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Title: Laparoscopic Anatomic S7+S8d Resection Preserving Inferior Right Hepatic Vein and S6 with Right Hepatic Vein Transection

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Author Questionnaire

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✓ Correct

2. **Interview statements:** Which interview statement filming option is the most appropriate for your group? **Please select one.**



Interview Statements are read by JoVE's voiceover talent.

Current Protocol Length

Number of Steps: 12

Number of Shots: 21

Introduction

NOTE to VO: Please record introductory and conclusion interview statements

INTRODUCTION:

What is the scope of this research?

- 1.1. This study aims to develop accessible surgical techniques for complex liver tumors using anatomical landmarks instead of advanced technology in resource-limited settings.

1.1.1. B. roll: 2.3.1

What are the current experimental challenges?

- 1.2. The challenge is to perform precise resection without navigation because of poor visibility, unclear boundaries, and specific anatomical requirements.

1.2.1. B. roll: 2.5.1

CONCLUSION:

What advantage does this protocol offer compared to other techniques?

- 1.3. This landmark-based protocol enables precise functional liver preservation without advanced navigation in resource-limited settings.

1.3.1. B. roll: 2.2.1

What questions will future research focus on?

- 1.4. Future multicenter studies will compare outcomes and explore integrating augmented reality for advancing the surgeries.

1.4.1. B. roll: 3.2.1

Ethics Title Card

This research has been approved by the Institutional Review Board at the Bazhong Central Hospital.

Protocol

2. Laparoscopic S7+S8d Resection

Demonstrator: Wanli Wang

2.1. To begin, divide the round and falciform ligaments following abdominal access using a monopolar energy device [1].

2.1.1. LAB MEDIA: 69488-1 03:42-03:49 and 04:38-04:43

2.2. Dissect the second hilum to expose the caval fossa, achieving full visualization of the right hepatic vein [1]. Employ a 14-French catheter at the first hepatic hilum to pre-position the Pringle maneuver tourniquet [2].

2.2.1. LAB MEDIA: 69488-2 02:50-03:05

2.2.2. LAB MEDIA: 69488-3 01:20-01:35

2.3. Divide the right triangular ligament and fully mobilize the right liver from its dorsal inferior aspect to expose the inferior vena cava by carefully separating the areolar tissue [1].

2.3.1. LAB MEDIA: 69488-3 02:29-02:37, 04:45-04:55

2.4. Now, dissect the dorsal superior border of the right liver toward the right hepatic vein [1]. Divide the Makuuchi ligament, permitting circumferential exposure of the right hepatic vein, which is then encircled with a silk ligature [2].

2.4.1. LAB MEDIA: 69488-4 02:00-02:10

2.4.2. LAB MEDIA: 69488-5 01:45-01:55, 69488-6 03:10-03:20

2.5. With a temporary Pringle occlusion, bluntly dissect the Glissonean pedicle to the dorsal S7 subsegment along the avascular plane of Laennec's capsule and encircle it with silk [1].

2.5.1. LAB MEDIA: 69488-7 03:38-03:43, 04:22-04:31

2.6. After releasing the Pringle clamp, apply a non-crushing vascular clamp to the Glissonean pedicle of dorsal S7 [1]. Observe and mark clear ischemic demarcation of the dorsal S7

territory with electrocautery [2].

2.6.1. LAB MEDIA: 69488-7 05:13–05:27

2.6.2. LAB MEDIA: 69488-7 07:02–07:26

2.7. Identify Cantlie's line, the midplane of the liver, as the right and left hemiliver boundary by tracing the course of the middle hepatic vein and marking it [1], concurrently delineating the cranial and caudal right liver division [2].

2.7.1. LAB MEDIA: 69488-7 09:20-09:24 and 09:48-09:59

2.7.2. LAB MEDIA: 69488-8 01:35–01:46

2.8. Then, using non-traumatic forceps, adjust and mark the ventral resection line for segment 7 and dorsal segment 8 [1]. Mark a point 2.5 centimeters lateral to the middle hepatic vein guided by intraoperative visual estimation and preoperative imaging fusion, ensuring more than 2 centimeters resection margins while preventing exposure of the middle hepatic vein [2].

2.8.1. LAB MEDIA: 69488-8 04:30–04:40

2.8.2. LAB MEDIA: 69488-8 04:40–04:58

2.9. Now, expose and transect the right hepatic vein root using a vascular stapler after confirming safe circumferential dissection [1], revealing ischemic discoloration in segment 7 and congested areas in partial segments 6 and 5 [2].

2.9.1. LAB MEDIA: 69488-9 04:38–04:42 and 06:05-06:12

2.9.2. LAB MEDIA: 69488-10 04:35–04:48

2.10. Extrahepatically dissect the right hepatic pedicle from portal branch IV to VI along Laennec's capsule [1] and implement silk-loop-guided right hemihepatic inflow occlusion to demonstrate a sharp Cantlie's line [2].

2.10.1. LAB MEDIA: 69488-11 00:15–00:20, 04:30–04:40

2.10.2. LAB MEDIA: 69488-11 08:48–08:55, 09:00–09:10

2.11. Proceed with parenchymal transection along both the modified ventral resection line at the segment 7 ischemic boundary and the modified dorsal resection line at the horizontal limb of the reverse-L plane using a combination of ultrasonic aspirator and bipolar sealer [1].

2.11.1. LAB MEDIA: 69488-12 01:20–01:30, 03:55–04:05

2.12. Finally, with both the planes established, perform progressive parenchymal dissection [1], encountering and transecting the middle right hepatic vein, the superior right hepatic vein, the secondary Glissonean segment 7 branch, and the ventral segment 8 vein between clips or with staplers [2]. Maintain meticulous preservation of the inferior right hepatic vein throughout by direct visualization and avoid traction [3].

2.12.1. LAB MEDIA: 69488-13 02:40–02:50

2.12.2. LAB MEDIA: 69488-14 03:01–03:08, 03:50–04:00, 04:20–04:30

2.12.3. LAB MEDIA: 69488-15 05:50–06:00, 69488-16 09:20–09:26

Results

3. Results

3.1. Preoperative imaging revealed a tumor abutting the right hepatic vein [1], two dominant Glissonean pedicles to segment 7 identified as G7-1 and G7-2 [2], and a substantial inferior right hepatic vein draining segment 6 [3].

3.1.1. LAB MEDIA: Figure 8A.

3.1.2. LAB MEDIA: Figure 8B.

3.1.3. LAB MEDIA: Figure 8C.

3.2. Postoperative imaging confirmed a hepatic defect with a preserved patent inferior right hepatic vein [1].

3.2.1. LAB MEDIA: Figure 8 D and E .

3.3. On postoperative day 1, alanine aminotransferase and aspartate aminotransferase levels were elevated at 460 units per liter and 499 units per liter, respectively [1].

3.3.1. LAB MEDIA: Table 1. *Video editor: Highlight the row for ALT and AST under the column for POD 1.*

3.4. By postoperative day 3, alanine aminotransferase decreased to 305 units per liter and aspartate aminotransferase to 114 units per liter [1].

3.4.1. LAB MEDIA: Table 1. *Video editor: Highlight the row for ALT and AST under the column for POD 3.*

3.5. Perioperative bilirubin levels remained within normal limits [1].

3.5.1. LAB MEDIA: Table 1. *Video editor: Highlight all Tbil values.*

3.6. Coagulation profiles remained consistently normal before and after surgery [1].

3.6.1. LAB MEDIA: Table 1. *Video editor: Highlight the rows showing preoperative coagulation and postoperative coagulation rows.*

3.7. Preoperative alpha-fetoprotein measured 9.6 nanograms per milliliter and normalized after resection [1].

3.7.1. LAB MEDIA: Table 1. *Video editor: Highlight the two AFP rows.*

1. Falciform
Pronunciation link: <https://www.merriam-webster.com/dictionary/falciform>
IPA: /'fæl.səˌfɔːrm/
Phonetic Spelling: fal·suh·form
2. Monopolar
Pronunciation link: <https://www.merriam-webster.com/dictionary/monopolar>
IPA: /ˌmɑːnəʊˈpəʊlər/
Phonetic Spelling: mon·oh·poh·ler
3. Hilum
Pronunciation link: <https://www.merriam-webster.com/dictionary/hilum>
IPA: /'haɪləm/
Phonetic Spelling: hy·luhm
4. Caval
Pronunciation link: <https://www.merriam-webster.com/dictionary/caval>
IPA: /'keɪvəl/
Phonetic Spelling: kay·vuhl
5. Fossa
Pronunciation link: <https://www.merriam-webster.com/dictionary/fossa>
IPA: /'fɑːsə/
Phonetic Spelling: fah·suh
6. Hepatic
Pronunciation link: <https://www.merriam-webster.com/dictionary/hepatic>
IPA: /hɪˈpætɪk/
Phonetic Spelling: huh·pat·ik
7. Catheter
Pronunciation link: <https://www.merriam-webster.com/dictionary/catheter>
IPA: /'kæθətər/
Phonetic Spelling: kath·uh·ter
8. Pringle maneuver
Pronunciation link: <https://www.merriam-webster.com/dictionary/Pringle>
IPA: /'prɪŋɡəl/
Phonetic Spelling: prin·guhl
9. Triangular
Pronunciation link: <https://www.merriam-webster.com/dictionary/triangular>
IPA: /traɪˈæŋɡjələr/
Phonetic Spelling: try·ang·gyuh·ler
10. Areolar
Pronunciation link: <https://www.merriam-webster.com/dictionary/areolar>
IPA: /əˈrɪə.lər/
Phonetic Spelling: uh·ree·uh·ler

11. Inferior vena cava
Pronunciation link: <https://www.merriam-webster.com/dictionary/vena%20cava>
IPA: /ɪnˈfɪəriər ˈvi:nə ˈkeɪvə/
Phonetic Spelling: in·feer·ee·er vee·nuh kay·vuh
12. Makuuchi
Pronunciation link: No confirmed link found
IPA: /məˈku:tʃi/
Phonetic Spelling: muh·koo·chee
13. Circumferential
Pronunciation link: <https://www.merriam-webster.com/dictionary/circumferential>
IPA: /ˌsɜ:kəmˈfəːrənʃəl/
Phonetic Spelling: ser·kuhm·fuh·ren·shuhl
14. Ligature
Pronunciation link: <https://www.merriam-webster.com/dictionary/ligature>
IPA: /ˈlɪɡətʃər/
Phonetic Spelling: lig·uh·cher
15. Glissonean
Pronunciation link: No confirmed link found
IPA: /ˌɡlɪsəˈni:ən/
Phonetic Spelling: glis·uh·nee·uhn
16. Avascular
Pronunciation link: <https://www.merriam-webster.com/dictionary/avascular>
IPA: /eɪˈvæskjələr/
Phonetic Spelling: ay·vas·kyuh·ler
17. Laennec
Pronunciation link: <https://www.merriam-webster.com/dictionary/Laennec>
IPA: /ləˈnek/
Phonetic Spelling: luh·nek
18. Ischemic
Pronunciation link: <https://www.merriam-webster.com/dictionary/ischemic>
IPA: /ɪˈski:mɪk/
Phonetic Spelling: ih·skee·mik
19. Demarcation
Pronunciation link: <https://www.merriam-webster.com/dictionary/demarcation>
IPA: /ˌdi:ˌmə:rˈkeɪʃən/
Phonetic Spelling: dee·maar·kay·shuhn
20. Electrocautery
Pronunciation link: <https://www.merriam-webster.com/dictionary/electrocautery>
IPA: /ɪˌlektroʊˈkɔ:təri/
Phonetic Spelling: ih·lek·troh·kaw·tuh·ree
21. Cantlie's line
Pronunciation link: No confirmed link found

- IPA: /'kæntli:z/
Phonetic Spelling: kant·leez
22. Hemiliver
Pronunciation link: No confirmed link found
IPA: /'hɛmɪ,lɪvər/
Phonetic Spelling: hem·ih·liv·er
23. Parenchymal
Pronunciation link: <https://www.merriam-webster.com/dictionary/parenchymal>
IPA: /pə'reŋkɪməl/
Phonetic Spelling: puh·reng·kih·muhl
24. Ultrasonic
Pronunciation link: <https://www.merriam-webster.com/dictionary/ultrasonic>
IPA: /ˌʌltrə'sɑ:nɪk/
Phonetic Spelling: ul·truh·son·ik
25. Aspirator
Pronunciation link: <https://www.merriam-webster.com/dictionary/aspirator>
IPA: /'æspə'rextər/
Phonetic Spelling: as·puh·ray·ter
26. Bipolar
Pronunciation link: <https://www.merriam-webster.com/dictionary/bipolar>
IPA: /baɪ'pɒlər/
Phonetic Spelling: by·poh·ler
27. Transect
Pronunciation link: <https://www.merriam-webster.com/dictionary/transect>
IPA: /træn'sɛkt/
Phonetic Spelling: tran·sekt
28. Meticulous
Pronunciation link: <https://www.merriam-webster.com/dictionary/meticulous>
IPA: /mə'tɪkjələs/
Phonetic Spelling: muh·tik·yuh·luhs
29. Alpha-fetoprotein
Pronunciation link: <https://www.merriam-webster.com/dictionary/alpha-fetoprotein>
IPA: /ˌælfəˈfi:təʊˈprəʊti:n/
Phonetic Spelling: al·fuh fee·toh·proh·teen
30. Bilirubin
Pronunciation link: <https://www.merriam-webster.com/dictionary/bilirubin>
IPA: /ˌbɪlɪˈruːbɪn/
Phonetic Spelling: bil·ih·roo·bin
31. Alanine aminotransferase
Pronunciation link: <https://www.merriam-webster.com/dictionary/alanine%20aminotransferase>
IPA: /ˈæl.əˌniːn əˌmiːnoʊˈtrænsfəˌreɪs/
Phonetic Spelling: al·uh·neen uh·mee·noh·trans·fuh·rays

32. Aspartate aminotransferase

Pronunciation link: <https://www.merriam-webster.com/dictionary/aspartate%20aminotransferase>

IPA: /ə'spɑːrteɪt əˌmiːnoʊ'trænsfəˌreɪs/

Phonetic Spelling: uh·spar·tayt uh·mee·noh·trans·fuh·rays

33. Coagulation

Pronunciation link: <https://www.merriam-webster.com/dictionary/coagulation>

IPA: /koʊˌæɡjəˈleɪʃən/

Phonetic Spelling: koh·ag·yuh·lay·shuhn