

Clinical innovations in minimally invasive surgery in Korea

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Abstract: Over the past decade, the surgical approach to treating thoracic disease has shifted to minimally invasive surgery. Without compromising the outcomes, this approach may lead to fewer resections and fewer incisions for those resections. Video-assisted thoracoscopic surgery (VATS) is a recent but major advancement that has become an established approach for major thoracic surgery. More recently, robotic surgery has been gaining recognition because it can overcome the limitations of VATS and encourage a minimally invasive approach. Indications and applications of many other innovative surgical techniques and strategies to improve overall survival have expanded rapidly. In this article, we do not represent all thoracic surgeries occurring in Korea and do not reflect the large active centers in the country. However, as one of the most innovative and active Korean centers for thoracic surgery and research, we reviewed our procedures and programs for thoracic surgery.

Keywords: Minimal invasive thoracic surgery; robotic surgery; single port video-assisted thoracoscopic surgery (single port VATS); image-guided thoracic surgery

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Changing trends of VATS in Republic of Korea

In Korea, innovative devices have driven the rapid shift to minimally invasive surgery for thoracic procedures. The number of minimally invasive operations has been increasing (*Figure 1*); the minimally invasive approach to thoracic disease has been popularized by various organizations and is now the standard procedure in Korea. Earlier, a pioneer in video-assisted thoracoscopic surgery (VATS) was not able to attain sufficient interest within the country and could not establish the technique as strongly here as in other countries (1,2). Many Korean thoracic surgeons have been encouraged to use VATS by the Korean Association of Thoracic Surgical Oncology (KATSO) and the Asia Thoracoscopic Surgery Education Program (ATEP), an Asian collaborative VATS education program (3). Currently, most thoracic surgeons in Korea perform VATS (4). It is not clear who performed the first VATS lung surgery in Korea, but literature reviews in the

Korean Journal of Thoracic Cardiovascular Surgery revealed that VATS was first used in 1991 (5) and was first used for major lung resection in 1993 (6). VATS has been used increasingly frequently to treat thoracic disease, and the volume of robotic thoracic surgeries being performed has gradually increased in Korea: there were 2 centers in 2006, but 16 centers in 2015 (7). In addition, single-incision VATS has recently been popularized and is considered a feasible thoracoscopic alternative to conventional multiport VATS (8-10). Obviously great changes and progress has been made in thoracic surgery. *Figure 2* shows the rapid evolution in thoracic surgery in our center between 2000 and 2015. Currently, the single-port approach is often used for thoracic surgery at our center (11,12), but it is not popular at the major centers in Korea (>2,000 cases per year). Compared to conventional VATS, the single-port approach requires longer operation times and a longer learning curve at early period. In addition, the instruments

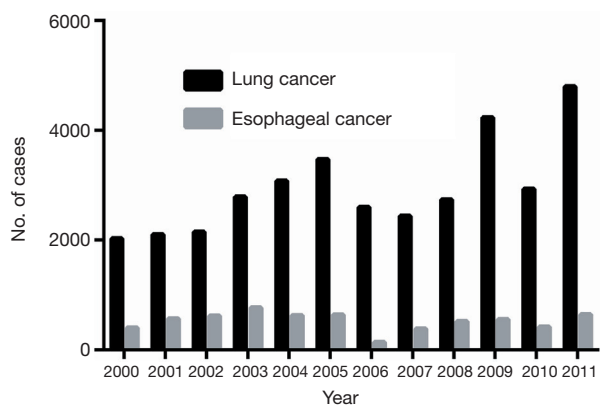


Figure 1 Major thoracic surgery in Korea. Data from the Association of Korean Thoracic and Cardiovascular Surgery.

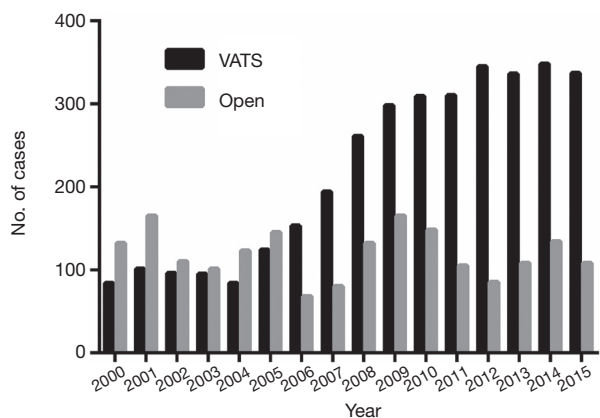


Figure 2 Changes of thoracic surgery in major lung resection. Data from Korea University Guro Hospital, Department of Thoracic and Cardiovascular Surgery. VATS, video-assisted thoracoscopic surgery.

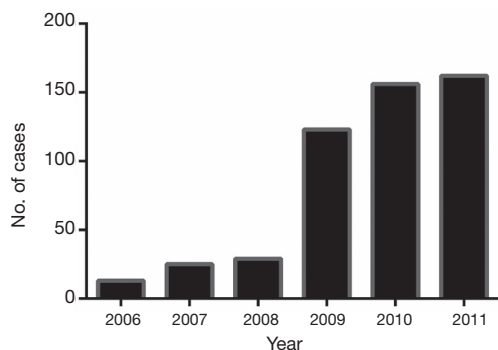


Figure 3 Robotic thoracic surgery in Korea.

for single-port VATS may not be as easily available as those for conventional VATS. These reasons have prevented widespread adoption of this innovative technique. In addition, the socioeconomic environment and debates over the increasing national medical costs and insurance limit the introduction of new instruments and devices without great benefit for patients even though they showed clear clinical evidence of success. Alternative techniques such as uniportal surgery (13,14) and robotic surgery for lung (15) and esophageal cancer (16) are being promoted by a few pioneers in Korea.

Robotic surgery in Korea

Robotic surgical systems provide high-definition 3-dimensional video systems, articulated wrists, tremor filtering, and other functions that are limited in conventional VATS systems. In Korea, robotic surgery for thoracic disease began in 2006 (7). Between 2006 and 2011, the use of robotic surgery for thoracic disease increased sharply in major hospitals; by 2011, this technique was being used for 150 patients per year (Figure 3). The most common indications were lung cancer, esophageal cancer, and mediastinal tumors. Some thoracic surgeons had reported the early outcomes of robotic surgery for lung cancer and esophageal cancer. However, the recent trend in robotic surgery has changed in Korea; currently, only a small number of thoracic surgeons perform robotic surgery, and these operations have been centralized to a few high-volume centers. In addition, higher costs, lack of clear benefits, and low volumes in most centers may be major causes in this phenomenon. In addition, because of specific provisions in the Korean National Health Insurance Service (NHIS), the patients are responsible for all medical costs of robotic surgery for thoracic disease. In contrast, more than 90% of the medical costs for other surgical procedures (VATS, open surgery) can be reimbursed by NHIS. Despite having many advantages for surgeon, robotic surgery is not used as often for thoracic disease as it is for other indications. This intuitive, remote surgical system has become the standard approach for pelvic, urological, gynecological, and colorectal surgery. However, the absolute indication for use in thoracic disease remains unclear, unlike for the use of VATS surgery in thoracic disease. Unfortunately, our center recently started using a robotic system [2016] and has not many experiences. The previously mentioned problems regarding medical cost reimbursement and centralization to high-volume center for proper education should be addressed.

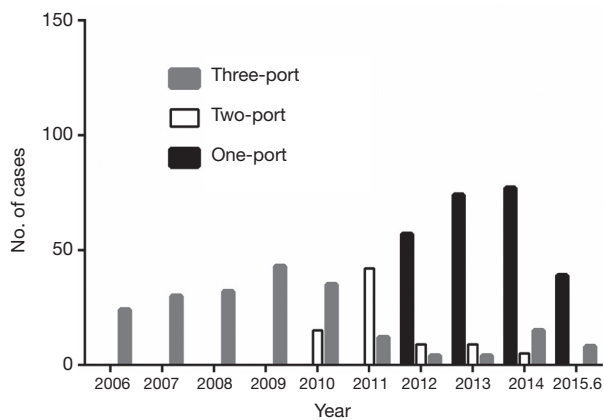


Figure 4 Changes of minimal invasive thoracic surgery in major lung resection. Data from Korea University Guro Hospital, Department of Thoracic and Cardiovascular Surgery.

Single-port VATS in Korea

Over the past decades, the minimally invasive approach has been used increasingly for thoracic surgical procedures; today, most of thoracic surgeries performed are minimally invasive. Recently, single-port VATS (uniportal or single-incisional approach) has been introduced as an alternative to conventional multiport VATS procedures (12,17); our center launched this procedure in 2005 (8). We have changed our procedure from conventional VATS to the single-port version for most thoracic diseases, including benign lung cancer and other lung diseases (*Figure 4*). The concept behind this procedure is that VATS can be performed through one small (2–4 cm) hole with the same benefits as multiport VATS, but with fewer incisions and less intercostal pain. Because of the technical limitations of the instruments, only a few thoracic surgeons are performing this procedure in Korea. However, uniportal VATS might become more popular in the future, with improvement in endoscopic instruments.

Innovative surgical option for thoracic surgery in Korea

As the elderly population in Korea has rapidly grown over recent decades, the number of older patients who need thoracic surgery has increased. In clinical situations, we usually encounter elderly patients (more than 75 years) who have early lung cancer with poor pulmonary reserve or with other comorbidities. Minimally invasive surgery could be the best option for these patients, for whom it may not be possible to perform open surgical procedures safely. Our

center is now focusing on using various innovative, image-guided surgical techniques to minimize resections and incisions, and we are performing clinical trials regarding this issue. Preservation of normal lung parenchyma might be an important prognostic factor for surgery, especially in older patients. Recent advances in image-guided VATS in hybrid settings (18,19) and in electromagnetic navigational bronchoscopic localization tools (20) might enable us to correctly localize tumors to perform sublobar resections, such as segmentectomies in patients with poor pulmonary reserve. In the near future, the use of image-guided surgery with various innovative techniques will increase and could become popular (21). Our center is the one of leading groups in Korea for clinical research on image-guided surgery with near-infrared imaging systems, although this technique is not popular at large volume centers (22).

Summary

Advancements in techniques have allowed thoracic surgery to evolve from radical resection by open surgery to minimal resection with minimally invasive techniques, and from requiring large incisions to requiring small incisions. Such changes in thoracic surgery are being seen in Korea. These innovations were made possible in Korea by pioneer surgeons who were dedicated to minimally invasive thoracic surgery and who overcame many obstacles to understand and adopt the latest surgical techniques. Currently, many Korean hospitals, including our center, are experiencing great changes in thoracic surgery, and the future will be challenging for young thoracic surgeons who are training in this country. The clinical experiences of Asian thoracic surgeons and the cooperation among them in research will promote the advancement of thoracic surgery in the future.

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Footnote

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

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