Introduction

The dog had accompanied man all over the world since it’s domestication 15,000 years ago (Savolainen et al, 2002) and it is the most abundant canid on earth (Green and Gipson, 1994) with a great impact on the environment. The dog was the first domesticated animal (Larson et al, 2012) and has been the most widely kept for working, hunting, and pet animal in human history.

The dogs populations were fast growing due to a high reproductive potential and this represents a hazard to the animals themselves, as well as to environment. Stray and feral dogs pose serious human health, socio-economic, and animal welfare problems in many countries throughout the world. Domestic dogs are the main reservoir and transmitter of rabies particularly in developing countries (Digafe et al, 2015). A diverse range of zoonotic infections including parasitic, bacterial, viral, protozoal, and fungal diseases can be transmitted from dogs to humans and animals (Robertson and Thompson, 2002; Acha and Szyfres, 2003; WHO, FAO, and OIE, 2004; Hunter and Thompson, 2005; Kahn, 2006).


The overpopulation of dogs has been a problem in the majority of countries and even though surgical methods of sterilisation, the most traditional and commonly used technique have been intensively performed, the impact on the dog population is negligible (Maenhoudt et al, 2014).

Sterilisation of dogs is the most common surgical procedure
performed in veterinary practice through which a veterinarian removes the reproductive organs in female dogs by removing both the ovaries and uterus (ovariohysterectomy) or spaying and in male dogs by surgical removal of both testicles (castration). The benefits of surgical sterilisation in dogs include prevention of diseases such as mammary neoplasia and benign prostatic hyperplasia (WHO and WSPA, 1990; Howe, 2006).

Sterilisation procedure has important role in controlling large populations of free-roaming or street dogs through animal birth control programme to reduce the overpopulation, zoonotic diseases transmission and reduce incidence of human dog bite injury. Castration and ovariohysterectomy have useful secondary benefits by altering undesirable behaviour such as aggression and the tendency to roam in dogs (Bloomberg, 1996; Howe, 2006). In bitches, to prevent indiscriminate breeding, less risk of mammary gland tumours and ovarian or uterine cancer is reduced or eliminated.

Various surgical conditions like pyometra, cystic ovary, testicular neoplasia, infectious prostate disease, cryptorchidism and testicular degeneration also require removal of genital organs in dogs.

Ultrasonography is a non-invasive imaging technique that allows internal body structures to be seen by recording echoes or reflections of ultrasonic waves. Unlike x-rays, ultrasound waves are considered to be safe. Ultrasound allows vets to look at the size and texture of organs in a two-dimensional way. An ultrasound can show abnormalities on the surface of organs as well as changes within those organs. However, the ability to distinguish solid masses from those containing fluid and to determine distribution of lesions in organs allow the sonographer to focus differential diagnosis and to formulate management plans (Walter, 2003).

The technique is invaluable for the examination of internal organs and was first used in veterinary medicine for pregnancy diagnosis.
However, the technique is also extremely useful in evaluating heart conditions and identifying changes in abdominal organs and the diagnosis of cysts and tumours.

An abdominal ultrasound is indicated to evaluate pets with abdominal symptoms such as vomiting, diarrhoea, straining to urinate or urinating blood. This test can also be helpful in cases of reproductive abnormalities, unexplained fever, loss of appetite or weight loss. The abdominal ultrasound can also be used to detect early pregnancy and determine viability of foetus later in the pregnancy.

Abdominal ultrasound helps in the evaluation of abdominal organs including the liver, spleen, stomach, intestines, kidneys, bladder, uterus and prostate gland. This test can be extremely useful for detecting changes in the shape, size, tissue density, internal structure, and position of organs. The ultrasonographic examination can also identify most abdominal masses or tumors, abdominal fluid, and abnormal lymph nodes. Frequently, abnormal tissue or fluid is sampled with a needle or biopsy instrument using the guidance of the ultrasound exam (Kealy and McAllister, 2000).

Abdominal ultrasonography is a safe and non-invasive procedure and generally takes about 20 to 60 minutes to complete than an exploratory surgery of the abdomen. Neither sedation nor anaesthesia is needed in most patients; however, some pets resent lying on their backs and may require some sedation to allow a diagnostic procedure. If a biopsy needle is used to obtain a tissue sample, a local anaesthetic or ultrashort anaesthesia is used.

Blood is an important medium in assessing the health status of animals. Both the physiological and a pathological conditions of animals can be assessed by the evaluation of hematological and biochemical analyses of the blood. (Coles, 1986 and Bush, 1991). Though ample work has been done on establishing the baseline values of biochemical and

In view of this the present investigation was undertaken with the following objectives:

I. To carry out ultrasonographic evaluation of abdomen in dogs undergoing sterilisation operation for the survey diagnosis of abdomen disorder.

II. To study the haemato-biochemical status of dogs undergoing sterilisation operation.

III. Corroborate ultrasonographic findings with the clinical and haemato-biochemical findings in dogs undergoing sterilisation operation.
Review of Literature

Wrigley et al (1988) found that ultrasonography has been useful in diagnosis of splenic hemangiosarcoma in 18 dogs with echo patterns of masses ranged from anechoic fluid to hyperechoic tissue. Metastasis was detected as anechoic to hypoechoic lesions in the liver ultrasonographically.

Eilts et al (1988) diagnosed unilateral cryptorchidism and sertoli cell tumor in the descended testis by use of ultrasonography in a 7-year-old Keeshound dog. The left testis was degenerated and there was no evidence of testicular or epididymal tissue while the contralateral testis contained a hypoechoic mass and was believed to be a testicular tumor. The ultrasonographic interpretations were confirmed by surgery and histopathologic findings.

The change in echogenicity of liver parenchyma have been evaluated by Biller et al (1990) in diffuse parenchymal hepatic disease as either hyperechoic due to fatty change, steroid hepatopathy, and cirrhosis or hypoechoic due to congestion, suppurative hepatitis, and lymphoma. They further suggested that ultrasonographic diagnosis of diffuse liver disease should be substantiated by biopsy and histopathologic evaluation.

Lamb et al (1995) studied ultrasonographic and radiographic findings in 16 dogs with pancreatic neoplasia. The sensitivities for pancreatic neoplasia were 12 of 16 (75%) for ultrasonography, 3 of 16 (19%) for radiography. The sensitivities for metastasis were 2 of 11 (18%) for radiography and 6 of 11 (%) for ultrasonography. In 2 dogs, jaundice was evident due to biliary obstruction by the primary tumor and metastases which was also diagnosed by ultrasonography.

Ultrasonography of the adrenal glands has been a valuable diagnostic procedure in dogs suspected of having pituitary-dependent hyper-adrenocorticism (Barthez et al, 1995). The study was conducted on
62 dogs (20 healthy dogs, 20 dogs with non-endocrine disease, and 22 dogs with untreated pituitary-dependent hyper-adrenocorticism) to determine normal adrenal gland size by means of ultrasonography in dogs and to determine the value of ultrasonography in the diagnosis of pituitary-dependent hyper-adrenocorticism. Length and maximum and minimum diameter of the adrenal glands were measured ultrasonographically. Significant linear relationship between adrenal gland length, body weight, aortic diameter, kidney length in healthy dogs and in dogs with non-endocrine diseases have also been reported.

Abdominal ultrasonography often provides the best diagnostic yield when used in combination with radiography and image-guided biopsy techniques. The cystic lesions can be differentiated from solid masses with ultrasound, but the appearance of focal abnormalities was not specific for any one disease process (Miles, 1997).

Rivers et al (1997) evaluated the utility of ultrasonography in the diagnosis of canine gastric neoplasia in 6 cases. Gastric neoplasia were found associated with mural thickening, loss of normal wall sonographic layers and decreased or absent local motility. The ultrasonographic findings were consistent with tumour localisation obtained by other diagnostic methods. Ultrasonographic-guided, percutaneous, fine-needle aspirations biopsies were successful in 2 of 3 cases.

The clinical, ultrasonographic and histopathologic findings of gastric ulceration in 7 dogs were reviewed by Penninck et al (1997). Ultrasonographic features of gastric ulcer included local thickening of the gastric wall, possible loss of the 5-layer structure, the presence of a wall defect or "crater," fluid accumulation in the stomach and diminished gastric motility. The ulcer crater was often located in the center of the thickened site and appeared as a mucosal defect associated with persistent accumulation of small echoes, most likely representing microbubbles.
Diez-Bru *et al* (1998) studied the ultrasonographic findings of histologically confirmed ovarian neoplasms in 10 female dogs. Ultrasonographic images and reports were reviewed for (1) location, size, outer margins, and echogenicity of the masses, (2) presence of free abdominal fluid, (3) evidence of uterine abnormalities, and (4) signs of metastatic disease. These ovarian masses were classified according to their ultrasonographic pattern in solid, solid with cystic component, and cystic.

Penninck *et al* (1998) performed an ultrasonographic study on 16 dogs with histologically confirmed gastric epithelial neoplasia. The most common ultrasonographic findings were transmural thickening of the gastric wall associated with altered wall layering. A poor echogenic lining was often noted on the innermost and the outermost portions of the gastric wall, separated by a more echogenic central zone. This ultrasonographic feature, called pseudo-layering, was present in 14 dogs. Regional lymphadenopathy was also identified ultrasonographically in 15 dogs. They suggested that ultrasonography has been a useful tool for the detection and diagnosis of canine gastric epithelial neoplasia.

Ruel *et al* (1998) obtained sagittal and transverse ultrasonographic images of the prostate gland in 100 healthy adult intact male dogs. Linear regression and correlation analysis were performed between prostatic parameters (length, width, height on sagittal and transverse images, and estimated volume) and parameters related to body size (body weight, body height, left kidney length and aortic diameter) and age of the dogs. Significant positive correlations were found between all prostatic parameters and parameters related to body size and age. The authors stated that such values represent a useful tool for ultrasonographic evaluation of the prostate in the dog.

Newell *et al* (1998) conducted gray-scale and doppler ultrasonography of prostate gland in 11 normal dogs and 5 dogs with
histologically confirmed chronic lymphocytic or lymphoplasmocytic prostatitis. The resistive index, maximum and minimum velocities of prostatic, capsular and parenchymal arteries were measured with pulsed wave doppler. No differences have been observed between normal dogs and dogs with prostatitis in either gray-scale or doppler ultrasound.

Ultrasonography has been a convenient method for examining adjacent organs, principally the kidneys and bladder, which may be affected in animals with ureteral abnormalities. Also, ultrasound guidance facilitates certain interventional diagnostic procedures for the ureters (Lamb, 1998).

Ultrasound images were reviewed with respect to appearance of the intussusception, suspected location, evidence of predisposing cause and concurrent lesions by Lamb and Mantis (1998). Ten intussusceptions were found, affecting a variety of breeds. The mean (range) age of affected dogs was 2.5 (0.3 to 7) years in 4 females and 6 males. Intussusceptions were jejunojejunal (5), ileocolic (3), caecocolic (1) and colocolic (1). A concentric ring sign was identified ultrasonographically in each dog and anatomical location was predicted correctly in 5 instances.

Lamb and Grierson (1999) studied ultrasonographic findings in 21 dogs with histologically confirmed primary gastric neoplasia. Location, shape of the gastric lesion, evidence of gastric wall thickening, wall layers affected, presence of ulceration, evidence of extension through the gastric wall and lymphadenopathy were recorded. Twelve dogs with carcinoma shared many ultrasonographic features with 6 dogs that had lymphoma, the majority having sessile masses that appeared to involve all layers of the gastric wall; many also had evidence of ulceration and lymphadenopathy. Signs of extension of the lesion through the serosal surface of the stomach were also identified ultrasonographically only in dogs with carcinoma.

Besso et al (2000) conducted abdominal ultrasound in 14 dogs with enlarged gallbladders and immobile stellate or finely striated bile patterns.
Ultrasonographically, mucocele were characterised by the appearance of the stellate or finely striated bile patterns and differ from biliary sludge by the absence of gravity dependent bile movement. On ultrasound, gallbladder wall thickness and wall appearance were variable and nonspecific. Loss of gallbladder wall integrity and gallbladder rupture was present in 50% of the dogs, all located in the fundus. Gallbladder wall discontinuity on ultrasound indicated rupture whereas; neither bile patterns predicted the likelihood of gallbladder rupture.

Beck et al (2001) conducted survey and contrast radiography, ultrasonography and endoscopy in the diagnosis of gastric carcinoma in dogs usually presented with clinical signs of vomiting, anorexia, and weight loss. Gastric neoplasia was suspected on ultrasound examination and confirmed histologically.

Paoloni et al (2002) evaluated the ultrasonographic features in 21 dogs with intestinal adenocarcinoma which included location, length, wall thickness, echogenicity, regional motility, layering, regional lymphadenopathy and fluid accumulation proximal to the lesion site. All lesions were transmural and associated with complete loss of wall layering. Most intestinal lesions were poorly echogenic and had an irregular lumen.

The effect of breed on serum biochemistry and hematological parameters of clinically healthy dogs were studied by collecting blood from the cephalic vein of 10 Alsatian and 10 local dogs. The parameters evaluated were not significantly different between the two breeds (Ariyibi et al, 2002).

Ultrasonography in conjunction with colour and pulsed doppler imaging had supplanted other imaging modalities in the evaluation of scrotal diseases and disorders (Dina and Joseph, 2002). They found that ultrasonography has been a valuable tool in the evaluation of acutely painful scrotum, scrotal masses and male infertility. They further stated that
advances in ultrasonographic spatial and low-contrast resolution have improved our ability to more clearly define diagnoses for the referring urologist and have led to new observations that are currently being investigated.

Penninck and Mitchell (2003) examined 4 dogs that had ingested wooden foreign bodies. Ultrasonography of the flank mass revealed a homogeneous subcutaneous tissue representing seroma, edema or reactive tissue. Long, linear, bright interfaces representing the wooden foreign bodies were identified in the stomach of 3 dogs and in the abdominal cavity of 1 dog.

A clinical study was conducted on 150 dogs with histopathologically confirmed intestinal disease. Sixty-one dogs had enteritis and 89 dogs had intestinal neoplasia. Ultrasonographic findings including the thickness and distribution of the intestinal lesion, the integrity of intestinal wall layering, regional lymph node thickness, the location of the intestinal segment involved, and regional motility were evaluated (Penninck et al, 2003)

Boysen et al (2003) performed a retrospective study to evaluate the sonographic features of gastrointestinal (GI) perforation in 19 animals (14 dogs and 5 cats) which included regional bright mesenteric fat (19), peritoneal effusion (16), fluid-filled stomach or intestines (12), GI wall thickening (11), presence of free air (9), loss of GI wall layering (9), regional lymphadenopathy (8), reduced GI motility (7), pancreatic changes (4), corrugated intestines (4), presence of a mass (3), presence of a foreign body (3), and mineralization of the gastric wall in 1 animal.

Cruz-Arámbulo and Wrigley (2003) evaluated abdominal organs viz. liver, biliary system, pancreas, stomach, small intestine, kidney, urinary bladder, uterus, and prostate by using ultrasound and stated that pathologies of the abdominal cavity and retroperitoneal space can be diagnosed with ultrasonography. They further stated that Interventional
ultrasound techniques have been found useful to either assist in getting the definitive diagnosis or to treat certain pathologic conditions.

Louvet and Denis (2004) conducted ultrasonographic examination in a 7-year-old White Terrier dog which had a 5-month history of diarrhoea, dysorexia, and weight loss. A neoplastic or severe inflammatory condition was suspected with a focal area of intestinal thickening with loss of layering on ultrasonographic examination and was diagnosed as intestinal lymphangiectasia, histopathologically.

Cruz-Arámbulo et al (2004) conducted a study to describe the ultrasonographic features of malignant histiocytosis, malignant fibrous histiocytoma, and histiocytic sarcoma in abdominal organs of 18 dogs. The organ most commonly affected was the spleen followed by liver. Malignant histiocytosis was the most common followed by histiocytic sarcoma and malignant fibrous histiocytoma seen as multiple hypoechoic nodules with well-defined borders often in the spleen and liver. Malignant histiocytosis in the abdominal lymph nodes resulted in hypoechoic lymphadenopathy. Malignant fibrous histiocytoma in the kidneys resulted in a single heteroechoic renal mass with well-defined borders. In the stomach of 1 dog, malignant histiocytosis was observed as a single well circumscribed hypoechoic mass with well-defined borders.

Ta-Kiguchi and Inaba (2005) evaluated ultrasonographic images of 8 dogs with polypoid cystitis. Ultrasonography confirmed the presence of a bladder mass or masses in all the dogs seen as mucosal projections and a polypoid to pedunculated mass of variable size and shape. Although, a polypoid mass tends to be located in the cranio-ventral bladder mucosa, the polyps could also arise in the cranio-dorsal bladder mucosa. Ultrasonographic images are well correlated with contrast radiographic studies and gross morphological appearance. He stated that ultrasound has been a non-invasive diagnostic tool for detecting bladder polyps, but histopathology is required for definitive diagnosis.
Howe (2006) described many techniques for surgical sterilisation of dogs and cats. Techniques that had been described include traditional midline ovariohysterectomy, lateral flank ovariohysterectomy, castration, early age gonadectomy, ovariohysterectomy, laparoscopic ovariohysterectomy and ovariohysterectomy, and vasectomy. Each technique offers advantages and disadvantages to both the patient and surgeon. Regardless of the technique selected, strict adherence to sound surgical technique and asepsis has been mandatory for good surgical outcome with minimal complications.

Abdominal ultrasound provides valuable clinical information about the peritoneal cavity, great vessels, abdominal viscera, and lymph nodes, in pediatric patients with congenital anomalies which is obtained in a non-invasive fashion and usually does not necessitate sedation or anaesthesia. Ultrasonography, thus greatly facilitates diagnostic evaluation of the pediatric patient (Baker and Davidson, 2006).

Tyrrell and Beck (2006) conducted survey abdominal radiography and ultrasonography in 16 small animals (11 dogs, 5 cats) with clinical signs of gastro-intestinal foreign body obstruction. Ultrasonography detected foreign body in all the 16 animals which were identified by their distal acoustic shadowing and variable degrees of surface reflection. An intestinal perforation was also detected sonographically but not radiographically. The value of additional sonographic findings including thickening of the gastrointestinal wall and loss of layering, free peritoneal fluid and lymphadenopathy in these animals is discussed. The findings in this series suggest that in a small animal with a gastrointestinal foreign body, ultrasonography alone could be used to make the diagnosis and may be a more appropriate choice than survey radiography.

Ultrasonography has been used to monitor daily follicular development, ovulation and corpora lutea formation in a bitch with a 8-MHz linear transducer. The follicles were identified as anechoic spherical
structures on day 6 of pro-oestrus. The average follicular size was 0.67 ± 0.06 cm on the right ovary and 0.48 ± 0.02 cm on the left ovary during the follicular phase. Apparent ovulation was characterised by rapid disappearance of the anechoic antrum in both ovaries within 24 h (Eker and Salmanoglu, 2006).

Abdominal ultrasonography of the right aspect of the liver, kidney, right adrenal gland, pancreas, and duodenum was performed in dogs as these sites are often not fully visible from ventral, or subcostal approach. The right lateral intercostal plane has been an alternative approach which allows evaluation of these structures and may prove useful in large and giant breed, deep-chested dogs (Brinkman et al, 2007).

Mundim et al (2007) studied physiological variations and the influence of sex and age on the serum biochemical profile of dogs based on the analysis of 132 blood specimens from 44 newly weaned and young adult Doberman dogs, ranging in age from 2 to 36 months. The mean values of serum biochemical parameters remained mostly within the physiological reference intervals. The only differences were observed in albumin, which showed higher values and chloride with lower values, suggesting that the animals were in good health. It has been observed that the age appeared to influence several serum biochemical parameters in young Doberman dogs, especially up to 6 months of age, while sex influenced only the serum phosphorus concentration and the Ca/P ratio.

An abdominal ultrasonographic examination was performed on 100 canine patients to assess factors that affected ultrasonographic visualisation of the pylorus, duodenal papilla, pancreas, adrenal glands, and jejunal and medial iliac lymph nodes. The parameters that negatively influenced the visibility of these organs were found to be the presence of air or food in the gastrointestinal tract (pancreas, duodenal papilla), age (lymph nodes), and body weight (pancreas, duodenal papilla). The parameters that positively influenced their visibility were found to be the
presence of air or food in the gastrointestinal tract (lymph nodes), body weight (lymph nodes), body condition score (right adrenal gland), and inherent image quality (left pancreatic lobe) (Barberet et al, 2008).

Gaschen et al (2008) studied 56 dogs with chronic diarrhoea and 10 control dogs were examined with 2D, gray-scale ultrasound and small intestinal mucosal biopsies were performed. Fifty-one dogs had inflammatory infiltration of the duodenal mucosa with 2 different patterns of increased echogenicity of the mucosa were detected; hyperechoic speckles and hyperechoic striations.

Irausquin et al (2008) compared the use of ultrasonography and contrast enhanced computed tomography to evaluate the accuracy of detecting hepatic neoplasia in dogs with splenic masses, independently, in series, or in parallel. No significant difference was found between ultrasonography and computed tomography. The study showed that computed tomography combined with ultrasonography could be a valuable tool in the evaluation of dogs with splenic masses.

Ivancic and Mai (2008) performed study on qualitative and quantitative evaluation of echogenicity of the renal cortex relative to the liver in 25 healthy dogs using 3 standard B-mode images (8.0 MHz) and 3 tissue harmonic images of the cranial pole of the right kidney adjacent to the caudate lobe of the liver. Renal and hepatic echogenicities were qualitatively compared by two observers. They were of the opinion that the framework within which the canine renal cortical parenchyma is routinely evaluated in abdominal ultrasonography should be reconsidered, and mild hyperechogenicity relative to the liver (at 8.0 MHz) interpreted as a normal finding.

Omer (2009) investigated gender based variations in normal serochemical values of German shepherd dogs in Sudan to establish an overall reference values for these parameters in this breed. Serum concentration
of total protein, albumin, glucose, cholesterol, triglycerides, creatinine, urea, uric acid, and the activity of the enzymes ALT, ALP and AST were estimated in 22 males and 22 females. He found that gender had no significant effect on the studied parameters, except the activity of AST activity. The overall mean and range of the investigated values were calculated, compared and discussed with results of other researchers in dogs.

Mahalingam et al (2009) studied 10 clinically healthy, adult male dogs randomly equally divided into 2 groups (I and II) were subjected to laparoscopic sterilisation and open method castration under xylazine-ketamine anaesthesia. In group I laparoscopic vasectomy by cauterisation and cutting of the vas deferens was performed and in group II conventional open castration by the pre-scrotal approach was done. Clinical observations revealed no significant changes. Differential leukocyte count (DLC) revealed significant neutrophilia and comparative lymphopenia on the 3rd postoperative day in both the groups. A significant increase (P < 0.05) in plasma alkaline and acid phosphatase level was observed in both the groups on day 3, postoperatively. On the basis of the parameters studied, it can be concluded that early healing and better cosmoses were achieved by laparoscopic sterilisation (vasectomy) in male dogs as compared to the conventional open method of castration and the technique can be successfully applied for mass sterilisation programs.

Crabtree et al (2010) performed abdominal ultrasonography in 28 dogs with a confirmed diagnosis of lymphoma. Needle aspirates were obtained for cytology from 3 separate sites in the liver and 3 sites in the spleen and the ultrasonographic appearance was noted at each site. They observed that the accuracy of hepatic and splenic abnormalities seen on ultrasound for diagnosis of lymphoma were 76.8% for the liver, and 68.1% for the spleen. Whereas, the diagnostic utility of abdominal ultrasound investigated in 89 dogs with chronic vomiting was found high in 27% of dogs with gastric adenocarcinoma or GI lymphoma (Lieb et al, 2010).
Choi \textit{et al} (2010) compared the ultrasonographic features for pyonephrosis in 18 dogs with that of hydronephrosis in 10 dogs. In most dogs with pyonephrosis, hyperechoic contents completely filled the dilated renal pelvis \((n = 8)\). Hyperechoic, oedematous mesentery, and peritoneal and retroperitoneal effusion, which represented peritoneal and retroperitoneal inflammation, have been observed in the perinephric region in 11 dogs. Compared with pyonephrosis, and as expected, hydronephrosis was characterised by anechoic contents within the urine-filled collecting system and there were no definitive findings to suspect peritonitis. Thus a distinct difference in the sonographic appearance of pyonephrosis vs hydronephrosis has been observed in dogs.

Splenomegaly with a diffuse heterogenic parenchyma and generally reduced echogenicity has been observed as ultrasonographic changes in 72 dogs naturally infected with babesiosis. Also, diffuse hypoechoic hepatomegaly and bilaterally increased cortical echogenicity of the renal parenchyma were found more frequently in severe uncomplicated and complicated babesiosis groups (Fraga \textit{et al}, 2011)

A study was conducted to provide basic data on physiological and hematological characteristics, and organ weights in 237 Beagle dogs depending on sex and age. The platelet count of female dogs was slightly higher than that of males. The red blood cell, haemoglobin, and haematocrit of both sexes increased non-significantly with age. In the leukocyte differential count, basophils, lymphocytes, and monocytes decreased whereas, neutrophilia, and eosinophilia was evident in both sexes with the age. In serum biochemical profiles, alkaline phosphatase was slightly higher in males than females, while the total cholesterol of female dogs at 9-months-old was higher than that of males at the same age. Other biochemical components, including alanine aminotransferase, blood urea nitrogen, creatinine, triglyceride, and total protein increased nonsignificantly with age in both sexes (Choi \textit{et al}, 2011).
Khan et al (2011) obtained haematology and serum chemistry values from 28 male and 22 female stray dogs in Chittagong Metropolitan area, Bangladesh to establish reference value for haematology and serum chemistry for these semi wild animals in relation to age, sex, reproductive stage and body condition. No significant differences were found for mean values of haemoglobin, packed cell volume, mean corpuscular haemoglobin concentration, total leucocyte count, differential leukocyte count, total protein, albumin, glucose, cholesterol, phosphorus and potassium among or between sexes, ages, reproductive states or body conditions.

Renal pelvic dilatation has been detected ultrasonographically in 81 dogs and 66 cats with clinically normal renal function, and that it increases with renal insufficiency, pyelonephritis, or outflow obstruction. Pelvic width ≥13 mm always indicated obstruction (D’Anjou et al, 2011).

Choi et al (2012) diagnosed ectopic kidneys by means of radiography and ultrasonography in 3 dogs referred with a history of vomiting, hematuria and ocular discharge, respectively. In all three dogs, oval-shaped masses with soft tissue density were observed in the mid to caudal abdomen bilaterally or unilaterally, and kidney silhouettes were not identified at the proper anatomic places on abdominal radiographs. Ultrasonography confirmed the masses were malpositioned kidney. The ectopic kidneys had relatively small size, irregular shape and short ureter but showed normal function on excretory urography.

Ultrasound was used to locate undescended testes in 30 dogs and 4 cats. The retained testes were located either in the abdomen or in inguinal region (Felumlee et al, 2012). They found that ultrasound has been a sensitive test for localisation of retained testes, and supported the opinion that preoperative ultrasound can help facilitate localisation of retained testes prior to surgical exploration or laparoscopy.
Krol and O'Brien (2012) conducted ultrasonographic assessment of abdominal lymph nodes in 53 clinically normal dogs between 4-6 weeks age. One hundred forty-five jejunal, 53 right medial iliac and 53 left medial iliac lymph nodes, with total 251 lymph nodes seen in all the dogs. Lymph nodes were either uniformly hypoechoic or centrally hyperechoic with a hypoechoic rim. Although most (60%) lymph nodes were oval, a variety of shapes were seen, including vermiform and complex branching shapes. They concluded that in 4- to 6-week-old dogs, medial iliac lymph nodes were similar in size to adult dogs and jejunal lymph nodes were multiple, routinely seen and larger than in adults and often had unconventional shapes.

Leib et al (2012) investigated that increased diagnostic utility has been associated with palpation of an abdominal or rectal mass in dogs which commonly have mass lesions visible on ultrasound examination and a final diagnosis of gastrointestinal neoplasia. Multivariable regression indicated that utility of abdominal ultrasonography would be 30 times more likely to be high in dogs in which an abdominal or rectal mass was palpated.

Citi et al (2013) ultrasonographically detected micronodular lesions in the colonic submucosa of 42 dogs and 14 cats. The lesions had rounded/oval shapes, measured 1-3 mm in size, and exhibited a hypo/anechoic ultrasonographic pattern. Concurrent sonographic abnormalities included; increased colon wall thickness (12.5%); small bowel wall thickening, altered layering, or hyperechoic mucosa (45%); abdominal effusion (29%); caudal mesenteric lymphadenopathy (46%); mesenteric lymphadenopathy (27%); and pericolic peritoneal fat reactivity (9%).

Hart et al (2013) performed abdominal ultrasound in 145 dogs over a 6-month period and divided into 6 groups based on body weight Chi-square analysis was used to determine the frequency of a hyperechoic outer medulla was significantly different between weight groups, sex, and
age. Forty five dogs had a hyperechoic outer medulla relative to the cortex and inner medulla. In the remaining dogs, the outer medulla was isoechoic to the cortex. Dogs less than 5 kg had the highest frequency of a hyperechoic outer medulla. However, Sexes had no influence on the presence or absence of the hyperechoic outer medulla.

Kemp et al (2013) evaluated liver by abdominal ultrasound examination as well as by histopathology in 138 dogs. The recorded ultrasonographic features were analysed to identify abnormalities associated with each histopathological findings or degree of fibrosis. They found 64% of sonographically unremarkable livers had histologic abnormalities which include masses, microhepatia, anomalous veins, and biliary changes associated with specific histopathologic abnormalities.

Jena et al (2013) studied the physiological and haematological parameters in 28 bitches affected with pyometra. Haematological parameters, haemoglobin, packed cell volume (PCV), total erythrocyte count (TEC) and lymphocyte count were decreased in the bitches affected with pyometra. The total leucocyte count (TLC), were increased in pyometra. Normocytic and normochromic anaemia, leucocytosis, neutrophilia, lymphopenia and monocytosis were the most common findings in all the bitches affected with pyometra. Several aspects including physiological and pathological mechanisms as well as molecular changes which take place during induction of endometritis-pyometra have also been studied by Kempisty et al (2013).

Ovariohysterectomy performed at the time of mammary tumour excision significantly reduced the risk of new tumours among dogs with non-malignant mammary tumours. Dogs were allocated to undergo ovariohysterectomy (n = 42) or not (n = 42) at the time of excision of non-malignant mammary tumours which were confirmed histologically. New mammary tumour has been developed in 27 of 42 (64%) intact dogs and 15 of 42 (36%) ovariohysterectomised dogs (Kristiansen et al, 2013).
Patil et al (2013) studied 20 bitches divided into 2 groups after a presumptive diagnosis of pyometra. Group I comprised of non-surgical cases receiving medicinal treatment and group II of the surgical cases going for ovariohysterectomy and blood samples of same animals were obtained again 15 days after undergoing treatment either non-surgical that is, medicinal (group III) or surgical (group IV), respectively. Haematological examination revealed a decrease in the total erythrocyte count (TEC), haemoglobin, and packed cell volume (PCV) in all pyometra infected animals. Biochemically, there were significant elevations of serum Alanine transferase (ALT), Aspartate transferase (AST), Alkaline phosphatase (ALP), Total bilirubin (BIT), Gamma glutamyltransferase (GGT), Blood urea nitrogen (BUN) and Creatinine (CRE), and decrease in protein and albumin concentration in serum of all dogs with pyometra.

Payne (2013) analysed the effect of spaying (ovariohysterectomy) on the performance of racing Greyhound. Random effects models were used to compare the racing performance before and after spaying in Greyhounds, matched by distance and date of racing, in spayed and intact bitches were compared. He stated that spaying of racing Greyhound bitches produced no overall change in performance, and had no apparent long term effect on performance.

Sacornrattana et al (2013) reviewed the ultrasonographic evaluation of abdomen in 118 dogs diagnosed with osteosarcoma. Fifty-seven percent had ultrasonographic abnormalities identified with the highest frequency of ultrasonographic changes noticed in spleen. While most sonographic changes have been considered to be either benign or of unknown clinical consequence. Metastases were identified in 3 dogs (2.5%), 2 of which (1.7%) did not have other evidence of metastasis.

Abdellatif et al (2014) performed ultrasonography in a 8 year old male German shepherd dog with signs of peritonitis revealed the presence of a large mass in the spleen. Laboratory tests reflected highly septic
pyogranulomatous inflammation and, together with imaging findings, raised a high suspicion of splenic abscess and septic peritonitis.

Cook et al (2014) determined the prevalence of clinical features associated with incidental adrenal gland lesions during abdominal ultrasonography in 151 dogs during a 3.5-year study. Dogs with an incidental adrenal gland lesions were significantly older (median age, 11.25 years) and heavier (median body weight, 21 kg [46.2 lb]) than the control population (median age, 9.5 years; median body weight, 14 kg [30.8 lb]). Incidental adrenal gland lesions were more likely in dogs ≥ 9 years of age.

Patsikas et al (2014) retrospectively reviewed histologically confirmed uterine tumors in 9 female intact dogs and the related ultrasonographic and radiographic signs of the lesions detected were recorded. Ultrasonography revealed masses in all dogs with uterine body/cervical tumours and could delineate the origin of the mass in 1 of 2 dogs with uterine horn tumours. The mass was characterised ultrasonographically as solid in 3 dogs (leiomyomas), solid with cystic component in 4 dogs (2 adenocarcinoma, 1 leiomyoma, and 1 fibroleiomyoma), and cystic in 2 dogs (leiomyoma). Hyperechoic foci in the mass were observed in 3 dogs.

Taylor et al (2014) observed ultrasonographic features of renal lymphoma in 10 dogs. Pyelectasia was found in all dogs. Other ultrasonographic findings were loss of cortico-medullary distinction (9/10 dogs), renomegaly (8/10 dogs), renal deformity (6/10 dogs), hypoechoic lesions described as masses, nodules, and indistinct areas (6/10 dogs), and hyperechoic lesions (2/10 dogs). In 30% of the cases (3/10 dogs) ultrasound revealed only minor abnormalities, including pyelectasia, mild renomegaly, and focal loss of cortico-medullary definition. The findings indicated that ultrasonographic signs of canine renal lymphoma may be subtle, and that canine renal lymphoma should be included in the
differential diagnosis when the above ultrasonographic features were observed.

Ultrasonographic examination revealed fluid filled uterus with variable wall thickness and proliferative changes in 12 bitches and 36 queens of different breeds and ages for CEHP then ovariohysterectomy was performed in positive cases. Higher incidence of CEHP was recorded in bitches and queens over 6 years old and the affection was more frequent during spring season (Younis et al, 2014).

Kaur et al (2015) evaluated 18 dogs to establish the reliability of ultrasonography for definitive diagnosis of gastrointestinal foreign bodies. Out of the 18 cases, non-linear discrete foreign bodies detected in small intestines (n=6) and stomach (n=1), and linear foreign bodies were detected in 11 dogs, characterised by hyperechoic structure within the intussusception with distal acoustic shadowing. They suggested that ultrasonography could be used as single diagnostic tool for definitive diagnosis of mechanical obstruction in dogs.

Lim et al (2015) described ultrasonographic features of *uterus masculinus* in 6 dogs. The walls appear isoechoic to the urinary bladder wall. They suggested that ultrasonographic findings indicated that *uterus masculinus* should be included as a differential diagnosis for male dogs with these characteristics.

The complications of ovariohysterectomy procedure included significant ovarian artery haemorrhage, wound healing complications, urinary incontinence, ovarian remnant syndrome (Muraro and White, 2015). They further stated that increasing patient weight and duration of anaesthesia time have been found to increase incidence of complications of ovariohysterectomy in the bitch.

Sharma et al (2015) conducted a study on 10 dogs presented with prostate involvement to determine effective diagnostic and therapeutic
option for managing benign prostatic hyperplasia. The urinalysis revealed normal or concurrent urinary tract infection with elevated activity of serum alkaline phosphatase, and no bacterial growth on culture of prostate fluid. They further stated that ultrasonographic assessment was found superior to conventional subjective assessment.
MATERIALS AND METHODS

The present study entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” was conducted on 29 clinical cases of dogs of either sex and different age groups, brought to the Teaching Veterinary Clinical Complex (TVCC), RAJUVAS and department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, Bikaner (Rajasthan). These dogs were divided into 2 groups i.e. group A and group B.

In group A, survey ultrasonographic examination of abdomen was performed in 18 dogs which are clinically healthy animals out of which 11 were male and 7 were females of different age. These animals were brought for sterilisation operation i.e. spaying in bitches and castration in male dogs as an elective surgery.

In group B, ultrasonographic examination of abdomen was performed in 11 dogs out of which 4 were male and 7 were females of different age. These dogs underwent sterilisation operation i.e. spaying in bitches and castration in male dogs as a surgical regimen indicated for the treatment of various surgical affections of reproductive organs in male and female dogs.

Ultrasonographic examination

Equipment and procedure

Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Sciences, RAJUVAS, Bikaner is well equipped with an ultrasound machine (Ultrasonix VET) to undertake ultrasonographic examination in dogs of the present study (Fig.1a).
The area over the ventral abdominal region extended laterally on both sides was clipped, shaved and washed with soap and water. The animal was secured in supine position and a contact gel was applied on the skin as a coupling medium followed by the ultrasound scanning of abdominal organs.

The ultrasound scanning of whole abdomen of male and female dogs in both the groups A and B was performed in either sagittal or in transverse plane using convex probe (2-5 MHz) (Fig.1b) and linear array probe (5-14 MHz) (Fig.1c) by placing it on the ventral aspect of abdominal region, the left and right side of sternum and parallel to the ribs to the left and right lateral abdomen up to the level of genitalia.

**Ultrasonographic Interpretation**

The ultrasound scans of abdominal organs *viz*, liver, gall bladder, spleen, kidneys, stomach, intestinal lymph nodes, urinary bladder, prostate, uterus, ovaries and testis in male and female dogs of groups A and B were obtained wherever feasible in sagittal or transverse plane in a systematic manner. Any alteration in the shape, size and echogenicity of these abdominal organs and the presence of any associated mass or space occupying lesion were diagnosed based on the ultrasonographic findings. The soft copies of the scans were saved and stored for the interpretation.

**Haemato-biochemical Examination**

All the dogs of groups A and B in the present study, underwent haemato-biochemical examination in order to evaluate the haemato-biochemical parameters.

**Collection of blood**
The venous blood samples were collected from the cephalic vein of the animals on the day of presentation in EDTA containing plastic tubes for haematological studies. For biochemical analysis, blood samples were collected in plain collecting vials or in sterilised syringes and the serum was separated and stored in deep freeze until used for biochemical tests.

**Haemato-biochemical examination**

Haematological examination of the blood samples taken from dogs in both the group A and group B comprising of haemoglobin (Hb), packed cell volume (PCV), total erythrocytes count (TLC), total leucocytes count (TLC) and differential leucocyte count (DLC). These parameter were analysed as per the methods described by Jain (1986).

1. Haemoglobin (Hb) was measured by Sahli’s haemoglobinometer.
2. Packed cell volume (PCV) was measured by microhaemotocrit method.
3. Total erythrocyte count (TLC) and total leucocyte count (TLC) were carried out on a haemocytometer (Neubaur’s counting chamber).
4. Differential leucocyte count (DLC) was done from giemsa stained blood smears.

Biochemical study of blood serum sample was performed For quantitative estimation of alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), serum urea nitrogen (SUN) and creatinine were done in dogs using standard spectrophotometric methods.

**Alanine aminotransferase (ALT)**

Serum Alanine aminotransferase was determined by spectrophotometric method described by King (1965).

The activity of enzyme is measured by the increase of pyruvate with time. After a fixed time the pyruvate formed from L-alanine and α2-
oxoglutaric acid according to equation is determined colorimetrically by treating the 2, 4 dinitrophenylhydrazine with alkali.

**Aspartate aminotransferase (AST)**

Serum aspartate aminotransferase was determined by spectrophotometric method described by King (1965).

The activity of enzyme is measured by the increase of oxaloacetate with time. After a fixed time the oxaloacetate formed is determined colourimetrically by treating the 2, 4 dinitrophenylhydrazine with alkali.

**Alkaline phosphatase (ALP)**

Serum alkaline phosphatase was determined by spectrophotometric method described by King (1965).

The phosphate liberated on incubation of serum with buffered phenyl phosphate is used as an index of phosphate activity. A colour reaction is there as Folin and Ciocalteu can be recorded in the form of optical density.

**Total protein (TP)**

Total protein was determined by colourimetric method described by Lowry et al (1951). The test is based on a coloured reaction of amino acid tyrosine, constituent of protein with Folin-Ciocalteu. The amount of protein and colour intensity had linear relationship which can be recorded on a spectrophotometer at 660 µ wavelength.

**Serum urea nitrogen (SUN)**

Serum urea nitrogen was determined by diacetyl monoxime method of Natelson as described by Varley (1988). When urea is heated with diacetyl containing 2 adjacent carbonyl groups, coloured compound are
formed. The coloured intensity recorded as optical density by using distilled water blank at 480 µ wavelength in spectrophotometer.

**Serum Creatinine**

Serum creatinine was determined by the method of Bonsnes and Taussky described by Varley (1988). For determination of serum creatinine, prior precipitation of protein is required, and then reaction with alkaline picrate solution formed red coloured compound. The colour intensity is determined by using spectrophotometer at 500 µ wavelength.

The haemato-biochemical values of dogs in the groups A and B were compared with normal reference values. Any alterations in haemato-biochemical values were recorded and these were corroborated with ultrasonographic interpretations for the clinical diagnosis made thereof.
RESULTS

The present study, entitled ‘Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status’ was performed on 29 clinical cases of dogs of either sex and age, underwent sterilisation operation. The results of pre-sterilisation ultrasonographic and haemato-biochemical examinations in dogs is detailed out in 2 groups i.e group A and group B.

Ultrasonographic and haemato-biochemical examination in animals of Group A

Ultrasonographic examination

In group A, survey ultrasonographic examination of abdomen was performed in 7 female and 11 male (n=18) clinically healthy dogs. These were brought for sterilisation operation as an elective surgery.

The ultrasound scans of abdominal organs viz, liver, gall bladder, spleen, kidneys, stomach, intestinal lymph nodes, urinary bladder, prostate, uterus, ovaries and testis in male and female dogs of groups A, were obtained in a systematic manner. The details of ultrasonographic interpretations are detailed out in table 1 with a conclusive diagnosis. Any alteration in the shape, size and echogenicity of these abdominal organs and the presence of any associated mass or space occupying lesion were diagnosed based on the ultrasonographic findings. The ultrasonogram of abdominal organs in dogs of group A have been depicted in figures (2-19).

The pre-sterilisation ultrasonographic examination in animals of group A showed normal shape size and echotexture of various abdominal organs and no evidence of any space occupying lesion or abdominal mass associated with abdominal organs.
Haemato-biochemical examination

In present study, the haemato-biochemical examination was done in 18 clinically healthy dogs (7 female and 11 male) of group A, brought for sterilisation operation as an elective surgery. The haematological parameters revealed values of Hb (range 12 – 15.1 gdl⁻¹), PCV (range 37 – 50.1 %), TEC (range 4.1 – 8.1×10⁻⁶ µl⁻¹), TLC (range 5.2 – 13.4×10⁻³ µl⁻¹), neutrophils (range 63 – 70%), lymphocyte (range 22 – 28%), monocytes (range 3 – 8%), eosinophils (range 1 – 4%), basophils (range 0 – 1%) (Table 2) and biochemical parameters viz. ALT (range 21 – 52 uL⁻¹), AST (range 20 - 50 uL⁻¹), ALP (range 56 – 98 uL⁻¹) TP (range 62 – 75 gL⁻¹) SUN (range 3.1 – 5.3 mmolL⁻¹) and creatinine (range 80 – 120 µmolL⁻¹) values were found within reference range (Table 3).

Ultrasonographic and haemato-biochemical examination in animal of Group B

Ultrasonographic examination

In present study, ultrasonographic examination of abdomen in group B l was performed in 12 dogs, out of which 4 were male and 8 were females of different age. The diverse affection diagnosed ultrasonographically in dogs were pyometra (6 case), abdominal mass (uterine tumour) (1 case), herniated urinary bladder (perineal hernia) (1 case), non-testicular scrotal tumour (1 case) and prostatic hyperplasia (2 case). These dogs underwent sterilisation operation as a surgical regimen indicated for the treatment of these surgical affections.

The ultrasonograms of this group have been depicted in figures (20-30). The ultrasonographic interpretation of each ultrasonogram with a conclusive diagnosis has been given.
CASE 1

**History and Clinical sign** - A 9 year old female dog was presented with clinical signs of anorexia, chronic vomiting and was refractory to the treatment given from last 7 days.

**Ultrasonographic Interpretation** (Fig. 20 a-f)

The midline sagittal ultrasonogram of the abdomen a female dog showed a series of large, circular, anechoic, thin walled, distended uterine loops were seen adjacent to one another with the walls touching each other. The liver parenchyma has normal echogenicity with rounded margin. Multiple focal hyperechoic lesion with indistinct margin were also evident in liver parenchyma. Gall bladder, spleen, intestine, urinary bladder and right and left kidney have normal shape, size and echogenicity.

**Diagnosis** – Pyometra with hepatomegaly

CASE 2

**History and Clinical sign** - A 7 year old female dog was presented with the clinical sign of foul smelling vaginal discharge, anorexia and weight loss from last 3 days.

**Ultrasonographic Interpretation** (Fig.21a–f)

The midline sagittal ultrasonogram of the liver, gall bladder, spleen, intestine, urinary bladder and both kidneys showed normal shape, size and echogenicity. The distended uterine horns were seen as anechoic luminal structures occupied in the abdomen.

**Diagnosis** – Pyometra

CASE 3
**History and Clinical sign** - A 10 year old female dog was presented with the clinical sign of anorexia, chronic vomiting and depression from last 6 days.

**Ultrasonographic Interpretation** (Fig. 22a–f)

The midline sagittal ultrasonogram of the abdomen of a female dog showed the uterus as anechoic circular structures occupied the abdominal cavity. These represented the uterus in multiple cross sections. The liver, gallbladder, spleen, intestine, urinary bladder and both kidneys showed normal shape, size, and echotexture on ultrasonographic examination.

**Diagnosis** – Pyometra

**CASE 4**

**History and Clinical sign** - A 8 year female dog was presented with the clinical sign of anorexia, chronic vomiting, weight loss and depression from last 5 days.

**Ultrasonographic Interpretation**- (Fig. 23a–f)

The midline sagittal ultrasonogram of the abdomen of a female dog showed normal shape, size and echotexture of liver, spleen, intestine, urinary bladder and right or left kidneys. The uterus seen as multiple, anechoic, thin walled structures occupied in the abdomen adjacent to one another with the walls touching each other.

**Diagnosis** – Pyometra

**CASE 5**

**History and Clinical sign** - A 5 year old female dog was presented with the clinical sign of chronic vomition, polyuria and polydypsia from last 8 days.
Ultrasonographic Interpretation- (Fig. 24a – f)

The midline sagittal ultrasonogram of the abdomen of a female dog showed normal shape, size and echogenicity of liver, gall bladder, spleen, intestine, urinary bladder, right and left kidneys. The uterus is seen as a multiple circular structures variable echogenicity situated in the vicinity of urinary bladder.

Diagnosis – Pyometra

CASE 6

History and Clinical sign - A 9 year female dog was presented with the clinical sign of anorexia, depression, weight loss, chronic vomiting and was refractory to the treatment given from last 4 days.

Ultrasonographic Interpretation- (Fig. 25a–e)

The midline sagittal ultrasonogram of the abdomen of a female dog revealed normal shape, size and echogenicity the liver, gallbladder, spleen, intestines, right and left kidneys. The uterus seen as massive sacs of thin walled tubular structures distended with anechoic luminal content.

Diagnosis – Pyometra

CASE 7

History and Clinical sign – A 7 year old female dog was presented with clinical sign of anorexia, dull, depress from last 8 day. The semisolid mass feel on palpation of abdominal cavity.

Ultrasonographic interpretation – (Fig.26a – e)

The mid line sagittal and transverse sonogram of abdomen of a female dog showed enlarged, rounded mass with heterogeneous echogenicity adjacent to liver and also seen with hyperechoic area in the centre and relatively hypoechoic
area in the periphery indistinctly attached to the uterus. The liver, gallbladder, urinary bladder, intestine and kidneys have normal in shape, size and echogenicity.

The intra-abdominal mass was confirmed as uterine tumour after ovariohysterectomy

**Diagnosis** – Intra-abdominal mass (uterine tumour)

**CASE 8**

**History and Clinical sign** - A 9 year old male dog was presented with a clinical sign of difficulty in urination and restlessness. On clinical examination, a conspicuous reducible swelling was present lateral to the anus, was noticed. A rectal examination revealed a muscle separation and herniated abdominal viscera.

**Ultrasonographic Interpretation** (Fig. 27a-e)

The midline sagittal ultrasonogram of the abdomen of a male dog showed normal shape, size and echotexture of liver, spleen, intestine, right and left kidneys. The ultrasonogram of perineal region was completely occupied by anechoic area of echogenicity due to herniated part of urinary bladder.

**Diagnosis** – Herniated urinary bladder (perineal hernia)

**CASE 9**

**History and Clinical sign** - A 4 yr old male dog presented with the clinical sign of dull, depress, anorectic, swelling and tumours growth on the scrotum. On clinical examination the growth show semi solid consistency.

**Ultrasonographic Interpretation**- (Fig. 28a– e)

The midline sagittal ultrasonogram of the abdomen of a male dog showed normal shape, size and echotexture of liver, gallbladder with mirror image
artefact, spleen, intestine, right and left kidneys. The non-testicular tumours growth present on the scrotum is seen as a mass with mixed echogenicity in ultrasonogram.

**Diagnosis** – Non-testicular scrotal tumour.

**CASE 10**

**History and Clinical sign** - A 7 year old male dog was presented with the clinical sign of stranguria, haematuria, painful defaecation, still hind limbs and weakness from last 13 days.

**Ultrasonographic Interpretation** (Fig. 29a–f)

A large circumscribed echogenic mass was seen attached to the neck of urinary bladder dorsally. The enlarged prostatic tissue was visualised as compacted structure obstructing the urinary bladder. A cystic lesion was also visualised within the substance of prostate gland as anechoic circumscribed lumen. The liver, gall bladder, stomach, spleen, intestine and kidneys were normal in shape, size and echotexture.

**Diagnosis** - Prostate enlargement

**CASE 11**

**History and Clinical sign** - A 8 year old male dog was presented with the clinical sign of haematuria, painful defecation, still hind limbs and weakness since last 15 days.

**Ultrasonographic Interpretation** - (Fig.30a–f)

The midline sagittal ultrasonogram of the abdomen of a male dog revealed the liver, gallbladder, spleen, intestine, right and left kidney of normal shape, size and echotexture. The enlarged prostate gland was visualised as round and elongated hyperechoic mass surrounded by a hypoechoic periphery lying dorsal to the neck of urinary bladder. The enlarged prostatic mass obstruct the urinary passage at the neck of urinary bladder.

**Diagnosis** – Prostate enlargement
Haemato-biochemical examination

The haemato-biochemical examination was performed in 11 dogs (7 female and 4 male) of group B. The alterations in haemato-biochemical parameters were recorded in these dogs (Tables 4 and 5) in which sterilisation operation was performed as a surgical regimen indicated for the treatment of various affections diagnosed by ultrasonographic examination.

In the present study, pyometra were recorded in 6 female dogs in which haematological examination revealed decreased Hb value (range 8.5-11.4 g dL\(^{-1}\)) in all the cases than the normal reference range. The PCV value were found decreased (range 22-27 %) in 3 out of 6 female dogs. The TLC value in all the recorded case of pyometra were towards the higher limit (12-16 \(10^3\) µL\(^{-1}\)) of the normal clinical range. Differential counts revealed neutrophilia (72-76 %) in all the cases. The TEC value were found normal in all the cases of pyometra.

In biochemical examination, the ALT values were found increased (90.6 and 91.2 uL\(^{-1}\)) in 2 cases, whereas, it was found towards higher limit (48.2 and 50.6 uL\(^{-1}\)) of normal range in 2 cases. The AST values were increased (94.6 and 95.9 uL\(^{-1}\)) in 2 out of 6 cases. The ALP value were found increased (range 102.1-132.0 uL\(^{-1}\)) in 5 out of 6 cases of pyometra. The total protein value were found increased (76 gL\(^{-1}\)) in 1 case whereas, in 3 cases, it was found towards higher limit (range 70-74 gL\(^{-1}\)) of normal reference range. The SUN values were found normal in all the cases of pyometra except in 1 case, it was found increased (10.1 mmolL\(^{-1}\)) than normal clinical range. The serum creatinine value were found increased (range 152-159 µmolL\(^{-1}\)) in 3 cases than the normal reference range.

The haematological examination in a case of uterine tumour in female dog revealed decreased Hb value (9.1 g dL\(^{-1}\)) and PCV (28%) than the normal range. The TEC, TLC and differential counts were found within normal reference range. In biochemical study, the ALT, AST, TP and SUN
values were normal, except ALP (103 uL\(^{-1}\)) and creatinine (195 µmolL\(^{-1}\)) found increased than normal clinical range.

One case of perineal herniated mass was recorded in the present study. The haemato-biochemical examination revealed normal Hb (14.0 gdl\(^{-1}\)), PCV (41%), TEC (7.3 \(\times\) 10\(^6\)µL\(^{-1}\)), TLC (7.0 \(\times\) 10\(^3\) µL\(^{-1}\)), Neutrophils (71%), Lymphocyte (23%), Monocyte (4%), Eosinophils (2%), ALT (36.3 uL\(^{-1}\)), AST (29.2 uL\(^{-1}\)), ALP (88.9 uL\(^{-1}\)), TP (73 gL\(^{-1}\)), SUN (3.1 mmolL\(^{-1}\)), and serum creatinine (120 µmolL\(^{-1}\)) values.

In present study, the haematological examination in a case of scrotal tumour revealed Hb, PCV, and TLC found decreased than normal clinical range. The biochemical value of ALT (91 uL\(^{-1}\)), AST (94 uL\(^{-1}\)), ALP (130 uL\(^{-1}\)) and creatinine (158 µmolL\(^{-1}\)) were found increased than the normal clinical range. The SUN (5.0 mmolL\(^{-1}\)) and TP (6.1gL\(^{-1}\)) showed normal values.

The prostatic enlargement was recorded in 2 male dogs. The haematological examination revealed the normal Hb, PCV and TEC value except TLC (18.5 and 19.1 \(\times\) 10\(^3\) µL\(^{-1}\)) found increased than the normal reference range. The differential counts revealed neutrophilia (79 and 80%) found higher than the normal value. The biochemical estimation of ALT, AST, ALP, TP, serum urea and creatinine showed the normal clinical values.

In present study, the alterations in haemato-biochemical parameters corroborates with the ultrasonographic and clinical findings in dogs, Thus accomplished a correct diagnosis of the pathologic changes associated with abdominal organs.
Discussion

In present study, pre-sterilisation survey ultrasonographic evaluation of abdomen and haemato-biochemical examination was done in the animals of groups A and group B.

Abdominal ultrasound provides valuable clinical information about the peritoneal cavity, great vessels, abdominal viscera, and lymph nodes, which is obtained in a non-invasive fashion and usually does not necessitate sedation or anaesthesia. The diagnosis of pathologies of abdominal organs viz. liver, biliary system, pancreas, stomach, small intestine, kidney, urinary bladder, uterus, and prostate have been evaluated by Cruz-Arámbulo and Wrigley (2003) using ultrasound.

Ultrasonography greatly facilitates diagnostic evaluation (Baker and Davidson, 2006) and is one of the most frequently used modalities to screen and evaluate organs of the abdominal cavity in health and disease. It is a non-invasive, well tolerated and safe technique to the diseased animals for making serial follow up of the condition and response to treatment feasible (Gaschen, 2009).

The pre-sterilisation ultrasonographic examination of abdomen was performed in 18 dogs in group A, showed normal shape, size and echogenicity of abdominal organs viz. liver, gall bladder, stomach, intestines, kidneys, uterus, ovaries and no evidence of any space occupying lesions. Acorda and Algre (2011) conducted diagnostic ultrasound of the uterus, urinary bladder, liver, spleen and general abdomen in 90 dogs, 36 males and 54 females, 6 months to 11 years old, with chief complaint of abdominal distension. The ultrasonography permits evaluation of the retro-peritoneal space (Feeney et al, 1989; Nyland et al, 1995) and most often jejuna and iliac lymph nodes (Pugh,1994).

Liver was recognised less echogenic than the spleen and have similar to more echogenicity than the renal cortex (Burk and Feeney,
2003). The liver appeared enlarged with smooth margins with diffuse, increased echogenicity and consequently poor definition of the portal vessels (Kealy and Mc Allister, 2000). The architecture of the liver is interrupted by short, highly echogenic paired parallel lines surrounding an anechoic lumen that represent the portal veins and anechoic linear structures that represent the hepatic veins (Nyland et al, 2002).

The gall bladder is seen within the right cranio-ventral hepatic parenchyma as an anechoic oval shape with the neck extending caudally. The bile duct is normally not seen in the dog (Larson, 2007). The size of gallbladder is variable depending on whether or not the animal has recently eaten (Kealy and Mac Allister, 2000).

The spleen in dogs is superficial and well suited to ultrasound examination (Larson, 2007). The spleen has the uniform splenic parenchyma with a fine dense pattern and smooth outline (Nyland et al, 2002). The spleen is hyperechoic when compared with the liver and renal cortex (Wood et al, 1990; Larson, 2007).

The stomach was scanned in longitudinal and transverse planes lies in the cranial abdomen caudal to the diaphragm and liver (Kealy and Mac Allister, 2000). The ultrasonographic appearance of the stomach varied with the extent of luminal contents and distension (Penninck, 2008) and have a ‘wagon-wheel’ appearance because of rughal folds, when empty (Larson, 2007).

Intestinal sonography included assessment of wall thickness, wall layer pattern and motility using transducer frequency of 7.5 MHz and higher (Larson, 2007). The lumen of the small intestine always contains some gas bubbles and therefore can be recognised as a hyperechoic linear or curved structure (Penninck et al, 1989). The normal intestinal wall consisted of alternating hyperechoic and hypoechoic layers. The hypoechoic mucosal layer is the thickest and is visually dominant (Lamb and Grierson, 1999).
The kidneys are smooth and bean-shaped in appearance and are located in the retroperitoneal space in the cranial abdomen. (Kealy and McAllister, 2000). A thin echogenic capsule may be visible except at poles (Dennis et al, 2010). The renal cortex in dogs is brighter than the medulla, with echo intensity equal to or slightly less than that of the liver and markedly less than the echo intensity of the spleen (Konde, 1985).

The urinary bladder is seen as the anechoic urine contrasts well with the echogenic bladder wall (Biller et al, 1990). The normal filled bladder is seen ovoid in shape, with a slight elongation caudally at the trigone (Park and Wrigley, 2007).

In normal anoestrous bitch, uterus is located between the urinary bladder and the colorectal junction as a tubular structure, lacks central echogenic stripe associated with bowel (Feeney and Johnston, 2007).

The normal prostate gland in male dog is uniformly echogenic similar to that of the surrounding fat but have medium to fine textured echogenicity than coarse echotexture of surrounding fat (Lattimer and Essman, 2007), seen as a round or oval structure with a smooth margin and a distinct hyperechoic capsule (Kealy and McAllister, 2000).

In animals of group B, ultrasonographic examinations was performed in 11 dogs and various pathological conditions were diagnosed based on clinical and ultrasonographic findings in which sterilisation i.e. ovariohysterectomy and surgical castration were indicated for the treatment.

The ultrasonographic evaluation of reproductive tract of a bitch has been very helpful as the information concerning pathologic conditions (e.g. ovarian cysts, metritis), and also in evaluating response to therapy (Davidson and Baker, 2009).
In present study, 6 cases of pyometra were diagnosed by ultrasonographic examination revealed a large heterogeneous mass with an anechoic area presumed to be the fluid-filled uterine horns. Similar findings were observed by (Kachwaha, 2015) in 10 bitches affected with pyometra on midline sagittal ultrasonogram of the caudal abdomen showed elongated tubular structure filled with echogenic material within the lumen. Kealy and McAllister (2000) also identified uterus as a series of large, circular, thin-walled structures in the caudal abdomen with distended anechoic uterine loops seen adjacent to one another with a variable quantity of echogenic floccules in close pyometra. In an open pyometra, the uterus is identified immediately dorsal to the bladder and anechoic circular structure as seen in cross section. Younis et al (2014) also revealed fluid filled uterus with variable wall thickness and proliferative changes in 12 bitches and 36 queens of different breeds and ages for CEHP on ultrasonographic examination then ovariohysterectomy was performed in positive cases.

Uterine tumour was diagnosed in a bitch as rounded mass with heterogeneous echogenicity adjacent to liver and also seen with hyperechoic area in the centre and relatively hypoechoic at periphery, indistinctly attached to the uterus. Patsikas et al (2014) recorded ultrasonographic signs masses associated with uterine body cervical tumours in 9 female intact dogs The mass was characterised ultrasonographically as solid in 3 dogs (leiomyomas), solid with cystic component in 4 dogs (2 adenocarcinoma, 1 leiomyoma, and 1 fibroleiomyoma), and cystic in 2 dogs. Cecilia et al (2013) also diagnosed uterine tumour as heterogeneous in ecotexture for the presence of multiple cyst like lesion mixed with areas of hypoechogenicity. However, (Kealy and McAllister 2000) identified uterine neoplasms mainly homogeneous mixed echogenic tissue attached to the uterine wall.
Ultrasonography has been found valuable in assessing an enlarged uterus in pyometra or a mass suggestive of neoplasia (Poffenbarger and Feeney, 1986; England and Allen, 1989 and Rivers and Johnston, 1991).

The herniated urinary bladder was diagnosed on ultrasonographic examination in a case of perineal hernia in a male dog. The ultrasonogram of perineal region was completely occupied by anechoic area of herniated urinary bladder. Kealy and McAllister (2000) also stated that fat or the anechoic urine-filled bladder may be identified on ultrasound examination in dogs with perineal hernia with the urethera turned back on itself.

Ultrasonography can distinguish the testicular from the non-testicular causes for scrotal swelling and can differentiate unilateral from bilateral disease (Pugh and Konde, 1991). Scrotal tumour was diagnosed in a male dog of the present study seen as hypoechoic structure in ultrasonogram. Ragheb et al (2002) also evaluated the ultrasonographic diagnosis of the acutely painful scrotum in addition to scrotal masses and male infertility in dogs.

The canine prostate can be examined and measured ultrasonographically (Cartee and Rowles, 1983; Finn and Wrigley, 1989). In present study, the prostatic enlargement was effectively diagnosed in 2 cases, visualized as round and elongated hyperechoic mass with hypoechoic periphery lying dorsal to the neck of urinary bladder. Benign prostatic hypertrophy has also been diagnosed by ultrasonography (Kustritz, 1998; Atalan et al, 1998). Feeney et al (1989) also indicated the use of prostatic ultrasonographic examination in canines to diagnose various prostatic affections.

The haemato-biochemical findings in animals of present study reflected to normal or pathological state, were corroborated with the ultrasonographic findings. Haematology and serum clinical chemistry analyses have been used for health assessment of domestic animals and
a wide range of captive wildlife (Smith, 2000; Fowler and Miller, 2003; Kaneko et al, 2008). Ample work has been done on establishing the baseline values of biochemical and haematological parameters of dogs (Oduye, 1978; Awah and Nottidge, 1998).

In group A, haematobiochemical examination in 18 dogs showed normal values. Similar observations have also been recorded by Khan et al (2011) in 28 male and 22 female stray dogs in Chittagong Metropolitan area, Bangladesh.

In group B, decreased Hb (range 8.5-11.4 g dL\(^{-1}\)), TLC (12-16 10\(^3\) µL\(^{-1}\)) towards higher limit, and neutrophilia (72-76 %) was observed in all the cases of pyometra. Jena et al (2013) also found decreased Hb, packed cell volume (PCV), total erythrocyte count (TEC) and lymphocyte count in bitches affected with pyometra.

The ALT (90.6 and 91.2 uL\(^{-1}\)), AST (94.6 and 95.9 uL\(^{-1}\)) were increased in 2 cases. The ALP (range 102.1-132.0 uL\(^{-1}\)) increased in 5 cases and TP (76 gL\(^{-1}\)) increased in 1 case of pyometra. The serum creatinine (range 152-159 µmoL\(^{-1}\)) was increased in 3 cases and SUN (10.1 mmolL\(^{-1}\)) was increased in 1 case of pyometra. The low haemoglobin, PCV and high TLC, serum creatinine and SUN values in case of pyometra have also been recorded in bitches (Palecha, 2010), due to dehydration, haemoconcentration, septic shock and concurrent renal damage. Serum creatinine level increased in processes like pyometra (Braun et al, 2003; Stone et al, 1988; Gayakawad et al, 1999). Marked leukocytosis and neutrophilia were observed in pyometra (Palecha, 2010), well articulated with the similar findings (Haigler and Hawkins,1940; Osborne et al, 1972; Jones and Joshua, 1982) with neutrophilia and shift to left in cases of pyometra.

The decreased Hb and PCV values and increased ALP and creatinine values revealed in a case of abdominal mass identified as
uterine tumour in female dog. Palecha (2010) also observed decreased Hb and PCV and increased SGOT, SGPT, ALP, BUN and serum creatinine value in a case of abdominal mass indicated a chronic devastating disease. However, Shammi et al (2010) revealed reduced haemoglobin while normal serum biochemistry results.

The haemato-biochemical examination revealed normal values in a case of perineal hernia with herniated urinary bladder recorded in 1 male dog of group B. Normal values of PCV, MCV, TLC and DLC while Hb (10.6 g dL\(^{-1}\)) was found decreased and the biochemical parameters SGPT, SGOT, ALP, BUN, serum creatinine, electrolytes and total protein were found within the normal range in case of perineal hernia (Palecha, 2010).

The haematological examination in a case of scrotal tumour revealed decreased Hb, PCV, and TLC values while the biochemical value ALT, AST, ALP and creatinine were found increased than the normal clinical range. Crivellenti et al (2013) also reported moderate normocytic normochromic anaemia and increased serum concentrations of the urea, creatinine and total protein in dogs with scrotal tumour.

In 2 dogs of group B, increased TLC (18.5 and 19.1 \(\times\) 10\(^3\)µL\(^{-1}\)) and neutrophilia (79 and 80%) was found in prostate enlargement with normal ALT, AST, ALP, TP, serum urea and creatinine values. In case of concomitant infection of prostate gland, leucocytosis and neutrophilia with the left-shift have been observed (Barsanti and Finco, 1989; Bell et al, 1991).

The pre-sterilisation ultrasonographic evaluation precisely determined the pathologic changes associated with the abdominal organs in dogs of the present study and is well articulated with the haematobiochemical and clinical findings thus accomplished a correct diagnosis of various abdominal disorders.
SUMMARY

The present study entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” was conducted on 29 clinical cases of dogs of either sex and different age groups, These dogs were divided into 2 groups i.e. group A and group B.

Pre-sterilisation survey ultrasonographic examination of abdomen was performed in 18 clinically healthy dogs (11 male and 7 female) in group A and 11 dogs (4 male and 7 female) in group B. These dogs underwent sterilisation operation i.e. spaying in bitches and castration in male dogs either as an elective surgery or indicated as surgical treatment.

The ultrasound scanning of whole abdomen in dogs of groups A and B was performed in either sagittal or in transverse plane using Ultrasonix Vet Machine with convex (2-5 MHz) and linear array probes (5-14 MHz) and the ultrasound scans of abdominal organs viz, liver, gall bladder, spleen, kidneys, stomach, intestinal lymph nodes, urinary bladder, prostate, uterus, ovaries and testis in male and female dogs were obtained. Any alteration in the shape, size and echogenicity of these abdominal organs and the presence of any associated mass or space occupying lesion were diagnosed based on the ultrasonographic findings.

Haemato-biochemical examination was performed in both the groups for the estimation of haematological parameters; Haemoglobin (Hb), packed cell volume (PCV), total erythrocytes count (TLC), total leucocytes count (TLC), differential leucocyte count (DLC) and biochemical parameters alanine aminotransferase (ALT), aspartate aminotransferase (AST), alkaline phosphatase (ALP), total protein (TP), serum urea nitrogen (SUN) and creatinine using standard methods. The haemato-biochemical values of dogs in the groups A and B were compared with normal reference values. Any alterations in haemato-biochemical values were recorded and
corroborated with ultrasonographic interpretations for the clinical diagnosis made thereof.

The pre-sterilisation ultrasonographic examination in animals of group A showed normal shape, size, echotexture of various abdominal organs and no evidence of any space occupying lesion or abdominal mass associated with abdominal organs.

Pre-sterilisation ultrasonographic examination of abdomen in group B was performed in 11 dogs (4 were male and 7 female) and various pathological conditions were diagnosed based on ultrasonographic findings viz. pyometra (6 case), abdominal mass (uterine tumour) (1 case), perineal herniated mass (1 case), scrotal tumour (1 case) and prostatic hyperplasia (2 case) in which sterilisation i.e. ovariohysterectomy and surgical castration were indicated for the treatment.

In present study, 6 cases of pyometra were diagnosed by ultrasonographic examination revealed a large heterogeneous mass with an anechoic area presumed to be the fluid-filled uterine horns. Uterine tumour was diagnosed in a bitch as rounded mass with heterogeneous echogenicity adjacent to liver and also seen with hyperechoic area in the centre and relatively hypoechoic at periphery, indistinctly attached to the uterus.

The herniated urinary bladder was diagnosed on ultrasonographic examination in a case of perineal hernia in a male dog. The ultrasonogram revealed the perineal region completely occupied by anechoic area of herniated urinary bladder.

Ultrasonography can distinguish the testicular from the non-testicular causes for scrotal swelling. Scrotal tumour was diagnosed in a male dog of the present study seen as hypoechoic structure in ultrasonogram.
The canine prostate can be examined and measured ultrasonographically. In present study, the prostatic enlargement was effectively diagnosed in 2 cases, visualised as round and elongated hyperechoic mass with hypoechoic periphery lying dorsal to the neck of urinary bladder.

The haemato-biochemical findings in animals of present study reflected to normal or pathological state, were corroborated with the ultrasonographic findings.

In group A, the haematological parameters revealed values of Hb (range 12 – 15.1 g/dl), PCV (range 37 – 50.1 %), TEC (range 4.1 – 8.1×10^6 (µl)^{-1}), TLC (range 5.2– 13.4 ×10³ (µL)^{-1}), neutrophils (range 63 – 70%), lymphocyte (range 22– 28%), monocytes (range 3 – 8%), eosinophils (range 1 – 4%), basophils (range 0 – 1%) and biochemical parameters viz. ALT (range 21 – 52uL^{-1}), AST (range 20 - 50uL^{-1}), ALP (range 56 –98 uL^{-1}) TP (range 62 – 75 gL^{-1}) SUN (range 3.1 – 5.3 mmolL^{-1}) and creatinine (range 80 – 120 µmolL^{-1}) values were found within reference range.

In group B, decreased Hb (range 8.5-11.4 g/dl), TLC (12-16 10^3/µl) towards higher limit, and neutrophilia (72-76 %) was observed in all the cases of pyometra. The ALT (90.6 and 91.2 uL^{-1}), AST (94.6 and 95.9 uL^{-1}) were increased in 2 cases. The ALP (range 102.1-132.0 uL^{-1}) increased in 5 cases and TP (76 gL^{-1}) increased in 1 case of pyometra. The serum creatinine (range 152-159 µmolL^{-1}) was increased in 3 cases and SUN (10.1 mmolL^{-1}) was increased in 1 case of pyometra.

The decreased Hb and PCV values and increased ALP and creatinine values revealed in a case of abdominal mass identified as uterine tumour in female dog.

The haemato-biochemical examination revealed normal values in a case of perineal hernia with herniated urinary bladder recorded in 1 male dog of group B. The haematological examination in a case of scrotal
tumour revealed decreased Hb, PCV, and TLC values while the biochemical value ALT, AST, ALP and creatinine were found increased than the normal clinical range.

In 2 dogs of group B, increased TLC (18.5 and 19.1 × 10³μL⁻¹) and neutrophilia (79 and 80%) was found in prostate enlargement with normal ALT, AST, ALP, TP, serum urea and creatinine values.

The pre-sterilisation ultrasonographic evaluation precisely determined the pathologic changes associated with the abdominal organs in dogs of the present study and is well articulated with the haemato-biochemical and clinical findings thus accomplished a correct diagnosis of various abdominal disorders.

1. In present study, pre-sterilisation survey ultrasonographic evaluation of abdomen in animals of group A revealed normal shape, size and echotexture of abdominal organs in dogs.
2. The ultrasonographic examination of abdomen in group B animals provided diagnosis of pyometra, abdominal masses (uterine tumours), non-testicular scrotal tumour, prostate enlargement and herniated urinary bladder.
3. No alterations in the haemato-biochemical evaluation in animals of group A were recorded, thus corroborates with the normal ultrasonographic findings in animals of same group.
4. The haemato-biochemical alterations observed in group B animals were found logical and in accordance to the pathology involved as revealed in ultrasonographic findings in animals of the same group.
5. The ultrasonography has been found a reliable, non-invasive imaging modality to detect any pathological condition, space occupying lesion or masses associated with the abdominal organs in dogs undergoing sterilisation operation.
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biochemical profile of Doberman dogs in the growth phase. 
*Comparative Clinical Pathology* **16**:41–46


Thesis. Submitted Swami Keshvanand Rajasthan Agriculture University, Bikaner.


A Clinical Study on Pre-sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-biochemical Status in Dogs

श्वानों में बन्ध्याकरण पूर्व उदर के पराध्वनिक मूल्यांकन और रुधिर-जैव विज्ञानी अवस्था पर रोग विषयक अध्ययन

Ghanshyam Koli
B.V.Sc. & A.H.

THESIS
MASTER OF VETERINARY SCIENCE
(Veterinary Surgery and Radiology)

2016

Department of Veterinary Surgery and Radiology
College of Veterinary and Animal Science, Bikaner
Rajasthan University of Veterinary and Animal Sciences
Bikaner - 334001
A Clinical Study on Pre-sterilisation
Ultrasonographic Evaluation of Abdomen and Haemato-biochemical Status in Dogs

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THESIS
Submitted to the
Rajasthan University of Veterinary and Animal Sciences
Bikaner
In partial fulfilment of the requirements for the degree of
Master of Veterinary Science
(Veterinary Surgery and Radiology)
FACULTY OF VETERINARY & ANIMAL SCIENCE

By
GHANSHYAM KOLI
B.V.Sc. and A.H.

2016
Rajasthan University of Veterinary and Animal Sciences, Bikaner
College of Veterinary and Animal Science, Bikaner

CERTIFICATE-I

Date.................

This is to certify that Dr. GHANSHYAM KOLI had successfully completed the comprehensive examination held on ............... as required under the regulations for Master of Veterinary Science degree.

(Dr.Praveen Bishnoi)
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CERTIFICATE-II

Date......................

This is to certify that this thesis entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” submitted for the degree of Master of Veterinary Science in the subject of Veterinary Surgery and Radiology embodies bonafide research work carried out by Dr. Ghanshyam Koli under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation have been fully acknowledged. The draft of the thesis was also approved by the advisory committee on .................

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(Dr.S.K Jhirwal )  
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CERTIFICATE-III

Date……………………

This is to certify that the thesis entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” submitted by Dr. Ghanshyam Koli to Rajasthan University of Veterinary and Animal Sciences, Bikaner, in partial fulfillment of requirements for the degree of Master of Veterinary Science in the subject of Veterinary Surgery and Radiology after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination on his thesis has been found satisfactory; we therefore recommend that the thesis be approved.

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Major advisor

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DEAN  
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CERTIFICATE – IV

Date……………………

This is to certify that Dr. Ghanshyam Koli of the Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, Bikaner has made all corrections/modifications in the thesis entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” which were suggested by the external examiner and the advisory committee in the oral examination held on………….The final copies of the thesis duly bound and corrected were submitted on……………, are enclosed herewith for approval.

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Enclosed are one original and two copies of bound thesis.
Forwarded to the Dean, Post Graduate Studies, RUVAS, Bikaner through the Dean, College of Veterinary and Animal Science, Bikaner.
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(Ghanshyam koli)
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A Clinical Study on Pre-sterilisation
Ultrasonographic Evaluation of Abdomen and
Haemato-biochemical Status in Dogs

M.V. Sc. Thesis

Department of Veterinary Surgery and Radiology,
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Submitted by: GHANSHYAM KOLI
Major Advisor: Dr. S.K. JHIRWAL

ABSTRACT

The present study was conducted on 29 clinical cases of dogs of either sex and different age groups. These dogs were divided into 2 groups i.e. group A and group B. Pre-sterilisation survey ultrasonographic examination of abdomen was performed in 18 clinically healthy dogs in group A and 11 dogs in group B. The ultrasound scanning of whole abdomen and haemato-biochemical examination was performed in both group A and B. The alterations in haemato-biochemical values were recorded and corroborated with ultrasonographic interpretations for the clinical diagnosis. The pre-sterilisation ultrasonographic examination in animals of group A showed normal shape size and echotexture of various abdominal organs and in group B, various pathological conditions were diagnosed based on ultrasonographic findings viz. pyometra (6 case), abdominal mass (uterine tumour) (1 case), perineal herniated mass (1 case), scrotal tumour (1 case) and prostatic hyperplasia (2 case) in which sterilisation
i.e. ovariohysterectomy and surgical castration were indicated for the treatment. The haemato-biochemical findings in animals of present study reflected to normal or pathological state, were corroborated with the ultrasonographic findings. The pre-sterilisation ultrasonographic evaluation precisely determined the pathologic changes associated with the abdominal organs in dogs of group B and is well articulated with the haemato-biochemical and clinical findings thus accomplished a correct diagnosis of various abdominal disorders. The ultrasonography has been found a reliable, non-invasive imaging modality to detect any pathological condition, space occupying lesion or masses associated with the abdominal organs in dogs undergoing sterilisation operation.
श्वानों में बन्ध्याकरण पूर्व उदर के पराधवनिक मूल्यांकन और रुधिर-जैव विज्ञानी अवस्था पर रोग विषयक अध्ययन

स्नातकोत्तर ग्रंथ

पशु शल्य क्रिया एवं विकिरण विभाग,
पशु चिकित्सा एवं पशु विज्ञान महाविद्यालय,
राजस्थान पशु चिकित्सा एवं पशु विज्ञान विश्वविद्यालय,
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मुख्य समारोह: डॉ सुरेश कुमार झिरवाल

अनुक्षेपण

वर्तमान अध्ययन २९ विभिन्न आयुवर्त के नर और मादा श्वानों के रोग विषयक मामलों पर किया गया। इन श्वानों को दो समूहों में विभाजित किया गया जो कि समूह 'अ' व समूह 'ब' थे। समूह 'अ' के १८ चिकित्सीय स्वस्थ श्वानों में तथा समूह 'ब' के ११ चिकित्सीय अस्वस्थ श्वानों में बंध्याकरण-पूर्व उदर का पराधवनिक निरक्षण द्वारा सर्वेक्षण किया गया। रुधिर-जैवविज्ञानी परिक्षण व इनमें परिवर्तन दर्ज कर इन परिवर्तनों का रोग विषयक निदान के लिए पराधवनिक व्यक्ति के साथ पुष्टीस्वरूप किया गया। समूह 'अ' के बंध्याकरण पूर्व विभिन्न उदरीय अंगों का पराधवनिक निरक्षण सामान्य आकृति, अकार व पराधवनिक संरचना का पाया गया। समूह 'ब' में पराधवनिक निरक्षण आधारित विभिन्न विकृतिजन्य दसायं पायी गयी थी जैसे कि पायोमेट्रा (६ मामले), उदरीय अधिक्य (गर्भाशय अबुई) (१ मामला) पेप्रिनिअल हाइपरप्लास्टिक अधिक्य (१ मामला), वृषणकोष अबुई (१ मामला) तथा प्रोस्टेटिक वायूप्लास्टिक (२ मामले) जिनमें बंध्याकरण जैसे कि ओवरियाहिस्टरटोमी व शल्य-बंध्याकरण ईलाज के लिए निर्देशित थे। वर्तमान अध्ययन में सामान्य व विकृतिजन्य जानवरों में प्रतिबिंबित जैव-विज्ञानी निष्कर्षों को पराधवनिक निष्कर्षों के साथ पुष्टीकृत किया गया। समूह 'ब' के श्वानों में उदरीय अंगों से सम्बंधित विकृतिजन्य परिवर्तन बंध्याकरण पूर्व
पराध्वनिक मूल्यांकन द्वारा शुद्ध रूप से निर्धारित किये गये | तथा इन पराध्वनिक मूल्यांकन को संधी जैव-विज्ञानी व रोग विषयक निष्कर्षों के साथ जोड़कर विकिरण उदर्दी विकारों का सही निदान किया गया | श्वानों में उदर्दी अंगों से सम्बंधित विकृतिजन्य दशा, जगह घेरने वाले जख्म और आधिक्य का पता लगाने में पराध्वनिक चित्रण एक विश्वनीय नौन-इजनवेसिव प्रतिबिम्ब बनाने का साधन पाया गया |
A Clinical Study on Pre-sterilisation
Ultrasonographic Evaluation of Abdomen
and Haemato-biochemical Status in Dogs

श्वानों में बन्ध्याकरण पूर्व उदर के पराध्वनिक मूल्यांकन और रुधिर-जैव विज्ञानी अवस्था पर रोग विषयक अध्ययन
Ghanshyam Koli
B.V.Sc. & A.H.

THESIS
MASTER OF VETERINARY SCIENCE
(Veterinary Surgery and Radiology)

2016
Department of Veterinary Surgery and Radiology
College of Veterinary and Animal Science, Bikaner
Rajasthan University of Veterinary and Animal Sciences
Bikaner - 334001
A Clinical Study on Pre-sterilisation
Ultrasonographic Evaluation of Abdomen and Haemato-biochemical Status in Dogs

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THESIS

Submitted to the
Rajasthan University of Veterinary and Animal Sciences
Bikaner
In partial fulfilment of the requirements for the degree of

Master of Veterinary Science
(Veterinary Surgery and Radiology)

FACULTY OF VETERINARY & ANIMAL SCIENCE

By
GHANSHYAM KOLI
B.V.Sc. and A.H.

2016
This is to certify that Dr. GHANSHYAM KOLI had successfully completed the comprehensive examination held on ............. as required under the regulations for Master of Veterinary Science degree.

(Dr. Praveen Bishnoi)
` Head
Department of Veterinary Surgery and Radiology
College of Veterinary and Animal Science
Bikaner
This is to certify that this thesis entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” submitted for the degree of Master of Veterinary Science in the subject of Veterinary Surgery and Radiology embodies bonafide research work carried out by Dr. Ghanshyam Koli under my guidance and supervision and that no part of this thesis has been submitted for any other degree. The assistance and help received during the course of investigation have been fully acknowledged. The draft of the thesis was also approved by the advisory committee on .................

(Dr. Praveen Bishnoi)
Head
Department of Veterinary Surgery and Radiology
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Bikaner

(Dr. Sakar Palecha)
(Major Advisor)

(Dr. Tribhuwan Sharma)
Dean
College of Veterinary and Animal Science
Bikaner
This is to certify that the thesis entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” submitted by Dr. Ghanshyam Koli to Rajasthan University of Veterinary and Animal Sciences, Bikaner, in partial fulfillment of requirements for the degree of Master of Veterinary Science in the subject of Veterinary Surgery and Radiology after recommendation by the external examiner was defended by the candidate before the following members of the examination committee. The performance of the candidate in the oral examination on his thesis has been found satisfactory; we therefore recommend that the thesis be approved.

(Dr. Sakar Palecha) Major advisor

(Dr. Praveen Bishnoi) Advisor

(Dr. J.S. Mehta) Advisor

(Dr. R.K. Dhuria) Dean, PGS Nominee

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DEAN
Post Graduate Studies
RAJUVAS, Bikaner
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College of Veterinary and Animal Science, Bikaner

CERTIFICATE – IV

Date…………………

This is to certify that Dr. Ghanshyam Koli of the Department of Veterinary Surgery and Radiology, College of Veterinary and Animal Science, Bikaner has made all corrections/modifications in the thesis entitled “A Clinical Study on Pre-Sterilisation Ultrasonographic Evaluation of Abdomen and Haemato-Biochemical Status in Dogs” which were suggested by the external examiner and the advisory committee in the oral examination held on...........The final copies of the thesis duly bound and corrected were submitted on................., are enclosed herewith for approval.

(Dr. Sakar Palecha)  
Major Advisor

(Dr. Praveen Bishnoi)  
Head  
Department of Veterinary Surgery and Radiology  
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Dean  
C.V.A.S.Bikaner

Approved

DEAN,  
Post Graduate Studies  
RAJUVAS, Bikaner

Enclosed are one original and two copies of bound thesis.  
Forwarded to the Dean, Post Graduate Studies, RUVAS, Bikaner through the Dean, College of Veterinary and Animal Science, Bikaner.
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(Ghanshyam koli)
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Materials and Methods
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Discussion
Summary
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A Clinical Study on Pre-sterilisation
Ultrasonographic Evaluation of Abdomen and Haemato-biochemical Status in Dogs

M.V. Sc. Thesis

Department of Veterinary Surgery and Radiology,
College of Veterinary and Animal Science, Bikaner
Rajasthan University of Veterinary and Animal Sciences,
Bikaner - 334001

Submitted by: GHANSHYAM KOLI
Major Advisor: DR. SAKAR PALECHA

ABSTRACT

The present study was conducted on 29 clinical cases of dogs of either sex and different age groups, These dogs were divided into 2 groups i.e. group A and group B. Pre-sterilisation survey ultrasonographic examination of abdomen was performed in 18 clinically healthy dogs in group A and 11 dogs in group B. The ultrasound scanning of whole abdomen and haemato-biochemical examination was performed in both group A and B. The alterations in haemato-biochemical values were recorded and corroborated with ultrasonographic interpretations for the clinical diagnosis. The pre-sterilisation ultrasonographic examination in animals of group A showed normal shape size and echotexture of various abdominal organs and in group B, various pathological conditions were diagnosed based on ultrasonographic findings viz. pyometra (6 case), abdominal mass (uterine tumour) (1 case), perineal herniated mass (1 case), scrotal tumour (1 case) and prostatic hyperplasia (2 case) in which sterilisation
i.e. ovariohysterectomy and surgical castration were indicated for the treatment. The haemato-biochemical findings in animals of present study reflected to normal or pathological state, were corroborated with the ultrasonographic findings. The pre-sterilisation ultrasonographic evaluation precisely determined the pathologic changes associated with the abdominal organs in dogs of group B and is well articulated with the haemato-biochemical and clinical findings thus accomplished a correct diagnosis of various abdominal disorders. The ultrasonography has been found a reliable, non-invasive imaging modality to detect any pathological condition, space occupying lesion or masses associated with the abdominal organs in dogs undergoing sterilisation operation.
श्वानों में बन्ध्याकरण पूव्व उदर के पराध्वनिक मूल्यांकन और रुधिर-जैव विज्ञानी अवस्था पर रोग विषयक अध्ययन

स्नातकोत्तर ग्रंथ

पशु शल्य क्रिया एवं विकरण विभाग,
Pशु चिकित्सा एवं पशु विज्ञान महाविद्यालय,
राजस्थान पशु चिकित्सा एवं पशु विज्ञान विश्वविद्यालय,
बीकानेर-334,001

शोधकर्ता

मुख्य समादेश्ता

घनश्याम कोली

मुख्य समादेश्ता

डॉ साकार पालेकर

अनुक्षेपण

वर्तमान अध्ययन 29 विभिन्न आयुवर्ग के नर और मादा श्वानों के रोग विषयक मामलों पर किया गया। इन श्वानों को दो समूहों में विभाजित किया गया जो कि समूह 'अ' और समूह 'ब' थे। समूह 'अ' के 18 चिकित्सीय स्वस्थ श्वानों में तथा समूह 'ब' के 11 चिकित्सीय अस्वस्थ श्वानों में बंध्याकरण-पूव्व उदर का पराध्वनिक निरीक्षण द्वारा सर्वेक्षण किया गया। रुधिर-जैवविज्ञानी परिक्षण व इनमें परिवर्तन दर जानकारी की रोग विषयक निदान के लिए पराध्वनिक व्यवहार के साथ पुष्टिकरण किया गया। समूह 'अ' के बंध्याकरण पूव्व विभिन्न उदरीय अंगों का पराध्वनिक निरीक्षण सामान्य आकृति, अकार व पराध्वनिक संरचना का पाया गया। समूह 'अ' के बंध्याकरण आधारित विभिन्न वृक्षितज्ञ दसायें पायी गयी थी जैसे कि पायोमेट्रा (6 मामले), उदरीय अधिकत्व (गर्भास्थ अबुब्बु) (1 मामला), पेरिनिसाल हाइपरप्लासी (6 मामले), उदरीय अधिकत्व (गर्भास्थ अबुब्बु) (1 मामला), पेरिनिसाल हाइपरप्लासी (6 मामले) तथा गैर-प्रौढ़ीय हाइपरप्लासी (2 मामले) जिनमें बंध्याकरण जानकारी के लिए निर्देशित थे। वर्तमान अध्ययन में सामान्य व वृक्षितज्ञ जानकारों में प्रतिबिंबित जैव-विज्ञानी निष्कर्ष को पराध्वनिक निष्कर्षों के साथ पुष्टिकरण किया गया | समूह 'ब' के श्वानों में उदरीय अंगों से सम्बंधित वृक्षितज्ञ विभिन्न परिवर्तन बंध्याकरण पूव्व
पराध्वनिक मूल्यांकन द्वारा शुद्ध रूप से निर्धारित किये गये। तथा इन पराध्वनिक मूल्यांकन को सूचित जैव-विज्ञानी व रोग विषयक निष्कर्षों के साथ जोड़कर विश्लेषण उद्देश्य विकारों का सही निदान किया गया। श्वानों में उद्दीय अंगों से सम्बंधित विकृतिजन्य दशा, जगह घेरने वाले जख्म और आचिक्य का पता लगाने में पराध्वनिक चित्रण एक विश्वनीय नौन-इज़नेविस युक्तिबन्ध बनाने का साधन पाया गया।
30 a: Normal ultrasonogram of liver and gall bladder

30 b: Normal Ultrasonogram of intestine

30 c: Enlarged prostate gland dorsal to the neck of urinary bladder

30 d: Enlarged prostate gland visualised as elongated hyperechoic mass

30 e: Normal ultrasonogram of spleen

30 f: Normal ultrasonogram of kidneys

Fig. 30: Ultrasonographic examination of abdominal organs in male dog of group B
(Case 11)
Fig. 29: Ultrasonographic examination of abdominal organs in a male dog of group B (Case 10)
Fig. 28: Ultrasonographic examination of abdominal organs in male dog of group B (Case 9)
Fig. 27: Ultrasonographic examination of abdominal organs in male dog of group B (Case 8)
Fig. 26: Ultrasonographic examination of abdominal organs in female dog of group B (Case 7)
Fig. 25: Ultrasonographic examination of abdominal organs in female dog of group B
(Case 6)
Fig. 24: Ultrasonographic examination of abdominal organs in female dog of group B (Case 5)
Fig. 23: Ultrasonographic examination of abdominal organs in female dog of group B (Case 4)
Fig. 22: Ultrasonographic examination of abdominal organs in female dog of group B (Case 3)
Fig. 21: Ultrasonographic examination of abdominal organs in female dog of group B (Case 2)
Fig. 20: Ultrasonographic examination of abdominal organs in female dog of group B
(Case 1)
Fig. 19: Ultrasonographic examination of abdominal organs in male dog of group A (Case 18)
Fig. 18: Ultrasonographic examination of abdominal organs in male dog of group A  

(Case 17)
Fig. 17: Ultrasonographic examination of abdominal organs in male dog of group A (Case 16)
Fig. 16: Ultrasonographic examination of abdominal organs in male dog of group A (Case 15)
Fig. 15: Ultrasonographic examination of abdominal organs in male dog of group A (Case 14)
Fig. 14: Ultrasonographic examination of abdominal organs in male dog of group A (Case 13)
Fig. 13: Ultrasonographic examination of abdominal organs in male dog of group A (Case 12)
Fig. 12: Ultrasonographic examination of abdominal organs in male dog of group A (Case 11)
Fig. 11: Ultrasonographic examination of abdominal organs in male dog of group A (Case 10)
Fig. 10: Ultrasonographic examination of abdominal organs in male dog of group A (Case 9)
9 a: Normal ultrasonogram of liver, gall bladder and stomach
9 b: Normal ultrasonogram of spleen
9 c: Normal ultrasonogram of intestine
9 d: Normal ultrasonogram of urinary bladder
9 e: Normal ultrasonogram of kidneys

Fig. 9: Ultrasonographic examination of abdominal organs in male dog of group A (Case 8)
Fig. 8: Ultrasonographic examination of abdominal organs in female dog of group A (Case 7)
Fig. 7: Ultrasonographic examination of abdominal organs in female dog of group A
(Case 6)
Fig. 6: Ultrasonographic examination of abdominal organs in female dog of group A (Case 5)
5 a: Normal ultrasonogram of liver and gall bladder
5 b: Normal ultrasonogram of intestine
5 c: Normal ultrasonogram of spleen
5 d: Normal ultrasonogram of urinary bladder
5 e: Normal ultrasonogram of kidneys

Fig. 5: Ultrasonographic examination of abdominal organs in female dog of group A (Case 4)
Fig. 4: Ultrasonographic examination of abdominal organs in female dog of group A (Case 3)
Fig. 3: Ultrasonographic examination of abdominal organs in female dog of group A
(Case 2)
2 a: Normal ultrasonogram of liver and gall bladder

2 b: Normal ultrasonogram of spleen

2 c: Normal ultrasonogram of urinary bladder

2 d: Normal ultrasonogram of intestine

2 e: Normal ultrasonogram of kidneys

Fig. 2: Ultrasonographic examination of abdominal organs in female dog of group A (Case 1)
1a: Ultrasonix Vet Machine

1b: Convex probe (2-5MHz) 1b: Linear array probe (5-14 MHz)

Fig. 1: Ultrasonographic equipment
Table 2: Haematological examination of clinically healthy animals undergoing sterilisation operation in group A.

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<th>Case no</th>
<th>Sex</th>
<th>Hb gdl⁻¹ (12-18)</th>
<th>PCV% (37-55)</th>
<th>TEC ((5.5-8.5) \times 10^6\mu L⁻¹)</th>
<th>TLC ((5-17) \times 10^3\mu L⁻¹)</th>
<th>Different Leucocyte Count (%)</th>
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Table 3: Biochemical examination of clinically healthy animals undergoing sterilisation operation in group A.

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<th>Case No.</th>
<th>Sex</th>
<th>ALT (8.2-52.5) uL(^{-1})</th>
<th>AST (8.9-48.5) uL(^{-1})</th>
<th>ALP (1.6-101) uL(^{-1})</th>
<th>TP (55-75) gL(^{-1})</th>
<th>SUN (3.1-9.2) mmolL(^{-1})</th>
<th>Cr (44.2-144) µmolL(^{-1})</th>
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<td>Liver and Gall bladder (Fig.2a); Spleen (Fig.2b); Urinary bladder (Fig.2c); Intestine (Fig.2d) and Kidneys (Fig.2e) have normal shape, size and echotexture.</td>
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<td>Liver with mirror image artifact and Gall bladder (Fig.3a); Intestine and Spleen (Fig.3b); Stomach (Fig.3c); Urinary bladder (Fig.3d) and Kidneys (Fig.3e) have normal shape, size and echogenicity.</td>
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<td>Liver and Gall bladder (Fig.4a); Intestine (Fig.4b); Spleen (Fig.4c); Urinary bladder (Fig.4d) and Kidneys (Fig.4e); have normal shape, size and echotexture.</td>
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<td>Liver, Gall bladder and Stomach (Fig.6a); Spleen (Fig.6b); Intestine (Fig.6c); Urinary bladder (Fig.6d) and Kidneys (Fig.6e) have normal shape, size and echotexture.</td>
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<td>Liver and Gall bladder (Fig.7a); Spleen and left kidney (Fig.7b); Urinary bladder (Fig. 7c); Intestine (Fig.7d) and Kidneys (Fig.7e). have normal shape, size and echotexture.</td>
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<td>Liver and Gall bladder (Fig.8a); Spleen (Fig.8b); Intestine (Fig.8c); Urinary bladder (Fig.8d) and Kidneys (Fig.8e) have normal shape, size and echotexture.</td>
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<td>Liver, Gall bladder and Stomach (Fig.9a); Spleen (Fig.9b); Intestine (Fig.9c); Urinary bladder (Fig.9d) and Kidneys (Fig.9e) have normal shape, size and echotexture.</td>
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<td>Liver, Gall bladder and Stomach (Fig.10a); Stomach and liver (Fig.10b); Intestine (Fig.10c); Spleen (Fig.10d); urinary bladder (Fig. 10e) and Kidneys (Fig.10f) have normal shape, size and echotexture.</td>
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<td>Liver, Gall bladder and Stomach (Fig.11a); Spleen (Fig.11b); Intestine (Fig.11c); Stomach and liver (Fig.11d); Urinary bladder (Fig.11e) and Kidney (Fig.11f) only left kidney shows mirror image artifact, have normal shape, size and echotexture.</td>
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<td>M</td>
<td>Liver, Gall bladder and Stomach (Fig.16a); Intestine (Fig.16b); Spleen (Fig.16c); Urinary bladder (Fig.16d) and Kidneys (Fig.16e) have normal shape, size and echotexture.</td>
<td></td>
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<tr>
<td>16</td>
<td>M</td>
<td>Liver, Gall bladder and Stomach (Fig.17a); Spleen (Fig.17b); Intestine (Fig.17c); Urinary bladder (Fig.17d) and Kidneys (Fig.17e) have normal shape, size and echotexture.</td>
<td></td>
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<tr>
<td>17</td>
<td>M</td>
<td>Liver, Gall bladder and Stomach (Fig.18a); Spleen (Fig.18b); Intestine (Fig.18c); Urinary bladder (Fig.18d) and Kidneys (Fig.18e) have normal shape, size and echotexture.</td>
<td></td>
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</tr>
<tr>
<td>18</td>
<td>M</td>
<td>Liver and Gall bladder (Fig.19a); Stomach (Fig.19b); Spleen (Fig.19c); Intestine (Fig.19d); Urinary bladder (Fig.19e) and Kidneys (Fig.19f) have normal shape, size and echotexture.</td>
<td></td>
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</table>
Table 4: Haematological examination of clinically affected animal undergoing sterilization operation.

<table>
<thead>
<tr>
<th>Case No</th>
<th>Affection</th>
<th>Hb g/dl (12-18)</th>
<th>PCV% (37-55)</th>
<th>TEC (5.5-8.5) ×10^6 µL⁻¹</th>
<th>TLC (5-17) ×10^3 µL⁻¹</th>
<th>Different Leucocyte count %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>N  (60-70)</td>
</tr>
<tr>
<td>1</td>
<td>Pyometra</td>
<td>9.2</td>
<td>26</td>
<td>5.4</td>
<td>15</td>
<td>72</td>
</tr>
<tr>
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<td>10.2</td>
<td>32</td>
<td>6.3</td>
<td>16</td>
<td>76</td>
</tr>
<tr>
<td>3</td>
<td>Pyometra</td>
<td>8.5</td>
<td>22</td>
<td>7.0</td>
<td>12</td>
<td>74</td>
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<td>5.2</td>
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<tr>
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<td>45</td>
<td>5.4</td>
<td>12</td>
<td>72</td>
</tr>
<tr>
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<td>Uterine tumour</td>
<td>9.1</td>
<td>28</td>
<td>7.6</td>
<td>11</td>
<td>69</td>
</tr>
<tr>
<td>8</td>
<td>Herniated urinary bladder (perineal hernia)</td>
<td>14.0</td>
<td>41</td>
<td>7.3</td>
<td>7.0</td>
<td>71</td>
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<tr>
<td>9</td>
<td>Non-testicular Scrotal tumour</td>
<td>9.8</td>
<td>30.6</td>
<td>5.0</td>
<td>4.0</td>
<td>68</td>
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<tr>
<td>10</td>
<td>Prostate Enlargement</td>
<td>14.8</td>
<td>46</td>
<td>6.5</td>
<td>19.1</td>
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<tr>
<td>11</td>
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<td>13.0</td>
<td>40</td>
<td>5.8</td>
<td>18.5</td>
<td>79</td>
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</table>
(Table 5) Biochemical examination of clinically affected animal undergoing sterilization operation

<table>
<thead>
<tr>
<th>Case No</th>
<th>Affection</th>
<th>ALT (8.2-52.5) uL(^{-1})</th>
<th>AST (8.9-48.5) uL(^{-1})</th>
<th>ALP (1.6-101) uL(^{-1})</th>
<th>TP (55-75) gL(^{-1})</th>
<th>SUN (3.1-9.2) mmolL(^{-1})</th>
<th>Cr (44.2-144) µmolL(^{-1})</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pyometra</td>
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<td>36.0</td>
<td>94.6</td>
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<td>Pyometra</td>
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<td>94.6</td>
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<td>70</td>
<td>5.2</td>
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<tr>
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<td>95.9</td>
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<td>4.3</td>
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<td>Non-testicular scrotal tumour</td>
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<td>94.0</td>
<td>130.0</td>
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<td>5.0</td>
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<tr>
<td>10</td>
<td>Prostate Enlargement</td>
<td>49.1</td>
<td>51.3</td>
<td>87.5</td>
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<td>3.0</td>
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<tr>
<td>11</td>
<td>Prostate Enlargement</td>
<td>47.9</td>
<td>47.0</td>
<td>92.0</td>
<td>68</td>
<td>5.3</td>
<td>119</td>
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</tbody>
</table>