

“Hook and Roll Technique” Using an Articulating Hook Cautery to Provide a Critical View during Single-incision Laparoscopic Cholecystectomy

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We describe a new simple and easy technique called the “Hook and roll technique” (HRT) that uses an articulating hook cautery to provide a critical view during single incision laparoscopic cholecystectomy (SILC). A 2-cm incision is made at the umbilicus to insert three 5-mm trocars or a multichannel port. After dissection of the serosa of the dorsal and ventral sides of the gall bladder, including Calot’s triangle, the angled tip of the hook cautery is inserted between the cystic artery and duct with its tip placed dorsally. The tip is then rotated in a clockwise manner to avoid bile duct injury, allowing the connective tissue between them to be hooked, coagulated and cut. This procedure is repeated several times, followed by dissection between the cystic artery and the liver bed to achieve a critical view. From December 2008 to May 2011, 121 patients underwent SILC using HRT in our hospital without any serious complications. This technique is suitable for SILC, as it consists of simple procedures that can be performed safely and easily, even by left hand in a cross-over approach, and it allows complete dissection of Calot’s triangle to achieve a critical view without using any dissector under dangerous in-line viewing.

Key words: critical view of safety, single incision laparoscopic cholecystectomy, articulating hook cautery

Laparoscopic cholecystectomy (LC) is considered the gold standard treatment for benign gallbladder diseases. The initial technique of LC was associated with various complications, including bile duct injury (BDI), due to the technical difficulties encountered in completing the procedure [1]. To prevent BDI, Strasberg and colleagues [2] introduced the concept of the “critical view of safety.” In this technique, the neck of the gallbladder must be dissected

off the liver bed to achieve conclusive identification of the 2 structures to be divided: the cystic duct and cystic artery.

In contrast, single-incision laparoscopic surgery (SILS), which has been developed in recent years, has become an optional LC technique [3, 4]. Access through a wound at the umbilicus reduces scar visibility after surgery and at the same time allows use of standard laparoscopic techniques.

The drawback of this newly introduced technique is similar to the problem surgeons faced when LC was first introduced: the avoidance of bile duct injury. To our knowledge, there is no precise and standardized

technique to achieve the critical view during single incision laparoscopic cholecystectomy (SILC). We therefore are introducing a new surgical technique that provides a critical view suitable for SILC that we are calling "Hook and roll" technique (HRT). We describe herein the technical aspects and results of SILC using HRT.

Surgical Technique

The patient was in the lithotomy position, and the surgeon stood on the left side of the patient. The assistant was on the right side, and the camera operator was between the patient's legs. Under general anesthesia, a 2-cm vertical incision was made at the umbilicus, and a veress needle (Versastep Veress System, Covidien, North Haven, CT, USA) was placed into the peritoneum. A pneumoperitoneum was established with CO₂ gas insufflation to an abdominal pressure of 10mmHg. Three 5-mm ports were placed through the same incision via separate fascial incisions. However, in the last 105 cases, multichannel ports (SILS™ port by Covidien: n = 101, EZ access by Kaken Japan: n = 2) were used instead through a 2-cm incision at the umbilicus. The surgical table was adjusted to a reverse Trendelenburg position with a slight rotation to the patient's left side. A 5-mm flexible endoscope (Olympus, Tokyo, Japan) was inserted through the lower port, while the upper ports were used by the surgeon (Fig. 1). The fundus of the gallbladder was grasped and retracted using the Mini loop retractor II™ (Covidien) through the right hypochondrium. An articulating grasper (Roticulator endodissect™, Covidien) and an articulating hook cautery (Karl Storz, Tuttlingen, Germany) (Fig. 2) were used for this technique. The hook cautery was used with its tip set at a 15° angle.

Among the 2 types of cross-over approaches (Fig. 3-A, B), type A was primarily used in this technique, with the instrument in the right hand being placed on the left side of the screen through the left upper port, and the instrument in the left hand being placed on the right side of the screen through the right upper port.

First, the serosa of the dorsal and ventral sides of the gall bladder, including Calot's triangle, were dissected using the angled hook cautery. The connective tissue between the cystic duct and the cystic artery was then dissected using HRT. In detail, the tip of the

angled hook was inserted between these structures and rotated in a clockwise fashion, and the connective tissue between them was hooked, coagulated and cut (Fig. 4). Similarly, the connective tissue between the liver bed and the cystic artery was also dissected and isolated. This procedure was repeated several times to penetrate Calot's triangle to show the liver bed dorsally (Fig. 5A), and the cystic duct and cystic artery were then dissected completely to achieve a

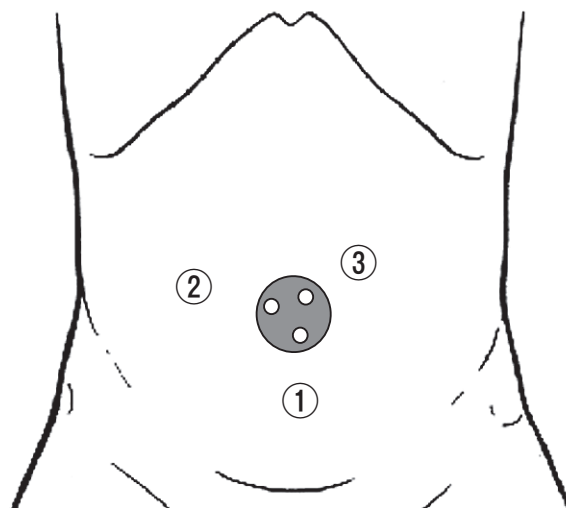


Fig. 1 Three 5-mm ports were inserted as shown in the diagram either directly or through the SILS™ port. A 5-mm flexible endoscope (Olympus, Tokyo, Japan) was inserted through the lower port (①), while the upper ports (②, ③) were used by the surgeon.



Fig. 2 An articulating hook cautery (Karl Storz, Tuttlingen, Germany). The hook cautery has a long body (46 cm), and the connecting jack is located behind the body. It is used with its tip set at a 15° angle.

critical view (complete critical view, CCV) (Fig. 5B). When a critical view could not be achieved due to

obstruction by the cystic artery (Fig. 6A), the artery was dissected first, allowing a critical view of the

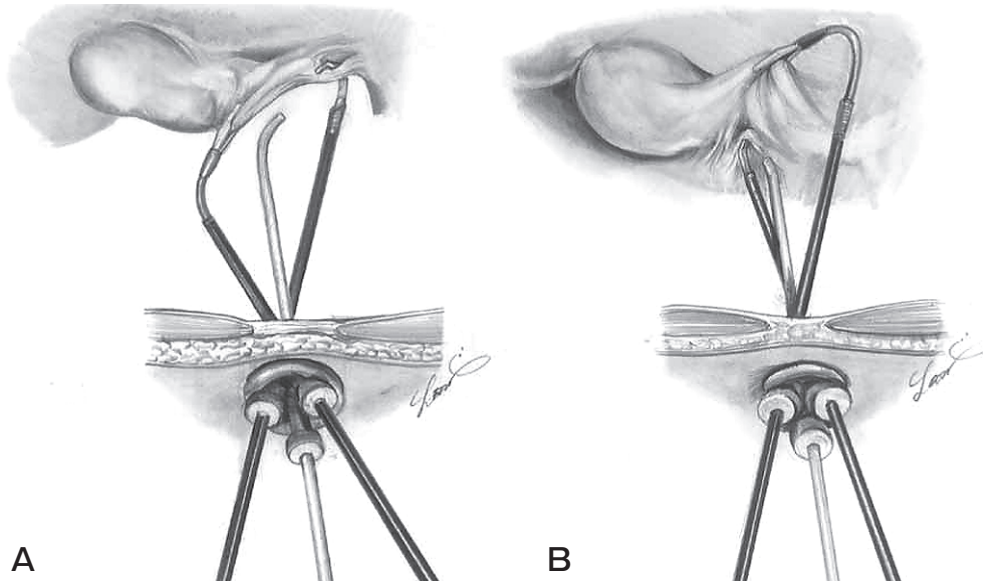


Fig. 3 The cross-over approach type (A) and type (B). In type A, the instrument in the right hand is placed on the left side of the screen to grasp the gall bladder through the left upper port, and the instrument in the left hand is placed on the right side of the screen to dissect Calot's triangle through the right upper port. In type B, the surgeon changes the instruments from the right hand to the left hand. (By permission of Leon Sakuma, Shoukaki Geka (Gastroenterological surgery) (2012) 35: 1333-1343 (in Japanese).



Fig. 4 Diagram showing the HRT

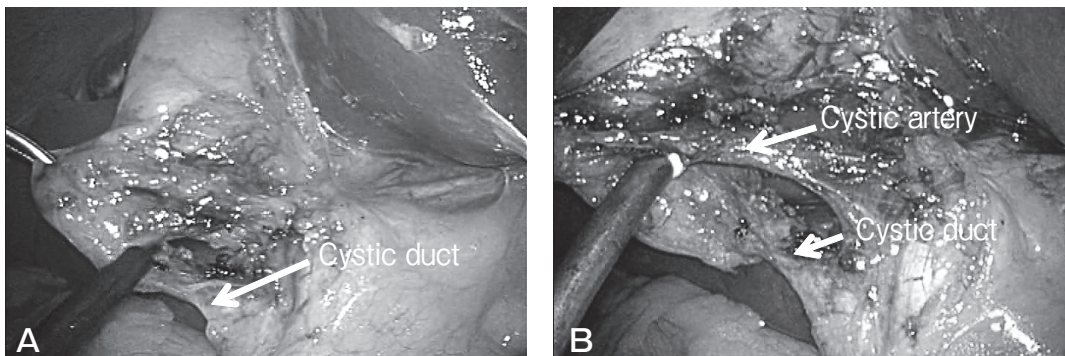


Fig. 5 Complete critical view. Calot's triangle was penetrated via several hook and roll procedures to show the liver bed dorsally (A), and a complete critical view was obtained (B).

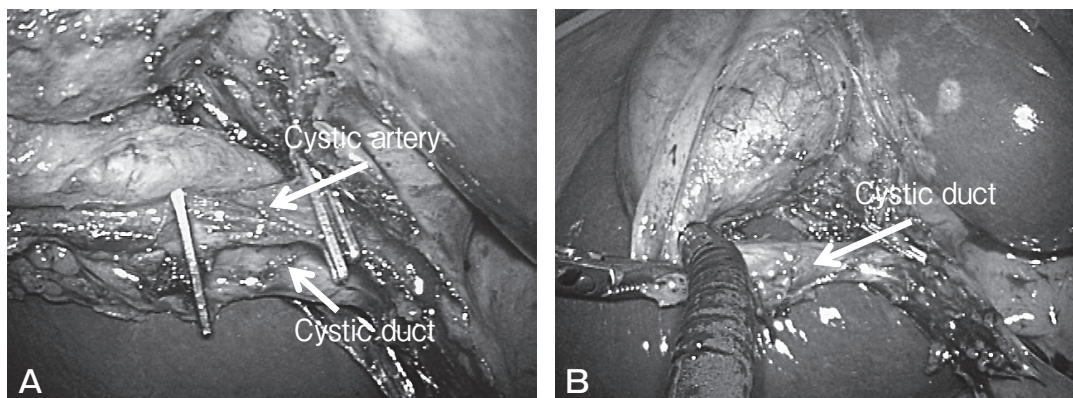


Fig. 6 Stepwise critical view. When a critical view could not be achieved due to obstruction by the cystic artery (A), the artery was dissected first and a critical view of the cystic duct was obtained (B).

cystic duct was achieved (stepwise critical view: SCV) (Fig. 6B). After the cystic duct and artery were divided, the gallbladder was dissected and cut using the hook cautery. The pneumoperitoneum was released, and the gallbladder was removed through the umbilical incision.

Results and Discussion

From December 2008 to May 2011, 121 patients underwent SILC using HRT in our hospital. The operating time was 78.6 ± 32.9 (26–177) min, and blood loss was negligible. Time from the start of the dissection of Calot's triangle and to achievement of a critical view in the most recent 25 patients was 9.7 ± 2.1 min. The critical view was achieved in 118 out of 121 patients (98.2%; CCV: 88/119, SCV: 31/119).

To perform a safe LC and reduce potential BDI, the cystic duct and artery must be completely identified. Establishment of this critical view before dissection reduces BDI [1]. The importance of the critical view has been reported based on a large series, and it has become the gold standard for avoidance of BDI [5].

However, it is difficult to dissect Calot's triangle by SILS, even when using an articulating forceps, since the angle between the forceps and Calot's triangle during SILC is quite different from that during standard LC. In such "in-line viewing," the tip of the dissector cannot always be sufficiently visualized for safe dissection.

Several surgical techniques for SILC have been

reported. Curcillo *et al.* [6] have reported a parallel approach using the same devices as those used for the standard LC. On the other hand, Tacchino *et al.* [4] have reported a cross-over approach using articulating forceps held in both hands. Romanelli *et al.* [7] have praised the cross-over approach using an articulating grasper in the right hand and the standard straight devices in the left hand. Roberts *et al.* [8] have also mentioned the usefulness of the same technique as Romanelli *et al.*, and we quite agree with their comments. Although Curcillo *et al.* [6] have reported that the critical view can be achieved using their parallel approach with standard straight forceps, we found that a conflict between each forceps and the scope was encountered more often in the parallel approach than in the cross-over approach. Joseph AR *et al.* have reported that the cross-over approach improves surgeon performance and eliminates arm collision compared to the standard technique in an experimental robotic SILS model [9]. In this cross-over approach with the robotic SILS model, the right forceps of the screen was manipulated by the surgeon's right hand by switching right and left in the robotic system. This report indicates that the cross-over approach results in better performance when the problem of having to handle the main forceps with the left hand is solved. From this perspective, our HRT is a suitable procedure for the cross-over approach since it requires only simple rotation and hooking techniques easy enough for a right-handed surgeon to carry out with the left hand for achievement of the critical view during SILC.

Two variations on our cross-over approaches were

used, as shown in Fig. 3A, B. The dissection is performed by the surgeon's right hand in type B, whereas the surgeon's left hand is used in type A. Therefore, right-handed surgeons might find it difficult to use the left hand for dissection of Calot's triangle. However, in our experience, the type A technique is suitable for safe dissection by the HRT since the hook cautery is at a right angle with both the cystic artery and the cystic duct in type A but not in type B in most patients. The method therefore allows for safe and easy rotation of the hook with its tip parallel to the cystic duct and the artery.

To rotate the hook cautery, only the soft connective tissues between the cystic duct and the artery can be hooked, and there is little risk for injury of the cystic duct and artery. Similarly, introduction of the angled hook between the cystic artery and the liver bed is also safe. In this regard, it is important to rotate the hook cautery in a clockwise manner, as a counterclockwise rotation could increase the risk of injury to the common bile duct. For that reason, the hook cautery must be rotated in a counterclockwise manner when dissecting from behind Calot's triangle. In one of our patients with a cystic duct originating from the right hepatic duct, CCV was achieved perfectly, thus illustrating the usefulness of HRT even in those patients with anomaly of the cystic duct.

However, the critical view cannot be achieved before dividing the cystic artery in all patients because the cystic duct cannot be visualized well in some patients until the cystic artery is dissected, especially in the view of SILC. We therefore divided the critical view into 2 categories: "complete" and "stepwise." In approximately 30% of patients, it was necessary to divide the cystic artery before we could achieve a critical view of the cystic duct.

Wijsmuller *et al.* [10] have reported that the surface area of Calot's triangle is significantly increased by transection of the cystic artery. Although their study was performed using embalmed human bodies, it is true that the critical view could be easily achieved after dissection of the cystic artery.

Our HRT relies in most part on the hook cautery. We regard this angled hook cautery as an ideal device for HRT at present because it has a long body (46 cm) that is sufficient to reach the operating field from the umbilicus even in a tall patient, and the connecting

jack in this device is located behind the body, an advantageous design as it avoids possible conflict among the devices used during surgery.

Finally, the type of the laparoscope is another important factor in facilitating this surgery. At present, we regard the 5-mm flexible endoscope the most suitable for SILC because it provides a good overview of Calot's triangle and viewing of the space behind the cystic duct and cystic artery.

Although several studies have discussed various technical aspects of SILC, we believe that our HRT is superior in providing a critical view during SILC for both right- and left-handed surgeons.

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