CLINICAL TECHNIQUE

U-shaped Dissection for Achieving Critical View of Safety during Laparoscopic Cholecystectomy: A Novel Technique

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Abstract

Introduction: The critical view of safety (CVS) is the definitive endpoint for safe laparoscopic cholecystectomy (LC), yet the pathway to CVS varies by surgeon. We present a standardized U-shaped dissection that integrates anatomical landmarks, safe planes, and photographic verification to operationalize CVS.

Technique: After standard port placement and exposure, dissection begins posteriorly in the inner subserosal layer over the cystic plate, remains superior to the hepatocystic fat, and advances laterally, then anteriorly to form a U-shaped arc superior to the R4U zone. The lower one-third of the gallbladder is mobilized off the cystic plate. Critical view of safety is verified against three criteria and documented using standardized posterior and anterior "doublet photography."

Key points: The technique of geometric reproducibility (U-shaped dissection) when combined with plane fidelity (inner subserosal layer), anatomical orientation (R4U, Rouviere's sulcus), and mandatory documentation (doublet view) will be helpful in enhancing safety.

Conclusion: U-shaped dissection provides a simple, teachable pathway to consistently achieve and document CVS. It complements culture of safety and safe cholecystectomy programs and is suited for training and quality assurance.

Keywords: Bile duct injury, Critical view of safety, Laparoscopic cholecystectomy, Safe cholecystectomy.

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Introduction

Laparoscopic cholecystectomy (LC) is one of the most commonly performed surgical procedures worldwide. It is generally considered safe but carries the risk of major bile duct injury, a complication associated with significant morbidity. The critical view of safety (CVS), described by Strasberg SM and Brunt LM[1] has become the globally recognized standard for preventing such injuries. Critical view of safety requires clearance of the hepatocystic triangle, separation of the lower gallbladder from the cystic plate, and identification of only two tubular structures entering the gallbladder.[1]

Despite this, CVS is often misunderstood as a dissection technique, whereas it is an end target that multiple approaches can achieve. To emphasize this, CVS has also been incorporated into the SAGES Safe Cholecystectomy Program, which outlines strategies to reduce common errors during LC and highlights the importance of safety culture in minimizing injuries.[2–4] Similarly, the use of doublet photography, whereby anterior and posterior intraoperative views are recorded as permanent proof of CVS attainment, is also advocated.[5]

Anatomical landmarks have also been studied extensively to provide surgeons with orientation during dissection.[6–8] The Rouviere's sulcus may be identified in up to 80% of patients and provides a reliable transverse landmark, superior to which safe dissection can be performed.[6,7] Similarly, the R4U plane is a dissection zone from the roof of Rouviere's sulcus across segment four to the umbilical fissure, further delineating safe territories during LC.[9]

Nevertheless, practical dissection approaches differ among surgeons. This variability can lead to inconsistencies, particularly in teaching hospitals. We, therefore, devised a novel yet simplified, structured "U-shaped dissection" technique that integrates these principles for consistent attainment of CVS.

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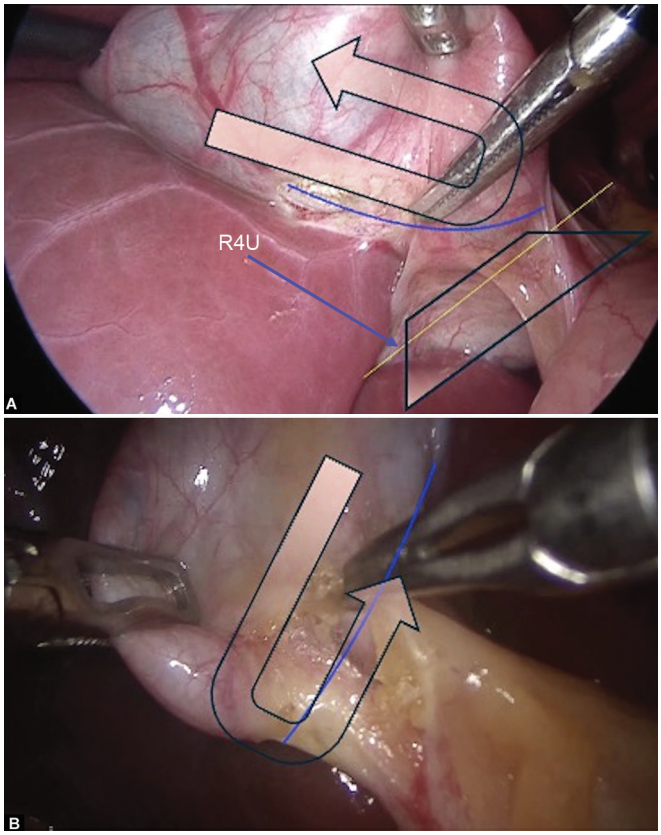
Technique

The technique is designed to achieve Strasberg's CVS as the mandatory endpoint while standardizing how that endpoint is reached through a reproducible geometric pathway and consistent tissue planes. It is aligned with the culture of safety in cholecystectomy, maintaining anatomic orientation using the R4U planes and reliable landmarks such as Rouviere's sulcus.[3,4,6–8]

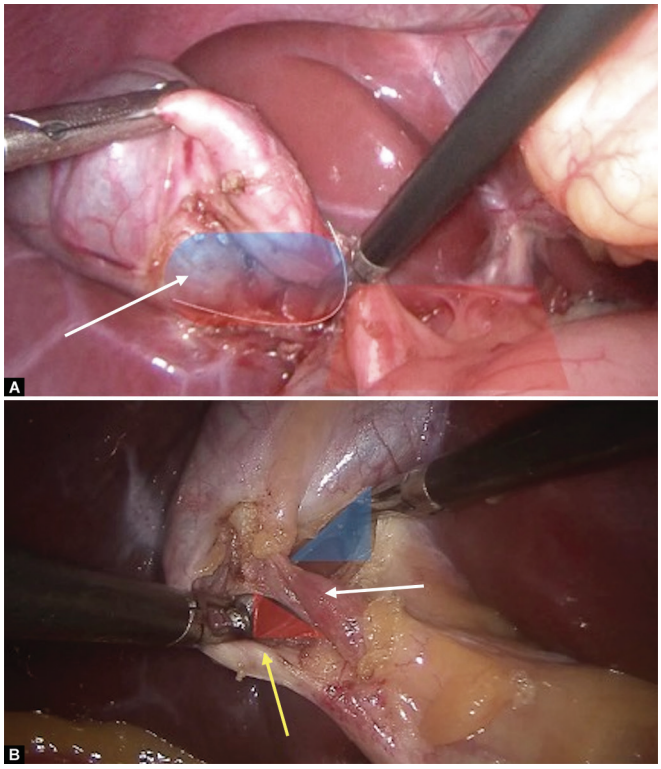
Step 1—Setup and Exposure

Patient positioned supine with reverse Trendelenburg and left tilt; standard four-port LC configuration is used. Traction on the gallbladder fundus is applied cephalad and laterally to expose Calot's triangle.

Initial orientation references include the roof of Rouviere's sulcus and the segment four base, anticipating the R4U plane trajectory for safe dissection corridors.[8]



Figs 1A and B: U-shaped dissection. (A) Dissection started posteriorly in the subserosal plane (curved arrow and blue line), remaining superior to R4U plane (shown by yellow line and quadrangular plane); (B) Dissection continued posteriorly (curved arrow and blue line)



Figs 2A and B: Critical view of safety completion. (A) Lower one-third of cystic plate being separated from the gallbladder, with an arrow showing the subserosal plane of dissection. Blue plane representing the zone of U-shaped dissection, and red plane showing the R4U plane and no-go zone; (B) Two structures – cystic duct (yellow arrow) and cystic artery (white arrow) – enter into gallbladder. Red and blue triangles represent a doublet view

Step 2—Posterior Entry in the Inner Subserosal Layer (Base of the "U")

Enter the dissection plane posteriorly at the gallbladder–liver interface, staying superior to the hepatocystic pad of fat and deliberately developing the "inner subserosal layer" over the cystic plate (Fig. 1A) as described elsewhere.[10] This is done to maintain a close, areolar, and avascular plane against the gallbladder wall to minimize bleeding and reduce the chance of straying toward extrahepatic bile ducts.

Step 3—Forming the "U" (Posterior → Lateral → Anterior) within the R4U Plane

Extend the posterior plane laterally, then sweep anteriorly to create a clear U-shaped arc around the hepatocystic triangle while keeping dissection superficial to the hepatocystic fat and within the R4U demarcated safe zone. Use Rouviere's sulcus as a horizontal safety reference; remain cranial to its line to avoid inadvertent deep dissection toward the common bile duct (Fig. 1B).

Step 4—Mobilize the Lower One-third of the Gallbladder Off the Cystic Plate (Still in Inner Subserosal Layer)

Continue dissection in the same Honda inner subserosal plane to detach the lower one-third of the gallbladder (Fig. 2A) from the liver bed, skeletonizing the cystic duct and artery without traction-related distortion. Electrosurgery is avoided deep to the plane to prevent thermal spread toward hilar structures.

Step 5—Achieve and Verify CVS

Confirm Strasberg's three CVS criteria: (1) Hepatocystic triangle cleared of fat/fibrous tissue, (2) Lower gallbladder separated from the cystic plate, and (3) Two and only two tubular structures (cystic duct and cystic artery) entering the gallbladder are clearly identified (Fig. 2B). Obtain "doublet photography" with standardized posterior and anterior images to create a permanent record of CVS completion and scoring (0–6; ≥5 indicates completion).

Step 6—Clip and Divide; Complete Cholecystectomy

After photographic verification, clip and divide the cystic duct and artery under direct vision and complete gallbladder detachment in the same inner subserosal layer to the fundus.

Inspect the cystic plate and operative field for hemostasis and bile leakage before extraction.

Discussion

Attainment of CVS is universally recognized as the safest approach for avoiding bile duct injury in LC. Yet, variation in surgical technique remains a challenge, and the risk of misidentification persists, especially in inflamed or difficult cases. To address this, structured systems for safety, such as the culture of safety in cholecystectomy, stress that CVS must be seen not as optional but as mandatory.[3,4]

Our technique integrates lessons from all these frameworks, and the approach starts posteriorly and advances in a reproducible "U-shaped dissection" arc, ensuring dissection remains above the

hepatocystic fat pad and within the R4U plane.[9] This respects the zonal demarcations of safe dissection as well as the practical value of Rouviere's sulcus as a reference line.[8,9] Moreover, dissection proceeds within the "inner subserosal layer" as described by Honda et al.[10] to standardize hemostatic, anatomical, and low-risk progression toward CVS.

Incorporating doublet photography ensures that CVS achievement is documented and verifiable. Therefore, the U-shaped technique has the potential to streamline training and improve consistency in CVS achievement. However, prospective studies on difficult gallbladder surgery are needed for further validation.[5]

Conclusion

The U-shaped dissection is a novel, reproducible, and safe technique to achieve CVS during LC. It complements established safe cholecystectomy frameworks and is particularly suited for surgical training and standardization.

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