary in one case (0.40 per cent), senile atrophy in 14 pairs of ovaries (5.56 per cent), persistent corpus luteum associated with hydrometra in 2 ovaries (0.79 per cent), retention cysts on tunica albuginea in 2 ovaries (0.79

per cent), par-ovarian cyst in 8 genital tracts (3.17 per cent) and a single case of par-ovarian abscess (0.40 per cent).

i. Pathology of Ovary:

Inactive Ovaries

Inactive ovaries were observed in 59 genitalia (23.41 per cent).

Macroscopic Pathology

The affected ovaries in most of the cases were small in size, flat and pale yellow in colour. In a few cases they had round contour and were nearly normal in size due to the presence of antral follicles. The length of the affected ovaries ranged from 1 to 2.8 cm with a mean of 1.960 $\pm$ 0.077 cm, while the breadth of the ovaries were in the range of 0.5 to 2.2 cm with a mean of 1.317 $\pm$ 0.064 cm and the thickness 0.2 to 2 cm with a mean of 0.977 $\pm$ 0.058 cm. Numerous pin head sized follicles and luteal scars were seen on the surface of ovaries in genitalia from parous cows. In contrast the ovaries of heifers were smaller, paler and smoother with pin head sized follicles but no luteal scars (Fig.1). When incised the ovarian cortex was found to be comparatively thin, firm in consistency and showed only small follicles 5mm or less in diameter and a few dark brick red

coloured corpora albicans. There was no clear demarcation between cortex and medulla. The salient feature in all these cases were the absence of follicles above 5 mm diameter and corpus luteum in any stage of cyclic growth and regression.

Microscopic pathology

The ovarian cortex had predominance of stromal tissue with only a few antral follicles and numerous luteal scars. There were also numerous atretic follicles in various stages of atresia. The cortex did not reveal tertiary follicles and/or functional or regressing corpora lutea (Fig.2). In the uterus of such cases, the mucosal folds were low and were lined by pseudostratified columnar epithelium. The submucous layer showed normal endometrial glands with a few cystic endometrial glands in cases where the ovary had a rounded contour, due to antral follicles. In cases with flat inactive ovaries, the endometrium was very thin and contained very small atrophic endometrial glands with a flat mucosal layer.

Cystic ovaries

Since the size of the largest pre-ovulatory follicle in this study was only 1.6 cm, any follicle over 1.6 cm was

considered cystic. The incidence of the condition was 2.78 per cent of which bilateral involvement was in 0.79 per cent and unilateral in 1.99 per cent (Table I). The size of cystic graafian follicles varied from 1.2 to 3.3 cm, but all single cysts were larger than 1.7 cm in diameter. There was great variation in the size of the cysts in multiple cystic conditions and even cysts as small as 1.2 cm were recorded. The cyst was found to affect the right ovary (57.14 per cent) more than the left overy (14.29 per cent). Both the ovaries were found to be affected in 28.57 per cent cases. The follicular cysts were more predominant (85.71 per cent) than the luteal cysts (14.29 per cent).

Macroscopic pathology

Two types of cysts were identified on gross examination based on the nature of cysts.

1. **Luteal cysts:**

A large thick walled single cyst 2.7 cm in diameter in the left ovary was diagnosed as luteal cyst. The inner wall of the incised cyst showed thick yellowish patches of luteal tissue and the cavity of the cyst contained dark yellow

fluid. The cyst occupied nearly 90 per cent of the ovary with the ovarian tissue having undergone pressure atrophy. The thin rim of ovarian tissue had few developing follicles (Fig.3).

Follicular cyst:

Those cystic graafian follicles which were thin walled with no evidence of yellowish luteal tissue lining the inside wall on gross morphological examination were considered as follicular cysts. Single follicular cysts (2 cases) were large thin walled cysts, 2.9 cm and 1.3 cm in diameter and were seen in right ovary and one was bilateral (2.3 cm and 2.4 cm) (Fig.4). Multiple follicular cysts numbering from 2 to 5 cysts and having a diameter ranging from 1.2 to 2.8 cm were seen either in right ovary (2 cases) or bilateral in nature (Fig.5). In one case of multiple follicular cyst partial luteinisation of the one of the cyst as evidenced by a very thin patch of luteal tissue was noticed on microscopic examination. In yet another case of multiple follicular cyst (5 cysts)in the right ovary associated with hydrops bursa and ovarian encapsulation, the most deeply situated cyst was luteal with a thick rim of luteal tissue while the other four were thin follicular cysts.

The uterus in all cases of cyst was grossly normal except in a case of single cyst in which it was found filled with a clear fluid measuring about 200 ml. The uterine wall was extremely thin.

Microscopic Pathology

The luteal cyst wall was found to consist of an inner thin layer of connective tissue capsule lining the cyst cavity and a fairly thick middle luteinised theca interna layer and an outer theca externa. There was no membrana granulosa layer and even a single layer of flat epithelium on the basement membrane was lacking. The luteinised theca interna layer showed both the luteal cell type I and II which showed vacuolation. There was intense proliferation of fibroblasts and laying of collagen fibres (Fig.6). The lumen of the cyst did not contain neither the degenerated ovum nor the degenerated and desquamated granulosa cells.

In the case of follicular cyst the membrana granulosa layer was extremely thin with two or three layers at places and only a single layer of flattened epithelial cells in many places. There were a few desquamated granulosa cells in the lumen of the cyst. Eventhough the theca interna and externa could be distinguished histologically in 2 follicular cysts,

in all others it was difficult to distinguish the two layers due to destruction of theca interna cells and fraying of the connective tissue fibres (Fig.7). In one follicular cyst which was absolutely thin walled luteinisation of the theca interna layer was seen as a patch in only a small area. The luteal cells were degenerated and the fibroblasts actively proliferating (Fig.8). The multiple follicular cyst in which one of the cyst showed clear luteinisation, histological study of the intervening cyst wall revealed that while the follicular cyst wall contained from inside a flat layer of epithelium on the basement membrane, thin degenerated layers of theca interna and theca externa, the wall of the luteal cyst comprised from inside a layer of connective tissue, the thick luteinised layer of theca interna with degenerated luteal cells of class I and II and actively proliferating fibroblasts and the common outer theca externa (Fig.9).

In the uterus of the genitalia affected with luteal cyst, the mucosal lining was intact in most of the places with pseudostratified columnar epithelium with patchy desquamation. The lumen contained desquamated epithelium with infiltrating neutrophils. The superficial mucous glands showed severe hyperplasia with desquamation of the lining epithelial cells. The glands were irregular in shape and were seen in clusters. The deeply situated endometrial glands were much smaller. In cases of follicular cysts, the

endometrium was found studded with large number of regularly arranged endometrial glands with large lumen. The lining epithelium of mucous fold was hypoplastic. In few cases there were large number of cystic endometrial glands where the lumen contained desquamated necrotic epithelial cells. There was increased vascularity in the mucous layer. The stroma appeared hyalinised in deeper mucosa with smaller sized endometrial glands which contained light eosinophilic material. In a case of hydrometra, the endometrium was thin and had only a few endometrial glands with desquamated epithelium. There was oedema of submucosa and complete destruction of lining epithelial cells. The myometrium was thin and atrophied.

Cystic corpus luteum

The incidence of the condition was 2.78 per cent (7 cases), of which five were in the right ovary and the remaining two in the left ovary.

Macroscopic pathology

The cystic corpora lutea were soft and fluctuating unlike the solid corpora lutea. The size of the corpus luteum appeared slightly larger than the normal corpus luteum

with a central cavity diameter of 0·6 to 1·3 cm. The cavity contained light straw coloured fluid (Fig.10). In two of the specimens with central cavity diameter of 1.1 cm and 1.2 cm each had semi solid blood clots packed in it instead of the normal straw coloured fluid. The largest corpus luteum measuring about 2 cm had a central cavity of 1.3 cm diameter and was quite soft and fluctuating. When sliced a straw coloured fluid gushed out which contained a long white thread like worm which was later identified as an adult female Setaria cervi (Fig.11).

Microscopic Pathology

The cyst cavity was lined by a fairly thick layer of connective tissue without any lining epithelium. The thick luteal layer did not show the normal lobulation and was least vascular. There was extensive vacuolation due to regressive changes in the luteal cells. The nuclei of luteal cells were lightly stained and the outline of cells was indistinct. There was an outer investment of connective tissue which separated the corpus luteum from ovarian cortex (Fig. 12).

Haemorrhage

The incidence of ovarian haemorrhage was 5.56 per cent which included (1) haemorrhagic follicle (14.29 per cent),

(2) haemorrhage into central cavity of corpus luteum (14.29 per cent), (3) haemorrhage into central cavity of corpus albicans (7.14 per cent) (4) haematoma in the cortex (7.14 per cent), (5) haemorrhage between parenchyma of corpus luteum and its capsule (14.29 per cent), (6) diffuse haemorrhage in the ovarian cortex (28.57 per cent) (7) haematoma on tunica albuginea (7.14 per cent) and (8) a large haematoma in the mesovarium (7.14 per cent) Table I and III).

Macroscopic Pathology

Out of the total 14 cases of ovarian haemorrhage 12 (85.71 per cent) were in the cortex of the ovary involving germinal elements and in the stromal elements of the cortex. In haemorrhagic follicles (2 cases) the liquor folliculi in the antrum of graafian follicle was dark bluish in colour. These follicles measuring about 8 mm in size were soft and tense, and showed on the surface of the ovary, with a bluish colour (Fig.13). In all other haemorrhages into cortex, the ovary did not reveal any evidence of bleeding on its surface. In two cases of cystic corpora lutea the central cavity contained dark reddish brown mass which was organised haematoma. When the ovary was incised focal areas of haemorrhage and haematomas were discernable on the cut surface of the ovary in organised haematoma of cortex and haemorrhage

between parenchyma of corpus luteum and its capsule. In the case of diffuse haemorrhage in the cortex severe hyperaemic areas were identified throughout ovarian cortex. There was no gross change in the ovarian cortex in a case of haemorrhage into central cavity of a corpus albicans, which was only identified in the sections of an inactive ovary. In a single case there was a soft dark bluish miliary spot seen projecting on the Tunica albuginea. In another specimen there was a large brownish red mass attached to mesovarium close to the right ovary (Fig.14), which was diagnosed as an organised haematoma.

Microscopic Pathology

The central cavity of the haemorrhagic follicle showed desquamated granulosa cells and dark eosinophilic liquor folliculi stained with blood. . The membrana granulosa layer was only 2 to 4 layers thick. There was separation of fibres of theca interna and externa (Fig.15). In case of haemorrhage into cavity of cystic corpus luteum fresh blood containing RBC's and WBC's was observed close to the fibrous connective tissue lining the cavity of corpus luteum. Towards the centre of the cavity organisation of the haemorrhage into haematoma by the laying of collagenous connective tissue was evident (fig.16). In case of organised haematoma in the cortex, the area of haemorrhage was completely organised by connective tissue proliferation

without any evidence of RBC or other blood cells. However there was brownish hemosiderin pigments towards the periphery of haematoma (Fig.17). A case wherein a corpus luteum showed haemorrhage between parenchyma and outer connective tissue capsule, severe distension of the capillaries of the outer connective tissue capsule and the septa dividing corpus luteum into lobes was noticed. The distended capillaries were seen packed with blood (Fig.18). There was haemorrhage between the parenchyma of corpus luteum and connective tissue capsule in a part of the corpus luteum (Fig. 19). Severe distension of the capillaries and their sinusoids were noticed throughout the cortex of the ovary with rupture of blood vessels and escape of the contents into the stroma and corpora albicans in cases of diffuse haemorrhage into cortex. The ovarian cortex did not reveal any antral follicles and functional or regressing corpus luteum but had only a few atretic follicles (Fig.20). In sections from an inactive ovary clusters of corpora albicans (luteal scars) of which the largest one showed fresh haemorrhage into its lumen was noticed (Fig.21). The haematoma on the tunica albuginea appeared as a focal area of haemorrhage which was partially organised (Fig.22). The large haematoma on the mesovarium was found to be fully organised with fibrous connective tissue.

Ovarian Abscess

There was a single case (0.40 per cent) of ovarian abscess in the right ovary.

Macroscopic Pathology

A miliary abscess of 2 mm diameter was seen projecting on the surfce of an inactive ovary which when incised was found to contain thick creamy pus.

Microscopic Pathology

The wall of the abscess was composed of thick fibrous connective tissue which was found frayed at places. The abscess cavity contained necrotic material with pus which stained light eosinophilic in colour. There was cellular infiltration around the connective tissue capsule and the superficial cortex of the ovary. The cortex did not reveal any antral follicles above 5 mm in diameter but there were numerous atretic follicles.

Senile Atrophy

Fourteen pairs of ovaries (5.56 per cent) were found to be affected with senile atrophy.

Macroscopic Pathology

The senile ovaries were pale and waxy with a rough pitted surface, the typical 'pock mark' appearance. The ovaries were considerably larger than both inactive and active ovaries. The mean length, breadth, thickness in centimetres and weight in grams of the senile ovary was 2.953 $\pm$ 0.139, 2.262 $\pm$ 0.109, 1.416 $\pm$ 0.085 and 6.659 $\pm$ 0.579. The surface of the ovary only showed small antral follicles but no follicles above 3 mm diameter and/or functional or regressing corpus luteum. There were numerous luteal scars which were white in colour. The consistency of ovary was rubbery. The cut surface revealed a firm partially fibrosed interior interspersed with numerous bands of fibrous connective tissue. The ovarian cortex was a thin investment over the medulla and was found studded with numerous pin head sized follicles and 'red bodies'. The Tunica albuginea was considerably thick (Fig.23).

The uteri in the affected genital tracts were larger and showed transverse and longitudinal striations and were otherwise normal to the naked eye.

Microscopic Pathology

Germinal epithelium was almost completely missing in

most cases but in the few places where it remained the cells had lost their cuboidal character and had become flattened and pyknotic. The tunica albuginea was thickened and the cells were denser and more closely grouped than in the ovaries of young animals. The cortical area was reduced and the thin fibrous connective tissue strands separating the whirl like portions of the cortical stroma were more apparent. There were only a few primary follicles which had a density of less than 2 follicles per field under low power of microscope. Majority of the follicles were atretic. There were numerous luteal scars arranged in clusters (Fig.24).

In the uterus the endometrial mucosa was flat and lined by a single layer of columnar epithelial cells. The submucous layer had few numbers of atrophied mucous glands and large number of sclerosed blood vessels with hyalinised wall.

Persistent Corpus luteum

The incidence of the condition was 0.79 per cent.

Macroscopic Pathology

Both the persistent corpora lutea were found on the left ovary. These corpora lutea were solid and slightly

larger than the normal corpus luteum in size. The corpus luteum felt slightly hard on palpation and was pale in appearance. In both the cases there was associated hydrometra of the horns of the uterus which was found filled with thin watery fluid measuring approximately 50-100 ml. The uterine wall was very thin.

Microscopic Pathology

Microscopic examination of the corpora lutea revealed presence of considerable amounts of fibrous connective tissue breaking up the lutein tissue into irregular cell masses. Both the luteal cell type I and II showed regressive changes and there was intense proliferation of fibroblasts and laying of collagen fibres. There was reduced vascularisation of parenchyma. The outer connective tissue capsule of the corpus luteum was considerably thickened. There was clear demarcation of corpus luteum from the surrounding ovarian stroma. There was thinning of the uterine wall which showed marked degenerative changes in the mucosa and atrophy of myometrium. The endometrium did not show mucosal folds and lining epithelium. Similarly there was complete absence of endometrial glands in submucosa. Instead the endometrial mucosa had only the connective tissue stroma which also showed marked degenerative changes.

The miscellaneous conditions found on the ovary or its proximity were retention cysts on tunicaalbuginea (0.79 per cent), par ovarian cysts (3.17 per cent) and par ovarian abscess (0.40 per cent). The retention cysts on tunica albuginea were small transparent blibs on the surface of inactive ovaries. Par ovarian cysts were small cysts of 3-5 mm diameter in the mesovarium in the close proximity of the ovaries. The cyst was unilocular and contained clear watery fluid. The cyst wall was made up of a layer of fibrous connective tissue lined by a single layer of low columnar or cuboidal epithelium. The lining epithelium showed pseudociliary protoplasmic prolongations. A single par ovarian abscess found very close to right ovary was pale and hard and when incised was found to contain thick yellowish pus. On microscopical examination the abscess cavity did not show much of purulent material. The lining epithelium was flattened and there was focal infiltration around the abscess wall.

ii.Pathological conditions involving bursa

A total of 68 (26.98 per cent) genital tracts showed bursal involvement. This included ovarobursal adhesion in 65 cases (25.79 per cent) of which, 53 were unilateral (21.03 per cent) and 12 bilateral (4.76 per cent), hydrops bursa in one case (0.40 per cent) associated with cystic ovaries and complete encapsulation, and two cases of haemorrhagic bursitis (0.79 per cent) (Table IV).

Bursitis and Ovarobursal adhesion

A total of 65 specimens (25.79 per cent) showed this lesion. The three types of bursal adhesions were fibrinous (44.62 per cent) strandular (50.77 per cent) and complete encapsulation (4.62 per cent) (Table V).

In the fibrinous type of bursitis and adhesion, very thin fibrinous strands were seen connecting the surface of ovary with the bursa. They numbered from a single thread to numerous threads connecting ovary and bursa. In majority of the cases the threads originated from the scars of regressed corpus luteum on the surface of ovary. Among the 29 fibrinous types four cases were bilateral (6.15 per cent), seven on the left side (10.77 per cent) and 18 (27.69 per cent) on the right side making a total of 44.62 per cent.

In strandular bursitis the connecting strands were much thicker than the fibrinous type which limited the movement of bursa. Among a total of 33 specimens(50.77 per cent), seven were bilateral (10.77 per cent) and the remaining 26 (40 per cent) were unilateral of which, 23.08 per cent were left sided and 11.92 per cent right sided.

The total number of cases affected with bursitis, ovarobursal adhesion and complete ovarian encapsulation was

three (4.62 per cent) of which one was bilateral (1.54 per cent) and two unilateral and right sided (3.08 per cent). Among the unilateral cases one was found associated with a multiple follicular cyst and hydrops bursa (Fig.25) and in the other the cut surface of ovary revealed a regressing corpus luteum.

Hydrops Bursa

A single case (0.40 per cent) of hydrops bursa was recorded unilaterally on the right side in association with a cystic ovary. The cyst was multiple in nature with the largest cyst measuring about 9.4 cm in diameter with 2 small cysts of about 4 cm diameter each. The cyst in the bursa was very tense, transparent and highly vascular (Fig.25).

Haemorrhagic bursitis

The incidence of the condition was 0.79 per cent. The bursa in this case was patent, but the mesovarium had a focal area of haemorrhage closer to the attached border of the ovary. Microscopical section of the bursa showed an area of haemorrhage in the membrane and a focal area of infiltration with polymorpho nuclear leucocytes in an area away from the area of haemorrhage.

iii. Weight and biometrics of ovary and biometrics of corpus luteum and graafian follicles

Eighty seven pairs of ovaries from genitalia showing cyclic activity, 9 pairs of ovaries from gravid genitalia, 12 pairs of inactive ovaries and 14 pairs of senile atrophic ovaries were utilised for biometrical studies.

Weight of Ovary

Weight of ovaries in the follicular and luteal phases of the cycle, inactive ovaries and senile atrophic ovaries are presented in Table VI.

The mean weight of the left ovary in grams was recorded to be 3.933 $\pm$ 0.571 as against 4.080 $\pm$ 0.361 for right ovary with a mean ovarian weight of 4.007 $\pm$ 0.433 grams in the follicular phase of the cycle. Similarly the weight of the left and right ovaries in the luteal phase of the cycle was found to be 3.344 $\pm$ 0.232 grams and 3.844 $\pm$ 0.216 grams with a mean ovarian weight of 3.685 $\pm$ 0.175 grams. In contrast, in the case of inactive ovaries the mean ovarian weight for the left and right ovaries were 2.425 $\pm$ 0.195 g and 2.562 $\pm$ 0.189 g with a mean weight of 2.519 $\pm$ 0.180 g. In case of senile atrophic ovaries the ovarian weight was much more than the above three groups with the left ovary weighing, 6.820 $\pm$

0.566 g and the right ovary 6.496 ± 0.617 g with a mean of 6.659 ± 0.579 g.

Statistical analysis using students 't' test for comparison between groups showed highly significant difference between senile atrophic ovaries and inactive ovaries, senile atrophic ovaries and ovaries at follicular phase of cycle, and senile atrophic ovaries and ovaries at luteal phase of cycle ($P < 0.01$). Similarly there was highly significant difference in weight between inactive ovaries and ovaries at follicular phase of cycle and inactive ovary and ovaries at luteal phase of cycle. However there was no significant difference between weight of ovaries in the follicular phase of cycle and luteal phase of cycle. Similarly there was also no significant difference in weight of right and left ovaries both in follicular phase of cycle and luteal phase of cycle (Table VII).

Biometrics of Ovary

The length, breadth and the thickness of ovaries in follicular and luteal phase of oestrous cycle, inactive ovaries and senile atrophic ovaries are furnished in Table VIII. The mean length, breadth and thickness of left ovary in follicular phase of cycle in centimeter were respectively 2.490 ± 0.125, 1.724 ± 0.088 and 1.348 ± 0.098. The corresponding measurements for the right ovary were 2.542 ±

0.109 cm, 1.738 ± 0.098 cm and 1.305 ± 0.101 cm with a mean ovarian measurements of 2.471 ± 0.101 cm, 1.690 ± 0.087 cm and 1.374 ± 0.097 cm. Similarly the length, breadth and thickness of the left and the right ovaries in the luteal phase of the cycle were 2.462 ± 0.059 cm, 1.738 ± 0.051 cm, 1.270 ± 0.054 cm and 2.498 ± 0.068 cm, 1.802 ± 0.055 cm, 1.350 ± 0.054 cm respectively with a mean ovarian dimension of 2.495 ± 0.065 cm, 1.842 ± .049 cm and 1.333 ± 0.046 cm. In contrast inactive ovaries had a much smaller dimension, the left ovary measuring 1.950 ± 0.080 cm in length, 1.270 ± 0.062 cm in breadth and 0.886 ± 0.052 cm in thickness as against 1.990 ± 0.086 cm length, 1.357 ± 0.065 cm breadth and 1.047 ± 0.055 cm thickness for right ovary. The mean ovarian length, breadth and thickness of both the ovaries were 1.960 ± 0.077 cm, 1.317 ± 0.064 cm and 0.977 ± 0.058 cm respectively. The ovarian measurements for senile atrophic ovaries were much higher than those of inactive ovaries and ovaries in the follicular and luteal phase of the cycle. The left and right ovaries had length, breadth and thickness of 3.057 ± 0.160 cm, 2.256 ± 0.146 cm, 1.418 ± 0.107 cm and 2.868 ± 0.132 cm, 2.15 ± 0.101 cm, 1.412 ± 0.071 cm with a mean of 2.953 ± 0.139 cm, 2.262 ± 0.109 cm and 1.416 ± 0.085 cm respectively for both the ovaries.

The results of statistical analysis of the dimensions of ovaries between groups and between left and right side

in follicular and luteal phase are given in Table IX. The results followed the same pattern as shown by the weights of ovaries. There was significant difference ($P < 0.01$) between dimensions of inactive ovaries and those of the other 3 groups. Similarly senile atrophic ovaries differed significantly ($P < 0.01$) in length, breadth and thickness from those of ovaries in follicular phase and luteal phase of cycle. Ovaries of follicular phase and luteal phase did not differ significantly in their dimensions. Similarly the dimensions of left and right ovaries both during follicular and luteal phase of cycle did not differ significantly.

The diameter of follicles (above 5 mm) and corpora lutea present in the ovary at follicular phase, early luteal phase, late luteal phase and pregnancy are given in Table X. The mean diameter of the follicles in centimeter in the follicular phase, early luteal phase, late luteal phase and pregnancy were 0.907 ± 0.042, 0.883 ± 0.056, 0.893 ± 0.028 and 0.612 ± 0.041 respectively. Similarly corpora lutea had the mean diameter (greater dimension) of 1.033 ± 0.048 cm, 1.127 ± 0.103 cm, 1.400 ± 0.054 cm and 1.750 ± 0.044 cm in the follicular phase, early and late luteal phase and pregnancy respectively.

Table 1 Pathological conditions in the ovaries of cross-bred cattle

S.No.	Condition	Unilateral		Bilateral		Total	
		No	per cent	No	per cent	No	per cent
1.	Inactive ovaries	..	..	59	23.41	59	23.41
2.	Cystic ovary	5	1.99	2	0.79	7	2.78
3.	Cystic corpus luteum	7	2.78	..	..	7	2.78
4.	Haemorrhage	14	5.56	..	..	14	5.56
5.	Ovarian abscess	1	0.40	..	..	1	0.40
6.	Senile atrophy	..	..	14	5.56	14	5.56
7.	Persistent CL Associated with hydrometra	2	0.79	..	..	2	0.79
8.	Retention cysts on surface of ovary	2	0.79	..	..	2	0.79
9.	Par ovarian cyst	8	3.17	..	..	8	3.17
10.	Par ovarian abscess	1	0.40	..	..	1	0.40
	Total	40	15.88	75	29.76	115	45.64

Table II Incidence of cystic ovarian degeneration in cross-bred cattle

S.No.	Type of cyst	Unilateral				Bilateral		Total	
		Left		Right					
		No.	Per cent	No.	Per cent	No.	Per cent	No.	per cent
1	Luteal	1	14.29	..	..	..	..	1	14.29
2	Follicular								
	a) Multiple			2	28.57	1	14.29	3	42.86
	b) Single			2	28.57	1	14.29	3	42.86

Table III Incidence of ovarian haemorrhage in the ovaries of cross-bred cattle

S.No.	Type of haemorrhage	No.	per cent
1.	Haemorrhagic follicle	2	14.29
2.	Haemorrhage in central cavity of cystic CL	2	14.29
3.	Haemorrhage in central cavity of corpus albicans	1	7.14
4.	Organised haematoma in cortex	1	7.14
5.	Haemorrhage between parenchyma of CL and its connective tissue capsule	2	14.29
6.	Diffuse haemorrhage in cortex	4	28.57
7.	Haematoma on the tunica albuginea	1	7.14
8.	Organised haematoma attached to mesovarium	1	7.14
		14	100

Table IV Pathological conditions involving bursa in cross-bred cattle

Pathological condition	Unilateral		Bilateral		Total	
	No.	Per cent	No.	per cent	No.	per cent
1. Ovaro bursal adhesion	53	21.03	12	4.76	65	25.79
2. Hydrops bursa	1	0.40			1	0.40
3. Haemorrhagic bursitis	2	0.79			2	0.79
Total	56	22.22	12	4.76	68	26.98

Table V Incidence of ovarobursal adhesion in cross-bred cattle

Type	Unilateral				Bilateral		Total	
	No.	per cent Left	No.	Per cent Right	No.	per cent	No.	per cent
1. Fibrinous	7	10.77	18	27.69	4	6.15	29	44.62
2. Strandular	15	23.08	11	16.92	7	10.77	33	50.77
3. Complete encapsulation	0	0	2	3.08	1	1.54	3	4.62

Table VI Weight of ovaries in cross-bred cattle

S.No.	Functional ovarian activity	Left ovary (Gram)	Right ovary (Gram)	Mean (Gram)
1.	Follicular phase (12)	3.933 ± 0.571	4.080 ± 0.361	4.007 ± 0.433
2.	Luteal phase (21)	3.344 ± 0.232	3.844 ± 0.216	3.685 ± 0.175
3.	Inactive (16)	2.425 ± 0.195	2.562 ± 0.189	2.519 ± 0.180
4.	Senile (6)	6.820 ± 0.566	6.496 ± 0.617	6.659 ± 0.579

Figures in paranthesis indicate number of ovaries studied.

Table VII Result of statistical analysis of weights of ovaries

			Follicular phase			Luteal phase		
	Inactive	Senile	Right	Left	Mean	Right	Left	Mean
Inactive		- ** 6.8239			- ** 3.1711			- ** 4.5678
Senile					** 3.5925			** 6.7029
Follicular phase								
Right				- NS 0.2168				
Left								NS 0.607
Mean								
Luteal phase								
Right						- ** 1.5750		
Left								
Mean								

** Stands for significance at 1% level
N S Stands for non significant

Table VIII Biometry of ovary of cross-bred cows (Dimension in cm)

Ovarian functional activity		Left ovary			Right ovary			Mean		
		Length	Breadth	Thickness	Length	Breadth	Thickness	Length	breadth	thickness
1. Follicular phase	(2)	2.490 ± 0.125	1.724 ± 0.088	1.348 ± 0.098	2.542 ± 0.109	1.738 ± 0.098	1.305 ± 0.101	2.471 ± 0.101	1.690 ± 0.087	1.374 ± 0.097
2. Luteal phase	(66)	2.462 ± 0.059	1.738 ± 0.051	1.270 ± 0.054	2.498 ± 0.068	1.802 ± 0.054	1.350 ± 0.054	2.495 ± 0.065	1.842 ± 0.049	1.333 ± 0.046
3. Inactive	(41)	1.950 ± 0.080	1.270 ± 0.062	0.886 ± 0.052	1.990 ± 0.086	1.357 ± 0.065	1.047 ± 0.055	1.960 ± 0.077	1.317 ± 0.064	0.977 ± 0.058
4. Senile	(16)	3.057 ± 0.160	2.256 ± 0.146	1.418 ± 0.107	2.868 ± 0.132	2.150 ± 0.101	1.412 ± 0.071	2.953 ± 0.139	2.262 ± 0.109	1.416 ± 0.085

Figures in paranthesis indicate no. of ovary studied.

Table IX Result of statistical analysis - Dimension of ovary

			Inactive			Senile			Follicular phase									Luteal phase					
									Right			Left			Mean			Right			left			Mean		
			L	B	T	L	B	T	L	B	T	L	B	T	L	B	T	L	B	T	L	B	T	L	B	T
Inactive		Length				- ** 6.5682									- ** 3.9252									- ** 5.2102		
		Breadth					- ** 7.6058									- ** 3.3830									- ** 6.4711	
		Thickness						- ** 4.0422									- ** 3.6763									- ** 4.7464
Senile		Length													** 2.8538									** 3.0757		
		Breadth														** 4.1374									** 3.6934	
		Thickness															NS 0.3104									NS 0.3055
Follicular phase	Right	Length										NS 0.2267														
		Breadth											- NS 0.0987													
		Thickness												NS 0.3395												
	Left	Length																								
		Breadth																								
		Thickness																								
	Mean	Length																						- NS 0.1802		
		Breadth																							- NS 1.5006	
		Thickness																								NS 0.4176
Luteal phase	Right	Length																- NS 0.4034								
		Breadth																	- NS 0.8437							
		Thickness																		- NS 1.0452						
	Left	Length																								
		Breadth																								
		Thickness																								
	Mean	Length																								
		Breadth																								
		Thickness																								

** Stands for signifcance at 1% level

NS Non significant

Table X Biometrics of follicles and corpora lutea in follicular and luteal phase of cycle

S.No.	Ovarian activity	Follicles(cm)	Corpus luteum (cm)
1.	Follicular phase	0.907 ± 0.042 (61)	1.033 ± 0.048 (20)
2.	Early luteal phase	0.883 ± 0.056 (25)	1.127 ± 0.103 (13)
3.	Late luteal phase	0.893 ± 0.028 (95)	1.400 ± 0.054 (48)
4.	Pregnancy	0.612 ± 0.041 (12)	1.750 ± 0.044 (9)

Only follicles larger than 5 mm diameter were measured

Figures in paranthesis indicate the number of follicles/CL studied

DISCUSSION

There are numerous reports on the pathology of ovary and bursa based on morphological and/or histopathological studies of the organs collected at slaughter from different parts of the world. Such studies have inherent limitation, as the material is not from representative herd population. Morecver the breeding history of the animals are unknown. However an insight into the pattern of genital abnormalities based on the study of abattoir specimens would help a lot to throw light on the common conditions causing infertility.

In the present study, out of a total of 252 non-gravid genitalia 139(55.16 per cent) showed one or more pathological lesions in the ovary and bursa. This incidence is much higher than those reported in cross-bred and exotic cattle by earlier workers (Nair and Raja, 1974 a&b; Al-Dahash and David,1977 a; Herenda, 1987 and Garcia, 1988). This might probably be on account of the fact that most of the animals slaughtered in the local abattoirs are cows which have been culled due to infertility.

i. Pathology of Ovary

The incidence of the ovarian lesions was recorded to be 39.28 per cent in the non-gravid genitalia which included major conditions such as inactive ovaries (23.41 per cent)

cystic ovary (2.78 per cent), cystic corpus luteum (2.78 per cent), ovarian haemorhage (5.56 per cent), abscess in the ovary (0.40 per cent), senile atrophy of ovary (5.56 per cent) and persistent corpus luteum associated with hydrometra (0.79 per cent), which could impair the fertility of the affected animals. In addition there were a few minor pathological lesions such as cyst in tunica albuginea (0.79 per cent), par ovarian cysts (3.17 per cent) and par ovarian abscess (0.40 per cent) which may not have any functional significance with respect to fertility of animals.

The incidence of inactive ovary in the genital organs examined was found to be 23.41 per cent. Ovaries were classed as inactive based on its pale colour, small size, tougher consistency and the absence of graafian follicles above 5mm diameter and/or corpus luteum in any stage of cyclic growth and regression. These gross findings were supported by histological findings of thinner ovarian cortex showing only a few antral follicles and numerous atretic follicles and corpora albicans. In contrast to the size of functional ovaries either in follicular phase or luteal phase of cycle inactive ovaries were much smaller. The mean length, breadth and thickness of inactive ovaries in centimeter were 1.960 $\pm$ 0.077, 1.317 $\pm$ 0.064 and 0.977 $\pm$ 0.058 respectively as against 2.471 $\pm$ 0.101 cm, 1.690 $\pm$ 0.087

cm and 1.374 ± 0.097 cm for ovaries in the follicular phase of cycle and 2.495 ± 0.065 cm, 1.842 ± 0.049 cm and 1.333 ± 0.046 cm for ovaries in luteal phase of the cycle. The clinical manifestation of these animals with inactive ovaries will be anoestrum. Hence it is reasonable to assume that these slaughtered animals which includes both cows and heifers might have had prolonged anoestrum prior to slaughter. This observation is in confirmity with the report of higher incidence of anoestrum in cross-bred cattle of Kerala based on clinico-gynaecological investigations (Pillai, 1980., Iyer et al. 1992).

Cystic ovarian degeneration is assuming importance in the recent years on account of it being a production disease, the incidence of which is closely related to milk production potential of the animal. In the present study the incidence of cystic ovarian degeneration was found to be 2.78 per cent. Since biometrical studies of the graafian follicle during follicular and luteal phase of the cycle in the present study has revealed that the largest mature graafian follicle in cross-bred cows was 1.6 cm in diameter, any graafian follicle measuring above 1.6 cm in either of the ovaries, which did not have any regressing or functional corpus luteum was taken as cystic graafian follicle. The observation that the right ovary was more frequently affected than the left ovary is in

confirmity with earlier reports (Al-Dahash and David, 1977b). This can possibly be explained on the basis of the fact that the right ovary being more active than the left, is more prone to the condition. On gross morphological examination two distinct types of cysts viz: follicular and luteal were identified based on the thickness of the cyst wall and the absence or presence of yellowish luteal tissue. The incidence of follicular cysts (85.71 per cent) was more than luteal cysts (14.29 per cent) which is in agreement with earlier reports (Wahid, et al. 1991). However histopathological studies of the cyst wall revealed that in one of the thin walled follicular cyst there was a patch of luteal tissue in the theca interna. Mc-Kenzie and Kenny (1973) stated that follicles undergoing cystic degeneration continued to be distended until all the granulosa disappeared and theca layer became thickened. Al-Dahash and David (1977c) stated that the chance of luteinisation of theca layer was three times more in cystic follicles without granulosa layer when compared to those with granulosa layer. In the follicular cyst with patch of luteal tissue the granulosa layer was only two layer thick. Similarly one of the ovaries with multiple cysts had four follicular cysts and one luteal cyst. There does not seem to be any earlier report on the presence of both the follicular cyst and luteal cyst in the same animal. Contrary to the report of Al-Dahash and David

(1977b) who observed cystic graafian follicle associated with corpus luteum in the ovary, in the present study there was no case in which both these structures were present in the same or either of the ovaries. The incidence of cystic ovary in cross-bred cattle of this area registered a rise from 1.44 per cent in 1974 (Nair and Raja, 1974a) to 2.78 per cent in 1993, which could probably be linked up to increased milk production of the population due to selective cross-breeding.

There were seven cases (2.78 per cent) of cystic corpora lutea which were soft and fluctuating and had a central cavity of 0.6-1.3 cm diameter. While five cystic corpora lutea contained light straw coloured fluid the remaining two had comparatively larger central cavity containing semi-solid blood clots. The largest cystic corpus luteum contained an adult female Setaria cervi in the lumen. Unlike cystic graafian follicle cystic corpus luteum follow a normal ovulation followed by formation of corpus luteum which develop a central cavity in the course of cyclic growth and regression. Dawson (1959) classified cystic corpora lutea with a central cavity diameter of 1.6 cm and above, with a mean estimated tissue volume of 37 per cent of normal as a definite case and those having a central cavity of 8 mm and an average tissue volume of 70 per cent of normal as borderline cases. Since the size of the corpus luteum in cross-bred cattle is much smaller than in exotic cattle a

fluctuating corpus luteum with a central cavity of 6 mm and above was considered as cystic corpus luteum. Since the size of cystic corpus luteum was only marginally larger than the normal corpus luteum with no central lacunae, a cavity size of 6 mm and above is bound to reduce the tissue volume. This might probably lead to luteal insufficiency and resultant subfertility. It is possible that the female Setaria cervi worm in the central cavity of a corpus luteum might have got into ruptured graafian follicle and got itself entrapped in the corpus haemorrhagicum and later in the central cavity of the cystic corpus lutuem.

The incidence of ovarian haemorrhage was 5.56 per cent. Of the total ovarian haemorrhages 85.71 per cent was affecting germinal and stromal elements of the cortex and the remaining in the tunica albuginea and mesovarium. With every ovulation there can be slight haemorrhage, but this seldom attains considerable proportions. The commonly reported haemorrhage in the ovary is on account of severe trauma during enucleation of corpus luteum or rupture of cystic graafian follicle. In either case there will be evidence of trauma on the surface of the ovary associated with haemorrhage or haematoma. In none of the cases presently encountered there was any evidence of trauma on the surface of the ovary. Neberlie and Cohrs (1966) reported that haemorrhage into the ovary could occur on account of toxic-infectious causes in

which case internal haemorrhage into the ovarian cortex could take place. With the possible exception of haemorrhage on tunica albuginea and haematoma of mesovarium all other cases of haemorrhage in the cortex could be internal haemorrhage due to toxic-infectious causes. In the cases of diffuse haemorrhage with cortex and haemorrhagic corpus albicans the ovaries were inactive.

The incidence of senile atrophy (5.56 per cent) presently recorded was much higher than that reported earlier by Nair and Raja (1974) who observed only 0.30 per cent of ovaries affected with this condition. Seitaridis and Metareopoulos (1971) reported a much higher incidence of 10 per cent senile atrophy of ovaries. Sharp reduction in the primordial and growing follicles with a corresponding increase in the solid stromal tissue and a high proportion of atretic follicles were the characteristic changes in the ovary as described by Bone (1954). The senile atrophic ovaries were firm in consistency with rough pitted surface and was much larger than both functional and inactive ovaries. In contrast Bone (1954) observed that senile atrophic ovaries were smaller than functional ovaries. The higher incidence of senile atrophic ovaries could be attributed to slaughter of large proportion of cows of older age group.

A single ovarian abscess of miliary type was encountered in the present study which could possibly be on account of haematogenous metastatic infection as reported earlier (Neberlie and Cohrs, 1966 and Nair and Raja, 1974). Par ovarian cysts which are cystic enlargements of the vestigeal Wolfian ducts were not of any functional significance as they were small and did not exert any pressure on the ovary. Infection of the par-ovarian cyst by pyogenic organisms might have resulted in the formation of a par ovarian abscess presently encountered. Two corpora lutea which were slightly harder and found associated with hydrometra of uterus were diagnosed as persistent corpus luteum. The persistent corpus luteum revealed evidence of regressive changes in the luteal cells unlike a normal corpus luteum.

ii) Pathology of Bursa

The incidence of pathological conditions of bursa was recorded to be 26.98 per cent which included bursitis and ovarobursal adhesion (25.79 per cent), hydrops bursa (0.40 per cent), and haemorrhagic bursitis (0.79 per cent). Three distinct types of bursitis were identified of which the most frequently encountered one was the fibrinous type (44.62 per cent of the total) which does not seem to be serious enough to cause infertility. However the fact that the strands were

found to connect the corpus albicans on the surface of ovary with the bursa signifies that they persist in the ovary for quite sometime after ovulation. The second common type of bursitis was strandular in nature, the strands being much thicker . Such type of bursitis reduces the depth of the bursa and imposes restriction on the free movement of the bursa and the fimbriated end of fallopian tube. Therefore strandular bursitis might cause infertility due to inefficient 'egg pick up' mechanism. Bursitis, ovarobursal adhesion and encapsulation whether unilateral or bilateral would certainly produce infertility. Similarly the single case of ovarobursal adhesion, encapsulation and hydrops bursa encountered is serious enough to cause infertility. The presence of haemorrhagic bursitis in two cases points out the possibility of trauma during the course of per rectal examination.

iii) Biometrics of Ovary

The mean length, breadth and thickness of both the ovaries in cross-bred cattle in follicular and luteal phase of oestrous cycle recorded in the present study were much lower than those reported for exotic cattle (Perkins et al. 1965., Drennan and Mac pherson 1968). Similarly the mean of ovarian weight in cross-bred cattle was significantly lower than that of exotic cattle. The inactive ovaries recorded a

significantly lower weight and dimension as compared to the ovaries in follicular and luteal phase of cycle. In contrast senile atrophic ovaries had significantly higher weight and dimension than those of inactive ovaries and ovaries from cycling animals. In cross-bred cows the diameter of mature follicles, corpora lutea in cyclic growth and regression and pregnancy corpora lutea had lesser diameter than reported for exotic cattle (Dobson and Kamanpatana 1991). These data on the normal dimension of the ovary and the structures thereon in cross-bred cows could greatly help the clinician to evaluate the reproductive health status of the cow.

Summary

SUMMARY

The objective of the study was to investigate the common pathological conditions affecting the ovaries and bursa of cross-bred cattle based on a study of slaughter house specimens. Biometrical studies of the ovaries, corpora lutea and graafian follicles in the follicular and luteal phase of the cycle and in pregnancy, inactive ovaries and senile strophic ovaries will generate useful data which would be of great help to the clinician in evaluating the functional status of the ovaries.

Two hundred and fifty two non-gravid genitalia and thirteen gravid genitalia of cross-bred cows collected from Municipal slaughter house, Trichur and Meat Plant, Kerala Agricultural University were subjected to detailed morphological examination and those found to be affected with lesions were examined histopathologically after processing the tissues. Random specimen of ovaries of cycling, pregnant, anoestrus and senile cows were utilised for biometrical studies of corpora lutea and graafian follicles.

Among the 252 non-gravid genitalia examined 139 (55.16 percent) showed either one or more lesions in the ovary and bursa. Of these, in 36 genitalia there were two or more

lesions affecting the ovary, bursa and the ligaments.

Out of the 252 non-gravid genitalia 99 (39.28 per cent) showed one or more lesions in the ovaries. The conditions encountered were inactive ovaries (23.41 per cent), cystic ovaries (2.78 per cent), cystic corpora lutea (2.78 per cent), haemorrhage in the ovaries (5.56 per cent), abscess in the ovary (0.40 per cent), senile atrophy (5.56 per cent), persistent corpus luteum associated with hydrometra (0.79 per cent), retention cysts in the tunica albuginea (0.79 per cent), par ovarian cysts (3.17 per cent) and par ovarian abscess (0.40 per cent). Major conditions such as inactive ovaries, cystic ovaries, cystic corpora lutea, ovarian haemorrhage, abscess in the ovary, senile atrophy and persistent corpus luteum might impair the fertility of the affected animals.

The incidence of inactive ovaries was 23.41 per cent which was the major functional abnormality in the ovaries. The mean length, breadth and thickness of inactive ovaries in centimetres were 1.960 ± 0.077, 1.317 ± 0.064 and 0.977 ± 0.058 respectively as against 2.471 ± 0.101, 1.68 ± 0.870 and 1.374 ± 0.097 for ovaries in the follicular phase of the cycle and 2.495 ± 0.065 cm, 1.842 ± 0.049 cm and 1.333 ± 0.046 cm for ovaries in luteal phase of cycle. The abnormally small size of the ovaries, tougher consistency,

pale colour and absence of graafian follicles above 5 mm diameter and corpus luteum in any stage of cyclic growth and regression helped to diagnose the condition. These gross findings were supported by histological findings of a thinner cortex showing numerous atretic follicles and corpora albicans with few antral follicles. The clinical manifestation in the affected animal will be functional anoestrum.

The incidence of cystic ovarian degeneration was 2.78 per cent of which 1.98 per cent showed unilateral involvement while the remaining 0.79 per cent was bilateral. Ovaries with follicles larger than 1.6 cm diameter which did not have any functional or regressing corpus luteum were considered as cystic graafian follicles. This was further confirmed on histopathological studies by the regressive changes in the membrana granulosa and theca layers. Differentiation of cyst into follicular and luteal was made by the observation of yellowish luteal tissue in the cyst wall on morphological examination which was confirmed on microscopic study of the specimens. While the right ovary was found to be affected in 57.14 per cent cases the left ovary showed cysts only in 14.29 per cent. Both the ovaries were found to be affected in 28.58 per cent cases. The follicular cysts were the most predominant type involving about 85.71 per cent cases. The observation of a patch of luteal tissue in the thin cyst wall

of a follicular cyst on microscopical examination and the occurrence of both follicular and luteal cysts in multiple cystic condition of ovary were interesting observations in the present study. The incidence of cystic ovary in cross-bred cows based on abattoir studies registered a rise from 1.44 per cent in 1974 to 2.78 per cent in 1993.

Large fluctuating corpora lutea with a central cavity diameter of 0.6 to 1.3 cm and containing a light straw coloured fluid were considered as cystic corpora lutea. The condition was recorded in 7 cases (2.78 per cent). While in two of the cystic corpora lutea the central cavity contained solid blood clots, instead of straw coloured fluid there was an adult female Setaria cervi in the largest cystic corpus luteum. The luteal cells showed regressive changes as evidenced by vacuolation. Since the size of the cystic corpus luteum was only marginally larger than a normal corpus luteum and there was a central cavity of 6 mm or above the tissue volume is found to be much less than in normal corpus luteum. This coupled with extensive regressive changes might lead to luteal insufficiency and resultant sub-fertility.

Ovaries showed internal haemorhage in 5.56 per cent cases which included haemorrhagic follicles (14.29 per cent), haemorrhage in central cavity of cystic corpus luteum (14.29

per cent), haemorrhage in central cavity of corpus albicans (7.14 per cent) haematoma in the cortex (7.14 per cent), haemorrhage between luteal parenchyma and capsule (14.29 per cent), diffuse haemorrhage in the ovarian cortex (28.57 per cent) haematoma on tunica albuginea (7.14 per cent) and haematoma in mesovarium (7.14 per cent). The commonly reported haemorrhage on the ovary is on account of severe trauma during enucleation of corpus luteum or rupture of cystic graafian follicle in which case there will be evidence of trauma on the surface of ovary. In none of the cases with the exception of haematoma of mesovarium there was any evidence of trauma of the ovary. Moreover the haemorrhage was in the deeper cortex which points to the possibility of an internal haemorrhage possibly due to toxic-infectious causes.

The incidence of senile atrophy of the ovary was 5.56 per cent. The affected ovaries presented a pale waxy appearance with a rough pitted surface. The mean length, breadth and thickness in centimetres and weight in grams of the senile ovaries were 2.953 ± 0.139, 2.262 ± 0.109, 1.416 ± 0.085 and 6.659 ± 0.579 respectively which are much more than those of inactive or functional ovaries. Sharp reduction in primordial and growing follicles with corresponding increase in the atretic follicles, solid stromal tissue and corpora

albicans were the characteristic histopathological changes of affected ovaries.

A single case of ovarian abscess of miliary type recorded in the present study could possibly be on account of haematogenous metastatic infection. Retention cysts on tunica albuginea, par ovarian cysts (3.17 per cent) and par ovarian abscess (0.40 per cent) were not of major significance. There were two cases (0.79 per cent) of persistent corpus luteum associated with hydrometra. The luteal tissue showed evidence of regressive changes. The uterine wall was extremely thin.

The incidence of pathological conditions of bursa was 26.98 per cent which included bursitis and ovarobursal adhesions (25.79 per cent), hydrops bursa (0.4 per cent) and haemorrhagic bursitis (0.79 per cent). Three distinct type of bursitis viz: fibrinous (44.62 per cent), strandular (50.77 per cent) and complete ovarobursal adhesion (4.62 per cent) were encountered. Eventhough the fibrinous type of bursitis may not be serious enough to impair fertility of the animals the strandular bursitis limits free movement of bursa and fimbriated end of fallopian tube which might result in inefficient "egg pick up" mechanism and resultant sub-fertility.

Eighty seven pairs of ovaries from genitalia showing cyclic activity nine pairs of ovaries from gravid genitalia 12 pairs of inactive ovaries and 14 pairs of senile atrophic ovaries were utilised for biometrical studies.

The mean weight of the ovaries in the follicular and luteal phase, functional inactivity and senility in grams were respectively 4.007 ± 0·433, 3.685 ± 0.175, 2·519 ± 0.180 and 6.659 ± 0.579. There was highly significant difference in weight between senile atrophic ovaries and inactive ovaries, senile atrophic ovaries and ovaries in the follicular and luteal phase of cycle ($P > 0.01$). Similarly weight of the ovaries in both follicular and luteal phase of cycle was significantly higher than those of inactive ovaries ($P > 0.01$). However there was no significant difference in weight between ovaries of follicular and luteal phases of cycle and between right and left ovaries both in follicular and luteal phases of the oestrous cycle.

The mean ovarian length breadth and thickness in the follicular phase of the cycle were 2.471 ± 0.11 cm, 1.690 ± 0.087 cm, 1.374 ± 0.097 cm as against the corresponding measurements of 2.494 ± 0.065 cm, 1.842 ± 0.049 cm and 1.333 ± 0.046 cm for the ovaries in luteal phase of cycle. There was no significant difference in the dimensions of ovaries between follicular and luteal phases of cycle. In contrast

inactive ovaries had much smaller dimension of 1.960 ± 0.077 cm, 1.317 ± 0.064 cm and 0.977 ± 0.058 cm respectively which were significantly lower than those of both senile atrophic ovaries and of ovaries in follicular and luteal phases of cycle ($P > 0.01$).

The mean diameter of follicles in centimetres in the follicular phase early luteal phase, late luteal phase and pregnancy were respectively 0.907 ± 0.042, 0.883 ± 0.056, 0.893 ± 0.028 and 0.612 ± 0.041. Similarly corpora lutea had the mean diameter (greater dimension) of 1.033 ± 0.048 cm, 1.127 ± 0 103 cm, 1.400 ± .054 cm and 1.750 ± 0.044 cm in follicular phase, early and late luteal phase and pregnancy respectively.

It can be concluded that the incidence of pathological conditions affecting the ovaries and bursa of cross-bred cows slaughtered are fairly high probably on account of the fact that most of the slaughter animals are problem breeders.

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ABSTRACT

Two hundred and fifty two non-gravid genitalia and 13 gravid genitalia of cross-bred cows collected from slaughter houses were examined morphologically for lesions in the ovary and bursa and those with gross lesions were examined histopathologically for confirmation of the conditions. Eighty-seven pairs of ovaries showing cyclic activity, nine pairs of ovaries from pregnant animals, 12 pairs of inactive ovaries and 14 pairs of senile atrophic ovaries were utilised for biometrical studies of ovaries, corpora lutea and graafian follicles.

While out of the 252 genitalia examined, 139 (55.16 per cent) showed one or more lesions of the ovary and bursa, only 39.28 per cent showed one or more lesions in the ovary. The ovarian pathological conditions were inactive ovaries (23.41 per cent), cystic ovaries (2.78 per cent), cystic corpora lutea (2.78 per cent), haemorrhage in the ovary (5.56 per cent), persistent corpus luteum (0.79 per cent), retention cyst (0.79 per cent), par ovarian cyst (3.17 per cent) and par ovarian abscess (0.40 per cent).

The incidence of pathological conditions of bursa was

26.98 per cent, which included bursitis and ovarobursal adhesion (25.79 per cent), hydrops bursa (0.40 per cent) and haemorrhagic bursitis (0.79 per cent). The most common type of bursitis was fibrinous which was the mildest and was of no significance in causing infertility. The strandular type of ovarobursal adhesions might lead to subfertility or infertility.

The weight and dimension of senile atrophic ovaries were significantly higher than those of ovaries in follicular and luteal phases of the cycle and inactive ovaries ($P > 0.01$). Similarly the weight and dimensions of ovaries in follicular and luteal phases of the cycle were significantly more than those of inactive ovaries ($P > 0.01$). However no significant differences in the weight and dimensions of ovaries in follicular and luteal phases of cycle and the right and left ovaries in both phases of cycle were noticed.

It may be concluded that the pathological conditions affecting ovaries and bursa of cross-bred cows slaughtered at local slaughter houses were fairly high probably on account of the fact that most of the cows slaughtered were problem breeders. The biometrical and gross morphological studies of the ovaries of cross-bred cows in cycle, anoestrum and senility would greatly help the clinician in differential diagnosis of these conditions.

Photographs

Fig. 1 Inactive ovary - Small, pale and smooth with pin head sized follicles

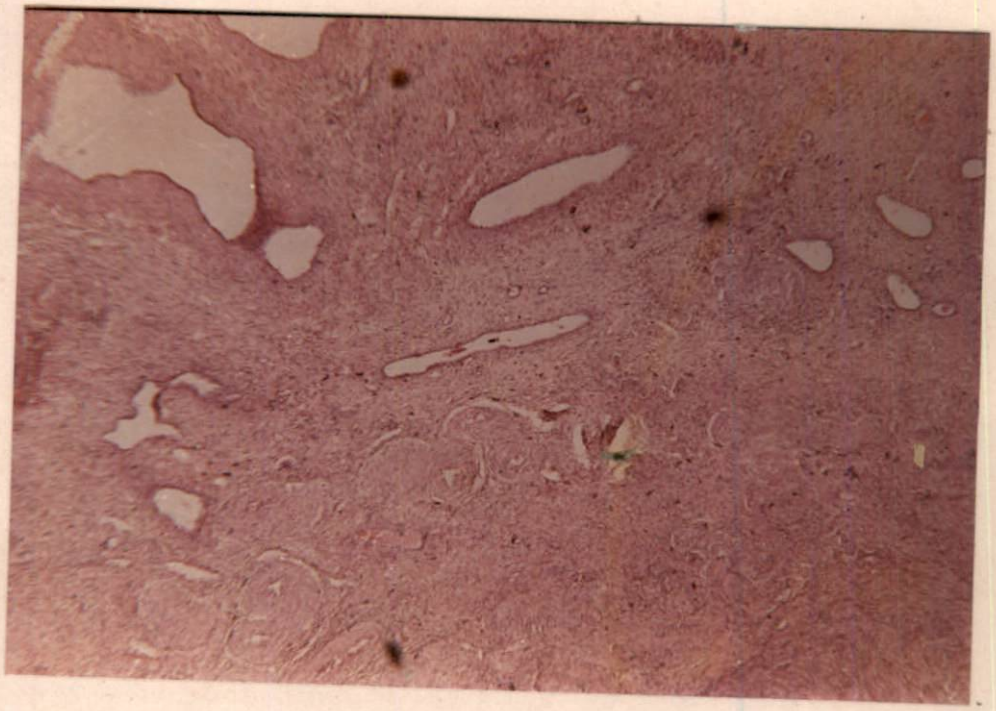

Fig. 2 Inactive ovary - Ovarian cortex with predominance of stromal tissue and numerous atretic follicles (H & E x 150)

Fig.3 Luteal cyst - Large cyst with thick patch of yellowish luteal tissue

Fig.4 Follicular cyst - Thin walled single cyst in both ovaries

Fig.5 Multiple follicular cyst - Both the ovaries showing multiple thin walled follicular cysts with partial luteinisation of one of the cyst

Fig. 6 Luteal cyst - The cyst wall showing the luteinised theca interna with vacuolated luteal cells (H & E x 150)

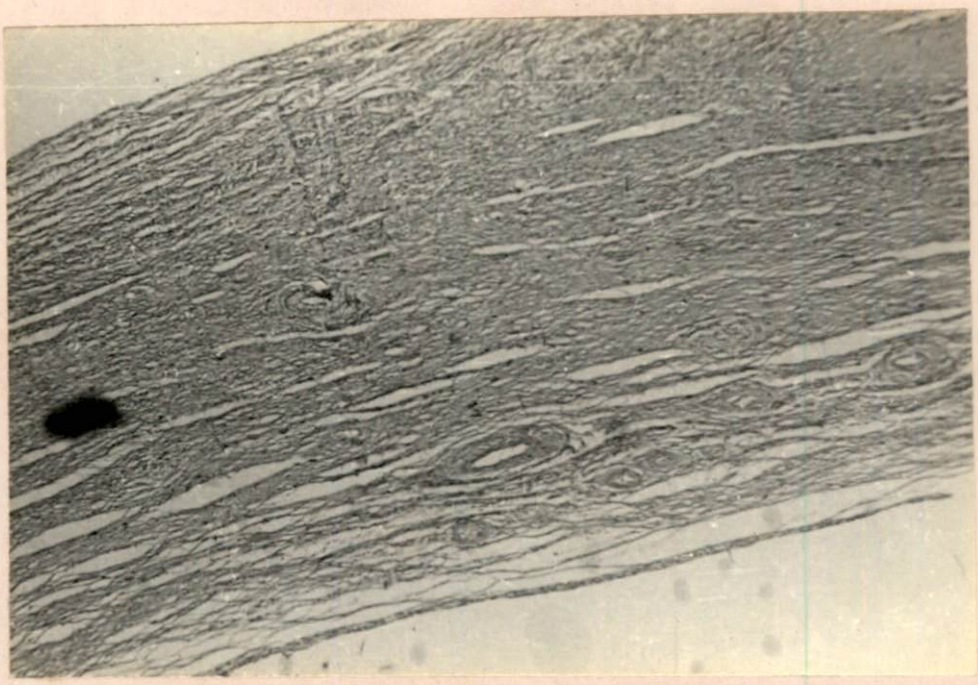

Fig.7 Follicular cyst - Thin cyst with an inner flattened membrana granulosa lining the connective tissue wall (H & E x 250)

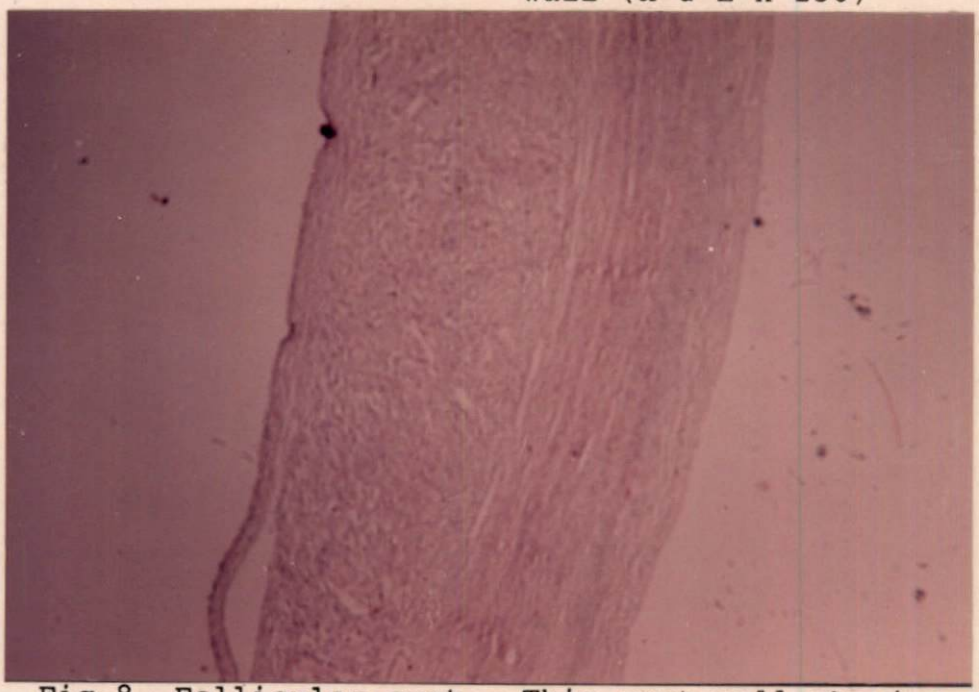

Fig.8 Follicular cyst - Thin cyst wall showing a small patch of luteal tissue (H & E x 150)

Fig.9 Multiple follicular cyst - Cyst wall between the neighbouring cysts showing luteinisation on one side (H & E x 250)

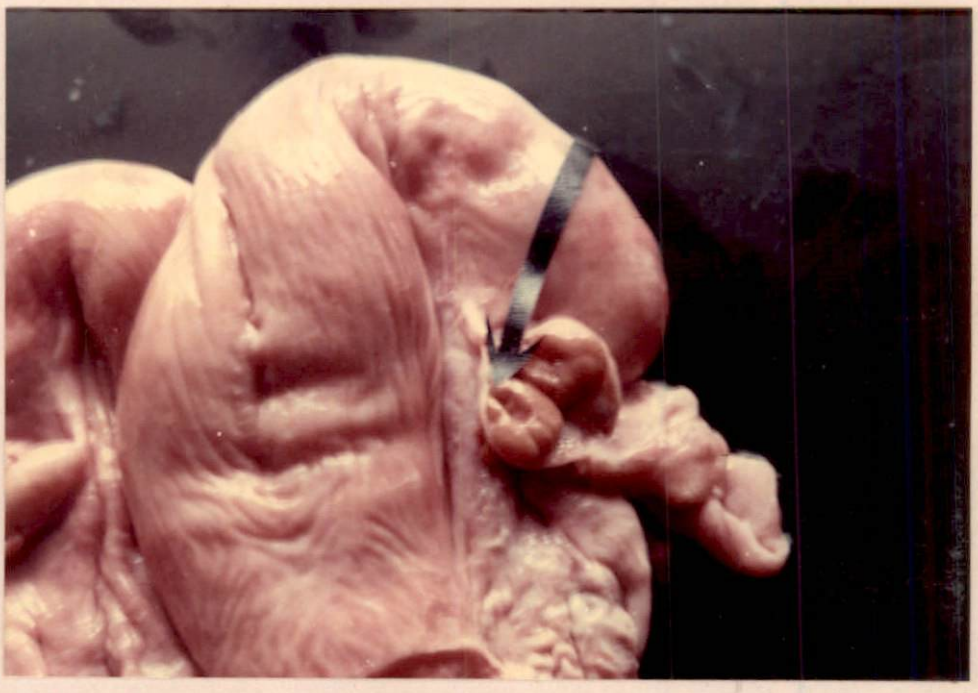

Fig.10 Cystic corpus luteum - With a large central cavity

Fig. 11 Cystic corpus luteum - The cyst cavity showing a long white thread like worm identified as an adult female Setaria cervi

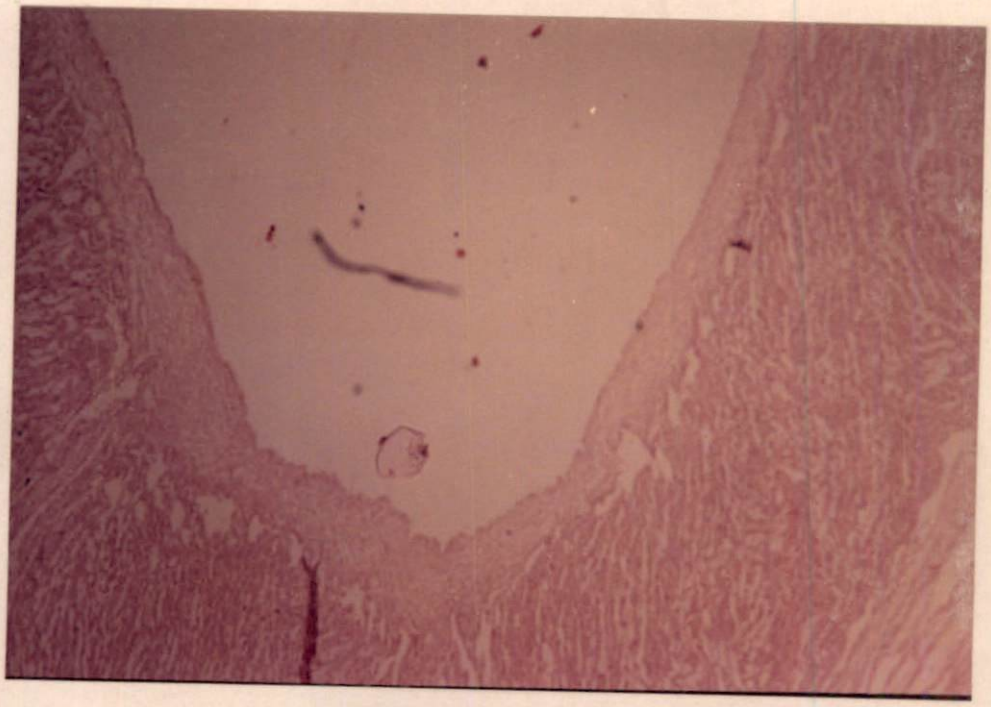

Fig.12 Cystic corpus luteum - A large central cavity and regressing vacuolated luteal cells in the wall (H & E x 250)

Fig.13 Haemorrhagic follicle - A large bluish follicle in the cortex packed with clotted blood

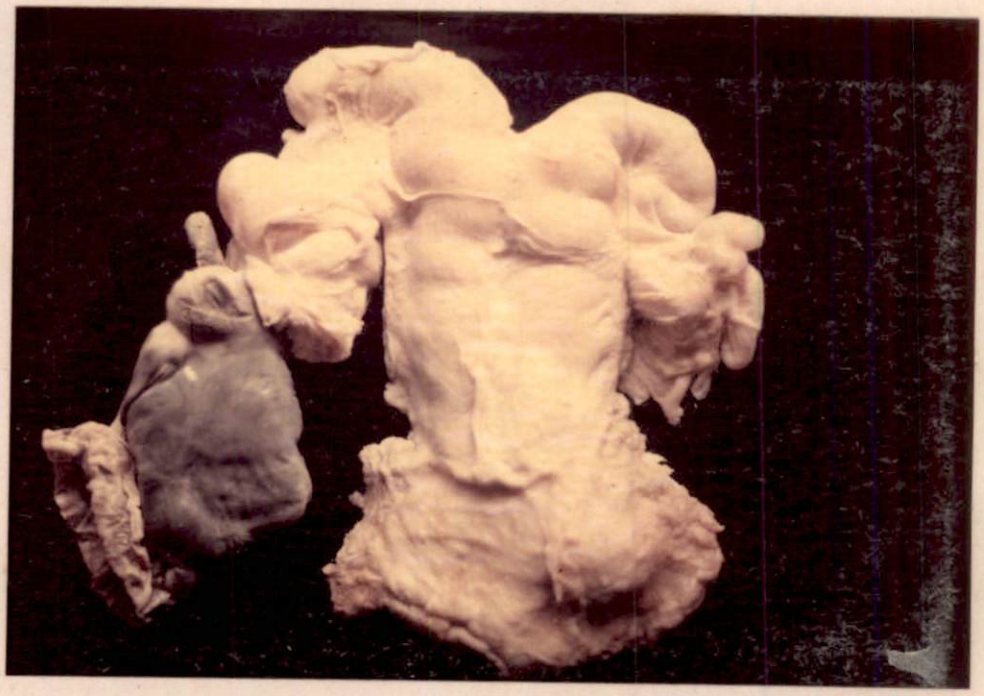

Fig. 14 Haemorrhagic mesovarium - A large organised haematoma in the mesovarium close to the right ovary

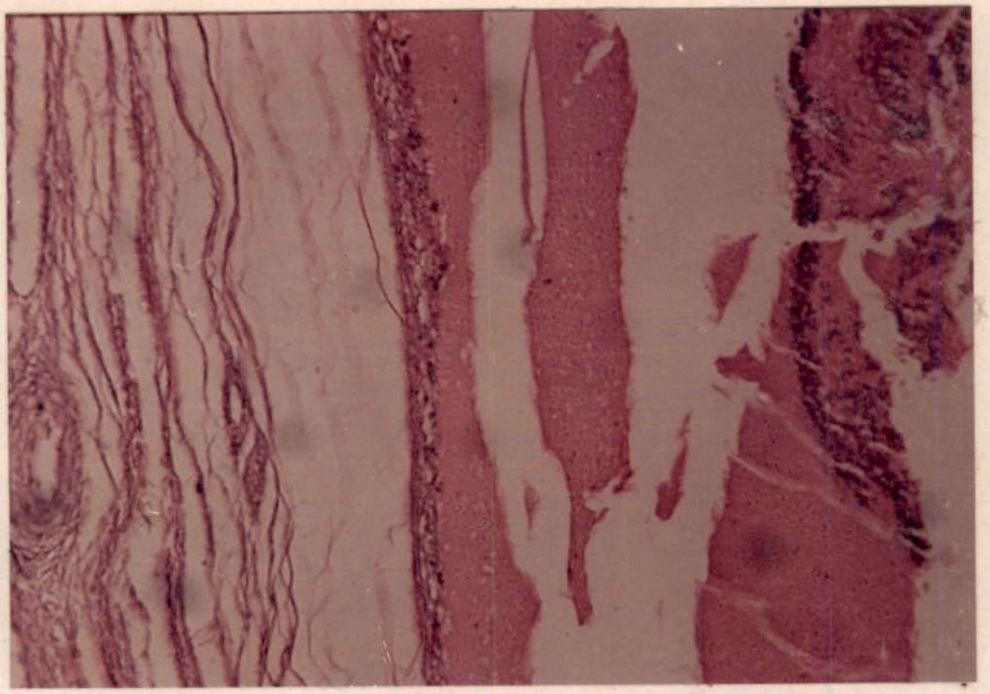

Fig. 15 Haemorrhagic follicle - Extremely thin membrana granulosa layer, desquamated granulose cells with clotted blood (H & E x 250)

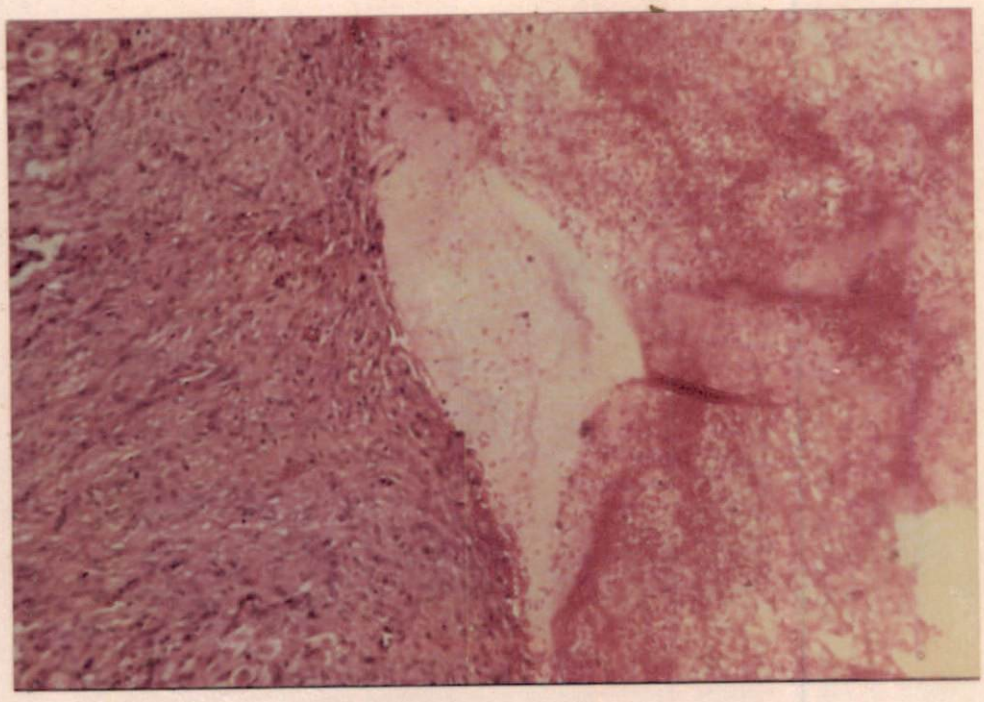

Fig. 16 Haemorrhagic cystic corpus luteum - Cystic cavity showing fresh blood (H & E x 250)

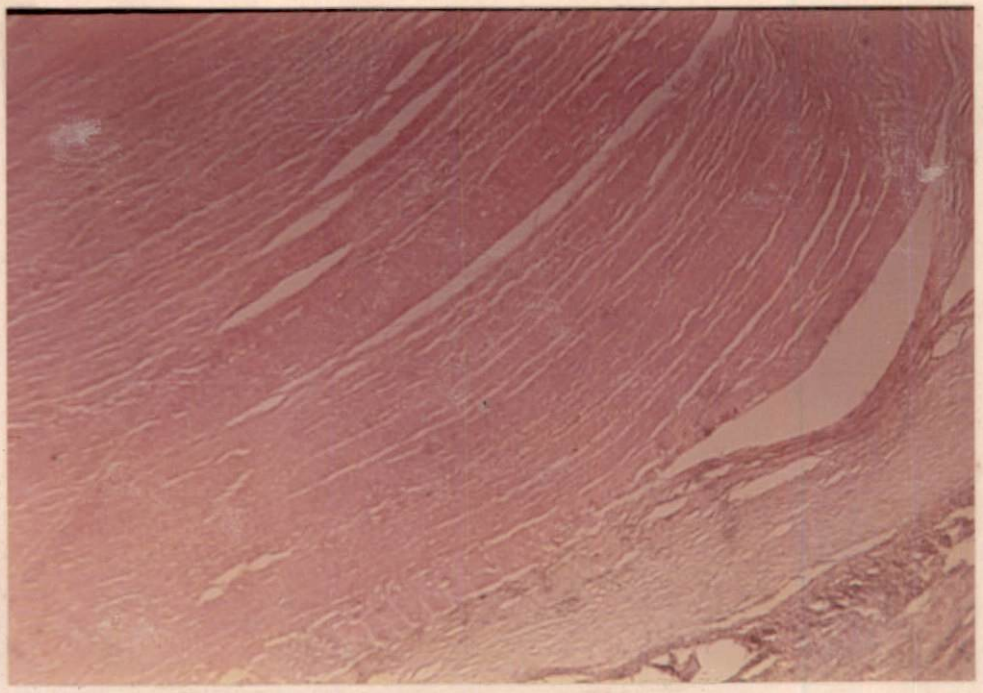

Fig. 17 Haematoma ovary - An organised haematoma in the cortex with haemosiderin pigments on its periphery (H & E x 150)

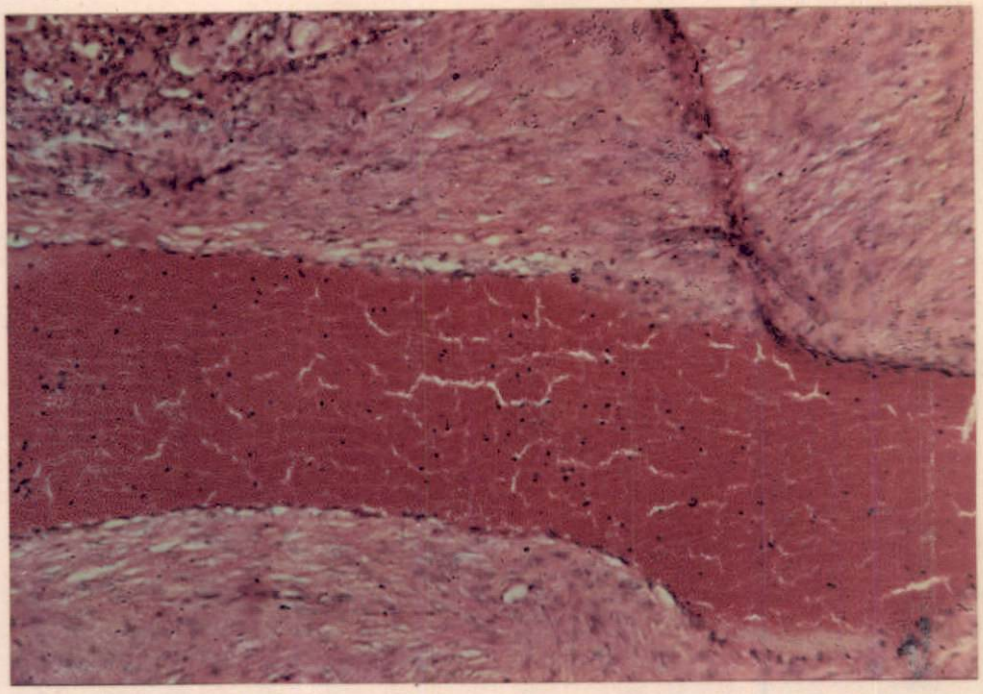

Fig. 18 Haemorrhagic corpus luteum - Capillaries in the outer connective tissue capsule engorged with blood(H & E x400)

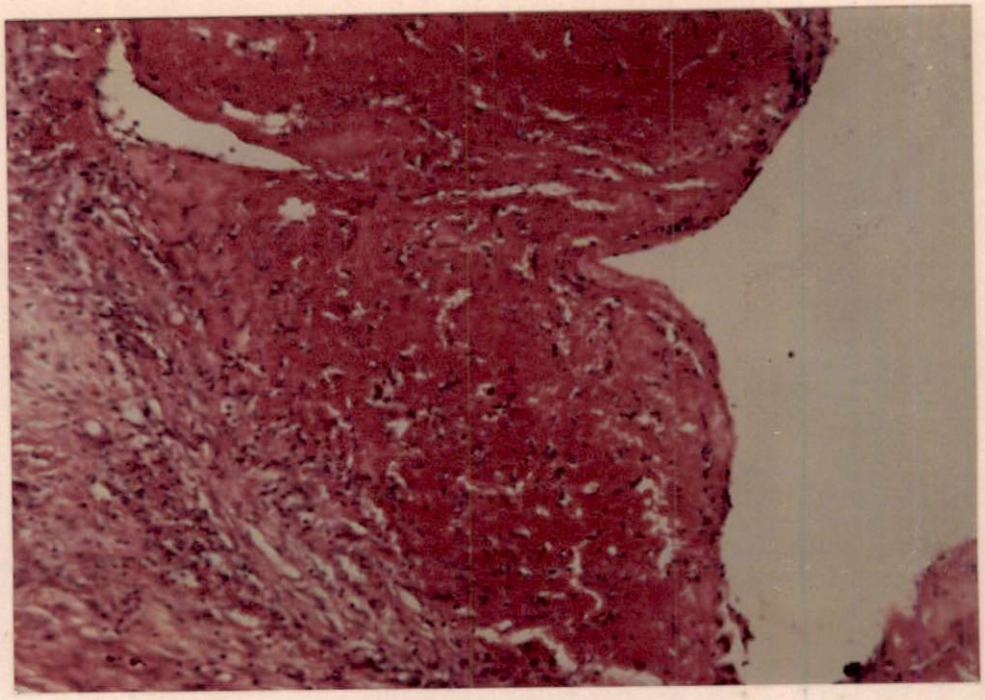

Fig.19 Haemorrhagic corpus luteum - Diffuse haemorrhage between the outer connective tissue capsule and the parenchyma of corpus luteum (H & E x 400)

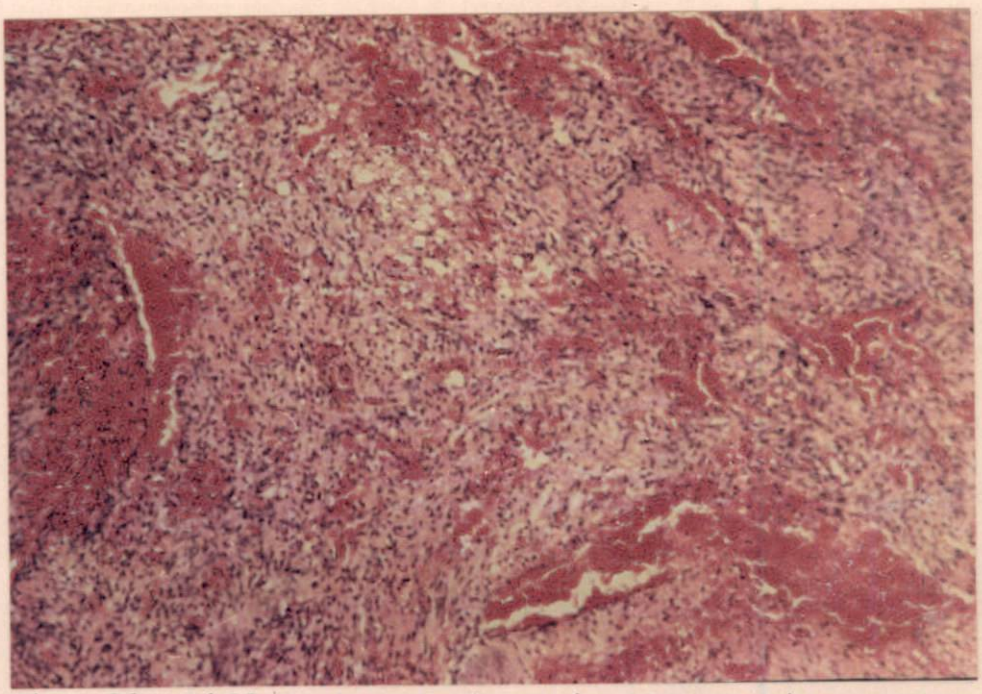

Fig. 20 Diffuse haemorrhage in the ovarian cortex - Extensive haemorrhage in the ovarian cortex (H & E x 400)

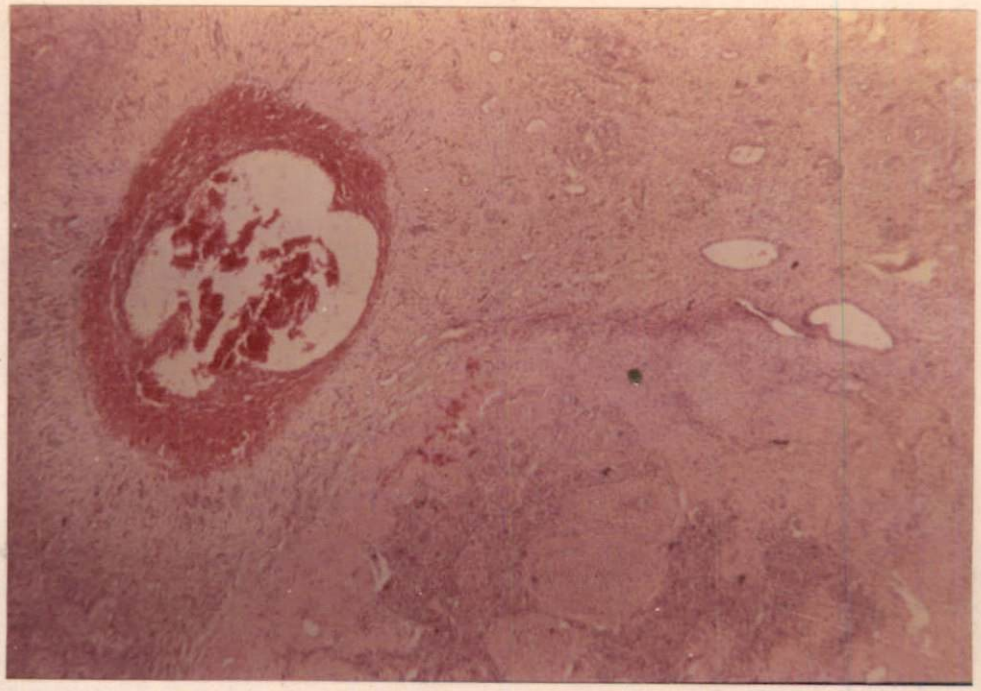

Fig.21 Haemorrhagic corpus albicans - The cavity of corpus albicans showing haemorrhage(H & Ex 250)

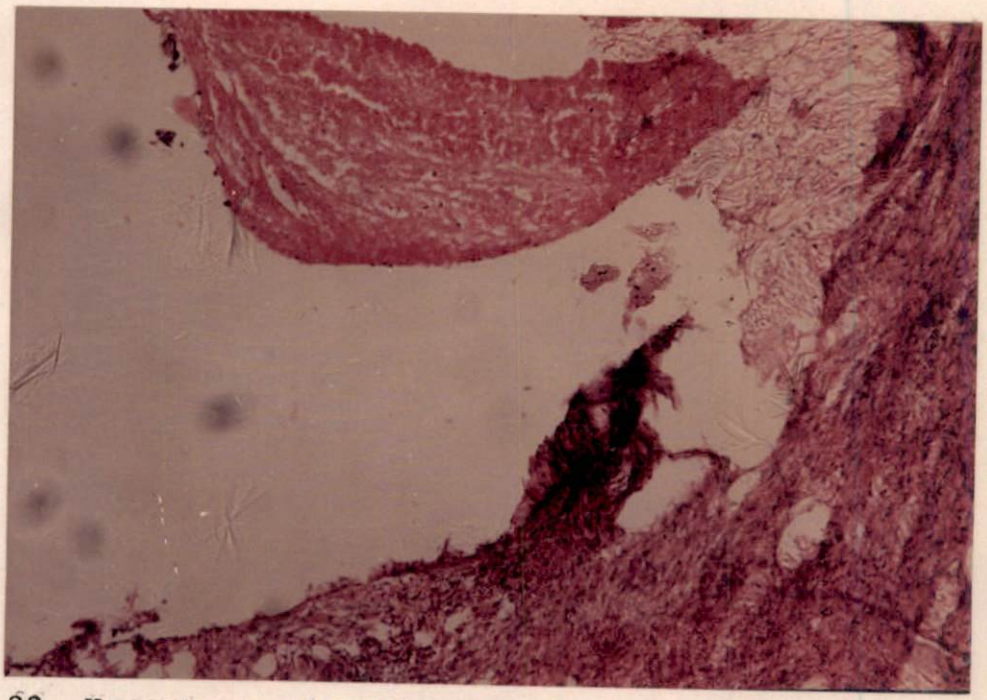

Fig.22 Haematoma of tunic albuginea - A partially organised haemorrhage in tunica albuginea (H & E x 400)

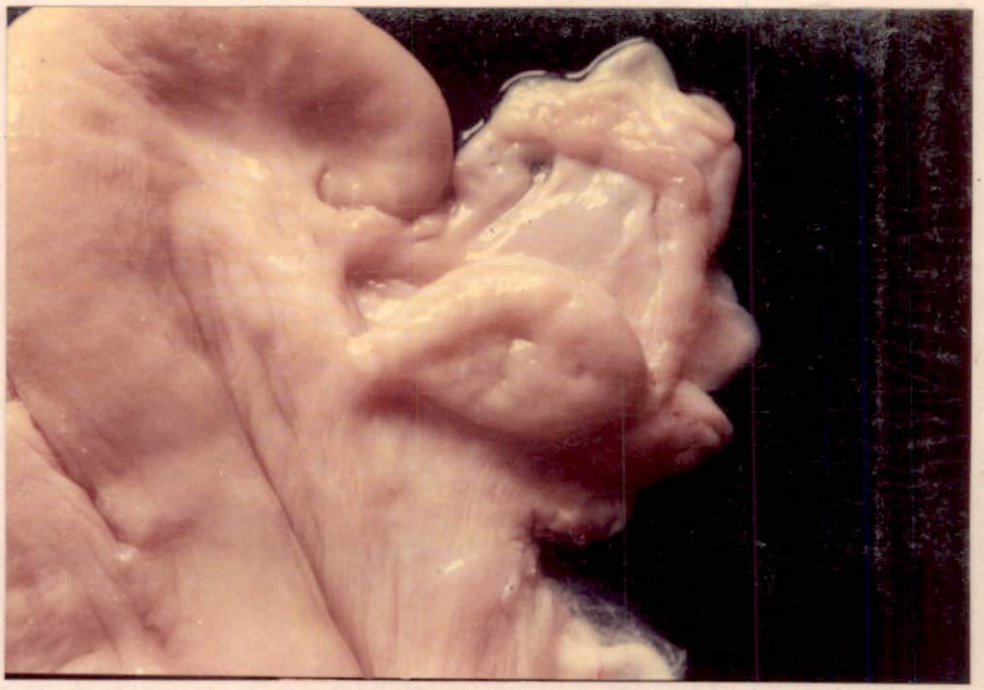

Fig.23 Ovary senile atrophy - Ovarian surface showing 'pock' markings appearance

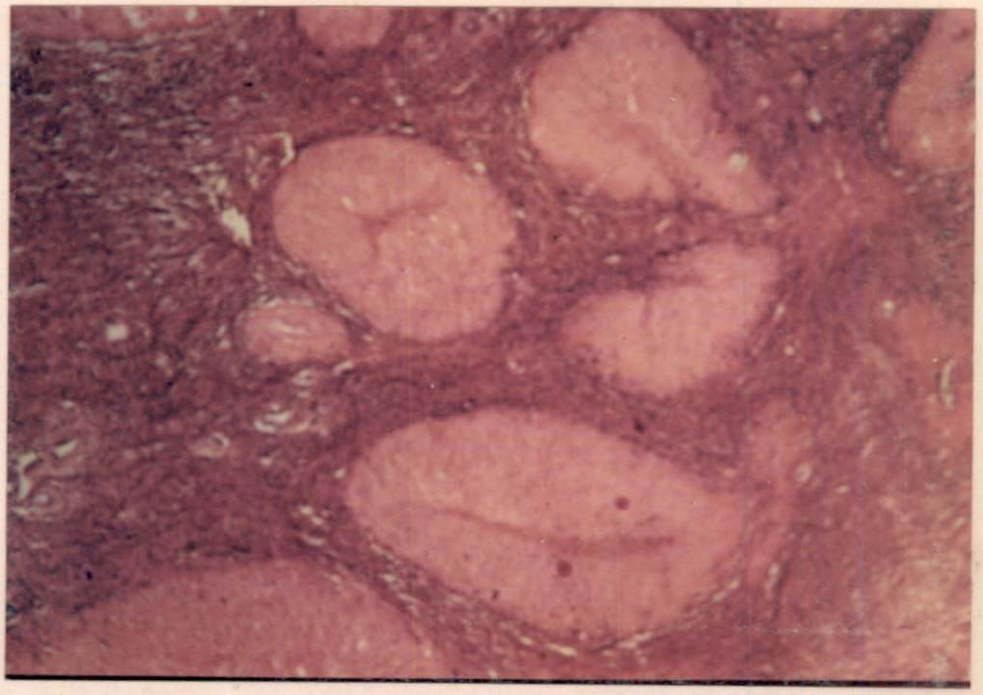

Fig.24 Ovary-Senile atrophy - The cortex showing clusters of luteal scars with few atretic follicles(H&Ex400)

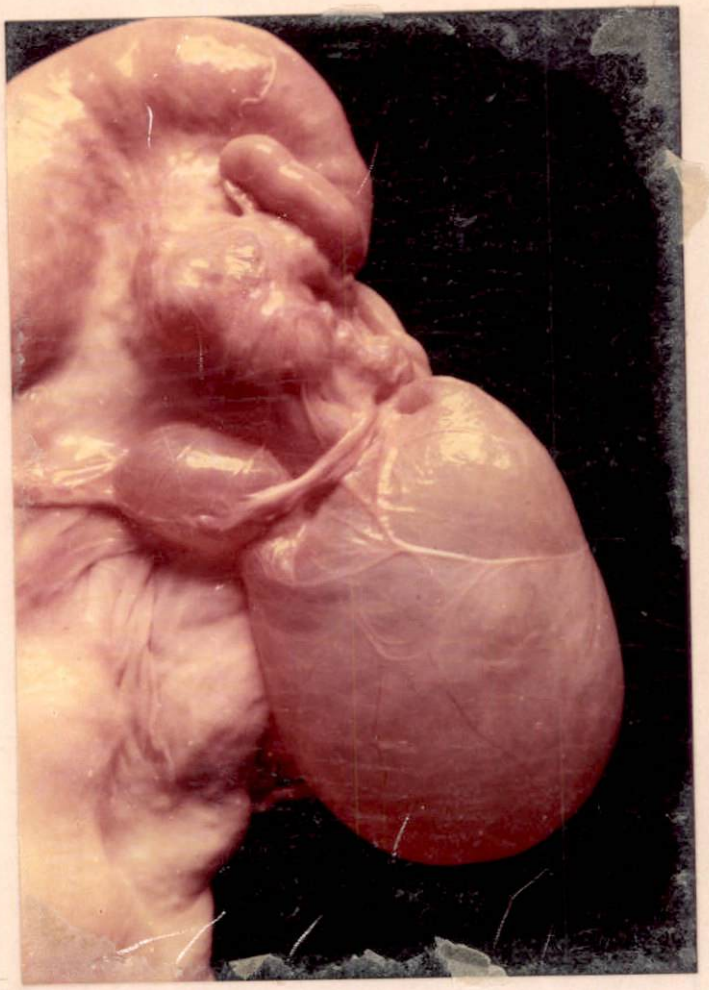

Fig. 25 Hydrops bursa - The right bursa showing multiple cysts of varying size.