Successful concomitant minimally invasive surgery for aortic valve stenosis and right lung cancer via right mini-thoracotomy: a case report

Satoshi Sakakibara
Osaka General Medical Center

Hiroyuki Nishi (✉ hiroyukinishi24@yahoo.co.jp)
Osaka General Medical Center

Shinya Fukui
Osaka General Medical Center

Mutsunori Kitahara
Osaka General Medical Center

Kazuma Handa
Osaka General Medical Center

Yumi Kakizawa
Osaka General Medical Center

Takasumi Goto
Osaka General Medical Center

Yasunobu Funakoshi
Osaka General Medical Center

Case Report

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Abstract

Background

The case of aortic valve stenosis complicated with lung cancer have compelled cardiovascular surgeons to make challenging. We report the first successful short-term outcomes of one-stage minimally invasive aortic valve replacement and video-assisted thoracoscopic surgery lobectomy through right mini-thoracotomy in a patient with synchronous bicuspid severe aortic valve stenosis which was unsuitable for transcatheter aortic valve implantation and right lung cancer.

Case presentation

A 76-year-old man with severe aortic valve stenosis was diagnosed with lung cancer of the right upper lobe. Considering the potential risk of tumor metastasis, a one-stage surgical therapy for right lung cancer and aortic valve stenosis was required; however, transcatheter aortic valve implantation was unsuitable due to a bicuspid aortic valve with severe calcification. Therefore, concomitant minimally invasive aortic valve replacement and lobectomy via right mini-thoracotomy were performed. The postoperative course was uneventful.

Conclusion

Concomitant aortic valve replacement and right lobectomy via right mini-thoracotomy may reduce surgical invasiveness, leading to early recovery. This surgical strategy is a useful option, particularly for patients with aortic valve stenosis complicated with right lung cancer.

Background

The incidence of concomitant cardiovascular diseases and lung cancer (LC) is increasing. These cases have compelled cardiovascular surgeons to make challenging, individualized choices, integrating life expectancy and quality-of-life assumptions. Traditionally, such cases are surgically approached by staged or simultaneous open strategies that present significant morbidities and surgical risks. We report the first successful short-term outcomes of one-stage minimally invasive aortic valve replacement (MICS-AVR) and video-assisted thoracoscopic surgery (VATS) lobectomy through right mini-thoracotomy in a patient with synchronous bicuspid severe aortic valve stenosis (AS) and LC.

Case Report

A 76-year-old man presenting with severe AS was admitted to our hospital for investigation of a nodular shadow in the right upper lobe of the lung on computed tomography (CT) (Fig. 1A). Histopathological analysis by transbronchial biopsies demonstrated adenocarcinoma. Echocardiography showed a heavily calcified type 0 bicuspid aortic valve and severe AS with an orifice area, peak velocity, mean pressure gradient, and left ventricular ejection fraction of 0.59 cm$^2$, 4.2 m/s, 47 mmHg, and 79%, respectively.
Given the decreased potential risk of tumor metastasis and early recovery to normal work, a one-stage procedure was desirable. However, transcatheter aortic valve implantation (TAVI) was unsuitable due to severe calcifications around the aortic root and annulus, which included a relatively high potential risk of aortic root rupture (Fig. 1B). We considered that ND1b lymph node dissection would be enough because LC stage was relatively early. Therefore, we planned to perform concomitant MICS-AVR and right upper lobectomy through the same incision.

After general anesthesia and double-lumen tube intubation, the patient was placed in the left decubitus position. This concomitant surgery was performed using usual instruments by which we use MICS-AVR and VATS procedure. A 7.5-cm skin incision was made at the lateral edge of the pectoralis major muscle along the anterior axillary line, and a right lateral mini-thoracotomy was performed through the fourth intercostal space. A videoscope was inserted through the port at the fourth intercostal space on the midaxillary line. Cardiopulmonary bypass (CPB) was established via the right femoral artery and vein (19- and 25-Fr cannulas). Cold blood cardioplegia was administered antegrade for the first time and selective for the second and subsequent times. Aortotomy was performed 2 cm above the right coronary artery. The aortic valve was bicuspid, with severe calcifications (Fig. 2A). After removal of the valve, AVR was performed using a 23-mm Mosaic Ultra aortic valve (Medtronic, MN, USA). This valve was implanted in the supra-annular position with 15 pledgeted mattress sutures. The patient was easily weaned from CPB, and protamine was systemically administrated.

Subsequently, with the insertion of two additional ports for VATS, a right upper lobectomy was performed using a GIA (Covidien Inc., MA, USA). The pulmonary vein and artery were cut. The upper lobe bronchus was divided using a GIA (Fig. 2B). The right upper lobe and some lymph nodes (ND1b) were resected. The total operating time, CPB time, and MICS-AVR time were 513, 193, and 127 min, respectively. The postoperative blood loss was 1020 ml.

Postoperative histopathological analysis revealed adenocarcinoma with no lymph node metastases. The pathological stage was T1bN0M0 stage IA2. The postoperative course was uneventful. The intensive care unit stay and hospital stay were 1 and 12 days, respectively. He returned to normal work 24 days postoperatively.

**Discussion**

The incidence of concomitant cardiovascular diseases and LC is increasing. There is no consensus regarding the surgical method for such cases. The surgical strategy for each case needs to be considered based on the severity of AS, curability of LC, and patient safety. Lung surgery 4–6-week after AVR may lead to unreliability or metastasis. Conversely, lung surgery before AVR significantly increases the risks associated with anesthesia and death. The concomitant procedure is not without limitations, such as the risk of dissemination due to the manipulation of the lung, inability to perform lymph node dissection, and excessive blood loss due to heparinization. A recent study revealed that TAVI for AS complicated with early cancer was effective and provided promising early results. Furthermore, some reports suggested
that TAVI with simultaneous lung resection has good long-term results.\textsuperscript{2,5} However, not every patient with AS can undergo TAVI due to a lack of anatomical suitability. In this case, it was not appropriate owing to the anatomical morphology of the aortic valve. Considering the patient’s recovery and avoiding potential tumor dissemination, we decided to perform a one-stage minimally invasive surgery for AS and LC. To the best of our knowledge, this is the first successful case of simultaneous MICS-AVR for severe AS and VATS oncologic resection via right mini-thoracotomy.

Conventional concomitant valve replacement and lung resection are usually performed with median sternotomy. However, lobectomy through median sternotomy is more difficult than the thoracotomy approach in terms of lymph node resection. If the surgery uses two different approaches, the patient will experience more postoperative discomfort. Conversely, minimally invasive valve surgery can be performed for valve diseases under CPB via a right mini-thoracotomy. Fujii et al. studied MICS-AVR under CPB via the femoral artery and femoral vein in Japan and reported no cases with postoperative neurological complications.\textsuperscript{6} When the pulmonary nodule is located on the right lung, we can use the same incision on the right side to complete the lobectomy. Therefore, concomitant minimally invasive cardiac surgery and VATS lobectomy via right mini-thoracotomy are beneficial for and do not affect the safety of the operation while possessing cosmetic benefits. Furthermore, avoiding a sternum incision can reduce bleeding and the risk of wound infection, mediastinal infection,\textsuperscript{7} and sternal osteomyelitis.

**Conclusion**

Although TAVI is a powerful option for patients with simultaneous AS and LC, the outcome of this patient who underwent one-stage MICS-AVR and VATS lobectomy was favorable. Given our case, particularly for patients with AS complicated with right LC who have unsuitable anatomical morphologies for TAVI, concomitant MICS-AVR and VATS lobectomy can be a safe and useful surgical option.

**Abbreviations**

AS : aortic valve stenosis  
LC : Lung cancer  
MICS-AVR : Minimally invasive aortic valve replacement  
VATS : Video-assisted thoracoscopic surgery  
CT : Computed tomography  
TAVI : Transcatheter aortic valve implantation  
CPB : Cardiopulmonary bypass
Declarations

Ethics approval and consent to participate: Not applicable

Consent for publication: The patient agreed the doctors could use and publish his disease related article with personal information deleted.

Availability of data and materials: available

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Authors' information (optional):
Department of Cardiovascular Surgery, Osaka General Medical Center, 3-1-56 Bandai-higashi, Sumiyoshi-ku, Osaka, 558-8558, Japan

Satoshi Sakakibara, Hiroyuki Nishi, Shinya Fukui, Mutsunori Kitahara, Kazuma Handa, Yumi Kakizawa, Takasumi Goto

Department of Thoracic Surgery, Osaka General Medical Center, 3-1-56 Bandai-higashi, Sumiyoshi-ku, Osaka, 558-8558, Japan

Yasunobu Funakoshi

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**Figures**

**Figure 1**

Preoperative CT findings

A: a nodular shadow in the right upper lobe without enlarged lymph nodes or distant metastases (yellow arrow).

B: a severely calcified type 0 bicuspid aortic valve stenosis.

**Figure 2**

Intraoperative findings

A: Bicuspid aortic valve was with severe calcification (white arrow). The aortic valve was excised via right mini-thoracotomy.

B: Right upper lobectomy was performed by VATS.

C: Skin incisions; main thoracotomy was made at the lateral side on the edge of the pectoralis major muscle, and three right lateral mini-thoracotomies through the 4th and 7th intercostal spaces (black arrows).