

Anatomy and Surgical Relevance of the Hepatocaval Ligament

A Study on Cadaveric Livers

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Key Words

Hepatic veins • Hepatocaval ligament • Liver • Right hemiliver surgery • Vena cava inferior

Abstract

Background: There are nearly no data on the hepatocaval ligament (HCL) in the anatomical literature, though it is of high importance during surgery of the right hemiliver. **Aim:** The aim of this study was to determine the frequency of the HCL, its description and its relations to the inferior vena cava (IVC) and the right hepatic vein (RHV) as well as the evaluation of the surgical relevance of the data obtained. **Materials and Methods:** The dissection of the livers of 43 cadavers of both sexes was performed and the presence of the HCL was established. The ligament was measured and dissected to expose the IVC and the extrahepatic part of the RHV from its inflow to the liver parenchyma. **Results:** The ligament was present in 77% of the cases. It was 12–35 mm long and 3–18 mm wide. The extrahepatic part of the RHV was 2–12 mm long. **Conclusion:** Dissection of the HCL revealed the terminal extrahepatic part of the RHV in all cases. Anatomically, resection of the right hemiliver with elective vascular control would be possible in 85% of the cases in which the length of the extrahepatic part of the RHV was ≥ 3 mm.

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Introduction

During embryogenesis, the inferior vena cava (IVC) is surrounded by hepatic parenchyma. At the end of embryogenesis, a bridge of parenchyma which links the right and the left hemiliver behind the IVC begins to undergo atrophy and is transformed into the hepatocaval ligament (HCL) [Langman, 1975; Heloury et al., 1988].

In the 1950s, some liver surgeons were aware of the presence and importance of the HCL, and described it as the posterior bed of the IVC, which enabled the control of the small retrohepatic veins [Lortat Jacob and Robert, 1952] or the structure extending to the posterior aspect of the vena cava encircling it almost completely [Couinaud, 1957]. Kune [1969] reported about a ligament enclosing the retrohepatic IVC, making it difficult to expose the hepatic veins without cutting the hepatic parenchyma. Rouvière and Delmas [1991] described the fissure

Abbreviations used in this paper

HCL	hepatocaval ligament
IVC	inferior vena cava
RHV	right hepatic vein

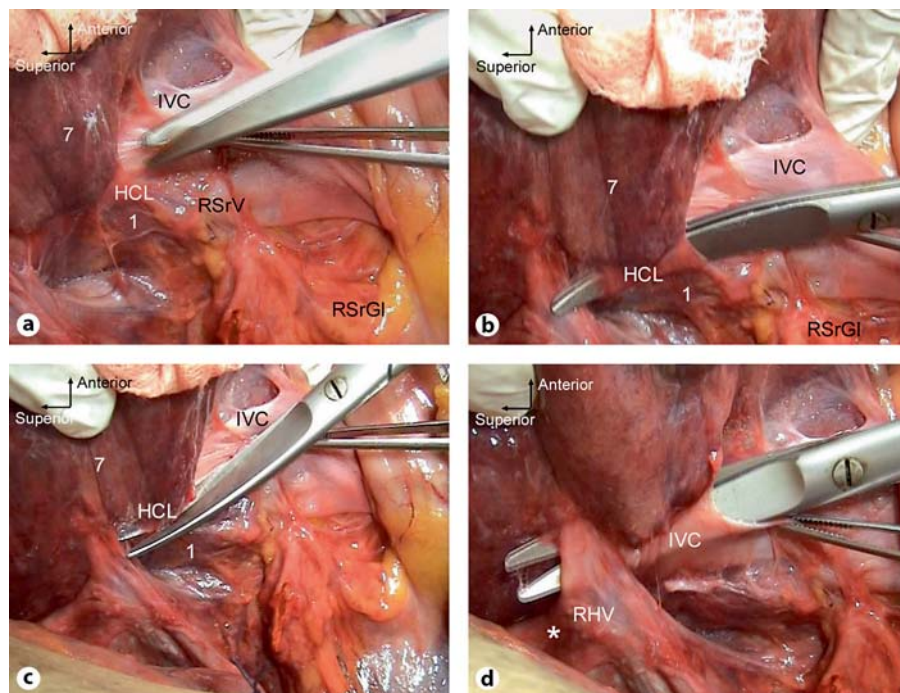


Fig. 1. Right lateral view to the liver during the dissection of the HCL, IVC and the RHV. **a** HCL above the suprarenal vein. **b** HCL liberated from the right edge of the IVC. **c** Dissection of the HCL in the axis of the IVC. **d** Exposition of the RHV. Asterisk indicates RHV inflow to the IVC. RSrGl = Right suprarenal gland; RSrV = right suprarenal vein; 7 = right liver segment 7; 1 = left liver segment 1 (Spiegel lobe).

of the IVC as a deep and large gutter with two edges, which tend to join on the posterior face of the IVC or sometimes even join and transform the gutter into a canal. Mizumoto and Suzuki [1988] described the HCL as an extension of the caudate lobe lying mostly on the left side of the retrohepatic IVC and with a protrusion behind the vessel, reaching its right border. In the study on the liver dorsal sector, Gadžijev et al. [1997] reported about small bile ducts, which could be found in the IVC ligament.

Nevertheless, the existence of the HCL is not widely accepted. There are nearly no data in the referential anatomical literature – its frequency is not well defined and its morphology has not been described. However, with the development of liver surgery, especially the techniques with total vascular exclusion, the surgical interest in the HCL and its relation to the hepatic veins has increased in recent years [Makuuchi et al., 1987].

The aim of the present study was to determine the frequency of the HCL, its description and its relations to the IVC and the right hepatic vein (RHV), as well as its relevance to techniques in liver surgery, particularly elective vascular exclusion during right hemiliver surgery.

The terminology for liver subunits used in the present article is in accordance with the Brisbane 2000 terminology [Strasberg et al., 2000].

Material and Methods

Using the right subcostal approach, the liver was dissected in 43 cadavers of both sexes. After mobilization of the liver, the presence of the HCL or the parenchymatous bridge behind the IVC was established and the HCL was measured.

In the livers with HCL, the part of the IVC between the liver and the diaphragm and the inflows of hepatic veins were exposed from the right lateral side, simulating a surgical procedure. Special attention was paid to the right margin of the retrohepatic IVC, the RHV and the right suprarenal vein. The HCL, which was located above the right suprarenal vein towards the RHV, was then carefully isolated (fig. 1a). Its medial part, and the cranial and the caudal borders were loosened from the right side of the IVC (fig. 1b) and RHV. The dissection was carried out with scissors placed first in the axis of the IVC (fig. 1c). HCL covering the IVC was cut in the cranial direction to expose the RHV inflow from the posterior side (fig. 1d). Then the dissection was proceeded in the axis of the RHV from its inflow to the liver parenchyma. Finally, the RHV was exposed, measured and clamped. During HCL dissection, the small retrohepatic veins draining into the IVC from the right side were also searched for.

HCL frequency or the parenchymatous bridge behind the IVC was determined. The length and width of the ligament and the length of the extrahepatic part of the RHV were measured.

Statistics

Data were expressed as means $\pm$ SD and ranges.

Results

Hepatocaval Ligament

The HCL was identified in 33 of 43 livers (77%), it was absent in 20% of the cases, and the parenchymatous bridge behind the IVC was found in 3% of the cases.

The ligament was unique in all cases. Its mean length was 22 ± 10 mm (range 12–35 mm), its mean width was 8 ± 5 mm (range 3–18 mm) and its thickness was about 0.5–2 mm. The color of the HCL was yellow to yellow purple. It contained small retrohepatic veins with a caliber >1 mm in 2 cases (5%).

The HCL was located behind and at the right side of the retrohepatic IVC, above the right suprarenal vein, and partly or completely covered the RHV inflow to the IVC. Regarding continuity, the HCL was related to the liver parenchyma of segment 7 and in 30% of the cases it extended behind the IVC to the left, thus binding the right liver segment 7 and the left liver segment 1 (Spiegel lobe). Regarding contiguity, the HCL was related to the diaphragm posteriorly, to the IVC anteriorly and to the right suprarenal gland at its right caudal side.

Right Hepatic Vein

In all the cases where the HCL was present, it was dissected, exposed and ligated without difficulty, and thus the terminal extrahepatic part of the RHV was revealed. In 10% of the cases without HCL, the RHV had already been located extrahepatically. In the other 10% of the cases without HCL and in the 3% with the parenchymatous bridge, the RHV was intraparenchymatous.

The mean length of the extrahepatic part of the RHV was 5 ± 2 mm (range 2–12 mm). Its length on the caudal end of its junction with the IVC was ≥ 5 mm in 52.5% of the cases and ≥ 3 mm in 85% of the cases. Thus, in 85% of the cases, the RHV could be clamped, and in 52.5% it could be resected extrahepatically. In 15% of the cases, the RHV was either intraparenchymatous or its extrahepatic part was <3 mm long.

Discussion

Embryology

During organogenesis, the IVC remains completely intraparenchymatous in most mammals. In the human embryo, it lies intrahepatically until the 19th week. Because of the rapid growth of the right hemiliver and the rotation of the primitive bowel to the right, it gradually obtains the extrahepatic position – the parenchymatous

retrocaval bridge becomes thinner and in most cases finally disappears together with a narrow strip of tissue on the right side of the IVC [Langman, 1975; Heloury et al., 1988]. The fibrous tissue that remains becomes the HCL at the end of organogenesis. The hepatic origin of the HCL can be supported by the studies of Gadžijev et al. [1997] and Mackenzie et al. [2005], who have found bile ducts in the ligament.

Terminology

In the surgical literature, different names for the ligamentous tissue between the IVC and the liver can be found. Lortat Jacob and Robert [1952] named it ligament expansion of Glisson's capsule. Kune [1969] described it as a ligamentous tissue surrounding the IVC. Belghiti and Panis [1992] called it the retrocaval ligament. For Makuuchi et al. [1987] and Champetier et al. [1989], it was the ligament of the IVC. Due to its hepatic origin and its position between the IVC and the liver, we decided to name it the hepatocaval ligament, in agreement with the study by Mackenzie et al. [2005].

Anatomy

Most of the classic anatomical literature [Williams et al., 1995; Moore et al., 1999] does not include data on the HCL. Rouvière and Delmas [1991] described it as an anatomical variation – a parenchymatous bridge transforming the gutter of the IVC into a canal on the posterior face of the liver. Heloury et al. [1988] described an inconstant retrocaval process in 56.7% of the cases which might completely encircle the IVC and come into contact with segment 7, or was connected with it by fibrous tissues that might contain fine biliary channels or hepatocytes in 23.5% of the cases. Rosset et al. [1995] demonstrated the presence of hepatocytes in the HCL in 25% of the cases. In our study, the parenchymatous bridge was found only in 3% of the cases. Rosset et al. [1995] reported that the ligament was 8 mm long and 2 mm wide, i.e. smaller than in our study (mean length 22 mm and mean width 8 mm).

Surgical Relevance

Detailed anatomical knowledge on the HCL and its relations to the IVC and hepatic veins is important in hepatic resections and liver partitions in split liver and living donor transplantations. It relieves elective vascular control preserving the IVC flow and the liver from devitalization.

Makuuchi et al. [1987] were the first to report that during the resection of the right hemiliver RHV control was

possible in 89% of the cases if the IVC ligament was resected, and only in 34% of the cases if the IVC ligament was not resected. The results of our study support their data – the resection of the right hemiliver with elective vascular control would anatomically be possible in 85% of the cases (in 77/85% of livers with HCL the ligament should be dissected previously) and impossible or difficult to perform in 15% of the cases.

The presence of the HCL is also favorable during controlling and pediculation of hepatic veins in bi- or tripartition of the liver in split liver transplantations and in living donor transplantations. Its dissection and ligation reveals the retrohepatic part of the IVC and terminal parts and inflows of the main hepatic veins.

Conclusions

The HCL is an inconstant but frequent anatomical structure. It is always situated above the right suprarenal vein and covers the RHV inflow into the IVC. Its dissection reveals the terminal extrahepatic part of the RHV and enables elective vascular control during right hemiliver surgery.

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