



Precise anatomical resection of the ventral part of Segment VIII

Canhong Xiang^a, Zhe Liu^a, Jiahong Dong^a, Keiji Sano^b, Masatoshi Makuuchi^{c,*}

^a Hospital & Institute of Hepato-Biliary Surgery, Chinese PLA General Hospital, No. 28 Fuxing Road, Haidian District, Beijing 100853, China

^b Department of Surgery, Teikyo University School of Medicine, 2-11-1 Kaga, Itabashi-ku, Tokyo 173-8605, Japan

^c Department of Hepato-Biliary-Pancreatic Surgery, Japanese Red Cross Medical Center, University of Tokyo, 4-1-22 Hiroo, Shibuya-ku, Tokyo 150-8935 Japan

ARTICLE INFO

Article history:

Received 31 July 2014

Received in revised form 12 October 2014

Accepted 12 October 2014

Available online 25 October 2014

Keywords:

Anatomical resection

Segment VIII

Precision surgery

ABSTRACT

INTRODUCTION: Anatomical resection of the ventral part of Segment VIII (S8vent) is demanding and there are no accurate methods to identify the demarcation line inside the liver. The current authors have proposed a method to solve the problem.

PRESENTATION OF CASE: The tumor was located in the S8vent and was 4 cm in size. One tributary of the middle hepatic vein (MHV), designated V8i, was running between S8vent and the dorsal part of Segment VIII (S8dor). Another tributary of the MHV, designated V8-5i, was running between S8vent and the ventral part of S5 (S5vent). About 5 ml of indigo carmine dye was injected into the proximal part of P8vent. After the small tributary of V8-5i was exposed, it was followed all the way to the main trunk of the MHV. The portal pedicle of S8vent was then ligated and divided. Next, the V8i was gradually exposed from the distal MHV to its trunk.

DISCUSSION: A recent study showed that the subsegmental border visualized between the ventral and dorsal region always coincided with the plane of V8i, so the subsegmental plane can be divided along with V8i by preserving the very small tributaries near the liver surface and following them to determine where they meet as they run into V8i. Also, the landmark vein of V8-5i in the transverse S8–S5 intersegmental plane was determined for the first time.

CONCLUSION: Proposed here is a more accurate method of dividing the liver parenchyma along the intersegmental and intersubsegmental demarcation.

© 2014 The Authors. Published by Elsevier Ltd. on behalf of Surgical Associates Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/3.0/>).

1. Introduction

Since Couinaud's Segment VIII is the largest segment of the liver¹ and patients with hepatocellular carcinoma (HCC) often have impaired liver function, reduced anatomical resection of the ventral part of Segment VIII (S8vent) has been used as an alternative to full anatomical resection of Segment VIII in its entirety in actual clinical settings. Anatomical resection of S8vent is generally considered a demanding procedure due to its anterosuperior location, its boundaries marked by tributaries of the middle or right veins and their tributaries, and the complete absence of anatomical landmarks on the liver surface, particularly in the cirrhotic liver. Thus, only a few cases have been reported in the literature.^{2–4} Several techniques of anatomical resection have been proposed, including the technique involving puncture of the portal branch as proposed by Makuuchi et al.⁵ That technique remains the most precise and practical method for anatomical demarcation on the liver surface.⁶ However, there are no accurate methods to

identify the demarcation line inside the liver and divide the liver parenchyma along the intersegmental or intersubsegmental plane, which is not a straight line but rugged and irregular. The current authors have proposed a method of identifying the intersegmental and intersubsegmental border inside the liver to facilitate more precise anatomical subsegmentectomy. This technique is described here along with an example of its implementation.

2. Patient

A 63-year-old male was referred with a hepatic tumor. His liver function was normal, and his indocyanine green retention rate at 15 min was 6.5%. Both serum α -fetoprotein and carcinoembryonic antigen levels were within normal ranges. The tumor was located in the ventral part of Segment VIII (S8vent) (Fig. 1A) and the tumor was 4 cm in size. According to three-dimensional images (IQQA-Liver, EDDA Technology, Princeton, NJ, USA), one tributary of the middle hepatic vein (MHV), designated V8i, was running between S8vent and the dorsal part of Segment VIII (S8dor). Another tributary of the MHV, designated V8-5i, was running between S8vent and the ventral part of S5 (S5vent) (Fig. 1A). Volumetric analysis indicated that the volume of the SVIII was 297 cm³ (22.1% of the

* Corresponding author. Tel.: +81 3 3400 9517.

E-mail address: masatoshi.makuuchi@gmail.com (M. Makuuchi).

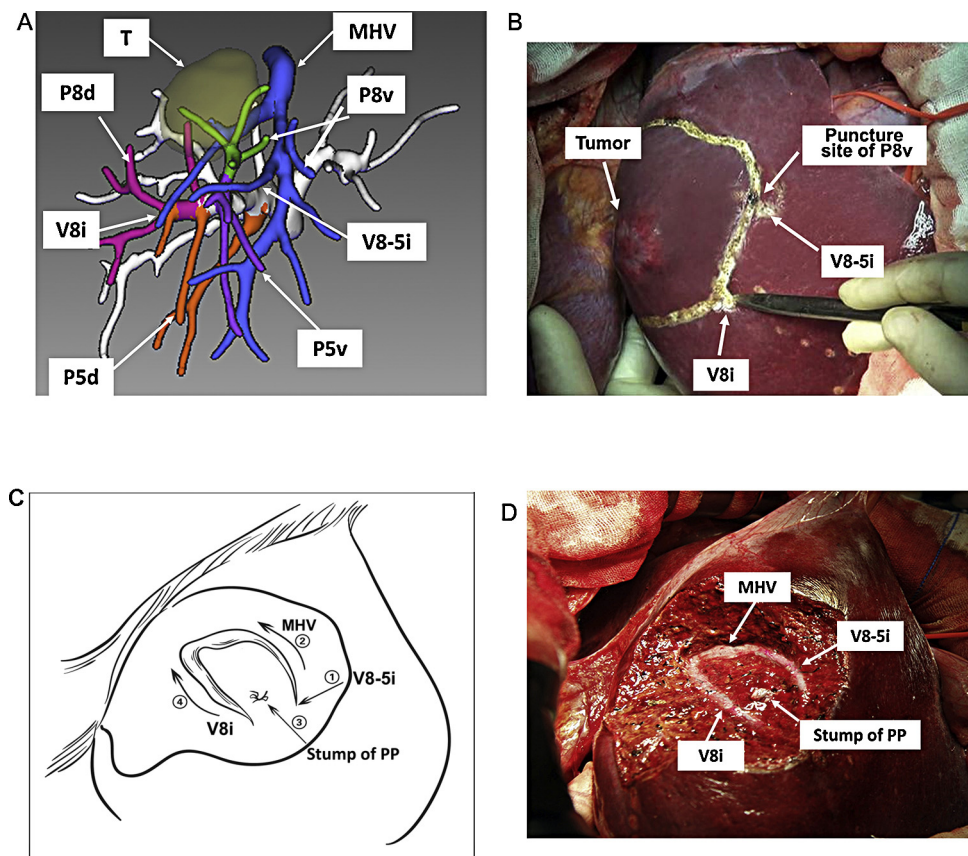


Fig. 1. (A) The tumor and portal and venous system of the right paramedian sector. The tumor (brown color) is located in the ventral part of Segment VIII (S8vent). (B) The resection line at the ventral part of Segment VIII (S8vent). The paths of V8i and V8-5i were identified using intraoperative ultrasound and marked on the liver surface. (C) Diagram of the transections done as part of anatomical resection (lateral view). ① From the liver surface to V8-5i; ② from the distal part of V8-5i to its proximal part; and the trunk of the MHV was also exposed; ③ from V8-5i to the proximal part of portal pedicle of S8vent; the proximal part was ligated and transected (stump of PP); ④ from the distal part of V8i to its proximal part; with this, transections finished. (D) Photograph after resection. MHV: middle hepatic vein. V8i: tributary of MHV running between the ventral part and dorsal part of Segment VIII. V8-5i: tributary of the MHV running between the ventral part of Segment VIII and Segment V. P8v: portal branch of the ventral part of Segment VIII. P5v: portal branch of the ventral part of Segment V. P8d: portal branch of the dorsal part of Segment VIII; P5d: portal branch of the dorsal part of Segment V. Stump of PP: a stump of divided portal pedicle of S8vent.

total liver volume) and that the volume of S8vent was 165 cm³ (12.3%). Anatomical resection of S8vent was scheduled.

3. Surgical procedure

After laparotomy and thoracotomy along the ninth intercostal space with a J-shaped incision, intraoperative ultrasonography was used to scan the entire liver to determine access to the vascular architecture and the tumor. Thoracophrenolaparotomy facilitated mobilization of the right liver and provided excellent views of the insertion of the hepatic veins into the vena cava. Guided by ultrasound, about 5 ml of indigo carmine dye (Indigocarmine Injection 20 mg/5 ml; Daiichi Sankyo, Tokyo, Japan) was injected into the proximal part of portal branch of S8vent (P8vent) after clamping of the hepatic artery. The border of stained surface of the liver was marked using electrocautery and the tumor was located within the resection line (Fig. 1B). The locations of the aforementioned P8 vent, V8i, and V8-5i were then ascertained and marked on the surface (Fig. 1B). Flow was intermittently occluded by clamping of the hepatoduodenal ligament, and the parenchyma was dissected using the clamp and crush method.

The sequence of liver parenchymal transection is shown in Fig. 1C. Resection was initiated at the borderline between S8vent and S5vent. After the small tributary of V8-5i was exposed, it was followed all the way to the main trunk of the MHV. The portal

pedicle of S8vent, which lay near the V8-5i, was then ligated and divided. Next, the V8i was gradually exposed from the distal MHV to its trunk. After anatomical resection of S8vent, V8i and V8-5i were clearly exposed in almost their entirety and then preserved. The main trunk of the MHV between the two tributaries was also exposed (Fig. 1D). The minimal surgical surface inside the liver was 1 cm. The operating time was 240 min and intraoperative blood loss was 50 ml. Drains were inserted in the transected surface of the liver and right subphrenic space, and these drains were removed on day 6 postoperatively. An intercostal drain was left in the pleural space and removed on day 2 postoperatively. The postoperative course was uneventful and the patient was discharged 7 days after surgery.

4. Discussion

According to the oncological principle, it is reasonable to radically remove HCC by inclusion of the feeding portal area since the portal vein is the main gate for intrahepatic tumor spread. Meanwhile, the volume to be resected is limited since patients with HCC often have background liver disease. Anatomic segmental or sub-segmental resection, taking into consideration both preservation, to the maximal extent possible, of liver functional parenchyma and eradication of intrahepatic metastasis, would be a theoretically reasonable procedure. Several studies have demonstrated the

superiority of anatomic resection in comparison to non-anatomic resection, showing better disease-free or overall survival.^{7–9} As for this patient, the tumor was located in the ventral part of S8vent, so the anatomical subsegmentectomy of S8vent was decided.

However, anatomical segmentectomy, and especially S8vent resection, is technically demanding and two main difficulties exist. One relates to the demarcation of S8vent on the liver surface and the other relates to the direction of transection along the intersubsegmental planes inside the liver.

Several studies have described techniques for demarcation of S8vent on the liver surface.^{2,4,5,10} Of these, the intraoperative ultrasound-guided portal branch puncture technique proposed by Makuuchi et al. in the mid-1980s is still the most precise method.⁶ In relation to the direction of transection along the intersubsegmental planes inside the liver, Sakairi and Makuuchi¹¹ proposed a method in which the portal pedicle is clamped and dye is injected. With this method, staining of the portal unit persists even after resection is complete, and the margin of the portal unit within the parenchyma is easily followed during transection. However, if a small branch of the portal vein is injured in an actual clinical setting, the dye spreads to the dividing planes and also stains the counter plane. This often hampers identification of the intersegmental or intersubsegmental margins.

Previous study indicated that V8i runs between S8vent and S8dor.^{12,13} Moreover, a recent study showed that the subsegmental border visualized between the ventral and dorsal region always coincided with the plane of the V8i according to computer simulations,¹⁴ so the subsegmental plane can reasonably be divided along with V8i by preserving the very small tributaries near the liver surface and following them to determine where they meet as they run into V8i. The small venous tributaries meet along the way, gradually becoming a larger vessel that eventually joins the main three hepatic veins. The method is time-consuming but may be the only method to accurately divide the liver parenchyma along the intersegmental or intersubsegmental plane demarcation.

In the current case, a tributary of the MHV (V8-5i) was found to be running on the segment border of S8vent and S5vent in three-dimensional images and it was detected and exposed during transection. The landmark vein of V8-5i in the transverse S8–S5 intersegmental plane was determined for the first time since it had not been described in the literature.^{2,14,15} In recent practice, these subsegmental venous tributaries have been exposed as they are in anatomical studies.

5. Conclusion

Anatomical S8vent resection is technically demanding, and previously reported techniques for anatomical resection are not without their drawbacks. Proposed here is a more accurate method of dividing the liver parenchyma along the intersubsegmental and intersegmental demarcation to facilitate more precise anatomical S8vent resection.

Conflict of interest

None declared.

Funding

None.

Ethical approval

Written informed consent was obtained from the patient for publication of this case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request.

Author contributions

Xiang, Dong, and Makuuchi had done the study conception and design and drafted the manuscript. The acquisition of data was done by Xiang, Liu, Dong, and Sano. Liu and Dong involved in the analysis and interpretation of data. Dong and Makuuchi had done the critical revision.

References

- Shindoh J, Mise Y, Satou S, Sugawara Y, Kokudo N. Intersegmental plane of the liver is not always flat – tricks for anatomical liver resection. *Ann Surg* 2010;**251**:917–22.
- Cho A, Okazumi S, Miyazawa Y, Makino H, Miura F, Ohira G, et al. Limited resection based on reclassification of segment 8 of the liver. *Hepatogastroenterology* 2004;**51**:575–6.
- Kishi Y, Hasegawa K, Kaneko J, Aoki T, Beck Y, Sugawara Y, et al. Resection of segment VIII for hepatocellular carcinoma. *Br J Surg* 2012;**99**:1105–12.
- Torzilli G, Procopio F, Palmisano A, Donadon M, Del Fabbro D, Marconi M, et al. Total or partial anatomical resection of segment 8 using the ultrasound-guided finger compression technique. *HPB (Oxford)* 2011;**13**:586–91.
- Makuuchi M, Hasegawa H, Yamazaki S. Ultrasonically guided subsegmentectomy. *Surg Gynecol Obstet* 1985;**161**:346–50.
- Torzilli G. Adjuncts to hepatic resection: ultrasound and emerging guidance systems. In: Jarnagin WR, editor. *Blumgart's surgery of the liver, biliary tract, and pancreas*. 5th ed. Philadelphia: Elsevier Press; 2012. p. 1601–49.
- Eguchi S, Kanematsu T, Arai S, Okazaki M, Okita K, Omata M, et al. Comparison of the outcomes between an anatomical subsegmentectomy and a non-anatomical minor hepatectomy for single hepatocellular carcinomas based on a Japanese nationwide survey. *Surgery* 2008;**143**:469–75.
- Hasegawa K, Kokudo N, Imamura H, Matsuyama Y, Aoki T, Minagawa M, et al. Prognostic impact of anatomic resection for hepatocellular carcinoma. *Ann Surg* 2005;**242**:252–9.
- Regimbeau JM, Kianmanesh R, Farges O, Dondero F, Sauvanet A, Belghiti J. Extent of liver resection influences the outcome in patients with cirrhosis and small hepatocellular carcinoma. *Surgery* 2002;**131**:311–7.
- Curro G, Bartolotta M, Barbera A, Jiao L, Habib N, Navarra G. Ultrasound-guided radiofrequency-assisted segmental liver resection: a new technique. *Ann Surg* 2009;**250**:229–33.
- Sakairi T, Makuuchi M. Identification of the intersegmental or subsegmental plane in the liver with a surgical clip. *Surgery* 1991;**110**:903–4.
- Cho A, Okazumi S, Makino H, Miura F, Ohira G, Yoshinaga Y, et al. Relation between hepatic and portal veins in the right paramedian sector: proposal for anatomical reclassification of the liver. *World J Surg* 2004;**28**:8–12.
- Hjortsjo CH. The topography of the intrahepatic duct systems. *Acta Anat (Basel)* 1951;**11**:599–615.
- Shindoh J, Satou S, Aoki T, Beck Y, Hasegawa K, Sugawara Y, et al. Hidden symmetry in asymmetric morphology: significance of Hjortsjo's anatomical model in liver surgery. *Hepatogastroenterology* 2012;**59**:519–25.
- Charbel S, Greig PD. Segment-oriented anatomic liver resections. In: Jarnagin WR, editor. *Blumgart's surgery of the liver, biliary tract, and pancreas*. 5th ed. Philadelphia: Elsevier Press; 2012. p. 1559–67.

Open Access

This article is published Open Access at scimedirect.com. It is distributed under the [IJSCR Supplemental terms and conditions](#), which permits unrestricted non commercial use, distribution, and reproduction in any medium, provided the original authors and source are credited.