Editorial

Future view of safe, painless and curative video assisted thoracoscopic surgery for lung cancer

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Before video-assisted thoracoscopic surgery (VATS) became widespread, surgical curability was thought to be the most important issue concerning thoracic surgery; extended surgery was preferred, and postoperative pain did not appear to be a priority. Therefore, only few studies have so far focused on postoperative pain associated with VATS. Although surgical disease curability is important, postoperative pain is also an important issue for patients. Patients will choose to undergo surgery in the institute that can perform both curative and postoperatively painless surgery if possible. Lesser postoperative pain also leads to earlier ambulation and discharge, and could potentially allow earlier initiation of the next stage of therapy (including chemotherapy and radiation) due to faster patient recovery both mentally and physically; this may result in a better outcome.

Conventional thoracotomy caused prolonged postoperative pain due to the transection of ribs and intercostal nerve injury. Rib resection may be avoided in anterolateral or posterolateral thoracotomy, but a rib retractor may still be used. In contrast, VATS is performed without rib transection, intercostal nerve injury, or the use of a rib retractor. VATS was shown to reduce postoperative pain and improve quality of life compared with anterolateral thoracotomy in treatment of stage I non-small cell lung cancer (1). Interestingly, although VATS is superior to anterolateral thoracotomy in the degree of immediately postoperative pain, the degree of severe pain in the two groups after a long postoperative interval was similar (1). Thus, the main advantage of VATS may be reduction in immediately postoperative pain.

The questions that must be addressed are how VATS compares to conventional thoracotomy in terms of safety, curability (including lymph node dissection and prognosis), and surgical indication. These questions have been investigated in many recent reports.

Regarding safety, some authors have reported that VATS is a safe and feasible treatment (2). Risk factors for major adverse events in VATS include age >70 years, comorbidities, long operative time, and hybrid procedure (3). VATS has the major advantage of providing an enlarged field of view, allowing precise surgery to be performed. However, the appropriate surgical technique for cases involving major bleeding, extensive lung adhesion and prior operation history must be carefully considered without sticking to VATS procedure. The best procedure must be selected according to the case details.

Regarding curability, it has been reported that VATS lymph node dissection is effective, and that the systemic and local recurrence rates are significantly lower after VATS compared with conventional thoracotomy (4,5). Nakano *et al*. reported that VATS was associated with less intraoperative bleeding and shorter hospital stay than thoracotomy, and that the 5-year overall survival rate was similar in both techniques (6).

The indication of VATS has been extended to include advanced cases such as patients with stage IIIA or primary lung cancer >5 cm in diameter (2,6). In cases involving

large tumor size, VATS lobectomy may be performed by implementation of an approach that involves removal of the resected lobe through an abdominal incision (7). However, the suitability of VATS remains unclear for cases in which chest wall resection or extended lymph node dissection is required. Future long-term follow-up data is needed to clarify this.

Recently, uniportal VATS has been compared with multi portal VATS. Uniportal VATS may be better from an aesthetic point of view, but it is unclear whether postoperative pain is decreased. Some authors reported that uniportal VATS was safe and feasible, and led to better outcomes than multi portal VATS (8,9). However, others reported that uniportal VATS was similar to multi portal VATS in timing of chest drain removal, duration of hospitalization, complication rate, 30-day mortality, and outcome (10). At the moment, the effectiveness of uniportal VATS is controversial. Regarding two-dimensional (2D) versus three-dimensional (3D) VATS, Yang *et al*. revealed that 3D VATS can be performed in a shorter operative time than 2D VATS (11). 3D VATS will be popular procedure in the near future.

The number of comparative analyses between robotic surgery and VATS is increasing. So far, research has shown that complication rate, duration of hospitalization, and 30-day mortality after robotic surgery are almost the same as after VATS (12). Further clinical research into robotic surgery is anticipated.

The learning curve for VATS is similar for surgeons with limited experience and for more experienced senior surgeons (13). A commercially available virtual reality simulator for VATS lobectomy has come to be used (14), although Jensen *et al*. have shown that traditional black-box training was still more effective compared to virtual-reality laparoscopy (15). Moreover, 3D image reconstruction using 3D computed tomography technology for preoperative simulation in thoracic surgery was developed (16). Therefore, it may not be difficult for young surgeons from the internet generation to acquire the technique of VATS.

In conclusion, VATS lobectomy causes minimal postoperative pain and avoids a long thoracic incision, extensive rib injury, and the use of a rib retractor. The procedure of VATS lobectomy for patients with stage I lung cancer has already been established (17). The indication of VATS will be further extended in the future, as the operative complication rate and prognosis in VATS lobectomy are almost the same as those in conventional thoracotomy.

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