Ultrasound Anatomical Visualization of the Rabbit Liver

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Abstract

The topic was to investigate the anatomical features of the rabbit liver by two- and three-dimensional ultrasonography. Eighteen sexually mature healthy clinically New Zealand rabbits aged eight months were studied. Two-dimensional ultarsonographic anatomical image of the rabbit liver presented it in the cranial abdominal region as a relatively hypoechoic finding. Its contours were regular and in close contact with the hyperechoic diaphragm. Liver parenchyma was heterogeneous. The gall bladder was visualized as an oval soft tissue structure, filled with anechoic content. Its walls were hypoechoic. Two-dimensional ultarsonographic anatomical image of left hepatic lobe was sharply distinguished to right hepatic lobe's outlines. In three–dimensional ultrasonogarphic anatomical study, the organ image was in three orthogonal planes. Its relief was regular and uninterrupted. Left hepatic lobe was found on the left and the right hepatic lobe was a soft tissue point for gall bladder position. Left and lateral was left lateral hepatic lobe. It was covered partly by left medial hepatic lobe. The right hepatic lobe was visualized as a single structure. The gall bladder was an oval finding. Its walls were hyperechoic and regular, without roughness. The results could be used as a base for modern interpretation of rabbit liver anatomy.

Keywords: anatomy, liver, rabbit, ultrasound

1. Introduction

The rabbit liver is situated in the cranial abdominal region, between both costal arches. It is located transversally to the median plane and reaches 7th rib on the right and 9th on the left. It is composed of five lobes: right hepatic lobe, caudate lobe, quadrate lobe, left lateral hepatic lobe and left medial hepatic lobe [1].

Ultrasonography (2D and 3D) as non-invasive method is suitable for imaging anatomical study of the rabbit liver, including determination of organ sizes, echogenicity's intensity, topography and boundaries [2].

Ultrasonography is widely distributed functional non-invasive method to study the imaging anatomical features of human liver in order to diagnose accurately the liver diseases. The obtained ultrasonographic images present structures with different echoic granularity which corresponds to the tissue structures in different anatomical parts of the investigated organ [3].

Many authors [4] carry out imaging anatomical ultrasonographic study of the rabbit abdominal organs by 7.5 MHz sector transducer. Data of the investigation, giving information for liver shape, surface, borders and echogenicity are used as a base for diagnosis of non-infectious nodular pathologies and inflammatory alterations in the liver parenchyma.

Three-dimensional ultrasonography is a non-invasive method that gives information not only for the echoic parameters of the investigated organs, but links them to their morphological features. Thus much more accurately is found a correlative connection between the echoic structure and morphological structure of the studied organs [5].

By data of some researchers [6] three-dimensional ultrasonography creates panoramic anatomical

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images quite widely, that acquire mosaic appearance due to set volumes with different values, which are reported at the same time in the creation of sonographic images.
The lack of data about rabbit liver 2D and 3D ultrasonographic anatomy motivated us to carry out the present study. The results could be used as a base for modern interpretation of rabbit liver anatomy.

2. Materials and methods

We studied 18 mature healthy white New Zealand rabbits, aged 8 months and weighed from 2.8 kg to 3.2 kg. The animals were anesthetized with 15 mg/kg Zoletil® 50 (tiletamine hydrochloride 125 mg and zolazepam hydrochloride 125 mg in 5 ml of the solution) Virbac, France. 2D ultrasonography study was made with Ultrasound System Model CHISON 600 VET (China) and 7 MHz micro convex transducer C20605 with radius 20 mm. The findings were documented by termoprinter device Mitsubishi P91E. 3D ultrasonography study was made with Diagnostic Ultrasound System model VOLUSON730Pro and volume 3D convex transducer with frequency 7.5 MHz. A contact gel (Eko-gel® Lessa, Espana) was used. The animals were positioned in supine recumbency. The sonographic approach in both methods was transabdominal percutaneous hypochondrial.
The study was approved by the institutional committee of animal care. The experiments were made in strict compliance with European convention for vertebrate animals' protection, used for experimental and other scientific purposes (Starsbourg /16th May, 1986), European convention for companion animals' protection (Starsbourg/13th November, 1987) and animal protection's law in Republic of Bulgaria (section IV-Experiments with animals, art. 26, 27 and 28, received on 24th January 2008 and published in Government Gazette, № 13, 2008).

3. Results and discussion

By performed 2D transabdominal ultrasonographic anatomical study at B-mode ultrasonic regime, the rabbit liver was visualized as an echoic structure with lower echogenicity, compared to the adjacent soft tissue findings. Its contours were regular and in close contact to the hyperechoic diaphragm. The liver parenchyma showed heterogeneous echogenicity. The gall bladder was visualized as an elongated oval finding filled with anechoic content and its wall was hypoechoic. The image of the fibrous liver capsule merged to this of diaphragm so that in some places both structures were not well defined (Figure 1).

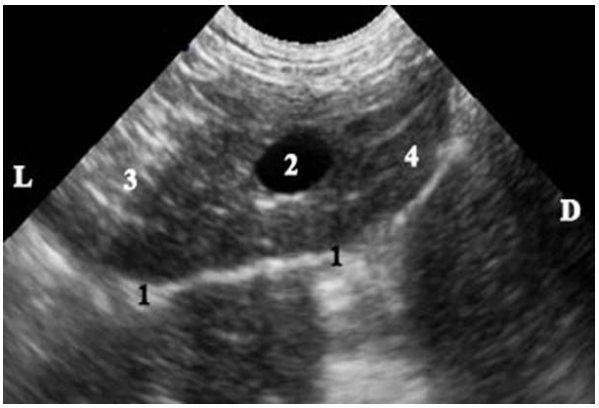

Figure 1. Transversal 2D ultrasonographic image of the rabbit liver (microconvex transducer-7 MHz; B-mode). L-left, D-right. (1) capsula fibrosa; (2) vesica fellea; (3) lobus hepatis sinister; (4) lobus hepatis dexter

At 3D transversal ultrasonographic study of the rabbit liver, the whole image of the studied organ was found in three geometric planes-length, width and depth. The relief of the liver was smooth without local convexity. The macrostructure of lobus hepatis dexter and lobus hepatis sinister was homogeneous, as in some places was violated by passing branches of portal vein and biliary ducts. 3D ultrasonographic image of the rabbit liver visualized it as a highly acoustic soft tissue finding, composed of two symmetric halves. Left and lateral to the median plane was lobus hepatis sinister lateralis as its anatomical image was overlapped partly by that of lobus hepatis sinister medialis. Lobus hepatis dexter was visualized as a single structure and was used as an anatomical marker to define the topography of gall bladder. Gall bladder was an elongated oval finding whose walls were hyperechoic and smooth without roughness. Close to the portal branches were the biliary ducts, without own walls, whose contours were defined in depth by parenchyma (Figure 2).

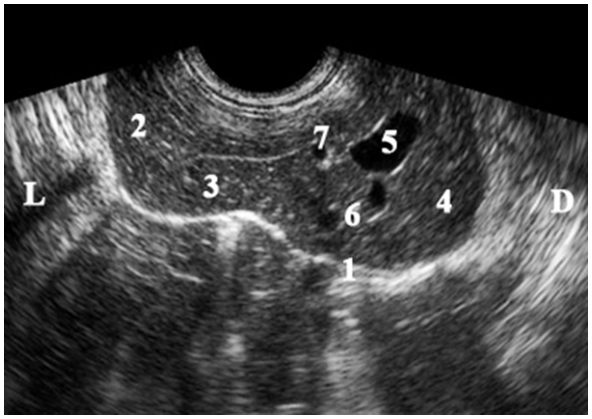

Figure 2. 3D Transversal ultrasonographic image of the rabbit liver (volume 3D convex transducer-7.5 MHz). (1) diaphragma and capsula fibrosa; (2) lobus hepatis sinister lateralis; (3) lobus hepatis sinister medialis; (4) lobus hepatis dexter; (5) vesica fellea; (6) ductuli biliferi; (7) right branch of v. portae

When discussing the obtained results, it should be mentioned that both imaging ultrasonic modalities confirmed data about the anatomical location of the rabbit liver in cranial abdominal region, and the presence of five well developed five liver lobes [1].

Our results, concerning 2D and 3D ultrasonographic image of rabbit liver, regarding organs' topography close to diaphragm, heterogenous character of echogenicity, oval shape of gallbladder, and regular borders gave us motivation to conclude that these imaging modalities are suitable for imaging anatomical study of the rabbit liver [2].

The obtained ultrasonographic anatomical images of the rabbit liver and gall bladder presented them as heterogeneous structures with different granularity. According to us this is due to the features of their tissue structure, which corresponds to the attitude of some authors [3] for the same human anatomical structures. This motivated us to propose 2D and 3D ultrasonography as definitive methods for the study of the imaging anatomical characters of the rabbit liver.

Our results corresponded to data of the researcher [4] about the effect of 2D transabdominal ultrasonography for the study of rabbit liver's morphological features. The obtained results could serve as a base for diagnosis of many diseases as non-infectious nodular pathologies and inflammatory alterations in the liver parenchyma.

The obtained results added those for human liver [5] for imaging anatomical correlation between morphological structure of the investigated organ, its relief and 3D ultrasonographic features of its lobes and gall bladder in the rabbit.

In accordance to the available studies [6] concerning the application of 3D ultrasonography for detailed anatomical visualization of the human abdominal organs, we obtained also panoramic anatomical images of the rabbit liver structures and found 3D ultrasonic anatomical features of the liver that defined its topography in regio abdominis cranialis.

4. Conclusions

Data of the present study, concerning anatomical localization of the rabbit liver in regio abdominis cranialis, comparable acoustics of parenchyma to the adjacent soft tissue structures, presence of well-defined anatomical images of the liver lobes motivate us to conclude that with 2D ultrasound can be obtained comparative, detailed anatomical and imaging anatomical information for the structure, topography and anatomical boundaries of the organ.

3D ultrasonography possesses wide diapason for the anatomical visualization of the rabbit liver, because of the high tissue penetration of the ultrasonic ray and capturing of the investigated structures as panoramic images in three orthogonal planes.

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