A novel tourniquet technique for transient pulmonary artery occlusion during video-assisted thoracoscopic surgery

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Central Message

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▶ Video clip is available online.

With the development of surgical technique and instruments, video-assisted thoracic surgery (VATS) has become more widely used in the treatment of lung cancer, including more complicated procedures, such as big, central tumors.

The advantages of VATS for lobectomy have been reported, including reduced perioperative pain, shorter hospital stays, preservation of pulmonary function, and less surgical complications. In addition, the oncologic results of VATS in terms of local recurrence and overall survival are equivalent to those of conventional thoracotomy.¹

However, concerns over how to manage inadvertent pulmonary artery injury are still prominent for thoracic surgeons. Previous studies reported that the presence of fibrocalcified lymph nodes were the primary cause of conversion in VATS lobectomy.^{2,3} In such cases, dissection of vessels can be difficult, and the risk of vascular injury is high, even during thoracotomy. It is still a great challenge to deal with massive bleeding during thoracoscopic lobectomy. Safe and effective occlusion of the pulmonary artery under a thoracoscope is a key step to avoid conversion to thoracotomy.

We describe our technique of achieving transient pulmonary artery occlusion using a tourniquet during VATS lobectomy. This has been used routinely and safely in our practice for more than 2 years and offers substantial advantages over other techniques described in the literature.

VATS pulmonary arterial angioplasty in the left upper lobe is the most frequently performed and will be described in this report. The case was a 74-year-old male patient who was found to have a left upper lobe mass during a health

check. Contrast-enhanced thoracic computed tomography revealed multiple enlarged lymph nodes around the branches of the left upper pulmonary artery (Figure 1). Positron emission tomography/computed tomography suggested malignancy and excluded mediastinal lymph node or distant metastasis. All other test results were within normal range.

SURGICAL TECHNIQUE

The patient was placed in a lateral decubitus position under general anesthesia with a double-lumen endotracheal tube. A 3-cm incision was placed routinely in the fourth intercostal space for a left upper lobectomy. A wound protector kept the wound open by retracting the soft tissue.

Intrapleural adhesions were divided with a Harmonic device and an electro scalpel. The left hilar and aortopulmonary window lymph nodes were then dissected. The oblique fissure was opened to expose the arterial branches of the lingular and posterior segments. These 2 branches were ligated and divided. We then encountered the first branch of the pulmonary artery that could not be directly divided because of swollen lymph node involvement. The superior pulmonary vein was transected to allow a better view of the pulmonary artery. After positioning the double suture line (Covidien Suture Surgilon 0 [3.5 METRIC] Black Braided Nylon; Dublin, Ireland) with a passage around the main pulmonary artery and the interlobar artery, the suture line was pulled to the outside of the occlusion tube and fixed with a polymer tube in traction to maintain

FIGURE 1. A, Chest computed tomography shows a mass located in the left upper lobe. B and C, An enlarged lymph node (*arrow*) around the first branch of the left upper pulmonary artery.

the necessary occlusion pressure (Figure 2). Before clamping the pulmonary artery, 5000 units of heparin were given intravenously to prevent clotting.

After dissecting the adhesion between the lymph nodes and the first branch of the pulmonary artery, this branch was cut off by a linear cutting stapler. The distal tourniquet was removed to ensure intactness of the artery, and the proximal tourniquet was removed. The bronchus was transected, and the specimen was removed using an Endobag (Covidien). Systematic mediastinal lymphadenectomy was performed routinely operative time, 120 minutes; occlusion time of the pulmonary artery, 15 minutes; blood loss, 50 mL (Video 1).

CLINICAL SUMMARY

Between July 2016 and October 2017, we applied this technique in 17 patients who received a left upper

lobectomy. All patients were operated under the protection of this tourniquet technique. The artery was broken during lymph node dissection in 9 patients, of whom 5 required angioplasty (several Prolene stitches) after the branch of artery was divided by a linear cutting stapler. Mean occlusion time of the pulmonary artery was 15.6 ± 4.1 minutes.

They were followed up for at least 3 months. Chest computed tomography during the third or sixth postoperative month showed no pulmonary artery stenosis, aneurysmal formation, or pulmonary thromboembolism.

DISCUSSION

Intraoperative bleeding caused by dense pulmonary vascular structure adhesions during VATS lobectomy is risky because controlling the sudden bleeding can be a surgical crisis. In such cases, the VATS approach is converted to an open thoracotomy because of the lack of an adequate

FIGURE 2. A, After positioning the double suture line with a passage around the main pulmonary artery and the interlobar artery, the suture line was pulled to the outside of the occlusion tube. B, The suture line is fixed with a polymer tube in traction to maintain the occlusion pressure desired.

VIDEO 1. VATS left upper lobectomy with transient pulmonary artery occlusion. Video available at: [http://www.jtcvsonline.org/article/S0022-5223\(18\)30606-8/fulltext](http://www.jtcvsonline.org/article/S0022-5223(18)30606-8/fulltext).

device or technique for pulmonary artery clamping during VATS lobectomy.

Safe and effective control of pulmonary artery under a thoracoscope is a key step in this surgery. Nakanishi and colleagues⁴ used Satinsky clamps to control the proximal and distal pulmonary artery through 2 utility incisions. Watanabe and colleagues⁵ used a 1-0 silk suture to clamp the main pulmonary artery. The present technique avoided making an additional port and saved more operative space for surgeons. After clamping the pulmonary artery, a sharp dissection could be performed safely to achieve a complete resection of the artery involved, and thoracoscopic angioplasty could be achieved.

The tourniquet might induce injury on the intima of the pulmonary artery because of excessive clamping force. An elastic tourniquet may be a better choice for this concern. A prophylactic dose of a low-molecular-weight heparin such as dalteparin or enoxaparin was used after the operation to prevent deep vein thrombosis and pulmonary embolism. Chest computed tomography follow-up on the third or sixth postoperative month showed no local complications, such as pulmonary artery stenosis, aneurysmal formation, or pulmonary thromboembolism. We recommend the technique for patients with difficulty on pulmonary artery dissection during VATS lobectomy.

CONCLUSIONS

The tourniquet permits rapid, easy, and safe occlusion of the pulmonary artery and reduces the risk of abrupt intraoperative bleeding and the chance of converting to open thoracotomy, and avoids pneumonectomy.

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