

VARIATIONS OF HEPATIC VEINS: STUDY ON CADAVERS

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Abstract: The common trunk of the intermediate and left hepatic veins were studied by anatomical dissection of 40 adult human cadaver livers. The common trunk of the intermediate and left hepatic veins showed 5 types of termination of intermediate and left hepatic vv.: classification of Nakamura. In types A, B, C, and D, the intermediate and left hepatic veins showed a common trunk in 31/40 or 77.5% of cases, that flowed into the inferior vena cava. Whereas in type A termination (3/40 cases) common trunks of 1 cm or over which do not receive a branch in the last cm, in type B terminations (11/40 cases) the trunk received two branches less than 1 cm from the IVC,ie, short trunks, or trunks of over 1 cm associated with one branch, in type C terminations (12/40 cases), the common trunks having three branches less than 1 cm from the IVC and in type D terminations (5/40 cases),the trunk received four branches. The diameter of the common trunk was $16.09 \pm 3.3\text{mm}$ and its length, $7.5 \pm 2.3\text{mm}$. In type E terminations (9/40 or 22.5% of cases), the intermediate and left hepatic veins ended separately in the inferior vena cava. The diameter of the intermediate and left hepatic veins in 40 cases was $8.68 \pm 1.51\text{ mm}$ and $8.6 \pm 1.22\text{ mm}$, respectively.

Key words: Hepatic veins, Inferior vena cava, Left hepatic, Liver.

I. INTRODUCTION

In this study, the liver segments were numbered according to Couinaud [1] and named according to the Federative Committee on Anatomical Terminology [2]. In this classification, the left liver included the left lateral division (the posterior lateral or S₂ segment and anterior lateral or S₃ segment) and the left medial division (the left medial segment S₄). The left liver was drained by the intermediate and left hepatic veins, but the intermediate hepatic veins also drained part of the right medial division (the right posterior medial or S₈, and the right anterior medial or S₅ segments) and part

of the right anterior lateral segment, S₆ according to Hata et al.[3,4].

An anastomosis between the common trunk of the intermediate and left hepatic veins of the receiver and the cranial portion of the inferior vena cava of the donor is one the techniques for restoration of hepato-caval continuity in orthotopic liver transplantation [5,6]. The aim of this study was to classify the variations of the common trunk of the intermediate and left hepatic veins, to determine the frequency of each type, to analyze the intermediate and left hepatic veins inflow into the inferior vena cava (IVC).

II. MATERIALS AND METHODS

The material we used in our study consists of 40 samples from cadaveric incisions that took place at the Laboratory of Department of Anatomy, Health and Sciences University of Mongolia during the period of June 2013 to October 2013. The study received appropriate approval from the Health and Sciences university of Mongolia ethics committee. Our material derives from 19 males and 21 females.

This study consisted of two parts: an anatomic study of the morphology of the common trunk by injection-corrosion in the explanted liver and a biometric study in situ of the hepatic vv. and of the IVC where it traversed the diaphragm in fresh human subjects.

The morphology of the intermediate and left hepatic vv. was studied in 40 livers of fresh subjects by the

technique of injection-corrosion. The corrosion cast methodology used has been reported on previously in detail (Ravnik et al. 1995). Acrylate monomers (acrylate powder and liquid, Polirepar S, Polident), used as prosthetic material in dentistry, were mixed and used for injection [7]. A polyurethane pigmentary paste of various colours was added to the mass, which was then injected into liver structures. The preparations, placed in a plastic mould of the upper part of the abdominal cavity, were put in a hot bath at +45°C, where the injected mass completely polymerized in approximately 20-30min. After corrosion in hydrochloric acid, the cast of the vessels allowed study of the arrangement of the intermediate and left hepatic vv., measurement of the frequency of a common trunk and its length, noting the pattern of the collateral vv. The intermediate and left hepatic vv. were distributed according to the classification of Nakamura [8]. The biometric of the hepatic vv. and the IVC was studied by measurement with a bougie calibrated on 40 livers in situ. The length of the common trunk was measured between the junction of the intermediate and left hepatic vv. and the ostium of this trunk in the IVC [5,9]. The diameter of the IVC was measured at its passage through the diaphragm.

III. RESULTS

A common trunk was present in 31 of the 40 cases (77.5%). The result of the morphologic study are given in Table 1 (Fig. 1A-E). In 9 cases (22.5%), the intermediate hepatic and left hepatic veins ended separately in the inferior vena cava. A type was in 3 of the 40 cases (7.5%), B type in 11 (27.5%), C type in 12 (30%), D type in 5 (12.5%), E type in 9 (22.5%). B, C types were present in the majority of all cases. The length of the common trunk varied from 5.5 ± 2.1 mm. The diameter of the new ostium created by section at 5 cm proximal to the junction of the intermediate and left hepatic vv. was 19.0 ± 3.37 mm. That of the IVC at its diaphragmatic passage was 23.6 ± 2.72 . However, the diameter of the actual ostium of the common trunk at its termination in the IVC was 16.09 ± 3.32 mm. The result are given in Table 2.

Opening patterns of intermediate and left hepatic veins, we observed 9/40 (22.5%) cases of single openings, followed by double openings 23/40 (57.5%), triple openings 8/40 (20%).

IV. DISCUSSION

The literature of the last years more and more indicates the importance of the hepatic veins in liver surgery, especially in living related liver transplantation [10]. This study was to classify the variations of the common trunk of the intermediate and left hepatic veins, to determine the frequency of each type, to analyze the intermediate and left hepatic veins inflow into the inferior vena cava (IVC). The diameter of the intermediate hepatic and left hepatic veins averaged 8.68 ± 1.51 mm, and 8.33 ± 1.22 mm, respectively. These values were similar to the 48.7 ± 1.8 mm and 8.6 ± 2.0 mm mentioned by Wind et al, but slightly smaller than the 10.0 ± 2.5 mm and 10.7 ± 2.3 mm, respectively mentioned by Jose Roberto Ortale et al [6]. The frequency of 77.5% we observed for the confluence of the intermediate hepatic vein with the left vein to form a common trunk was within the range (50%-95%) reported by others [10,11].

The length of this trunk was higher than 9.5 mm in 10% of the cases of the IVC. This frequency was 9.4% in the cases reported by Wind et al, 10% in those reported by Jose Roberto Ortale et al, and 3.3% in those reported by Honda [6,12]. Several classifications based on the morphology of the common trunk have been described. Masselot and Leborgne proposed a simple classification into 3 types based solely on the length of the common trunk (common trunk short, long or absent) [10]. This classification is not sufficient to systematize all the varieties of common trunk that exists. Nakamura described a classification based on the branching of the intermediate and left hepatic vv. less than 1 cm from the IVC. Indeed, for this author 1 cm is the minimum length allowing control of the vein [5,8]. Type A includes common trunks of 1 cm or more not receiving a branch in its last cm. Type B includes common trunks combined with two branches less than 1 cm from the IVC. Type C includes common trunk having three branches less than 1 cm from the IVC. Type D has four branches less than 1 cm away. Type E includes cases where there is no common trunk present. Of our 40 cases, 3 (7.5%) were type A, 11 (27.5%) were B type, 12 (30%) were C type, 5 (12.5%) were D type. The respective values reported by Wind et al. for 64 cases were: 6 (9.4%) were A, 25 (39.06%) were B, 16 (25%) C, 7 (10.94%) were D.

Thus, in type E, where the intermediate hepatic and left hepatic veins separately, were 9 (22.5%) in our cases, a frequency higher than the 15.6% and 15.66% mentioned by Wind et al. and Nakamura et al [5,8]. According to the venous anatomy defined by Masselot et al [10] and Wind et al [5], we defined variations of the common trunk of the intermediate and left hepatic veins, to determine the frequency of each type, to analyze the intermediate and left hepatic veins inflow into the inferior vena cava (IVC). If resections along the intermediate and left hepatic vein (hemihepatectomy, liver lobe resection) are considered the segmental anatomy of the hepatic veins follows the Couinaud segmental anatomy. The venous segments/subsegments have to be considered

Table 1. Classification of injection-corrosion 40 specimens in term of the morphology of the intermediate and left hepatic vv.: comparison with the study of Wind in 64 livers

	Our study	Wind et al	Nakamura et al.
Type	No. of case (%)		
A	3 (7.5)	6 (9.4)	9 (10.84)
B	11 (27.5)	25 (39.06)	35 (42.17)
C	12 (30)	16 (25)	22 (26.51)
D	5 (12.5)	7 (10.94)	4 (4.82)

Table 3. Opening patterns of intermediate and left hepatic veins

Combination patterns	Number	%
Single opening	9	22.5
Double opening	23	57.5
Triple opening	8	20

independently in volume, position and shape of the corresponding Couinaud.

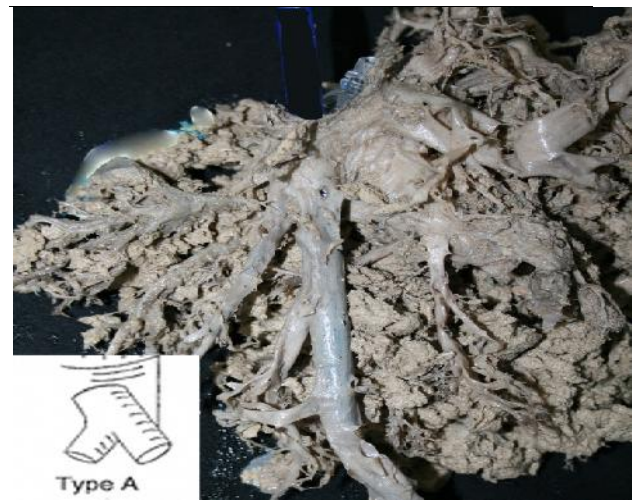
V. CONCLUSION

A common trunk for the intermediate and left hepatic vv. is present in 77.5% of cases. The intermediate hepatic and left hepatic veins ended separately in the inferior vena cava 22.5% in cases. B, C types were present in the majority of all cases. The increasing complexity of hepatic surgical procedures, necessitate widespread and appropriate knowledge of these anatomic variations, in order to avoid possible complications and help achieve the most effective result.

E	9 (22.5)	10 (15.6)	13 (15.66)
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Table 2. Measurements made in 40 specimens having a common trunk

	Our study	Wind et al.
Parameter	Diameter ±SD (mm)	
Inferior vena cava	23.3 ± 2.7	24.4 ± 2.0
Intermediate hepatic v.	8.68 ± 1.5	8.7 ± 1.8
Left hepatic v.	8.33 ± 1.2	8.6 ± 2.0
Ostium of common trunk	16.09 ± 3.3	13.6 ± 1.9



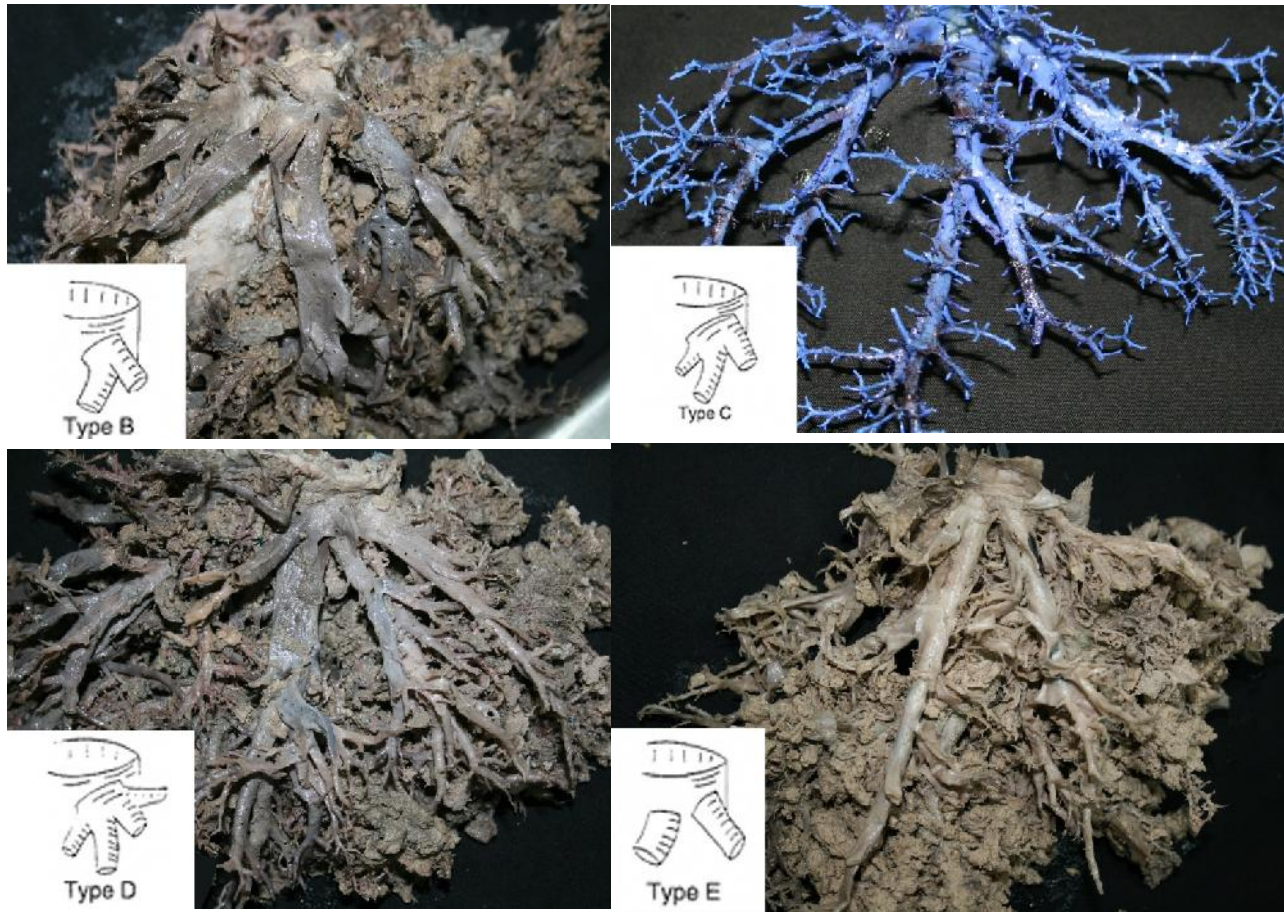


Fig 1 a-e

a-e Casts of hepatic vv. obtained after injection-corrosion.

Termination of intermediate and left hepatic vv. : classification of Nakamura. This classification is based on the branching of the intermediate and left hepatic vv. less than 1cm of the common trunk. When the common trunk measures less than 1cm, the intermediate and left hepatic vv. each count as one branch. Type A includes common trunks of 1 cm or

more not receiving a branch in its last cm. Type B includes common trunks combined with two branches less than 1 cm from the IVC. Type C includes common trunk having three branches less than 1 cm from the IVC. Type D has four branches less than 1 cm away. Type E includes cases where there is no common trunk present

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