The dog had accompanied man all over the world since its 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 and has been the most widely kept for working, hunting, and pet animal in human history (Larson et al., 2012).

The abdominal cavity of the domestic dog (Canis lupus familiaris) is the space contained in the trunk, partially covered by the rib cage dorsally, diaphragm cranially, muscle wall laterally and the pelvic cavity caudally. Abdominal organs are; the stomach, spleen, liver, gall bladder, kidneys, intestines, prostate, pancreas, adrenal glands, uterus, urinary bladder, mesentery, lymph nodes, blood vessels and nerves. These organs perform various metabolic, physiologic, endocrinologic and reproductive functions. Diagnosis of abdominal disease conditions is challenging due to the involvement of multiple organ systems and the diverse nature of clinical and pathological changes (Dyce et al., 1996).

Some of the manifestations of abdominal disease conditions include vomiting, ascites, palpable masses, diarrhoea, body wasting, melena, hematemesis, tenesmus, bloating and constipation. Diagnosis is based on history, clinical examination, and confirmatory tests such as haematology and clinical chemistry. In most cases, confirmatory diagnostic tests are required to confirm clinical diagnosis. These include abdominocentesis with fluid evaluation, exploratory laparotomy and post mortem examination (Tams, 2003).

Diagnostic imaging is a vital component of evidence based medicine. It allows the visualization of the internal structure of abdominal organs and interpretation of disease. Imaging also allows for non-invasive techniques to confirm diagnosis. The diagnostic imaging techniques available for small animal practice include radiography, ultrasonography, endoscopy, computed tomography, magnetic resonance imaging and scintigraphy. The extent of their use may be limited by availability, cost and expertise. Despite global trends in diagnostic imaging, radiography remains the most commonly used technique in developing countries,
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including India. The use of radiography as the sole imaging technique has limitations in the differentiation of soft tissue masses. The technique is also not sufficient in identifying masses surrounded by fluid. In such cases, ultrasonography is recommended to complement radiography (Freeman, 2002; Hayward, 2006).

Diagnostic ultrasound is a rapidly developing imaging technology which is widely used in both industrialized and developing countries. Since its introduction in the 1960s, ultrasound has found widespread application in anatomical imaging, blood-flow measurement, and evaluation of physiology in almost all aspects of medicine (Goldberg and Kimmelman, 1988).

As ultrasound instruments have become smaller, less expensive, and easier to use, diagnostic ultrasound has become increasingly popular among a wide variety of veterinarians. Ultrasound imaging technique has substantiated or complemented a large number of radiographic procedures and has opened new areas of diagnostic investigation (Wells, 1987).

Ultrasound is an easy to perform and non-invasive imaging modality (Lamb, 1991; Freeman, 2002) in diagnosing various diseases (Hanazono et al., 2013). Ultrasound is available in A (Amplitude) mode suitable in ophthalmology, B (Brightness) mode most commonly use in abdominal diagnostic imaging and M (motion) mode generally use in cardiac application, other is real time mode and Doppler (Lattimer, 2000).

Ultrasonography is a diagnostic imaging technique based on the application of sound waves with frequencies of more than 20,000 Hz to create an image. It does so via a transducer (probe) which produces the sound waves and receives their reflected echo’s (Chandak et al., 2011).

There are three kinds of electronic probes available based on the type of footprint; Linear probe with frequencies (2.5 - 12 MHz) have long and a rectangular footprint suitable for tendon, muscle, vascular check-up and for abdomen diagnosis while convex and phase array probes with frequencies (2.5 - 7.5 MHz) have fan shape footprint suitable for abdominal application, diagnosis of various organs and cardiac application. The probe is lined with 64 piezoelectric (Quartz) crystals arranged in a straight line when charged by a voltage, the crystals vibrate causing ultrasound waves (pulse) to be produced at a set frequency. Once the sound waves hit a tissue interface of different densities, few are reflected back (echo) and are detected by the
piezoelectric crystals. These produce a corresponding current, which is converted to a
two dimensional digital image on the machine monitor which describes the tissue
appearance (Lamb, 1995; Barr, 1988).

The appearance of tissues depends on the acoustic impedance. This is based on
their density and velocity of the sound in the tissue (Burk and Feeny, 2003). The
ultrasonographic appearance may be described as dark (anechoic), grey (hypoechoic)
or white (hyperechoic). It may also be isoechoic (echotexture similar to some other
adjacent structure or organ). An image having all the varying mixture of descriptions,
it is referred to have heterogenous echogenicity (Lamb, 1995).

Abdominal ultrasound helps in the evaluation of abdominal organs including
liver, spleen, stomach, intestines, kidneys, bladder, uterus and prostate gland. This
test can be most useful in detecting changes in the shape, size, tissue density, internal
structure, and position of organs. The ultrasonographic examination can also identify
most abdominal masses or tumours, abdominal fluid, and abnormal lymph nodes
hence abdominal organ ultrasound has greater accuracy, and provides greater
diagnostic confidence compared to radiography (Sharma et al., 2011).

Diagnostic imaging is an important part of many diagnostic conditions in dogs
and cats but it does not always allow inflammatory or infectious conditions to be
differentiated from neoplastic disorders. Cytological or histopathological diagnoses
are required for accurate diagnosis, prognosis and therapeutic planning (Vignoli et al.,
2007).

Ultrasonography is most useful in canine to evaluate such hepatic mass lesion
as primary and secondary neoplasm, cysts, abscesses, ascites, vascular engorgement,
granulomas and biliary system (Nyland and Park, 1983). Ultrasonography is an
excellent non-invasive way to evaluate liver parenchyma. It is particularly useful in
differentiating focal from diffuse disease, cystic from solid masses and obstructive
from non-obstructive icterus. Indications for hepatic ultrasound usually include
elevated liver enzymes and presence of free abdominal effusion. This procedure is
also indicated for determining the extent of abdominal metastasis in cases of hepatic
neoplasia and to image congenital or acquired portocaval or portosystemic shunts.
Doppler imaging confirms the location of the suspicious vessels and direction of the
blood flow within and can also provide supportive evidence of intrahepatic portal
hypertension by allowing the assessment of the speed and direction of portal flow
(Kumar et al., 2012).
Ultrasonographic scanning of the GI tract offers complementary information to other imaging modalities, such as upper gastrointestinal contrast study, gastrogram, and barium enema. Ultrasound is a valuable complementary diagnostic tool which can detect unpalpated GI masses, gastrointestinal foreign body, small peritoneal effusion and abnormalities of bowel peristalsis (Penninck et al., 1990).

Ultrasound is most commonly used imaging method for studying urinary tract disorder and renal disease in dogs hence useful for guiding interventional procedures, cystic calculi, cystic neoplasm and cystitis. Evaluation of Doppler indices has become a valuable tool in assessment of renal hypertension. Abnormalities of urinary bladder either in its wall or in the density of urine can be judged by ultrasonography (Dehmiwal et al., 2015).

Ultrasound can also be used in the assessment of uterine pathologies such as pyometra and endometrial hyperplasia (Lattimer, 2000). Pyometra is a commonly occurring uterine disease in dogs that often leads to loss of breeding potential and in some cases it can be life threatening. An increased incidence of pyometra is seen with age. Abdominal ultrasound is the best tool for diagnosis of pyometra and for monitoring response to therapy (Baithalu et al., 2010).

Canine pyometra is a life-threatening disease common in countries where spaying of dogs is not routinely performed. The disease is associated with endotoxaemia, sepsis, systemic inflammatory response syndrome with a mortality rate of 3-4 per cent in dogs. Common clinical signs of pyometra include local sign of vaginal discharge and systemic signs such as vomiting, inappetence, polyuria / polydipsia and lethargy (Brady and Otto, 2001; Egenvallet et al., 2001; Hagman et al., 2006a).

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 resist lying on their backs and may require some sedation to allow a diagnostic procedure. If biopsy needle is used to obtain a tissue sample, a local anaesthetic or ultra-short anaesthesia is used. Ultrasonography is an excellent diagnostic tool in evaluating the prostate gland. It is very useful for visualizing the internal architecture, external texture, as well as cystic structures within the prostate. Ultrasonography is also very useful for guidance when percutaneous biopsy or aspiration is performed (Smith, 2008).
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Blood is an important medium in assessing the health status of animals. Both the physiological and pathological conditions of animals can be assessed by the evaluation of hematological and biochemical analyses of the blood (Coles, 1986; Bush, 1991). Though ample work has been done on establishing the baseline values of biochemical and hematological parameters of dogs (Oduye, 1978; Awah and Nottidge, 1998).

The purpose of this study therefore was to establish a model framework for the diagnosis of abdominal disease conditions in dogs. The findings of the study were aimed at aiding in quick diagnosis and management of small animal patients presented with clinical signs of abdominal disease conditions.

Objectives

1. To study the ultrasonographic appearance of abdominal organs in normal and diseased dogs.
2. To study various clinico-physiological and haemato-biochemical changes in abdominal pathological conditions in dogs.
3. To corroborate ultrasonographic findings with the clinical and haemato-biochemical findings in abdominal pathological conditions in dogs.