2.1 Ultrasonographic findings

Shille et al. (1984) reported that ultrasound was performed using 2.5, 3.5, 5, 7.5 and 10 MHz sectorial probes. The uterus was examined to evaluate the integrity of endometrium, presence of exudates and cystic hyperplasia of endometrial glands. The widest cross-sectional diameter of uterine horns was measured by electronic calipers. The ovaries were examined to evaluate the presence of pathological changes such as cysts, neoplasia, etc.

Konde (1985) stated that canine renal cortex 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.

Nyland and Hager (1985) studied ultrasonographic findings in animals suffering from hepatic, splenic and pancreatic disorders. Ultrasonography in cholelithiasis case revealed thickening of the gall bladder wall, large and elongated gall bladder filled with anechoic bile which was creating acoustic enhancement artifact.

Konde (1989) stated that with increasing amounts of fluid, the normal renal architecture disappears as the parenchyma is compressed. Severe hydronephrosis is most often associated with long-standing and severe urethral obstruction and the kidney is seen as a round or ovoid anechoic sac. A thin rim of parenchyma and several hyperechoic bands extending from the hilus to the capsule are typical findings.

Penninck et al. (1989) examined that the lumen of the small intestine always contains some gas bubbles and therefore can be recognized as a hyperechoic linear or curved structure. The wall of the small intestine can be identified and, although the layers of the wall are the same as the stomach, in most cases all five layers cannot be distinguished.

Stowater and lamb (1989) described ultrasonographic features of para prostatic cysts in 9 dogs along with historical, clinical, surgical and pathologic findings and stated that paraprostatic cysts were usually large anechoic structures and many contained internal septa. Moderately large anechoic cavities or cysts were also detected in the prostatic parenchyma of 5 dogs.
Barr (1990) observed that intrahepatic blood vessels can be identified as anechoic channels seen in both longitudinal and cross sections, portal veins have strongly echogenic margins due to fibrous tissue of portal tract while hepatic veins in general don’t have echogenic walls.

Biller et al. (1990) examined ultrasonography in 102 persian cats which were suffering from renal cysts and stated that cysts were identified as anechoic spherical structure with smooth, sharply margined walls showing edge shadowing and slice thickness artifacts and mentioned that ultrasonography is ideally suited for examination of the urinary bladder. A small bladder is not detected by abdominal palpation or radiographs but it can be identified using ultrasonography. The anechoic urine contrasts well with the echogenic bladder wall.

Lamb (1990) reported ultrasonography of the liver, spleen, pancreas and ultrasound guided biopsy in small animals and stated that ultrasonography is an important diagnostic technique in veterinary medicine. It may be used to examine most structures in the small animal abdomen, providing a rapid, non-invasive means of supplementing information obtained by physical examination and radiography.

Spaulding et al. (1990) reported that intussusception can be identified using ultrasonography. In addition to the dilation of the intestines and lack of peristalsis, the intussusception itself can be identified as a multi layered lesion.

Biller et al. (1992) reported that ultrasonography can be an important adjunct in the evaluation of diffuse parenchymal hepatic disease. Diffuse liver disease appears ultrasonographically as a change in liver echogenicity from normal when compared with the renal cortex or spleen. Diffuse liver disease can be characterized as either hyperechoic due to fatty change, steroid hepatopathy, and cirrhosis or hypoechoic due to congestion, suppurative hepatitis, and lymphoma. Ultrasonographic diagnosis of diffuse liver disease should be substantiated by biopsy and histopathologic evaluation.

Braun et al. (1992) studied the position, dimensions and structure of the kidneys, ureters, bladder, and urethra in 20 healthy adult rams by use of ultrasonography. The findings were compared with those of 7 rams with obstructive urolithiasis. Ultrasonographic examination of seven rams with obstructive urolithiasis revealed a markedly dilated urethra and urinary bladder. Due to severe cystitis, the contents of the urinary bladder appeared as multiple, tiny, uniformly distributed echoes. The renal pelvis and medullary pyramids of both kidneys were dilated in four rams. In two rams, uroperitoneum and accumulation of urine in the abdomen were
diagnosed via ultrasonography. In one ram this was due to a ruptured ureter and in one to a ruptured bladder and stated that ultrasonography is a useful aid in the diagnosis of obstructive urolithiasis.

Neer (1992) stated normal anatomy and physiology of the gall bladder, bile duct, and bile in the dog and cat and then summarizes the historic, physical examination, clinicopathologic, diagnostic, histologic and therapeutic aspects of all the cases of extrahepatic biliary tract disease. Ultrasonography of gall bladder revealed thickened and hyperechoic gall bladder wall, dilation of common bile duct, intrahepatic biliary duct dilation tortuous biliary ducts and rounded hyperechoic visible calculi at the bottom of gall bladder in case of cholelith (Stieger et al., 2001)

Tidwell and Penninck (1992) studied ultrasonographic findings of 14 animals having gastrointestinal foreign bodies. Ultrasonography confirmed the presence and location of foreign material within the gastrointestinal tract when radiographic findings were unclear. The acoustic patterns arising from each foreign body varied depending on its physical properties and interaction with the ultrasound beam. These patterns, some of which seemed characteristic for certain types of foreign bodies, and the associated findings of mechanical ileus, ascites, mesenteric lymph node enlargement and localized pancreatitis were accurately demonstrated with ultrasonography and may likewise aid diagnosis.

Memon and Mickelsen (1993) examined ultrasonic features of close pyometra in a four year old Golden Retriever bitch on transabdominal ultrasonography and they observed a large fluid filled uterus involving both uterine horns, the diameter of left and right horns were 4.0 cm and 3.2 cm respectively.

Munro and Stead (1993) studied a case of 10 years old female terrier suffering from ventral hernia. Ultrasonography revealed hypoechoic strangulated small intestinal loop, with distension of the bowel proximal to the obstruction.

Spaulding (1993) observed that cholecystitis is sonographically characterized by a hyperechoic gall bladder wall with thickness more or equal to 3 mm and may have thickness of more than 4 mm in cases of neoplasia. In cholecystitis of inflammatory origin, the thickened gall bladder wall may be isoechogenic with hepatic parenchyma Stieger and Url (2001).

Nyland and Mattoon (1995) reported that gall bladder is seen as anechoic, round to oval structure just to the right of midline in most liver scans. The size is variable depending on when the animal was fed.
Review of literature

Yeager and Concanon (1995) studied that the uterine diameter of 1.0 - 1.1 cm along with small amount of fluid is normal during diestrus. Ultrasonographic characteristic of pyometra varied depending upon the extent of involvement and nature of contents. Extensive involvement depicted round hypo echoic to anechoic area, placed side by side covering the complete abdomen while moderate involvement exhibited hypo echoic roughly round structure ventral or ventrolateral to the anechoic urinary bladder in transverse section. Mild involvement was more readily visualized on longitudinal section as mixed anechoic to hypo echoic tubular structure.

Voges and Neuwirth (1996) reported a case of female dog suffering from cystic endometrial hyperplasia and pyometra complex ultrasonography revealed enlarged uterus with a diameter of approximately 1.5 cm. Multiple irregularly shaped anechoic to hypo echoic cyst like areas, ranging in size from 3 mm to 14 mm in diameter, were present throughout the uterine walls.

Penninck et al. (1997) stated that ultrasonographic findings of gastric ulceration included thickening of the gastric wall with reduced layering, presence of mucosal wall defect “crater” with accumulation of micro bubbles, fluid accumulation within the stomach and diminished gastric motility was noted.

Vaden et al. (1997) stated that the ultrasonography can be used to characterize the renal shape and size. It provided information about renal parenchyma, increased overall renal echogenicity and decreased corticomedullary distinction can be seen but this cannot be diagnostic for CRF.

Lamb (1998) stated that ultrasonography has been a convenient method for examining adjacent organs, principally the kidneys and bladder, which may be affected in animals with ureteral abnormalities and ultrasound guidance facilitates certain interventional diagnostic procedures for the ureters. Ultrasonographic findings of congenital portovascular anomalies which includes markedly increased and abnormally variable portal blood flow velocity with attenuated intrahepatic portal vessels and localized dilatation of the intrahepatic Portal Vein (PV) at the site of communication with the Caudal Vena Cava (CVC).

Lamb and Mantis (1998) examined ultrasound images with respect to appearance of the intussusception, suspected location, evidence of predisposing cause and concurrent lesions. Ten intussusceptions were found, affecting a variety of breeds. Showing clinical signs of vomition, haemorrhagic diarrhoea, depression, abdominal pain and sometimes palpable elongated abdominal mass. 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 “bull’s-eye” was identified ultrasonographically in each dog and anatomical location was predicted correctly in 5 instances.

Leveille (1998) observed that blood clots may occur secondary to trauma, bleeding disorders, infection, or neoplasia. Usually blood clots are anticipated at the time of ultrasound study based on history and clinical signs. Clots are commonly hyperechoic nonshadowing echogenicities with an irregular shape, which settle to the dependent portion of the bladder lumen on positional studies. The lumen of the bladder may be filled with a lacy cob-like material. Blood clots usually move when the bladder is agitated. When they are adherent to the bladder wall, they may produce an irregularity along the mucosal surface. Urinary bladder injuries resulting from blunt trauma are classified as contusions, extraperitoneal ruptures and extraperitoneal ruptures and it can easily diagnosed by real-time ultrasonography. The ultrasonographic detection of micro bubbles or turbulent flow through the visualized defect, and shortly thereafter in the extravasated fluid collection, is diagnostic of extraperitoneal rupture of the bladder. Partial rupture of the urinary bladder wall with sub-serosa accumulation of urine can be easier to detect as a focal anechoic halo associated with a portion of the wall.

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 lymph plasmocytic 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.

Schwarz et al. (1998) studied 14 dogs with hepatic abscess which were identified over a 12 year period and reported that hepatic abscess in dogs are relatively uncommon. Ultrasonographic feature of hepatic abscess were variable in echogenicity ranging from 1-11cm at different locations of liver showing round, oval and irregular margins with solitary and multiple cavitation’s. Differences in echogenicity can be seen within different areas of the same lesion. Some display an echogenic rim which can have a variety of thickness.

Churchill et al. (1999) opined that in normal sonographic anatomy of kidney, the cortex is outer rim of tissue and is normally hyperechoic to the more central
hypoechoic medulla. The cortex is typically isoechoic to hypoechoic to the liver and hypoechoic to the spleen.

Willard (1999) reported that diffuse thickening of the colonic wall is a nonspecific change which can be due to inflammatory or infectious disease such as lymphocytic - plasmacytic colitis and inflammatory bowel disease. Focal areas of wall thickening or mural masses may be neoplastic, lymphosarcoma’s and polypoid or granulomatous.

Besso et al. (2000) described enlarged gall bladder and immobile stellate or finely striated bile pattern ultrasonographically in 14 dogs which were exhibiting clinical signs of vomition, anorexia, lethargy, abdominal pain, icterus, and hyperthermia. Ultrasonographic finding were gall bladder wall thickness, loss of gall bladder wall integrity and gall bladder rupture presented in 50% of the dogs. Histopathological examination revealed that gallbladder wall necrosis in 9 of 10 dogs. Cholecystitis in 5 dogs and mucosal hyperplasia was present in all gall bladders and stated that ultrasonographic evidence of an enlarged gall bladder with an immobile stellate or finely striated bile pattern is diagnostic for a gall bladder muceocele and gallbladder muceocele were associated with a 50 % incidence of loss of gall bladder wall integrity or acute rupture, all located in the fundus.

Bhadwal and Mirakhur (2000) observed enlarged area of increased echogenicity at the level of the neck of urinary bladder in prostatomegaly large anechoic area containing a mass of mixed echo patterns in prostatomegaly with prostate hyperplasia. They emphasized that transabdominal ultrasonography presented a very safe, satisfactory and realistic image of the anatomical and pathological status of the canine prostate.

Hill et al. (2000) observed that sonographic features of cirrhosis vary from multiple hepatic nodules, hyperechoic hepatic parenchyma, decreased liver lobe size, increased hepatic echogenicity accompanied with less distinct appearance of the echogenic portal vein margins and decreased distal visualization. Periportal fibrosis in cirrhotic liver is suggested by abnormally heterogeneous hepatic echogenicity giving it a mottled appearance. Increase in hepatic echogenicity may be present in disease conditions like cirrhosis, hepatic lipidosis, steroid hepatopathy, lymphosarcoma, long-term cholangiohepatitis, and some toxic hepatopathies (Partington and biller 1995).

Johnston et al. (2000) reported that canine prostatic disorders include Benign Prostatic Hypertrophy (BPH), prostatitis, prostatic cysts and prostatic adenocarcinoma.
BPH is a spontaneous and age-related disorder of intact male dogs, which occurs in more than 80 % male dogs over 5 years of age, and which is associated with clinical signs of sanguineous prostatic fluid, constipation and dysuria. Ultrasonographic appearance of the neoplastic canine prostate includes prostatomegaly, mineralization of the parenchyma, presence of focal to diffuse hyperechoic areas, and irregular discontinuous prostatic contour (Bell et al., 1995).

Kealy and McAllister (2000) stated that kidneys are bean-shaped in appearance and are located in the retroperitoneal space in the cranial abdomen. They lie obliquely tilted in a craniodorsal to caudoventral direction. The left kidney is less firmly attached to the dorsal wall than the right and hence is more variable in position. The right kidney lies more cranially than the left and is in contact with the renal fossa of the caudate lobe of the liver. Its cranial pole is within the rib cage, and it is usually bisected by the 13th rib. It is related to the right adrenal gland. Medially, it is close to the vena cava; ventrally, it is in contact with the right limb of the pancreas and the ascending colon. Cranially, the left kidney is in contact with the spleen, the greater curvature of the stomach, the pancreas, and the left adrenal gland. Dorsally, it is related to the sublumbar muscles; caudally, it is in contact with the descending colon. Medially, it is related to the descending colon and the ascending duodenum. Ventrally, it is related to the descending colon. Prostate gland on the sagittal (longitudinal) scan, it is seen as a round or oval structure with a smooth margin and a distinct hyperechoic capsule. Linear echogenic streaks are seen in the central gland area, and these are associated with periurethral tissue. This is termed the hilar echo, which may be surrounded by a hypoechoic zone. The urethra is not usually seen except in sedated or anesthetized animals or when the bladder is distended. On the transverse scan the prostate has a bilobed, rounded appearance, with a distinct hyperechoic capsule. The urethra is identified as an echolucent circular area in the dorsal half of the gland. The spleen is situated in the left cranial abdomen, approximately parallel to the greater curvature of the stomach. Its head is attached to the stomach by the gastrosplenic ligament and lies adjacent to the gastric fundus, the cranial pole of the left kidney, and the left body wall. The rest of the organ, the body and tail, is freely movable. The spleen is triangular in cross section. It is related to the greater curvature of the stomach and the left kidney proximally; at its middle, it is related to the colon; distally, it is related to the small intestine.
Polzin et al. (2000) stated that up to 67% loss of renal function occurs as clinically asymptomatic condition and that with a 67-75% per cent of loss of renal function polyuria and polydipsia may be manifested and they further stated that loss of 75-95% per cent of renal function would be manifested as vomiting, diarrhoea, apathy and when less than ten per cent of renal function is present. It was accompanied with the signs of uremic encephalopathy, indicating terminal stages of illness.

Fromsa et al. (2011) mentioned that cystic calculi are common in dogs and unusual in cats. Phosphate calculi are the most frequently encountered, although ureate, cysteine, oxalate and mixed calculi are also found. The calculi found in bitches are often larger than those found in male dogs as smaller calculi are more readily passed through the comparatively wide female urethra.

Ginel et al. (2001) reported that the parasitic infestations such as Haemobartonella, Babesia or Ehrlichia are known to cause diffuse enlargement of the spleen. Enlargement of the spleen may be due to a variety of causes: neoplasia, portal hypertension, hyperplasia in anaemia or infection, myeloproliferative disease, toxaemia, abscessation, anaesthesia and torsion.

Khan et al. (2001) studied a case of 4 years old cocker spaniel suffering from ileocolic intussusception. Ultrasonography of the intestine revealed a series of concentric hyperechoic and hypoechoic rings appeared on ultrasound examination with very weak intestinal motility in the transverse plane and sausage-shaped mass with folded layers of intestinal wall appeared on longitudinal scan. The ultrasound examination confirmed an intestinal intussusception of about 8 inches in length and 4 inches in diameter.

Kumar et al. (2001) reported that gall bladder wall, owing to cholecystitis gives thickened appearance due to visualization of both the inner and outer walls and is perceived as double rim effect. A hyperechoic thickened gall bladder (GB) wall with echogenic bile and biliary sludge were the features associated with cholecystitis.

Nyland et al. (2002) stated that liver parenchyma is less echogenic (blacker on a black background) than the spleen and ranges from similar to more echogenic (whiter) than the renal cortex. The architecture of the liver is composed of a uniform texture, which 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. The resulting pattern is heteroechoic with the uniformly echogenic hepatic cells interrupted by the portal and hepatic veins.
Nyland and Mattoon (2002) studied a case of female dog suffering from pyometra. Ultrasonography of uterus showed luminal contents are usually homogenous, but the contents may also be echodense with slow, swirling patterns.

Penninick (2002) reported that in the transverse plane, the colon usually appears as a semicircle because the gas within the lumen shadows the far wall. In the longitudinal plane, the colon appears as an echogenic line. If the colon is fluid filled, the far wall will be evident and the tubular nature of the bowel can be recognized.

Boyson et al. (2003) evaluated sonographic features of gastrointestinal (GI) perforation in dogs and cats. Sonographic findings in 19 animals (14 dogs and 5 cats) 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 (5), 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 (1) presence of focal bright fat or local fluid accumulation appear to be the strongest indicators of the location of the perforation, and stated that sonography allowed determination of the underlying cause of the perforation and has provided additional pertinent information on other abdominal structures.

Burk and Feeney (2003) reported that stomach wall thickness varies from 3 to 5 mm, with larger breeds having a thicker wall. Five layers may be identified starting with a hyperechoic serosa, a hypoechoic muscularis, a hyperechoic submucosa, a hypoechoic mucosa, and a hyperechoic lumen or mucosal surface.

Hoffmann (2003) studied the sonographic signs identified in 3 dogs with confirmed gastro duodenal linear foreign bodies. The sonographic signs included the following an abnormal tortuous path of the descending duodenum, the presence of a hyperechoic linear structure within the duodenal lumen which was carefully followed orally to the pylorus. The presence of a mass with strong acoustic shadow within the pylorus also imaged. The normal intestinal layers were present in the duodenal wall. In real time, the intestinal path was followed through many “hairpin” turns, and during this process the lumen was observed for identification of a linear structure. Secondary sequelae of gastrointestinal perforation were more difficult to identify with confidence in the cases presented.

Papazoglou et al. (2003) mentioned that intestinal foreign bodies are some of the most common causes of intestinal obstruction in dogs and cats. The size of the
foreign body determines whether obstruction is partial or complete. Life-threatening complications caused by fluid and electrolyte imbalances, hypovolemia, and toxaemia may be associated with intestinal foreign bodies. Ultrasonography appears to be a valuable adjunct to radiography for detection of foreign bodies (FB). Acoustic patterns vary upon the physical properties of the FB and interaction with the ultrasound beam. FBs that transmit sound can be accurately detected; strongly attenuating FBs produce acoustic shadows that, if seen in association with the intestinal lumen, can be a useful indicator of an FB. Ultrasonographic examination may detect intestinal plication and intussusception which is considered diagnostic for linear FBs.

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.

Peter and Widmer (2003) examined the prostate appear symmetric with variable prostatic parenchyma in case of prostatomegaly on ultrasound examination. In general, loss of the normal homogenous appearance can be seen. Increased echotexture may be seen due to sub gross cystic change, fibrosis, or increased vascularity. Occasionally small intraprostatic cysts were also identified. Ultrasonographically cystic changes appear as an anechoic area and macroscopic cysts may occur with BPH in certain conditions. Sonographic examination of neoplasia shows focal or multifocal hyperechoic area in the parenchyma with loss of normal architecture with asymmetric, irregular prostatic contour.

Bigliardi et al. (2004) reported that cystic endometrial hyperplasia pyometra complex is the most frequent and important endometrial disorder encountered in bitches. The resulting lesions of pyometra are due to the interaction between bacteria and hormones. The study was carried out on 45 bitches with pyometra, 10 pure breeds and 35 cross breeds, 1–15 years old, 20% of which had whelped at least once. Clinical signs, blood parameters, uterine ultrasonography, bacterial swabs and uterine histopathological results were recorded. Results suggest that ultrasonographic examination is a useful and reliable tool for the diagnosis of cystic endometrial hyperplasia-pyometra complex. In cystic hyperplasia-pyometra complex in the bitch reported that ultrasound examination was useful in detecting uterine exudate. However, mild to moderate cases of CEH in which the endometrial surface was
normal with none or few small cysts and anechoic uterine content was not always diagnosable. More severe cases of CEH were well identified by ultrasound because of extent of changes in the uterine tissue and therefore, its early diagnosis would help in deciding to choose ovariohysterectomy as the only choice of treatment as against medical therapy.

Widmer et al. (2004) observed that hyperechoic kidneys may be associated with diffuse infiltration disease which is characterised by an irregular shape, decrease cortical thickness, irregular margination with thick capsule ultrasonographically. The renal cortex is usually primarily involved however infiltrative processes may also affect the medulla, causing loss of corticomedullary demarcation. Ultrasonographic findings of the kidney is hyperechoic compare with liver, sometimes kidney becomes more echogenic than the spleen due to fibrosis of renal parenchyma.

Eastwood et al. (2005) reported a case of 10 years old female suffering from caecal impaction and chronic intestinal obstruction. Abdominal ultrasonography revealed dilated and hypoechoic intestinal loop with static appearance.

Sahal et al. (2005) studied a case of a 6 month-old German shepherd complaints of urinary incontinence, polydipsia, polyuria, apathy, anorexia and continuous weakness. Abdominal pain, leucocytosis, slight anaemia, mild elevation in serum urea and elevation in creatinine were detected. Ultrasonography detected extremely dilated renal pelvis and grossly thinned renal parenchyma diagnosis was confirmed by the exploratory laparotomy, bilateral hydronephrosis and hydroureter with stenosis in both ureters were observed. On the histopathological examination, there were tubular dilation and medullar fibrosis in both kidneys. In the stenotic areas of ureters; transitional cell hyperplasia, collagen bundles and haemorrhagic areas were observed.

Singh et al. (2005) conducted the study on 9 clinical cases of canine urolithiasis. The urinary tract was subjected to ultrasonography using 7.5 MHz 60 mm liner probe and 3.5 MHz mC2 micro convex transducer. The ultrasonograms revealed solitary to multiple calculi in urinary bladder which was hyperechoic.

Locke and Barber (2006) reported that neoplasia of the kidney is not common. It may be benign or malignant, primary or metastatic. Carcinoma arising from tubular epithelium is the most common neoplasm in dogs. A variety of malignant tumours have been reported including hemangiosarcoma, fibrosarcoma, transitional cell
carcinoma and squamous cell carcinoma. Benign tumours include fibromas, adenomas and lymphomas.

Paclikova et al. (2006) reported prostatic disorders in older aged dogs as Benign Hyperplasia (BPH), squamous metaplasia, prostatic inflammation, prostatic cysts and abscesses and neoplasia. Ultrasonographic findings revealed increase in echogenicity in case of prostatic hyperplasia. Hyperechogenic foci in case of inflammation or neoplasia and hypoechochogenic or anechogenic nodules in cases of cyst or abscesses.

Pallavi et al. (2006) studied 37 dogs of either sex, with presenting signs of fever, in appetence, tense abdomen, polyuria, polydipsia, passing foul smelling or blood tinged urine and difficult micturition. The dogs were subjected to ultrasonography using 3.5 MHz micro-convex and 7.5 MHz linear transducers. Ultrasonographic features were supported with haematobiochemical parameters, urine analysis and clinical signs. Ultrasonographically nephroliths (n = 3), nephrocalcinosis (n = 3), pyelonephritis (n = 5), glomerulonephritis (n = 1), chronic renal failure (n = 3), cystitis (n = 15) and cystoliths (n = 7) diagnosed. In majority of cases more than one condition was found.

Romagnoli (2006) stated that Benign Prostatic Hyperplasia (BPH) as the most common canine prostatic disorder that affects almost 100% of intact male dogs developing histologic evidence of BPH with aging. He further defined BPH as an increase in epithelial cell numbers (Hyperplasia) as well as an increase in epithelial cell size (Hypertrophy) where the increase in cell number is more marked which begins as glandular hyperplasia in dogs as young as 2.5 years of age.

Smith (2006) reported that pyometra literally meaning pus in the uterus, is a common disease entity of intact bitches. Similar conditions occur, including hydrometra and mucometra. The exact etiology is unknown; however the repeated and prolonged response to estrogen followed by long intervals of progesterone dominance in the intact bitch leads to hormonally mediated changes in the endometrium. The endometrium changes when impacted by bacterial infiltration; changes in endometrial steroid receptors can result in the clinical syndrome described as pyometra. The diagnosis of canine pyometra is best made with ultrasonography and radiology. Ultrasonographically, a fluid filled organ with variable wall thickness and proliferative changes can be visualized.
Tyrrell and Beck (2006) conducted survey abdominal radiography and ultrasonography in 16 small animals (11 dogs, 5 cats) with clinical signs of gastrointestinal 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.

Valocky and Mojzisova (2006) observed that ultrasonography as a very important diagnostic procedure in the gynaecological disorders of bitches as it measures internal diameter of uterine horn, thickness of uterine horn wall and external diameter of uterine horn.

Ward (2006) studied a case of 10 year old keeshond dog suffering from cholelithiasis ultrasonography of the abdomen revealed large calcification to the common bile duct at the entrance to the duodenum. Proximal to the obstruction, the common bile duct was markedly distended, measuring up to 2 cm in diameter. The gall bladder was distended and contained biliary sludge.

Chandler et al. (2007) examined ultrasonographic changes in 37 boxer dogs. Ultrasonographic findings included hyper echoic renal cortices, loss of corticomedullary junction definition, dilated pelvis and irregularly shaped small kidneys.

Gal et al. (2007) studied a case of 6 week old dog infected with *Ehrlichia canis*, *Babesia canis*, *Hepatozoon canis*, *Isospora* spp., *Giardia* spp., and *Dipylidium caninum*. The effect of multi-pathogen infection was a fatal combination of gastrointestinal and hematologic abnormalities, including diarrhoea, vomiting, anorexia, distended painful abdomen, intussusception, severe thrombocytopenia, anaemia and hypoproteinemia.

Marchetti et al. (2007) studied a case of 14 year old intact male siberian husky suffering from choledecholithiasis. Abdominal ultrasound showed a distended gall bladder with thickened, irregular and hyperechoic walls. Intrahepatic biliary ducts were dilated and were tortuous. The common hepatic duct was dilated with the latter
presenting an intraluminal hyperechoic image close to the duodenal papilla measuring about 7 mm in diameter with acoustic shadowing artifact.

Rubens (2007) reported that cholelithiasis may be seen as an incidental finding in many animals and can be identified within intrahepatic bile ducts, large hepatic ducts, the cystic duct, the cystic bile duct, the sphincter of oddi, or in gall bladder. These stones may be large and well defined or may consist of “sand” or sludge like. Gallstones are usually hyperechoic and may or may not cause shadows (Neer, 1992).

Shin et al. (2007) studied 24 dogs with histopathologic confirmation of chronic hepatitis. Ultrasonography was performed on 21 dogs changes in hepatic echogenicity were present in 16 of 21 dogs and included inhomogeneous (8), hypoechoic (5), or hyperechoic (3) parenchyma. Nine dogs had one or more nodules in the liver. Abnormal liver size was noted in 6 dogs (microhepatica [5], hepatomegaly [1]) and 2 dogs had an irregular border to their liver. Abdominal effusion was present in 2 dogs. The liver was normal in 3 dogs. Splenic abnormalities were noted in 7 dogs, 4 had splenomegaly, 3 had abnormal foci and 3 had masses associated with the spleen. Nine dogs had hyperechoic renal cortices and 1 had a cyst in the renal cortex.

Jawre et al. (2008) recorded hypoechoic multi-layered concentric rings representing the layers of intussusceptum and intussuscipiens with anechoic lumen in the centre, ventral to the spine in a bull mastiff bitch with ileo-caecal intussusception.

Korodi et al. (2008) described prostatitis as an uncommon urologic disorder and inflammation of the prostate gland occurring in older intact male dogs and recognized as the second most frequent prostatic disease after BPH. They also reported that 10 % of dogs have prostatitis at 6 months but 45 % have them at 7 years of age.

Makhdoomi and Shiekh (2008) performed ultrasonography in 25 cow calves suffering from complete obstructive urolithiasis and stated that ultrasonography was found accurate in diagnosing cystitis, uroperitoneum, serosal erosion of cystic wall and urocystoliths and further reported that ultrasonography can detects multiple small sized stones in urinary bladder by their strong acoustic shadowing.

Mantis (2008) reported that gastric ulceration may be present in severe cases the changes may mimic a mass. Characteristic ‘ulcer craters’ may be difficult to demonstrate sonographically but focal hyperechoic zones of increased gas accumulation at the mucosal surface and a spastic wall are suggestive findings. Blood clots accumulating at the site of ulceration may also appear hyperechoic.
Center (2009) stated that engorgement of the gall bladder and dilated cystic ducts are evident within 24 hours of acute complete extra hepatic bile duct obstruction. Distension of intrahepatic bile ducts is evident within 5 to 7 days which can be seen by ultrasonographically.

Gadelha et al. (2009) observed that the dimensions of prostate varied according to age, being small in young animals and large in old ones and a therefore positive correlation could be noticed between prostatic dimensions and age.

Pillai et al. (2009) observed that multi layered concentric lesion with hyper echoic and hypoechoic rings and multiple layered lesions with alternating hyper echoic and hypo echoic lines in transverse and longitudinal planes respectively in a pup with intussusception. They preferred abdominal ultrasonography as the most useful diagnostic technique for diagnosing intra-abdominal soft tissue abnormalities in small animals.

Suryawanshi et al. (2009) reported 2 cases with cystic calculi in dogs including an 8 year old male pomeranian and a 4 year old male labrador retriever presented to department of veterinary surgery and radiology, college of veterinary science, Hyderabad. The diagnostic confirmation of cystoliths was based on clinical and radiographic examination in the pomeranian. Plain radiograph taken in lateral view revealed presence of radio-opaque material in the urinary bladder which was suggestive of cystolithiasis. Characteristic ultrasound findings were presence of anechoic appearance of urinary bladder structure in ventral pubic area with presence of calculi as detected by hyperechoic focal echogenicities followed by an acoustic shadow depending on position of the bladder and stated that ultrasonography along with survey radiograph is the best and effective diagnostic modality for diagnosis of cystic calculi and when survey abdominal radiograph used with ultrasound examination it remain best and effective diagnostic approach for diagnosis of cystic calculi.

Baithalu et al. (2010) examined that ultrasonographic findings includes an enlarged uterus with convoluted, tubular horns filled with anechoic to hypoechoic fluid. The diagnosis of uterus may vary depending upon whether the cervix is open or closed. The uterine wall is usually relatively hypoechoic and increase in thickness. The luminal contents are usually homogenous and filled with anechoic fluid, although small echogenic particles may be identified. Radiography may also be used as an aid in diagnosis of pyometra in the bitch. In pyometra radiographically, a fluid dome,
tubular structure should be seen in the ventral and caudal abdomen, displacing loops of intestine dorsally and cranially. In open cervix pyometra with significant drainage of uterine contents through vagina, uterus may not visualize radiographically.

Gumber et al. (2010) studied a case of histologically confirmed with uterine endometrial polyp with severe haemorrhage and cystic endometrial hyperplasia—pyometra complex in a 9.5 year old female Doberman Pinscher with a 2 day history of bloody discharge from the vulva and an enlarged abdomen. Abdominal ultrasound examination revealed a severely enlarged abdomen with no evidence of free fluid in the abdominal cavity. The right uterine horn (10 cm in diameter) was larger than the left (3 cm in diameter), and both horns were filled with hyperechoic floating debris.

Kealy et al. (2010) reported that site of most intussusceptions occurs in the distal third of the small bowel of puppies and young dogs at the level of ileocolic junction, although it may occur within small or large intestine.

Malancus et al. (2010) studied 36 dogs of different breeds and ages. Twelve cases representing 33.33 % showed only gastric disorders, 9 subjects representing 25 % only intestinal disease and the remaining 15 cases, representing 41.77 % showed associated gastric and intestinal disorders. Ultrasound diagnosed disease were represented by gastritis (24 cases), pyloric hypertrophy (3 cases), enteritis (22 cases) and intussusception (2 cases).

Papazoglou et al. (2010) studies 4 cases of dogs suffering from intestinal obstruction resulting from an intramural foreign body-associated pyogranuloma. Abdominal ultrasonography showed hyperkinetic fluid-filled dilated intestinal loops and a hypoechoic small intestinal mass in all the dogs and stated that ultrasonography can be useful in detecting non-palpable gastrointestinal masses or in differentiating enteritis from intestinal neoplasia.

Stander et al. (2010) studied that ultrasonographic appearance of the gastrointestinal tract of 40 puppies age between 6 to 24 weeks and mentioned that enteritis commonly occurs secondary to viral or bacterial infections (feline and canine pan leukopenia, haemorrhagic gastroenteritis and parvovirus) and may be acute or chronic.

Tripathi and Mehta (2010) studied renal disorders in dogs using ultrasound technique and correlate the clinical findings, haematobiochemical changes and urine analysis with ultrasound observations. Out of 72 dogs, 11 (15.28 %) were diagnosed
for renal diseases. Out of renal disorders (15.28 %) 07 comprising of renal failure (9.73 %) and 04 of pyelonephritis (5.55 %). Ultrasonographically, loss of architectural detail, hyperechoic periphery, indistinct contours of renal cortex and small sized kidney were observed in renal failure. In pyelonephritis increased echogenicity of the renal cortex and medulla. Renomegaly detected as lack of demarcation of corticomedullary junction.

Girishkumar et al. (2011) stated that ultrasonography was useful in evaluating the diffuse lesions of the parenchyma and differentiating acute and chronic renal failure in canines.

Gracia et al. (2011) studied 92 cases of dogs which were suspected for intestinal obstruction. Abdominal ultrasonography of intestinal obstruction revealed hypermotility and hypomotility of intestinal contents, segmental intestinal dilation and without progression of luminal content.

James and Pillai (2011) studied a case of a male boxer dog aged about 11 months with a body weight of 20 kg with the history of anorexia, lethargy, melena and abdominal distension since three weeks. Based on the clinical examination, ultrasonographic findings, serum biochemistry, physical characteristics of the ascitic fluid and liver biopsy, the case was diagnosed as ascites due to hepatic cirrhosis. The ultrasonography of liver revealed irregular hepatic margins and increased parenchymal echogenicity associated with fibrous tissue and ascites. Kidneys were found to be of normal size and corticomedullary distinction was clear. The ultrasonographic finding was suggestive of hepatic cirrhosis.

Kealy et al. (2011) described that ultrasonographic appearance of the prostate in normal sexually mature dogs as hyperechoic and small and hypoechoic in immature or neutered dogs. The urethra can be identified as a hypoechoic area within gland and may be centrally or eccentrically located. In benign prostatic hyperplasia, the gland retains its shape, symmetry and smooth margin. The echogenicity is slightly hyperechoic. Small anechoic areas may be seen representing cysts. In prostatic neoplasia mild to severe enlargement of the prostate gland is seen. The prostate gland often appears asymmetrically enlarged and has an irregular contour. Hypoechoic parenchyma with poorly defined hyperechoic foci or small focal mineralization may be noticed. Prostatitis may cause focal areas of anechoic or hypoechoic regions. Patchy echogenic foci with a generalized increase in echotexture have also been described. Focal mineralization may also be present.
Kumar *et al.* (2011) studied 10 dogs of either sex with primary indication of azotaemia. All the dogs were subjected to detailed clinical, haematobiochemical, urinalysis, and microbiological examination along with radiographical and ultrasonographical examination. Based on the ultrasonographic structural abnormalities, the different renal affections associated with chronic renal failure (CRF) in majority of dogs were diagnosed. The different affections included “end-stage” kidneys ($n = 4$), hydronephrosis ($n = 1$), renomegaly ($n = 1$), nephritis ($n = 1$), nephrolithiasis ($n = 1$), nephrocalcinosis ($n = 1$), and renal cyst ($n = 1$). The significant ultrasonographic features in these affections included small kidneys with loss of corticomedullary demarcation (“end-stage” kidneys), increased cortical echogenicity (nephritis), dilation of the renal pelvis, separation of the central renal sinus with anechoic space, atrophy of renal medulla, (hydronephrosis), enlarged kidneys with increased overall echogenicity of renal cortex (renomegaly and associated nephritis), hyperechoic-mineralized structure with shadowing (nephrolithiasis), diffuse small multiple hyperechoic structures in the renal parenchyma with distal acoustic shadowing (nephrocalcinosis), small spherical intercortical anechoic structures fluid (renal cysts) and stated that ultrasound proved to be a quick, convenient, and sensitive modality in detecting alterations in renal size and parenchymal architecture.

Marin *et al.* (2011) concluded that ultrasound diagnosis in cases of pyometra as an easily achievable modality with cent percent accuracy and designated the technique as non-aggressive for the patient and the examiner. They observed round or ovoid shaped, large sacs containing anechoic fluid with artifactual distal enhancement and without parietal thickening. They described the characteristic “snow storm” appearance of the uterus due to particulate uterine matter together with abdominal wall movements.

Resende *et. al.* (2011) reported that acute hepatic failure may be characterized by hepatomegaly with normal, increased or decreased parenchymal echogenicity along with diffuse parenchymal abnormalities wherein the discrete hepatic borders are not visualized. Passive congestion observed in acute hepatic insult is the most common benign cause of diffuse decreased liver echogenicity which result from dilatation of hepatic sinusoids and hepatitis, owing to swelling of hepatocytes (Selcer, 1995).

Sridevi (2011) described a case of pyometra coexisting with gestation in a 4.5 year old miniature short haired dachshund. The dog exhibited depression, vaginal
discharge, polydipsia and dehydration. Ultrasound examination revealed the presence of low to moderate anechoic fluid collection in the left uterine horn. Blood analysis revealed mild neutrophilia with a left shift. Based on these findings a presumptive diagnosis of pyometra was made and the bitch was treated using amoxicillin-clavulanate with dopaminergic agonist (cabergoline). A second ultrasound scan revealed the presence of two gestational vesicles in the right uterine horn that were successfully carried to term. Unusually, while pyometra persisted in the left uterine horn, two viable puppies were delivered by caesarean section from the right uterine horn. Ultrasound of the uterine horn with endometrial hyperplasia endometrial surface shows numerous endometrial cysts. Uterine lumen contains anechoic fluid. Insert shows gross appearance of the endometrium after ovariohysterectomy.

Edwin (2012) studied a case of 5 year old cross breed suffering from inguinal hernia diagnosis was confirmed through radiography and ultrasonography. Ultrasonography of the swelling area revealed hypoechoic circular intestinal loops and acoustic enhancement due to air and fluids in the intestines.

Hefny et al. (2012) observed sonographic findings of an obstructed bowel include dilated fluid filled bowel loops with hyperechoic spots of gas moving within the fluid. The normal small intestine diameter is 3-4 cm while the diameter of the large intestine 4-5 cm. Those dilated loops may show thickened wall (normally up to 3 mm), thickened vavulae conniventes (normally up to 2 mm), and increased to-and-fro motion of the bowel contents (Silva et al., 2009).

Kibar et al. (2012) studied 40 cases of dogs which were divided in 2 groups each group containing 20 dogs in each. In group I intact healthy 20 males included and in group II 20 geriatric male dogs included which were suffering from various prostatic disorders. Ultrasonography revealed diffuse hypoechogenic prostate parenchyma and asymmetrical prostate gland in case of benign prostatic hyperplasia.

Atray et al. (2012) studied 3 cases of dogs suffering from intussusception which was confirmed by radiologically and ultrasonographically. Ultrasonographic findings of intestine revealed a series of multiple hyperechoic and hypoechoic concentric rings with a hyperechoic centre in the transverse plane and multiple hyperechoic and hypoechoic parallel lines were seen in the longitudinal plane.

Gupta et al. (2013) concluded that, the ultrasonography was a rapid, safe and an accurate diagnostic aid for the qualitative and quantitative evaluation of canine pyometra. They observed echogenic fluid and hypoechoic tubular uterus with
enhancement effect due to large quantity of uterine fluid. The hypoechoic and enlarged uterus folded upon itself so that the sections of the both horns could be visualized in a single plane.

Patil et al. (2013) studies 10 cases of dogs suffering from pyometra ultrasonography of uterus revealed the lumen of the horn was filled with homogenous anechoic contents with the hyperechoic bands in between which gave it fluid filled pocket like appearance.

Singh et al. (2013) studied 10 dogs ultrasonographically suffering from urolithiasis, cystoliths and nephroliths. Ultrasonography revealed a hyperechoic half-moon shaped image of the cystolith which was observed in the urinary bladder surrounded by the hypoechoic area. Density of the urine was appeared cloudy.

Kumar and Srikala (2014a) studied a case of a female labrador dog presented with a history of distended abdomen was subjected for clinical, physical, haematobiochemical and ultrasonographic evaluations. Ultrasonography of abdomen revealed floating viscera in the anechoic effusion with engorged and distended hepatic vasculature. No abnormal echogenicity was noticed with the abdominal organs such as spleen, kidney and bladder, except liver where there was presence of hyperechoic to mixed echogenicity indicative for hepatic disease. Further the liver was greatly engorged with dilated portal and hepatic veins with hyperechoic focal areas and rounded borders of hepatic lobes.

Kumar and Srikala (2014b) studied a case of an 8 years old male Labrador retriever suffering from cholecystitis. Ultrasonography of sagittal and transverse scans of liver parenchyma revealed no abnormal echogenicity but the gall bladder was oval in shape with symmetrically thickened wall that which was hyperechoic when compared with the surrounding liver tissue. The gall bladder was filled with sludge which appeared as uniform echogenic sediment.

Sravanthi et al. (2014) examined presence of hyperechoic focal echogenic spots accompanied with an acoustic shadow in cystic calculi and left kidney besides thickening of the urinary bladder wall. They inferred that survey radiography and ultrasonography were proved to be helpful in diagnosing urolithiasis in dogs.

Hollerweger (2015) reported a case of intestinal obstruction in dog. Ultrasonography revealed dilated intestinal lumen with hyperechogenic echogenicity due to ingested particles and collapsed intestinal segments distal to the stenosis.
Kamalakar *et al.* (2015) studied a case of pyloro-duodenal hernia in 8 months old buffalo. Ultrasonography examination revealed discontinuity in the abdominal muscle layers and subcutaneous herniation of the viscera with hypoechoic intestinal loops.

Kachwaha (2015) studied 4 cases of female bitches suffering from pyometra ultrasonography revealed sacculation of uterus filled with anechoic to hyperechoic fluid with thickened hyperechoic endometrial wall.

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.

Sharma *et al.* (2015) studied 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.

Potier and Reineau (2015) studied a case of 14.5 year old female kinkajou diagnosed with cholelithiasis. An ultrasound exam showed dramatic thickening of the gall bladder wall suggestive of cholecystitis, enlarged bile ducts as well as two hyperechoic densities casting acoustic shadows, strongly suggestive of choleliths or gallstones. Cholelith measuring 4 mm were located in the gall bladder and in the common bile duct.

Yehia and salem (2015) observed 32 cases of dogs suffering from numerous urinary and prostatic affections. Ultrasonography diagnosed urinary bladder affections (No = 18) included cystitis, cystic calculi, cystic neoplasms, and bladder haemorrhage. Kidney affections (No = 8) included renal cyst, hydronephrosis, nephrolithiasis, chronic interstitial nephritis and end-stage kidney failure. Prostatic affections (No = 6) involved benign prostatic hyperplasia, prostatitis and prostatic cysts. Ultrasonographic examination of prostate revealed enlarged prostate but retains its shape, symmetry and smooth margin. The echotexture was unchanged, but the echogenicity was slightly
more prominent in case of Benign Prostatic Hyperplasia (BPH). Prostatic cysts were recorded as enlarged and hyperechoic prostate than normal with presence of intra prostatic cyst containing clear anechoic fluid.

Maxon et al. (2016) studied 240 bitches for the diagnosis of Cystic Endometrial Hyperplasia (CEH) aged between 1.6- 7.2 years. Ultrasound examinations of the uterus revealed almost one fifth of the bitches within the breeding population had CEH which was first diagnosed between 2.5 and 7.3 years of age. Examinations on older bitches were more likely to find individuals affected with CEH (60 % of the examinations on bitches 6–7 years of age and 100 % of the examinations on bitches 7–8 years of age) than examinations on younger bitches (6.8 % of the examinations on bitches 2–3 years of age and 9.6 % of the examinations on bitches 3–4 years of age) and stated that there was a significant positive relationship between mean age at examination and presence of CEH.

Paolo Bargellini et al. (2016) revealed that conventional and contrast enhance ultrasonography in histologically confirmed 65 dogs which were suffering from intraluminal mass forming lesions, cystic mucosal hyperplasia, tumours, oedema, nacrosis, rupture of wall and mucoceles of gall bladder and reported that conventional ultrasonography correctly identified biliary sludge or mucoceles in 36/37 dogs, cholecystitis/oedema in 44/47 dogs, necrosis/rupture in 19/25 dogs, and gall bladder neoplasia in 3/3 dogs with these pathologies. On the other hand contrast enhanced ultrasound correctly identified cholecystitis/oedema in 42/47 dogs, necrosis/rupture, benign polypoid lesions, and gall bladder neoplasia in all dogs with no false positive results. Findings supported contrast-enhanced ultrasound as a complement to conventional ultrasonography for dogs with suspected gall bladder pathologies such as oedema, necrosis, tumours and rupture.

Adel and Khadidja (2017) examined prostate hyperplasia enables the visualisation of an observable increase in prostate volume showing modified echogenicity, marked by hyperechoic points at the beginning of prostate development and appears symmetrical with a regular capsule and stated that ultrasound examination has become a tool of choice in the diagnosis of prostatic disorders in dogs.

Haji et al. (2017) studied a case of 5 year old pug suffering from with Cystic Endometrial Hyperplasia (CEH)-open pyometra complex. The uterine ultrasound showed hyperplasia and multiple distended circular hypoechoic and anechoic cysts
filled with echogenic material in the uterine wall along with distended uterine horns containing large volume of cellular contents.

Konwar et al. (2017) examined 6 cases of dogs suffering from benign hyperplasia and cyst. Ultrasonography revealed loss of bi-lobed prostate appearance with presence of three anechoic cavities and parenchyma surrounding the cavity was slightly hypoechoic and heterogeneous which was diagnosed as prostatic cyst. Diffusely enlarged prostate with uniform echotexture, spherical in sagittal section and asymmetrical on transverse plane was diagnosed as prostatic hyperplasia.

Lima et al. (2017) studied 113 dogs with diagnosis of urolithiasis by radiography, ultrasonography and urinary parameter. Urolithiasis data was compared with radiographs and ultrasonography images. Survey radiographs enables the detection of radiolucent stones and when ultrasonography performed the sensitivity was increased and stated that ultrasonography is fast, non invasive, sensitive test to evaluate and count the numbers of stones it also enables the detection of radiolucent stones.

Lopez et al. (2017) reported a case of 6 year old female keeshond dog suffering from ovarian mass. Abdominal ultrasound of the genitourinary tract revealed a partially mineralized ovarian mass measuring 7 cm at the largest diameter within the left ovary and mild dilation of the uterine tubules with trace uterine fluid and stated that abdominal ultrasound is helpful to localize the disease in the ovary (unilateral or bilateral) and to evaluate tumour size and ovarian internal architecture, to identify free abdominal fluid, and to assess for other abdominal organ involvement.

2.2 Haemato-biochemical findings

Asheim (1965) studied 10 cases of bitches suffering from pyometra with renal damage and reported that blood urea nitrogen (BUN) levels increases along with hyperproteinemia, hypoalbuminemia and hyperglobulinemia.

Hardy and Osborne (1974) observed mild to marked hyper proteinemia and 17.7 per cent of 79 cases examined had an elevated blood urea nitrogen values and elevated creatinine values in dogs suffering from pyometra.

Schalm et al. (1975) observed increase in total protein and albumin concentration in cases of intestinal obstructions in dogs.
Singh et al. (1975) observed leucocytosis and neutrophilia with shift to left which were occurred in a case of simple and strangulated intestinal obstruction in equines.

Strombeck and Gribble (1978) reported that in about 100% of dogs with chronic active hepatitis, serum Alkaline Phosphatase (ALP) level was elevated almost five times the normal. Increased serum ALP level in cirrhosis might be due to cholestasis secondary to intrahepatic biliary obstruction. Blood Urea Nitrogen (BUN) level is found to be reduced in all types of chronic hepatitis.

Barsanti and Finco (1979) studied that the presence of abnormal number of leucocytes in urine sample indicated an inflammatory response by the urinary tract. The cause of inflammation could be bacterial infection, neoplasia, necrosis or response to a physical irritant. Pyuria alone or in conjunction with haematuria and proteinuria suggested the presence of bacterial urinary tract infection in dogs.

Borrenson (1979) studied 5 cases of female dogs suffering from pyometra in which diapedesis of erythrocytes into the uterine lumen and a shortened life span of circulating erythrocytes observed due to iron deficiency and it was responsible for the non-regenerative normocytic normochromic anaemia.

Borresen and Skrede (1980) examined pathophysiological mechanisms underlying the hypoalbuminemia and the hypercholesterolemia in 15 dogs which was suffering from pyometra syndrome and stated that the presence of intrahepatic cholestasis in most of the dogs was indicated by an increase of serum Alkaline Phosphatases and phosphodiesterase I. Fibrinogen and alpha 2-globulins were increased in most patients and decreased level of albumin.

De Toma et al. (1983) reviewed the serum changes of a number of markers in an animal model of bowel ischemia in a search for a clinically useful blood test for intestinal infarction and they noted that mesenteric infarction resulted in a significant increase in serum LDH, AST, ALP and total CK. However, none of these enzymes were specific for intestinal infarction.

Benjamin (1985) studied a case of intussusception in 4 months old pup and stated that leucocytosis, neutrophilia and lymphocytopenia were haematological findings.

Huszenicza et al. (1985) investigated the importance of Packed Cell Volume (PCV) and haemoglobin values in assessment of anaemia in pyometra affected bitches
and reported that the values of haemoglobin, haematocrit and erythrocyte count were suggestive of anaemia in 54 bitches affected with pyometra.

Johnston and Morris (1987) observed variable changes in plasma total proteins following simple and strangulated intestinal obstruction in equines.

Schepper et al. (1987) studied 112 cases of dogs suffering from pyometra and stated that 31 % cases showed a normal red blood cell picture, 57 % cases showed non-regenerative normocytic normochromic anaemia and 12 % non-regenerative microcytic hypochromic anaemia along with leucocytosis, neutrophilia shift to left and monocytosis.

Wheaton et al. (1987) examined 80 cases of pyometra in bitches and reported the clinical signs as depression (79 %), anorexia (79 %), vaginal discharge (88 %), polydipsia (63 %), polyuria (38 %), vomiting (33 %), dehydration (15 %), diarrhoea (26 %), pyrexia (43 %) and palpable uterus (40 %).

Stone et al. (1988) observed renal function and pathologic changes in 27 dogs with pyometra. Evaluation included CBC, serum biochemical evaluation, urinalysis, urine and uterine bacteriologic culture, uterine morphologic features and also light, electron, immuno fluorescent microscopic evaluation of renal tissues. Measurements of 24 hour creatinine clearance, protein excretion, sodium excretion and urine volume were made in 12 dogs without azotaemia. In 27 dogs, 26 % were azotemic and 89 % had a urine specific gravity less than 1.035. Glomerular filtration rate was reduced in 75 % of 12 dogs without azotaemia. None of these 12 dogs was proteinuric. Examination of renal biopsy specimens revealed a high prevalence of mild tubulointerstitial nephritis, but few specific glomerular lesions. Escherichia coli and Klebsiella were recovered from the uterus in 59 and 15 % of the dogs, respectively.

Braun et al. (1989) observed increase levels of plasma total proteins following simple intestinal obstruction in cattle.

Wheaton et al. (1989) noted that in 12 % of affected dogs the serum creatinine levels were higher than 1.5 mg/dl. In 27 % of affected dogs the serum urea nitrogen levels were over 20 mg/dl, while the serum Alanine Transaminase concentration was more than 60 u/l in 22 % of the cases.

Booth (1990) reported that BUN level in a dog with chronic renal failure as 48.6 m mol/L against the normal level of 2.8 to 8.3 m mol/L.

Braun et al. (1990) and Nath et al. (1991) observed increase levels of plasma total proteins following simple intestinal obstruction in cattle.
Sevelius *et al.* (1990) reported that 19% of the pyometra cases were markedly anaemic. In the study normal haematocrit values (PCV >39%) were reported in 36% cases PCV between 30 to 39% in 34% of cases and <30% in another 16% of cases. The existence of a border line anaemia masked by dehydration was described in 50 pyometra cases by (Schalm *et al.*, 1991).

Eschbach and Adamson (1991) reported that a major factor related to anaemia appeared to be decreased erythropoietin production by chronic renal failure kidneys.

King *et al.* (1992) reported non regenerative normochromic normocytic anaemia in 70.6 per cent of dogs with chronic renal failure and were of opinion that many factors including decreased erythropoietin, haemolysis and blood loss might influence the development of anaemia in CRF.

Neer (1992) observed mild to moderate neutrophilic leucocytosis with a left shift and mild to moderate non-regenerative anaemia. Increase levels of serum Alanine Transaminase (ALT), Aspartate Transaminase (AST), serum Alkaline Phosphatase (ALP) and Gamma-Glutamyl Transferase (GGT) in diseases associated with cholestasis and cholangitis in dogs and cats and mentioned that obstruction of common bile duct causes an increase of total serum bilirubin.

Sokolowski (1992) reported that white cell count in excess of 30,000 cells /mm3 was a common finding in pyometra. An inflammatory response characterised by leucocytosis with a left shift and neutrophilia observed in the pyometra group (Hagman *et al.* 2006)

Callan *et al.* (1993) observed leucocytosis and neutrophilia in 11 young Chinese Shar-Pei dog suffering from in hiatal hernia.

Leopold (1993) reported that blood urea and creatinine values were elevated in bitches with pyometra.

Memon and Mickelsen (1993) studied a case of four year old golden retriever bitch with a closed cervix pyometra and reported neutrophilic leucocytosis with left shift, monocytosis and thrombocytopenia.

Renton *et al.* (1993) revealed that 88.2% of the bitches diagnosed with pyometra had a vulvar discharge which was indicative of an open cervix and only three had a closed cervix. Malodorous, sanguineous to mucopurulent vaginal discharge was the most common clinical finding in bitches with open cervix pyometra.
Srinivasan et al. (1993) observed that the mean creatinine level and the mean BUN level in dogs affected with chronic renal failure was 4.56 ± 0.72 mg/dl and 78.18 ± 7.06 mg/dl respectively.

Sevelius (1995) reported that mean serum albumin concentration in dogs with cirrhosis was significantly reduced when compared to other liver diseases. The sensitivity of albumin to detect cirrhosis was 96 % while for chronic non-specific hepatitis it was 16.7 % and hypoalbuminemia was an important marker of chronic inflammatory liver disease.

Cheri and Johnson (1996) reported that the total WBC count ranged from 25000 to 1,00,000 per cmm. A leucocytosis with a marked reduction in the RBC count was reported (Melih et al. 2012).

Farrar et al. (1996) studied 14 dogs with hepatic abscess. Haematobiochemistry performed in all dogs. Hematologic abnormalities included leucocytosis with neutrophilia, mild to moderate thrombocytopenia, and mild anaemia. Serum biochemical abnormalities included high alkaline phosphatase and alanine aminotransferase activities and high bilirubin concentration. Hypoalbuminemia and prolonged coagulation values were also reported.

Guilford (1996) reported electrolyte imbalances such as hypochloremia and hyponatremia and biochemical imbalances such as azotaemia, elevation in creatinine and hyperphosphatemia in case of gastric dilatation and volvulus in 5 year old german shepherd dog.

Finco (1997) suggested that the progressive increase in Urine Protein Creatinine (UPC) might be a marker of an accelerated rate of renal injury.

Cowgill et al. (1998) stated that the severity and progression of the anaemia and clinical signs correlate with the degree of Chronic Renal Failure (CRF) in dogs. PCV as 27 ± 6.60 %, RBC count as 4.20 ± 0.96 × 106 /µl, TLC as 10100 ± 696 /µl is associate with protein loosing glomerular disease. It is observed that 90 per cent dogs showed anaemia with chronic renal failure (Mrudula et al. 2005).

Guelbahar et al. (1998) recorded that total erythrocyte count of 4.25 x 106 /µl, hemoglobin 10.4 g/dl, packed cell volume 33% and white blood cells 19.6 x 103 /µl in a 12 year old male Germen Shepherd dog affected with splenic hemangiosarcoma with abdominal dissemination.

Meyer and Harvey (1998) stated that hyperbilirubinemia support the cholestasis alteration with hyperphosphatemia, the increase of GGT and
hypercholesterolemia, because the excretion of bilirubin into the canalicular lumen is against a high concentration gradient and is the rate limiting step in its elimination.

Schwarz et al. (1998) examined 13 dogs with hepatic abscess. A Complete blood Count (CBC) was obtained in 12 dogs. The most common CBC abnormalities were an increased White Blood Cell count (WBC) in nine dogs, 17.5-43.1 x 10^3/μl (normal range 6.0-17.0 x 10^3/μl); anaemia in six dogs, 24-35 % hematocrit (normal range 37-55 %); neutrophilia in 10 dogs, 12.5-38.5 x 10^3 μl (normal range 3.0- 1.5 x 10^3/μl); left shift in seven dogs, 0.43-3.72 x 10^3/μl (normal range 0-0.3 x 10^3/μl); monocytosis in five dogs, 1.48-1.99 x 10^3/μl (normal range 0.15-1.35 x 10^3/μl). Thrombocytopenia was present in 11 dogs, with platelet counts ranging from 32 to 195 x 10^3/μl (normal range 200- 500 x 10^3/μl). A serum chemistry profile was obtained in all dogs. Serum Alkaline Phosphatase (ALP) was increased in all dogs. Values ranged from 237-5485 U/L (normal range 20-200 U/L). Increases in Aspartate Transferase (AST) 52-721 U/L in eight dogs (normal range 10-40 U/L), and Alanine Transferase (ALT) 79-3748 U/L in 10 dogs (normal range 10-70 U/L) were also present. In five dogs, increased Total Bilirubin (TB) 0.52-10.87 (normal range 0.04-0.4 mg/dl) was noted.

Ravindran et al. (2001) observed Increased level of BUN and serum creatinine have been recorded in cases of obstructive nephrolithiasis and cystoliths in canine patients.

Kaymaz et al. (1999) observed that importance of estimation of blood urea nitrogen and creatinine in the evaluation of hepatic and renal functions in bitches affected with pyometra. Hyperproteinemia and hypoalbuminemia is common while serum urea and creatinine levels are not among the consistent findings.

Borku et al. (2000) observed that mean BUN levels in dogs that were apparently healthy and suffering with nephritis as 16.93 ± 1.33 mg/dl and 263.94 ± 18.92 mg/dl respectively.

Cowgill et al. (2000) estimated mean PCV as 17.6 ± 5.2% and RBC count as 2.50 ± 0.7 x 10^6/μL in dogs suffering from chronic renal failure.

Gayle et al. (2000) stated that intestinal mucosal injury causes neutrophilia due to neutrophil attractants such as leukotriene, interleukins and activated complements that lead to accelerated production of neutrophils.
Tanyel (2000) stated that significantly higher urine protein creatinine (UPC) (1.71 ± 0.19) occurred in dogs exhibiting signs of renal dysfunction than the healthy dogs.

Heiene et al. (2001) stated that high urinary enzyme, viz Alkaline Phosphatase, Gamma-glutamyl transpeptidase, N-acetyl Bglucosamidase values often reflected extensive lesions in renal proximal tubular cells and sometimes reduced glomerular filtration rate.

Khan et al. (2001) studied a case of 4 years old cocker spaniel suffering from ileocolic intussusception. Haematology observation revealed decrease in haemoglobin, total erythrocyte count, packed cell volume with leucocytosis, neutrophilia and lymphopenia.

Takayuki et al. (2001) studied 30 cases of patient suffering from small bowel obstruction. Haematology revealed significant increase in lymphocyte count along with neutrophilia.

Eich and Ludwig (2002) observed neutrophilia, hyperglycaemia and hypercholesterolemia. Increase in Alanine Transaminase (ALT), Aspartate Transaminase (AST), Alkaline Phosphatase (ALP) and total bilirubin in 9 cats suffering from obstructive cholelithiasis.

Davis et al. (2003) observed higher serum AST and ALP in horses with proximal enteritis and small intestinal strangulated obstruction.

Bigliardi et al. (2004) collected blood samples and processed 45 ovariohysterectomized bitches with clinical diagnosis of pyometra and found neutrophilia ranging from 15000 to 60000/ml (means value 23000/ml) was detected in 75% of bitches, whereas other haematological parameters were within normal range.

Dixon (2004) studied a case 2 years old dog suffering from intussusception and haematology report showed as decrease values of haemoglobin, packed cell volume and total erythrocyte count.

Ravishankar et al. (2004) studied 29 cases of clinical pyometra and reported that the occurrence of pyometra was highest in the middle-aged bitches (6-8 years). Doberman and Spitz breeds were found to be more predisposed. Haematological studies indicated a normocytic, normochromic anaemia and leucocytosis with absolute neutrophilia in pyometra. Biochemical estimations revealed elevation of serum urea nitrogen, creatinine, AST, ALT, ALP and globulin and hypoalbuminemia. Proteinuria
was observed in the affected cases. The CRP and MPO levels were elevated in pyometra cases.

Axiom (2005) examined that serum ALT and AST increases in dogs suffering from gastrointestinal obstruction.

Jacob et al. (2005) reported that initial high UPC determination i.e. more than 1.0 in dogs with Chronic Renal Failure (CRF) was associated with greater risk of developing uremic crisis and death, compared to dogs with UPC less than 1.0 and thus concluded that UPC determination in dogs with CRF could be prognostic value.

Mrudula et al. (2005) studied 60 dogs showing clinical signs of renal insufficiency. Haematology revealed there was significant (P<0.01) reduction in PCV, Hb and Total Erythrocytes Count (TEC) values and no significant changes in erythrocytes indices in nephritis cases indicating a normocytic normochromic type of anaemia. Fifty- four out of 60 cases (90 %) showed anaemia out of 54 cases 44 (81.5 %) revealed normocytic normochromic anaemia and 10 (18.5 %) revealed microcytic hypochromic anaemia. There was leucocytosis accompanied by absolute neutrophilia in nephritis cases. The mean ALP and GGT in renal failure in dogs at 15.34 ± 2.05 and 12.25 ± 2.16 against a normal level of 3.67 ± 1.27 and 2.5 ± 0.36 U/m, mean serum creatinine level in dogs that were apparently healthy and suffering with nephritis as 6.56 ± 0.09 mg/dl and 5.59 ± 0.45 mg/dl respectively, mean total protein levels in canine nephritis as 6.08 ± 0.13 g/dl, serum albumin levels in dogs with nephritis as 2.5 ± 0.10 against healthy control as 3.33 ± 0.09 g/dl and stated that the dogs with renal insufficiency showed azotaemia, hypo proteinemia, hypoalbuminemia and hypophosphatemia.

Sharma et al. (2005) studied haemato-biochemical changes in dogs suffering from obstructive urolithiasis. Diagnosis was made by clinical examination, abdominoacentesis, radiography and ultrasonography and suggested that early haemato-biochemical changes following urethral obstruction in dogs include increased blood urea and creatinine, decreased blood glucose and hemoconcentration and further observed that timely treatment could result in return of these parameters to normal levels.

Dabhi and Dhami (2006) studied serum biochemical profile of 14 bitches with pyometra and 10 normal bitches before and 8-15 days after ovariohysterectomy. BUN and creatinine level increased 3 times in pyometra affected bitches than the normal
Review of literature

ones. Serum total protein and globulin concentrations were also significantly increased.

Paclikova et al. (2006) observed elevation in Alkaline Phosphatase, leucocytosis with the shift to left and neutrophilia in up to 75% of dogs suffering from prostatic disorders.

Rajathi et al. (2006) reported clinical, radiographical, serum biochemical and haematological changes before and after surgery in six dogs suffering from urolithiasis and observed that haematological and biochemical values remained at a higher level preoperatively but reached to normal range after surgery. The mineral composition revealed the presence of calcium oxalate followed by calcium phosphate, magnesium ammonium phosphate and uric acid which all were radio opaque calculi.

Singh et al. (2006) studied 11 cases of females suffering from Cystic Endometrial Hyperplasia and Pyometra Complex (CEHPC) and stated that leucocytosis, neutrophilia, lymphocytopenia, anaemia, increase of Blood Urea Nitrogen (BUN) and hyperproteinemia was haematobochemical findings of animals suffering from CEHPC. A significant (P<0.01) rise in PCV and TLC with neutrophilia, and decline in Hb, TEC and ESR in were noted in plyometric bitches as compared to normal ones (Dabhi and Dhami, 2007).

Ward (2006) observed increase level of Alanine Transferase (ALT) (627 U/L; reference range 19 to 59 U/L), Sorbitol Dehydrogenase (SDH) (21 U/L; reference range 0.0 to 4.0 U/L), Alkaline Phosphatase (ALP) (1372 U/L; reference range 9 to 90 U/L), cholesterol (9.37 mmol/L; reference range 2.70 to 5.94 mmol/L), Gamma Glutamyl Transpeptidase (GGT) (26 U/L; reference range 0 to 8 U/L), total bilirubin (23 mmol/L; reference range 1.0 to 4.0 mmol/L) and decrease level of albumin in case of 10 year old keeshond dogs suffering from cholelithiasis and cholecystitis.

Hasan et al. (2007) reported that level of total protein in dogs with renal failure ranged between 5.9 to 6.9 g/dl.

Marchetti et al. (2007) observed mild normocytic normochromic anaemia, hypereosinophilia with activated monocytes. Increase of serum Alanine Transaminase (ALT), Aspartate Transaminase (AST), serum Alkaline Phosphatase (ALP) and Gamma-Glutamyl Transferase (GGT) cholesterol and total bilirubin in case of cholelithiasis.

Mukaratirwa and Chitura (2007) observed low level of haemoglobin, packed cell volume and total erythrocyte count in case of benign prostatic hyperplasia.
Shin et al. (2007) screened 24 dogs with histopathologic confirmation of chronic hepatitis. Serum biochemical analyses were performed on all dogs at the time of diagnosis. The median and the range of values in all dogs tested were as follows. Increased serum Alkaline Phosphatase (ALP) activity was present in 21 dogs (median, 398 U/L; range, 50–7460 U/L), increased Alanine Amino Transferase (ALT) activity in 20 dogs (median, 794 U/L; range, 32–7580 U/L), increased Aspartate Amino Transferase (AST) activity in 20 dogs (122 U/L; range, 39–1250 U/L), and increased Gamma Glutamyl Transpeptidase (GGT) activity in 9 dogs (median, 11 U/L; range, 2–86 U/L). Activity of a single liver enzyme was high in 4 dogs, activities of 2 liver enzymes were high in 3 dogs, activities of 3 liver enzymes were high in 8 dogs, and 9 dogs had increases in all 4 liver enzymes. Eleven dogs were hyperbilirubinemic (median, 1.65 mg/dL; range, 0.45–27.30 mg/dL), 5 dogs were hypoalbuminemic (median, 2.4 g/dL; range, 2.1–2.6 g/dL), high Blood Urea Nitrogen (BUN) and creatinine concentrations were noted in 5 cases. One low BUN concentration was observed. Four dogs had low (median 2.1 g/dL; range 1.9–2.2 g/dL), and 1 dog had high serum globulins. A CBC was performed on all dogs. The median White Blood Cell (WBC) count was 11.5 × 10³ /mL (range, 4.7–35.2 × 10³ /mL). Nine dogs had an increased WBC (median, 25.6 × 10³ /mL; range, 17.2–33.5 × 10³ /mL), and 2 were neutropenic. Two dogs had a left shift, 7 had lymphopenia and 2 had a monocytosis. The median hematocrit was 46% (range, 26–58%). Seven dogs were anemic (median, 31%; range, 23–35%). Four dogs had thrombocytopenia (median, 128 3 10³ /mL; range, 67–177 3 10³ /mL), and 1 dog had a thrombocytosis.

Vijayanand and Nagarajan (2007) recorded that increased levels of serum alanine amino transferase, alkaline phosphatase and decreased levels of albumin in a dog with cirrhosis.

Barsanti (2008) observed that neutrophilic leucocytosis with or without a left shift, elevation of bilirubin, alkaline phosphatase and bile acids in cases of various prostatic disorders in dogs.

Bexiga et al. (2008) recorded leucocytosis (16600/µl) with elevated neutrophils (12000/µl) and decreased chloride (92 mmol/L) and sodium (130 mmol/L) in 38 cattle suffering with pericarditis and herniation.

Chaudhary et al. (2008) observed that levels of total protein, serum albumin, blood glucose and increased values of alkaline phosphatase, alanine aminotransferase in dogs diagnosed with hepatitis and cirrhosis.
Jawre et al. (2008) observed that elevated values of serum alkaline phosphatase in a bull mastiff bitch with ileo-caecal intussusception. Mild hyperproteinemia (4.9 g/dl) with mild hypoalbuminemia (2.3 g/dl) was noted in a dog suffering from intestinal obstruction due to a mango kernel (Cyrus et al., 2010).

Langston et al. (2008) observed normal blood picture in dogs suffering from urolithiasis and simple cystitis and leucocytosis in pyelonephritis.

Verstegen et al. (2008) stated that pyometra is a common reproductive disorder which affects nearly one fourth of all female dogs before they reach 10 years of age. Leucocytosis, absolute neutrophilia with shift to left, lymphopenia, mild monocytosis, mild elevation in alanine aminotransferase, markedly increase in Alkaline Phosphatase (ALP), total protein were haematological-biochemical findings.

Dabhi et al. (2009) studied haematological parameters in 14 pyometric and 10 healthy female dogs before and after ovario - hysterectomy and stated that mean haemoglobin, total erythrocyte count were significantly lower a James and Pillai (2011) reported that hyperproteinemia (4.4 g/dl) with hypoalbuminemia (1.3 g/dl) and normal globulin level (3.1 g/dl) reduced A:G ratio (0.4), hypoureemia (BUN- 8 mg/dl), normal bilirubin levels (Total 0.2 mg/dl, Direct - 0.1 mg/dl and Indirect - 0.1 mg/dl) and elevated serum ALP level (609 U/L) in case of cirrhosis and ascitic fluid collected was found to be a clear transudate with protein level 0.2 g/dl.

Nath et al. (2009) observed leucocytosis along with absolute neutrophilia, lymphopenia and monocytosis in bitches suffering from pyometra.

Vanitha et al. (2010) studied 30 cases of stray cattles suffering from rumen impaction with Indigestible Foreign Bodies (IFB). Haematological and biochemical examination revealed normocytic normochromic anaemia with increased BUN, hypoproteinemia, hypoalbuminemia, hypocalcaemia, hypoglycaemia and hypophosphatemia.

Vinodkumar et al. (2010) conducted retrospective study on necropsy data pertaining to urolithiasis in 27 weaner lambs and confirmed that uroliths cases had slightly higher Hb, PCV, TEC, RBC, WBC and epithelial casts in urine with significantly higher serum urea creatinine, magnesium and copper compared to 13 suspected and healthy animals and further stated that abnormal calcium phosphorus ratio predisposes the animals to urolithiasis.
Tomar et al. (2011) observed decreased values of haemoglobin, packed cell volume, while elevated levels of total leucocyte count and neutrophils in dogs suffering from cholecystitis.

Patel et al. (2012) observed leucocytosis (7500 to 13500/µl) and neutrophilia (55-70%) with shift to left in 14 Mehasana buffaloes suffering from ventral hernia.

Singh et al. (2012) observed decreased values of haemoglobin, packed cell volume and leucocytosis with neutrophilia in dogs affected with perineal disorders.

Bradea et al. (2013) observed changes in red cellular series translated by hemoconcentration, hypochromic anaemia and in white cell series leucocytosis in dogs suffering from uretero hydronephrosis.

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).

Patil et al. (2013) examined haematological values which revealed decrease in the Total Erythrocyte Count 4.85 ± 1.47 (6.67 ± 0.71), haemoglobin 9.32 ± 2.51 (13.42 ± 0.76), and Packed Cell Volume 29.73 ± 8.48 (40.15 ± 1.88) in all pyometra infected animals in comparison to control value. Leucocytosis 30.45 ± 21.72 (8.02 ± 1.67) with neutrophilia 82.4 ± 4.47 (67 ± 5) was a consistent finding along with increased number of band cells per microscopic field in pyometra cases which were decreased after both surgical and medicinal treatments. Biochemically, there were significant elevations of serum Alanine Transferase 71.86 ± 21.95 (20.4 ± 2.32), Aspartate Transferase 50.81 ± 17.22 (21.67 ± 2.92), Alkaline Phosphatase 102.33 ± 46.03 (9.50 ± 2.23), Total Bilirubin 1.42 ± 0.61 (0.10 ± 0.02), Gamma Glutamyl Transferase 11.74 ± 9.99 (4.52 ± 1.68), Blood Urea Nitrogen 36.45 ± 22.86 (10.94 ± 2.25) and Creatinine 2.38 ± 1.11 (0.57 ± 0.29), and decrease in protein 4.78 ± 0.89 (6.8 ± 0.99) and albumin 2.57 ± 0.57 (2.63 ± 0.62) concentration in serum of all dogs with pyometra. An increase in serum CRE and BUN values were recorded in all cases of pyometra which reduced to lower levels during both treatments in follow-ups. All
the haematoto-biochemical parameters were comparable to their respective reference values after either medicinal treatment or ovariohysterectomy of dogs. Thus the dogs with pyometra show significant abnormalities in haemato biochemical parameters indicative of reversible nature of liver and kidney dysfunction in pyometra.

Singh et al. (2013) studied 10 dogs, seven male and three female between age group of 5 to 7 years suffering from cystoliths. Haematological examination revealed mild anaemia, increased TLC, DLC and PCV values. Biochemical values indicated high creatinine, Blood Urea Nitrogen (BUN), AST and ALT.

Tantary et al. (2013) reported that non-significantly decreased in haemoglobin, packed cell volume, total erythrocyte count and platelet count, unaltered total leucocytes and increased clotting time. Significantly decreased total protein, albumin, globulin, albumin/globulin ratio, blood glucose and cholesterol levels; and significantly increased alanine amino transferase, aspartate amino transferase, alkaline phosphatase, gamma glutamyl transferase, blood urea nitrogen and bilirubin in dogs suffering from ascites due to chronic hepatitis.

Dodia et al. (2014) studied 50 clinical cases of stray cattle suffering from plastic foreign bodies. Haematology examination revealed decrease level of haemoglobin, packed cell volume, erythrocytes along with leucocytosis and neutrophilia whereas serum biochemical examination revealed decrease values of glucose, serum creatinine, serum albumin, total protein and whereas blood urea nitrogen and phosphorus were at higher level during preoperative period.

Ramprabhu et al. (2014) studied 25 cases of stray cattle suffering from rumen impaction. Haematological findings revealed decrease value of haemoglobin, packed cell volume, total erythrocyte count with leucocytosis and neutrophilia. Biochemistry revealed decrease values of albumin, total protein and creatinine in these animals.

Sravanthi et al. (2014) studied 10 dogs presented for treatment of canine urolithiasis. The mean ± SE of total red blood cell count, total leucocytic count and haemoglobin content preoperatively were 4.17 ± 0.02 mill/cumm, 9177 ± 122 cells/cmm and 11.2 ± 0.6 grams/dl respectively while, the mean + SE level of blood urea nitrogen and serum creatinine were found to be 16.7 ± 2.7 mg/dl and 0.95 ± 0.02 mg/dl respectively.

Tantary et al. (2014) recorded that significant increase in values of aspartate amino transferase, alanine amino transferase, alkaline phosphatase, total bilirubin and blood urea nitrogen, gamma glutamyl transferase and creatinine; and significantly
decreased mean values of total protein, albumin, globulin, albumin/globulin ratio, plasma glucose, plasma cholesterol in dogs with hepatic disorders.

Younis et al. (2014) stated that 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.

Elhiblu et al. (2015) observed that decreased in values of haemoglobin, lymphocytes, packed cell volume, platelet count, fibrinogen and increased values of total leucocytic and neutrophilic counts in dogs affected with liver cirrhosis.

Kandula and Karlapuri (2015) studied 79 dogs showing clinical signs of renal insufficiency. The blood samples were analysed for 4 haematological parameters, viz., Total Erythrocyte Count (TEC), Total Leucocyte Count (TLC), and its constituents (Neutrophils, Lymphocytes, Eosinophils, Basophils, Monocytes), Haemoglobin content (Hb %), and Packed Cell Volume (PCV %), and nine biochemical parameters, viz., Blood Urea Nitrogen (BUN), Creatinine, Total Proteins, Albumin, Calcium, Phosphorus, Sodium, Potassium, and chloride. The study revealed that the Haematological parameters, viz., TEC (4.02 ± 1.15 × 10⁶/μL), Hb (9.02 ± 1.12 g %) and PCV (33.22 ± 1.36 %) were significantly (P≤0.05/0.01) lower and the TLC (17.76 ± 1.30 ×10³/ μL) was significantly (P≤0.01) higher in dogs with renal insufficiency. The neutrophils (79.02 ± 1.00 %) was significantly (P≤0.01) higher, while lymphocytes (16.24 ± 1.52 %) and eosinophils (1.72 ± 0.02 %) were significantly (P≤0.05/0.01) lower indicating leucocytosis with neutrophilia, lymphopenia, and eosinopenia. The serum biochemical parameters viz., blood urea nitrogen (74.18 ± 2.02 mg/dl) and creatinine (6.02 ±2.56 mg/dl) were significantly (P≤0.01) higher in dogs with renal insufficiency. Total protein (3.26 ±1.84 g/dl), albumins (1.38 ± 1.28 g/dl), were significantly (P≤0.01) lower. Indicating hypercreatinemia, hyperproteinemia and hypoalbumenemia.

Kumar et al. (2015) recorded that moderate leucocytosis and neutrophilia in an adult Labrador retriever dog suffering from ileo-caeco-colic intussusception.

Mesquita et al. (2015) recorded hypo chromic microcytic anaemia, elevated urea and creatinine levels in spayed crossbreed female dogs with bilateral hydronephrosis and hydro ureters. Serum creatinine and urea values were found to restore to normal levels following treatment for a prolonged period of 40 days.
Singh *et al.* (2015) studied 14 canine patients suffering from mechanical obstruction of GIT due to intussusception. Diagnosis was made on the basis of history, clinical presentation, abdominal palpation, radiography and ultrasonography. Leucocytic anaemia, neutrophilia, lymphocytopenia, hyperproteinemia, hypoalbuminemia, hyperglobulinemia, hypoglycaemia and elevated levels of Alkaline Phosphatase (ALP) were the important haematobiochemical alterations.

Dehmiwal *et al.* (2016) studied 3 dogs of 6 to 12 years of age which were confirmed for cystoliths on the basis of ultrasonography and radiography. Haematology revealed leucocytosis and neutrophilia. An increase in BUN and creatinine were observed in 2 of 3 dogs.

Lakshmikant *et al.* (2016) studied that physiological and haematological change in open and closed pyometra. Normocytic normochromic anaemia was evident in both pyometra affected groups. Total Leucocyte Count (TLC) and neutrophil count was significantly higher in pyometra affected group. Lymphopenia and eosinopenia was evident in open and closed pyometra. A slight monocytosis was observed in closed pyometra. Band neutrophil was significantly higher in affected groups. Hepatic enzymes Alanine Amino Transferase (ALT) did not show any significant changes, while Aspartate Amino Transferase (AST) was significantly increased in closed pyometra. Hyperglobulinemia with hypoalbuminemia with unaltered total protein concentration was consistent with open and closed pyometra. The serum creatinine levels were higher than 1.5 mg/dl in 12 % of the affected dogs and serum urea nitrogen values were over 20 mg/dl in 27 % of the affected dogs in open and closed pyometra (Wheaton *et al.* 1987).

Das *et al.* (2017) evaluate the clinico-physiological, haematato-biochemical alterations, urinalysis along with histomorphological and histological changes of prostate glands in 57 dogs affected with Benign Prostatic Hyperplasia (BPH). Haematology revealed reduction of haemoglobin, packed cell volume and total erythrocyte count. Serum biochemical analysis showed a non-significant increase in creatinine and blood urea nitrogen with a significant decrease in total protein, albumin, globulin and its ratio.

Shah *et al.* (2017) reported that 8 bitches with pyometra of six different breeds, mean age 7.6 years were clinically examined and diagnosed for pyometra. The presumptive clinical diagnosis was based on case history, clinical signs and ultrasonography or radiography or both. The diagnosis was verified by gross
examination of a pus filled uterus during and after the ovariohysterectomy. In haematological examination Total Leucocyte Count (TLC), Differential Leucocyte Count (DLC), Total Erythrocyte Count (TEC), reticulocyte count and Haemoglobin (Hb) concentration were determined for haematology and as biochemical parameters Blood Urea Nitrogen (BUN) and plasma creatinine were estimated to assess the renal dysfunction. Alanine Amino Transferase (ALT), Aspartate Amino Transferase (AST), Alkaline Phosphatase (ALP) Total Plasma Protein (TP) and albumin was also determined in the pyometric bitches. Haematology of pyometra cases showed leucocytosis, neutrophilia, lymphocytopenia and normocytic and normochromic anemia. Biochemically, the increased BUN and creatinine and hyperproteinemia were observed. Alterations in the haematological and biochemical parameters were more marked in cases where the cervix was closed.

Uma et al. (2018) studied a 2 year old dachshund female dog suffering from cystoliths. The blood picture showed mild leucocytosis (16000 cells /cmm). The DLC revealed neutrophilia (94 % neutrophils, 6 % lymphocytes). The serum blood urea nitrogen and creatinine levels were 78 g/dl and 3.1 mg/dl respectively.

2.3 Clinico- physiological findings

Hardy and Osborne (1974) reported that vomition, polyuria, polydipsia, nocturia, diarrhoea and vulvar discharge were common signs in pyometra.

Larsson et al. (1981) studied total and regional plasma water and extracellular fluid in rats after obstruction of the small intestine and stated that intestinal obstruction caused a 19 % reduction of the total plasma water volume, while the total extracellular fluid volume was unchanged. Regional extracellular fluid volumes were diminished in the lung, liver and gastric antrum and increased in omental fat.

Huszenicza et al. (1985) observed that pyometra cases of bitches examined prior to ovario hysterectomy exhibited polyuria, polydipsia and more variable clinical signs such as anorexia, weakness, fever, dehydration, vomition, anaemia and icterus.

Nelson and Feldman (1986) studied 57 female dogs affected with pyometra having clinico-physiological signs as lethargy, depression, inappetance, polyuria, polydipsia, vomiting, mucopurulent vaginal discharge, dehydration, hyperthermia, tachycardia and tachypnea.

Robinson et al. (1989) studied that chronic renal failure in Bull Terrier dogs and observed signs like lethargy, anorexia, polydipsia, polyuria and weight loss.
Stowater and lamb (1989) observed depression, inappetance, stranguria, tenesmus, bloody penile discharge, palpable abdominal mass in 9 cases of benign prostatic hyperplasia and cysts in dogs.

Brown et al. (1990) recorded that signs like vomiting, polydipsia, polyuria and weight loss in dogs affected with renal diseases.

Krawiec and Heflin (1992) studied 177 male dogs determined to have prostatic abnormality. Of the 177 dogs, 87 were determined to have specific prostatic disease. The most common prostatic disease identified was bacterial prostatitis, followed by prostatic cyst, prostatic adenocarcinoma, and benign hyperplasia and most common clinical signs animals were showing in case of benign prostatic hyperplasia were sanguineous prostatic fluid dripping from the tip of the penis, blood in the urine or semen, constipation, and difficult urination.

Levitt and Bauer (1992) documented the clinical and surgical findings in 9 cats and 27 dogs diagnosed as having intussusception and observed bowel obstruction, vomition, haemorrhagic diarrhoea, depression and abdominal pain in animals.

Neer (1992) observed vomiting, diarrhoea, anorexia, lethargy, abdominal enlargement and abdominal pain and icterus in case of cholelithiasis in dogs and cats.

Munro and Stead (1993) observed lethargy, inappetance, anorexia and vomition as a clinical signs animal suffering from ventral hernia in white terrier female.

Nomura (1994) studied 207 bitches with pyometra and reported that 73.2 % were dull, 78.5 % anorectic, 70 % had polydipsia and 80 % had vaginal discharge. Vomition was recorded in some cases but the body temperature remained normal in all cases.

Johnson (1995) reported typical signs of pyometra in bitches as vulvar discharge, lethargy, vomiting, polyuria, polydipsia, weight loss, abdominal distension and dehydration.

Dhaliwal et al. (1998) reported 88.2 % of the bitches diagnosed with pyometra had a vulvar discharge which was indicative of an open cervix and only three had a closed cervix.

Schwarz et al. (1998) observed lethargy, vomiting, diarrhoea, trembling, polyuria, polydipsia, fever, colic, dehydration and tachypnea etc. in dogs with hepatic abscess.
Aric et al. (2001) observed vomition, fever, lethargy, dehydration and anorexia, dietary indiscretion, tense and palpable abdomen in case of intussusception in dog.

Khan et al. (2001) observed vomition and tenesmus, dehydration, absence of defecation, fresh blood was coming from rectum and the animal was taking only a few sips of water in case of intussusception in a cocker spaniel dog.

Sharma et al. (2001) reported a history of urinary incontinence, anorexia and abdominal pain. Abdominal ballottement revealed distension of urinary bladder. Haematuria during the past one year, complete retention of urine for the past 30-36 hours, the dog was severely depressed and not responding even to the owner, inability even to stand properly and was not passing urine, the body temperature, pulse and respiration were 99.5°F, 65 per min. and 24 per min., respectively.

Eich and Ludwig (2002) studied 9 cases of cats suffering from obstructive cholelithiasis and observed clinical signs as included progressive vomiting (9/9), dehydration (9/9), anorexia (6/9), icterus (5/9) and lethargy (4/9).

Prathaban (2002) reported that, benign prostate hyperplasia might a sub clinical condition but occasionally characterized by symptoms, like tenesmus, haematuria, haemorrhagic urethral discharge in dogs and dyschezia was more common than dysuria and the stools were often ribbon shaped. An intermittent haemorrhage or clear to light yellow urethral discharge or persistent haematuria was also noticed in some dogs.

Vijay kumar (2002) observed that abdominal distension, breathing difficulty, abdominal discomfort, groaning while lying down, scrotal or penile oedema, weight gain, vomiting, cough, anorexia, lethargy, episodic weakness and fever in dogs with ascites.

Fransson (2003) observed increase in rectal temperature, heart rate and C-reactive protein in cases of pyometra in bitches.

Hardie and Kyles (2004) stated that urinary incontinence, stranguria, dysuria, pollakiuria, polyuria, haematuria, persistent urinary tract infection, abdominal pain, vomiting, anorexia, depression or lethargy, emaciation and fever or hypothermia were clinical findings of animal suffering from urinary obstruction.

Ranganath et al. (2004) observed the signs of dysuria, haematuria, loss of appetite and occasional vomition. Temperature, pulse and respiration were normal. Animal voided small quantity of blood tinged urine with severe pain. On palpation
abdomen was tense, painfull and revealed distended bladder with hard movable mass, suggestive of stones in the bladder of a bitch.

Eastwood et al. (2005) studied a case of 10 years old female suffering from caecal impaction and chronic intestinal obstruction with clinical signs of chronic intermittent diarrhoea, vomiting, weight loss poor appetite and dehydration.

Singh et al. (2005) stated that clinical signs exhibited by the dogs included dysuria, haematuria, intermittent urination, dribbling of urine, anuria and mild to moderate dehydration. Haematuria and dysuria exhibited by dogs might be due to irritation of bladder mucosa caused by uroliths. Other signs were emesis, anorexia, depression and weight loss. Rectal temperature and pulse rate were within normal limits with slight increase in respiratory rate. Few dogs had foul smelling urine along with yellow discolouration. Abdomen was tense and painful in case of uroliths and cystoliths.

Hagman et al. (2006a) reported elevated temperature, heart rate and respiration rate in canine pyometra

Tyrell and Beck (2006) studied 16 cases of dogs with confirmed gastrointestinal foreign body with the clinical signs of vomiting, inappetance (10/16), lethargy (8/16), diarrhoea (1/16), and weight loss (1/16). Physical findings included abdominal pain (8/16), a palpable mass (2/16) and fever (1/16).

Ward (2006) observed clinical signs as vomiting, lethargy, icterus, and anorexia in case of 10 year old keeshond dog suffering from obstructive cholelithiasis.

Memon (2007) opined the clinical signs of benign prostatic hyperplasia in dogs include constipation, sanguineous fluid dripping from the urethra, haematuria and haemospermia. Prostatitis shows haematuria or haemospermia or both. Dogs with prostatic cysts may remain symptomless during initial stage however, if the dog is symptomatic will show tenderness, lethargy, dysuria, haematuria and straining during defecation. The clinical presentations of dogs with prostatic neoplasia are similar to other prostatic disease including tenesmus, bloody urethra discharge, haematuria and stranguria. Additional clinical signs in more advanced cases include lumbar or caudal abdominal pain, rear limb weakness, weight loss, anorexia and cachexia.

Barsanti (2008) observed haemorrhagic urethral discharge, haematuria, or difficult defecation is the most common signs found in benign prostatic hyperplasia in dogs
Chaudhary *et al.* (2008) recorded that nausea, vomiting, mild anaemia, jaundice, ascites, constipation, polydipsia, pyrexia, polyuria, muscle tremors, weakness, debility, anorexia etc. in dogs with hepatic diseases. They also reported history of prolonged erratic anorexia and weakness aroused suspicion of liver involvement.

Jawre *et al.* (2008) reported that diarrhoea, intermittent in appetite, polydipsia, depression, bloated tense abdomen etc. in a bull mastiff bitch with double ileo-caecal intussusception.

Langston *et al.* (2008) observed that haematuria, pollakiuria, stranguria, and dysuria in obstructive urolithiasis in dogs. Small uroliths could cause partial or complete urinary obstruction of the urethra, leading to bladder distension, abdominal pain, paradoxical incontinence, stranguria and signs of post renal azotaemia (anorexia, vomiting, and depression). In unattended cases they noticed rupture of urinary bladder, resulting in uroabdomen.

Lucre *et al.* (2008) observed that chronic renal failure in thirteen dogs with advanced kidney disease. Signs reported were anorexia, lethargy and weight loss.

Pillai *et al.* (2009) noticed that diarrhoea, vomiting, abdominal pain, depression, dehydration, emaciation, pale mucous membrane and a palpable sausage shaped mass in a pup with intussusception.

Vijayanand *et al.* (2009) studied a case of 7 year old female spitz which was suffering from cystic endometrial hyperplasia complex. Body temperature, pulse rate and heart rate were within normal range. Dehydration, abdominal distension and mucoid discharge from the external genitalia were observed. On abdominal palpation distended uterus was appreciated.

Cyrus *et al.* (2010) observed that vomiting and absence of stools for four days in a dog affected with intestinal obstruction due to a mango kernel.

Tripathi and Mehta (2010) studied 72 dogs suffering from renal disorders. Out of 72 dogs, 11 (15.28 %) were diagnosed for renal diseases. Out of renal disorders (15.28 %) 07 comprising of renal failure (9.73 %) and 04 of pyelonephritis (5.55 %). Most clinical signs observed as anorexia, polydipsia, polyuria, oedematous swelling in limbs, weakness, consistent vomiting, weight loss, and seizures.

Upadhye *et al.* (2010) recorded that anorexia for 6 days, inability to pass faeces for eight days, arched back, dullness, tenesmus, scanty dark brown or black
stools, dehydration, distended abdomen, marginally elevated body temperature, increased heart and respiratory rates in a dog affected with intussusception.

Geddes (2011) observed variety of clinical signs including difficulty in defecation, urination, ribbon like faeces, abdominal pain and haemorrhagic urethral discharge in animal suffering from benign prostatic hyperplasia.

Gracia et al. (2011) studied 92 cases of dogs which were suspected for intestinal obstruction. Clinical signs included emesis, weight loss, diarrhoea, anorexia, presence of tubular mass on abdominal palpation and abdominal pain along with history of ingestion of foreign bodies.

Marin et al. (2011) observed that polyuria and polydipsia syndrome in bitches affected with pyometra.

Rousset et al. (2011) reported that hydronephrosis in dogs did not cause any clinical signs due to continuous dilation of renal pelvis.

Amarpal et al. (2012) reported two cases of urolithiasis in non-descript dogs of 3 and 5 years of age brought to Veterinary Polyclinic of IVRI, Izatnagar, India. Clinical signs associated with urolithiasis were recurrent unsuccessful attempts to urinate indicating urinary incontinence, stranguria, occasional dribbling and haematuria as well as phalitis. They stated that urolithiasis is considered as the third most frequently reported condition of the lower urinary tract in dogs. Furthermore, they mentioned that cystic as well as urethral calculi may represent partial or complete obstruction of passage with clinical signs varying from dribbling, stranguria to haematuria.

Atray et al. (2012) observed anorexia, vomiting, bloody diarrhoea, illness, varying degrees of dehydration and pale mucous membranes in dogs suffering from intussusception.

Edwin (2012) studied a clinical case of 5 year old cross breed suffering from inguinal hernia. Clinical examination revealed emaciation, depression, dehydration and vomition. Rectal temperature, femoral pulse and respiratory rate were 39.5°C, 108 beats per minute and 20 breaths per minute respectively.

Gupta et al. (2012) examined that dullness, depression, lethargy, poor general condition, grey to chocolate coloured, foul smelling vaginal discharge sticking to the hair of tail and perineum, distended abdomen, vomiting, polyuria, polydipsia and toxaemia in pyometra bitches.
Kibar et al. (2012) investigated prostatic diseases by clinical, radiographical, ultrasonographical and laboratory examinations in 20 geriatric dogs and noticed high temperature in seven dogs, vomiting in two cases, anorexia in eight cases, and depression and lethargy in solitary case. Furthermore, there were abdominal pain in two cases, tenesmus and haematuria in three cases, and preputicial discharge in three cases.

Pradhan and Roy (2012) studied Chronic Renal Failure (CRF) in dogs found that which are in advanced stage of renal disease showed nervous signs like ataxia, tremors, in coordination, seizures, syncope and progressive deterioration of health.

Jena et al. (2013) studied physiological parameters in canine pyometra and revealed that rectal temperature and respiration rate were increased in the bitches affected with pyometra whereas heart rate did not reveal any significant change.

Singh et al. (2013) studied 10 dogs suffering from urolithiasis between age group of 5 to 7 years. The dogs were showing clinical signs such as dullness, depression, dehydration, signs of abdominal pain on palpation, haematuria and dysuria.

Kumar and Srikala (2014b) observed anorexia, persistent vomiting, dullness, depression, poor physical condition, moderate dehydration and icterus as a clinical signs in case of 8 year old labrador retriever suffering from cholelithiasis.

Hollerweger et al. (2015) stated that abdominal distension, severe vomiting, typically convulsive abdominal pain and constipation are clinical signs indicating bowel obstruction.

Mesquita et al. (2015) observed that progressive weight loss, emesis, anorexia lasting for one month in a crossbred female dog suffering from bilateral hydronephrosis and hydro ureter.

Haji et al. (2017) stated that inappetance, polydipsia, occasional vomition diarrhoea and the vaginal brown chocolate malodorous discharge were clinical signs of Cystic Endometrial Hyperplasia (CEH)-open pyometra complex.

Konwar et al. (2017) observed anorexia, tenesmus, lethargy, dull and depressed with dribbling of foul smelling bloody urine, slightly tensed abdomen with pale mucous membrane in cases of prostatic disorders in dogs.

Uma et al. (2018) studied a case dog suffering from cystolith and reported that vomiting, anorexia, restlessness, abdominal discomfort, high rise of temperature, high
pulse rate, heart rate respiratory rates were common findings in animal suffering from cystolithis.