**Sudan University of Science and Technology**

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# Fetal Death in Goats in Khartoum State Diagnosed by Ultrasonography and Treated by $PGF_{2\alpha}$ and Oxytetracycline

**تشخيص الأجنة الميتة في الماعز في ولاية الخرطوم بواسطة الموجات فوق الصوتية وعلاجها بواسطة البروستاغلاندين والأوكسي تيتراسايكلين**

**A Thesis Submitted for Fulfillment of the Requirements for Master Degree in Veterinary Medicine (Reproduction and Obstetrics)**

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## Dedication

To the soul of my father

To my beloved mother Jachinta Nyakwic

To my siblings

To my small family Jully and Gieth

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## ABSTRACT

A cross sectional study was performed from October, 2015 – October, 2016 on 962 female goats to diagnose fetal mortality, find the prevalence of fetal death and investigate the associated risk factors using ultrasound technique. Treatment of dead fetuses was also done and the subsequent fertility was registered. Transabdominal ultrasound was performed using a real-time scanner (Pie Medical, Easote, the Netherlands) equipped with dual frequency (3.5-5) MHz convex probe while the goats were on their backs on a comfortable table. Results of the current study revealed that out of 962 examined goats, 431 were found non-pregnant (44.8%), 88 (9.14%) were pseudopregnant and 4 (0.42%) were diagnosed as having pyometra. 439 (45.63%) were diagnosed as pregnant. Out of 439 pregnant goats, 36 were diagnosed as bearing dead foetuses. The prevalence of fetal death in Khartoum state, Sudan was found to be 8.2%. Nine risk factors were investigated to found their association with fetal death. All factors; season of the year ($\chi2$ = 4.873, P-value = 0.087), locality ($\chi2$ = 4.398, P- value = 0.494), breed of the dam ($\chi2$ = 7.147, P- value = 0.067), age of the dam ($\chi2$ = 2.566, P-value = 0.277), parity number ($\chi2$ = 3.024, P-value = 0.221), feeding type ($\chi2$ = 0.728, P-value = 0.501) and breed of the inseminating buck ($\chi2$ = 0.560, P-value = 0.756) were not significantly associated with fetal death. Out of 36 goats diagnosed as bearing dead fetuses; 13 goats were subjected to medical treatment using 0.5 ml single intramuscular injection of 250 µg cloprostenol and 5% oxytetracycline with a dose of 5 ml for five consecutive days. Out of 13 treated goats, 11 responded successfully to the treatment and dead fetuses were expelled within 48-96 hours. Follow up of the treated goats was performed using ultrasonography. Two full term goats with fetal death did not respond to $PGF_{2\alpha}$ treatment and thus referred to surgery. Cesarean section and hysterectomy was done for three goats. It is concluded that fetal death is a major herd problem in goats in Khartoum state and real-time ultrasonography is a rapid, accurate and non-hazardous method for detecting fetal mortality. In addition, $PGF_{2\alpha}$ in conjunction with oxytetracycline was found an effective treatment for fetal death in goats.

**المستخلص**

أجريت دراسة مقطعية في الفترة من أكتوبر 2015 – أكتوبر 2016 علي 962 من إناث الماعز لتشخيص الأجنة الميتة,إيجاد نسبة الإنتشار والعوامل المرتبطة بموت الأجنة في الماعز في ولاية الخرطوم/ السودان باستخدام تقنية الموجات فوق الصوتية. تمت المعالجة وتوبعت الحالات المعالجة أيضا. تم استخدام الموجات فوق الصوتية عن طريق البطن بواسطة جهاز (بايميديكال– هولندا) مزود بمجس ذو تردد قابل للتغير (3.5–5 ميغاهيرتز) بعد تثبيت الحيوان في وضع الرقاد الظهري على منضدة مريحة مخصصة لهذا الغرض. أظهرت نتائج الدراسة على أن 431 (44.8%) من 962 ماعز شخصت غير حامل, 88 (9.14%) شخصت علي أن بها حمل كاذب, 4 (0.42%) كانت مصابة بالتهاب الرحم الصديدي. 439 (45.63%) ماعز شخصت حامل. 36 ماعز من أصل 439 ماعز حامل شخصت علي أنها تحمل أجنة ميتة. كانت نسبة انتشار الحمل بالأجنة الميتة في الماعز بولاية الخرطوم 8.2%. كل العوامل الذي تمت دراستها لمعرفة ارتباطها بحدوث موت الأجنة وهي: فصل السنة (مربع كآي = 4.873، القيمة الاحتمالية = 0.087)، المحلية (مربع كآي = 4.398، القيمة الاحتمالية = 0.494)، نوع سلالة الأم (مربع كآي = 7.147، القيمة الاحتمالية = 0.067)، عمر الأم (مربع كآي = 2.566، القيمة الاحتمالية = 0.277)، عدد الولادات (مربع كآي = 3.024، القيمة الاحتمالية = 0.221)، نوع التغذية (مربع كآي = 0.728، القيمة الاحتمالية = 0.501) وسلالة الذكر الملقح (مربع كآي = 0.560، القيمة الاحتمالية = 0.756) لم يكن لها ارتباط معنوي بحدوث موت الجنين باستخدام التحليل أحادي المتغير بعلاقة إحصائية معنوية. عولجت 13 عنزة من الحالات الموجبة باستخدام هرمون البروستاغلاندين بجرعة 0.5 مل جرعة واحدة (250 µg كلوبرواستينول/المانيا) و5 مل (5%) أوكسي تتراسايكلين (لمدة خمسة أيام متتالية) في العضل. استجابت 11 معزة للعلاج وتم لفظ الجنين الميت في فترة 48–96 ساعة و متابعة كل الحالات التي تم علاجها. أثنين من الماعز كانت تحمل أجنة ميتة كاملة النمو لم تستجيب للعلاج الطبي وتم تحويلها للجراحة. تم إجراء عملية قيصرية واستئصال للرحم لعدد ثلاث معزات لم تستجيب للعلاج الطبي. خلصت الدراسة إلي أن موت الأجنة يعتبر مشكلة رئيسية في قطعان الماعز في ولاية الخرطوم/ السودان وأن تقنية الموجات الصوتية تعتبر وسيلة سريعة, دقيقة وآمنة لتشخيص الأجنة الميتة. إضافة إلي أن البروستاغلاندين بصحبة الاوكسي تتراسايكلين يعتبر علاج فعال للأجنة الميتة في الماعز.

# INTRODUCTION

Goat's population is estimated to be approximately 100,560 million heads worldwide (FAO, 2015). In the Sudan there are about 31 million head of goats (MOAR, 2015) classified into four main groups distributed throughout the country; the Nubian, the Desert, the Nilotic and the Dwarf (Ibrahim, 2000). Goats are very valuable in poverty alleviation and used as an easily cashable source of investment in rural areas (Abdel Aziz, 2010; Mahgoub *et al.*, 2012).

Goat is a domesticated, sociable and intellectual species, which has been used for leather, milk and meat (Morand-Fehr and Lebbie, 2004; Miranda-de la Lama and Mattiello, 2010). Goats of the world can be grouped into meat breeds (indigenous goat breeds, Boer), milk breeds (Saanen, Alpine, Toggenburg) and Angora goat for mohair (FAO, 2007).

Embryonic and fetal mortality contribute to large considerable economic loss due to the loss of offspring and prolonged open periods (Jonker, 2004; Dixon *et al.*, 2007). The high percentage of embryonic loss in domestic species during early pregnancy will lead to false positive diagnosis (Moraes *et al.*, 2009). The causes of fetal death are numerous and can be divided into infectious and non-infectious (Jonker, 2004). Non-infectious causes of fetal death include malnutrition, stress, hormonal disturbances, and ambient temperature (Jonker, 2004; Marai *et al.*, 2007; Kara *et al.*, 2010). Several infectious agents that cause fetal death are zoonotic (Jonker, 2004). Fetal fluids and placentomes can be used as a technique for identifying dead or retarded fetuses using ultrasound technique (Jonker, 2004; Schatten and Constantinescu, 2007). Viable fetus can be identified by documenting fetal heartbeats and movements (Matthews, 2009). Appropriate, sonolucent amniotic fluid, normal posture of the fetus and measurements of fetal parameters equivalent to predicted gestational age are also signs of a viable fetus (Jonker, 2004; Matthews, 2009).

Ultrasound is one of the most widely used imaging technique in human and veterinary medicine; it is a rapid, trustworthy, non-hazardous and real-time (Hangiandreou, 2003; Aiello and Moses, 2012).

Early pregnancy identification, determination of fetal number and estimation of gestational age are crucial for effective reproductive performance in goats (Yotov, 2005; Oral *et al.*, 2007; Anwar *et al.*, 2008; Suguna *et al.*, 2008). Ultrasound technique represents a dramatical invent which has revolutionized knowledge of reproductive biology (Medan and Abd El-Aty, 2010; Gonzalez-Bulnes *et al.*, 2010). This imaging technique has become an important tool in veterinary medicine for imaging the fetus in utero (Serin *et al.*, 2010). In goats, the transabdominal and transrectal approaches are most frequently used without need for sedation (DesCoteaux *et al.*, 2010).

In the Sudan, there is scarcity in literature regarding usage of ultrasound technique for diagnosis of fetal death in goats and few case reports were published (Abdelghafar, 2010, 2015); however treatment of fetal death, follow up of subsequent fertility of the treated dams was not reported. In addition, the prevalence and associated risk factors of fetal death in Khartoum State, Sudan was not documented. Thus the objectives of the present study were to:

1. Diagnose fetal death in goats in Khartoum State using ultrasound technique.
2. Report the prevalence and investigate the associated risk factors of fetal death in goats in Khartoum State.
3. Treat the affected goats with $PGF_{2\alpha}$ in conjunction with oxytetracycline and follow up of the consequent reproductive performance.

# CHAPTER ONE

# LITERATURE REVIEW

## 1.2. Goat

Goats belong to the family bovidae in the suborder ruminantia of the order artiodactyla and genera Capra (Salami *et al.,* 2011). Goats play a significant socio-economic role in the augmentation of human civilization around the world (Mahgoub *et al.*, 2012). They are a major source of meat, milk, and leather in many classical societies and considered as a source of poverty alleviation (Lebbie, 2004; Vries, 2008; Mahgoub *et al.*, 2012).

Goats are mostly kept under traditional, extensive and semi-intensive systems around the world. There are four major goat production systems in the developing countries: rural landless, extensive, crop-based and rangeland-based (Devandra, 2010).

Goats utilize poor quality nutrients to produce food. They are adapted to harsh environment (Pollott and Wilson, 2009).

### 1.2.1. **Reproductive properties of goats**

#### 1.2.1.1. Puberty

As general, puberty occurs at 5-7 months in goats. Angora goats reach puberty at 18-20 months while pygmy goats reach puberty as early as 3-4 months (Hafez and Hafez, 2006; Youngquist and Threlfall, 2007; Noakes *et al*., 2009).

#### 1.2.1.2. Estrous cycle

Goats are seasonally polyestrous and young are born during the spring (Hafez and Hafez, 2006). The estrus length is 21 days and estrus phase is 18-36 hours. Onset and length of the breeding season depends on many factors such as climate, latitude, breed and breeding system (Hafez and Hafez, 2006; Noakes *et al.*, 2009). In temperate regions most breed of goats are anestrous during spring and summer but start cycling with decreased daylight during fall. In the tropics indigenous goats tends to breed throughout the year. And they gradually lose their seasonality and get adapted to the new environment (Hafez and Hafez, 2006).

#### 1.2.1.3.Gestational length and placentation

The gestational length for goats is about 150 days. The length differ between breeds and individuals by up to 13 days (Hafez and Hafez, 2006; Solaiman, 2010). The placentomes (functional unit) is made up of fetal cotyledons and maternal caruncles and they said to be cotyledonary (Hafez and Hafez, 2006; Noakes *et al.*, 2009).

#### 1.2.1.4. Fecundity

Fecundity is defined as a number of off-spring born in reproductive age per year (ILCA, 1995; Taye *et al.*, 2013).

#### 1.2.1.5. Fertility (Conception rate)

It is defined as proportion of animals mated that get pregnant (Hafez and Hafez, 2006).

#### 1.2.1.6. Prolificacy

Prolificacy or litter size is defined as the number of progenies born per parturition. Other definitions which specify that the kids need to be alive at birth may not be appropriate (ILCA, 1995). In goats, the average prolificacy is 1.77 (Mellado *et al.*, 1991). Litter size of Saanen breed reared under Sudan conditions was found to be 1.65 (Abdelghafar, 2011).

## 1.3. Pathological conditions of the uterus diagnosed by ultrasound technique

Almost all pathological conditions of the uterus such as pseudopregnancy, pyometra, endometritis can be diagnosed using ultrasound techniques. In addition to that abnormalities during pregnancy such as hydramnion, hydrallantois, fetal mummification and maceration can also be diagnosed efficiently (Buckrell 1988; Kahn, 2004).

### 1.3.1. **Pseudopregnancy**

Pseudopregnancy or hydrometra which is regarded as synonymous is accumulation of a septic fluid in the uterus with persistent corpus luteum (CL) and failure of the doe to return to estrus (Hesselink and Taverne, 1994; Noakes *et al.*, 2009; Sridevi *et al.*, 2011). It is very important pathological condition that lead to impermanent infertility in dairy goats (Kornalijnslijper *et al.*, 1997a; Gonzalez-Bulnes *et al.*, 2010 Souza *et al.*, 2013). The definite etiology is still unknown (Hesselink and Elving 1996; Purohit and Mehta 2012).

Pseudopregnancy is an incidental finding. It occurs in mated and unmated, non-cycling goats and could happen both inside and outside the breeding season (Taverne *et al.*, 1995; Wittek *et al.*, 1997). Ultrasound scanning revealed non-echogenic or slightly hypoechoic compartmentalized fluid-filled uterus with absence of fetal parts and placentomes (Kahn, 2004). Early hydrometra can be confused with early pregnancy (less than 40 days) during ultrasound examination and thus rescanning of goats after 40 days of pregnancy should be done (Hesselink and Taverne, 1994; Kahn, 2004). In the Sudan there were few published reports regarding pseudopregnancy in goats (Ahmed *et al.*, 2010; Almubarak *et al.*, 2016).

### 1.3.2. **Pyometra**

Pyometra is an acute or chronic purulent infection of the uterus. It is characterized by accumulation of pus which led to great distension of the uterus and anestrous (Hafez and Hafez, 2006; Noakes *et al.*, 2009). There are two types of pyometra: closed and open. In the closed form the dam does not exhibited clinical signs which appear only after intoxication with the pathogen (Kempisty *et al.*, 2013). Open pyometra is characterized by dilatation of the cervix with observed purulent vaginal discharge (Hafez and Hafez, 2006).

In the Sudan Ahmed *et al.* (2010) reported pyometra in Damascus goat; in which the uterus was hypoechoic, fluid-filled compartmentalized with echogenic spots. (Hesselink and Taverne 1994; Kahn 2004) stated that the pyometra fluid contains obvious reflections and the echogenicity vary from non-echogenic with echogenic spots to snowy-storm like.

### 1.3.3. **Metritis and endometritis**

Metritis is defined as an infectious disease that extends into deeper layers of the uterus, which may include the serosa or the broad ligament (Noakes *et al.*, 2009). It is uncommon in goats but it could happen in dairy goats associated with fetal death, abortion, dystocia and retained placenta (Smith and Sherman, 2009; Pugh and Baird, 2012). Endometritis is the inflammation of the endometrium. It is divided into: acute, sub acute, and chronic based on the degree and type of inflammatory changes (Radi, 2005; Hafez and Hafez, 2006).

Ultrasonography is a valuable diagnostic modality that can be helpful in detecting endometritis and metritis (Aiello and Moses, 2012). It allows determination of the size of the uterus, measurement of uterine wall thickness and demonstration of cystic changes in the uterine wall (Troxel *et al.*, 2002).

### 1.3.4. **Fetal/embryonic death**

Fetal death is defined as cessation of heart beats, absence of fetal movement, decreased or complete absence of fetal fluid followed by close attachment between the uterine wall and fetal parts (Hafez and Hafez, 2006; Noakes *et al.*, 2009). Prenatal mortality, responsible for most gestation failure is divided into embryonic and fetal mortality. Embryonic mortality denotes the death of fertilized ova and embryos up to the end of implantation and 25-40% of embryos are lost during this period. Early embryonic death (EED) is more common than late embryonic death (Hafez and Hafez, 2006). Late embryonic death occurs after the 30-40 days of gestation (Maxwell *et al.*, 1992; Yotov, 2012). Embryonic mortality can be due to maternal factors, fetal factors or both. Maternal failure tends to affect an entire embryos, resulting in total loss of pregnancy while embryonic failure affects embryos individually (Hafez and Hafez, 2006). Sonographic detection of fetal fluids and placenta can be used as a technique for identifying non-viable or retarded fetuses (Jonker, 2004). An undifferentiated image of the uterine content with anechoic to hyperechoic structure will be demonstrated if fetal degeneration occurs (Hesselink and Taverne, 1994). Debris materials should not be seen in fetal fluids during an ultrasound examination (Ginther, 1998). Lack of echogenicity of amniotic fluid, the appropriate amount of fluid for the predicted gestational stage and normal fetal posture and movement are signs of a healthy viable fetus (Matthews, 2009). Fetal size less than expected gestational age may indicate fetal death. Absence of heart beats and movements, increase fluid echogenicity, collapsed fetal posture and hyperechogenicity of the cotyledons are common findings in a non-viable pregnancy (Jonker, 2004; Matthews, 2009). In the Sudan there were few published studies concerning diagnosis of fetal death using ultrasound technique (Abdelghafar, 2010, 2015).

#### 1.2.4.1. Causes of fetal/embryonic death

Fetal death may be due to infectious or non-infectious causes. Infectious causes account for a major percentage of the fetal death in farm animals. Non-infectious causes may be due to genetic and/or chromosomal, hormonal imbalance, malnutrition and stress (Hafez and Hafez, 2006).

##### 1.3.4.1.1. Non-infectious causes

###### 1.2.4.1.1.1. Genetic or chromosomal causes

Genetic factors causing embryonic or fetal death include single-gene defect, polygenic abnormalities and chromosomal anomalies. A few single-gene mutations are lethal and result in the death of the conceptus. A single copy may be sufficient to cause death if the gene is dominant. Some abnormal fetuses survive to term, which is biologically and economically wasteful (Noakes *et al.*, 2009).

###### 1.2.4.1.1.2. Hormonal factors

Accelerated or delayed transport of the egg, as a result of estrogen-progesterone imbalance leads to pre-implantation death. An abnormally undersized conceptus might not be able to counteract the uterine luteolytic effect with consequent regression of the CL and termination of pregnancy (Hafez and Hafez, 2006).

###### 1.2.4.1.1.3. Nutritional factors

Malnutrition affects ovulation and fertilization rate, as well as causing embryonic death. Also extremes in level of feeding is deleterious to embryo survival leading to fetal death (Hafez and Hafez, 2006; Noakes *et al.*, 2009).

###### 1.2.4.1.1.4. Toxic plants and pharmaceuticals

Prenatal mortality has been associated with several plant species such as *Nicotiana tabacum*. Other plants have been incriminated as possible causes of abortion in goats but data are scarce. Nitrate poisoning may cause plant-induce abortion in pregnant animals. Consumption of stressed nitrate accumulators, such as oat or wheat hay, sorghums, rape and pigweed will change hemoglobin into methehemoglobin, causing tissue anoxia that is the probable cause of abortion (Youngquist and Threlfall, 2007). Various pharmaceuticals have proved to be abortifacients, or at least their use has been reported to be followed by fetal loss. Phenothiazine, given in the last month of gestation may cause fetal losses, as may the use of levamisole. Cambendazole and elevated doses of Albendazole may be embryotoxic in early pregnancy, but their use later in pregnancy seems to be safe (Youngquist and Threlfall, 2007). The use of xylazine or high doses of acepromazine in the first half of pregnancy may cause abortion because of their adverse effect on placental perfusion (Ludders, 1988).

###### 1.2.4.1.1.5. Stress

Embryonic death due to heat stress is an important factor in goat production. Dams exposed to high ambient temperatures around breeding and during the early cleavage stages experience some embryo loss (Youngquist and Threlfall, 2007).

##### 1.2.4.1.2. Infectious causes

###### 1.2.4.1.2.1. Toxoplasmosis

Toxoplasmosis (*Toxoplasma gondii*) is one of the most common parasitic infections in goats, known to cause reproductive losses. The animal can be affected by ingestion transmission. Abortion can occur in does of all ages but primarily in does that acquire infection during pregnancy due to necrosis of the cotyledons. Abortion may be repeated in the next gestation (Youngquist and Threlfall, 2007).

###### 1.2.4.1.2.2. Brucellosis

*Brucella melitensis* is the cause of brucellosis in goats during late pregnancy. Occasionally, *Brucella abortus* infection occurs in goats running with infected cattle or after vaccination with strain 19 (Hafez and Hafez, 2006; Youngquist and Threlfall, 2007). The most common route of transmission is by ingestion of contaminated feed and water. The organism enters through mucous membranes and becomes localized in the lymph nodes, udder, uterus, and spleen. In pregnant animals, localization in the placenta leads to the development of placentitis with subsequent abortion (Youngquist and Threlfall, 2007).

###### 1.2.4.1.2.3. Vibriosis (*Campylobacter fetus or jejuni*)

*Campylobacter* is the most important cause of fetal loss in sheep. However, it is rarely documented as the cause of fetal loss in goats. The route of transmission is by ingestion (Hafez and Hafez, 2006). Clinical signs include late-gestation abortions, stillbirth and metritis. Aborting goats may or may not show signs of systemic illness (Hafez and Hafez, 2006; Youngquist and Threlfall, 2007).

### 1.2.4.1.2.4. Salmonellosis

*Salmonella* which transmitted through ingestion causes abortion, metritis, and systemic illness in does. *Salmonella abortus-ovis* is first implicated as a cause of fetal death in late stages and neonatal mortality. The organism has been isolated from goat fetuses and placentas in France (Hafez and Hafez, 2006; Youngquist and Threlfall, 2007).

### 1.2.4.1.2.5. Listeriosis

Listeriosis most commonly causes meningioencephalitis but can also cause pregnancy loss in goats at early gestation. Later, infection results in stillbirth or weak kids. *Listeria* may be found in soil, water, plant litter, silage, and the digestive tract. Abortions have been reported on farms on which the goats were fed hay with the addition of concentrate (Hafez and Hafez, 2006; Youngquist and Threlfall, 2007).

### 1.2.4.1.2.6. Enzootic abortion of ewe (*Chlamydia psittaci*)

Chlamydiosis is the most common cause of infectious pregnancy wastage in late gestation in goats and it is transmitted by ingestion (Hafez and Hafez, 2006; Youngquist and Threlfall, 2007). This disease must be differentiated from vibriosis. Diagnosis of Chlamydiosis depends on finding elementary bodies of the infectious agent in smear from the cotyledon or placenta exudates (Hafez and Hafez, 2006).

### 1.2.4.1.2.7. Rift Valley Fever

Rift Valley fever is a per acute or acute, mosquito-borne, zoonotic disease of domestic and wild ruminants in Africa. This virus belongs to the genus phlebovirus and is a typical Bunya virus which transmitted by insects (Hafez and Hafez, 2006). Large outbreaks of clinical disease are usually associated with heavy rainfall and localized flooding. During epidemics, the occurrence of abortions in livestock and deaths among young animals, particularly lambs, together with an influenza-like disease in human, is characteristic. However, infections are frequently subclinical or mild (Aiello and Moses, 2012).

### 1.2.5. Outcome of fetal death

The exact outcome of early fetal mortality is unpredictable and is influenced by several factors, including the cause, differences in pregnancy between species, stage of gestation at fetal death and number of fetuses (Lefebvre, 2015).

Fetal death may be followed by mummification, maceration or abortion. In cases of abortion and fetal maceration, the hormonal support of pregnancy is lost (Aiello and Moses, 2012).

#### 1.2.5.1. Mummification

Fetal mummification is characterized by fetal death, failure of abortion, resorption of placental fluids, dehydration of the fetus and its membranes and involution of the uterus (Hafez and Hafez, 2006). If fetal death occurs after ossification has begun fetal resorption cannot take place (Hafez and Hafez, 2006; Noakes *et al.*, 2009).

Fetal mummification is occasionally diagnosed in almost all domestic species, including the goat with the highest prevalence occurring in the swine. It is most often found in polytocous species but it can also occur in monotocous ones (Lefebvre, 2015). Diagnosis of mummified fetuses is straight forward and can be done by transrectal palpation and ultrasound. Using ultrasound technique the mummified fetus appear as a compact, firm and immobile mass without fetal fluids or placentomes with the general health of the dam being an affected (Lefebvre *et al.*, 2009).

#### 1.2.5.2. Maceration

Fetal maceration defined as disintegration of a fetus that occurs at any stage of gestation in all animal species (Deori *et al.*, 2015). Fetal maceration is uncommon in goats (Rautela *et al.*, 2016). This generally occurs in the event of fetal death after formation of the fetal bones beyond 100 days of gestation in such animals failed to abort or parturition (Givens and Marley, 2008; Purohit *et al.*, 2011). Bacteria enter the uterus through the dilated cervix and the soft tissues are digested by combination of putrefaction and autolysis leaving a mass of bones in the uterus (Noakes *et al.*, 2009; Deori *et al.*, 2015; Rautela *et al.*, 2016). Ultrasonographic examination of the uterus reveals hyperechoic bone shadows, absence of fluid contrast and loss of fetal architecture (Matthews, 2009).

#### 1.2.5.3. Prolonged gestational period

Prolonged gestational periods occur as a result of genetic and non genetic factors. The gestation is prolonged for periods ranging from three weeks to three months. Dystocia usually occurs and the fetuses should be delivered by caesarean section (Hafez and Hafez, 2006).

#### 1.2.5.4. Still birth/still born

Still birth is a fetus that has matured in utero but is born dead. It is of infectious or non-infectious origin. Infectious agents affect fetuses; usually die before the end of gestation and around the prenatal period. Most common non-infectious causes include hypoxia secondary to umbilical rupture or impairment of umbilical blood flow, high atmospheric carbon monoxide concentration, high temperatures, and prolonged parturition (Youngquist and Threlfall, 2007).

#### 1.2.5.5. Abortion

Abortion is termination of pregnancy with the expulsion of immature fetus, either live or dead, before the completion of gestational period as a result of the failure of the mechanisms that control pregnancy (Youngquist and Threlfall, 2007; Noakes *et al.*, 2009). Abortion may be spontaneous or induced, infectious or non-infectious (Hafez and Hafez, 2006).

Major infectious agents of abortion in goats are *Chlamydia*, *Toxoplasma*, *Leptospira*, *Brucella*, *Coxiella burnetii*, and *Listeria*. Non infectious causes of abortion may be genetic, chromosomal, hormonal and nutritional. Nutritional factors include plant toxins, such as broom weed or loco weed poisoning; dietary deficiencies of copper, selenium, vitamin A and magnesium. Certain drugs such as estrogen, glucocorticoids, phenothiazine, carbon tetrachloride and levamisole also cause abortion (Hafez and Hafez, 2006; Aiello and Moses, 2012).

### 1.2.6. Treatment of fetal death

#### 1.2.6.1. $PGF_{2\alpha}$

Prostaglandins are secreted by almost all body tissues. $PGF_{2\alpha}$ is the natural luteolytic agent that terminates the luteal phase of the estrous cycle and allows for the launch of a new one in the absence of pregnancy (Hafez and Hafez, 2006).

Administration of $PGF_{2\alpha}$ and its analogs is an efficient treatment of fetal death in goats (Purohit *et al.*, 2011; Ali, 2011). It is a drug of choice for induction of abortion resulting in more number of live births when parturition is near. It is efficient in terminating pregnancy throughout gestational period in goats (Purohit *et al.*, 2011). $PGF_{2\alpha}$ causes contractions of the uterus (Hafez and Hafez, 2006; Palliser *et al.*, 2006). The goat depends on corpus-luteum-derived progesterone throughout pregnancy and is thus susceptible to luteolytic agents, including prostaglandins, throughout the whole period of pregnancy (Matthews, 2009). In goats, administration of synthetic prostaglandins will usually cause luteolysis and termination of a pregnancy within 24-48 hours from day 5 of gestation till term (Purohit *et al.*, 2011). In small ruminants, Ali (2011) reported that administration of $PGF_{2a}$ intramuscularly will cause cervical dilatation within 72 hours.

### 1.2.6.2. Dexamethazone

In domestic animals, pregnancy can be terminated at any stages using single or repeated injections of dexamethasone (Purohit *et al.*, 2011).

### 1.2.6.3. Estradiol

In domestic species, estradiol can be administered to relax the cervix and expel the dead fetus (Ghosh *et al.,* 1992; Wu *et al.*, 2004; Lefebvre, 2015).

### 1.2.7. Subsequent fertility

In farm animals, the subsequent fertility of fetal death has not been reported except for very few studies (Lefebvre *et al.*, 2009). In small ruminants, Brounts *et al.* (2004) reported that animals that were pregnant with fetal death and delivered using caesarean section became pregnant after rebreeding. In cattle, Drost, (2007) stated that the prognosis of induced abortion in case of macerated fetuses is always poor because of the severe endometrial damage. Kumaresan *et al.* (2013) stated that $PGF_{2\alpha}$ in conjunction with estradiol for treatment of mummified fetuses in cattle would not affect future fertility.

### 1.2.8. Prevalence of fetal death worldwide and possible risk factors

Engeland *et al.* (1998) reported a prevalence of fetal death (11.1%) in dairy goats in Norway. They reported that, fetal loss associated significantly with many risk factors including increased age, building design and combined feeding. Other diseases and routine flock management procedures were not found to be significant. In abattoir study, Bokko (2011) stated a prevalence of 17.88 % fetal death in goats in the Sahel region of Nigeria. According to their study, higher frequencies of fetal death occurred in the dry season. The slaughter mediated fetal loss incidence was highest in the first trimester. Idahor (2013) reported a prevalence of 50% of fetal death in does in Nasarawa State in Nigeria. He observed a higher rate of fetal death in West African Dwarf breed than Red Sokoto breed. Samir *et al.* (2015) found a prevalence of 41.28% embryonic and fetal losses in goats.

### 1.2.9. Ultrasonography

#### 1.2.9.1. Sound waves, definition and spectrum

Sound is a mechanical energy transmitted by pressure waves in a medium. It propagates through a material medium; it cannot travel through a vacuum (Zagzebski, 1996). Acoustic waves are classified according to their frequency. 20 Hz-20 KHz is an audible sound and most human beings can hear sound within this range. A sound wave whose frequency is greater than 20 KHz is termed ultrasound; while mechanical vibrations whose frequencies are below the audible range are termed infrasound (Zagzebski, 1996).

#### 1.2.9.2. The transducer

A transducer is a device that converts one form of energy to another; in medical ultrasound, the transducer converts electrical energy to mechanical energy and vice-versa (Hendee and Ritenour, 2002). Ultrasound transducers use piezoelectricity principle discovered by Curie and Curie (1880). Piezoelectric materials have the unique ability to respond to the action of an electric field by changing shape. They also have the property of generating electrical potentials when compressed. Changing the polarity of a voltage applied to the transducer changes the transducer thickness, which expands and contracts as the polarity changes. This results in the generation of mechanical pressure waves that can transmit into the body (Rumack *et al.*, 2011). The current technology uses a transducer composed of multiple elements, usually produced by precise slicing of a piece of piezoelectric material into numerous small units, each with its own electrodes. Such transducer arrays may be form into various configurations; i.e. linear, curved, phased or annular arrays (Fulton, 2014). The individual elements that are arranged in a linear fashion producing a rectangular image-shaped display which is well suited for scanning of small parts, vascular and obstetrics applications (Fulton, 2014).

Linear arrays have been configured into convex curves to produce an image that combines a relatively large surface field of view with a sector display format i.e. trapezoid-image shaped field (Zagzebski, 1996). They are used for a variety of applications and the larger one serving for general abdominal, obstetric and transabdominal pelvic scanning. The small, high frequency curved array scanners are used for transvaginal and transrectal probes for pediatric imaging. In contrast to mechanical sector scanners, phased array has no moving parts. A sector field of view is produced by multiple transducer elements fired in precise sequence under electric control. These transducers are particularly useful for intercostal scanning to evaluate the heart, liver and spleen or in other areas where access is limited (Fulton, 2014). It produces a triangular-image shaped (Zagzebski, 1996).

#### 1.2.9.3. Principal echo display modes

##### 1.2.9.3.1. Amplitude modulation (A-mode)

Amplitude modulation is indicated by the height of the vertical deflection displayed on the oscilloscope. With A-mode ultrasound, only the position and strength of a reflecting structure are recorded (Rumack *et al.*, 2011). It is used where accurate measurements are needed as in ophthalmological studies (Zagzebski, 1996).

##### 1.2.9.3.2. Brightness modulation (B-mode)

The mainstay of imaging with ultrasound is provided by real-time gray-scale, B-mode display, in which variation in display intensity or brightness are used to indicate reflected signals of different amplitude (Hagen-Ansert, 2012). To generate a two-dimension (2-D) image, multiple ultrasound pulses are sent down a series of successive scan lines, building a 2-D representation of echoes arising from the object being scanned (Hangiandreou, 2003; Abu-Zidan *et al.*, 2011; Shriki, 2014).

##### 1.2.9.3.3. Motion modulation (M-mode)

It displays echo amplitude and shows the position of moving reflectors. M-mode imaging uses the brightness of the display to indicate the intensity of the reflected signal. The major application of M-mode is evaluation of the rapid motion of cardiac valves, chambers and vessels wall (Rumack *et al.*, 2011).

#### 1.2.9.4. Sonographic echo texture

Echo texture is defined as a reflection that returns from the tissue to the transducer. Display of specular interface is highly dependent on the angle of insonation (exposure to ultrasound waves). Specular reflectors return echoes to the transducer only if the sound beam is perpendicular to the interface. If interface is not at a 90º to the sound beam, it will be reflected away from the transducer, and echo will not be detected (Rumack *et al.*, 2011).

Most echoes in the body do not arise from specular reflectors but it is rather arise from interfaces within solid organs. If large and relatively smooth, the interface reflects sound much as a mirror reflects light. Thus, sound striking reflect directly back to the transducer resulting in a strong echo and a portion of the waves is reflected by tissue interfaces, while other parts of the waves are propagated (Zagzebski, 1996; Rumack *et al.*, 2011). Images are displayed as two-dimensional maps of grey-scale based on location and strength of the echoes returning from the tissue interfaces. Grey-scale images are composed of thousands of picture elements, known as pixels (Zagzebski, 1996).

The terms anechoic, hypoechoic, hyperechoic and echogenic are related to the assessment of tissue echogenicity. Echogenic refers to the ability to reflect ultrasound waves in the context of surrounding tissues. Anechoic is a reflection that produces from the lacking structures such as a cyst containing fluids. Hypoechoic is defined as a less echogenic tissues such as smooth muscle with the rectal wall and structures frequently contain fluids. Hyperechoic is a more reflection which produced from tissues such as fat or fascia (Cochlin *et al.*, 1994).

#### 1.2.9.5. Different ultrasound techniques in goats

Three types of transducers are available which include transabdominal, transrectal and transvaginal (Ayres *et al.*, 1999; Hafez and Hafez, 2006; Youngquist and Threlfall, 2007; Noakes *et al.*, 2009). Transabdominal scanning is applied to the skin surface of the abdomen just cranial to the udder (Ayres *et al.*, 1999). This is generally used for examinations made more than 35 days after breeding and can be also used between 80-100 days to differentiate between single and multiple pregnancy, although the accuracy in identifying the precise number of fetuses is poor (Youngquist and Threlfall, 2007; Noakes *et al.*, 2009). Transrectal scanning is done by inserting the lubricated probe into the rectal and slowly rotating it from side to side. This is usually reserved for diagnosis at less than 30-35 days after breeding. A poor quality image or no image is usually occurs due to feces trapped under the probe. Transvaginal approach using a cylindrical sectorial probe with variable angle head can be used to diagnose pregnancy from the cranial vagina (Ayres *et al.*, 1999).

#### 1.2.9.6. Ultrasound bioeffects and hazards

Ultrasound has provided a wealth of knowledge in diagnostic medicine and has greatly impacted medical practice, particularly obstetrics. It remains one of the fastest-growing imaging modalities because it is cheap, real-time, portable with no apparent adverse effects (Rumack *et al.,* 2011). At present, the U.S. Food and Drug Administration (FDA) regulate the maximum output of ultrasound devices to an established level. The physical effects of sound can be divided into two types: thermal and non-thermal. The thermal effects caused by ultrasound are similar to those of any localized heat source (Rumack *et al.*, 2011).

##### 1.2.9.6.1. Thermal effect

There is no evidence that diagnostic ultrasound produces harm in dams or the developing fetus when used properly. Up to 8 weeks of pregnancy is the period when cell damage might lead to developmental changes or anomalies. Increased mineralization of developing bones will increase potential for heating of the brain and spinal cord (Nelson *et al.*, 2009). Bones have high attenuation of ultrasound beam. When gestation is progressing there is increased degree of bone mineralization, thereby increasing risk of localized heating as in measurement of the Bioparietal diameter of the skull (Rumack *et al*., 2011).

##### 1.2.9.6.2. Non- thermal effects (cavitation)

Cavitation is defined as interaction of ultrasound with gas bodies. Acoustic cavitation inception is demarcated by a specific threshold value: the minimum acoustic pressure necessary to initiate the growth of a cavity in a fluid during the rarefaction phase of the cycle. This threshold is affected by many factors including cavitation nucleus size, acoustic pulse characteristics, ambient hydrostatic pressure and host fluid parameters (Rumack, *et al*., 2011).

Non-thermal bioeffects are recently defined as those resulting from exposures in which the temperature rises by less than 1° C above normal physiological levels

(Stratmeyer *et al.*, 2008). These effects arise either directly from the interaction with the sound field or as a consequence of this interaction.  The action of an ultrasound wave on a bubble will give rise to small-scale circulation in the fluid surrounding it, i.e. micro streaming. Induced localized shear stresses can lead to changes in the cell membrane if a bubble is close to it. Collapsing bubbles have a highly destructive effect on cells nearby. Shock waves may be produced, leading to high stresses locally, which can distort and lyses cells (Haar, 2010). Histological effects on mammalian and embryo tissues may occur after irradiation which may lead to damage in the walls of blood vessels (Hill *et al.*, 2004).

# CHAPTER TWO
# MATERIALS AND METHODS

## 2.1. Materials

### 2.1.1. Animals

962 female goats of different breeds (Saanen, Sannen crosses, Damascus and local breeds) were involved in the present study.

### 2.1.2. Study design, location and duration

A cross sectional study was performed on goats that were presented to the Veterinary clinic, College of Veterinary Medicine, Sudan University of Science and Technology (SUST) from different localities of Khartoum State (Khartoum, Um Bada, Bahri, Sharq El Nile, Karari and Um Durman) from October, 2015 – October, 2016. Khartoum state lies in the central Sudan in the semi-arid zone between longitudes 31.5-34º east and latitude 15-16º north. The Veterinary clinic received goats from almost all localities of Khartoum State; hence it was selected for the conduction of the present study.

### 2.1.3. Sample size determination

The sample size was calculated using the formula $4PQ/L^2$ given by (Martin *et al.*, 1988) where:

P = Prevalence

Q = 1-P

$L^2$ = allowable error, with 41.28% prevalence reported by (Samir *et al.*, 2015) and 5% allowable error. Accordingly the sample size was determined to be 388.

### 2.1.4. Ultrasound machine and image recorder

A real-time ultrasound scanner (Pie-medical easote, Aquila, Holland) equipped with switchable frequency (3.5-5) MHz convex transducer was used in the current study and images were printed in thermal papers using video graphic printer UP-895EC**,** Sony-Japan (figure 2.1).

**Figure 2.1 Ultrasound machine and video graphic printer**

## 2.2. Methods

### 2.2.1. Ultrasound scanning

#### 2.2.1.1. Animal preparation

Area of scanning which extend from one side of the udder to the other and 15 cm cranial to the udder (Goddard, 1996) was clipped and shaved appropriately.

#### 2.2.1.2. Animal positioning

Animals were put on a dorsal recumbency on especially designed table (Figure 2.2). Copious amount of water soluble, hypoallergenic gel (Aquasonic-Turkey) was administered to the area prior to the scanning.

#### 2.2.1.3. Ultrasound technique

Carful transabdominal scanning was done and all possible sections were taken to ensure accurate diagnosis.

### 2.2.2. Questionnaire

A well prepared questionnaire was constructed for collection of all data seems to have a relationship to the subject under investigation. Season of the year, locality, breed of the dam, age of the dam, rearing system, parity number, feeding type, oestrous type and breed of the inseminating buck were all registered as assumed risk factors for fetal death according to previous studies. All data concerning the owners of the goats under investigation were also recorded.

### 2.2.3. Clinical examination and age determination

A full clinical examination was carried out. Vital parameters such as temperature, respiratory rate and heart rate were all taken. The os cervix was also examined. Determination of the age of the goats was done (Ebert and Solaiman, 2010).

**Figure 2.2 Ultrasound table**

### 2.2.4. Treatment

Out of 36 goats with dead fetuses; only 14 goats were treated. Animals which do not respond to the medical treatment were referred for surgical intervention.

#### 2.2.4.1. Medical treatment

Goats were treated using 0.5 ml single intramuscular injection of 250 µg cloprostenol (Estrumate, Schering-Plough Animal Health, Germany) and 5 ml 5% oxytetracycline for five consecutive days (Purohit *et al.*, 2011)

#### 2.2.4.2. Caesarean section

Caesarean section and hysterectomy were performed for goats that did not respond to medical treatment according to (Hichman *et al.*, 1995).

### 2.2.5. Subsequent fertility

Follow up of the treated animals was made. Expulsion of dead fetuses and return to estrus, as well as pregnancy diagnosis and delivery of the treated dams were also followed and registered.

### 2.2.6. Statistical analysis

Collected data were analyzed using Statistical Packages for Social Sciences (SPSS) version 22.0 (SPSS Inc, Chicago, USA). Descriptive statistics of the examined variables were obtained. Univariate analysis using chi square test ($\chi 2$) was done. A level of $\leq 5\%$ was considered significant.

# CHAPTER THREE

# RESULTS

## 3.1. Sonographic pregnancy diagnosis

In the present study, out of 962 investigated goats, 439 (45.63%) were diagnosed as pregnant. The animal was designated as pregnant when fluid-filled gestational sac with placentomes and/or fetal parts were displayed (Figure 3.1). Out of 439 pregnant goats, 403 (91.8%) were diagnosed as having viable fetuses by documenting fetal heart beats and movements. 36 (8.2%) were diagnosed as having dead fetuses (Table 3.1). Fetal death was confirmed when there is lack of fetal heartbeats and movements (Figures 3.2, 3.3). 431 out of 962 (44.8%) were found non-pregnant as confirmed by absence of placentomes and/or fetal parts. 4 (0.42%) were diagnosed as having pyometra which is characterized by hypoechoic compartmentalized fluid-filled uterus with echogenic spots and debris sediments (Figure 3.4). 88 (9.14%) goats were diagnosed as having pseudopregnancy with anechoic/hypoechoic fluid-filled compartmentalized uterus with absence of fetus and placentomes (Figures 3.5, 3.6).

**Table 3.1: Frequency table of 439 pregnant goats examined in Khartoum State during 2015-2016**

| Result | Number of goats | (%) |
|---|---|---|
| Viable fetuses | 403 | 91.8 |
| Dead fetuses | 36 | 8.2 |
| Total | 439 | 100 |

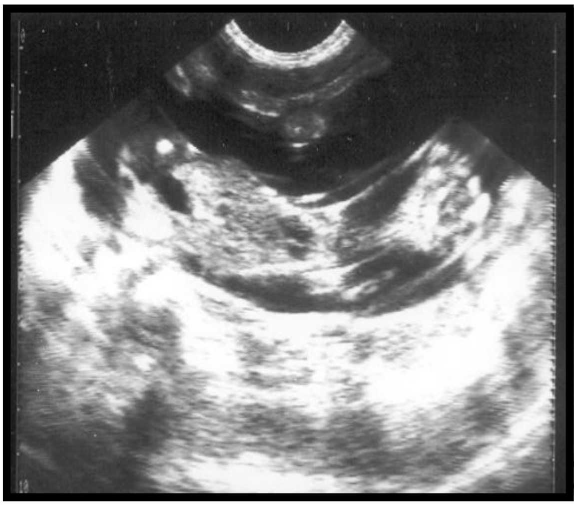

Figure 3.1 Pregnant goat

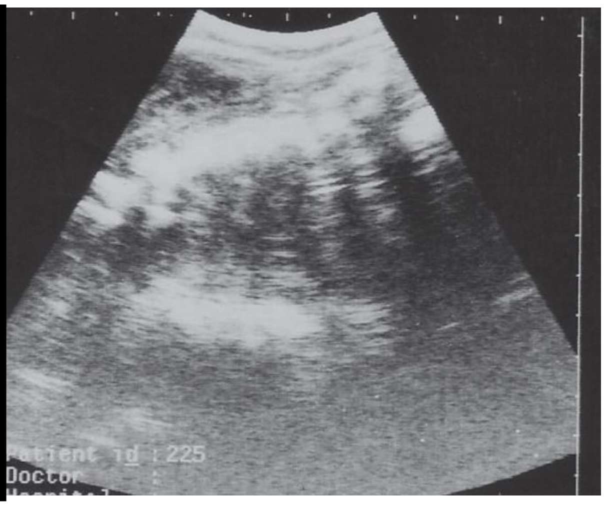


Figure 3.2 Single dead fetus

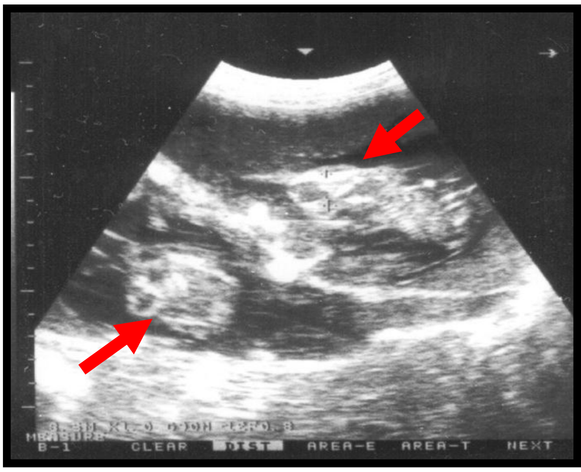


Figure 3.3 Dead twin fetuses (arrows)

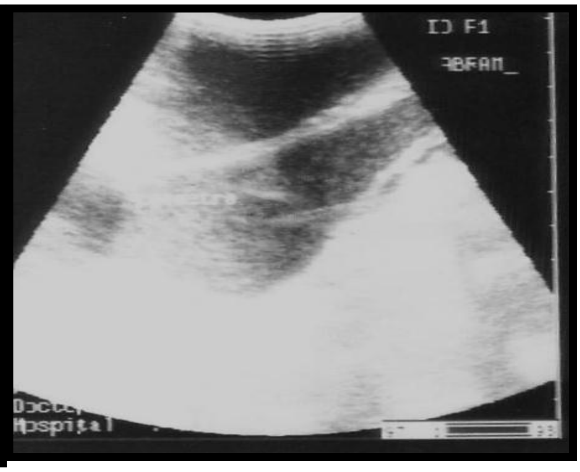


Figure 3.4 Pyometra

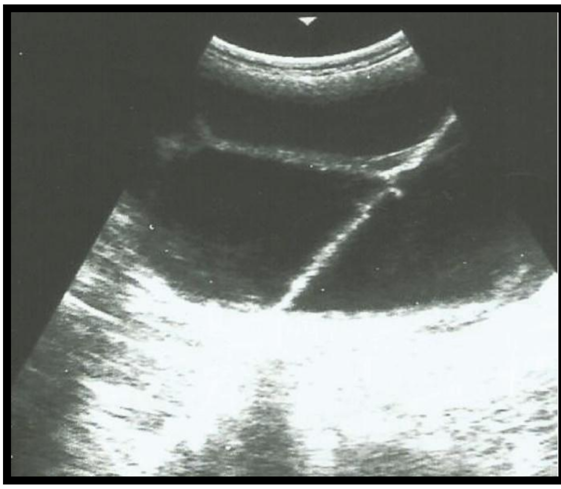

Figure 3.5 Anechoic compartmentalized fluid filled uterus (hydrometra)

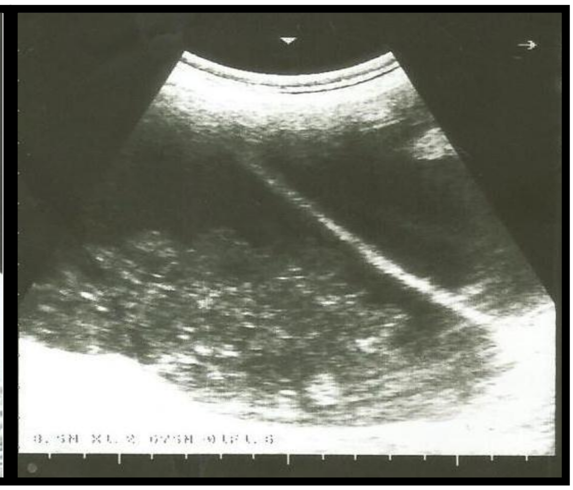

Figure 3.6 Hypoechoic compartmentalized fluid filled uterus

### 3.2. Prevalence of fetal death and associated risk factors

The prevalence of fetal death in goats in Khartoum State was found to be 8.2% (Table 3.1). Out of nine examined risk factors; two factors (rearing system and type of estrus) were not statistically analyzed because they were constant.

#### 3.2.1. Season of the year

No significant association ($\chi2$ = 4.873, P-value = 0.087) was found between season of the year and fetal death. High prevalence (13%) of fetal death was reported from dry summer season followed by winter (6.7%) and wet summer (6.2%) seasons (Table 3.2).

#### 3.2.2. Locality

In the present study, no significant association ($\chi2$ = 4.398, P-value = 0.494) was found between locality and fetal death. High prevalence (13.3%) of fetal death was recorded from Um Durman (Table 3.2).

#### 3.2.3. Breed of the dam

In the present study, no significant association ($\chi2$ = 7.147, P-value = 0.067) was found between breed of the dam and fetal death. High occurrence of fetal death was reported from Saanen (11%) followed by local breeds (Table 3.2).

#### 3.2.4. Age of the dam

No significant association ($\chi2$ = 2.566, P-value = 0.277) was found between age of the dam and occurrence of fetal death. Higher prevalence (11.8%) of fetal death was reported from goats aged > 4-6 years (Table 3.2).

#### 3.2.5. Parity number

No significant association ($\chi2$ = 3.024, P-value = 0.221) was found between parity number and fetal death. High prevalence (10.3%) of fetal death was reported from multiparous goats followed by nulliparous goats (6.7%). However, the least occurrence (3.8%) of fetal death was recorded from primiparous goats (Table 3.2).

### 3.2.6. Feeding type

No significant association ($\chi2$ = 0.728, P-value = 0.50) was found between type of feeding and the occurrence of fetal death. The occurrence of fetal death (8.4%) was only observed in animals that were fed on roughages and concentrates (Table 3.2).

### 3.2.7. Breed of the inseminating buck

No significant association ($\chi2$ = 0.560, P-value = 0.756) was found between breed of the inseminating buck and fetal death. High occurrence (9%) of fetal death was reported from goats that were mated with Saanen buck followed by Damascus (6.1%) and local breed (5.6%) bucks as shown in Table 3.2.

## 3.3. Clinical examination

Temperature, respiratory rate and fetal heartbeats were found to be within the normal physiological range in 438 goats. One goat had elevated temperature (41.8 C˚), increased heart rate (103 bpm) and respiratory rate (44 cycle/min). The Os cervix was found closed in all goats except the one with abnormal vital parameters.

## 3.4. Treatment

Thirteen goats were subjected to medical treatment using 0.5 ml intramuscular injection of 250 µg cloprostenol (Estrumate, Schering-Plough animals Health, Germany) and 5 ml 5% oxytetracycline for five consecutive days. After treatment, 11 goats responded successfully to the treatment as judged by dilatation of the cervix and abortion of fetuses after 48-96 hours. The animals returned to estrus and the animal's owners were advised to breed their goats at the next coming estrous cycle. Two full term goats with fetal death did not respond to the treatment and the cervix was not dilated. Another dose of $PGF_{2\alpha}$ was administered. The goats did not respond to the treatment for the second time and hence were referred to surgery. Regarding the $14^{th}$ goat which had dilated cervix, more than a few attempts were made to deliver the goat but all attempts were unsuccessful. Supportive treatment and broad spectrum antibiotic injection was administered to the goat and also referred to surgery. Cesarean section and hysterectomy were performed for the three full term goats and fetuses were removed (Figure 3.7).

**FIGURE 3.7. FULL TERM DEAD FETUS REMOVED BY CESAREAN SECTION**

## 3.5. Subsequent reproductive performance

Follow-up of the medically treated goats was performed using ultrasound technique. Seven out of 11 (63.6%) goats were confirmed as pregnant and gave birth at the normal gestational period. One goat was diagnosed as non-pregnant and one goat developed hydrometra. Two goats were not mated and thus the subsequent fertility was unknown. The outcome of the hysterctomized three full term goats was unfavorable.

**Table 3.2: Univariate analysis of associated risk factors with fetal death in 439 pregnant goats using Chi-square test**

| Risk factors | No. examined | No. positive | % | χ2 | df | P-value |
|---|---|---|---|---|---|---|
| **Season of the year** | | | | | | |
| Winter | 180 | 12 | 6.7 | | | |
| Dry summer | 115 | 15 | 13.0 | 4.873 | 2 | 0.087 |
| Wet summer | 144 | 9 | 6.2 | | | |
| **Locality** | | | | | | |
| Khartoum | 84 | 10 | 11.9 | | | |
| Um-Badah | 46 | 5 | 10.9 | | | |
| Bahri | 47 | 3 | 6.4 | 4.398 | 5 | 0.494 |
| Sharq El Nile | 126 | 10 | 7.9 | | | |
| Karari | 121 | 6 | 5.0 | | | |
| Um-Durman | 15 | 2 | 13.3 | | | |
| **Breed of the dam** | | | | | | |
| Saanen | 273 | 30 | 11 | | | |
| Saanen crosses | 76 | 3 | 3.9 | 7.147 | 3 | 0.067 |
| Damascus | 44 | 1 | 2.3 | | | |
| Local breed | 40 | 2 | 5.0 | | | |
| **Age of the dam** | | | | | | |
| 0.5-2 year | 185 | 11 | 5.9 | | | |
| > 2-4 years | 148 | 15 | 10.1 | 2.566 | 2 | 0.277 |
| > 4-6 years | 34 | 4 | 11.8 | | | |
| **Parity number** | | | | | | |
| Nulliparous | 119 | 8 | 6.7 | | | |
| Primiparous | 53 | 2 | 3.8 | 3.024 | 2 | 0.221 |
| Multiparous | 243 | 25 | 10.3 | | | |
| **Feeding type** | | | | | | |
| Roughages | 8 | 0 | 0.00 | 0.728 | 1 | 0.394 |
| Roughages &Concentrates | 431 | 36 | 8.4 | | | |
| **Breed of buck** | | | | | | |
| Saanen | 321 | 29 | 9.0 | | | |
| Damascus | 33 | 2 | 6.1 | 0.560 | 2 | 0.756 |
| Local breed | 18 | 1 | 5.6 | | | |

# CHAPTER FOUR

# DISCUSSION, CONCLSION AND RECOMMENDATIONS

B-mode real-time ultrasonography is considered a method of choice for diagnosis of fetal death in goats. It is non-invasive, non-time consuming and unfailing method for detecting fetal death throughout gestational period. Transabdominal approach was used for diagnosis of fetal death in the present study and ultrasound scanning was performed only once to confirm fetal mortality. Yotov (2012) reported that single ultrasound scanning could be successfully used for diagnosis of fetal death. Absence of fetal movements and heartbeats were the first signs of fetal death in the current study. Jonker (2004) and Samir *et al.* (2015) reported that lack of fetal movement and heartbeats were basic signs of the dead fetus monitored by ultrasonographic technique. In the present study, no clinical signs were observed in goats that carried dead fetuses except for one goat with dilated cervix. Engeland *et al.* (1998) stated that goats with dead fetuses don't exhibit any clinical symptoms.

In the present study, the prevalence of fetal death in goats in Khartoum State was found to be 8.2 %. Our result was lower than Samir *et al*. (2015) who identified embryonic and fetal death (41.28%) using both transrectal and transabdominal approaches during different stages of pregnancy. In the current study, transabdominal ultrasonography was used and only fetal death was documented. The higher rate of embryonic loss might be due to malfunction of the placenta in the embryonic stage of pregnancy compared with the fetal period (Inskeep, 2004).

Nine associated risk factors were investigated in the current study. No significant association was found between season of the year and prevalence of fetal death. However a high prevalence of fetal death was reported from dry summer season compared with winter and wet summer seasons and this may probably be due to high temperature and low feed intake during dry summer season. Our results agree with Bokko (2011) who reported higher prevalence of pregnancy wastage in dry season due to forage scarce.

No significant association was found between locality and fetal death and this may probably be due to the same environmental conditions.

No association was found between the breed of the dam and prevalence of fetal death. However, the high occurrence of fetal death was recorded from Saanen breed followed by Saanen crosses. This could most probably be due to that Saanen breed is a temperate breed which delivered to tropical climatic regions with high temperature. Also, the experimental groups were not numerically balanced and the majority of the examined goats were Saanen and Saanen crosses.

In the current study, no significant association was found between the age of the dam and fetal death. This is in agreement with Samir *et al.* (2015). High prevalence of fetal death was reported from goats > 4-6 years. Engeland *et al.* (1997) reported that the prevalence of fetal loss increased with increasing age of the goats. Hafez and Hafez (2006) reported that the higher incidence of fetal death in animals over 6 years resulted from impaired uterine environment. Furthermore, the quality of the endometrium might be deteriorated in elderly animals resulting in inauspicious medium for maintenance of pregnancy (Vanroose *et al.*, 2000; Yotov, 2012).

In the current study, all goats diagnosed as having dead fetuses were reared under closed system. This result is similar to Samir *et al.* (2015) who reported an occurrence of fetal death in closed rearing system.

No significant association was found between parity number and fetal death which is in agreement with Samir *et al.* (2015). High prevalence of fetal death was observed in multiparous goats compared to primiparous and nulliparous. In multiparous goats, bacteria could find access to the uterus during previous parturitions and estrous cycles which will contaminate the environment and causes fetal mortality (Vanroose *et al.,* 2000; Hafez and Hafez, 2006; Yotov, 2012).

In the current study, no significant association was found between fetal death and breed of inseminating buck. This result was in accordance with Engeland *et al.* (1997) who found that no significant association between fetal loss and specific mated buck. However, (Hafez and Hafez, 2006) reported that fetal death is attributable to the male and the mating system because of inherited genetic materials from the male and incompatibility between zygote and mother.

**Conclusion**

It is concluded that ultrasound technique is an accurate, rapid and non-invasive modality for diagnosis of fetal mortality. It is well thought-out as the method of choice for diagnosis of fetal mortality which is found to be a major problem in goat herds in Khartoum State. $PGF_{2\alpha}$ was found as a sufficient treatment for fetal death in goats.

## Recommendations

It is recommended that:

1. Ultrasound technique should be introduced as a routine diagnostic modality in veterinary clinics and teaching hospitals.
2. Further studies should be performed to find the specific causes of fetal death and to investigate other risk factors which might be associated with it.
3. Awareness of owners of the goats should be raised and risk factors of fetal death should be put into consideration.

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## Appendix: Questionnaire form

**Date:** **Serial No:**

**Owner's name:**

**Phone No:**

**Address (locality):**

**Animal ID**

| No | Risk factors | |
|---|---|---|
| 1 | **Breed of the dam** | |
| 2 | **Age of the dam** | |
| 3 | **Rearing system** | |
| | 1. Closed | |
| | 2. Opened | |
| 4 | **Parity number** | |
| | 1. Nulliparous | |
| | 2. Primiparous | |
| | 3. Multiparous | |
| 5 | **Estrous type** | |
| | 1. Natural | |
| | 2. Induced | |
| 6 | **Feeding type:**<br>1. Roughages:<br>2. Roughages and concentrates: | |
| 7 | **Breed of the insemination buck** | |
| | 1. Saanen | |
| | 2. Damascus | |
| | 3. Local breed | |

| Ultrasound result | |
|---|---|
| Empty | |
| Pregnant | |
| 1. Dead fetus<br><br>2. Viable fetus | |
| **Physiological parameters** | |
| Heartbeats | |
| Respiration | |
| Temperature | |

**Treatment**

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**Follow-up**

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**Comments:**

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