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Title: Laparoscopic Anatomical Resection of the Right Anterior Lobe Based on the Laennec Capsule Technique

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Author Questionnaire

1. We have marked your project as author-provided footage, meaning you film the video yourself and provide JoVE with the footage to edit. JoVE will not send the videographer. Please confirm that this is correct.

√ Correct

2. Microscopy: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **no**

3. Software: Does the part of your protocol being filmed include step-by-step descriptions of software usage? **no**

4. Proposed filming date: To help JoVE process and publish your video in a timely manner, please indicate the proposed date that your group will film here: **MM/DD/YYYY**

When you are ready to submit your video files, please contact our China Location Producer, Yuan Yue.

Current Protocol Length

Number of Steps: 25
Number of Shots: 46

Introduction

1.1. **HongBo Liang :** The scope of our research focuses on the effectiveness of laparoscopic anatomical resection combined with neoadjuvant therapy for treating complex hepatocellular carcinoma involving major vascular structures.

1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.3.1*

What technologies are currently used to advance research in your field?

1.2. **ShuWen Lin:** Currently, advanced imaging techniques like 3D liver reconstruction and intraoperative ultrasound, along with neoadjuvant therapies, are key technologies driving progress in liver cancer surgery.

1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.5.1*

What are the current experimental challenges?

1.3. **ShuWen Lin:** Current experimental challenges include accurately assessing tumor boundaries near major blood vessels and improving resection precision while minimizing complications during complex liver surgeries.

1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 3.4.1*

Ethics Title Card

This research has been approved by the Institutional Review Board at the Dongguan Bin-Hai-Wan Central Hospital

Protocol

NOTE: The authors have provided timestamps spanning entire step and the same have been written in red font against each step. The writer has not reviewed the footage for talent shots.

2. Laparoscopic Right Anterior Liver Lobe Resection

~~2.1. To begin, make an incision at the surgical site and explore the abdominal cavity using the laparoscope **[1]**. Identify nodular sclerosis of the liver and locate the tumor in the right anterior lobe **[2]**. Confirm the absence of metastatic lesions in the peritoneum and other organs **[3]**.~~

~~2.1.1. Talent manipulating the laparoscope.~~

~~2.1.2. Shot of Tumor being visualized in the right anterior lobe with signs of nodular sclerosis.~~

~~2.1.3. Shot of the peritoneum and other organs confirming no metastasis.~~

2.2. To begin, access the surgical site and fully mobilize the right liver ligaments **[1]**.

2.2.1. Talent mobilizing right liver ligaments. Video 1, 10:00–12:00; Video 4, 11:40–17:30

2.3. Then, use intraoperative ultrasound to determine tumor boundaries and visualize the hepatic veins, portal veins, bile ducts, and hepatic arteries **[1]**. Place the high-frequency ultrasound probe at appropriate liver regions to assess tumor size, shape, and its anatomical relationships **[2]**.

2.3.1. Talent applying intraoperative ultrasound to the liver surface to locate major vessels and tumor borders. Video 4, 17:55–19:05

2.3.2. Shot of Ultrasound imaging showing tumor dimensions and proximity to vessels and ducts. Video 4, 19:25–25:00

2.4. Now, mark the resection margins on the liver surface using electrocautery **[1]**. Use color Doppler ultrasound to assess blood flow in hepatic veins, portal veins, and hepatic arteries for accurate structure identification and injury prevention **[2]**. Video 4, 27:41–30:00

2.4.1. Talent marking liver surface using electrocautery.

2.4.2. Talent applying the color Doppler ultrasound probe for guidance.

2.5. Monitor the tumor's vascularity and proximity to major blood vessels in real-time using imaging **[1-TXT]**.

2.5.1. Shot of the tumor and surrounding vessels. **TXT: This helps in precise tumor excision, avoiding complications** Video 5, 00:00–10:51

2.6. Next, apply the Pringle maneuver using a vascular tape to occlude the hepatoduodenal ligament **[1]** and maintain the occlusion in 15-minute intervals followed by 5-minute reperfusion periods **[2]**. Video 1, 19:30–20:50
  2.6.1. Talent looping vascular tape around hepatoduodenal ligament to perform Pringle maneuver.
  2.6.2. Shot of concluding the occlusion and performing repurfusion.

2.7. To separate the right anterior Glissonean pedicle, using Laennec's membrane **[1]** and bluntly separate the left edge of the gallbladder plate from the root of the Glisson's pedicle at gate IV *(4)* **[2]**. Video 1, 26:08–28:50
  2.7.1. Talent dissecting and isolating right anterior Glissonean pedicle.
  2.7.2. Talent using blunt dissection along Laennec's membrane at gate IV to separate gallbladder plate.

2.8. Now, separate the right edge of the gallbladder plate above the Rouvieres groove at gate V *(5)* **[1]** and dissect the right anterior lobe, which includes segments 5 and 8, along the line connecting gate IV and gate V **[2]**. Video 2, 25:20–30:02; Video 3, 02:00–03:40; 15:40–25:30
  2.8.1. Talent identifying and separating tissue above Rouvieres groove at gate V.
  2.8.2. Talent dissecting right anterior lobe along the anatomical path from gate IV to V.

2.9. Expose the gallbladder to dissect it using an ultrasonic scalpel **[1]**. Then, set the ultrasonic scalpel to an appropriate frequency and power level **[2]**. Use it to separate the gallbladder from the liver bed, simultaneously cutting tissue and sealing small blood vessels to reduce bleeding **[3]**. Video 2, 00:00–02:35
  2.9.1. Talent exposing gallbladder and positioning ultrasonic scalpel.
  2.9.2. Talent adjusting the settings of Ultrasonic scalpel.
  2.9.3. Talent dissecting gallbladder from liver bed, demonstrating cutting and vessel sealing.

2.10. Now, carefully isolate the cystic duct and cystic artery **[1]**. Divide both using the ultrasonic scalpel and secure any bleeding vessels with clips **[2]**. Video 2, 14:50–17:28
  2.10.1. Talent exposing cystic duct and artery using forceps.
  2.10.2. Talent dividing duct and artery with ultrasonic scalpel and applying clips on bleeders.

2.11. Once the gallbladder is completely detached, remove it from the abdominal cavity through the incision **[1]**. Video 2, 14:50–17:28
  2.11.1. Talent extracting the gallbladder through the abdominal incision.

2.12. After removing the gallbladder, perform another intraoperative ultrasound to identify and mark the tumor boundaries and the surface projections of the middle hepatic vein, right hepatic vein, and right anterior liver pedicle **[1]**. Then, use ICG-mediated near-infrared imaging to confirm the tumor margins **[2]**. Video 5, 05:10–08:50
2.12.1. Talent applying intraoperative ultrasound probe to liver surface for anatomical marking.
2.12.2. Shot of Near-infrared ICG imaging showing tumor boundaries.

2.13. Occlude the right anterior liver pedicle using a 7-0 *(7-oh)* suture to stop blood flow to segments 5 and 8 **[1]**. Then, inject 0.5 to 1 milligram per kilogram of ICG intravenously about 15 to 30 minutes before the resection begins **[2]**. Video 5, 13:30–16:27
2.13.1. Talent using 7-0 suture to ligate the right anterior liver pedicle.
2.13.2. Shot of ICG injection process.

2.14. During surgery, visualize ICG uptake using a near-infrared fluorescence camera **[1]**. Observe that the right anterior lobe shows no fluorescence, clearly defining the resection boundary **[2]**. Video 5, 24:50–28:38
2.14.1. Talent operating near-infrared camera system intraoperatively.
2.14.2. Shot of Fluorescence image showing right anterior lobe without ICG signal.

2.15. Now, incise the liver capsule along the middle hepatic vein's course **[1]** and identify small hepatic vein branches **[2]**. Use non-energy instruments like forceps and suction to separate tissue along the plane between Laennec's capsule and the vein **[3]**. Video 6, 00:00–01:20; 26:00–30:02; Video 7, 01:30–02:40; 05:00–05:30; 17:05–17:50
2.15.1. Talent incising liver capsule.
2.15.2. Shot of pointing to the hepatic vein branches.
2.15.3. Talent using forceps and suction to dissect along the vein plane.

2.16. Then, clamp and cut the veins on the resection side **[1]**. Transect the liver parenchyma with an ultrasonic scalpel **[2]**. Video 7, 23:10–26:10; Video 8, 18:00–20:27
2.16.1. Talent clamping and cutting resection-side veins.
2.16.2. Talent using ultrasonic scalpel to transect liver tissue.

2.17. Continue separating the tumor using laparoscopic dissecting forceps **[1]**. Dissect along the cephalic side of the middle hepatic vein until both the right and middle hepatic vein roots are fully exposed **[2]**. Video 8, 20:30–23:05; Video 9, 04:45–06:14; Video 10, 08:45–12:25
2.17.1. Talent dissecting tumor from Laennec's capsule and veins.
2.17.2. Shot of Progressive exposure of vein roots with delicate dissection.

2.18. Dissect tissue around the right anterior hepatic pedicle and transect it with a stapler **[1]** before transecting the liver parenchyma between the right anterior and posterior

lobes **[2]**. Confirm that the tumor remains closely adherent to the right hepatic vein but does not invade it **[3]**.

2.18.1. Talent positioning stapler and transecting right anterior hepatic pedicle. Video 10, 23:20–25:25; 29:25–30:02

2.18.2. Talent continuing transection along interlobar boundary. Video 11, 00:00–00:57; 04:00–12:00

2.18.3. LAB MEDIA: Figure 5B.

2.19. Then, using blunt dissection and suction, separate the tumor from the right hepatic vein along Laennec's capsule **[1]**. Clamp tributary veins on the resection side and use an energy device to complete liver transection **[2]**. Video 11, 27:40–30:02; Video 12, 04:50–07:05; 08:10–09:47; 17:10–19:50; 27:16–30:00; Video 13, 04:28–08:54

2.19.1. Talent using blunt forceps and suction to separate tumor-vein interface.

2.19.2. Talent clamping venous branches and applying energy device to transect parenchyma.

2.20. Finish the right anterior lobe resection, preserving both hepatic veins **[1]** and place the resected liver specimen in a sterile bag **[2]**.

2.20.1. Talent placing specimen into retrieval bag after resection. Video 13 08:50–09:10 and Video 14, 15:00–16:00; 28:40–30:02

2.20.2. Talent taking out the right anterior lobe. Video 13, 12:25–13:30; Video 14, 09:50–12:40

2.21. Now, irrigate the abdominal cavity with sterile distilled water **[1]** and inspect the surgical site for bleeding, bile leaks, or gastrointestinal injury **[2]** before placing drains at the liver cut surface and gallbladder fossa **[3-TXT]**. Video 13, 12:25–13:30; Video 14, 09:50–12:40

2.21.1. Talent irrigating abdominal cavity with syringe or suction tip.

2.21.2. Shot of the surgical site showing no bleeding.

2.21.3. Talent placing silicone drains at liver transection and gallbladder fossa sites.

TXT: Close the abdominal wall with layered sutures

Results

3. Results

3.1. The surgery was completed in 240 minutes with 200 milliliters of intraoperative blood loss **[1]**, and the patient showed recovery signs within 24 hours by passing gas and starting a liquid diet after 1 day **[2]**.

3.1.1. LAB MEDIA: Table 1. *Video editor: Highlight the values "240", "200", in the first 2 rows*

3.1.2. LAB MEDIA: Table 1. *Video editor: Highlight the values "24", and "1" in the 3rd and 4th row for first flatus and first liquid diet.*

3.2. The patient had no postoperative complications such as bleeding, bile leakage, abdominal infection, or incision infection, and was discharged after 7 days **[1]**.

3.2.1. LAB MEDIA: Table 1. *Video editor: Highlight the "no" entries for the complication rows "postoperative complications, bleeding, bile leakage, abdominal infection, or incision infection "and the number "7" for hospital stay duration*.

3.3. Histopathological examination confirmed moderately to poorly differentiated hepatocellular carcinoma with 76 percent tumor necrosis and clear resection margins **[1]**.

3.3.1. LAB MEDIA: Figure 7.

3.4. Six-month follow-up using liver function tests and CT scans showed no signs of tumor recurrence **[1]**.

3.4.1. LAB MEDIA: Figure 8.

1. **Intraoperative**
Pronunciation link:
https://www.merriam-webster.com/dictionary/intraoperative
IPA: /ˌɪn.trəˈɑː.pəˌreɪ.tɪv/
Phonetic Spelling: in-truh-ah-pruh-ray-tiv

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2. **Hepatic**
Pronunciation link:
https://www.merriam-webster.com/dictionary/hepatic

IPA: /həˈpætɪk/
Phonetic Spelling: huh-pa-tik

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3. **Portal** (in medical context, e.g., portal vein)
   Pronunciation link:
   https://www.merriam-webster.com/dictionary/portal
   IPA: /ˈpɔːr.təl/
   Phonetic Spelling: por-tuhl

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4. **Electrocautery**
   Pronunciation link:
   https://www.merriam-webster.com/dictionary/electrocautery
   IPA: /ɪˌlɛk.troʊˈkɔː.tə.ri/
   Phonetic Spelling: ih-lek-troh-kaw-tuh-ree

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5. **Doppler** (as in Doppler ultrasound)
   Pronunciation link:
   https://www.merriam-webster.com/dictionary/Doppler
   IPA: /ˈdɑː.plər/
   Phonetic Spelling: dop-lur

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6. **Pringle maneuver**
   Pronunciation link:
   https://www.howtopronounce.com/pringle
   IPA: /ˈprɪŋ.gəl/
   Phonetic Spelling: pring-guhl
   ("maneuver" → https://www.merriam-webster.com/dictionary/maneuver
   IPA: /məˈnuː.vɚ/
   Phonetic Spelling: muh-noo-vur)

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7. **Hepatoduodenal** (ligament)
   Pronunciation link:
   https://www.howtopronounce.com/hepatoduodenal
   IPA: /hɪˌpætoʊˌduːəˈdiː.nəl/ (alt. /ˌhɛpətoʊˌduːəˈdiː.nəl/)
   Phonetic Spelling: hep-uh-toh-doo-uh-dee-nuhl

8. **Glissonean** (pedicle)
   Pronunciation link:
   No confirmed link found
   IPA: /glɪˈsoʊ.ni.ən/
   Phonetic Spelling: glih-soh-nee-uhn

9. **Laennec's** (membrane/capsule)
   Pronunciation link:
   https://www.howtopronounce.com/laennec
   IPA: /læˈnɛk/
   Phonetic Spelling: lah-nek

10. **Rouvieres** (groove)
    Pronunciation link:
    No confirmed link found
    IPA: /ruːˈvjɛər/
    Phonetic Spelling: roo-vyehr

11. **Ultrasonic** (scalpel)
    Pronunciation link:
    https://www.merriam-webster.com/dictionary/ultrasonic
    IPA: /ˌʌl.trəˈsɑː.nɪk/
    Phonetic Spelling: uhl-truh-sah-nik

12. **Cystic** (duct, artery)
    Pronunciation link:
    https://www.merriam-webster.com/dictionary/cystic
    IPA: /ˈsɪs.tɪk/
    Phonetic Spelling: sis-tik

13. **Intravenous** (injection of ICG)
    Pronunciation link:
    https://www.merriam-webster.com/dictionary/intravenous

IPA: /ˌɪn.trəˈviː.nəs/
Phonetic Spelling: in-truh-vee-nuhs

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14. **Fluorescence** (camera / imaging)
Pronunciation link:
https://www.merriam-webster.com/dictionary/fluorescence
IPA: /flʊˈrɛsəns/
Phonetic Spelling: floo-res-uhns

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15. **Parenchyma** (liver parenchyma)
Pronunciation link:
https://www.merriam-webster.com/dictionary/parenchyma
IPA: /pəˈrɛŋ.kə.mə/
Phonetic Spelling: puh-renk-uh-muh

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16. **Cephalic** (side)
Pronunciation link:
https://www.merriam-webster.com/dictionary/cephalic
IPA: /səˈfæl.ɪk/
Phonetic Spelling: suh-fal-ik

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17. **Histopathological** (examination)
Pronunciation link:
https://www.howtopronounce.com/histopathological
IPA: /ˌhɪs.toʊˌpæθəˈlɑː.dʒɪ.kəl/
Phonetic Spelling: his-toh-path-uh-lah-jih-kuhl

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18. **Hepatocellular carcinoma**

- Hepatocellular: https://www.merriam-webster.com/dictionary/hepatocellular
IPA: /hɪˌpæt.oʊˈsɛl.jə.lɚ/
Phonetic Spelling: hep-a-toh-sel-yuh-lur
- Carcinoma: https://www.merriam-webster.com/dictionary/carcinoma
IPA: /ˌkɑːr.səˈnoʊ.mə/
Phonetic Spelling: kar-suh-noh-muh