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Original Research Article

Assessment of the Variations in Gross Morphology and Any Change in Histological Architecture in Cadaveric Liver

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Conflict of interest: Nil

Abstract

Background: The aim of the present study was to investigate the type and frequency of anatomical variations and to find out any histological changes and correlate these with intrauterine development, in a collection of cadaveric livers.

Methodology: Fifty livers from adult human cadavers irrespective of age and gender, fixed in 10% buffered formalin solution available in the department of Anatomy, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India was studied. The specimens looked apparently normal. Histological sections from lingular process (if present) and different areas from the lobes in other specimens were taken and processed by H and E staining. These were observed for any variations in architecture and cellular structure. Livers were examined on different occasions by three observers. The results obtained were compared and ratified. The distinct morphological characteristics observed were recorded on data sheets.

Results: The present study showed an incidence of 39 specimens of type 1 i.e. normal (78%). Types 4 and 5 are defined as livers with very deep renal and costal impression and diaphragmatic grooves respectively with incidence of 1 specimen each (2%). Type 6 is defined as liver with enlarged left lobe which was seen in 2 specimens (4%). Type 7 is defined as liver with lingular process of left lobe (8%). Lingular process is defined as tongue-like projection from the margin of liver. They have been categorized into three types: apical (2 specimen, 4%), conical (1 specimen; 2%) and rounded (1 specimen; 2%).

Conclusion: Though many anatomical variations in the shape of the liver were encountered, histologically all specimens were normal hence the present study suggests that functionally these livers were normal. The possible explanation for gross anomalies could lie in its embryological development.

Keywords: Hepatic, Liver, Lingular, Cadaver.

Background

The liver is wedged-shaped and largest of the abdominal viscera. The size of the liver also varies according to sex, age and body size. The liver is responsible for a wide range of metabolic activities including homeostasis, nutrition, immune defences, blood detoxification and purification, synthesis of plasma proteins, production of bile and the metabolism of carbohydrates, fats and proteins. It is an important site of haemopoiesis in the fetus [1]. The knowledge of normal and variant anatomy of the liver is important during radiological investigation and surgery. Variations in the liver morphology can be either congenital or acquired. The congenital abnormalities of the liver include agenesis, atrophy or hypoplasia of lobes, accessory lobes, accessory fissures etc. It has been found out in Indian population, that accessory lobes are present in 10% of the population. The mini accessory lobe might be mistaken for a lymph node due to its small size and removed during the surgeries [2].

Liver disease has become increasingly common throughout the world by virtue of unhealthy lifestyle and causes a high degree of morbidity. To reduce this risk, proper medical care in the form of various diagnostic and therapeutic interventions is necessary [3]. But the anatomy of liver is complex and challenging due to a high prevalence of variations. It is quite sensible to believe that along with variations in vascular anatomy, morphology of liver in terms of fissures, lobes, processes might influence the progress of hepatobiliary surgery. Major fissures are often used as important landmarks for delineating lobar anatomy as well as locating liver lesion [4-6]. Nowadays, despite various sophisticated radiological techniques, there are numerous pitfalls in interpretation of images; anatomic variants are considered as important as other mimickers [7]. Therefore, accuracy and reliability of radiological analysis still often depend on anatomical references. Variant anatomy of liver either congenital or acquired or coexistences of multiple anomalies of hepatobiliary system has been reported [8].

At a specific embryonic stage, due to interruption of development, congenital anomalies like agenesis, atrophy, hypertrophy or hypoplasia of lobes, accessory fissures or accessory lobes are seen. Detailed studies of the macroscopic anatomy of cadaveric livers can still contribute to the identification of important anatomical variations. In many cases, such variations have enabled researches to understand specific responses to therapies applied in the treatment of liver disease. In the era of imaging and minimally invasive approaches, it is very important on the part of both the radiologists and operating surgeons to have a thorough knowledge of the anatomy and the commonly occurring variations of this organ. Anatomists witness most of the variations of the lobes and fissures of the liver. Although the segmental anatomy of the liver has been extensively researched, there are very few studies regarding the surface variations of the liver. The aim of the present study was to investigate the type and frequency of anatomical variations and to find out any histological changes and correlate these with intrauterine development, in a collection of cadaveric livers.

Methodology

Fifty livers from adult human cadavers irrespective of age and gender, fixed in 10% buffered formalin solution available in the department of Anatomy, ESIC Medical College and Hospital, Bihta, Patna, Bihar, India were studied. The specimens looked apparently normal. Histological sections from cornu and lingular process (if present) and different areas from the lobes in other specimens were taken and processed by H and E

staining. These were observed for any variations in architecture and cellular structure. Livers were examined on different occasions by three observers. The results obtained were compared and ratified. The distinct morphological characteristics observed were recorded on data sheets.

Results

The organs were classified into seven groups on the basis of distinct morphological characteristics as depicted in table 1. The lingular process of left lobe (Type 7) was further defined according to shape. Type 1 is defined as the morphologically normal liver as classically described in the standard textbooks. [1]. The present study showed an incidence of 39 specimens of type 1 (78%).

Types 4 and 5 are defined as livers with very deep renal and costal impression and diaphragmatic grooves respectively with incidence of 1 specimen each (2%). Type 6 is defined as liver with enlarged left lobe which was seen in 2 specimens (4%). Type 7 is defined as liver with lingular process of left lobe (8%). Lingular process is defined as tongue-like projection from the margin of liver. They have been categorized into three types: apical (2 specimen, 4%), conical (1 specimen; 2%) and rounded (1 specimen; 2%).

Table 1: Different types of livers

Organ types	Characteristic features	Number	Frequency (%)
Type 1	Normal liver	39	78
Type 2	Very small left lobe	2	04
Type 3	Transverse “saddle-like” liver	1	02
Type 4	Very deep renal or costal impression	1	02
Type 5	Diaphragmatic grooves	1	02
Type 6	Enlarged left lobe	2	04
Type 7	Lingular process of left lobe	4	08

Table 2: Different types of lingular process of the left lobe

Type	Number	Frequency (%)
Apical	2	04
Conical	1	02
Round	1	02

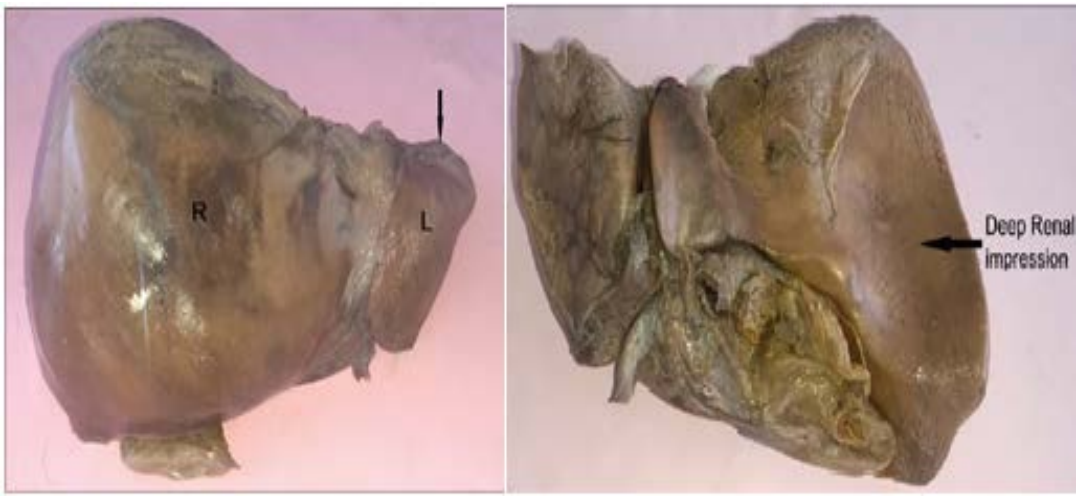

Figure 1: Nomal liver (type 1), Figure 2: Liver with deep renal impressions (type 4)

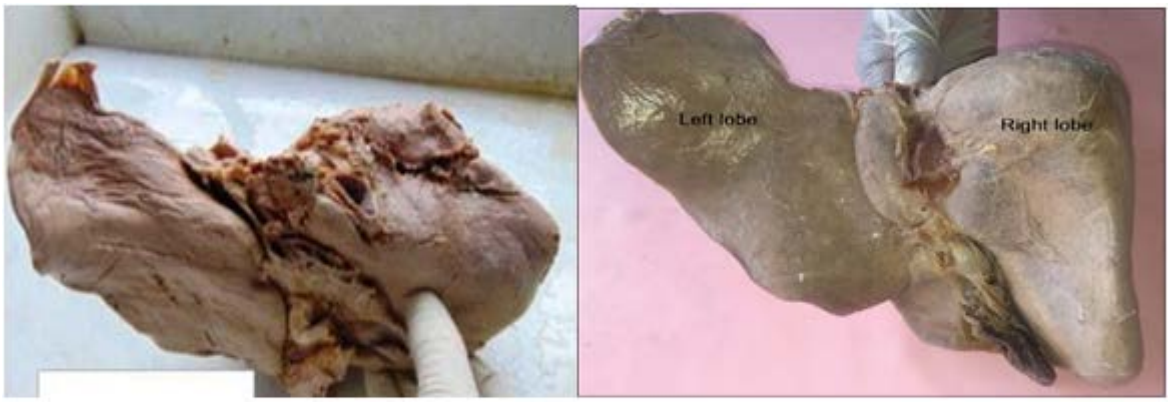

Figure 3: Small left Lobe of liver (Type 2), Figure 4: Enlarged left lobe (Type 6)

Discussion

The liver is the largest internal organ of the human body, weighing approximately 1.5 kg. Embryologically, it develops from the foregut and it spans the upper right and part of left abdominal quadrants. Embryological, the liver primodium appears in the middle of the 3rd week as an outgrowth of the endodermal epithelium at the distal end of the foregut. This outgrowth, the hepatic diverticulum or liver bud, consists of rapidly profile rating cells that penetrate the septum transversum [9]. Anatomically, the liver consists of four lobes: two larger ones (right and left) and two smaller ones (quadrate and caudate). Histologically, it has a complex microscopic structure that can be viewed from several different angles.

The variations observed in the anatomy of the human liver have been classified as congenital or acquired. Congenital anomalies can be attributed to the following factors: separate lobes (considered to be a congenital variation by some anatomists), atrophy at some locations in the parenchyma, presence of only one lobe, presence of multiple lobes, typically involving numerous divisions (up to 16) of the right lobe, small lobes, peduncular lobes, lobes without division, and accessory lobes. Acquired changes in liver morphology are represented by the following characteristic features: linguiform lobes, costal organ with very small left lobe, deep renal impressions [10].

Out of the 50 livers studied, 39 specimens (78%) were found to be normal. Morphological variations were observed in 11 specimens (22%). On the basis of these variations, the livers were classified into seven groups. This type of variant has been described previously by Nagato AC *et al* [11] and Yoshimitsu K *et al* [12]. These authors considered the diaphragmatic grooves to be accessory hepatic fissures caused by invaginations of the diaphragm. This can also be due to peritoneal fold or non-union of segments in fetal life.

The liver has been considered to be divided into four lobes by the surface peritoneal and ligamentous attachments. The left lobe is the smaller of the two main lobes, although it is nearly as large as the right lobe in young children. It lies to the left of the falciform ligament with no subdivisions and is substantially thinner than the right lobe [1]. According to Gray and Williams, [13] the right lobe is typically larger and more bulky than the left. On this basis, two livers (4%) described as type 6 is considered as a morphological variation because the left lobe was very much larger than the right.

Bezerra ASA *et al* [14] suggested that the reduction in size of the right hepatic lobe and the compensatory increase of the left and caudate lobes may result from

pathological processes in patients with schistosomiasis. Type 7 of liver specimens with lingular processes may be due to excessive tissue formed at a localized site in the form of extensions or pressure from the surroundings organs during fetal life causing inhibition of formation of complete left lobe so these processes developed in the area of least resistance. Histologically, all the specimens were normal according to the description in standard textbooks of histology.

Though distinct morphological types of human liver can be identified in the literature, relatively few studies are available on this topic and detailed descriptions of the different types of anatomical variations are scarce. One reason for this may be associated with a particular difficulty encountered in the present study relating to the characterization of cadaveric sources in terms of sex, age and previous diseases, all of which may impact on liver morphology. This data suggests that there is a high incidence of anatomical variations in the human liver. No statistical data relating to the frequency of occurrence of livers displaying gross variations in morphological character could be found in the literature in order to serve as a basis for comparison with the studied samples.

Conclusion

Though many anatomical variations in the shape of the liver were encountered, histologically all specimens were normal hence the present study suggests that functionally these livers were normal. The possible explanation for gross anomalies could lie in its embryological development. Detailed descriptions of normal and variant liver morphologies can make a significant contribution to understanding the causes of the changes and is a prerequisite for the favourable outcome of a surgical procedure.

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