Management of intraoperative bleeding in the video-assisted thoracoscopic surgeries

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Abstract: Minimally invasive approach using video-assisted thoracoscopic (VATS) to lung and esophageal cancer resection offers enormous benefits over open surgery. Yet, the intraoperative bleeding is still a primary cause of conversion to open surgery as well as a major risk for VATS surgery. We present two cases of intraoperative bleeding during thoracoscopic lobectomy and esophagectomy. Ethical approval was obtained from the institutional ethics board. Thoracoscopic management of intraoperative bleeding was demonstrated in different operations. Calm maintenance of a clear thoracoscopic view and prompt establishment of bleeding control, may allow for suture repair of injured vessels. Despite intraoperative bleeding remains the most challenging risk factor, proper management renders minimal invasive approach safe and effective for vasculature repair.

Keywords: Intraoperative bleeding; video-assisted thoracoscopic (VATS); minimal invasive surgeries (MIS)

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Introduction

With the rapid growing experience, it became prominent that minimal invasive surgeries (MIS) essentially allow for expedited recover to baseline functionality (1) with less pain (2) and fewer complications (3,4). Importantly, recent large retrospective-cohort, non-inferiority study using the Society of Thoracic Surgeons General Thoracic Surgery Database suggested that MIS is not oncologically inferior to traditional thoracotomy for lung cancer (5). Similarly, superior short-term surgical results and equal oncological outcomes were achieved with video-assisted thoracoscopic (VATS) esophagectomy compared with open surgeries (6). MIS is becoming the standard of care for surgical treatment of early stage pulmonary and esophageal malignancy (1-4,7).

However, intraoperative bleeding in VATS surgeries remains the leading cause for conversion to open surgery and the most challenging risk factor. Even in the hands of experienced surgeons from high volume centers, the incidence of conversion to thoracotomy due to massive bleeding may surprisingly exceed 5% (8). In our institute, the common causes of intraoperative bleeding include dissection of calcified lymph nodes firmly adherent to the vessel, tear stress during stapler passage or firing, vascular hemostatic clips being ripped off by stapler accidentally. Logically, the proper management of intraoperative bleeding is of vital importance for VATS surgeries. Despite that immediate conversion to thoracotomy in the bleeding scenario is well advocated, a minimal invasive approach to hemorrhage control and vascular repair can be safe and effective in experienced hands.

Case presentation

We present two cases of intraoperative bleeding during thoracoscopic lobectomy and esophagectomy, demonstrating that calm maintenance of a clear thoracoscopic view, prompt tamponade of the vascular injury, precise bleeding control and suture repair of the defect are key elements for management of bleeding.

Figure 1 is a video demonstrating a uniportal thoracoscopic left upper lobectomy complicated with an accidental

Figure 1 Uniportal thoracoscopic left upper lobectomy with suture repair of pulmonary artery injury following effective bleeding control and vascular defect exposure (9).
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Figure 2 Minimal invasive esophagectomy with long tamponade and subsequent suture repair of esophagus nutrient artery injury (11).
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pulmonary arterial injury hit by an endoscopic stapler incurred while dissecting the left upper bronchus. Detailed operation procedure for uniportal lobectomy was described before (10). We maintained the thoracoscopic view, and a thoracoscopic suction was immediately placed overlying the injury for both tamponade and blood suction to get a clear vision. We then managed to clamp the vascular defect with long straight hemostatic forceps, below which a second piece of right-angled hemostatic forceps was placed. Two hemostatic forceps were alternatively released to expose the exact site of vascular defect. Consequently, the clear surgical field and adequate hemostasis allowed for a suture repair of the vascular defect with a continuous running stitch of 4-0 prolene.

Figure 2 is a video recording a minimal invasive esophagectomy complicated with an accidental esophageal nutrient artery injury incurred while dissecting the esophagus. Detailed operation procedure was described before (12). This patient suffering locally advanced esophageal carcinoma had received neoadjuvant chemoradiotherapy prior to surgery, yet the tumor mass stuck tightly with the descending aorta with obscure tissue boundary. An extended period of tamponade with gauze at the bleeding site sufficed to reach temporary hemostasis. As the tumor was massive in terms of size and volume, the view of bleeding site was obstructed and limited space was left for surgical manipulations. We therefore dissected the residual esophagus to expose the hemorrhage location, which significantly improved the visualization of defect location and facilitated the suture repair.

Conclusions

We intend to illustrate with these videos our experience for management of intraoperative bleeding in the VATS surgeries. A prompt and precise control of bleeding should be established with gentle pressure, which allows the surgeons to assess the severity of injury. Judged from their own surgical skills and experiences, the surgeons could then make a decision whether a conversion to open surgery is necessary. Under the circumstances of moderate hemorrhage, gentle tamponade with hemostasis clamp usually suffice subsequent suture repair or direct hemostasis as demonstrated in these videos. Extended period of tamponade is sometimes demanded as shown in *Figure 3*. There is also an option to temporarily occlude pulmonary artery trunk in case of massive bleeding or poor exposure for clamping in VATS lobectomy. The pulmonary artery trunk could be temporarily occluded by either passing a vessel loop twice around the left or right main pulmonary artery and gently applying tension to the looped suture (serving as a tourniquet) thoracoscopically (13), or directly using vascular clamp after thoracotomy. Clamping the pulmonary artery trunk within the pericardium is an option but not always necessary. We also consider it helpful to remove the residual esophagus (or lobe) to improve the visualization and operating space. Our experiences confirm the feasibility of a minimal invasive approach for intraoperative bleeding management. However, once the significant bleeding could not be controlled by compression with sealant (Fibrillar, Ethicon, San Lorenzo, Puerto Rico), gauze or vascular clamp, followed by rapid blood loss more than 800 mL, an emergent conversion to mini- or thoracotomy is recommended. Notably, compression with

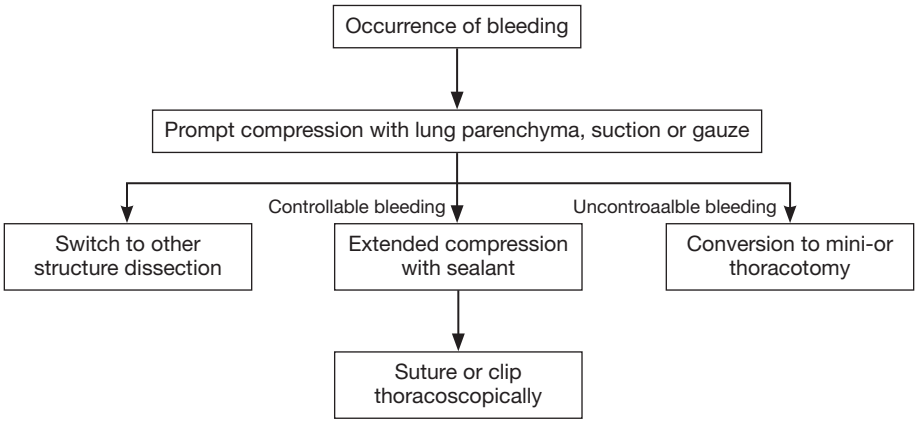

Figure 3 Proposed algorithm of conversion to thoracotomy.

sealant seemed more effective when dealing with arterial injuries as compared with gauze. Hemostatic clip should be used with caution as it may cause further damage to the vessels when surgical vision is obscure. Despite the decision for conversion does vary depending on individual experience, technique and confidence of the surgeon, we have proposed an algorithm for conversion from our own experience.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

Informed Consent : Written informed consent was obtained from the patient for publication of this manuscript and any accompanying images.

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