CAPRINE OVARIAN AND UTERINE LESIONS: AN ABATTOIR SURVEY

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DECLARATION

I, Mutebi Francis, declare that this work is original and has never been submitted to any institution for any award.

Signature…… Date…….

This work was carried out under the guidance of Professor Lonzy Ojok (University Supervisor) and is hereby submitted with his approval.

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DEDICATION

To Daizy Kunihirwa, Brian Mukisa and Benjamin Mutebi.

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LIST OF ABBREVIATIONS

CEH:	Cystic Endometrial Hyperplasia
GTCT:	Granulosa Thecal Cell Tumour
PCR:	Polymerase Chain Reaction
UBOS:	Uganda Bureau of Statistics
UNHS:	Uganda National Household Survey

ABSTRACT

Goat rearing is popular among Ugandan farmers especially the small scale farm holders. However, very limited information is available on the defects of the female reproductive organs despite their significance in guiding selection, breeding and strategic control programmes for various disease conditions which are ultimately aimed at increasing enterprise profitability. In order to bridge this gap, a study was carried out from Uganda Meat Industries (UMI) and Kampala City Council (KCC) abattoirs to establish the nature and prevalence of such defects. A total of 1000 female goats were randomly sampled for a period of seven months for gross genital defects. Gross genital defects-bearing tracts were sampled for histopathology on all the segments of the system. Gross genital defects had an overall prevalence of 20.9%, but those that can result into infertility or sterility were detected in 13.6% of the examined goats. The uterus exhibited the highest prevalence of lesions (14.6%) followed by the ovary (8.6%). Oviducts and the cervix had rates of lesions of 4.5% and 2.6%, respectively. Cervical lesions included cervicitis (1.4%), haemorrhages (0.3%) and adenomyosis (0.9%). Major uterine lesions included: metritis and endometritis (6.3%), adenomyosis (5.4%), intra-uterine foetal deaths (1.9%), haemorrhages (3.0%), hydrometra (0.5%) and pyometra (0.4%). Others were cystic endometrial hyperplasia (0.2%), perimetritis (0.3%), serosal cysts (0.2%), unilateral caruncular necrosis (0.2%) and melanosis (0.1%). Salphingeal lesions included salphingitis (3.7%) and hydrosalphinx (0.8%). Detected ovarian lesions included mainly tubo-ovarian–bursal adhesions (3.7%), paraovarian cysts (2.2%), cystic corpora lutea (2.2%), cystic graffian follicles (1.1%) and granulosa-thecal cell tumour (0.1%). Others were ovarian quiescence (0.4%) and *Cysticercus tenuicolis* cyst (0.1%). Overall, majority of the lesions were infectious in nature and their prevalence increased with age. Foetal wastage had a prevalence of 38.4%. This study implicated infections and foetal deaths as the major causes of genital lesions and revealed a higher prevalence of adenomyosis among goats than that reported in literature. Regular herd health investigations should be carried out to determine the extent and nature of the causes of infertility so as to appropriately advice the farmers.

CHAPTER ONE

INTRODUCTION

Goats are next to cattle in importance to Ugandans. The current population of about 8.1 million goats (UBOS, 2007) cannot meet the available demand. The availability of ready market in addition to goats' short generation lengths, potentially high reproductive rates and production efficiency make goats the best alternative to cattle production in Uganda especially in areas where land is limited. Consequently, many farmers, especially small-scale farmers have adopted goat rearing. This fact is evidenced by 2005/2006 Uganda National Household Survey indicating that 43% of the agricultural households in Uganda raise goats (UBOS, 2007).

Regular and successful reproduction is the key to profitable goat production. This entails early attainment of sexual maturity and raising of two crops of kids per year with a twinning rate of 10 – 30% during a doe's reproductive life (Cupps, 1991; Ogwal-Okwot, 2000). This target may not be attained due to sterility and/or infertility among female goats. A great deal of these reproductive disturbances may accrue from structural abnormalities of the reproductive organs. These may be congenital or acquired infectious and non-infectious conditions.

Venereal diseases and hereditary reproductive abnormalities in a flock may rapidly attain epidemic proportions if not detected early and an appropriate control strategy put in place. This calls for regular epidemiological studies into the causes of reproductive inefficiency. There are various methods that can be used to do this, among which is ultrasonography, radiology, laboratory diagnosis and postmortem or antemortem examination of abattoir animals. The latter method is very appropriate especially in developing countries because it allows for examination of a large number of animals in a short time at a very low cost. Abattoir based epidemiological studies on caprine female genital tracts defects have been carried out in various countries (Szatkowska *et al.*, 2004; Cockcroft *et al*., 1998; Timurkaan and Karadas, 2000). In Uganda, very little work has been done to this effect. This study was undertaken to generate preliminary information on the nature and prevalence of genital lesions in goats and therefore stimulate further investigations.

Lesions affecting the uterus and the ovary greatly contribute to infertility or sterility in goats. This results into poor reproductive performance hence reduced enterprise profitability. The problem is compounded by lack of adequate information on the nature of lesions and the magnitude of the problem given very limited clinical and post-mortem investigations in Uganda. This in turn curtails the implementation of strategic control programmes.

This study was conducted with the general objective of assessing the abnormalities affecting the female genital organs of goats slaughtered in Kampala Abattoirs. It therefore established the nature and prevalence of gross and histopathological lesions of female genital tracts of goats slaughtered in Kampala abattoirs.

Although abnormalities of female genital organs reduce goat fertility to varying degrees; very little is known about their frequency and nature in Uganda. This information is very essential in assessing their causes and magnitude of the problem so that proper control measures can be instituted if deemed necessary to boost production. This study was aimed at generating such critical preliminary information through gross and histopathological examination of abattoir materials. This method is quick, cheap and allows examination of many organs in a relatively short time. This will pave way for future investigations.

The study established the extent and nature of gross and histopathological lesions of the ovary and uterus among goats slaughtered in Uganda Meat Industries and Kampala City Council abattoirs. It involved determination of age, origin and body condition score of sampled goats, examination of genital systems, collection of tissue samples from all genitals with gross lesions, tissue processing and histopathology**.**

CHAPTER TWO

LITERATURE REVIEW

2.1. Status of goat production in Uganda

Uganda currently has a total goat population of about 8.1 million goats, comprising of 3.9% exotic and the rest indigenous goats under the management of about 43% of the 4.2 million agricultural house holds (UBOS, 2007). Majority of the goats are owned by pastoralists and small holder farms that raise goats as a tradition other than an economic activity (Okello-Lapenga, 2000). Breeds reared include mainly Mubende, Sebei, Teso, Kigezi and Karamoja which are indigenous, in addition to few imported breeds such as Boer, Toggenburg, Saanen, Anglo Nubian plus their crosses (Okello-Lapenga, 2000).

Systems of goat management vary from place to place depending on goat number and available land. Majority are herded or tethered. Very few are zero grazed and paddocked. Since goat rearing in Uganda is predominantly subsistence good husbandry practices are rarely adhered to. This predisposes the goats to many health problems which culminate into low productivity. Poor reproductive performance is among the major constraints to goat production. This is mainly attributable to lack of sound selection and breeding programmes in addition to poor health care.

2.2. Normal reproduction in a doe

Puberty marks the beginning of cyclicity in the female goats. It is attained at four to eight months depending on the breed, plane of nutrition, climate and geographical location in a healthy goat (Arthur *et al*., 1983). Age at first service also varies from seven to 18 months (Matthews, 2001) but Laing *et al*. (1988) recommend breeding when a goat has attained 65% of its adult body weight and is in good body condition. If bred at the right time by a fertile buck, a healthy female goat should be able to conceive and carry pregnancy to term. In absence of pregnancy, oestrus occurs at an interval of 18 to 21 days. Tropical breeds of goats are polyoestrus. Heat duration ranges from 24 to 96 (average 36-40) hours. The gestation period in goats takes five months (145-156 days) (Matthews, 2001). Following successful parturition; breeding should be done between 45 and 90 days post kidding to attain the optimal reproductive performance of three to four

kid crops in two years. This guarantees a long female reproductive life and profitability of the enterprise. However, infertility or sterility denies the farmer this desired performance.

2.3. Infertility and sterility in the female goat

According to Arthur *et al*. (1983), infertility is the reversible failure or delay to produce a kid in a given time interval while sterility is absolute or total failure to reproduce. The causes of infertility or sterility in female goats are diverse. While some causes are primary abnormalities of the female genital organs; others are complications that may present with or without lesions. Arthur *et al*. (1983) categorise the causes of infertility and sterility into four broad groups: primary genital organs structural defects, infections, managemental and functional factors. This study focuses on genital organs lesions.

2.4. Ovarian and uterine lesions

Literature on female genital tracts abnormalities in Ugandan goats is scanty. A number of abnormalities are known to affect the female reproductive system of goats. Some occur in specific disease conditions while others are general manifestations of organ injury. On the other hand certain lesions are acquired and others are congenital. For convenience and because of the differences in response to pathological stimuli, the review is based on anatomic units i.e. the cervix, uterus, salphinx and ovaries.

2.4.1. Cervical abnormalities

Congenital anomalies of the cervix are due to defective development (dysgenesis) of paramesonephric ducts during ontogenesis (Jones *et al.*, 1997). Among those described include cervix bifida, double external os, cervical dilatation, cervical diverticula, aplastic rugae, cervical hypertrophy or hypoplasia and tortuosity (Kennedy and Miller, 1993; Acland, 2001). Cervical congenital anomalies are rare in goats and most described cases have been associated with various forms of intersexuality such as freemartinism (Morrow, 1986; Timurkaan and Ozer, 2002).

Cervicitis which describes the inflammation of the cervix, is in most cases secondary to metritis or vaginitis due to specific or non-specific post parturient infections (Kennedy and Miller, 1993). As a single entity, cervicitis may occur as a consequence of poor artificial insemination or catheterisation techniques. This is unlikely in Uganda since none of the above techniques is routinely practiced in goats. Grossly, acute cervicitis presents with oedema and prolapse of the caudal rugae in addition to mucopurulent

exudation (Acland, 2001). Cervical rings prolapse may also be predisposed by trauma and pregnancy (Jones *et al*., 1997). Epithelial desquamation and degeneration together with inflammatory cell infiltrations characterise acute cervicitis histologically (Kennedy and Miller, 1993).

Neoplasms of the cervix are rare in domestic animals. Primary neoplasms of the cervix include leiomyomas and carcinomas. Lymphosarcomas are the common secondary neoplasms of the cervix (Kennedy and Miller, 1993). Cockcroft and Mc Innes (1998) reported a case of a leiomyoma of the cervix in a goat presenting with abdominal straining. Uzal and Puschner (2008) reported another case in an aged goat that resulted into massive haemorrhage and eventual death.

2.4.2. Uterine abnormalities

The nature of uterine lesions not only reflects the reproductive health status but also is useful in the diagnosis of the hypothalamo-pituitary abnormalities and the influence of external hormonal sources on the individual animal (Kurman, 2002).

Uterine congenital anomalies are rare among domestic animals and most cases are usually associated with inbreeding and intersex conditions (Jones *et al.*, 1997). Intersexes are relatively common among goats especially dairy breeds (Morrow, 1986). Bilateral uterine agenesis, uterus unicornis (hemiuterus), segmental aplasia and uterus didelphys are described congenital anomalies of the uterus among others usually in association with freemartinism and genetical intersexuality (Jones *et al*., 1997; Webb, 1985; Batista *et al*., 2000; Timurkaan and Ozer, 2000).

Endometrial atrophy is characterised by a thin, flat and greyish endometrium with no evidence of caruncles (Kennedy and Miller, 1993). It occurs in association with ovarian inactivity. The latter may result from hypopituitarism, debility, seasonal anoestrus and chromosomal aberrations (Kennedy and Miller, 1993).

Pyometra is the accumulation of pus in the uterine lumen following an acute or chronic uterine infection with cervical closure (Acland, 2001). Persistency of a functional corpus luteum precipitates occurrence of pyometra by increasing uterine susceptibility to infection, inducing mucus plug formation and inhibition of myometrial contraction. This is mediated by progesterone secreted by the corpus luteum (Kennedy and Miller, 1993). Pyometra can arise from an on-going specific bacterial infection such as

campylobacteriosis (Morrow, 1986) or non-specific uterine infections especially during the puerperal period.

Mucometra and hydrometra are conditions characterised by uterine distension by mucinous and watery fluids respectively in association with endometrial hyperplasia or a distal uterine tract obstruction (Kennedy and Miller, 1993). These conditions are common in goats with segmental aplasia of the uterus (Webb, 1985; Batista *et al.*, 2000) and pseudo-pregnancy (Morrow, 1986).

Cystic endometrial hyperplasia is pathological hyperplasia of the endometrium due to excessive and prolonged oestrogenic stimulation among goats (Blood and Studdert, 1999). Hyperestrogenic states may occur in cystic ovarian diseases, ingestion of oestrogenic plants and ovarian neoplasms such granulosa cell tumours and papillary cyst adenomas (Arthur *et al.*, 1983; Kennedy and Miller, 1993). Cystic endometrial hyperplasia presents with diffuse endometrial thickening by numerous clear fluid filled cysts grossly. Endometrial glandular hyperplasia and hypertrophy together with stromal oedema characterise this condition histologically (Kennedy and Miller, 1993). Zaher, (2005) reported three cases associated with endometritis.

Inflammatory lesions of the uterus are named according to the part(s) of the uterus involved. The terms metritis, endometritis, perimetritis and parametritis are used when the entire uterine wall thickness, endometrium, serosa and suspensory ligaments respectively are involved (Kennedy and Miller, 1993). Uterine inflammation is due to either specific diseases such as tuberculosis or non specific infections following breeding or parturition especially when there is assisted kidding and/or retention of the placenta (Morrow, 1986). Isolation and identification of the organisms is essential for diagnosis.

Foetal maceration is the disintegration of the dead foetus into parts by autolysis following bacterial invasion of the dead foetus in the uterus (Jones *et al.*, 1995). On the other hand foetal mummification is the progressive dehydration of the dead foetus in absence of uterine infections, presence of a functional corpus luteum and a mature foetal skin that is capable of resisting autolysis (Kennedy and Miller, 1993). Ssali, (1998) reported prevalences of 0.18% and 0.55% of foetal maceration and mummification, respectively in a gross lesions survey from Kampala City Council abattoir.

Hydrops is the excessive accumulation of fluids in foetal membranes. Hydramnios and hydrallantois describe excessive fluids presence in the amnion and allantois respectively (Kennedy and Miller, 1993). *Hydrops foetalis* is rare in goats but it's incidence is increased by sheep and goats interbreeding (Kelk *et al*., 1997; Jones and Fecteau, 1995). Caprine neoplasms are also rare**.** Adenocarcinomas, leiomyomas, fibromas and leiomyosarcomas have been reported (Whitney *et al*., 2000; Morrow, 1986).

2.4.3. Abnormalities of fallopian tubes

These usually occur in association with related uterine lesions. Salphingitis, pyosalphinx, agenesia, hydrosalphinx, neoplasia may occur independently or in association with similar uterine lesions. In an abattoir survey in Turkey, Timurkaan and Karadas, (2000) described 15, 5, 21, 10 and 2 cases of salphingitis, pyosalphinx, mesosalphingitis, hydrosalphinx and agenesia respectively in the 4000 doe reproductive organs examined.

2.4.4. Ovarian abnormalities

The occurrence of ovarian lesions can be either unilateral or bilateral. They are associated with varying degrees of infertility depending on the nature and extent of the abnormality. Ovarian malformations are rare among goats and usually occur in association with those of other organs of the reproductive system (Jones *et al.*, 1997). They are frequently described among Freemartins and other forms of intersexes (Buergelt, 2000). The following congenital anomalies among others have been reported in goats: ovarian hypoplasia, agenesis, ectopia, hermaphroditism, accessory and supernumerally ovaries.

Various cysts may develop in and around the ovaries. While some cysts are incidental findings at post-mortem, others are associated with fertility disturbances. Intra ovarian cysts include anovulatory graffian follicles, cystic corpora lutea, cystic rete ovarii and inclusion cysts. Paraovarian cysts are derived from mesonephric tubules and ducts, paramesonephric ducts, uterus and the mesosalphinx (Maclachlan and Kennedy, 2002).

Follicular and luteinised cysts are of major clinical significance and constitute the cystic ovarian diseases. These are larger and persistent anovulatory mature graffian follicles which only differ in the level of luteinisation (Maclachlan and Kennedy, 2002). In goats, follicles larger than 1.2 cm in diameter are considered cystic (Morrow, 1986). Cystic ovarian disease has been described mainly among dairy goats especially those

grazing oestrogenic pastures (Laing *et al*., 1988; Arthur *et al*., 1983). In their survey of pathological changes of caprine female genital organs in Elazig abattoirs in Turkey, Timurkaan and Karadas (2000) reported incidences of 1.15%, 0.8%, 0.77%, 0.37%, and 0.07% of paraovarian cysts, cystic corpora lutea, follicular cysts, luteal cysts and tubo-ovarian cysts respectively, among the 4000 doe reproductive systems examined.

Oophoritis (ovaritis) is inflammation of the ovary. It is a rare condition in domestic animals (Jones *et al*., 1997). It may arise as a direct extension from inflammations of adjacent organs or hematogenously as non specific or specific infections. It occasionally occurs in association with brucellosis and tuberculosis (Kennedy and Miller, 1993). Timurkaan and Karadas, (2000) reported an incidence of 0.23% in an abattoir survey.

Ovarian inactivity is a consequence of failure of folliculogenesis due to absence or suboptimal production or release of gonadotrophins (Arthur *et al*., 1983). The affected ovary lacks mature follicles and corpora lutea or its degenerative derivatives. Lack of cyclicity is associated with malnutrition and chronic debilitating diseases (Morrow, 1986). Weight loss influences the secretion of ovarian hormones hence ovarian quiescence (Tomomi *et al*., 2003).

Ovarian bursal adhesions involve the formation of fibrous tissue across the ovarian bursa which in severe cases obliterates its cavity (Acland, 2001). They usually follow inflammatory processes in and around the ovary (Arthur *et al.*, 1983). Where the ovarian bursa is completely adhered to the ovary and sometimes the fallopian tube; interference with ovulation, bursal and salphingeal occlusion may ensue. The later predisposes to development of bursal cysts, hydrosalphinx and pyometra. An incidence of 0.65% of ovario-bursal adhesions was reported by Timurkaan and Karadas (2000).

Tumours of the ovary are rare among goats (Kennedy and Miller, 1993).This is partly attributable to the short life span of domestic goats. Granulosa cell tumours, dysgerminomas and lymphosarcomas are among the most frequently reported neoplasms in goats (Morrrow, 1986). This does not rule out the occurrence of other tumours developing from any of the constituent tissues or metastising to it.

2.5. Intersexuality among goats

Intersexes are individuals exhibiting varying degrees of physical form, gonads, and sexual behaviour of both sexes (Blood and Studdert, 1999). Intersexes are called pseudo hermaphrodites if they have chromosomes and gonads of one sex but phenotypically they appear like the opposite sex. They are described as male or female pseudo hermaphrodites depending on gonads they have (Acland, 2001). On the other hand true hermaphrodites have both ovarian and testicular tissues in their gonads either as ovotestes or separate ovaries and testes on either side (Morrow, 1986).

Inter-sexuality in goats occurs in freemartinism and as a genetic defect usually reported in polled dairy goats (Arthur *et al*., 1983). Freemartins constitute approximately 6% of the reported cytogenetically analysed cases of intersexes (Morrow, 1986). A freemartin is a sterile genetic female co-twin to a male. It is due to inter-placental vascular anastomoses during early embryonic development (Jones *et al*., 1997). Freemartinism is very rare in goats and its incidence is not known (Bretzlaff, 1995). Intersexuality presents with variable degrees of genital tract developmental abnormalities which may include segmental aplasia, hermaphroditism, and hypoplasia of various genital organs (Jones *et al*., 1997; Szatkowska *et al*., 200; Laing *et al*., 1988; Acland, 2001).

2.6. Specific infections associated with uterine and ovarian lesions

Infertility or sterility can be a complication of various infectious diseases that localise in the reproductive organs of goats with or without specific morphological defects. Such lesions may be part of a systemic disease or initiated as reproductive organs disturbances following breeding or obstetric interventions. Various infections of the pregnant uterus usually cause placentitis. The later is associated with variable degrees of infertility through abortion, embryonic or foetal deaths, stillbirths, or birth of unthrifty kids depending on the severity and stage of infection (Kennedy and Miller, 1993). Brucellosis, campylobacteriosis, toxoplasmosis, listeriosis, leptospirosis, chylamydiosis, Q-fever, salmonellosis, yersinosis and various viral infections are reported to interfere with the reproductive performance of the goats (Morrow, 1986; Arthur *et al*., 1983; Kennedy and Miller, 1993). About 90% of the diagnosed causes of abortion are infectious in nature and they cause non specific lesions in genital organs (Kennedy and Miller, 1993).

Brucellosis in goats is principally caused by *Brucella mellitensis* and occasionally by *Brucella abortus* (Laing *et al.*, 1988). Brucellosis presents with necrotising placentitis and ulcerative endometritis which usually result into abortion in the third trimester especially in naïve animals (Laing *et al.*, 1988). Sometimes it may present with granulomatous endometritis (Mc Entee, 1990). Since lesions are non-pathognomonic, diagnosis is by serology, PCR and pathogen isolation and characterisation. The disease is endemic in African, Mediterranean, Central and South American countries (Arthur *et al*., 1983).

Campylobacteriosis is a rare abortive disease in goats caused by *Campylobacter fetus* and *Campylobacter jejuni* characterised by late gestation abortions and births of weak and/or undersized neonates among does (Morrow, 1986). Placental oedema, haemorrhage, necrosis and foetal multifocal necrotising hepatitis may be detected at post-mortem (Kennedy and Miller, 1993). Confirmation is by organism isolation.

Toxoplasmosis in pregnant goats caused by *Toxoplasma gondii* infections occur world wide. Infections occur following ingestion of feed contaminated with cat faeces in majority of the cases but congenital infections are also possible (Sherman and Smith, 1994). Necrotising non suppurative placentitis with mineralization and presence of cysts and tachyzoites in cotyledons are characteristic of toxoplasmosis in pregnant goats but also manifest in cases of *Sarcocystis* and *Neospora caninum* infections (Kennedy and Miller, 1993). Bisson *et al*. (2000) reported a *Toxoplasma gondii* sero-prevalence of 31% in Ugandan domestic goats.

CHAPTER THREE

METHODOLOGY

3.1. Study Area

The study was carried out at Uganda Meat Industries (UMI) and Kampala City Council (KCC) abattoirs. These were selected because they receive many goats for slaughter from various districts of Uganda.

3.2. Sample size

It was assumed that occurrence of genital lesions is normally distributed in the goat population. The approximate Sample size was obtained using the formula suggested by Selvin, (1991):

$$n = \frac{Z^2_{\alpha/2}\, p\,(1-p)}{e^2}$$

Where n =Sample size

$Z_{\alpha/2}$ =Critical value at specified degree of confidence

P =Expected prevalence

E =Margin of error

At 95% degree of confidence, allowable margin of error of 1.5% and assumed genital lesions prevalence of 6%, the sample size was calculated as indicated below:

$$n = \frac{3.84 \times 0.06 \times 0.94}{0.015^2} = 962.56 \approx 963$$

Therefore 1000 female goats were included in the study.

3.3. Research design and sampling

A descriptive survey of female reproductive tracts abnormalities was carried out. Both nulliparous and pluriparous female goats were examined. Samples were collected for at least four days each week from early October, 2007 to April, 2008. Sampling was in such a way that all female goats slaughtered on the day of abattoir visitation were included in the study. Age, breed, district of origin, and body condition score were determined immediately after assignment of the serial number. Age estimation was based on eruption and erosion of the incisor teeth pairs as described by Miller and Robertson (1959). The district of origin was established by inquiring from the traders. Breed was subjectively determined basing on physical traits while body condition score was based

on the animals' weight for age and relative proportions of muscle and fat. Particulars of every goat examined were recorded (Appendix II).

After evisceration, the genital systems of the selected goats were examined. Systematic examination of the female reproductive organs involved cervical, uterine, fallopian tubes and ovarian critical evaluation. Evaluation was by visual appraisal, palpation and incision. Lesions were described by their size, consistency, colour, shape, smell or location as it required. In addition, the reproductive status of the individual goats was ascertained basing on ovarian features and uterine contents. For pregnant goats, the approximate age of the foetus was determined by measuring the crown-rump length and computation using the formula suggested by Arthur *et al*. (1983). Any lesion-bearing reproductive system on any segment was sampled on every segment of the genital system, put in well labelled containers and transported to the Faculty of Veterinary Medicine, Makerere University for fixation in 10% buffered formalin. The tissue samples were sectioned into small pieces to ensure rapid fixation.

3.4. Preparation of tissue samples for microscopic examination

After ensuring thorough tissue fixation, the tissues were rinsed with tap water, trimmed (at least 2 sections per segment of sample) and processed for Haematoxylin and Eosin staining procedure as per the methods described in the Manual for Laboratory Methods in Histotechnology (AFIP, 1994). Special staining was done where necessary for diagnosis confirmation.

3.5. Histopathological examination

The processed slides were examined by light microscopy at various magnifications. Microscopic findings were described and then matched with gross lesions to give a lesion diagnosis. Where possible the aetiological diagnosis was accordingly ascertained. Photomicrography was done on selected tissue slides.

3.6. Data analysis

The study generated qualitative data. Descriptive statistics were used in data analysis. Percentages of the various lesions were computed and chi-square was used to test the influence of parity on the prevalence of the lesions.

CHAPTER FOUR

RESULTS

4.1. Prevalence of gross lesions in doe genital organs

Gross lesions were detected among 209 (20.90%) of the 1000 female reproductive systems of goats sampled during the seven months study period. Lesions that can cause infertility occurred in 60.8% (n=127) while those that can result into sterility occurred in 4.3% (n = 9) of the doe genitals with lesions.

4.2. Origin of sampled does and distribution of gross genital lesions

Of the 1000 genital systems examined, 848 and 152 were drawn from Uganda Meat Industries and Kampala City Council abattoirs, respectively. These abattoirs received goats from 23 districts of Uganda during the study period (Appendix III). However, the origin of 228 sampled goats could not be established (Table 1).

Table 1: Regions of origin of sampled does

Region	Number of goats sampled (n=1000)	Number of goats with genital defects (n=209)
Western	365 (36.5%)	81 (38.8%)
Central	396 (39.6%)	86 (41.2%)
North-Eastern	11 (1.1%)	01 (0.5%)
Unknown	228 (22.8%)	41 (19.65)

Luwero District of the central region had the biggest proportion (62.5%) of goats having gross lesions of female genital organs (Appendix IV). Bushenyi, Isingiro, Kayunga, Kibaale, Masindi (Western region), Soroti (North-Eastern region) and Wakiso (Central region) did not have any of the sampled goats having detectable gross genital lesions (Appendix IV).

4.3. The relationship between doe age and prevalence of genital lesions

All sampled goats were grouped into nulliparous and parous goats basing on age. Of the 1000 goats sampled, 34 (3.4%) were nulliparous (<1.5 years) while 966 (96.6%)

were parous (≥1.5 years). Of the 209 goats with genital defects, only five (2.4%) were nulliparous and the rest parous (97.6%)

4.4. Relationship between breeds of goats examined and prevalence of genital defects

Of the 1000 female goats sampled, 989 goats were local and the rest boer goat crosses. Only four crosses were among goats with genital defects while the remaining 205 goats with gross lesions of genital tracts were local. Since the number of crosses was very low compared to that of the local goats, no statistical relationship was elucidated from the findings.

4.5. Cervical lesions

Abnormalities of the cervix were detected in 26 (2.6%) genital tracts of the 1000 goats sampled. Cervical lesions included cervicitis, haemorrhages and adenomyosis (Table 2).

Table 2: Prevalence of cervical lesions among female goats (n=209)

Cervical lesion	Number of affected goats	%
Cervicitis (overall)	14	6.7
i) Chronic cervicitis	09	4.3
ii) Acute cervicitis	04	1.9
iii) Hemorrhagic necrotising cervicitis	01	0.5
Cervical haemorrhages	03	1.4
Cervical adenomyosis	09	4.3

Cervical inflammation was evident in 14 (6.7%) cases among the genital tracts with gross lesions. Acute cervicitis occurred in association with foetal maceration, purulent vaginitis and open pyometra. Grossly only two cases were detected. These were characterized by cervical mucosa hyperaemia and coverage by thin creamy or serosanguinous exudates and in one case there was prolapse of the caudal cervical rugae. Histologically only the mucosa was involved. There were haemorrhages and diffuse mucosal infiltration by neutrophils and hemorrhages. Chronic (or sub-chronic) cervicitis was only detectable microscopically in association with endometritis. The mucosa of the cervix was diffusely infiltrated by mononuclear cells notably lymphocytes, plasma cells and a few macrophages.

Haemorrhagic necrotising cervicitis was detected in a two and half year old doe from Kyenjojo District of Western Uganda The external cervical opening was dilated, ruptured and deformed grossly. On sectioning the caudal part of the cervical mucosa was brownish and necrotic with a green-black tinge. The cervical canal was filled with coagulated blood. Histopathology revealed extensive necrosis of the cervical wall, hemorrhage and diffuse infiltration by lymphocytes, plasma cells and a few neutrophils (Figure 2). Also evident was the extensive fatty tissue infiltration into the necrotic cervical wall.

Only relatively extensive cases of cervical haemorrhages were found in this study. These included focal or multifocal mucosal hemorrhages ranging from one to two centimeters in diameter. Grossly, they appeared as red or brown foci in the cervical mucosa (Figure 5). Majority (66.7%) of the haemorrhages occurred independent of other gross cervical lesions.

Cervical adenomyosis was an incidental finding detected only microscopically in nine (4.3%) goats. It was characterized by the occurrence of gland islands deep in the cervical musculature. Three cases occurred concurrently with uterine adenomyosis in the same genital system. One case occurred in association with the granulose-thecal cell ovarian tumour. The later case was characterised by the occurrence of multifocal islands of closely packed cystic glands in the cervical musculature (Figure 3).

4.6. Uterine lesions

The uterus exhibited the highest level of diversity and frequency of lesions of all the genital system segments studied (Table 3). Out of the 209 reproductive tracts that had gross lesions; 148 (14.8%) had either gross and/ or microscopic uterine lesions.

Table 3: Uterine lesions among doe reproductive tracts examined

Lesion	Number of affected goats	% of affected goats (n = 209)	Overall lesion prevalence (%) (n=1000)
Uterine adenomyosis	54	25.8	5.4
Chronic endometritis	39	18.7	3.9
Uterine haemorrhages	30	14.4	3.0
Purulent endometritis	20	9.6	2.0
Intrauterine foetal death	19	9.1	1.9
Hydrometra	05	2.4	0.5
Pyometra	04	1.9	0.4
Metritis	03	1.4	0.3
Uterine serosal cyst	02	0.96	0.2
Unilateral caruncular necrosis	02	0.96	0.2
Endometrial hyperplasia	02	0.96	0.2
Uterine melanosis	01	0.48	0.1
Post parturient emphysematous metritis	01	0.48	0.1
Perimetritis	03	1.4	0.3

Uterine adenomyosis was an incidental finding at microscopy. No specific gross lesions were discerned as characteristic of the lesion. Histologically, two forms of uterine adenomyosis were described in this study. The “infiltrative form” occurred in 14 cases, where the endometrial glands and stroma extended deep into the myometrium far beyond the junction between the endometrium and myometrium. The second form of uterine adenomyosis was detected in 36 (17.2%) uteri, and was characterized by presence of endometrial tissues islands or discrete clusters in myometrium with no communication with the endometrium (Figure 4). Four of the cases had both forms of presentations of uterine adenomyosis. The myometrial glands were all at the same cycle stage as the endometrial glands. In two cases, the ectopic glands were cystic. Adenomyosis occurred in goats of all age groups.

With the overall prevalence of 3.9% (n=39), chronic endometritis was the second most prevalent lesion during the study period. Gross features were not evident in many cases but for those where gross lesions were detected; they were only seen on the uterine

mucosa following organ incision. These included focal or multifocal white to grey foci or nodules and in some cases cysts of about one to five millimeters in diameter. The palpable nodules were firm in consistency and some were necrotic and gritty on incision. In a few cases the uterus was slightly thicker than normal. Histologically, the tissue changes were sub-grouped into chronic non-purulent endometritis and granulomatous endometritis.

Granulomatous endometritis occurred in six (2.9%) cases. Four of these cases were associated with nodular lesions seen grossly, while the other two cases were not grossly apparent. Histologically, multifocal endometrial caseous necrosis and cystic glandular distension were evident in some cases. The necrotic foci were encapsulated and surrounded by rims of mononuclear cells especially macrophages as the dominant cells in addition to plasma cells, lymphocytes and a few langerhan's giant cells (Figure 6). Neutrophils were detected in the lumens of some glands. Endometrial fibrosis was evident in majority of the cases. Other cases of granulomatous endometritis presented with multifocal macrophage aggregations interspersed with a few Langerhan's giant cells (Figure 7). Other mononuclear cells were also present in the endometrium. Tissue sections stained with Ziehl-Neelsen stain did not suggest presence of acid-fast bacteria.

Chronic non-purulent endometritis which occurred in 33 cases was characterized by diffuse to multifocal lymphocytic infiltration of the endometrium as the dominant feature. Plasma cells, scanty macrophages and neutrophils were also present in some sections. Superficial glands were distended and some contained cellular necrotic debris. Endometrial fibrosis especially around the glands was evident in some cases. Endometrial denudation was detectable in some of the cases. Affected goats were two years and above.

Uterine haemorrhages occurred in 30 cases in association or independent of other lesions. Uterine haemorrhages were seen as focal to multifocal 6 mm – 30 mm brown to red or black foci in the uterine mucosa (Figure 5) or myometrium on sectioning of the uterus. Histologically, foci of extensive erythrocytes extravasations or yellow to brown pigment were seen in the uterine tissues. In 60% (n=18) 0f these cases leucocytic infiltrations were detected around the affected area. In one case of myometrial hemorrhage, the surrounding tissues were necrotic.

Purulent (acute) endometritis encompasses all cases of uterine infections characterized by massive endometrial infiltration by neutrophils (Figure 8) but no pus accumulating in the uterus. Post-parturient endometritis, foetal maceration-associated endometritis and ascending uterine infections are all included here. Other than the massive endometrial infiltration by neutrophils, acute endometritis was also characterized by mucosal erosions, congestion of blood vessels, endometrial oedema, haemorrhages and glandular distension. The gross presentation varied slightly in the three categories of lesions grouped under acute endometritis.

There were 15 (7.2%) cases of post-parturient metritis described. Unilateral or bilateral uterine distension by luminal serosanguinous to chocolate coloured exudates, mucosal oedema, hyperemia (in some cases) and hemorrhage were the main features of post-parturient metritis (Figure 5). In some cases the uterine wall was collapsed and caruncles necrotic. The lochia were oozing out of the partially open cervix. Foetal membranes were not detected in any case. Foetal maceration and ascending infection-induced acute endometritis were less apparent grossly except for the thin pussy-exudate matting the mucosal surface and mucosal oedema. The vagina and/or cervix contained pussy exudates or foetal bones in case of foetal maceration.

Dead fetuses and/or evidence of foetal death occurred in 19 (9.1%) cases. Of these, 15 and 3 cases were undergoing mummification and maceration, respectively, while in one case, the foetus had recently died. The case of a recently dead foetus was of a pregnancy of about 2 months in gestation. The foetus and foetal membranes were autolytic; the cervix was closed and the corpus luteum was present in the left ovary. The uterine wall was icteric but without evidence of uterine inflammation was observed histologically. Inspection of the carcass of the dam revealed generalized jaundice.

Foetal mummification was the most frequent fate (7.2%) of dead fetuses in this study. Advanced desiccation of the uterine contents characterized by dried, shrunken and firm foetal membranes and fetuses occurred in four (1.9%) cases. The remaining 11 (5.3%) cases had varying degrees of dehydration characterised by a watery red to thick red and brown fluid bathing autolytic placentae and fetuses (Figure 9). In all cases caruncles were necrotic and some had petechiae on removal of the placentae. Corpora lutea were present in all cases in one or both ovaries and the cervices were closed. Five (2.4%) of the cases were twin pregnancies. In all these cases, all fetuses were affected and

at the same stage of mummification. The mummifying fetuses were in the second trimester and above. Histopathology revealed uterine caruncular necrosis with foci of calcification in some cases. In the majority of the cases (73.3%), mononuclear infiltrations especially of lymphocytes and plasma cells were evident. Six (40%) of the uteri carrying mummified fetuses exhibited adenomyosis and four (26.7%) cases had multifocal cystic glandular distension.

The three (1.4%) cases of foetal maceration were characterized by presence of foetal bones in the uterus, cervix and/or vagina as the major consistent feature. In two cases, the uterine mucosa appeared oedematous and covered by a thin layer of a pussy exudate but no uterine distension. In one case, the uterus grossly looked defect-free but the vagina contained thick pus and few fragments of foetal bones. Histologically, all the three cases exhibited purulent vaginitis, cervicitis and endometritis. It was difficult to ascertain the foetal age at the time of maceration since only few bones were recovered.

Two cases endometrial hyperplasia were detected and occurred in association with a cystic graffian follicle and granulosa–thecal cell tumour, respectively. The former was grossly characterized by endometrial thickening with few multifocal pinpoint mucosal cysts. Histologically, the glands were increased in number (closely packed) and size but few were slightly distended. The single granulosa–thecal cell tumour case was characterized by uterine atrophy but having multiple one millimeter diameter cysts in the mucosa. Histopathology revealed extensive glandular distension with some glands containing cellular necrotic debri and viable neutrophils. The uterine stroma was also heavily infiltrated by inflammatory cells especially neutrophils (Figure 11).

Hydrometra (pseudopregnancy) was detected in five (2.4%) female goats. It was indicated by the accumulation of a clear fluid in the uterus with or without fetal membranes in the presence of corpora lutea in one or both ovaries and the associated cervical closure. In the three cases where foetal membranes were evident; the chorioallantois was distended by a clear fluid of about 0.5 to 1 litre while the amnion contained a dirty brown fluid with necrotic debri of about 10-50 milliliters. The caruncles and foetal membranes were necrotic and the uterus thin walled. The two cases of hydrometra in which foetal membranes were not evident were characterized by a thin and translucent uterine wall in addition to endometrial atrophy (Figure 10). The watery fluid volume was about one litre in the two cases.

Uterine caruncular necrosis with foci of calcification and glandular distension especially of superficial glands occurred in cases with foetal membranes histologically. Endometrial glands were flattened in the uteri where the fluid had accumulated in the lumen in absence of foetal membranes. In all cases there was mild lymphocytic and other mononuclear cellular infiltration of the endometrium. Affected goats ranged from 2½ to 6 years of age.

Pyometra was observed in four (1.9%) does. Grossly, it presented with either unilateral or bilateral uterine distension by about 50mls to 250 mls of pus. The colour of pus was creamy in two cases and yellowish with a brown to red tinge in the other two cases. The uterine wall was thickened and hyperemic to variable degrees. Two cases were classified as closed pyometra given the functional closure of the cervix in presence of corpora lutea in the ovaries (Figure 12). Pus could readily flow out of the uterus through the partially open cervix on slight application of pressure on the uterus in two cases. In the two cases of open pyometra, the uterine horns were asymmetrically distended. The uterine mucosa was swollen in all cases and in one case of closed pyometra it had multifocal white foci and cysts all of about one millimeter in diameter. The histopathological appearance was basically that of severe persistent purulent metritis. The later was evidenced by massive endometrial infiltration by neutrophils; mucosal erosion, vascular congestion and widespread glandular distension by a purulent exudate. Lymphocytes and a few plasma cells were also present in all the uterine layers. Periglandular fibrosis was detected in one case. Salphingitis also occurred in association with pyometra. Affected goats were aged two to five years.

Only three (1.4%) cases of metritis were described and all were chronic in nature. Grossly, multifocal uterine endometrial cysts and white foci of about one millimeter in diameter were evident but the uterus appeared to be of normal size. Histopathology revealed diffuse to multifocal mononuclear cellular infiltrations in all uterine wall layers, although the endometrium was more severely affected. Lymphocytes were the dominant cells but plasma cells and macrophages were also present. Endometrial fibrosis, glandular atrophy and multifocal distension by cellular debri were also evident. Glandular and mucosal epithelial linings appeared eroded in two cases. Meanwhile, only two (0.96%) cases of uterine serosal cysts were observed. These were fluid filled cysts of 5mm and 3mm respectively on the greater curvature of the uterus. Histological examination did not

reveal any abnormality but the two cases were associated with extensive uterine adenomyosis.

Uterine melanosis which was observed in only one case (0.48%) presented with uterine caruncular and small intercaruncular foci of blackening grossly. Histologically melanin was detected as a brown granular pigment in the superficial endometrial layer especially in the caruncles (Figure 16). This was in a uterus of a pregnant two and half year old goat from Mbarara district of Western Uganda.

Post-parturient emphysematous metritis was detected in a puerperal uterus of a 3½-year-old goat from Mpigi of Central Uganda. It was characterized by a thick and doughy uterine wall, oedema and haemorrhagic necrotic caruncles. The uterus appeared icteric from the serosa. Histopathology revealed caruncular necrosis, oedematous endometrium and myometrial infiltration by air spaces (Figure 13). The myometrium had foci of necrosis. All uterine layers contained scanty multiple foci of mononuclear cells especially lymphocytes and macrophages. Endometrial glands were scanty and slightly distended. Some glands contained few neutrophils.

Unilateral caruncular necrosis lesions were detected in pregnant goats of 2½ years. In all cases the right uterine horn was gravid with normally developing foetus and gross lesion-free placenta but the left horn was devoid of foetal membranes and its caruncles appeared necrotic. The ovaries had more than one corpus luteum hence evidence of foetal or embryonic loss. Histologically, the caruncular superficial layers were necrotic and the endometrium of the affected side was mildly infiltrated by lymphocytes, plasma cells and scanty neutrophils.

Perimetritis was observed in three (1.4%) cases and occurred in association with ovario-bursal adhesions. Grossly, a creamy fibrinous material was adherent to the uterine serosa either in a focal or diffuse manner hence a rough uterine serosa (Figure 14). A fibrino-mononuclear material was detectable histologically in the uterine serosa. Lymphocytes and plasma cells were the major inflammatory cells.

4.7. Salphingeal lesions

Salphingitis and hydrosalphinx were the only types of defects detected in the uterine tubes. There were 37 (17.7%) and 8 (3.8%) cases of salphingitis and

hydrosalphinx respectively. Salphingeal lesions therefore had an overall prevalence of 4.5% (n=4).

Hydrosalphinx was described eight (3.8%) cases and occurred in association with ovario-bursal and tubo-bursal adhesions. Three cases were bilateral and the rest unilateral. At the point of salphingeal distension, the oviducts appeared thin walled and translucent with a diameter ranging from 4 mm to 10 mm. The affected segment varied from 20mm to 78mm in length. The uterine tubes appeared more tortuous in severe cases (Figure 14). The distending fluid was watery. Histologically the mucosal folds were somewhat flattened. Lymphocytes and plasma cells were evident in the mucosa. Salphingitis occurred in association with uterine inflammations associated with pyometra and 33 cases of endometritis. None of the cases was evident grossly. Histologically, the presentations were similar to those of the associated uterine defect but mild in nature.

4.8. Ovarian lesions

Gross morphological abnormalities of the ovary were detected in 86 (41.2%) reproductive systems. Of these, only 47 (22.5%) had lesions that can result into infertility or sterility. There were eight types of ovarian lesions described in the present study (Table 4).

Table 4: Ovarian lesions detected among goats with gross genital defects

Lesion	Number of goats affected	% of total with defects (n=209)
Ovario-bursal and tubo-bursal adhesions	37	17.7
Paraovarian cysts	22	10.5
Cystic corpora lutea	22	10.5
Ovarian inactivity	04	01.9
Cystic follicles	08	03.8
Luteal cysts	03	01.4
Cysticercus tenuicolis cyst	01	0.5
Granulosa-thecal cell tumour	01	0.5

Ovarian bursa adhesions to the ovary and the oviduct were the commonest ovarian lesions detected. Bilateral adhesions of the bursa to the ovary and the oviduct occurred in 11(29.8%) cases and the rest unilateral. The degree of adhesions varied from partial to

severe cases where the ovary and sometimes part of the oviduct were completely enveloped. Of the 37 cases detected, 33 were severe enough to cause infertility or sterility. Bursal attachments were by means of a white to creamy fibrinous material. In some cases, the adhesions were associated with hydrosalphinx (Figure 14), bursal cysts (Figure 18) or tubo-ovarian bursa cysts (Figure 17) depending on the severity and location of the occlusion point. There were eight, eight and seven cases of hydrosalphinx, bursal cysts and tubo-ovarian cysts respectively. Of these, three, four and one cases of hydrosalphinx, tubo-ovarian cysts and bursal cyst respectively were bilateral. A watery fluid ranging from 10mls to 25mls oozed out of these structures on incision. Histologically, the adherent surfaces had a fibrinous material with variable degrees of fibrosis within which few mononuclear cells (lymphocytes and plasma cells) were detected. There were 13 pregnant goats with cases of ovario-bursal adhesions. In nine of these, the sides of ovulation coincided with the side of adhesion. Affected goats were between 1.5 and 7 years but the majority (80%) were 2.5 to 5 years old.

Para-ovarian cysts were observed in 22 does (10.5%). These were 5mm to 30mm in diameter thin walled and round fluid-filled structures (Figures 14 & 15). The fluid was either watery to mucinous in nature. They were either within or attached to the ovarian bursa. Majority the paraovarian cysts were located between the ovary and the fimbriae.

Cystic graffian follicles included follicular and luteal cysts which were detected in eight (3.8%) and three (1.4%) cases respectively (Table 6). They occurred as single cysts of about 14mm to 20mm in diameter. Three cases of cystic graffian follicles were bilateral. They were either yellowish or milky white in colour. In cross section, the luteal cysts walls were about 2mm thick while the cystic follicles were thinner (Figure 19). Histologically, luteal cysts cavities were lined by a thin fibrous layer surrounded by luteinised thecal cells. Cystic follicles had a wall made of degenerative granulosa cells and a partially luteinised thecal cell layer. Two cases of luteal cysts and six of the cases of cystic follicles were described in association with ovario-bursal adhesions. Affected goats were between 1½ and 6 years but majority were aged 2½ years and above. Only one goat had its uterus with changes suggestive of endometrial hyperplasia.

Four primary cases (1.9%) of ovarian inactivity were described in this study occurred in emaciated goats of two to three years. The ovaries of both sides were devoid of mature follicle (<5mm in diameter) and/or corpora lutea and its degenerative stages (Figure 20A). The uteri of the same goats were atrophic. Their mucosae had very firm and atrophic caruncles. Only cases that did not have other primary lesions of the reproductive tract that can interfere with the activity of the ovary were considered.

Cystic corpora lutea were detected in 22 (10.5%) goats of which three cases were bilateral and the rest unilateral. These occurred either in presence or absence of other non-cystic corpora lutea in the ovary. They were one to two centimeters in diameter. The conspicuous cavity contained a brownish fluid in some cases (Figure 20B). Cystic corpora lutea were distinguishable from anovulatory luteal cysts by the presence of the ovulation papillae and the prominent luteal tissue grossly. *Cysticercus tenuicolis* cyst was also observed in one case (0.5%) and was attached on the serosa of left ovary at the uterine pole (Figure 15A). The ovarian bursa of the same side was mildly adhered to the opposite pole of the ovary.

Only single a case of ovarian neoplasia was described in a 3½ year old goat from Rakai district of central Uganda. The tumour was characterised as a granulosa thecal cell tumour basing on the gross and microscopic features. Grossly, the tumour occurred as a round mass of 50mm in diameter of the left ovary. The tumour surface was generally smooth but having some wrinkles at the free end. On sectioning, the tumour was dominantly cystic with small portions which were solid and white in colour. The biggest cyst was about 20mm in diameter and contained a serosanguinous fluid with necrotic debri. The ovary of the opposite side possessed a yellow cystic follicle of about 17mm in diameter but was atrophic. The uterus was also atrophic and it's mucosa had pinpoint white foci and cysts. At the salphingeal pole of the ovarian tumour was attached a round cystic structure of about 10mm in diameter enclosed by the ovarian bursa (Figure 21). Histologically, the ovarian stroma contained neoplastic cells arranged in various patterns. In some portions, the round neoplastic cells were diffusely infiltrating the stroma haphazardly and having few strips of stroma. In some parts of the tumour, typical Call-Exner bodies with or without a central eosinophillic fluid were detected (Figure 22). Large polyhedral eosinophillic cells sparsely occurred among the neoplastic cells in some areas, especially those that were diffusely infiltrated (Figure 23). The structure attached to

the tumour contained multiple cystic gland-like structures within a stroma of dense collagen (Figure 24).

Miscellaneous findings of this study included normal pregnancy that was detected in 38.4% of the goats examined. Of these 20.5%, 2.7%, 14.9% and 0.3% were twin, triplets, singles and quadruplets pregnancies respectively. The majority (79.2%) of the pregnant goats were in the first half of the gestation period. Embryonic loss (evidenced by the presence of fewer fetuses than the number of corpora lutea in the ovary) was detected in 6.8% of the pregnant goats. Mean while trans-uterine migration was seen in 107 (27.9%) pregnant goats. In two of these, two fetuses from the same side of ovulation all moved to the opposite side for implantation. Careful examination of pregnant uteri was done but no case of foetal blood vessels anastomoses was detected even among multiple foetal pregnancies (Figure 1).

Figure 1: Pregnant uterus: Foetal blood vessels anastomoses were not detected even among multiple foetal pregnancies

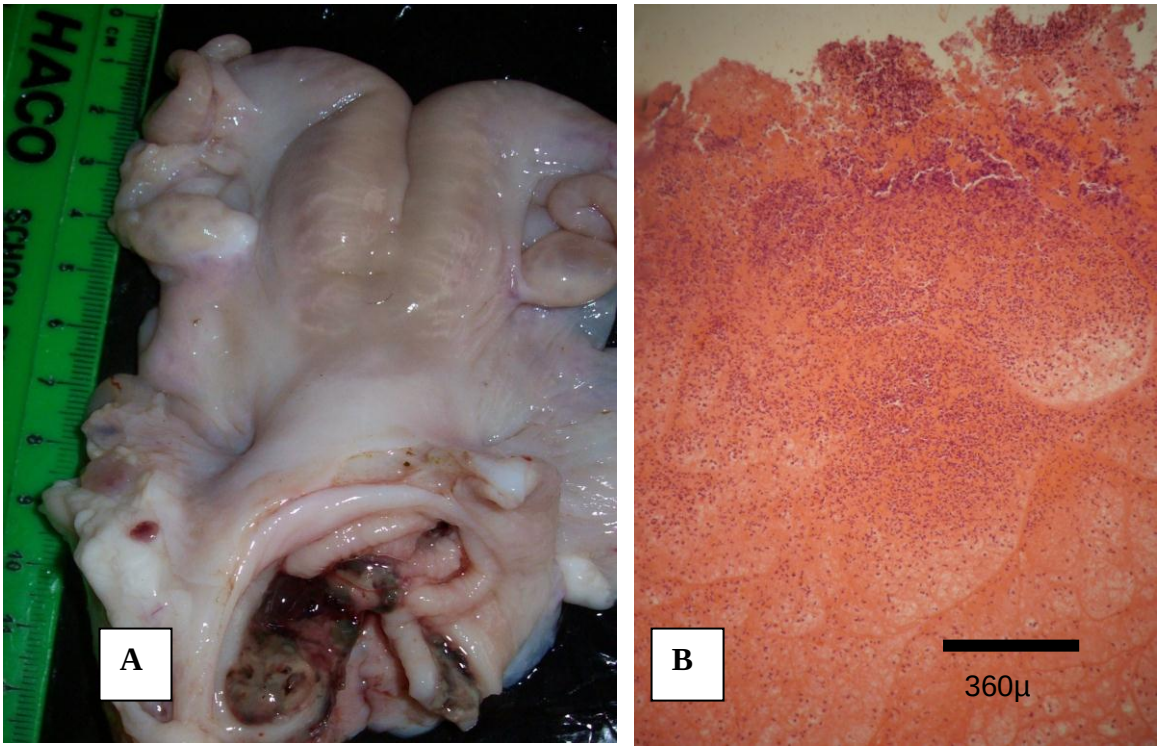

Figure 2: Haemorrhagic necrotizing cervicitis. Note the cervical canal dilation and haemorrhage (A). Diffuse cervical necrosis, haemorrhage and diffuse lymphocytic infiltration in the histological section (B)

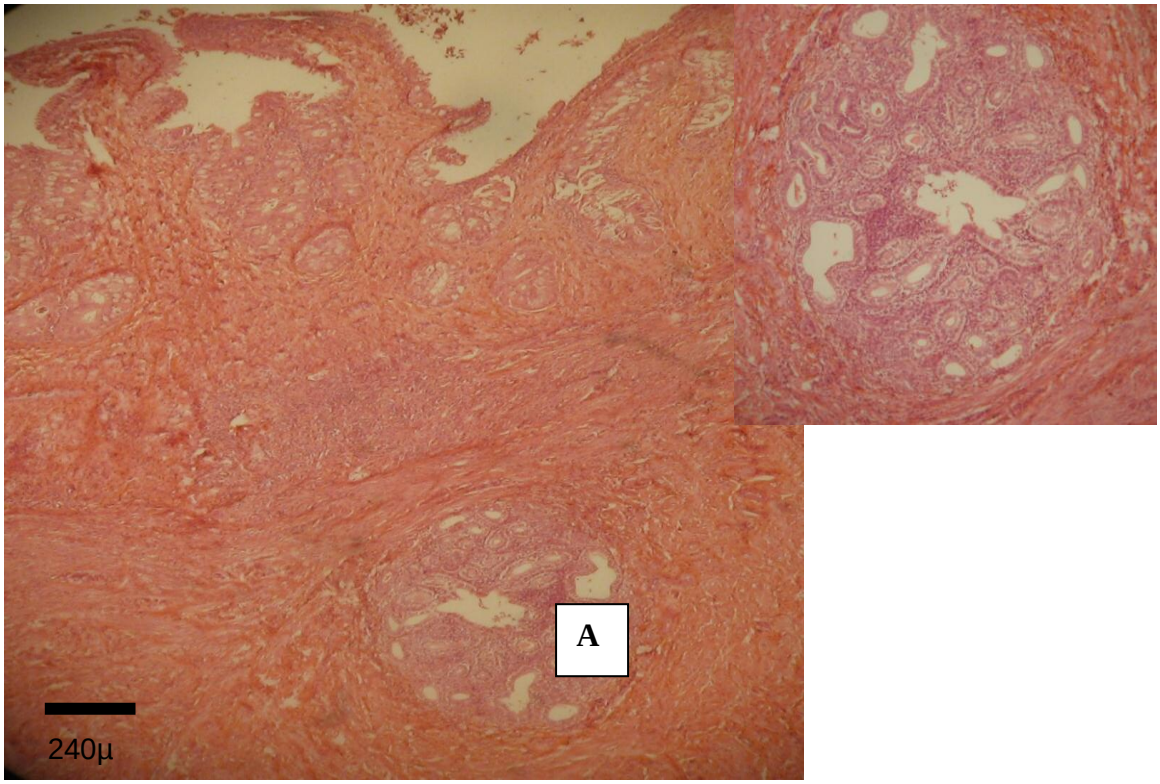

Figure 3: Cervical adenomyosis. Evident is a cluster of glands in the cervical musculature (A). Inset shows the glands at higher magnification

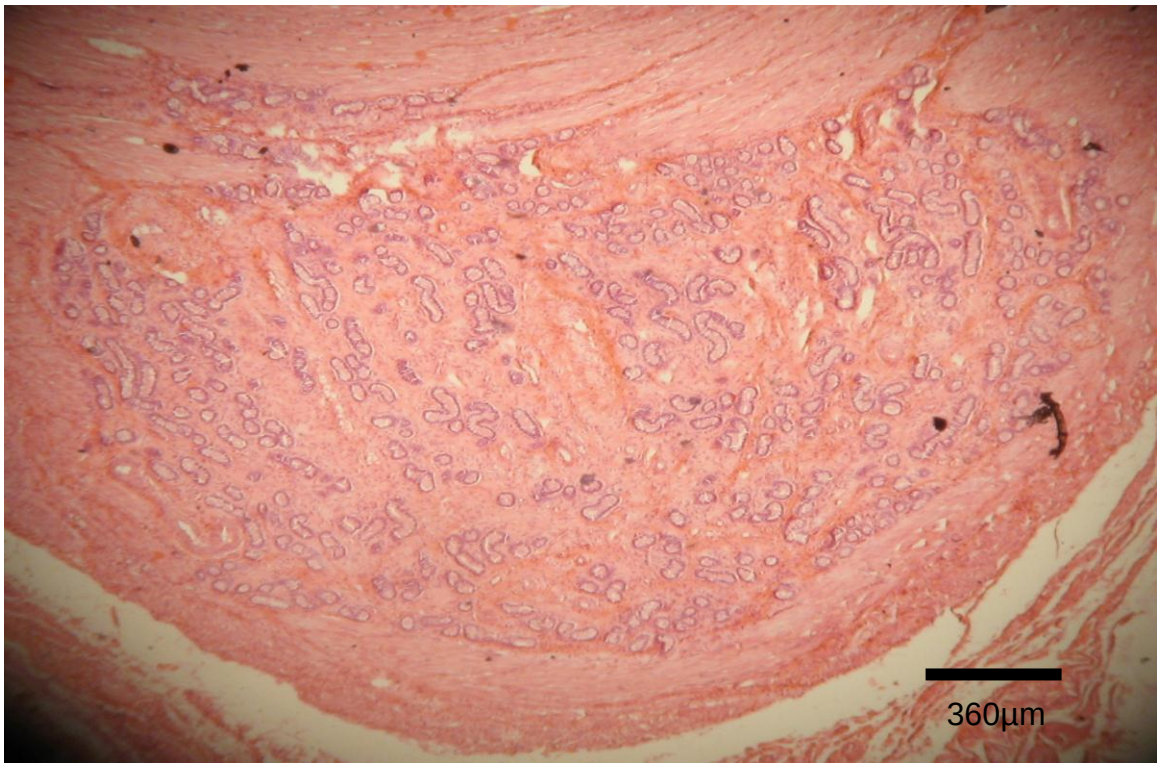

Figure 4: Uterine adenomyosis (presence of endometrial glands in uterine muscle)

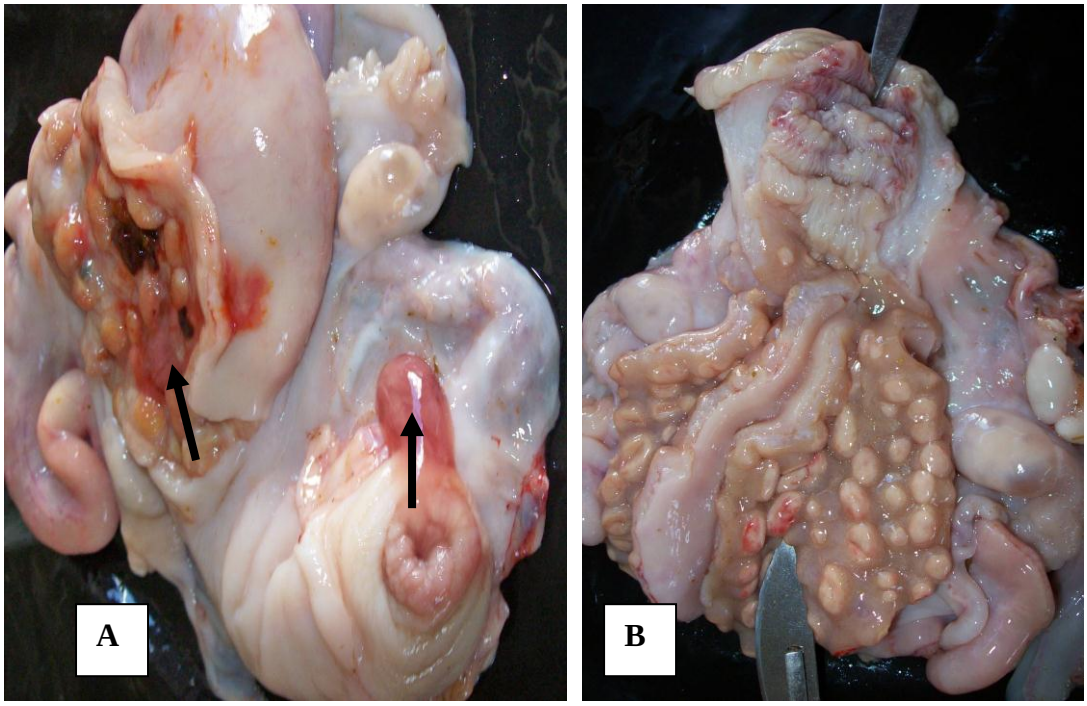

Figure 5: Post parturient endometritis (A). Note the serosanguinous exudate (arrows). Endometrial and cervical haemorrhages (B)

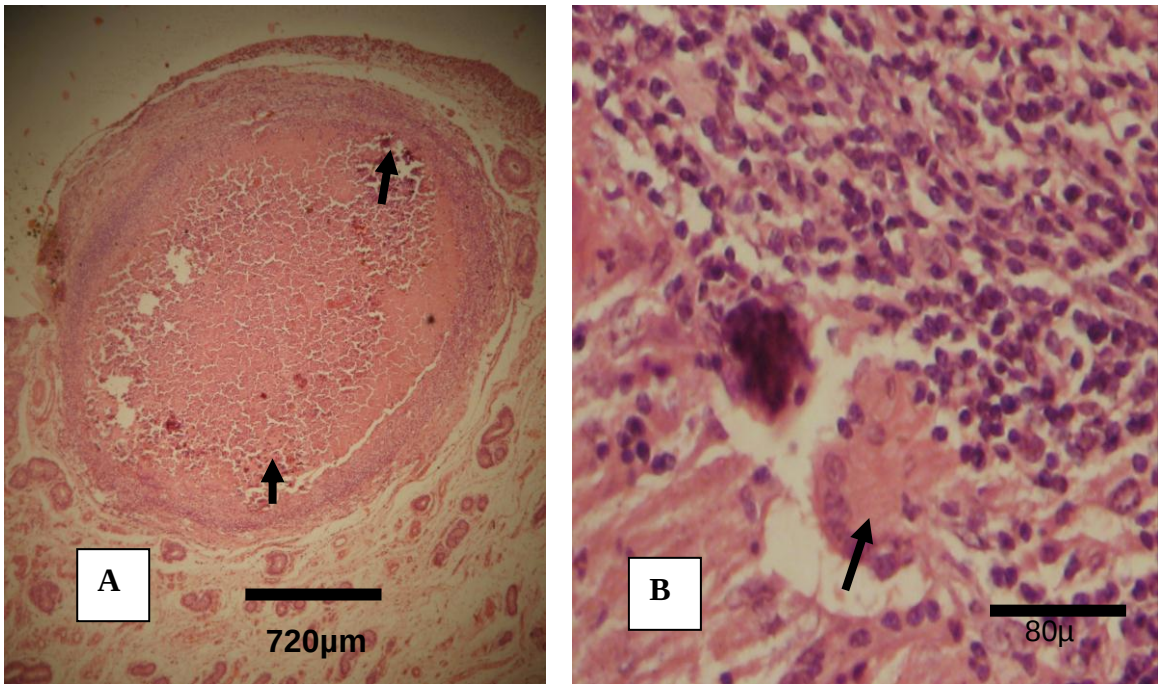

Figure 6: Granulomatous endometritis. A: Granuloma with foci of calcification (arrows). B: Higher magnification of A. Note the presence of the langerhans' giant cell at the periphery of the granuloma (arrow)

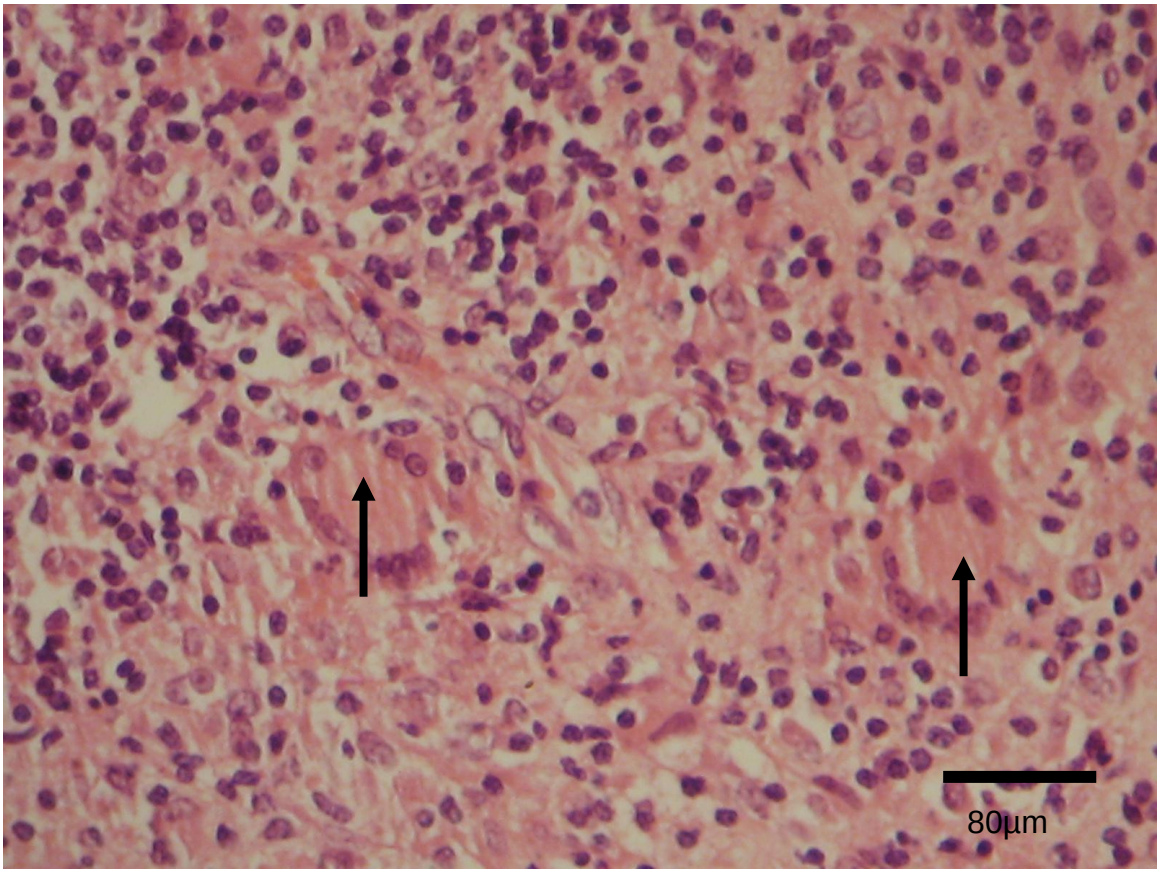

Figure 7: Granulomatous endometritis without necrosis and calcification. Langerhans' giant cells (arrows) are visible among mononuclear cells

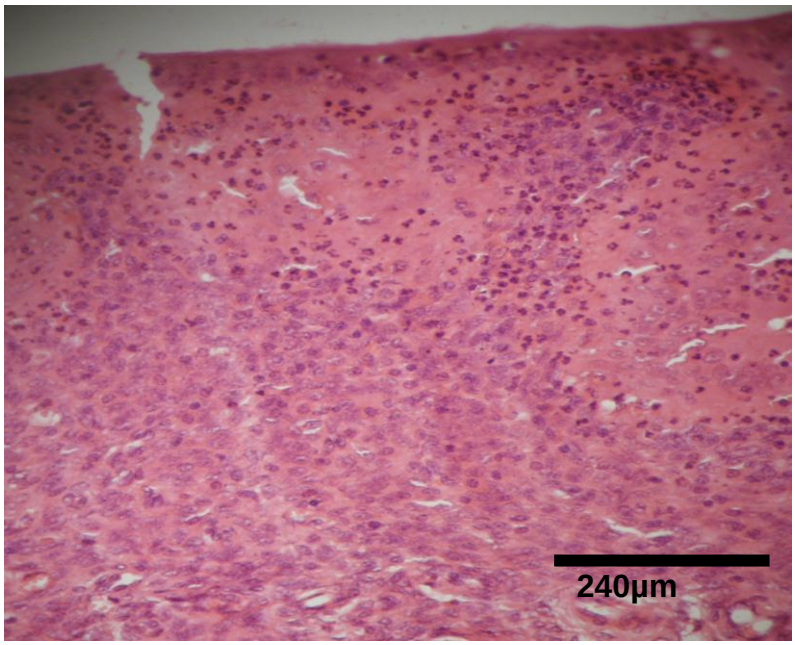

Figure 8: Acute purulent endometritis. Note the numerous endometrial neutrophils

Figure 9: Papyraceous foetal mummification (A and B). Note the completely dehydrated uterine contents (B). Haematic foetal mummification (C and D). Note the brown greasy uterine contents (C). D is the foetus extracted from the uterus in C

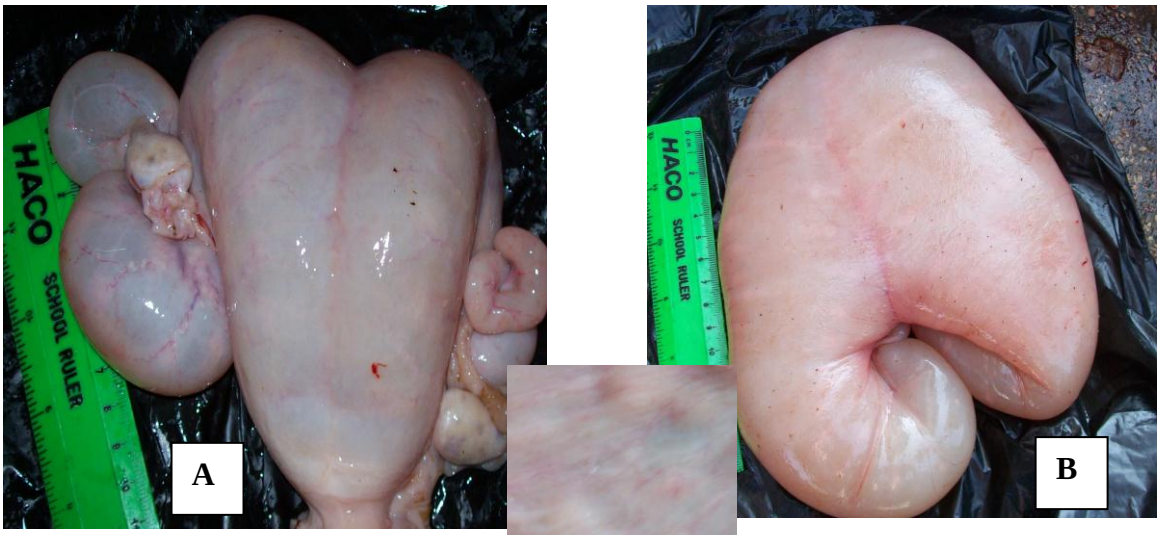

Figure 10: Hydrometra: Pseudo pregnancy with (A) and without (B) foetal membranes. Note the translucent uterine wall and the distension of the uteri in both cases. Inset is the uterine mucosa devoid of caruncles in B

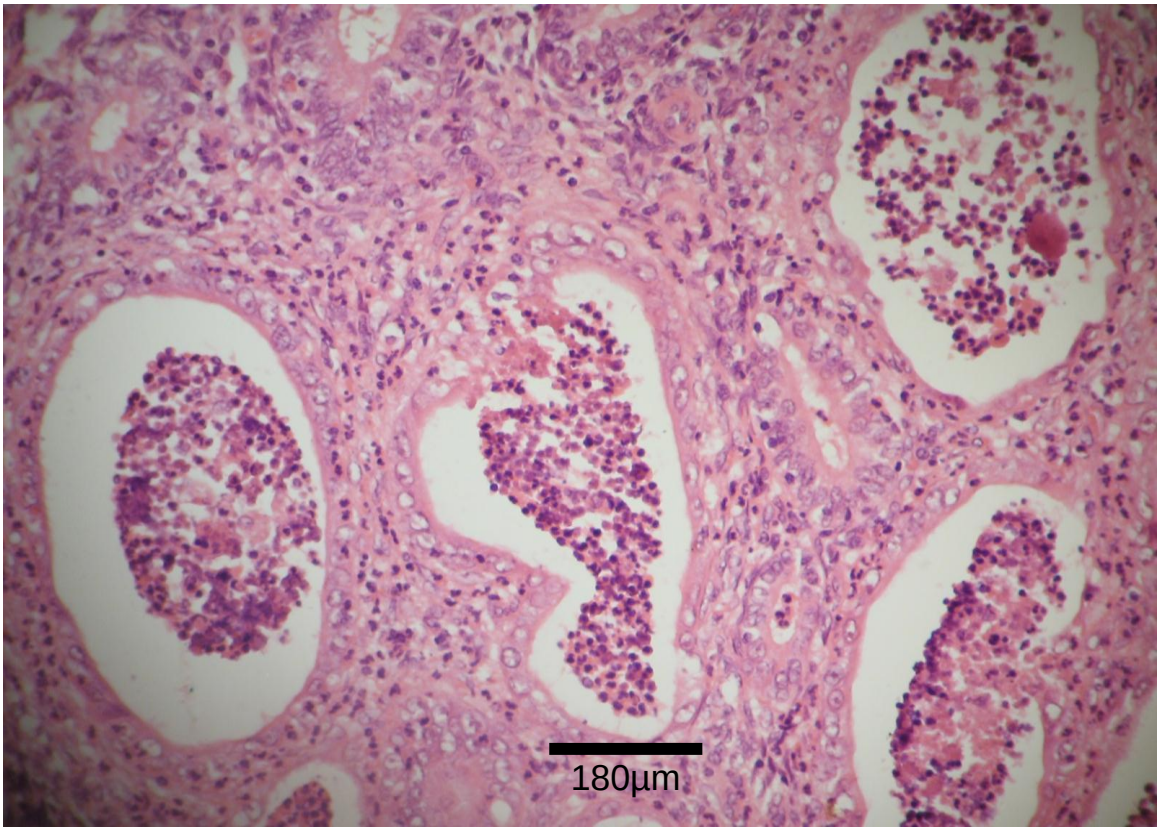

Figure 11: Cystic endometrial hyperplasia with endometritis. Note the numerous cystic glands, diffuse glandular and stromal infiltration by neutrophils

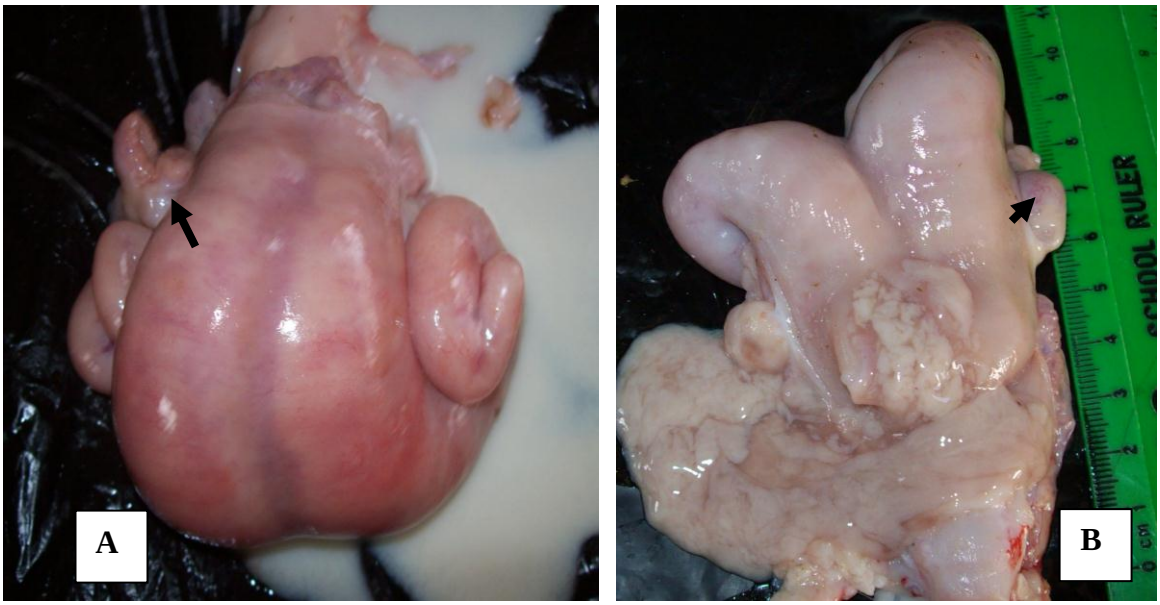

Figure 12: Pyometra: Corpora lutea (arrows) are evident in the right ovaries of both uteri in A and B

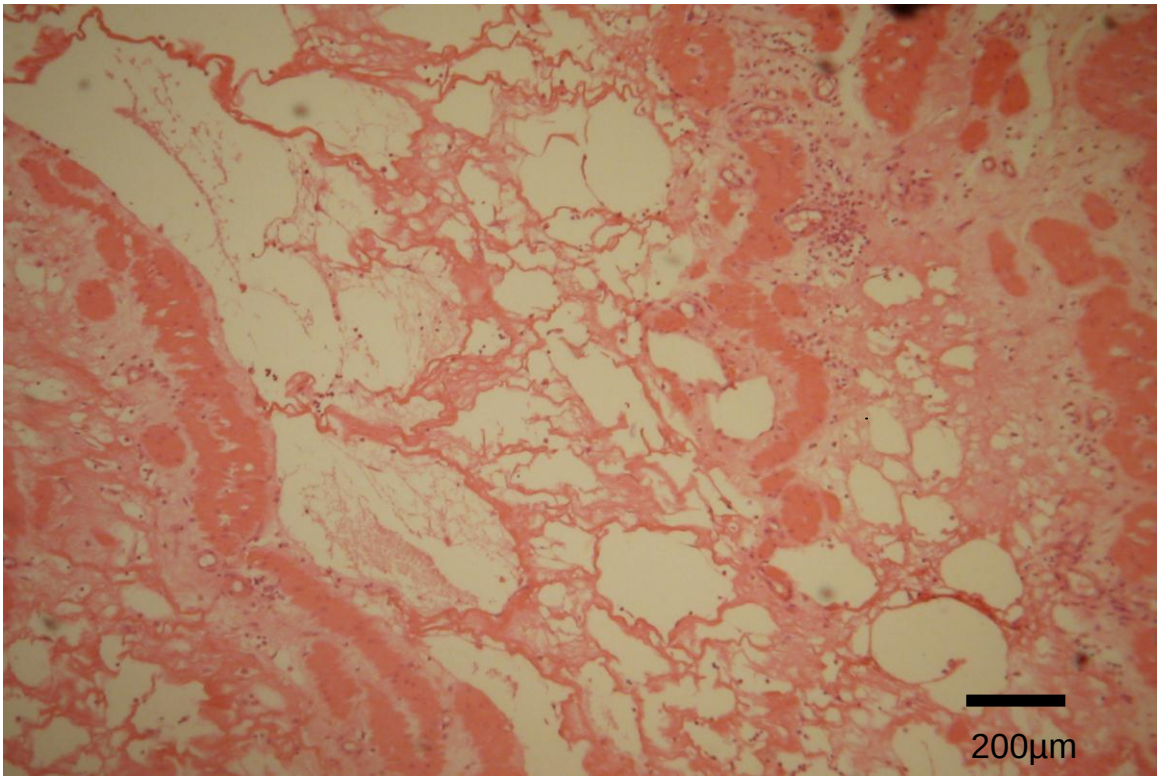

Figure 13: Post parturient emphysematous metritis: Note the air spaces in the degenerative myometrium and the infiltrating mononuclear inflammatory cells

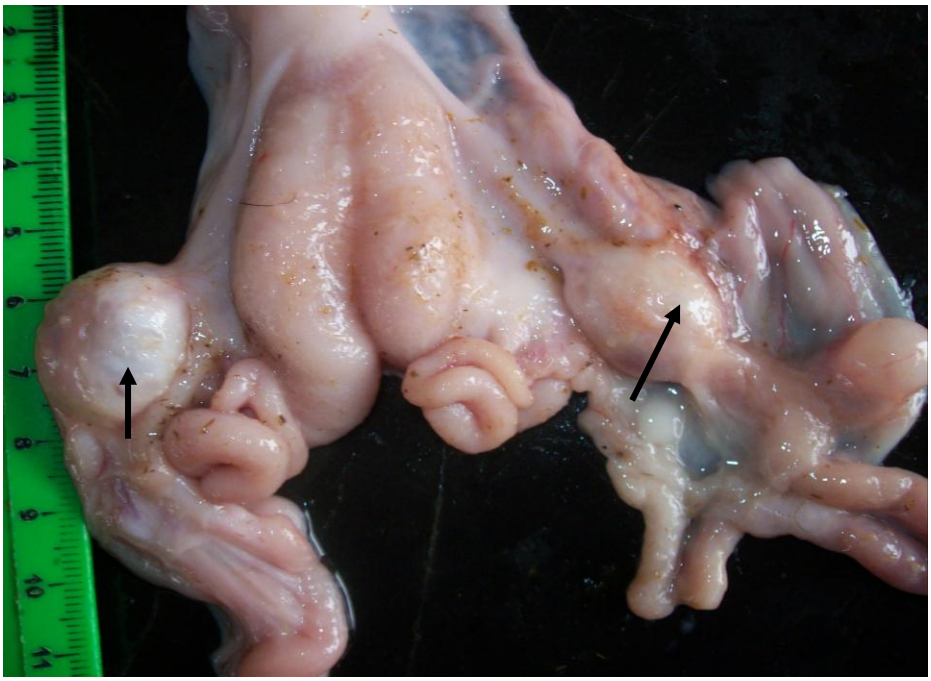

Figure 14: Perimetritis, cystic follicles (arrows) and bilateral hydrosalphinx. Note the extensive deposition of fibrin on the uterine, ovarian and salphingeal serosae

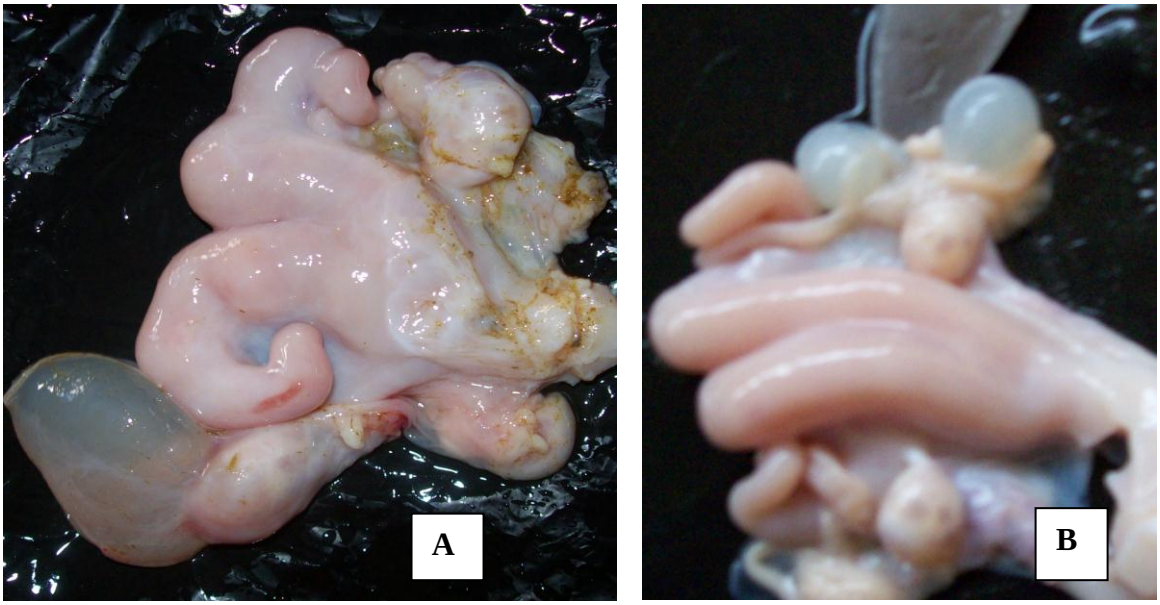

Figure 15: *Cysticercus tenuicolis* cyst attached to the left ovary (A) and paraovarian cysts in the right ovarian bursa (B)

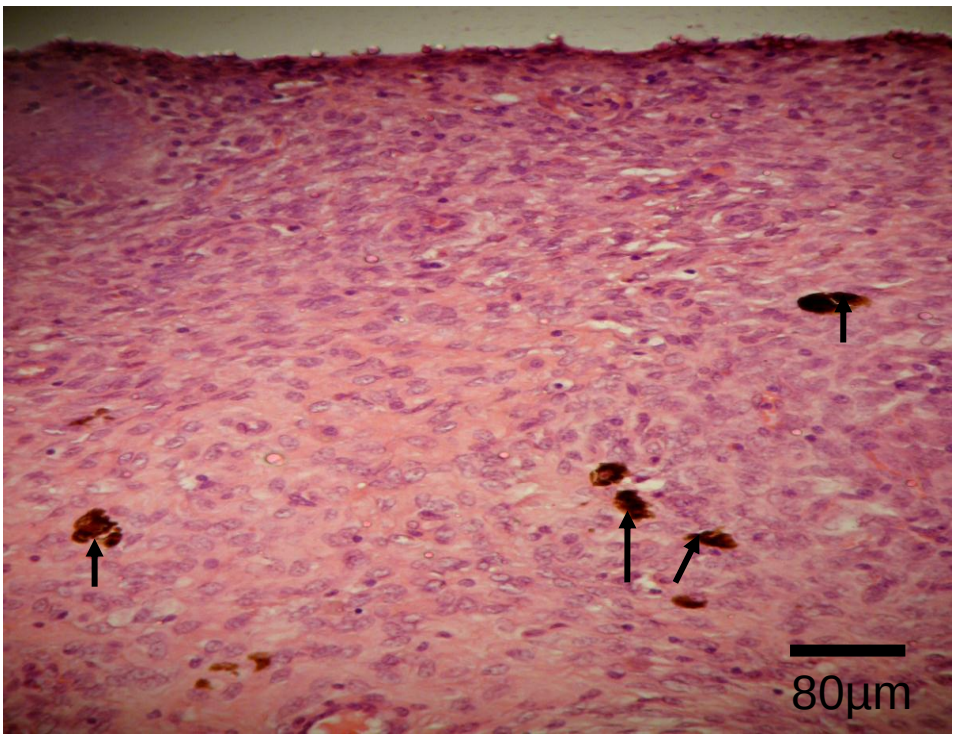

Figure 16: Uterine melanosis characterized by multifocal brown areas in the endometrium (arrows)

Figure 17: Bilateral tubo-bursal cyst: Note the bilateral distension of the oviducts and the ovarian bursae

Figure 18: Bilateral bursal cyst: There is bilateral accumulation of fluid in the ovarian bursa

Figure 19: Cystic ovarian disease**:** Cystic graffian follicle (arrow) and uterine wall thickening. Inset is the close up of the incised ovarian cyst. The uterine mucosa had numerous pin point cysts

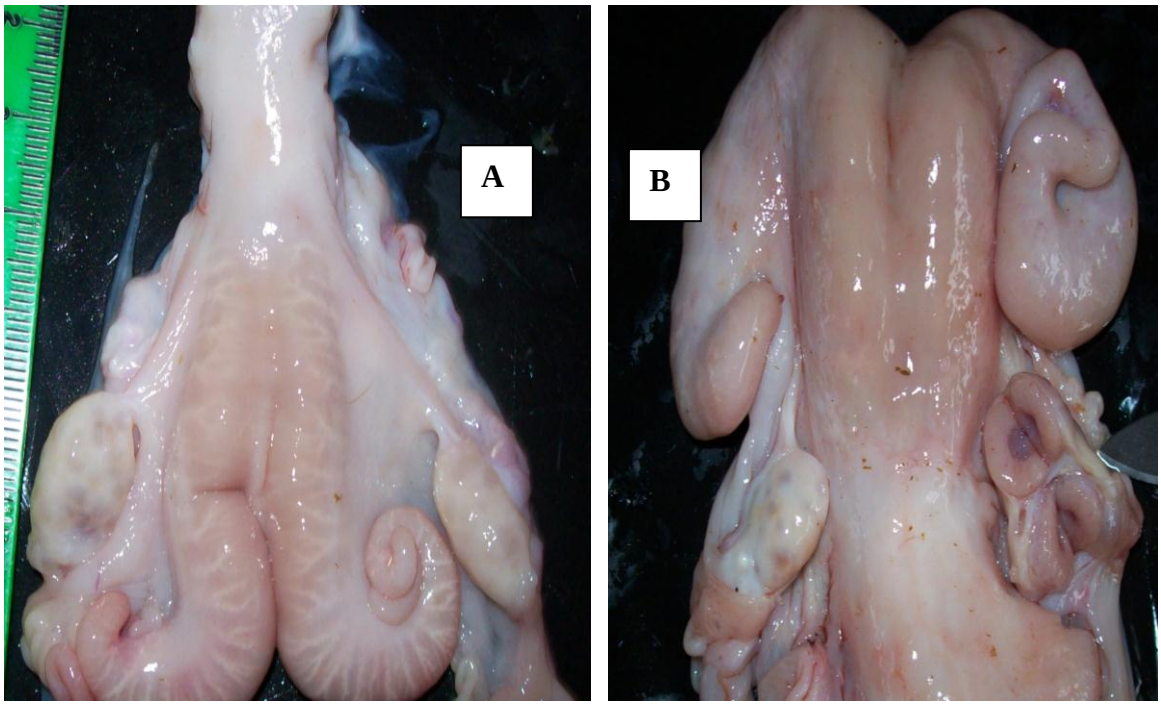

Figure 20: Inactive ovaries (A) and cystic corpora lutea (B)

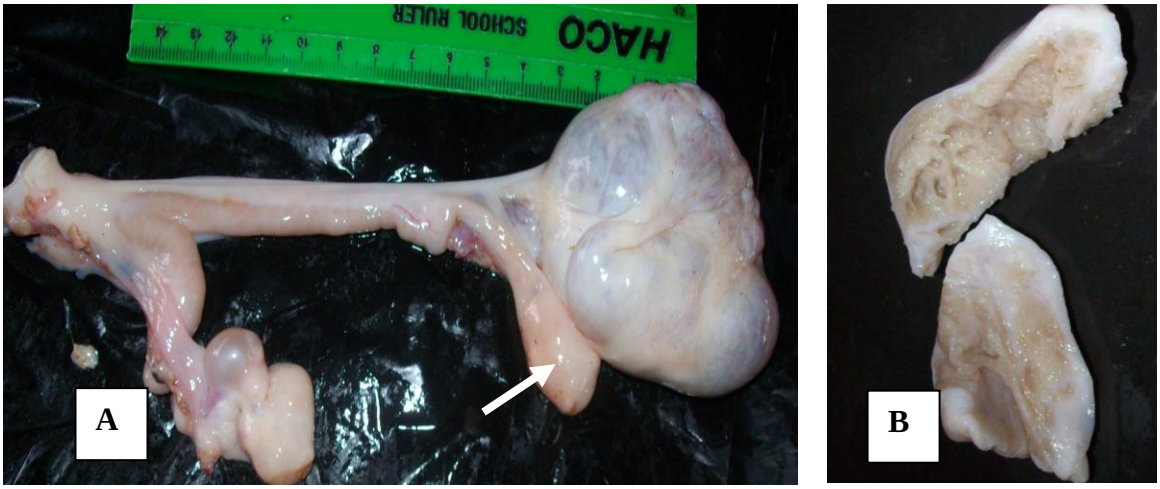

Figure 20: Granulosa thecal cell tumour of the left ovary and a cystic round structure attached on to the tumour (arrow). Note the general atrophy of the uterine horns. Solid and cystic portions of the tumour (B)

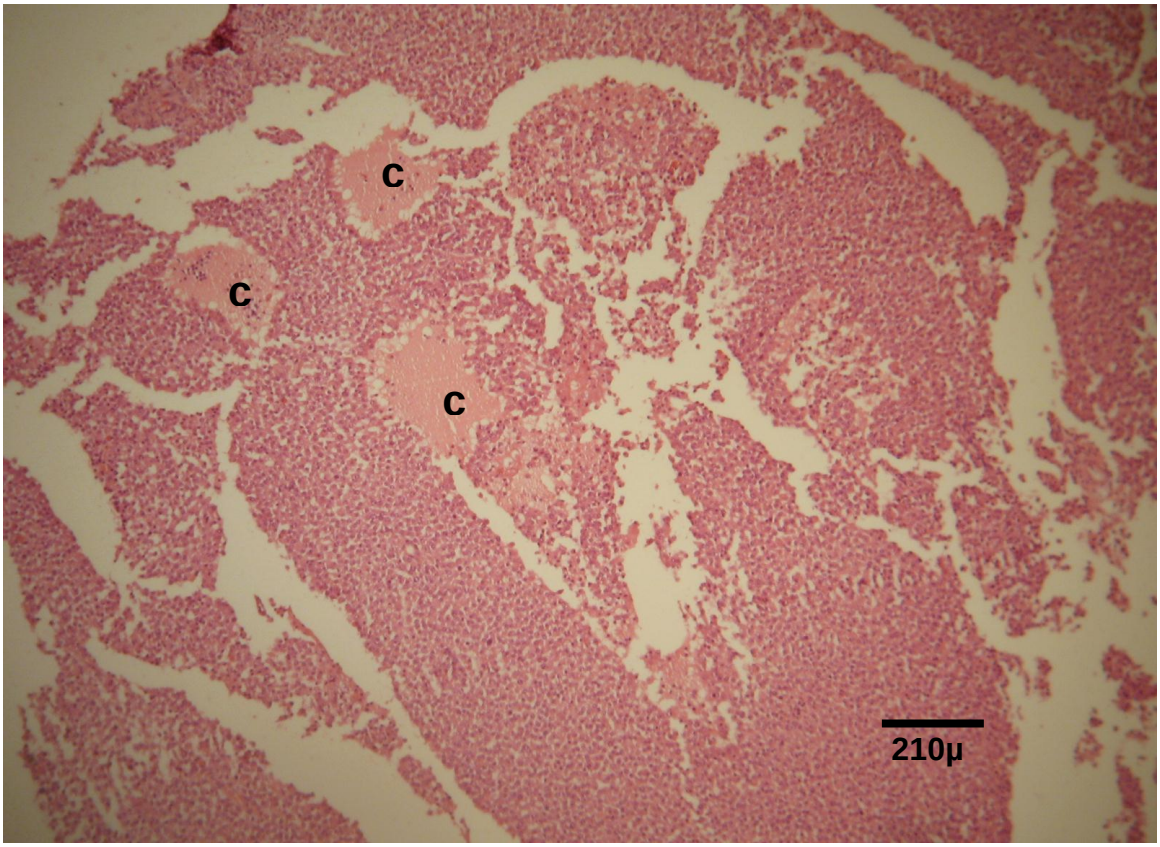

Figure 22: Granulosa thecal cell tumour: There is marked diffuse neoplastic cellular infiltration, foci of eosinophillic fluid (C) and no visible ovarian stroma

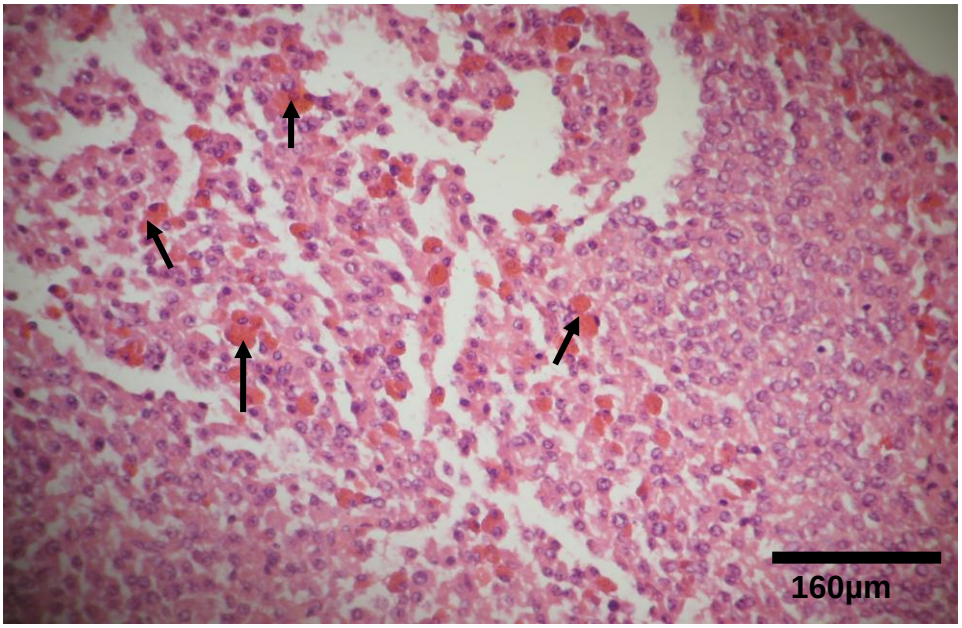

Figure 23: Granulosa thecal cell tumour: Note the large eosinophillic cells (arrows) among the neoplastic cells

Figure 24: Cystic degenerative ovarian follicles and a degenerative graffian follicle (C). Inset is the follicle having a degenerating ovum (O) among granulosa cells

CHAPTER FIVE

DISCUSSION

The overall prevalence of female reproductive organs defects among goats in the study was 20.9%. However, lesions that could result into infertility or sterility of the goats occurred in 13.6% of the reproductive systems examined. Among these 0.9% could result into sterility. This result does not reflect the general Ugandan situation since goats came from only 23 districts. Actually this study implicates a prevalence higher than 13% in Uganda. This is because some causes of infertility such as functional and managemental factors may not be reflected anatomically in such an abattoir survey. Also majority of the goats included in this study came from western and central Uganda where relatively better husbandry practices are believed to be employed. In addition, certain microscopic lesions may interfere with the goats' fertility but may not have been captured in this study since the presence of a gross lesion was a prerequisite to inclusion of organs for histopathology.

Uganda Meat Industries Limited (UMI) and Kampala City Council (KCC) abattoirs were selected as study areas with the belief that they receive big numbers of goats from majority of the districts in Uganda. This seems not to be the case since majority of the goats came from central (39.6%) and western Uganda (36.5%). Very few goats (1.1%) came from north-eastern Uganda. The origin of 22.8% of the studied goats was not established. This was attributable to poor record management in the abattoirs. For those whose origin was established, the researcher depended on the traders' ability to trace the origin. Although efforts were made to establish which districts had the biggest proportion of goats with genital defects; no genuine conclusions can be drawn from the data since the goats' number in the study greatly varied among districts.

In this study, parous does have a significantly higher prevalence of genital organs lesions than the nulliparous goats (χ^2 =0.82; P>0.05). Since parous goats are more affected than the nulliparous goats and majority of the lesions being infectious, changes associated with oestrus, pregnancy and parturition are implicated as the major predisposing factors to genital organ lesions. These physiological states create a favourable environment for pathogen access to and proliferation in the female reproductive system. Various lesions were described in the uterus (14.8%), ovary (8.6%),

salphinx (4.5%), and the cervix (2.6%) of the 1000 reproductive systems of goats examined.

Cervicitis was detected in 1.4% of the total number of genital systems examined. With the exception of a single case of haemorrhagic necrotising cervicitis, all cases were associated with concurrent endometritis and/ or vaginitis. Although cervicitis was detected in 14 cases and in most cases histopathologically, uterine inflammation with detectable changes was evident in 69 tracts. This supports the assertion that the cervix is relatively resistant to infection because it is endowed with the mucus-secreting epithelium and an infection resistant fibro-muscular layer (Acland, 2001). Isolation of pathogens from cases of cervicitis was however not attempted. Non-specific bacterial infections accruing from ascending infections in association with foetal maceration or post-parturient metritis could have played a major role in the aetiology of cervicitis. Haemorrhagic necrotising cervicitis involved the caudal three quarters of the cervical wall and the canal was occluded by a long standing desiccated blood clot. This single case could render the goat sterile, but other cases could easily be overcome by the body defence mechanisms. The exact cause of this complicated case was not evident. It could have accrued from trauma during assisted kidding. On the other hand cervical haemorrhages could have accrued from traumatic injury of the cervical canal during parturition. Uterine haemorrhages could be indicators of resolved infections, trauma during transportation or dystocia and also metoestral bleeding. With the exception of the two severe cases, cervical or uterine haemorrhages have negligible effect on the fertility of the goat.

Adenomyosis is the invasion of the muscular wall of an organ by glandular tissue (Blood and Studdert, 1999). With the overall prevalence of 6%, Adenomyosis was the most frequent lesion detected. Six and fifty-four cases occurred in the cervix and uterus only respectively, while three cases were described in both the uterus and the cervix. Although Buergelt (2000) associates a “soupy appearance” of the uterus to adenomyosis, no specific gross features of this condition were seen. Since adenomyosis was detected only microscopically, the presence of a gross defect on any part of the reproductive system was a prerequisite to histopathological studies on the organs of the affected genital system, therefore the prevalence of this lesion may actually be higher than the reported 6% in this study. Farenczy (1998) suggests that the efficiency of adenomyosis diagnosis

is increased by increasing the number of sections per organ and also taking superficial tissue sections. Adenomyosis is regarded as a rare lesion in domestic animals including goats (Kennedy and Miller, 1993) but this study seems to disagree with this assertion. The apparent rarity of the condition could be due to the limited histopathological studies on uteri of domestic animals. The aetiology of adenomyosis is idiopathic (Farenczy, 1998). Metaplasia or malformation of myometrial tissues and hyperplastic growth of endometrial tissues into myometrium have been postulated as possible mechanisms of adenomyosis development (Kennedy and Miller, 1993; Acland, 2001).

In mice, the occurrence of adenomyosis is greatly enhanced by experimental exposure to oestrogenic agents, prolactin, tomoxifen, torexifen, progesterone and synthetic progestins (Greaves and White, 2006). In goats, the lesion has been described in association with hyperoestrogenic states (Melo *et al*., 2001; Fouzy *et al*., 2007). Mean while in humans and other non human primates, adenomyosis may cause ill-health characterized by dysmenorrhoea, menorrhagia, increased uterine size and intrapelvic pain (Farenczy, 1998). The condition is not usually associated with clinical signs in non-primates. However, Hiromichi *et al*. (2005) and Stocklin-Gautchi *et al*. (2001) reported cases where the ectopic glands in the cervix and uterus of dogs have been infected and greatly distended. In this study no case of adenomyosis was associated with an infection. The six cases associated with foetal mummification could have occurred in response to the progesterone secreted during pregnancy or could have contributed to foetal death. There was however no evidence to confirm this. The single case observed in association with the granulosa-thecal cell tumour could have arisen in response to the concurrent steroidogenesis. However, the remaining cases could not be associated with any of the predisposing factors to adenomyosis suggested in the literature (Melo *et al*., 2001; Fouzy *et al*., 2007).

Chronic non-purulent endometritis had a prevalence of 3.9%. The diversity in the gross and histopathological presentations may be due to the differences in duration of the lesions at the time of slaughter. The prevalence of this defect could even be higher among the goats than what is reported in the present study. This is because severe chronic endometritis was detectable among cases where the uterus was devoid of detectable gross lesions. Six of these occurred in association with ovario-bursal or ovario-tubular-bursal adhesions. Six cases exhibited features typical of granulomatous endometritis, but

negative for Ziehl-Neelsen stain hence ruling out tuberculous reactions. Granulomatous endometritis can occur in association with brucellosis especially among swine (Mc Entee, 1990). Chronic endometritis is usually associated with varying degrees of infertility depending on the extent of endometrial damage. This can be due to reduced production of prostaglandin $F_2\alpha$ hence corpora lutea persistence and interference with embryo implantation (Acland, 2001). Chronic metritis exerts the same effects on the fertility of the goat. The lesions were the same as those for chronic endometritis but only deferred in the extent of involvement of the uterine functional layers. In this case the myometrium and uterine serosa were greatly involved in the inflammatory process.

Acute endometritis had a prevalence of 2.0% which is ten times higher than what Timurkaan and Karadas, (2000) reported in their study of 4000 goats from Elazig abattoirs, Turkey. In the present study, the described cases were characteristic of post-parturient purulent metritis (1.5%) and the rest occurred in association with foetal maceration and purulent vaginitis. This finding particularly implicated either unhygienic manipulative parturition assistance or housing of newly kidded does as major predisposing factors to uterine infection. No case could be associated with retained foetal membranes since placental remnants were not detected at all. Since the twinning rate is high in goats, the prolonged parturition time increases the chance of microbial access to the uterus especially when the doe is kidding from a dirty place. This high prevalence of post-parturient metritis is further explained by the fact that sample collection was mainly done during the rainy season when cold conditions prevail hence favouring the survival and proliferation of many microorganisms.

Four cases of pyometra were described in the present study. All the features of this condition were consistent with those reported before (Kennedy and Miller, 1993). Isolation and characterization of microorganisms in all cases of uterine infection was not done. Metritis and endometritis are caused by a number of both specific and non-specific infections. Specific diseases that may be associated with uterine inflammation include brucellosis, vibriosis, leptospirosis and salmonellosis among others (Arthur *et al*., 1983). These cause a transient endometritis and rarely survive for more than two to three oestrus cycles (Smith *et al*., 1996; Kennedy and Miller, 1993). Non-specific infections are however the major causes of endometritides among goats and other domestic animals. Such infections are predisposed by dystocia, abortion, retained fetal membranes,

unhygienic environment, coitus and a prolonged luteal phase. In their bacteriological study, Ababneh and Degefa (2006) isolated *Staphylococcus aureus, E. coli, Micrococcus spps* and *Corynebacterium pyogenes* as the major causes of postpartum uterine infections among Balady goats in Irbid Jordan. *Eschelichia coli* was the most common uterine infection. However, in Uganda Owiny and Acon (1998) isolated *Streptococci, Coliforms, Proteus, Klebsiella, Staphylococci, Bacilli and Micrcocci* from the uteri of indigenous cattle with *Coliforms* as the dominant bacteria. The situation in goats remains obscure although intrauterine infections are the major cause of gross genital defects among goats as shown in this study.

Intrauterine deaths occurred in 1.9% of the goats sampled. This is a relatively higher prevalence compared to what was reported by Ssali (1998). Owiny and Acon, (1998) reported three cases (0.6%) of foetal deaths among cattle indeginous to Uganda of which two (0.4%) and one (0.2%) were undergoing maceration and mummification respectively. On the other hand Miyingo (1984) reported foetal deaths prevalence of 0.5% in Ugandan cattle. The prevalence of foetal deaths reported in Ugandan goats in the present study is markedly higher than that in cattle (Miyingo, 1984; Owiny and Acon, 1998). Foetal deaths can accrue from mechanical injuries, nutritional imbalances, genetic defects and pathogens. In the present study, deaths of the foetuses could not be associated with any specific cause. In the case of the dead foetus that had recently died and associated with generalized jaundice, it was postulated that the death could have resulted from any of the haemolytic infectious diseases such as leptospirosis, anaplasmosis, babesiosis, ehrlichiosis and eperythrozoonosis among others. Confirmatory laboratory diagnoses were however not carried out.

The fate of the dead foetus varies depending on the ovarian status, stage of foetal development and absence or presence of uterine infections (Kennedy and Miller, 1993; Acland, 2001). Foetal Maceration occurs in presence of intrauterine infections. The later may be the cause of death or may be an ascending infection following the regression of the corpus luteum resulting into cervical opening (Arthur *et al*., 1983). In all the three cases described in this study, the cervices were open and corpora lutea were absent. They were all associated with variable degrees of endometritis. On the other hand, a sterile uterine environment, presence of viable (functional) corpora lutea in the ovaries and a mature foetal skin capable of resisting autolysis are prerequisites for the occurrence of

foetal mummification (Kennedy and Miller, 1993). According to Arthur *et al*. (1983), foetal mummification is of two types: papyraceous and haematic mummification. The former is characterized by complete desiccation of foetal membranes and the foetus while the later presents with an adhesive chocolate-like material between the uterus and the chorion. Based on this classification, there were four cases of papyraceous and 11 cases of haematic mummification. Although this distinction is suggested, the same process occurs but uterine contents only differed in extent of dehydration depending on period between foetal death and time of uterine contents examination.

Mummified foetuses may be macerated, expelled spontaneously before or after term or even retained indefinitely (Acland, 2001). Kennedy and Miller (1993) reported that in ewes, the mummified foetus may be carried to term alongside the normal one or aborted without any effect on the normal foetus. In this study, all five cases of twin pregnancy where the fetuses were mummified, were affected and were at the same stage of dehydration. Since diagnosis and treatment of doe infertility is rarely done in Uganda, the effect of foetal deaths has a profound effect on the fertility of individual goats and if the number of affected individuals is big, the general performance of the flock is greatly affected. The present study implicates intrauterine foetal deaths as a significant cause of infertility among goats.

Hydrometra (pseudopregnancy) was detected in 0.5% of the female goats. This was characterized by accumulation of aseptic clear fluid in the uterus due to cervical closure in presence of a functional corpus luteum. The aetiology of false pregnancy is idiopathic (Sherman and Smith, 1994). All cases occurred in association with a persistent corpus luteum and could have followed oestrus without conception or embryonic death with embryo resorption (Matthews, 2001). Predisposing factors include delayed breeding, ingestion of phytoestrogens, treatment of goats with human chronic gonadotrophins or gonadotrophin releasing hormone, certain infectious diseases such as toxoplasmosis, border disease and trypanosomiasis (if controlled by trypanocidal drugs) (Sherman and Smith, 1994). A genetic predisposition has also been cited (Hesselink and Elving, 1996). The condition is reportedly high among certain strains of dairy goat breeds and its chances of occurrence increase with age. In this study, hydrometra occurred in goats of kidding age between 2½ and 6 years all of which were of the local breed. This finding is

in agreement with the assertion that the condition occurs in sexually mature females (Matthews, 1999).

Clinically, a pseudopregnant doe exhibits body changes and behaviour typical of a pregnant goat (Matthews, 2001). The clinical presentation of the goats was not studied in this case given the rapidity of the slaughter exercise in the abattoirs. Pseudopregnancy causes infertility in individual goats for varying periods being longer if it follows embryonic death than if it follows oestrus without conception (Matthews, 2001). Resolution of pseudopregnancy is marked by a cloudburst. Average incidences of 33.3% and 10.4% have been reported in Brazilian and Dutch dairy goats by Lopes *et al*. (2004) and Hesselink and Elving (1996), respectively. Timurkaan and Karadas (2000) reported a prevalence of 0.15% in an abattoir survey carried out from Elazig abattoirs, Turkey. The prevalence of 0.5% reported in the present study is lower than that in Brazilian and Dutch herds but higher than that in turkey.

Uterine changes classified as endometrial hyperplasia occurred in two cases hence a prevalence of 0.2%in the present study. One of the cases occurred in association with granulosa-thecal cell tumour and occurred with a uterine infection hence could qualify to be classified as cystic endometritis. Although, cystic endometrial hyperplasia frequently occurs in association with mucometra or hydrometra (Jones *et al*., 1997), none of the two cases were consistent with this feature. Since the two cases were associated with a cystic graffian follicle and a granulosa-thecal cell tumour, they could be consequential to hyperoestrogenism and/or hyperprogesteronism, a feature of the two ovarian abnormalities respectively. This condition can result into sterility by preventing fertilization and implantation (Zaher, 2005).

Uterine serosal cysts were described in two cases but could not be linked to any cause. These appeared not to contribute to infertility in any way since they were small and located on serosa. Their association with adenomyosis could be incidental. Uterine serosal inclusion cysts are believed to develop during post-partum uterine involution when contraction of the myometrium causes in folding of the serosa. Most cases of uterine serosal cysts have been described in aged multiparous bitches and cows (Mc Entee, 1990).

In this study, uterine melanosis had a prevalence of 0.1% which is markedly lower than that of 0.62% reported by Timurkaan and Karadas (2000) among goats slaughtered in Elazig abattoirs, Turkey. Endometrial melanosis is reportedly common among certain breeds of sheep such as Suffolk and has no effect on the fertility of the goat (Buergelt, 2000).

Post-parturient emphysematous metritis was described in a puerperal uterus of only one goat whose uterus was doughy on palpation and thick walled grossly. Extensive wall infiltration by air spaces, foci of mononuclear infiltrations and myodegeneration were microscopically evident. This lesion shares features with uterine emphysema described by Mc Entee (1990) and post-parturient genital gas gangrene commonly reported among penned South African Angora goats (Sherman and Smith, 1994). Given the scanty inflammatory cells occurring in the uterus in association with the lesion, Mc Entee (1990) ruled out infections as causes of the lesion. He suggests sugar from intravenous fluid therapy as the predisposing factor. However, intravenous fluid therapy is rarely done in Uganda since it is considered economically non-viable. This lesion actually appears to be a mild form of genital gas gangrene due to *Clostridial* infections reported in Angora goats (Sherman and Smith, 1994). Similar defects occur in humans in association with clostridial infections (especially *Clostridium perfringens*) and are usually fatal (Baltzer *et al*., 1989; Halpin and Morinari, 2002; Patchell, 1978). The clinical presentation of this case was not studied. Given the extent of damage detected in this case, sterility was a likely sequel.

Perimetritis, the inflammation of the uterine serosa, was observed in three cases that occurred in association with bursal adhesions to the ovary or oviduct. These are likely to be extensions of generalized peritonitis or consequences to uterine infection. Perimetritis described in this study as an entity may have negligible effect on fertility.

All salphingeal lesions were associated with either uterine or ovarian infections. Therefore they could have arisen as a consequence of the inflammatory process extension from either the ovary or uterus or both. No primary salphingeal defect was detected. Salphingitis was associated with 56% of the cases of uterine inflammation. This is much lower than the reported 70–75% association (Kennedy and Miller, 1993). The efficiency of detection of the cases of Salphingitis could have been lowered by the limited number (1–2) of sections sampled from the oviducts of each of the 209 reproductive tract. Even

mild cases of salphingitis can cause infertility (Acland, 2001). All bilateral cases of hydrosalphinx can cause sterility while the unilateral cases can result into variable degrees of infertility. The association between bursal adhesions is 8.1%. This is relatively a low association.

With the prevalence of 3.7%, bursal adhesions to the ovary and the oviduct were among the most frequent defects in the present study. Since histopathology did not reveal severe ovarian stroma infiltration by inflammatory cells, primary oophoritis was ruled out as a contributing factor to the adhesions. For the pregnant animals with adhesions coinciding with the location of the corpora lutea, progression of the inflammatory response from the ovulation site is suspected. Widespread peritonitis due to specific and non-specific infections in addition to that associated with spillage of inflammatory fluids from uterine and salphingeal infections are suspected as the major contributing factors of this defect (Kennedy and Miller, 1993). Indeed, majority (83.8%) of the cases of bursal adhesions were associated with varying degrees of endometritis. Tubo-ovario-bursal adhesions cause infertility by interfering with ovulation and/or the passage of ova into the oviduct and also cause cystic degeneration of follicles. The prevalence of bursal adhesions to the ovary, and oviduct reported in this study is much higher than 1.24% reported by Timurkaan and Karadas (2000).

Paraovarian cysts are derived from the mesonephros (Kennedy and Miller, 1993). The cysts were not classified since histological studies and special staining of the cyst wall and lining were not done. All cases detected were not capable of interfering with the fertility of the goats. However, cystic corpora lutea occurred in 2.2% of the total number of goats sampled. Cystic corpora lutea arise as a consequence of premature closure of the ovulation site hence forming a central cavity (Jones *et al*., 1997). They have no effects on the goats' fertility (Acland, 2001). Although corpora lutea were detected among ovaries of many non-pregnant goats; it was difficult to ascertain the duration of their existence.

Ovarian inactivity had a prevalence of 0.4%. Absence of ovarian follicle of less than 5mm or corpora lutea and their degenerative forms on both ovaries was a prerequisite to inclusion of a case under this category. All the four affected does were emaciated and exhibiting signs of ill-health associated with helminthiasis. Parasitism induces nutritional deficiencies which result into body weight loss. The later causes ovarian quiescence through reduced production of ovarian steroids (Tomomi *et al*., 2003).

The low prevalence of ovarian inactivity could be partly attributed to the presence of forage for the goats throughout the year given their browsing ability. In addition, the study was done during the rainy season in which forage is in abundance.

Cystic graffian follicles (luteal cysts and cystic follicles) had a prevalence of 1.1%. This finding is in agreement with that of 1.14% reported by Timurkaan and Karadas (2000). According to Smith (1986), follicles larger than 1.2 cm are considered cystic. This was the only criterion used to qualify a follicle as cystic. The cause of cystic ovarian disease is idiopathic. In cows, insufficient release or mistiming of the release of the luitenising hormone is the major possible mechanism by which it occurs (Jones *et al*., 1997). The condition has been reported among dairy goats that graze oestrogenic pastures (Arthur *et al*., 1983). Heredity and phosphorous deficiency have also been associated with the condition among goats (Smith, 1986). Tanaka *et al*. (2007) have ruled out follicular cysts development in association with progesterone and oestradiol treatment among goats. Bursal adhesion to the ovary could have contributed to the development of the nine cases. Cystic graffian follicles are associated with nymphomania and failure to conceive despite breeding. All cases except one were not associated with uterine lesions characteristic of the condition. This implies that the detected cases were not persistent (Kennedy and Miller, 1993). Meanwhile, there was only one case in which a *Cysticercus tenuicolis* cyst was attached to one ovary. No disturbance of fertility was associated with this case.

One case of granulosa-thecal cell tumour was detected in the present study. The neoplasm exhibited a great variety of histologic appearance in many portions but all consistent with the features reported in literature (Kennedy and Miller, 1993). Granulosa-thecal cell tumours belong to the sex cord-stromal group of ovarian tumors of which they are the commonest (Maclachlan and Kennedy, 2002). The differentiation between granulosa and thecal cells is difficult hence the name (Gardner *et al*., 2005). Indeed in this particular case, the distinction between the two cell types was hard from the histologic sections. They occur in all age groups but their incidence increases with age. Majority of the cases reported are unilateral and benign in nature (Jones *et al*., 1997). In this particular case, there was no evidence of malignancy since blood vessels in the examined histologic sections did not contain neoplastic cells. However, malignancy could not be completely ruled out since regional lymph nodes were not examined.

There are few reports of granulosa-thecal cell tumours among goats (Cooke and Merall, 1992; Lofstedt and Williams, 1986). In the mare and the cow where the tumours are frequently reported and effects extensively studied; active steroid secretion has been documented. Progesterone, oestrogen, testosterone and inhibin are secreted by the tumour to varying degrees (Maclachlan and Kennedy, 2002; Jones *et al*., 1997; Kennedy and Miller, 1993). The reproductive behaviour of the animal and other extra-ovarian hormonal tissues changes depend on the type and quantity of the dominant hormone secreted by the neoplasm. Three behavioural patterns have been reported: anoestrus, persistent or intermittent oestrus (nymphomania) or male behaviour: anoestrus and ovarian hypoplasia are attributable to elevated levels of inhibin while male behaviour is due to high levels of plasma testosterone (>100 pg/ml) (Kennedy and Miller, 1993). In bitches, hyperoestrinism may manifest with alopecia, anaemia, leucopaenia, thrombocytopaenia, haemorrhagic diathesis and cystic endometrial hyperplasia (Maclachlan and Kennedy, 2002). Udder development, lactation, lameness and ascites have also been reported in an ewe in association with the tumour (Gardner *et al*., 2005). Oestrogen and progesterone were associated with udder development and lactation while ascites was referred to tumour rupture and lymphatic obstruction. On the other hand lameness was attributed to compression of nerves by the metastatic tumour nodules.

The clinical manifestations, hormonal assays and extra-genital defects were not studied in the present study. However, given the atrophy of the ovary and uterus, cystic endometrial hyperplasia and associated endometritis, one can predict that inhibin and oestrogen were the dominant hormones. The detected eosinophillic cells could be degenerating tumour cells or the polyhedral eosinophillic (Leydig-like) cells. The later have been reported in equine tumours and are associated with the production of testosterone (Kennedy and Miller, 1993). Surgical removal of the tumour is deemed curative and recovery normally occurs in six to twelve months (Mottershead, 2000). The case reported in this study was considered as a potential cause of sterility given the associated uterine changes. The cystic structure attached at the cranial extremity of the tumour was interpreted as a focus of cystic degenerative follicles. These are common in association with bursal adhesions to the ovary (Kennedy and Miller, 1993). This presentation tempts one to think of the cystic structure as an accessory ovary.

The cause of the two cases of unilateral endometrial caruncular necrosis was not established. Given the indicators of foetal or embryonic loss and the restriction of the necrosis to the caruncles, foetal death and resorption is believed to have resulted into this manifestation. However, the cause of foetal death remained idiopathic.

Of the 1000 female goats studied, 38.4% were slaughtered when pregnant. This is a relatively high level of foetal wastage in comparison to what is reported elsewhere about goats and other livestock (Ojo, 1996; Moghaddam *et al*., 2003). This could be partly attributable to poor record keeping and defective pregnancy diagnosis techniques. In addition to the above weaknesses, pregnant goats may at times be presented for slaughter intentionally because such animals are generally in good body condition hence attractive and easier to market. However, defective pregnancy detection techniques may be the major cause of slaughter of pregnant goats given the inaccuracy of the subjective methods, especially in the early stages of the gestation period that are widely used in Uganda. Multiple foetal pregnancies constituted 61.2% of the total number of pregnant goats. Majority were in the early stages of the gestation period. This implied that if embryonic loss is minimized by increasing the goat's plane of nutrition and controlling diseases, Ugandan goats have a potentially high fecundity.

Abnormalities of the genital tracts are usually not life threatening hence receiving limited attention of the farmers and the animal health workers. This partly explains the relatively high prevalence of defects that interfere with the goats' fertility. Possible seasonal variations in the prevalences of genital tract lesions were not studied. This is because of the limited period of study and inadequate financial resources. The trend of events could have aided the development of appropriate control strategies where possible. Although, most lesions were infectious in nature, the isolation of pathogens was not done. This could have generated data on the offending infectious agents and the kind of lesions associated with them. Uncooperative traders and the speedy nature of abattoir activities contributed to the incomplete investigation of some relevant aspects of the study such as goat origin, clinical manifestations of some defects, metastasis of neoplasms, relationship between genital lesions and changes in surrounding tissues among others.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

The following conclusions were drawn from the present study:

1. Genital organs infections and foetal deaths are the major causes of genital lesions which were observed among female goats slaughtered in the abattoir.
2. The incidence of adenomyosis in goats is much higher than that reported in the literature.
3. Foetal blood vessel anastomoses are extremely rare among goats even in multiple foetal pregnancies.
4. Gross pathomorphological studies of genital organs are not ideal for determining the prevalence of lesions associated with infertility. This is because many inconspicuous gross and microscopic lesions that can reduce fertility of the animal may be left out.
5. Many pregnant goats are presented for slaughter.

6.2. Recommendations

Based on the findings and conclusions, the following recommendations were made:

1. Future investigations of genital tract lesions should involve isolation and characterization of offending organisms.
2. Field animal health workers should be encouraged to carry out routine on-farm clinical investigations of reproductive defects. This will help in timely institution of treatment and control measures where possible or hasten the culling of goats that are not economically viable to maintain. In the long run goat production and profitability will be increased.
3. Good goat husbandry practices that promote the maintenance of healthy flocks, proper selection and breeding should be taught to the farmers. This is only possible with intensification of delivery of veterinary extension services.
4. The aetiology and functional inefficiencies of adenomyosis in goats should be extensively investigated.
5. Seasonal variations in the incidences of genital organs abnormalities should be studied in future surveys.

6. Modern techniques of pregnancy and morphological defect diagnosis such as ultrasonography and serum hormonal assays should be introduced in Uganda to relieve the farmers and animal health workers of the current difficulties faced. Such services should be offered at subsidized prices to encourage their utilisation by the farmers.

7. A law prohibiting slaughter of pregnant animals should be enacted and enforced. This will go a long way in limiting this vice and increasing the size of the national herd.

8. The causes of the detected cases of granulomatous endometritis need further studies.

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APPENDIX ONE

TIME FRAMEWORK

Serial No.	Activity	Remarks	2007				2008							
			Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June	July	Aug
01	Project proposal writing													
02	Presentation and approval of research proposal													
03	Sample collection													
04	Histological tissue processing and examination	To be done alongside sample collection												
05	Data analysis and report writing													
06	Examination													

APPENDIX TWO

ABATTOIR DATA COLLECTION SHEET

Serial No.	District of origin	Age	Breed	Body condition score	Reproductive status	Detectable gross lesions	Remarks
001							
002							
003							
004							
005							

APPENDIX THREE

DISTRICTS OF ORIGIN OF THE SAMPLED GOATS (n = 1000)

District	Number of goats sampled	% of total (n = 1000)
Unknown	228	22.8
Mbarara	119	11.9
Kiruhura	118	11.8
Mpigi	112	11.2
Kyenjojo	071	7.1
Lyantonde	060	6.0
Rakai	058	5.8
Kiboga	052	5.2
Sembabule	035	3.5
Kamwenge	023	2.3
Mubende	018	1.8
Nakaseke	018	1.8
Masindi	015	1.5
Ibanda	014	1.4
Wakiso	012	1.2
Masaka	010	1.0
Luwero	008	0.8
Nakasongola	008	0.8
Lira	007	0.7
Kayunga	005	0.5
Soroti	004	0.4
Isingiro	003	0.3
Bushenyi	001	0.1
Kibaale	001	0.1

APPENDIX FOUR

ORIGIN OF GOATS WITH FEMALE GENITAL DEFECTS

District	Number of affected female goats	% of total affected (n = 209)
Unknown	41	19.5
Kiruhura	32	15.3
Mbarara	26	12.4
Mpigi	25	11.0
Lyantonde	13	6.2
Kyenjojo	13	6.2
Rakai	12	5.7
Nakaseke	09	4.3
Sembabule	09	4.3
Kiboga	06	2.9
Ibanda	05	2.4
Luwero	05	2.4
Kamwenge	05	2.4
Masaka	04	1.9
Mubende	02	1.0
Lira	01	0.5
Nakasongola	01	0.5