Editorial

Is Robot-Assisted Thoracic Surgery for mediastinal disease truly minimally invasive?—anesthesiologists' perspective

Izumi Kawagoe^

Department of Anesthesiology and Pain Medicine, Juntendo University School of Medicine, Tokyo, Japan

Correspondence to: Izumi Kawagoe. Department of Anesthesiology and Pain Medicine, Juntendo University School of Medicine, Tokyo, Japan. Email: ikawago@juntendo.ac.jp.

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The superiority of robots in surgery for mediastinal diseases (1) is true from a surgical perspective, although this is not entirely true in terms of anesthesia. Robot-assisted thoracic surgery (RATS) is a new technique that was introduced in the early 1990s. In recent years, RATS has become more widespread and was positioned as a minimally invasive procedure at the beginning of the 21st century. The benefits of RATS lie in its lesser invasiveness, clearer three-dimensional visualization of the surgical field, greater precision and dexterity, and easier accessibility of targets with more flexible devices, compared with open or video-assisted thoracic surgery (VATS) (2,3). Recently, the number of RATS performed is increasing, while that of open thoracotomies is decreasing and that of VATS remains unchanged (4). Like VATS, RATS also requires a number of small incisions. However, although each incision for RATS is smaller, the number of incisions is not always less than for VATS. Yet, few previous studies have evaluated postoperative analgesia after RATS. Postoperative pain after RATS might be intense than expected because the surgical incisions range over many intercostal spaces, and due to the unique operating modes of the devices used in RATS (5-9). We previously investigated postoperative analgesia following RATS for mainly lung resection, comparing an intravenous patient-controlled analgesia (IV-PCA) group with a thoracic epidural analgesia (TEA) group (10). The study revealed that pain after RATS is severe, as was also suggested by the data showing higher pain scores and more rescue analgesic requirements in the IV-PCA group than in the TEA group. We typically use TEA for RATS in patients undergoing lung resection.

While, in RATS for mediastinal tumors, the number of surgical incisions is similar or less to the number required for RATS lung resection, the incisions are spread over fewer intercostal spaces. Additionally, the procedure might involve significantly less intrathoracic invasiveness as compared to RATS for lung resection in terms of postoperative pain. We currently use superficial thoracic blocks, such as erector spinae plane block (ESPB) (11-13) and thoracic paravertebral block (TPVB) (14) to achieve a good postoperative course and decrease the hospital stay to a single night in patients undergoing RATS for mediastinal disease. However, unfortunately, postoperative pain for RATS is not well investigated, especially in RATS for mediastinum, further studies on postoperative analgesia following RATS for the mediastinal disease are necessary. From a surgical perspective, RATS for mediastinal tumor resection has a few disadvantages: the mediastinum can be likened to a surgical area with tiny, sometimes difficult to reach, spaces with major vessels and nerves, where manipulation might be risky, so very precise dissection is required (1,15). Despite these disadvantages, oncologically comparable, if not superior, results are obtained both in the field of lung and mediastinal tumors. Further, from an anatomical perspective, the indications for RATS surgery have been increasing recently, and have even been extended to thymectomy as a treatment for myasthenia gravis (MG), which is usually performed via the lateral thoracic

^ ORCID: 0000-0002-5791-2700.

intercostal approach in our institution.

The anesthetic management for thymectomy in MG patients has been controversial for several decades for various reasons. First, neuromuscular blockade (NMB) should be avoided since it might lead to the need for prolonged postoperative mechanical ventilation, and, hence, regional anesthesia is preferred in these patients. Second, since it is essential to prevent perioperative cholinergic and myasthenic crises, it is important to reduce perioperative pain-induced stress by the administration of adequate analgesia. If nondepolarizing NMBs are used, the dose should be reduced to one-third or less, depending on the severity of the MG disease. Additionally, with the use of objective quantitative neuromuscular monitors, the right amount of NMBs to facilitate intubation can be titrated for the individual patient (16,17). Subsequent redosing can be at a fraction of the intubation dose and triggered by the return of train-of-four (TOF) responses or diaphragmatic excursion.

Currently, anesthesiologists are exploring the best anesthetic methods for RATS for thymectomy in MG patients (18). However, the relationship between MG exacerbation and NMBs has not been well investigated. A recent review (19) of anesthetic considerations for thymoma surgery and in MG patients reported that intubation should be avoided and the NMB dose should be reduced or completely avoided, even in patients who require intubation, since the use of NMBs might increase the risk of prolonged muscle weakness and myotonic crisis. Additionally, in many institutions, conventional TEA with or without opioids is preferred for intra- and postoperative analgesia due to its strong analgesic effect, and because it produces deep sedation and immobility without NB.

However, the biggest problem with this anesthesia protocol is that sudden intraoperative movement of the patient due to insufficient immobility during RATS is very dangerous, because, in extreme cases, the surgical port fixed to the patient's body surface might damage the heart. Hence, although RATS thymectomy is generally considered minimally invasive from surgical and patient perspectives, it is highly dangerous from the anesthesiologist's perspective. In Japan, RATS thymectomy for MG patients has been covered by national health insurance since 2019. Therefore, the number of RATS cases has been increasing. Although it is agreed that the use of NMBs is best avoided, there is currently still no gold standard anesthetic management protocol for thymectomy in MG patients, in particular for RATS. Other perioperative factors associated with MG exacerbation that should also be considered include the type of surgery, trauma, infection, fatigue, thyroid disease, preoperative bulbar symptoms, medications affecting the neuromuscular junction and opioids (19). Consequently, adequate analgesic methods, such as TEA and other thoracic blocks, should be administered to achieve adequate immobility during RATS thymectomy in MG patients.

Minimally invasive surgical techniques, adequate postoperative analgesia including regional analgesia, and avoidance or judicious administration of NMBs during the perioperative period if NMBs are used, are recommended in MG patients undergoing RATS for mediastinal diseases.

Further multifaceted experience is required to ascertain whether "RATS is ideal in mediastinal diseases", particularly during thymectomy in MG patients.

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