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# Determination of the Effect of Stomach Volume on Topography of Liver of New Zealand Rabbit (Oryctolagus Cuniculus L.)

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**Abstract:** *The purpose of this study is to determine whether the liver of New Zealand rabbit is affected by the fullness level of the stomach or not the help of transversal and paramedian sections through dissection. For this reason, totally 24 adult and healthy New Zealand rabbits including 12 males and 12 females were used. The rabbits were divided in three groups in order to get rabbits which were fed normal, had empty stomach and had full stomach. 6 of the rabbits in every three groups with the same saturation were dissected. The remaining rabbits were specified as recumbent in sternal position and frozen at -20 C. As three from these three animal groups; paramedian sections from 9 rabbits at total and transversal sections from other 9 rabbits were taken by the help of a saw. It was observed that a small part of the liver was placed intrathoracally and the large part was placed intraabdominally in the frontal side of the abdominal cavity. As a result, this study revealed how liver of New Zealand rabbit is affected by fullness level of the stomach through dissection and sectional images. It is thought that the results of the study will contribute to both the clinical anatomy of the rabbits and to the clinical practices.*

**Keywords:** *Rabbit, Liver, Stomach volume, Cross-sectional anatomy*

## 1. INTRODUCTION

Rabbit is a species of *Leporidae* family of *Lagomorpha* order [1]. Due to the usage of New Zealand rabbits in experimental researches, it is an animal species frequently preferred by the researches. Because of its anatomic and physiological properties, it appears as an animal model used in the research of some diseases and in surgical studies [2-4].

In the last 10 years, the increase of the rabbit number and concern in Europe has brought along the developments regarding the rabbit medicine. This situation leads the medicine into new searches. One of them is cross-sectional anatomy. For an efficient diagnosis, it is important to know a good cross-sectional anatomy [5]. Also the cross-sectional anatomy has the characteristic of being an atlas for computerized tomography (CT), ultrasonography (US), and magnetic resonance (MRI) imaging techniques.

Liver is placed in the right side and front of the abdominal cavity as lean just in caudal side of the diaphragma [6-11]. Facies diaphragmatica consists of the right, left, cranial, dorsal and ventral parts. Right side is the largest part. It stretches from the $6^{th}$ intercostal space to the final part or to the $12^{th}$ intercostal space [7,12]. In the left side, caudal border is at the $10^{th}$ intercostal interval. Cranial part is determined by impressio cardiaca. The part is considerably located in the left side on median line [13,14]. Dorsal part is nearly in the form of a deep recess that is formed by v. cava caudalis and esophagus on a median plane. Its facies visceralis is in an irregular concave form. It is located on the left side as caudoventrally. It is in contact with the stomach, duodenum, pancreas and the right kidney [14]. Its caudal part covers the cranial end of the right kidney and reaches to the transversal plane toward the $13^{th}$ vertebra thoracica. The liver is in relationship with omentum majus toward the ventral side [8,10,12,14]. In the rabbits, it is divided in the right and left halves with the help of the ligamentum falciforme. Left half of the liver consists of the lobus lateralis sinister caudalis and lobus medialis sinister caudalis. The right half is divided in 3 lobes as lobus medianus dexter, lobus lateralis dexter and lobus caudatus. Lobus caudatus passes to the ventral side around the vena cava caudalis and esophagus and it generally extends on the left side of the midline [13].

In the literature review, it is observed that even though some atlas formation studies are found for imaging techniques in dogs and cats, there is no such data regarding the liver of New Zealand Rabbit. Thus, the purpose of the study is to determine whether the liver of New Zealand rabbit is affected by the fullness level of the stomach or not with the help of transversal and paramedian sections through dissection.

## 2. Material and Method

In this study, 24 adult and healthy New Zealand rabbits including 12 males and 12 females were used. The rabbits were divided in three groups in order to get rabbits that were fed normal, had empty stomach and had full stomach. Rabbits in every three groups were placed in a cage and while the rabbits in the first group continued their feeding at normal meals, no food was given to the rabbits in the second group for 24 hours. The rabbits in the third group were deprived of food and given water only as they could drink for 24 hours and then given foods as much as they ate. Afterwards, the rabbits were anesthetized with 5 mg/kg Xylazine HCl and 35 mg/kg Ketamine HCl [15]. Before the animals came out of anesthesia, their blood was let. In order to explicitly reveal the arteries and vena in the abdominal cavity, latex colored by blue and red was injected into v.jugularis and a.carotis communis. 6 of the rabbits in every three groups with the same saturation were dissected (3x2). The remaining rabbits were determined as recumbent in the sternal position [5,16,17] and frozen at -20 C. As three from every three groups, paramedian sections of totally 9 of the rabbits and transversal sections from the other 9 rabbits were taken with the help of a BOSCH-PFZ 500E model reciprocating saw in order to prevent the damage of the tissues and organs. Even though there are various literature data regarding the receiving place and section thickness of the transversal sections [5,18-21], in our study transversal sections were received separately from every vertebrae lumbales level backwardly starting from the final vertebra thoracica. The distance between each vertebrae lumbales was measured as approximately 2 cm. Then, photographs of the rabbits, which were dissected and whose transversal and paramedian sections were received, were taken by using a NİKON D80 photograph machine. After the section surfaces were cleaned, the photographs of the transversal sections were taken from the cranial surfaces of the sections received. Literature data [5,22-24] were also used for the identification of the anatomic structures observed in the paramedian and transversal sections. In the study, Mitutoyo Digimatic Caliper was used for the measurements of the anatomic structures specified on the rabbits and Nomina Anatomica Veterinaria (2005) [25] was used for the denomination.

Usage of rabbits in this study was found suitable according to the decision of Süleyman Demirel University Animal Experiments Local Ethics Committee Directorate with number: 09/09 and date of 27.11.2008.

## 3. Results and Discussion

### A-Dissected Animals

**1st Group: Normally fed rabbits**

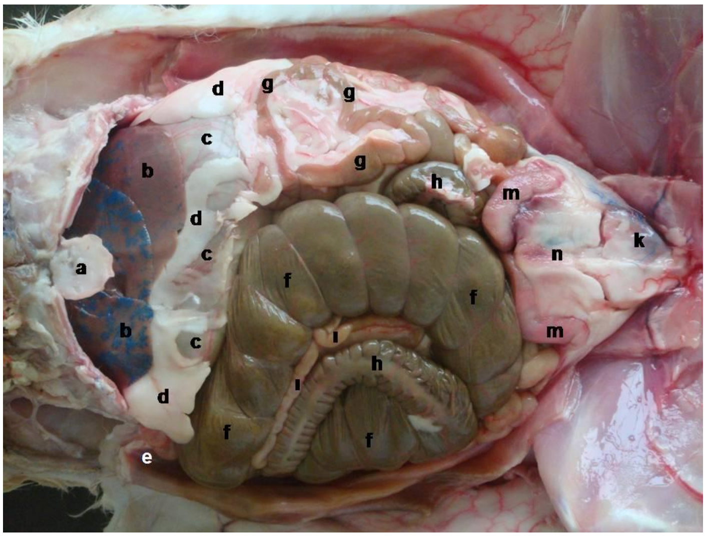


**Figure 1-** *Ventral view of normally fed, a)-Cartilago xiphoidea, b)-Hepar, c)-Ventriculus, d)-Omentum majus, e)-Pars descendens, f)-Cecum, g)-Jejunum, h)-Colon ascendens, ı)-Ileum, k)-Vesica urinaria, m)-Cornu uteri, n)-Corpus uteri*

It was observed that a small part of the liver was placed intrathoracally and the large part was placed intraabdominally in the frontal side of the abdominal cavity (Figure: 1-b; 4-a; 5-c). It was seen that left half of the liver was divided in two halves as the pars cranialis and pars caudalis of lobus hepatis sinister medialis and the right half was divided in 3 lobes as lobus hepatis dexter medialis, lobus hepatis dexter lateralis and lobus caudatus. It was determined that lobus hepatis dexter lateralis was located on the right side of the median plane and lobus hepatis sinister was located on the left side as it passed to the right side of the median plane. It was determined that lobus hepatis dexter lateralis separated from lobus hepatis dexter medialis through duodenum. It was observed that lobus caudatus was on the left side of the median plane.

### 2nd Group: Rabbits with empty stomach

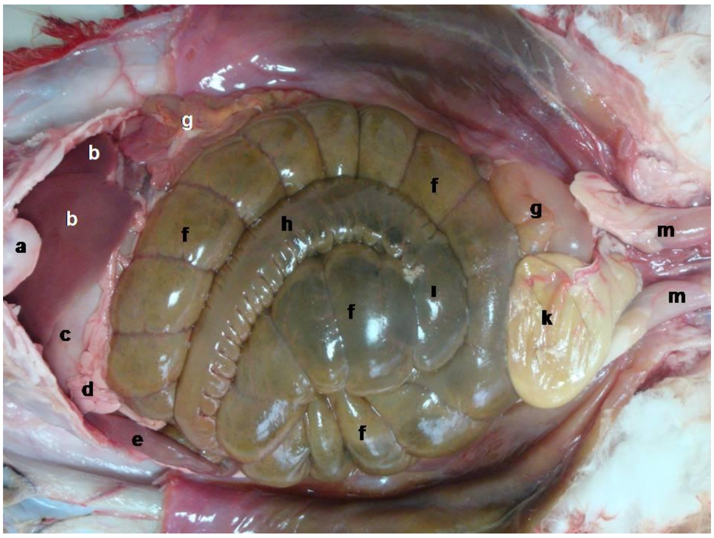

**Figure 2-** *Ventral view of animals with empty stomach, a)-Cartilago xiphoidea, b)-Hepar, c)-Ventriculus, d)-Omentum majus, e)-Pars descendens, f)-Cecum, g)-Jejunum, h)-Colon ascendens, ı)-Ampulla coli, k)-Vesica urinaria, m)-Testis.*

It was observed that the large part of the liver was located in the intrathoracal abdominal cavity and its 2/3 was on the left side of the median plane and 1/3 was on its right side. (Figure: 2-b; 6-c; 7-c). It was determined that it was in full contact with arcus costalis in the left side. In the right side, it was found that it covered the pylorus area of the curvatura ventriculi minor of the stomach. It extended to the 11th-12nd vertebrae thoracicae level corresponding to approximately 17.23 mm caudal of cartilago xiphoidea.

### 3rd Group: Rabbits with full stomach

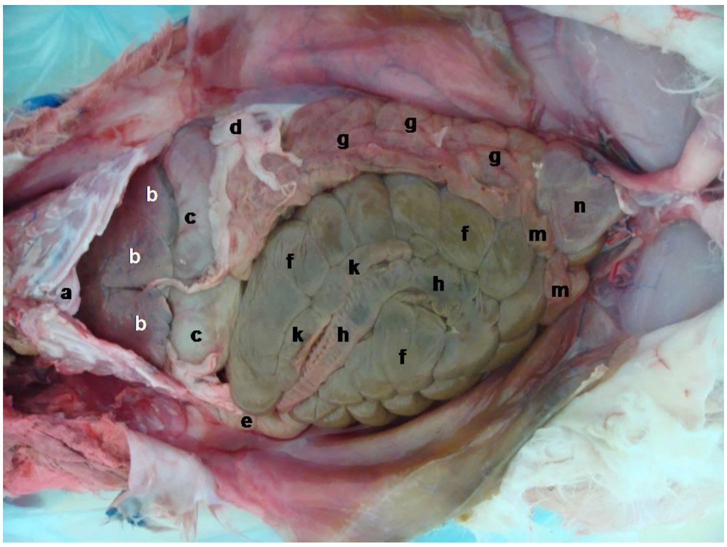

**Figure 3-** *Ventral view of animals with full stomach, a)-Cartilago xiphoidea, b)-Hepar, c)-Ventriculus, d)-Omentum majus, e)-Pars descendens, f)-Cecum, g)-Jejunum, h)-Colon ascendens, k)-Ileum, m)-Cornu uteri, n)-Vesica urinaria*

It was specified that the liver extended to approximately 40.34 mm caudal of processus xiphoidea. It was also specified that it extended to partially to intrathoracal and greatly to the abdominal cavity (Figure: 3-b; 8-b; 9-b). In ventral examination, it was observed that it was considerably formed by lobus hepatis dexter lateralis and lobus hepatis sinister lapsed to the right side at the rate of ½. Due to the extension of the liver towards the left side of facies visceralis, it was determined that lobus hepatis sinister lateralis and lobus hepatis sinister medialis completely covered the pylorus area along the curvatura ventriculi minor from the cardia area. It was seen that facies parietalis of lobus hepatis dexter contacted with costae in the intrathoracal abdominal cavity and facies visceralis covered the cardia and saccus ventriculi area of the stomach. It was determined that the border where the lobus hepatis sinister medialis extended on the lobus hepatis dexter was approximately the cardia area.

**B-Animals whose paramedian section was taken**

**1st Group: Normally fed rabbits**

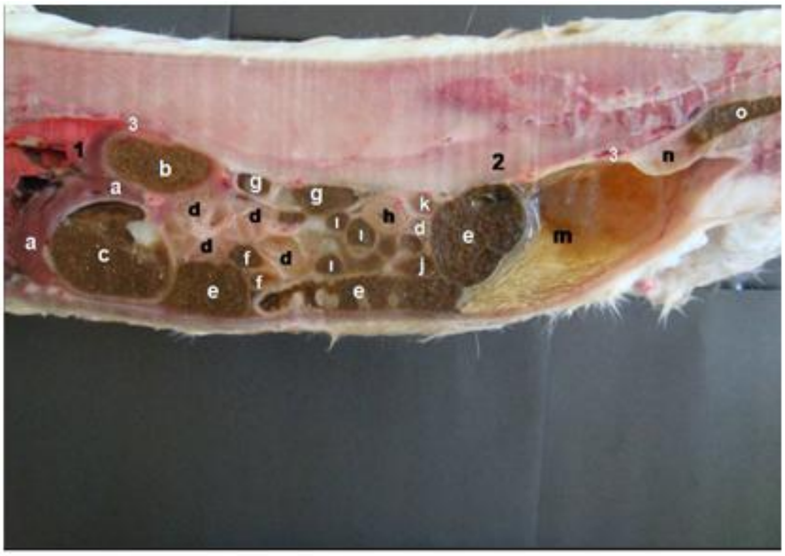

**Figure 4-** *View of right, paramedian section of normally fed animals, 1)-Diaphragma, 2)-Musculus quadratus lumborum, 3)-Aorta abdominalis, a)-Hepar, b)-Fundus ventriculi, c)-Corpus ventriculi, d)-Jejunum, e)-Cecum, f)-Colon transversum, g)-Pars ascendens, h)-Ileum, ı)-Colon ascendens, j)-Colon sigmoideum, k)-Appendix vermiformis, m)-Vesica urinaria, n)-Colon descendens, o)-Rectum*

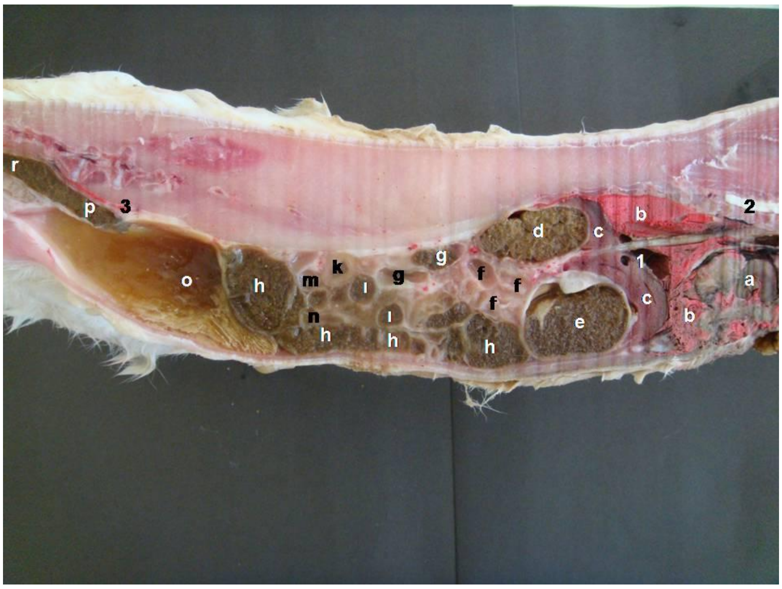

**Figure 5-** *View of left, paramedian section of normally fed animals, 1)-Diaphragma, 2)-Medulla spinalis, 3)-Aorta abdominalis, a)-Cor, b)-Pulmones, c)-Hepar, d)-Fundus ventriculi, e)-Corpus ventriculi, f)-Jejunum, g)-Pars ascendens, h)-Cecum, ı)-Colon ascendens, k)-Ileum, m)-Appendix vermiformis, n)-Colon sigmoideum, o)-Vesica urinaria, p)-Colon descendens, r)-Rectum*

## 2nd Group: Rabbits with empty stomach

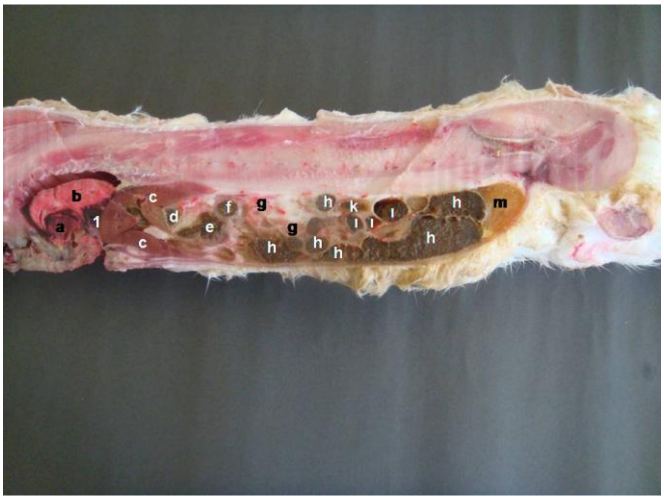

**Figure 6-** *View of right, paramedian section of animals with empty stomach, 1)-Diaphragma, a)-Cor, b)-Pulmones, c)-Hepar, d)-Fundus ventriculi, e)-Corpus ventriculi, f)-Colon transversum, g)-Jejunum, h)-Cecum, ı)-Colon ascendens, k)-Ileum, m)-Vesica urinaria*

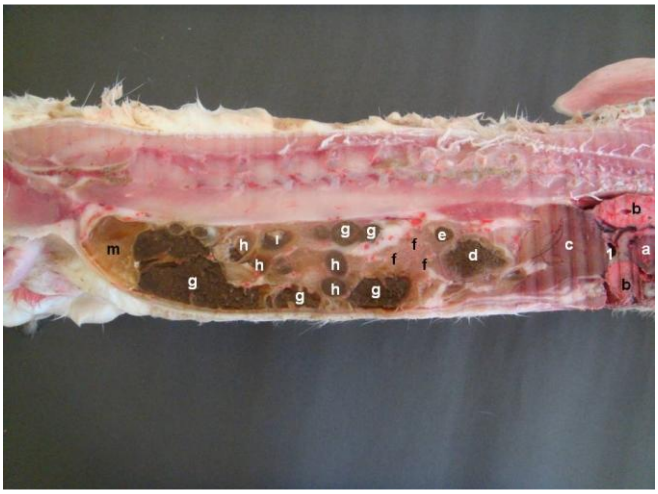

**Figure 7-** *View of left, paramedian section of animals with empty stomach 1)-Diaphragma, a)-Cor, b)-Pulmones, c)-Hepar, d)-Corpus ventriculi, e)-Colon transversum, f)-Jejunum, g)-Cecum, h)-Colon ascendens, ı)-Ileum, m)-Vesica urinaria.*

## 3rd Group: Rabbits with full stomach

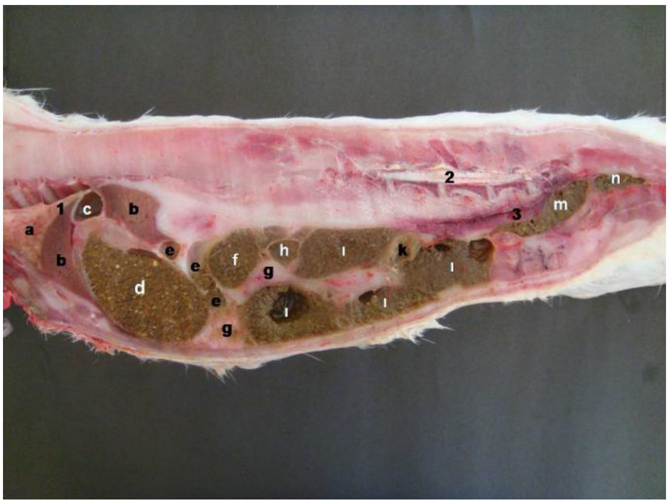

**Figure 8-** *View of right, paramedian section of animals with full stomach, 1)-Diaphragma, 2)-Medulla spinalis, 3)-Aorta abdominalis, a)-Pulmones, b)-Hepar, c)-Fundus ventriculi, d)-Corpus ventriculi, e)-Colon transversum, f)-Pars ascendens, g)-Jejunum, h)-Colon ascendens, ı)-Cecum, k)-Ileum, m)-Colon ascendens, n)-Rectum*

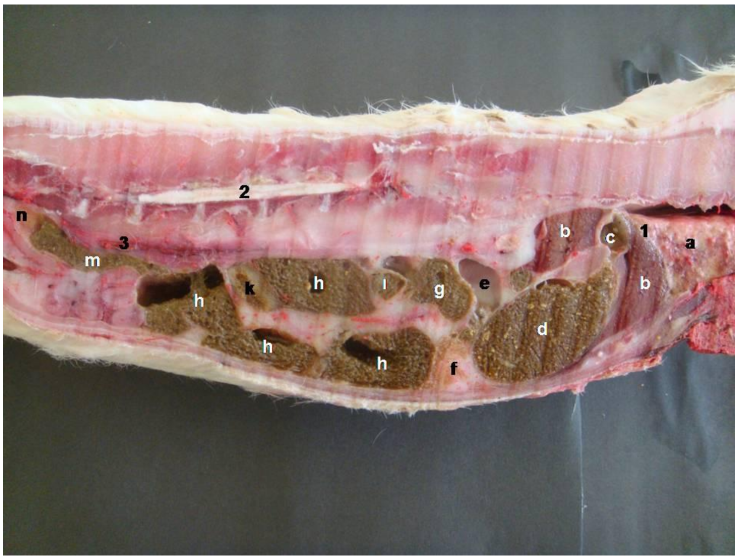


**Figure 9–** *View of left, paramedian section of animals with full stomach, 1)-Diaphragma, 2)-Medulla spinalis, 3)-Aorta abdominalis, a)-Pulmones, b)-Hepar, c)-Fundus ventriculi, d)-Corpus ventriculi, e)-Colon transversum, f)-Jejunum, g)-Pars ascendens, h)-Cecum, ı)-Colon ascendens, k)-İleum, m)-Colon descendens, n)-Rectum*

## C-Animals whose transversal section was taken

No transversal section image of the liver was obtained in normally fed animals and in the animals with empty stomach. Additionally, the liver was only observed in the cross-sectional image of the rabbits with full stomach taken at the 13$^{th}$ thoracal vertebrae level (Figure 10).

### 3$^{rd}$ Group: Rabbits with full stomach

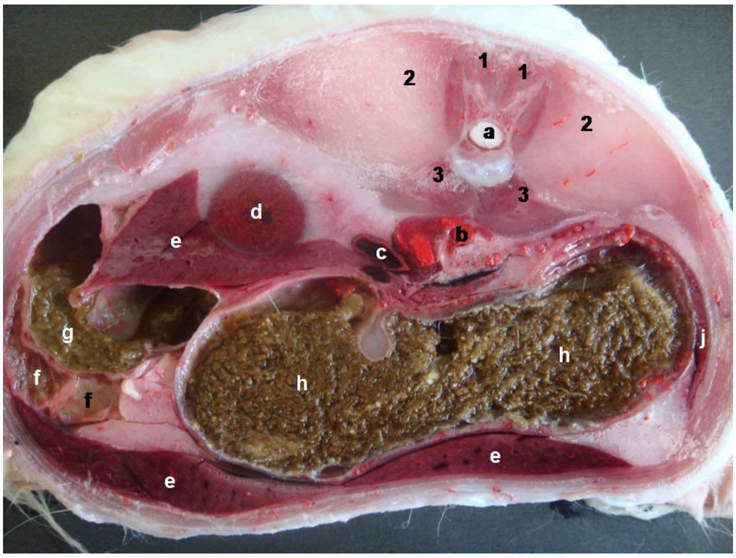


**Figure 10-** *Transversal section of animals with empty stomach (13. vertebra thoracalis): 1)-M.multifidi, 2)-M.iliospinalis, 3)-M.quadratus lumborum, a)-Medulla spinalis, b)-Aorta abdominalis, c)-Vena cava caudalis, d)-Ren dexter, e)-Hepar, f)-Duodenum, g)-Colon ascendens, h)-Ventriculus, j)-Lien*

In the study, it is tried to determine the effect of stomach volume in New Zealand Rabbit on liver topography through dissection and transversal and paramedian sections. The study includes some limitations in terms of the results. One of these limitations is that the number of studies comparing with the results is quite limited. Also, the determination of the liver in transversal sections only at 13$^{th}$ thoracal vertebrae level is among the limitations of the study.

Anatomical information is important in surgical and clinical practices in terms of gaining new dimensions for the diagnosis and treatment of the liver diseases. Anatomical sections provide true and reliable information about the location, shape and volume of both intraabdominal and intrathoracic organs [26]. Imaging techniques (US, CT, MRI) are frequently used in the diagnosis of liver diseases.

Cross sectional anatomy substantially increases the efficiency of these techniques [18, 19, 27-30]. Additionally, it is used in the location determination for liver biopsy used in the follow up of the disease process [31,32]. How the stomach appeared according to the fullness level was revealed through abdominal dissection of the liver in New Zealand Rabbit used as a laboratory animal in the study as well as transversal and paramedian sections.

As is stated by Eken et al., (2002) [26] for cats, it was determined that hepar was partially located in the intrathoracal abdominal cavity and its large part was dispersed more to the abdominal cavity among rabbits with full stomach compared to normally fed rabbits. It was observed that hepar was completely located in the intrathoracal abdominal cavity in the rabbits with empty stomach.

## 4. Conclusion

Consequently, in this study, it was shown how the liver of a New Zealand rabbit is affected by the fullness level of the stomach through dissection and sectional images. It is thought that the results obtained in the study will contribute to both the clinical anatomy of the rabbits and to the clinical practices.

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