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Mini-Review Article

How to Minimize Wound Trauma in Single Incision Thoracoscopic Surgery

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Introduction

Single Incision Thoracoscopic Surgery (SITS) aims to provide effective surgical treatment for thoracic disease within the thoracic cavity; it strives to minimize access-related morbidity while maximizing the cosmetic advantage [1]. Since Rocco first reported uniportal Video-Assisted Thoracic Surgery (VATS) pulmonary wedge resection in 2004 [2], Gonzalez-Rivas has shown the feasibility of uniportal VATS lobectomy as a routine practice since 2010 [3]. Within the past 5 years, SITS has steadily extended its clinical applicability as a treatment for a wide range of thoracic conditions [4-6]. The Asian single port VATS symposium has been held annually since 2013, and the number of thoracic surgeons participating in SITS has been increasing [7]. As the number of SITS cases grew, new developments in surgical approaches were also introduced to avoid intercostal neuralgia. The examples of these novel techniques are subxiphoid approach [8,9] and transumbilical-transdiaphragmatic approach [10]. Furthermore, non-intubated uniportal VATS was introduced to reduce the adverse effects of double lumen endotracheal intubation and general anesthesia.

SITS is expected to have less postoperative pain and paresthesia, in addition to favorable cosmetic wound compared with multi-port VATS [11-13]. To achieve these advantages, it is essential to minimize access wound trauma and use distinctive wound closure method. Single port surgeons are always challenged to make further progress in reducing wound trauma and improve cosmetic outcome, because unless this end is achieved, patient satisfaction will inevitability decline. This mini-review will be helpful to raise the advantages of SITS to a higher level.

How to minimize wound trauma in SITS?

Incision

A reduction in the length of surgical incision is closely correlated with wound trauma and cosmesis. For SITS lobectomy, it usually requires a 4 to 6cm skin incision [14], but the current surgical techniques and instruments allow for skin incision to 2.5cmin length [15]. Recently, SITS segmentectomy with 2cm incision was reported [16]. However, in the case of malignancy, specimen extraction through a small incision may be a problem. There should be further studies on a new and safe extraction method without tumor cell spillage for cases that faces difficulty in specimen extraction as a whole.

The location of skin incision can also affect the degree of wound pain. The preferred position is between anterior-axillary line and mid-axillary line, which has a wider intercostal space compared with the posterior axillary approach. Therefore, it makes a better use of the space and is helpful in reducing intercostal trauma. A different concept for avoiding intercostal nerve and chest wall muscle injuries has been reported as subxiphoid SITS. This subxiphoid approach has proven to be less invasive than conventional VATS [8].

Pain control

There is still an ongoing debate concerning the appropriate pain control method for minimally invasive surgeries. We believe that SITS must be treated as a cutting edge minimally invasive surgery. Our strategy for pain management is an intraoperative pre-emptive bupivacaine wound infiltration with postoperative regular oral pain killers with intermittent intravenous analgesia, as needed [17] (Figure 1). Theoretically, pre-emptive bupivacaine wound infiltration reduces the degree of sensitization produced in the nervous system by incision, retraction, and trocar insertion. The nociceptive system perceives less pain compared with analgesia given postoperatively [18]. Another advantage is that it can be applied in specific areas, such as incision and chest tube insertion site. Above all, we have to keep in mind as caregivers that “an ounce of prevention is worth a pound of cure”.

Figure 1: Regular oral pain killers with intermittent intravenous analgesia.

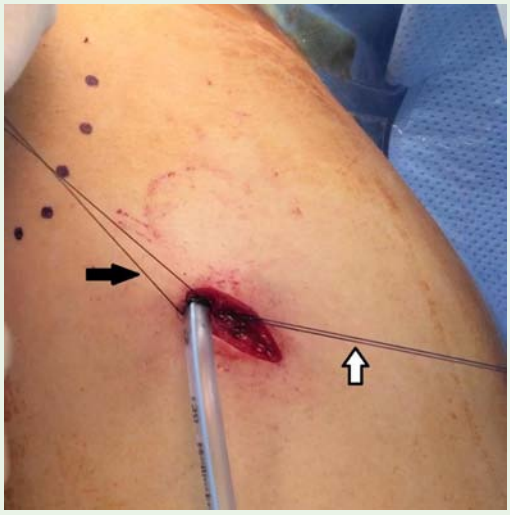

Figure 3: Chest tube tagging.

Wound protector

A wound protector is utilized to maintain a single wound window, which is helpful in preventing optical lens contamination from wound bleeding; also reducing the pain stimuli evoked by movement of surgical instruments (Figure 2). Especially in SITS, air venting is another important role for wound protector. For examples, smoke generated by electrocautery can be easily evacuated through this aperture and coming-up of the collapsed lung is prevented during the procedure.

Thoracoscope

Selecting an appropriate thoracoscope may also reduce wound trauma in SITS; this may be commonly overlooked. Usually, a 10mm rigid videoscope has been used most widely in VATS because it offers a wide range of clear vision. However, we prefer a 5mm videoscope with long working length. Although the 5mm videoscope with a long shaft may have a narrow view compared with the conventional 10mm videoscope, it can minimize instrument conflict, especially within a small port, and can also reduce the intercostal pain caused by the hinge effect of a rigid videoscope. These may contribute to minimal use of opioid drug and thoracic pain control in SITS. Furthermore, if an implantable video camera system becomes commercially available in the near future, it can eliminate blind spots and minimize-to some degree-instrument conflict and intercostal hinge pain.

Chest drain

Chest tube is a major disturbance to patients undergoing SITS. The most common cause of prolonged chest tube indwelling is persistent air leak. Meticulous interlobar and hilar dissection, careful intraoperative air leak test, and prevention of air leak from the lung surface are all essential steps to accomplish a fast track recovery. We routinely cover the hilar structure and fissural lung parenchyma with fibrinogen, thrombin, and calcium gluconate solution after SITS lobectomy. If possible, the usage of a small bore chest tube is helpful to reduce wound trauma. In our experience, a 20Fr chest tube is sufficient for when there is nearly no air leak through the water submersion test; a 28Fr chest tube is rarely used. Son *et al.* [19] suggested a novel chest tube fixation method to make more favorable cosmetic wound and reduce skin injury. In brief, subcutaneous suture

Figure 2: Wound protector.

Figure 4: Skin bond.

and ligation are performed with a 2-0 polyglactin in close proximity to the chest tube, and a 2-0 nylon is then anchored through the knot. And then, tube fixation is performed by the already prepared nylon suture (Figure 3). When the chest tube is removed, the use of a skin stapler once or twice is sufficient with mild gauze compression for two days.

Wound closure

A great amount of time is spent in the closure process to get a perfect, single wound. Our strategy is as follows: 1) Interrupted sutures are performed with a 2-0 polyglactin on the muscle layer and fascia layer; 2) a 4-0 barbed sutures are used on the subcuticular layer to make a superficial knotless state; and 3) finally, skin bond is used to prevent wound dehiscence. This durability may also attribute to decrease wound pain as well as more cosmetic effect (Figure 4).

Conclusion

SITS is continuously evolving, with the development of various techniques and instruments in efforts to minimize wound trauma. Since a small change can have a huge impact, we should all individually strive to contribute to the development of SITS, which would facilitate patient satisfaction, further perpetuating SITS development.

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