ULTRASONOGRAPHIC AND LAPAROSCOPIC STUDIES ON THE ABDOMEN IN SHEEP AND GOATS

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كلوا وارعوا أن تعامكم أن في ذلك آيات أولي النهى
(صدق الله العظيم)
بسم الله الرحمن الرحيم

قال نافع:

هذا هوا وادعو أيما أنتم كن فتى متيقنا أنابه لأشباء الظلمة النافع

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Laparoscopy and sonography are two techniques that contributed to a great progress in human as well as in veterinary medicine in the late years of the twentieth century, especially after being established for diagnostic as well as minimal invasive surgical procedures.

Ultrasonographic examination is routinely used in equine, bovine and small animals. It was established as a rapid non-invasive technique for obtaining information about the normal abdominal organs and an increasing number of abdominal disorders. Ultrasonography is obtaining anatomical information not easily obtainable by other means (Goddard 1995). It is occasionally carried out in sheep and goat because of low financial value of these animals. It is widely used in the field of small ruminant reproduction.

The first publication on veterinary diagnostic ultrasonography was done in sheep by (Lindahl, 1966) who used A-mode ultrasonographic to diagnose pregnancy. In countries where intensive sheep farming is practiced the sonographic examination of these animals for pregnancy detection and the determination of fetal numbers is applied routinely (Flower and Wilkins, 1984 and Davey, 1986).

Laparoscopic surgery, also called minimally invasive surgery, is a modern surgical technique in which operation in the abdomen performed through small incisions as compared to
larger incisions needed in conventional surgical procedures. Laparoscopic surgery belongs to the broader field of endoscopy.

The first examination of the abdominal cavity was carried out in dog with a cystoscope inserted through a small cutaneous incision reported by (Kelling, 1901).

The first report on laparoscopy in sheep, using the ventral trocar-cannula approach was mentioned by (Roberts, 1968). The similar methodology reported on the usefulness of laparoscopy to study estrous behavior – ovarian pituitary relationships in the ewe were used by (Thimonier and Mauleon, 1969). The similar technique of laparoscopy which was used in sheep and characterized the reproductive ovarian cycle of the African Pygmy and Toggenburg goat was used by (Dukelow, Jarosz, Jewett and Harrison, 1971). The laparoscope is a safe and reliable method for diagnosing pregnancy and estimating fetal numbers in this species (Phillippo, Swapp, Robinson and Gill, 1971).

The advantages of laparoscopy compared with conventional open surgical exploratory include improved patient recovery because of smaller surgical sites and lower post-operative morbidity with a lower infection rate, less postoperative pain, shortened anaesthesia time and reduce blood loss (Rothuizen, 1985 and Bessler; Welan and Halverson, 1994).

There are few contraindications to laparoscopy because of the minimal invasiveness of the procedure. Ascites, abnormal clotting times and poor patient condition are the only relative contraindications to laparoscopy. Absolute contraindications to laparoscopy include septic peritonitis or conditions where obvious conventional surgical intervention is indicated (Richter, 2001).
Introduction

The aim of this study:-

1. To describe the normal ultrasonographic and laparoscopic anatomy of some abdominal organs such as gastrointestinal tract, liver, spleen, kidney, uterus, ovaries and urinary bladder in sheep and goats.
2. To assess the feasibility of laparoscopy for cystotomy, as assisted surgical procedure, and for ovariectomy, as total laparoscopic surgical procedure considering sheep and goats as experimental animals.
3. To compare the feasibility of ultrasound-guided liver biopsy with laparoscopic liver biopsy.
5.1. Ultrasonographic study:

Ultrasonography will be the modality of choice in ruminants for the abdominal organs in sheep and goats. The other diagnostic imaging techniques for detecting diseases of the abdominal organs are not appropriate. Radiology could not be used in ruminants because of large soft tissue effect of the rumen. Computed tomography and magnetic resonance imaging are not applicable in ruminants and scintigraphy is expensive, has radiobiological problem and not applicable in the field.

For abdominal ultrasound scanning the linear and the convex probe were used in sheep and goats (Alireza et al., 2007; Sarang et al., 2008 and Braun et al., 2011).

In this study the use of the Micro convex probe auto-adapted frequency, central frequency 6.5MHz, a small transducer contact area was a suitable and desirable because it enabled the use of small acoustic windows such as intercostal spaces and it made the identification of the abdominal wall easier. While the micro convex probe multi-adapted frequency was not desirable for the inter costal spaces of the sheep and goats, because it was not thin enough and the determination of
the frequency accomplished by manual changes of the frequency according to the resolution of the picture.

In the present study, fasting of the animals for 12 hours before examination provide an adequate examination of the abdominal organs (Paddy Mannion, 2006). While, (Braun et al., 1992) stated that the full rumen pushed the left kidney closer to the abdominal wall in the right side which provided better ultrasonographic examination of the left kidney in sheep.

The presence of gas in the gastrointestinal tract may interfere with transmission of the ultrasound beam and produce artifacts (Goddard, 1995).

In the present study the use of ultrasound contrast gel provided good contact between the transducer and the skin and avoids air artifact (Barr, 1995; Nyland et al., 1995 and Alireza et al., 2003).

Ultrasonography of the abdomen is particularly useful for measurements of organs, obtaining anatomical information not easily obtainable by other means such as identifying the biliary tract, investigating peritoneal fluid, determining the origin and structure of masses and guiding biopsy to obtain definitive diagnosis (Goddard 1995).

The ultrasound examination of the abdominal organs in sheep and goats started with the urinary bladder as a guide for
the other abdominal organs. The inherent contrast produced by the anechoic urine made it ideal for ultrasound examination. These results were in agreement with those reported by (Braun et al., 1992 and Hafaze and Khodery, 2001) in sheep and (Hagag, 2005) in goat. The contents of the bladder appeared hypoechoic and the bladder wall was uniformly in thickness. These findings were in agreement with (Hagag, 2005) in goat and (Leil, 2006) in sheep.

For examination of the uterus the transducer was placed transversally across the abdomen and the urinary bladder. The uterus appeared as thick echogenic wall and very narrow lumen, this result was similar to that found by (Braun et al., 1992 and Bretzlaff et al., 1993). On the other hand (Amal, 2001) mentioned that the non-pregnant uterus could not be scanned transabdominaly and only the pregnant one could be scanned starting from day 25 of gestation.

The ovaries were examined in the area in both sides of the udder and extend 10cm forward. Determination of the ovary in sheep and goats in trans-abdominal examination was very difficult except when the animal was in oestrus and the ovary was contained follicle or corpus lutium. These results were the same with those obtained by (Leil, 2006 and AbdElhameed, 2008) in sheep and goat.
The sonographic architecture of the kidney was complex, containing a mixture of hyperechoic, hypoechoic and nonechoic patterns. In comparison, most of the other organs in the abdomen were relatively homogeneous. The right kidney was observed close to the caudal pole of the liver but the renal cortex was less echogenic than the liver. The renal pyramids were seen as hypoechoic areas in the renal parenchyma. The renal cortex appeared more echogenic than the medulla. It was visualized in the right paralumbar fossa behind the last rib in both sheep and goats. These results were in agreement with those reported by (Abuzaid, 1995) and (AbdElhameed, 2008) whom considered that the right kidney was visualized by placing the probe in the right paralumbar fossa just behind the last rib and 5-8cm under the 1st and 2nd lumber vertebrae.

The left kidney lied in the dorsal region of the left paralumbar fossa behind the last rib. The same area was mentioned by (AbdElhameed, 2008) in sheep and goat while, (Yamaga and Too, 1984 and Braun et al., 1992) mentioned that both kidneys were visualized from the right flank in domestic animals. Moreover (Abuzaid, 1990) stated that diagnostic ultrasonography of the ovine kidneys was difficult due to the location of the kidneys and the thickness of the skin and subcutaneous fat. For longitudinal section of the kidney the probe was parallel to the transverse processes of the lumbar vertebrae while for cross section one the probe was parallel to
the last rib, this is in agreement with (Abuzaid, 1995). The dimensions of the kidney are essential for assessment of the status of the kidney whether its normal or abnormal. The kidney size of male sheep and goats was bigger than the female size but there is no difference in renal parenchyma. This is similar with (AbdElhameed, 2008).

Ultrasonography can be used as an accurate and non-invasive method for detecting liver diseases and monitoring the progression of disease (Aiello, 1998). A complete assessment of the liver should provide detailed information about the liver and identify the location of the major vessels.

The liver was seen from the 7th intercostal space to just caudal to the last rib in sheep and goats in the right side of the abdominal cavity. The same result was obtained by (Braun and Hausammann, 1992; Pugh, 2002; Sarang et al., 2008 and Kandeel et al., 2009).

The texture of the liver appeared in low echogenicity and the portal vein appeared with an echogenic wall while the hepatic vein had a less echogenic one. These results were in agreement with that considered by (Goddard, 1995 and Kandeel et al., 2009). The parenchymal pattern of the liver and the cross sectional view of the portal vein of the goats resemble that of sheep. The bile ducts were not visible in the normal liver
structure, these findings were similar to those reported by (Sarang et al., 2008) in goats.

Ultrasonography is an ideal non-invasive method to examine the spleen in sheep and goats. Appearance, location and size of the spleen was easily assessed (Braun et al., 2010). The spleen was scanned from the left side extended from the 8\textsuperscript{th} to 12\textsuperscript{th} intercostal space. It appeared as a homogeneous with coarse granulation organ that contained small regular anechoic blood vessels. These results were coincided with that obtained by (Yamaga and Too, 1984 and Nyland and Hager, 1985) whom recommended that, the splenic texture was smooth and uniformly throughout parenchyma this was attributed to its vascular nature and trabeculae inside. The splenic vasculature appeared with difficulty in differentiating between artery and vein. The differentiation between the spleen and the liver was done from their different anatomical location, the same results were mentioned by (Dyce et al., 2010) and Chit et al., 2012) in calves.

Ultrasonography of the reticulum in sheep and goats is a valuable tool to determine the appearance of the reticulum. It was visualized in the left and right side from 5\textsuperscript{th} to 8\textsuperscript{th} intercostal spaces. The reticulum appeared as a crescent-shaped structure with smooth contour located immediately adjacent to the diaphragm and the reticulum wall appeared as echoic area
and we could identified its layers. These results were in agreement with (Braun et al., 2011)

Diagnostic ultrasonography may enable the clinician to get an accurate assessment of amplitude and frequency of rumen motility in comparison to the subjective physical examination by palpation and auscultation (Radostits et al., 2007).

Ultrasonographic examination of the rumen is a useful adjunct to the non-invasive diagnostic investigation, this is in agreement with the findings of (Sheik et al., 2011) in cows. The ruminal wall appeared as a thick echogenic line and the gaseous zone in the most dorsal aspect of the ruminal sac could be identified by artifact, these are in agreement with (Sheik et al., 2011). The rumen could be visualized from the 8th intercostal space to the flank on the left side in sheep and goats this is similar with the report of Braun et al. (2011) in goats.

Clinical examination of the omasum using a conventional methods is very difficult because of its location so ultrasonography is a practical and straight forward for the observation of the omasum in sheep and goats, this is in agreement with those reported by (Braun and Jacquat, 2011) in goats and (Braun and Blessing, 2007) in cows. In goats the omasum was found medial to the liver whereas in cattle (Braun and Blessing, 2007) found that the omasum located immediately adjacent to the abdominal wall in the 8th and 9th
inter costal space. Only the omasal wall which was closest to the transducer was visualized because of the gaseous nature of the omasal contents, this is in agreement with the findings of (Braun, Jacquat 2011) in goats.

The ultrasonographic appearance of the abomasum allowed it to be differentiated from adjacent organs, similar to that found in cattle (Braun et al., 1997a) and in goats (Braun and Jacquat, 2012). The abomasum wall could not be easily differentiated from the contents and abdominal wall. The abomasal wall in cows was described as a thin echogenic line and its contents had different echogenicity, similar findings were reported by (Wild, 1995 and Braun et al., 1997a and Braun et al., 1997a) in cattle and (Braun and Jacquat, 2012) in goat

Ultrasonographic examination is suitable method for differentiation of small and large intestine in sheep and goats, this is in agreement with (Marmier 1993) (Amrein et al. 1999). The duodenum could be seen and determined easily because of its location while the cranial part of the duodenum could not be seen. The ileum and jejunum appeared in cross sections in the right flank. These findings were similar to those reported by (Braun and Marmier 1995) in cattle and (Braun et al., 2011) in goats.
The large intestine contents appeared as a shadow because of intraluminal gas, this is in agreement with the reports of (Braun and Amrein 2001) in cattle. The presence of intraluminal gas made the differentiation between the large and small intestine more easier in sheep and goats. Only the caecal wall appeared medial to the greater omentum as a thick echogenic line. Its contents could not be seen because of the gaseous nature. The spiral loop of the colon was easily identified because it had an echoic garland-like appearance, these result were similar to that recorded by (Braun et al., 2011).

The omentum also appeared between the abdominal wall and the wall of the colon as a homogenous echoic structure with small hypoechoic foci which corresponded to blood vessels, this is in agreement with (Braun et al., 2011) in Saanen goats and (Braun et al., 2004) in cattle.

5.4. Laparoscopic study:

Laparoscopy or celioscopy is a minimally invasive technique that permits the observation of abdominal organs. Minimal invasion of the abdominal cavity is not only esthetically advantageous but also therapeutically beneficial.
Fasting of the animals for 24 hours prior to any laparoscopic surgery was mandatory. (Maxwell and Kraemer, 1980; Boure, 2005 and ElKhamary, 2008) considered that the presurgical fasting decreased the rumen and large intestine contents and reduced the intestinal peristalsis. This reduced the risk of organ penetration and improved the observation of the abdominal structures.

Laparoscopy in sheep can be performed using one or a combination of anaesthetics such as pentobarbital in a dose rate of 20mg/kg body weight, promazine-pentobarbital (Snyder and Dukelow, 1974). In goats the anaesthetic regimen atropine sulphate-xylazine-thiopental sodium was used by (ElKhamary, 2008). Sedation with xylazine and local infiltration anaesthesia was carried out in laparoscopic surgery (Leil, 2006). In sheep and goat laparoscopy was accomplished with chemical restraint and analgesia using Ketamine Hcl with combination of xylazine given intramuscularly (Harison and Wildt, 1980). In this study, the induction of anaesthesia with xylazine-ketamine revealed smooth induction and recovery, good muscle relaxation and reliable duration of anaesthetic time for laparoscopic surgery, these results were in agreement with (Al-Badrany et al., 2012) in dogs.

Maintenance of anaesthesia was needed in long operations. In the present study the maintenance of anaesthesia was carried
out by using total intravenous anaesthesia with a half dose of xylazine-ketamine in one syringe. While, Ether or halothane can be used to maintain anaesthesia in sheep and goats (Harison and Wildt, 1980 and ElKhamary, 2008).

When laparoscopy is performed with general anaesthesia and animals placed in dorsal recumbency, nasal oxygen supplementation is recommended and it is mandatory to place an orotracheal tube immediately after induction and use a positive pressure ventilator to ventilate the animal before creating the pneumoperitoneum (Boure, 2005). This explained the appearance of apnea in two cases in this study after creation of pneumoperitoneum and during tilting to the Trendeleburg position which increased the compression of the thorax and depressed respiration. This explanation was in agreement with that mentioned by (Duke et al., 1996 and Bufalari et al., 1997) in dogs.

The reliable ability to establish pneumoperitoneum was one of the important fundamentals of laparoscopy. Insufflation allowed displacement of the abdominal wall from the underlying viscera so that instruments could be manipulated without trauma to the abdominal organs. Pneumoperitoneum is mandatory for trocar insertion in the recumbent animal. This coincided with (Harison and Wildt, 1980; Fischer, 2002; Leil, 2006 and ElKhamary, 2008) whom reported that pneumoperitoneum