



Experiences of novel cotton device for uniportal video-assisted thoracoscopic surgery: CS Two-Way Handle™

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Abstract: In Japan, cotton is commonly used in thoracic surgery for the gentle handling of organs as well as obtaining a good surgical field. While uniportal video-assisted thoracoscopic surgery is being recognized as a major surgical approach, use of cotton is not noted in this technique. Uniportal video-assisted thoracoscopic surgery needs curved instruments because they are effective in preventing the interference of instruments. Thus, we developed a novel curved cotton instrument, known as the “CS Two-Way Handle™”, for uniportal video-assisted thoracoscopic surgery. The CS Two-Way Handle™ can be used not only as a cotton bar but also as a suction aid. Moreover, surgical smoke can be suctioned with the insertion of cotton. This instrument was introduced in our institution in September 2019, along with some other prototypes. When anatomical lung resection using uniportal video-assisted thoracoscopic surgery was first introduced, there were some instances of conversion to conventional multiportal video-assisted thoracoscopic surgery. However, after the CS Two-Way Handle™ introduction, the procedure has become easy to perform and the need for conversion to conventional methods has reduced. The main uses of the CS Two-Way Handle™ are: (I) exposure of the surgical view, (II) lymph node dissection, (III) bleeding control, (IV) suction, and (V) evacuation of surgical smoke. We present our experiences using the CS Two-Way Handle™ in uniportal video-assisted thoracoscopic surgery.

Keywords: Video-assisted thoracoscopic surgery (VATS); uniportal video-assisted thoracoscopic surgery (U-VATS); thoracic surgery

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Introduction

While uniportal video-assisted thoracoscopic surgery (U-VATS) has been recognized as a major surgical approach, it has not gained technical acceptance globally. This is mainly due to the following reasons: (I) the complexity of the surgical technique and (II) lack of equipment suitable for U-VATS. Since U-VATS needs to manipulate multiple devices from a single incision, it is necessary for the instruments to have the appropriate curvature and length to prevent interference between the instruments (1).

Conventional multiportal VATS instruments have been developed by industrial efforts and stimulated by surgeons' requests over the decades. In this respect, there is still room for improvement in the development of instruments because U-VATS is a newer surgical approach.

In VATS, a “cotton”, “peanut”, “sponge stick”, or “gauze stick” is considered an essential instrument for palpation and dissection. They are used instead of the surgeon's fingers (2). In Japan, thoracic surgeons use a commercially developed cotton “Naruke thoraco-cotton™”

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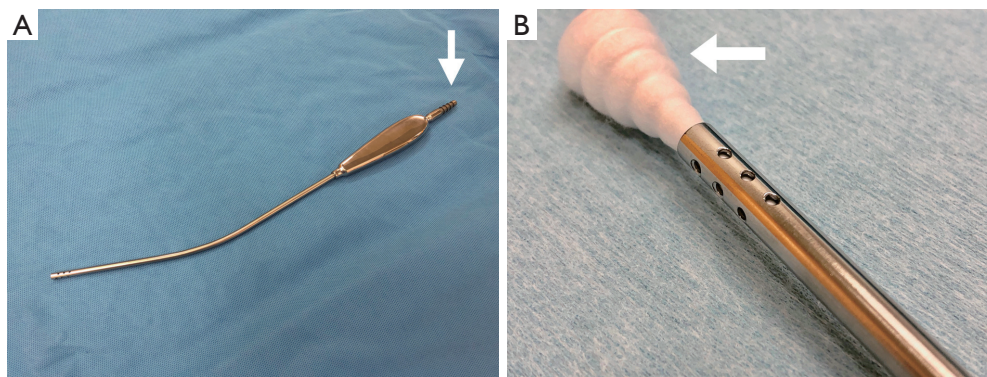
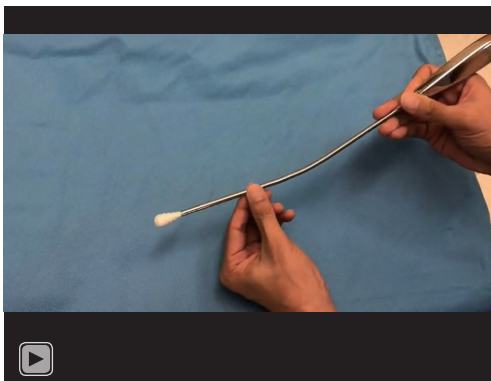


Figure 1 CS Two-Way Handle™. (A) This instrument consists of a curved bar and handle; the former has some holes in the tip, and the latter can be connected to a suction tube at its end (arrow). (B) Naruke thoraco-cotton™ (large size, arrow) and CS Two-Way Handle™. Side holes in the tip of the CS Two-Way Handle™ enables the suction of surgical smoke while cotton is inserted.



Video 1 The CS Two-Way Handle™. This instrument consists of a curved bar and handle; the former has some holes in the tip, while the latter can be connected to a suction tube at its end. The curved angle has been designed to make it possible for the cotton to be smoothly inserted and removed, and not break the inside of the bar.

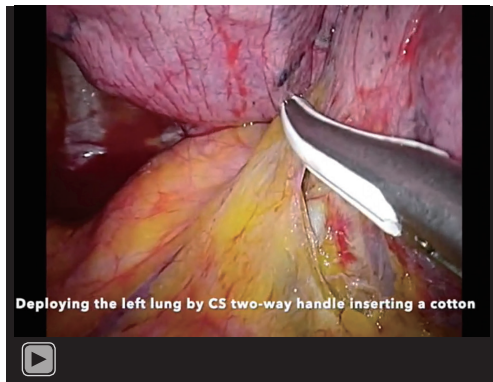
(Japan Cotton Buds Industry, Tokyo, Japan) created by Dr. Tsuguo Naruke (3). The Naruke thoraco-cotton™ is used by inserting it into a special metal rod “Naruke cotton finger™” (KENZMEDICO, Saitama, Japan). This makes it possible to gently manipulate the organs to provide an optimal view during VATS procedures. However, since the Naruke cotton finger™ is straight, the cotton was difficult to use in U-VATS. Although lung grasping forceps were used as a substitute for the cotton, lung parenchyma damage was sometimes noted when the forceps were handled carelessly or with excessive force. For this reason, a curved cotton instrument for U-VATS was necessary. In 2019, we developed a novel cotton and suction device, known as

the “CS Two-Way Handle™”, for U-VATS (Unimedica, Osaka, Japan) (Figure 1A). We introduced this instrument in September 2019, along with some other prototypes. This manuscript aims to report our experience with the use of the new device.

Brief reports

The development process of CS Two-Way Handle™

The CS Two-Way Handle™ was developed in collaboration with Unimedica (Osaka, Japan). This instrument consists of a curved bar and handle; the former has some holes in the tip, while the latter can be connected to a suction tube at its end (Figure 1B). The curved angle has been designed to make it possible for the cotton to be smoothly inserted and removed, and not break inside the bar (Video 1). The cotton we used was the Naruke thoraco-cotton™ (Japan Cotton Buds Industry, Tokyo, Japan) with a tip diameter of 5.6 mm and 12.6 mm. Both have a diameter of 3.2 mm, although the tip size is different. The price is about 100–140 yen. Tip holes were designed not only for the suction of water and blood but also for the suction of surgical smoke (Figure 1B). The purpose of the handle was to ensure effective manipulation of tension on the organs as much as possible. The final form was achieved through a process of trial and error, which involved repeated adjustments to the curvature, handle’s ease-of-grip, and length. If the curvature was too strong, it was difficult to remove the cotton, and there was a risk of internal damage. For the handle, we tried hexahedral, cylindrical, and other shapes, but these shapes sometimes slipped and tension was not applied to the tip, so the current



Video 2 Exposure of surgical view. The lungs need to be deployed with proper and gentle traction; otherwise, damage to the lungs and air leaks may occur. An advantage of using cotton is gentle maneuvers.

shape was the most effective. In U-VATS, if an instrument is too long, it may interfere with other instruments, thus in the end it was set at 37.0 cm. This was approved by the Ministry of Health, Labour Standards in Japan (JAN code: 458003273405, notification number: 27B1X00056013019). We also developed variations for robot-assisted thoracic surgery and subxiphoid approach (4), consisting of two types of long instruments with distinct curvatures.

Study design and patients

The study was conducted in accordance with the Declaration of Helsinki (revised in 2013). The study was approved by the institutional ethics board of Kurobe City Hospital (No. K-313). Written informed consent was obtained from the patients. U-VATS was introduced in 2013, while U-VATS anatomical lung resection was introduced in July 2018 (5). Currently, almost all procedures in our institution are performed by U-VATS. The exclusion criteria for U-VATS are as follows: infants, locally invasive lung tumor with angioplasty, and a large tumor with a minimum diameter ≥ 5 cm (6).

Surgical approach

General anesthesia was induced using a single-lung ventilation technique with a double-lumen endotracheal tube. The patients were placed in the lateral decubitus position. The position of the U-VATS port differed depending on the lobe. In the upper and middle lobes, a

3–4 cm port was placed at the fifth intercostal space at the mid-axillary line. In the lower lobe, a 3–4 cm port was placed at the sixth intercostal space at the post-axillary line (5). A thoracoscope was used with a 30-degree, 5 mm camera. The energy devices used were mainly advanced bipolar devices.

Conversion criteria

The conversion criteria to thoracotomy were set as follows: critical bleeding, unexpected local invasion, intractable air leaks, and severe adhesions that were difficult to manage with VATS.

Advantages and applications of the CS Two-way Handle™

There have been no adverse events or complications related to its use. We were able to smoothly insert and remove all pieces of cotton. This device has multiple uses and benefits in surgery, namely, (I) exposure of the surgical view, (II) lymph node dissection, (III) bleeding control, (IV) suction, and (V) evacuation of surgical smoke.

Exposure of surgical view (Video 2)

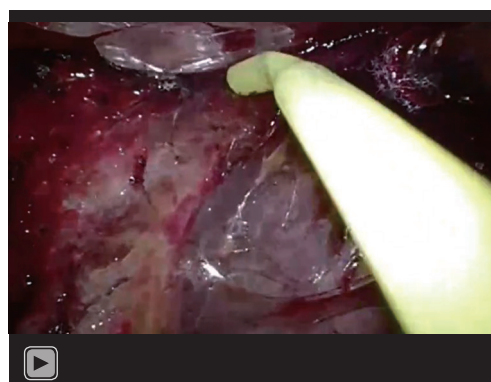
When manipulating the hilum or the interlobar fissure, the lungs located outside the intended manipulation area may be a hindrance. Consequently, it is essential to deploy the lungs. The lungs need to be deployed with proper and gentle traction; otherwise, damage to the lungs and air leaks may occur. An advantage of using cotton is gentle maneuvers. It has an exquisite frictional force and makes traction application easy. The CS Two-Way Handle™ is not just a stick; its handle makes it easy to hold and apply traction.

Lymph node dissection (Video 3)

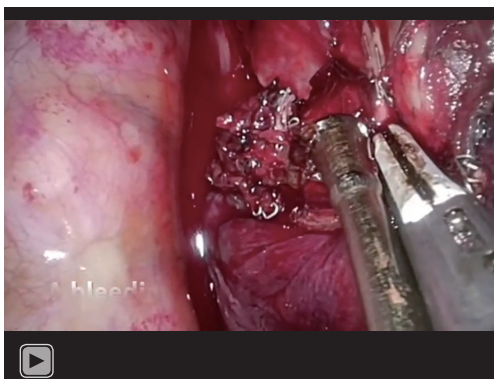
Lymph node dissection removes lymphatic tissues by separating them from the surrounding tissue. It is important to compress the superior vena cava and main pulmonary artery in the right upper mediastinum during lymphadenectomy, the bronchi and pulmonary artery during left 4th mediastinal dissection, and the esophagus and main bronchi during subcarinal lymphadenectomy (7). Damage to any of these organs can be fatal if not gently handled. Cotton is adept at gentle deployment maneuvers, as well as lung field deployments. There is also an exquisite friction force with cotton use, and it is easy to apply traction safely.



Video 3 Lymph node dissection in the right upper mediastinum. It is important to compress the superior vena cava and main pulmonary artery. Cotton is adept at gentle deployment maneuvers.



Video 5 Evacuation of surgical smoke. Surgical smoke not only obstructs the field of vision and slows the progress of surgery, but is also harmful to medical service workers in the operating room. The CS Two-Way Handle™ is designed so that surgical smoke can be suctioned by connecting a suction tube to the handle side while inserting cotton.



Video 4 Bleeding control. Most bleeding can be controlled using cotton, except for catastrophic bleeding. Cotton is very useful for both tissue retraction and control of oozing. If there is active bleeding, application of pressure using cotton could buy time until radical hemostasis.

Bleeding control (Video 4)

Most bleeding can be controlled using cotton, except for catastrophic bleeding. If there is oozing, it is possible to stop the bleeding by applying pressure only with smaller cotton (a tip diameter of 5.6 mm). Oozing from lymph nodes when their capsules are damaged obstructs the surgical view. Cotton is very useful for both tissue retraction and control of oozing. If there is active bleeding, application of pressure using cotton could buy time until radical hemostasis. Using thicker cotton (a tip diameter of 12.6 mm) could allow for more effective compression.

Suction

CS Two-Way Handle™ without cotton can aspirate water components such as intrathoracic lavage water, bleeding, and abscesses. Because it is thick (5 mm), suction efficiency is good, and it is hard to clog.

Evacuation of surgical smoke (Video 5)

Surgical smoke not only obstructs the field of vision and slows the progress of surgery, but is also harmful to medical service workers in the operating room. The surgery takes less time with fewer instruments in and out. The CS Two-Way Handle™ is designed so that surgical smoke can be suctioned by connecting a suction tube to the handle side while inserting cotton. Since there is a limit to the number of instruments that can be used at one time in U-VATS, it is an advantage to be able to maintain the field of view while using the cotton. Surgical smoke is particularly likely to occur during adhesiolysis, and it tends to stay locally in subcarinal lymphadenectomy. The CS Two-Way Handle™ is useful in these situations.

Comment

The CS Two-Way Handle™ enabled cotton device use for U-VATS. Due to its multiple uses and benefits, we believe that that the CS Two-Way Handle™ contributes to

improved accuracy and ease of operation.

Appropriate traction and counter traction are essential for a good surgical field (8). Damage to organs may lead to air leaks, bleeding, and fatal complications; hence, it is necessary to manipulate them gently. VATS uses rolled gauze or cotton (2,3). In U-VATS, the curved suction technique also called the non-grasping technique is often performed (9). The non-grasping suction technique provides adequate traction and does not destroy the tissue, but it may slip (10). In this regard, the Naruke thoraco-cotton™ enables gentle manipulation with exquisite frictional force. Since U-VATS requires an instrument with a unique curvature for the prevention of interferences (1), the curved applier was necessary for its development. It is believed that the CS Two-Way Handle™ improves the field of view and contributes to the reduction in the need for conversion or additional ports during surgery (5).

Regarding lung cancer surgery, lymph node dissection is performed by excising all tissues in the compartment surrounded by anatomical tissue (7). Because the Naruke thoraco-cotton™ is soft and elastic, and has effective frictional force, it enables gentle lifting or pressing of the tissues. Although, handling it carelessly or with strong force can still damage the organs. Yankauer suction is also an effective instrument, but the frictional force is different from the cotton. The Naruke thoraco-cotton™ is less slippery. However, when it gets wet, the frictional force decreases, so it needs to be replaced. In preparation for changing the cotton, the CS Two-Way Handle™ was developed so that it can be easily inserted and removed. The Naruke thoraco-cotton™ is tightly woven so that it does not unravel and does not remain as a foreign object. Using gauze sandwiched between forceps is also effective, but the size is different from the cotton. The Naruke thoraco-cotton™ is the minimum necessary size, so it does not interfere with the surgical view. In the case of severe bleeding, a bigger gauze compression is more suitable. However, the Naruke thoraco-cotton™ is effective in most cases of bleeding. If the bleeding point is obvious, a larger gauze may obscure the surgical view and make subsequent hemostasis procedures difficult. The largest cotton has a tip of 12.6 mm and does not obstruct the field of view.

An energy device creates surgical smoke (8,11). During mediastinal lymphadenectomy, surgeons often experience an obstructed visual field due to the retention of surgical smoke. If a suction instrument has to be taken in and out each time for the evacuation, the procedure is interrupted repeatedly. The CS Two-Way Handle™ provides a solution

to this problem as it enables the aspiration of surgical smoke while expanding the tissue with a single cotton instrument. It can be used as suction simply by connecting the wall suction tube. U-VATS has a limit on the number of instruments that can be inserted and the direction of traction because the incision is small. Therefore, it is logical to use U-VATS in such situations as it decreases the number of instruments needed.

The CS Two-Way Handle™ has mainly two weak points. The shaft's outer diameter of 5 mm and its curve were designed to ease the removal of the cotton. However, some surgeons may find it too thick or need a little more curvature.

Limitations

The surgical instruments are preferred by the surgeon. The Naruke thoraco-cotton™ is not sold outside of Japan, so it may be difficult to understand their necessity and effectiveness. However, it is a very popular device that continues to be traditionally used in Japan, and it is favored by many surgeons regardless of the surgical approach. The CS Two-Way Handle™ is currently sold only in Japan. At the time of writing this paper, the approval of the Ministry of Health, Labour Standards in Japan has been granted, but the CE mark has not been obtained.

Conclusions

We developed a novel curved cotton instrument, known as the “CS Two-Way Handle™,” for U-VATS. The CS Two-Way Handle™ was found to be useful for safer and more effective in U-VATS. This device has some benefits in U-VATS: (I) exposure of the surgical view, (II) lymph node dissection, (III) bleeding control, (IV) suction, and (V) evacuation of surgical smokes.

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Conflicts of Interest: The author has completed the ICMJE uniform disclosure form (available at <https://jtd.amegroups.com/article/view/10.21037/jtd-22-1602/coif>). The author has no conflicts of interest to declare.

Ethical Statement: The author is accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (revised in 2013). The study was approved by the institutional ethics board of Kurobe City Hospital (No. K-313). Written informed consent was obtained from the patients.

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