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ULTRASONOGRAPHICAL EXAMINATION OF THE LIVER OF ONE HUMPED CAMELS *(CAMELUS DROMEDARIUS)*

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ABSTRACT

This study was conducted on 41 camels from Sudan and Egypt. Sternal recumbancy was suitable and safer for examinations. The liver was visualized on the right side in the area from 11th to 6th intercostal space (ICS). The transverse process of the 2nd lumbar vertebrum was considered as a reference point (RP). The mean distance between the RP and the dorsal and ventral liver margins was measured. The parenchymal pattern consisted of numerous medium echoes homogenously distributed all over the area of the liver. Fissures observed in the visceral surface in the 10th to the 7th ICS. Hepatic, portal veins and the caudal vena cava were also visualized. Porta hepatis was found at the same level of the point of the shoulder joint at a distance of 70.3 ± 6.3 cm. The portal vein was best visualized in the 10th ICS. The thickness of the dorsal and ventral liver margins at the 10th ICS was thinner as it progressed cranially. The dorsal margin was thinner than the ventral margin in all ICS. The whole liver length in the described area for examination was 53.0 ± 7.1 cm. The presented data is a base for future use of ultrasound in diagnosis of liver diseases in the dromedary camel. The technique is non-invasive and can be applied in sitting non-tranquilized animals. This is the first study on ultrasonographical examination of the liver in the one humped camel.

Keywords: Dromedary, liver, anatomy, Ultrasonography.

INTRODUCTION

One humped camels (*Camelus dromedarius*) are very important in many countries as they are used as food and draft animals. The ability of camels to utilize range in marginal areas and to survive and produce under harsh environmental conditions has been recognized over the years ***(KNOESS 1977, GAUTHEIR-PILTERS and DAGG 1981, HJORT and HUSSEIN 1986, ABBAS and TILLEY 1990, SCHWARTZ 1992).*** Ultrasound examination enables the clinician to get an accurate assessment of most parts of the liver. It has been used in dogs ***(NYLAND and Matton 2002),*** horses ***(REEF 1991)*** and cattle ***(BRAUN 1990)*** for years to diagnose focal and diffuse changes in liver structure. The information obtained from an abdominal sonographic examination is often not obtainable from other diagnostic procedures, and can often lead the clinician to the correct diagnosis ***(HILLYER 1994)***.

The objective of this study was the examination of the liver in apparently healthy dromedary camels using transcutaenous ultrasonography. with special emphasis on which position can we perform this examination, which ICS can we scan the liver, what are the hepatic anatomical structures (borders, caudal vena cava, portal vein and its branches) that can be visualized, and what is the echo pattern of the liver parenchyma.

MATERIALS AND METHODS

This study was carried out on 41 (26 males, 15 females) clinically healthy one-humped camels (*Camelus dromedarius*). Their age ranged between 1.5 and 8 years old. These camels were studied in Egypt (27 camels, 17males, 10 females), and Sudan (14 camels, 9 males, 5 females). Camels from Egypt were ultrasongrophically examined for the purpose of establishing the image of the healthy liver, then livers were examined post-mortem at (Kerdasa slaughterhouse) for abnormal lesions or color change, where animals with gross liver lesions were excluded from the study.

Two ultrasound machines were used; Logic 100 from General electric (GE) ® used in Sudan whereas, ultrasound machine from Kontron medical company, Vetson color ® was used in Egypt. The transducer which was used for camel examination in Sudan was convex array transducers (C55) with a frequency of 3.5-5 MHz. The transducer for the Vetson color ® was a convex array transducer (3.5 MC) with 2-5 MHz. To differentiate the various vascular structures, livers of slaughtered camels were ultrasonographically examined in a water bath.

The sonographical examination study was done in sternal recumbency, being the most satisfactory position for safe clinical examination. Hair was clipped from a rectangular area on the right abdominal side and the surface was subsequently washed with soap and water. The area was defined cranially by the 5th ICS, caudally by a handbreadth from the last rib, dorsally by a handbreadth below the tips of the vertebral transverse processes and ventrally by the border of the sternum. Transparent gel (GYROLUX®) was then applied to this area for the purpose of the scan.

Ultrasonographic examination was performed in accordance with the following protocol: 1- The liver was examined from caudal (flank region) to cranial (5th ICS) and from dorsal to ventral in every ICS. 2- After application of transmission gel to the transducer, the area immediately caudal to the last rib (flank region) was examined for the location of the liver. 3- The transverse process of the 2nd lumbar vertebrum was considered as a reference point (RP). 4- In the last ICS

(11th) the transducer was placed dorsally and parallel to the rib and moved slowly ventrally to visualize the liver. Initially, the texture of the liver, hepatic and portal veins and visceral and diaphragmatic surfaces were examined. The dorsal margin was determined by measuring the distance between the dorsal margin of the liver and the RP using a measuring tape. Determination of the ventral margin was obtained following the same procedure. The diameter of the caudal vena cava, the portal vein and its branches in the hepatic parenchyma, the thickness of the liver over these vessels, the depth of these vessels and thickness of the liver were also visualized. The distance between the point of the elbow joint and the point where the *porta hepatis* is clearly visible, was measured. The ultrasonographic image was electronically stored and appropriate measurement was determined on the ultrasonogram by means of cursors. This procedure was repeated cranially to the level of the 5th ICS depending on the presence of each of the above mentioned structures (e.g caudal vena cava and portal vein). All obtained images were stored in the memory card mounted in the ultrasound machine after labeling it with a number indicative of each camel.

Due to the fact that different camels have different hump sizes, we choose the transverse process of the 2nd lumbar vertebrum (L2) as a reference point for measuring the dorsal and ventral liver margins. For the determination of the whole length of the liver which can be ultrasonographically examined, an imaginary triangle was obtained by drawing a line (representing the length of the liver) connecting the two ventral lines (Fig. 1). The length of this line was calculated using the conventional Archemedian geometrical theory stating that the square of the line facing the right angle is equivalent to the summation of the squares of the other two lines of a triangle.

Statistical package for social science (SPSS) program was used to analyze results of this experiment.

RESULTS

Sternal recumbancy was found to be the most suitable, practicable and safe position to perform clinical examination and ultrasonographic examination of the liver. On the right side, the area defined cranially by the 5th ICS, caudally by a handbreadth from the last rib, dorsally by a handbreadth below the tips of the vertebral transverse processes and ventrally by the border of the sternum was the best area where most of the liver can be examined (Fig.1 and 4). Anatomy of visceral and parietal surfaces of the liver is shown in (Fig. 2 and 3). The distance between the transverse process of the 2nd lumbar vertebrum and the dorsal margin of the liver in camels examined is shown in table 1.

Table (1): The distance between the transverse process of L2 and the dorsal margin of the liver in camels.

Number of the reference ICS	Number of camels	Mean ± SD
11th	41	12.9 ± 3.9^a
10th	41	19.2 ± 4.4^b
9th	41	27.7 ± 6.2^c
8th	41	36.6 ± 7.2^d
7th	38	45.6 ± 6.7^e
6th	27	52.7 ± 9.3^f

*Variations between this distance in different intercostals spaces was found to be significant ($P \leq 0.05$) in all examined camels.

*Lower case letters indicate significant difference ($p \leq 0.05$)

The distance between the transverse process of L2 and the ventral margin of the liver in different intercostals spaces is shown in (Table 2).

Table (2): The distance between the transverse process of L2 and the ventral margin of the liver in different intercostals spaces.

Number of the reference ICS	Number of camels	Mean ± SD
11th	41	21.9± 10.1[a]
10th	41	24.7 ± 6.2[b]
9th	41	36.9 ± 10.4[c]
8th	41	42.6 ± 7.1[d]
7th	38	49.9 ± 7.5[e]
6th	27	55.8 ± 9.2[f]

*Variations between this distance in different intercostals spaces was found to be significant ($P \leq 0.05$) in all examined camels.

*Lower case letters indicate significant difference ($p \leq 0.05$)

The ultrasonographic pattern of the normal camel liver parenchyma consisted of numerous medium echoes homogenously distributed over the entire area of the liver in all intercostals spaces. The visible dorsal liver margin ran from caudodorsal to cranioventral. The ventral margin had a cranioventral course and was situated near the costal arch with a part extending ventral to it in the 9th ICS (Fig. 5). In the area from the 8th to the 10th intercostals spaces, the liver was adjacent to the omasoabomasal complex (C3) which was clearly recognizable as a thick echogenic line (Fig. 6). Intestinal loops were situated adjacent to the liver in the 11th ICS (Fig. 7). In some cases (n=4) the right kidney could be imaged high dorsally in the 11th ICS (Fig. 8). In all examined camels, the diaphragmatic surface of the liver appeared as an even echogenic (white) line adjacent to the peritoneum. The visceral liver surface lays adjacent to the rumen (C1), omasoabomasal complex (C3) and intestines. This makes it difficult to assess the liver contours (Fig. 9 and 10). Fissures in the visceral liver surface were always observed in the 8th ICS. In some camels (n=18), fissures were also observed in the 10th, 9th and 7th intercostal spaces (Fig. 11). In the 9th ICS the lung shadow starts to appear, covering part of the liver and thus reducing its visible size (Fig. 12).

Hepatic vessels:

Portal and hepatic veins could be seen within the normal liver textures. The lumen of these vessels was anechoic and therefore appeared black. The hepatic veins could be differentiated from the portal veins by the lack of echogenic walls seen with portal veins and the ability to trace hepatic veins to the caudal vena cava. The caudal vena cava was characterized by an oval shape in cross section and runs from caudodorsal to cranioventral similar to the dorsal boundary of the liver (Fig. 7 and 8). It was always situated more dorsally and medially than the portal vein and could usually be visualized in the 11^{th} and 10^{th} intercostal spaces, rarely in the 9^{th} ICS and could not be seen in the more cranial intercostal spaces (8^{th}, 7^{th} and 6^{th}). The diameter and the depth of the caudal vena cava did not change significantly from the 11^{th} to 9^{th} intercostal spaces (Table 3).

Table (3): Mean and standard deviation of the diameter and depth of caudal vena cava (mm).

Parameter	Mean ± SD in 11^{th} ICS	Mean ± SD in 10^{th} ICS	Mean ± SD in 9^{th} ICS
Diameter of C.V.A. (mm)	24.6 ± 6.6 (n=40)	23.9 ± 4.4 (n=35)	23.6 ± 2.3 (n=27)
Depth of C.V.A. (mm)	94.4 ± 14.2 (n=40)	92.7 ± 6.2 (n=35)	90.2 ± 3.7 (n=27)

Porta hepatis lies at the level of the point of the shoulder joint at a distance of 70.3 ± 6.3 cm. It could be visualized in the 10^{th} ICS where the portal vein was characterized by star shaped ramification and hence could be clearly differentiated from the hepatic vein (Fig. 7 and 13). The portal vein was always situated ventrally and laterally to the caudal vena cava and it was best visualized in the 10^{th} ICS. However, branches of the portal vein could also be visualized in the area from the 11^{th} to the 7^{th}

intercostal spaces (Fig. 14). Table 4 summarize the values of the depth and diameter of the portal vein and its branches in the 11th, 10th, 9th, 8th and 7th intercostal spaces.

Table (4): Mean and standard deviation values of the depth and diameter of the portal vein and its branches (mm) in camels.

Parameter	Mean ± SD in 11th ICS	Mean ± SD in 10th ICS	Mean ± SD in 9th ICS	Mean ± SD in 8th ICS	Mean ± SD in 7th ICS
Depth of the portal vein and its branches	67.0 ±13.5 (n=38)	42.0 ±1.8 (n=41)	39.1 ± 2.3 (n=40)	34.8 ± 3.3 (n=31)	30.2 ± 4.8 (n=29)
Diameter of the portal vein and its branches	23.8 ±7.5 (n=38)	33.4 ±7.1 (n=41)	13.8 ± 2.8 (n=40)	11.0 ± 5.1 (n=31)	05.0 ± 3.1 (n=29)

The thickness of the dorsal and ventral liver margins varied in different intercostal spaces being thinner in the 10th than in the 11th ICS and getting thinner cranially (Table 5).

Table (5): Mean and standard deviation of the thickness of the dorsal and ventral liver margins (mm).

Liver margin	Mean ± SD in 11th ICS	Mean ± SD in 10th ICS	Mean ± SD in 9th ICS	Mean ± SD in 8th ICS	Mean ± SD in 7th ICS	Mean ± SD in 6th ICS
Dorsal	124.7 ± 16.6 (n=41)	137.2 ± 29.6 (n=41)	132.1 ± 26.2 (n=41)	101.1 ± 22.6 (n=41)	80.0 ± 32.3 (n=38)	29.1 ± 10.3 (n=27)
Ventral	105.0 ± 35.1 (n=41)	68.0 ± 22.4 (n=41)	50.6 ± 23.3 (n=41)	47.0 ± 25.4 (n=41)	29.7 ± 9.8 (n=38)	23.7 ± 12.1 (n=27)

Liver size; whole liver length which could be ultrasonographically examined in the area from the 11th to the 6th intercostal spaces was (53.0 ± 7.1 cm).

Plate I

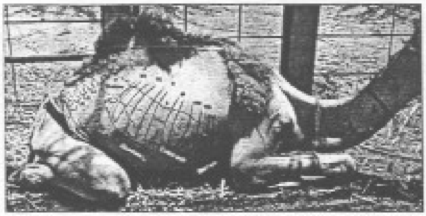

Figure 1: Schematic diagram showing area of liver examination in a sitting camel.
a: Distance between the transverse process of the L2 (RP) and the ventral margin of the liver in the 11th ICS.
b: Distance between the transverse process of L2 (RP) and the dorsal margin of the liver in the 6th ICS.
c: Imaginary line representing the length of the liver which can be ultrasonographically examined.

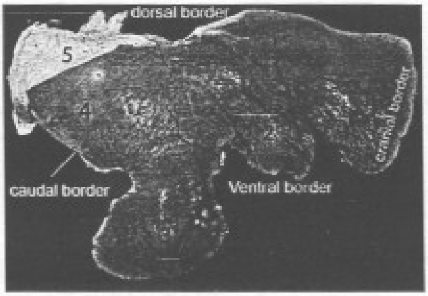

Figure 2: The diaphragmatic surface of the liver showing:
1- Left lateral lobe
2- Left medial lobe
3- Quadrate process
4- Right lobe
5- Tendineous center of diaphragm reflected

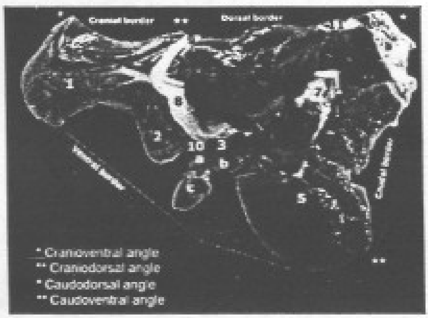

Figure 3: The visceral surface of the liver
1- left lateral lobe 2- left medial lobe
3- quadrate lobe:
a- cranial part
b- caudal part
c- quadrate process
4- papillary process 5- right lobe
6- caudate lobe:
a- isthmus of the caudate lobe
b- renal impression and hepatorenal lig.
7- porta hepatis 8- lesser omentum
9- esophgeal impression
10- fissure of round ligament of the liver
11- caudal vena cava

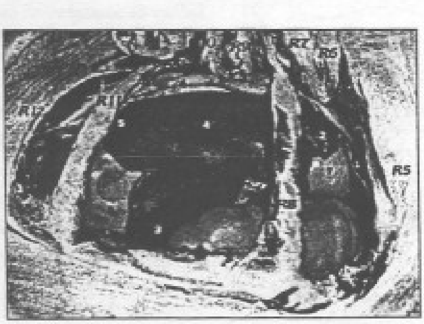

Figure 4: Right view showing parietal surface of the liver in situ
1- left lateral lobe 2- left medial lobe 3- quadrate lobe
4- right lobe 5- caudate lobe 6- diaphragm reflected
7- rumen (C1) 8- omasum/abomasum (C3)

Plate II

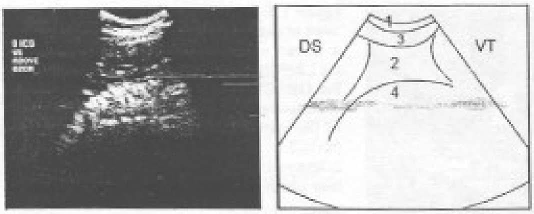

Figure 5: Ventral margin of the liver at the 8th ICS, 62 cm from the RP. 1- Abdominal wall 2- liver parenchyma 3- Costal arch 4- Third gastric compartment (C3) DS= dorsal VT= ventral

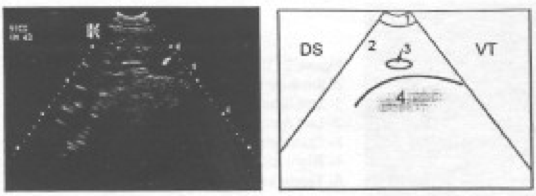

Figure 6: Ventral margin of the liver at the 9th ICS, 43 cm from the RP. 1- Abdominal wall 2- liver parenchyma 3-branch of portal vein 4-Third gastric compartment (C3) DS= dorsal VT= ventral

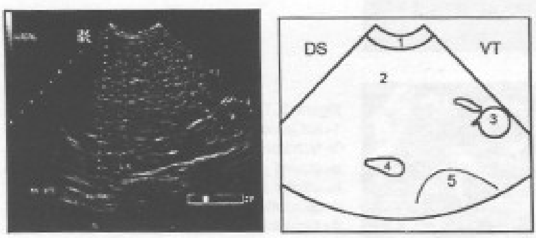

Figure 7: Dorsal margin of the liver at the 11th ICS.1- Abdominal wall 2- liver parenchyma 3- portal vein 4- caudal vena cava 5- Intestinal loops. DS= dorsal VT= ventral

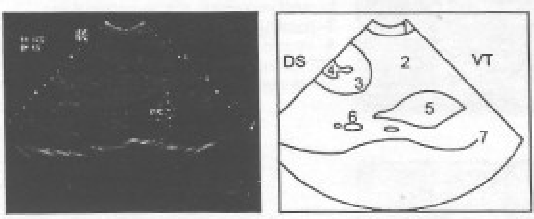

Figure 8: Dorsal margin of the liver at the 11th ICS, 19 cm from the reference point (RP). 1- Abdominal wall 2- liver parenchyma (caudate lobe) 3, 4 – cortex and medulla of the right kidney 5- caudal vena cava 6- branches of hepatic veins 7- Intestinal loops. DS= dorsal VT= ventral

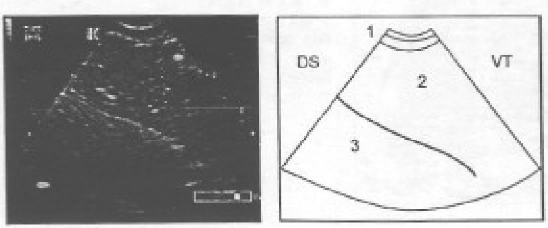

Figure 9: Dorsal margin of the liver at the 7th ICS, 45 cm from the RP. 1- Abdominal wall 2- liver parenchyma 3- rumen (C1) DS= dorsal VT= ventral

Plate III

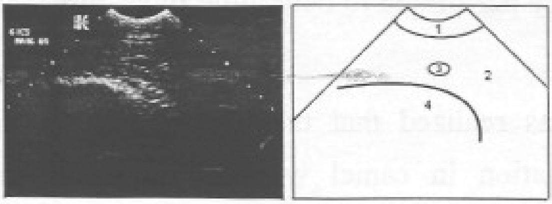

Figure 10: Margin of the liver at the 6th ICS, 69 cm from the RP. 1- Abdominal wall 2- liver parenchyma 3- branch portal vein 4- rumen (C1) DS= dorsal VT= ventral

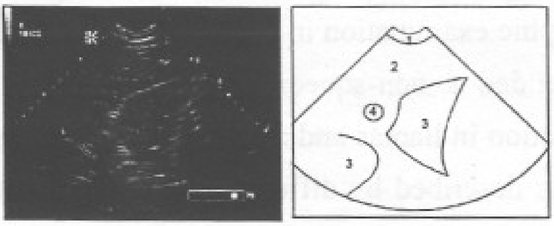

Figure 11: Ventral margin of the liver at the 10th ICS. 1- Abdominal wall 2- liver parenchyma
3- liver subdivision 4- portal vein DS= dorsal VT= ventral

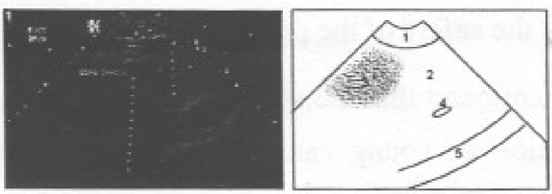

Figure 12: Dorsal margin of the liver at the 8th ICS, 39 cm from the RP. 1- Abdominal wall
2- liver parenchyma 3- lung shadow 4- branch of portal vein 5- Third gastric compartment (C3)
DS= dorsal VT= ventral

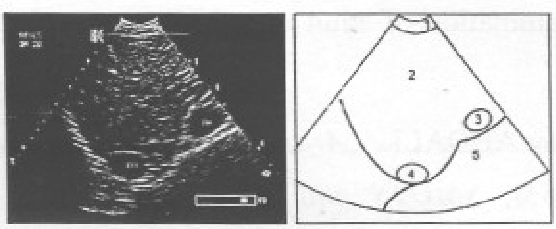

Figure 13: Dorsal margin of the liver at the 10th ICS, 20 cm from the RP. 1- Abdominal wall
2- liver parenchyma 3- Portal vein 4- Caudal vena cava 5- Third gastric compartment (C3)

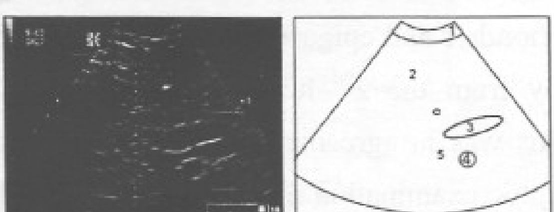

Figure 14: Dorsal margin of the liver at the 9th ICS, 27cm from the RP.
1- Abdominal wall 2- liver parenchyma 3,4- Branche of portal vein DS= dorsal VT= ventral

DISCUSSION

This is the first study performed to determine liver ultrasonography in dromedary camels.

In this study it was realized that the best position to perform ultrasonographic examination in camel was the sternal recumbency position. BRAUN 1990 stated that the standing position was the best position for ultrasonographic examination in cattle whereas ***CEBRA, and Watrous 2002*** recommended a non-squeezing restraint chute for the ultrasonographic examination in llamas and alpacas. These differences in the examination positions described by different authors may be due to differences in animal size or behaviour that affect restraining of the animals and consequently the safety of the procedure to the workers.

TEFERA (2004) mentioned that the standing position can be good for the clinical examination of young camels because they might not trained to kneel down whereas the sternal recumbency position was the best position for the examination of adult camels because of their long body.

As was described by ABDALLA,***Aranautovic,and Fahmy,(1971), NAGAPAL et al., (1985), SMUTS and BEYUIDENHOUT (1987), FARAG (1990) and SIDDIG (2002)***, the liver of the dromedary camel occupies the right hypochondric and epigastric regions with its long axis extending cranioventrally from the 2nd lumber vertebra to the caudal border of the 5th rib. This was in agreement with our findings. To our knowledge, ultrasonographic examination of the size, shape, and position of the liver and its vessels has not been reported in camels. In our work, the area on the right side, defined cranially by the 5th ICS, caudally by a handbreadth from the last rib, dorsally by a handbreadth below the tips of the vertebral transverse processes and ventrally by the borders of the sternum is the best area for liver examination. The liver could be ultrasonographically visualized in the area extending from the 11th to the 6th ICS on the right side of the animal.

From the available anatomical data about liver location in dromedary camel, our findings are in agreement with ***ABDALLA et al. (1971) and FARAG (1990)***. Both authors stated that the bulk of the liver is situated in the right side of the abdominal cavity and extends from the 5th to 12th rib (last rib). However, other authors mentioned that the liver extends cranioventrally from L2 to the caudal border of the 5th rib ***(HEGAZI 1945, NAGPAL et al. 1985, SMUTS and BEZUIDENHOUT 1987, ABDELMONIEM et al. 2000, SIDDIG 2002)***. In cattle, it was stated that the liver can be ultrasonographically examined from the caudal to the cranial end, beginning from the last rib and ending at the 5th ICS. The organ largest part is at the last three intercostal spaces i.e. 11th, 10th, 9th ***(BRAUN 1990, 1996)***. These findings are in agreement with our findings in that the liver in both animals (camel and cattle) can be best visualised at the last three intercostal spaces.

The distance between the RP and the dorsal liver margin was in the range of 12.9 ± 3.9 cm, 19.2 ± 4.4 cm, 27.7 ± 6.2 cm, 36.6 ± 7.2 cm, 45.6 ± 6.7 cm and 52.7 ± 9.3 cm in the 11th, 10th, 9th, 8th, 7th and 6th intercostals spaces consequently. The distance between the transverse process of the L2 and the ventral liver margin in these intercostal spaces was 21.9 ± 10.1 cm, 24.7 ± 6.2 cm, 36.9 ± 10.4 cm, 42.6 ± 7.1 cm, 49.9 ±

75 cm and 55.8 ± 9.2 cm respectively. From these results it was obvious that the distance between the L2 (reference point) and the dorsal and ventral liver margins in dromedary camels examined increases cranially which is in agreement with ***BRAUN (1990) and BRAUN and GERBER (1994)*** in cattle except that they considered midline of the back as the reference point.

The ventral liver margin on camels has a cranioventral course and is situated near the costal arch as in cattle ***(BRAUN 1990) and (BRAUN and GERBER 1994)*** but with a small part extending below it in the 9th ICS ***(ABDALLA et al 1971)***. Lung shadow started to appear from the 9th ICS which minimizes liver visibility .This has also been encountered by other workers ***(BRAUN 1990 and1996, BRAUN and GERBER. 1994, MELLING 2000)***.

The parenchymal pattern of the normal camel liver consists of numerous medium echoes homogenously distributed over the entire area of the liver in all intercostal spaces. The same pattern was described in dogs ***(NYLAND and MATTOON 2002)***. In cattle, the parenchymal pattern of the normal liver consisted of numerous weak echoes ***(BRAUN 1990, BRAUN and GERBER 1994)***. This difference may be due to the fact that camel liver contains higher amounts of visible interlobular connective tissue leading to a firmer consistency than other domesticated animals ***(LEESE 1927, HEGAZI 1945, ABDALLA et al. 1971, IBRAHIM. 1983, LALLA and DORMMER. 1997)***. In the area from the 8th to 10^{th} intercostal spaces the liver is adjacent to the omasoabomasal complex (C3). Intestinal loops are adjacent to the liver in the 11^{th} ICS. This finding is in agreement with the observations of several workers on camels *(HEGAZI 1945, ABDALLA et al 1971, NAGPAL et al. 1985, SMUTS and BEZUIDENHOUT 1987,FARAG 1990,ABDELMONIEM et al. 2000, SIDDIG 2002)* as well as ultrasonographic findings in cattle *(BRAUN 1990, BRAUN and GERBE 1994, DELLING. 2000)*.

Fissures were observed in the visceral liver surface in the 8^{th} and in some camels also in the 10^{th}, 9^{th}, and 7^{th} intercostal spaces. In some anatomical studies on the liver of dromedary camel, it was mentioned that liver surfaces are marked by several fissures cutting the surface in various directions and divide it into superficial lobes of variable sizes and that these fissures are more abundant and deeper in the cranial part of the liver particularly on the visceral surface *(ABDALLA et al. 1971, SMUTS and BEZUIDENHOUT. 1987, SIDDIG 2002)*.

Hepatic and portal veins were be visualized within the normal liver textures. The lumen of these vessels was anechoic and hence appeared black. It was mentioned that the portal veins are more echogenic than the hepatic veins in humans, dogs and horses *(BYARS and HALLEY 1986, YAMAGA 1984, WU and CARLISLI. 1995)*. The portal veins are surrounded by connective tissue, whereas little or no connective tissue surrounds the hepatic veins *(WU and CARLISLI 1995)*. In our study, the caudal vena cava was characterized by an oval shape in cross section and ran from a caudodorsal to cranioventral direction similar to the dorsal boundary of the liver. The same was mentioned in some anatomical studies on camels' livers *(HEGAZI 1945, ABDALLA et al. 1971, NAGPAL et al. 1985, SMUTS and BEZUIDENHOUT 1987, FARAG 1990, ABDELMONIEM et al. 2000, SIDDIG 2002)*. The caudal vena cava was always situated more dorsally and medially than the portal vein and could be visualized in the 11^{th} and 10^{th} intercostal spaces, rarely in the 9^{th} ICS and could not be seen in the more cranial intercostal spaces (8^{th}, 7^{th} and 6^{th}) because in these intercostal spaces the caudal vena cava was hidden by the lung. The diameter of the caudal vena cava in the 11^{th}, 10^{th} and 9^{th} intercostals spaces did not show significant difference. Depth of the caudal vena cava in camels was found to be 94.4 ± 14.2 mm, 92.7 ± 6.2 mm and 90.2 ± 3.7 mm in the 11^{th}, 10^{th}, and 9^{th} intercostal spaces respectively. This is in agreement with the anatomical fact stated by ***ABDALLA et al.(1971)*** that the caudal half of the dorsal border of the liver is thick and diminishes gradually as it goes cranially. The *porta hepatis* of the liver laid at the level of the point of the shoulder joint at a distance of 70.3 ± 6.3 cm. Knowledge of this fact is important for portocentesis and is described for the first time in this study as far as we know. The *porta hepatis* could be visualized in the 10^{th} ICS where the portal vein is characterized by a star-shaped ramification and can easily be differentiated from the hepatic vein. This star shape can be attributed to the fact that upon entering the porta hepatis, the portal vein divides into three branches ***ABDALLA et al. (1971)*** namely *ramus dorsalis dexter,ramus ventralis dexter* and *ramus sinister* ***FOUAD and SAFWAT (1986)***. The same anatomical finding was described in buffalo ***ANIS (1977)*** and sheep ***HEATH (1968)***. However, the initial branches of the portal vein in dogs are the right and left branches SLIEGHT and ***THOMFORD (1970)***. In cattle, *porta hepatis* could be visualized in the 11^{th} ***ICS BRAUN (1996)***.

The portal vein was best visualized in the 10^{th} ICS in all examined camels. The diameter of the vein in that ICS was 33.4 ± 7.1, whereas its depth in the same area was 42.0 ± 1.8 mm. These findings are in agreement with the anatomical fact that the left branch of the portal vein is the largest and main continuation of the portal vein distributed into the papillary process, quadrate and left lobes ***FOUAD and SAFWAT (1986), SIDDIG (2002)***. Ultrasonographic studies in cattle mentioned the 2nd ICS from the flank region as the best location for visualizing the portal vein ***LECHTENBERG, NAGARAJA, AVERY, and HARTKE (1989), BRAUN 2000, BRAUN et al. (2003)*** which is also similar to our findings as the 10th ICS in camel is the 2nd from the flank region.

The thickness of the dorsal and ventral liver margins were found to be thinner in the 10th intercostal space (137.2 ± 29.6 mm and 68.0 ± 22.4 mm respectively). Mean and standard deviation values of the thickness of the dorsal and ventral margins in were decreasing towards the cranial intercostal spaces. The dorsal margin is usually thinner than the ventral margin in all intercostal spaces which is in agreement with the anatomical findings described by ***ABDALLA et al. (1971) and FARAG (1990)*** that the dorsal border (*margo dorsalis*) is thicker than the ventral border (*margo ventralis*).

In all examined camels, the liver was ultrasonographically visible until a length of 53.0 ± 7.1 cm in the 11th ICS, whereas in the 6th ICS the visible liver size was 60.5 ± 5.7 cm. In previous gross anatomical studies a length of 60-80 cm was described for dromedary livers ***DROANDI (1936), HEGAZI (1954), ABDALLA et al. (1971), SMUTS and BEZUIDENHUT (1987), FARAG (1990) and SIDDIG (2002)*** which is in agreement with our findings keeping in mind the fact that we could not view the whole liver ultrasonographically.

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