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A Handy Tool to Teach Segmental Liver Anatomy to Surgical Trainees

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Sound knowledge of hepatic anatomy is a prerequisite for anatomical surgery of the liver.¹ In an era in which new technology and new techniques have increased the indications for hepatic surgery and improved the mortality rates after such procedures,² this statement rings more true now than ever. With hepatic resections being performed more frequently worldwide, more surgical trainees are exposed to these operative procedures.³ Therefore, there is a greater call for understanding functional hepatic anatomy⁴; a surgeon's knowledge of hepatic anatomy commonly determines a patient's outcome.⁵

The Couinaud model of hepatic anatomy, perhaps the most relevant to surgery, divides the liver into 8 segments that are related to the portal bifurcations (Figure 1A).^{6, 7} Each segment has its own vascular inflow and outflow and biliary drainage.^{8, 9} Tumor localization in 1 or more of these hepatic segments permits ablation or resection of only the involved segment(s), without injuring the adjacent parenchyma.⁹ It is knowledge of this segmental system, then, that underlies all hepatic resection and forms the basis of the Brisbane 2000 system of hepatic anatomy nomenclature and resections.¹⁰

Understanding this anatomical model can represent a daunting task for the surgical trainee because mistaken ideas about liver anatomy still pervade modern surgical teaching.^{5, 7} Digital attempts to permit easier anatomical understanding can be complex, including 3-dimensional reconstruction algorithms, immersive virtual reality environments, and dedicated computer learning software.^{11–15} We have found the following method to be a low-technological, reliable means of teaching Couinaud segmental anatomy to residents and medical students.

With the right hand, make a fist while tucking the thumb behind the remainder of the fingers (Figure 1B). Turn the fist facing yourself. The digits can then be numbered in a fashion identical to a Couinaud diagram of the liver, in which the thumb represents the caudate lobe positioned posteriorly (Figure 1A and B). The line formed by the proximal interphalangeal

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joint represents the plane in which the portal vein branches run, sending branches to the upper and lower segments. When the fist is viewed from a palmar perspective, the fingers representing the right lobe lay inferior to those representing the left, just as the right lobe is more posterior than the left.

The interdigitary spaces represent the intersegmental plains in which the right, middle, and left hepatic veins are located as they divide the 4 hepatic divisions (Figure 2). The right vein lies in the right fissure between the right anterior and posterior sectors, the middle vein in the principal plane between the right and left hemi-liver, and the left vein between the left medial and lateral sections (Figure 2B).

Armed with this basic understanding of anatomy (in a portable, 3-dimensional form), trainees can begin to master the first-, second-, and third-order divisional anatomy and resections. This mnemonic has proven both versatile and “handy” in operating rooms without access to more sophisticated hepatic modeling and has been used to teach many generations of surgical trainees.

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Figure 1. Couinaud segments 1 through 8. A, Segments overlaid on a model of the liver. R indicates right portal vein; L, left portal vein. B, Segments overlaid on a model of the right hand. The caudate lobe (segment 1) is represented by the thumb tucked behind the other digits.

Figure 2. Right (R), middle (M), and left (L) hepatic veins demonstrating the 4 hepatic divisions and 2 hemi-livers. A, Veins overlaid on a model of the liver; B, veins overlaid on a model of the right hand.