

# Liver Weight and the Dimensions of its Vessels and Biliary Ducts: A Study on 40 Iranian Cadavers

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## • Abstract

**Background**—The number of liver transplantations are increasing in Iran. Precise knowledge concerning the anatomical dimensions and the effect of racial and environmental factors on them is of importance. This study was carried out to determine the anatomical dimensions of the liver, its vessels and biliary ducts in cadavers autopsied in the Medical Foundation in 1997.

**Methods**— A total number of 40 cadavers without any abdominal surgeries or crushed intra-abdominal organs were studied. The personal and demographics attributes along with anatomical dimensions of the hepatic artery, portal vein, biliary, hepatic and cystic ducts ducts, their variants and probable anomalies along with the total liver weight were recorded.

**Results**—The cadavers were within the age range of 37±9 years and the weight range of 64±9 Kg. In all cases the portal vein was normal with a length ranging 8.3±2.2 cm. In 15% of the subjects the hepatic artery (right branch of superior mesenteric artery) was abnormal. The length of extra-hepatic ducts was 8.6±1.7 cm and the weight of the liver was 1453±260 g.

**Conclusion**—The anatomical dimensions of liver, its vessels and biliary ducts were different from western reports. It is recommended to perform more detailed research on corpses from habitants of the region.

**Keywords** • Liver Transplantation • anatomical dimensions • portal vein • hepatic artery • biliary ducts

## Introduction

As far as we are aware, the anatomical dimensions of the liver, hepatic vessels, biliary ducts and their abnormal variants have not been reported in Iran. This information is mandatory in the successful performance of liver transplantation and the assessment of prognosis.<sup>1</sup> Reports vary concerning the anatomical dimensions of the liver and hepatic artery and portal vein abnormalities are reported in only 30%, 40% and 20% of cases, respectively.<sup>2-5</sup>

The research was instigated due to a lack of data in Iran concerning the liver, its attributes and possible abnormalities encountered in the course of treatment. With the increasing incidence of liver transplantation, such data is of the utmost importance. The anatomical dimensions of the liver, hepatic vessels and biliary ducts in male cadavers autopsied in the Tehran Medical Foundation in 1997 were determined.

## Material and Methods

This study was carried out using 40 cadavers after legal permission for autopsy had been obtained. Cadavers who had undergone abdominal surgery, had died from unknown causes or who had some form of internal diseases were excluded from the study group. As were cadavers who had sustained extensive damage to the abdominal solid organs due to abdominal trauma of any kind.

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The characteristics of the cadavers including age, weight and cause of death were recorded. Using vascular surgery sets, abdominal exploration was performed. Midline and sub-costal incisions were made affording access to the hepatic vascular pedicles and macroscopic evaluation of intra-abdominal organs. Two vascular and transplantation surgeons performed the autopsies and measurement of liver dimensions. In all cases, one worked as a surgeon and the other assisted.

Classic hepatectomy was performed<sup>1,5</sup> and the weight, length, diameter of the liver and the anatomy of portal veins were measured. The hepatic artery and its branches were determined and followed closely to detect possible abnormalities. The inferior vena cava was cut and released above its connection with the renal veins and its length was measured and recorded up to its entrance to the posterior part of liver and from there to the diaphragm. Biliary ducts were cut from the upper duodenum and measured up to their bifurcation at the hilum of the liver and the type of connection of the cystic and common hepatic ducts were determined. The data obtained were classified and presented with descriptive statistics. The anatomical dimensions and a 95% confidence intervals were calculated.

## Results

The mean age of the cadavers was  $37 \pm 9$  years (ranging from 16 to 75 years) and the mean weight was  $64.7 \pm 8.9$  kg (ranging from 40 kg to 80 kg). The cause of death included accidents with cerebral concussion in 9 cases (22.5%), without cerebral concussion in 6 cases (15%) and heart attack; falling from heights and death due to bullet injuries, each in 5 cases.

Portal vein anatomy was normal in all subjects with a mean vein length and mean vein diameter of about 8.3 cm and 11.6 mm respectively. Hepatic artery was abnormal in 6 cases (15%). The right branch originated from the superior mesenteric artery (SMA) in all cases. The mean length of the extra-hepatic biliary ducts was 8.6 cm. The mean length of the CHD was 4.8 cm and the mean length of the common bile duct (CBD) was 3.9 cm. The type of connection of the cystic duct to the CBD was of type I in 30 cases (75%), type VI in 7 cases (7.5%), type VII in 2 cases (5%) and type III in only one case. In other words types II, IV and V connections were not seen in any of the subjects studied. There were two supra-hepatic veins in 26 cases (65%) and three in the remaining 14 cases (35%). The mean length of the inferior vena cava was 5.7 cm distal to the renal vein to the inferior edge of the liver, 5 cm from the inferior edge of liver to its superior edge (posterior part of liver), and 2.2 cm from the superior border of liver to the inferior side of diaphragm. Mean weight of the liver was 1,453 g and in 3 cases (7%), over 1,800 g. Concerning the mean liver weight of the studied cadavers, liver weight consisted of 2.2% of total body weight. A 35 year old male weighing 80 kg had a liver with a weight of 2,350 g.

The distribution of selective anatomical dimensions of the liver, its vessels and biliary ducts, and also their confidence intervals in society were calculated as shown in [Table 1](#).

## Discussion

In the available references<sup>5-8</sup>, liver weight is reported to range from 1,400-1,800 g in men (95% confidence interval). It appears that in Iran, liver weight does not differ significantly from values reported from elsewhere. Only 7% of the subjects had livers heavier than the maximum value previously reported. The mean length and diameter of the portal vein was 8.3 cm (min. 4 and max. 15 cm) and 11.6 mm (min. 7 and max. 20 mm) respectively. The values stated in references<sup>6,9,10</sup> are 5-8 cm and 10-30 mm, respectively. This shows that in our study, veins are longer but with smaller diameter in comparison to other reported measurements. Portal vein anatomy was normal and mono-pad in all cases. It is reported that the portal vein is triple-pad in 10% of the population from which two branches enter the right and one enters the left hepatic lobe.<sup>6</sup> Our study showed that in 15% of subjects, an abnormal artery originated from the right branch of the superior mesenteric artery. The reference textbooks have reported most of the abnormalities in the hepatic artery (30-40%).<sup>5,6,9</sup> In

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our sample however, these abnormalities were less than the values mentioned. This research showed that supra-hepatic veins were 2 in 65% and 3 in 35% of the studied subjects. Reference textbooks<sup>5-11</sup> have reported 2 and 3 veins in 80% and 20% of cases respectively. The percentage of 3 supra-hepatic veins in our study was 15% more than that previously reported. It was also shown that the mean length of the extra-hepatic biliary ducts was  $8.6 \pm 1.7$  cm (with a minimum of 4.5cm and a maximum of 13 cm).<sup>12</sup>

Data about the latter dimensions facilitate the performing of anastomosis with the intestine. Since knowing the length of CBD or CHD alone is of little value, we recommend that other investigators to report the latter index while studying the anatomical dimensions of the liver.

Our sample comprised of 40 male cadavers. We propose that more detailed studies with larger sample size and racial distribution be performed. Precious data may be obtained that will assist in facilitating and improving the outcome of liver transplantation.

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