



# Annual report of thoracic surgery services at the Shanghai Chest Hospital in 2020

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**Background:** The thoracic surgery team of the Shanghai Chest Hospital has been publishing its annual report since 2018, summarizing the services and major progress over the last year.

**Methods:** All patients receiving thoracic surgery services at the Department of Thoracic Surgery and the Department of Oncological Surgery at the Shanghai Chest Hospital in 2020 were enrolled. The number of surgical resections, types of surgical procedures, disease histological types, and perioperative outcomes were collected and compared with the results from previous years.

**Results:** In the year 2020, the thoracic surgery team of the Shanghai Chest Hospital faced the unprecedented challenge of the coronavirus disease 2019 (COVID-19) epidemic. A total of 15,664 patients received thoracic surgeries at the Shanghai Chest Hospital, only an 8.0% decrease compared with the previous year of 2019, despite of the COVID pandemic. These included 13,493 pulmonary procedures, 1,075 esophageal procedures, 969 mediastinal procedures, 66 tracheal procedures, 2 lung transplantations, and 59 other procedures. The rate of minimally invasive surgeries among all procedures was 91.1%, including 721 robotic-assisted thoracic surgeries, both of which increased from the year before. In addition, the average length of hospital stay continuously decreased, being only 3.82 days after pulmonary surgery and 10.96 days after esophageal surgery. Meanwhile, the quality of thoracic surgery has improved, with continuously lower rates of perioperative complications and an in-hospital mortality rate of only 0.14%.

**Conclusions:** The services provided and progress made in 2020 by the thoracic surgery team of the Shanghai Chest Hospital were reviewed in this annual report, reflecting a consistent effort to help our patients with high-standard services and state-of-the-art surgical techniques.

**Keywords:** Shanghai Chest Hospital; thoracic surgery; coronavirus disease 2019 (COVID-19); 2020

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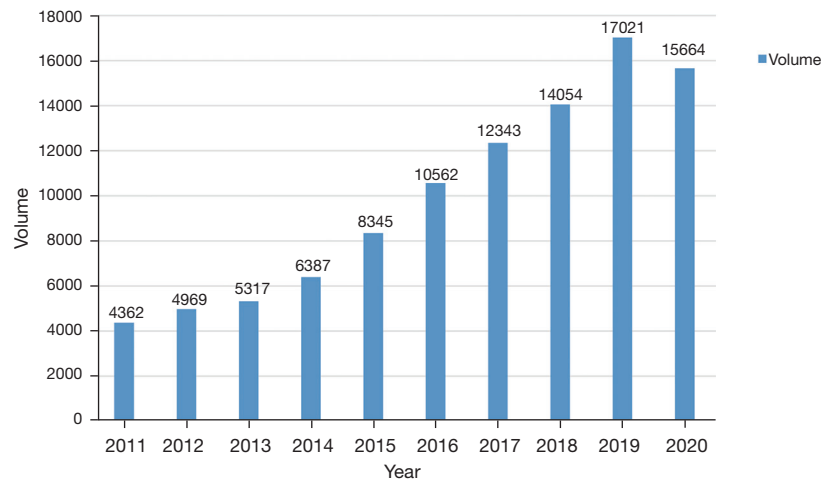
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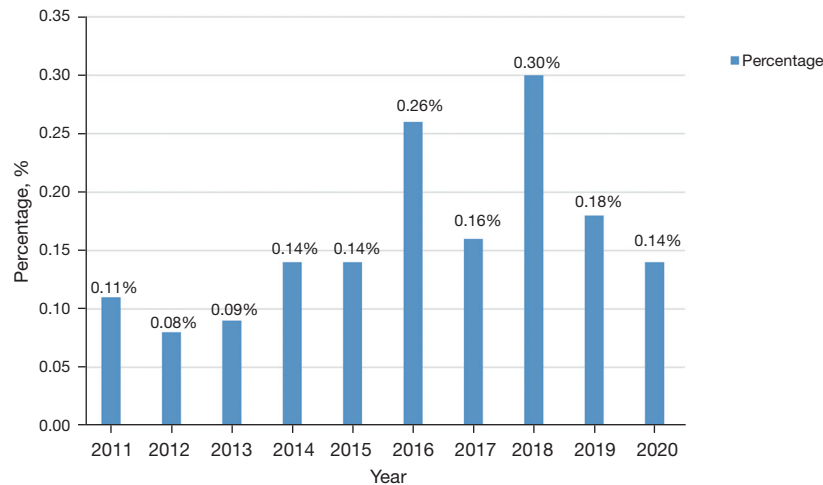
## Introduction

In 2020, the unprecedented pandemic of the coronavirus disease 2019 (COVID-19) caused heavy social and healthcare burdens and exacerbated the relative shortage of

medical resources all around the world. Fortunately, with great efforts by the Chinese government in implementing timely and effective measures, the situation of COVID-19 has gradually come under control (1). Nevertheless, this raging pandemic still had major consequences on routine



**Figure 1** Case volume of thoracic surgery in Shanghai Chest Hospital.



**Figure 2** Mortality of thoracic surgery in Shanghai Chest Hospital.

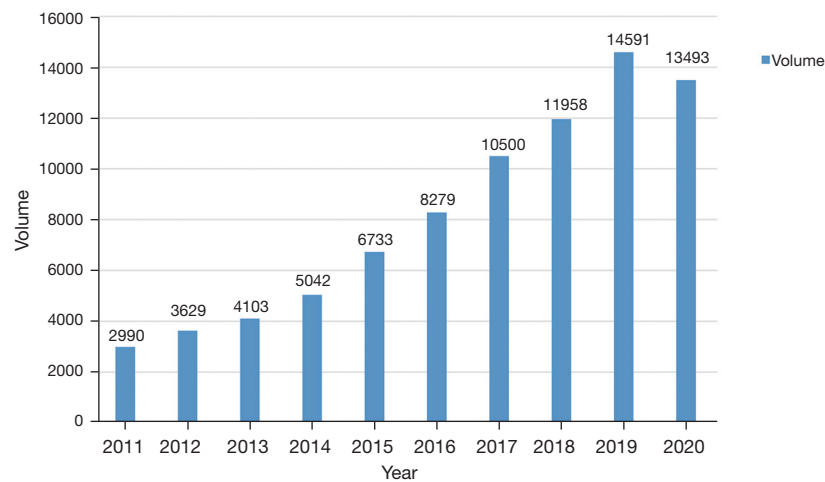
thoracic surgery services. A large amount of elective thoracic surgeries were postponed or cancelled. However, as one of the largest tertiary referral centers for chest diseases in China, the Shanghai Chest Hospital has overcome the significant impact of COVID-19 and has never stopped its service of thoracic surgeries during the pandemic (2). In 2020, there were 15,664 patients who received thoracic surgeries at the Shanghai Chest Hospital, which only decreased by 8.0% compared with the year before, including 13,493 pulmonary resections, 1,075 esophageal procedures, 969 mediastinal procedures, 66 tracheal procedures, 2 lung transplantations, and 59 other procedures (Figure 1). The percentage of minimally invasive surgery (MIS) cases was as high as 91.1%, including both video-assisted thoracic

surgery (VATS) and robotic-assisted thoracic surgery (RATS). Furthermore, the average length of hospital stay (LOS) continuously decreased despite of the pandemic, with a continuously lower rate of perioperative complications and an in-hospital mortality of merely 0.14% (Figure 2). In this report, we describe the surgery volume, the quality of service, and the efforts to move thoracic services forward under the COVID-19 pandemic.

## Methods

### Patients

Patients receiving thoracic surgeries along with the



**Figure 3** The total number of lung operations in Shanghai Chest Hospital.

types of surgical resections, the pathological types, the perioperative outcomes, and other characteristics were collected from the Department of Thoracic Surgery and the Department of Oncological Surgery of the Shanghai Chest Hospital between January 2020 and December 2020. Data were collected and analyzed by pulmonary, esophageal, mediastinal, tracheal, and lung transplantation divisions according to different diseases and surgical procedures, and were compared with the years before.

### Statistical analysis

Categorical and continuous variables were presented as frequencies (percentages) and mean  $\pm$  standard deviation (SD), respectively. Bar, line, and pie graphs were plotted, and the statistical analysis was performed using SPSS version 22.0 (IBM Corp., Armonk, NY, USA).

### Ethical statement

The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The individual consent for this retrospective analysis was waived.

## Results

### Pulmonary surgeries

In 2020, a total of 13,493 patients with pulmonary diseases received thoracic surgery at the Shanghai Chest Hospital. There was only a 7.5% decrease compared with the year

before, despite of the significant impact of the COVID-19 pandemic (*Figure 3*). Because of the COVID-19 outbreak, there was a temporary decrease in pulmonary surgeries at the Shanghai Chest Hospital around February. The number of both local and non-local patients seeking medical care at the Shanghai Chest Hospital declined sharply because of travel restrictions and local personal quarantine (3). Fortunately, routine thoracic surgery services gradually resumed and then increased steadily when the situation of COVID-19 was effectively controlled in China after April 2020 (*Figure 4*).

During the last year, 12,456 patients received VATS pulmonary resections (92.3%), 398 patients received RATS resections (2.9%), and 639 patients received open thoracotomy (4.8%) (*Figure 5*). In total, 11,938 (88.5%) patients were confirmed as having malignant diseases and 1,555 (11.5%) patients had benign diseases. Both the rate of malignancy and the percentage of MIS were similar to the previous year, not influenced by the outbreak of COVID-19. Lobectomy was still the most common surgical procedure ( $n=5,921$ , 43.9%), followed by segmentectomy ( $n=3,824$ , 28.3%), wedge resection ( $n=3,166$ , 23.5%), extended lobectomy ( $n=229$ , 1.7%), sleeve lobectomy ( $n=166$ , 1.2%), pneumonectomy ( $n=76$ , 0.6%), and others ( $n=111$ , 0.8%) (*Figure 6*).

Noticeably, the number of segmentectomies has almost tripled compared to 2019 (*Figure 7*). This rapid increase in anatomical segmentectomy was mainly due to the increased detection of peripheral small-size early-stage lung cancers through computed tomography (CT) scans during routine screening of COVID-19 before hospitalization or invasive examination for other diseases. To some extent, this also

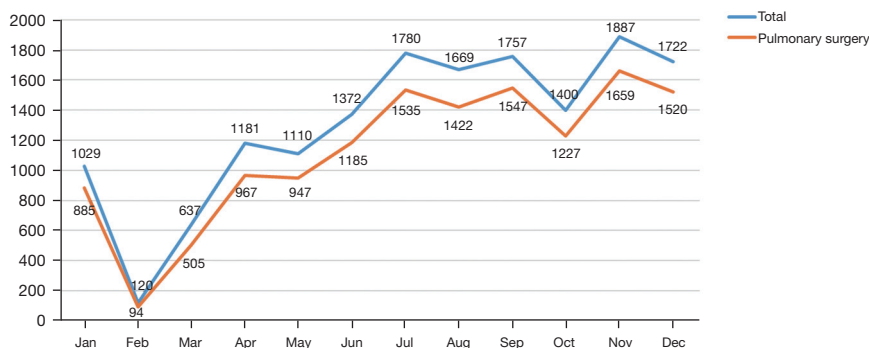


Figure 4 Case volume of each month in Shanghai Chest Hospital.

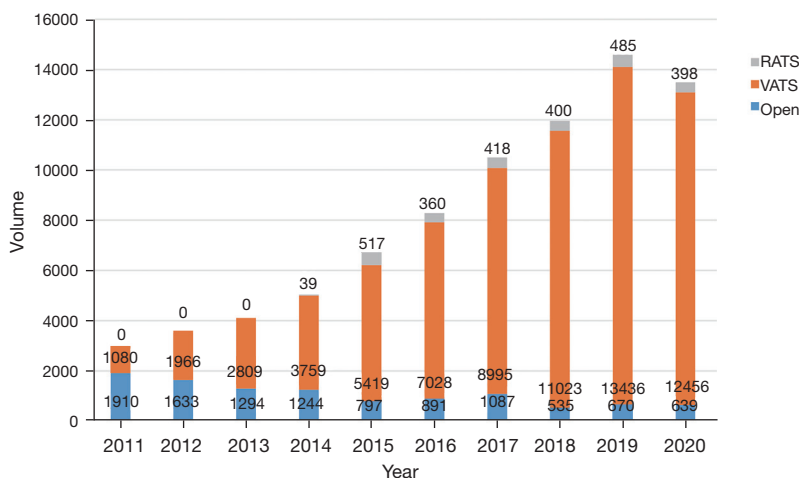


Figure 5 Case volume of pulmonary surgical approaches in Shanghai Chest Hospital.

reflects the importance of CT screening for lung cancers.

As an index for postoperative outcomes after pulmonary surgeries, the average LOS after surgery was further shortened to 3.82 days, which has continuously decreased over the past years (Figure 8). On the one hand, this was the result of the development of enhanced recovery after surgery (ERAS) program in recent years. On the other hand, it reflected a low rate of postoperative complications owing to improving surgical techniques and perioperative care.

**Esophageal surgeries**

In 2020, the total number of esophageal procedures exceeded 1,000 cases, reaching a historical high of 1,075 cases. A total of 868 esophageal cancer patients and 207 patients with benign esophageal diseases received surgical treatment at the Shanghai Chest Hospital, regardless of

the impact of the COVID-19 pandemic (Figure 9). Among the total of 790 patients who received esophagectomies, minimally invasive esophagectomies (MIE) accounted for 87.1% cases, including 518 video-assisted esophagectomies (65.6%) and 170 robotic-assisted esophagectomies (21.5%), both of which increased comparing with the year before (Figure 10). The three-hole McKeown procedure was still the most preferred approach, applied in 692 patients (87.6%), followed by the Ivor-Lewis procedure in 42 patients (5.3%) and the left-thoracic Sweet procedure in 37 patients (4.7%) (Figure 11). Furthermore, 78 patients with early-stage esophageal cancer received endoscopic submucosal dissection (ESD) in 2020 (Figure 12).

The 30-day mortality rate after esophageal procedures was as low as 0.3%, with an overall postoperative complication rate of 34.6%. The average LOS after esophageal surgeries was reduced to 10.96 days and has continuously shortened over the past years (Figure 13).

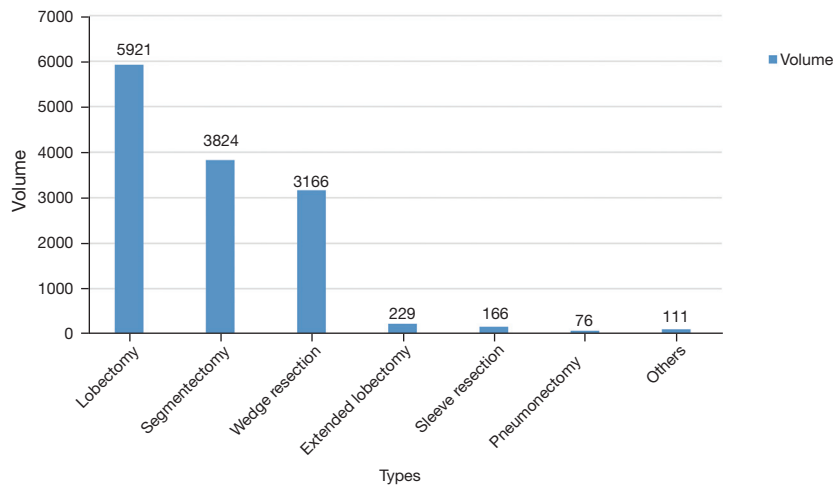


Figure 6 Surgical types of lung disease in Shanghai Chest Hospital.

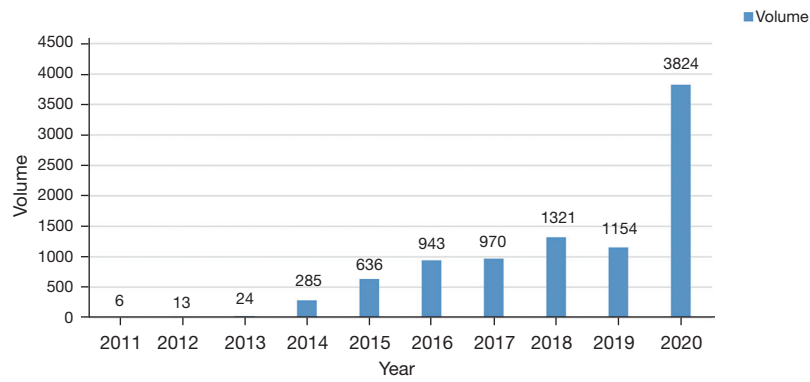


Figure 7 Case volume of segmentectomy in Shanghai Chest Hospital.

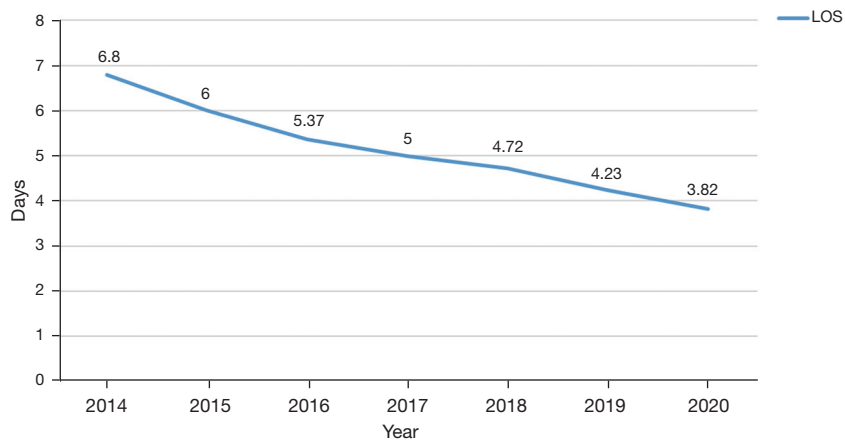
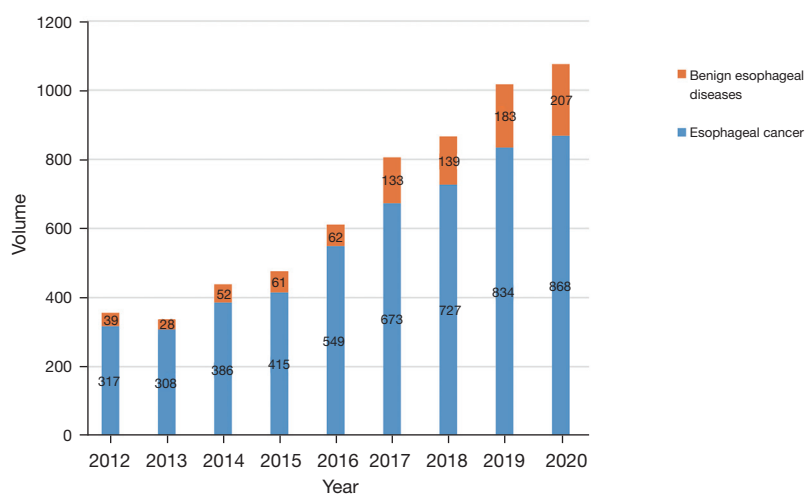
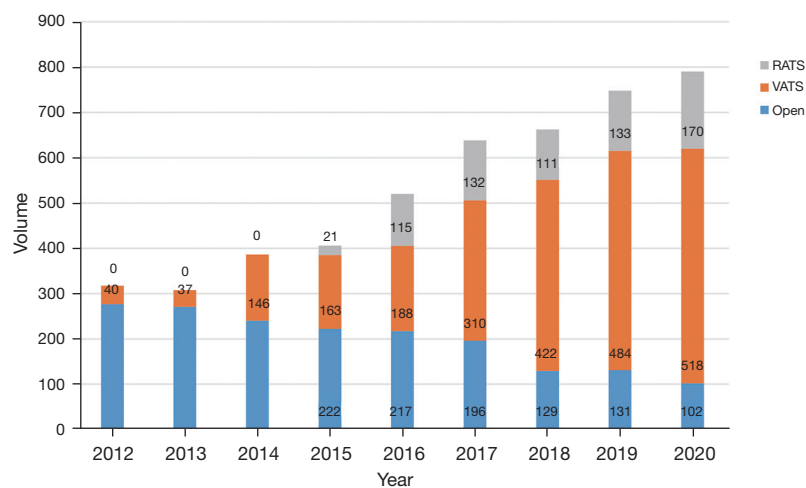


Figure 8 Average length of hospital stay after pulmonary surgery in Shanghai Chest Hospital.



**Figure 9** Case volume of esophageal surgeries in Shanghai Chest Hospital.



**Figure 10** Case volume of esophagectomy of esophageal cancer in Shanghai Chest Hospital.

### *Mediastinal surgery*

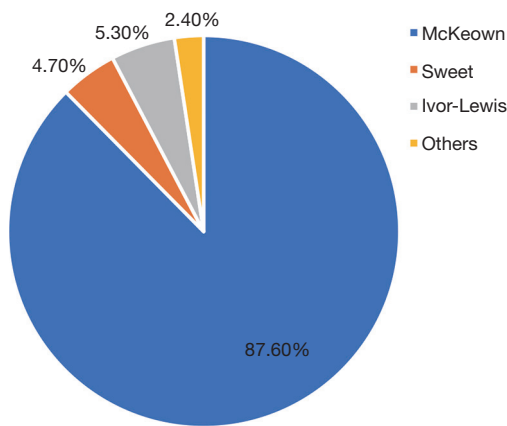
Despite of the influence of the COVID-19 pandemic, the volume of mediastinal procedures maintained a remarkable level during 2020. A total of 969 patients underwent mediastinal surgeries at the Shanghai Chest Hospital, among which 566 patients received VATS procedures (58.4%) and 135 patients received RATS procedures (13.9%). Noticeably, the volume of mediastinal RATS procedures reached a historical high of 135 cases. Furthermore, there were 268 patients (up to 27.7%) with locally advanced mediastinal tumors who received open thoracotomy or median sternotomy (*Figure 14*).

The in-hospital mortality after mediastinal surgeries was

merely 0.2% during the postoperative period. Meanwhile, the average LOS shortened from 4.95 days in 2019 to 4.18 days in 2020, owing to the development of ERAS and the limited number of severe postoperative complications or readmissions.

### *Tracheal surgery and lung transplantation*

The division of tracheal surgery successfully completed 66 tracheal and bronchial procedures in 2020, including complicated resections and reconstructions, representing an 11.9% increase compared to 2019 (*Figure 15*). Among them, there were 23 (35.6%) tracheal surgeries, 25 (37.2%) main bronchial resections, and 9 cases (13.6%) of carinal



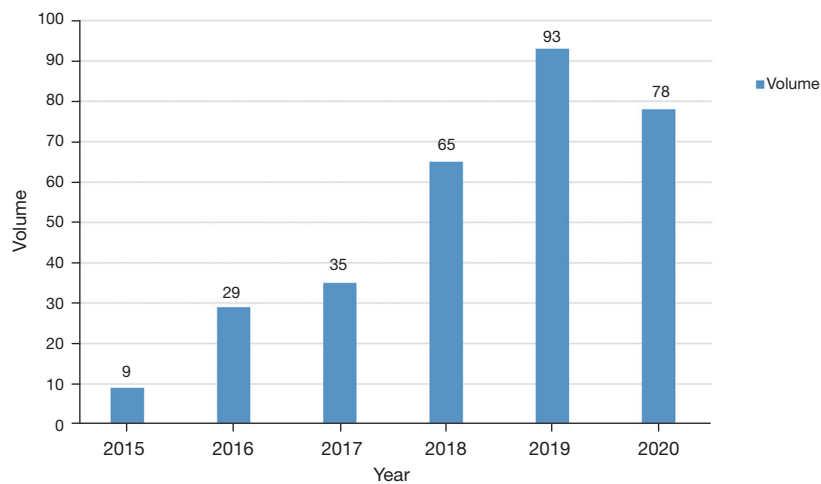
**Figure 11** Surgical approaches of esophagectomy in Shanghai Chest Hospital.

resection and reconstruction (*Figure 16*). The average LOS was 10.8 days, with an in-hospital mortality rate of 3.0%.

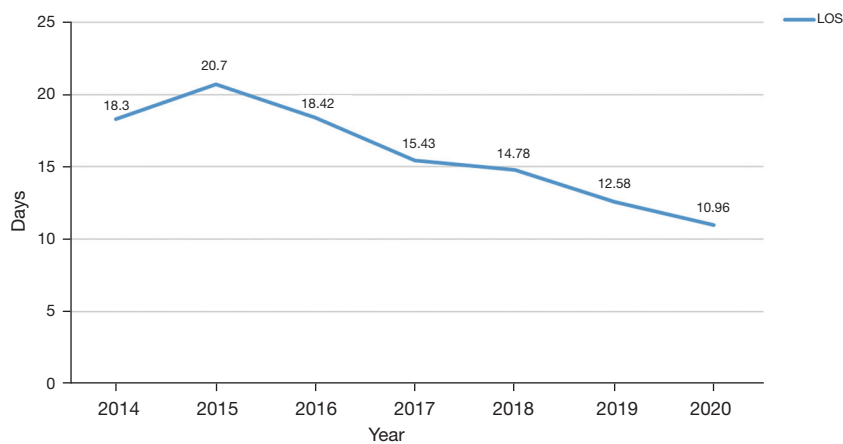
In 2020, lung transplantation grinded to a halt, with only 2 patients receiving lung transplantation at the Shanghai Chest Hospital. More efforts are required in the coming years in searching for qualified donors.

### Discussion

The thoracic surgery team of the Shanghai Chest Hospital has been publishing its annual reports to the public since the year 2018. Summarized in these reports are the major achievements made in the previous year, in addition to the increasing need for services from the public. As one of the



**Figure 12** Case volume of endoscopic submucosal dissection for esophageal cancer in Shanghai Chest Hospital.



**Figure 13** Average length of hospital stay after esophageal surgery in Shanghai Chest Hospital.

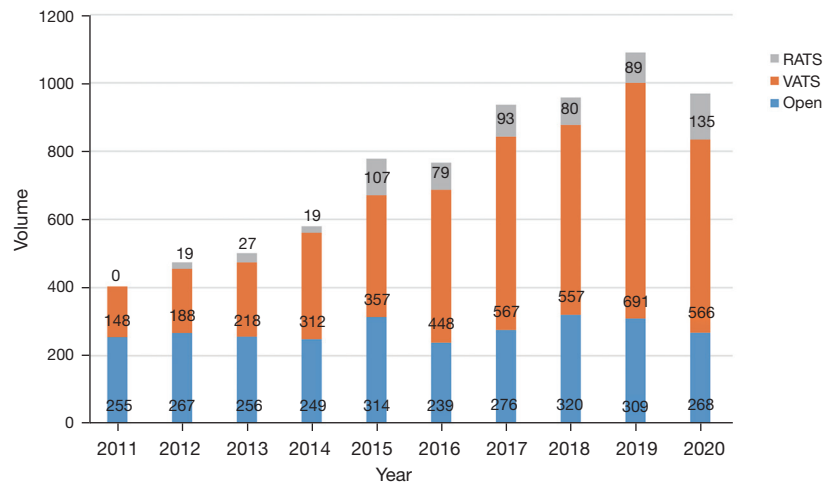


Figure 14 Case volume of mediastinal surgical approaches in Shanghai Chest Hospital.

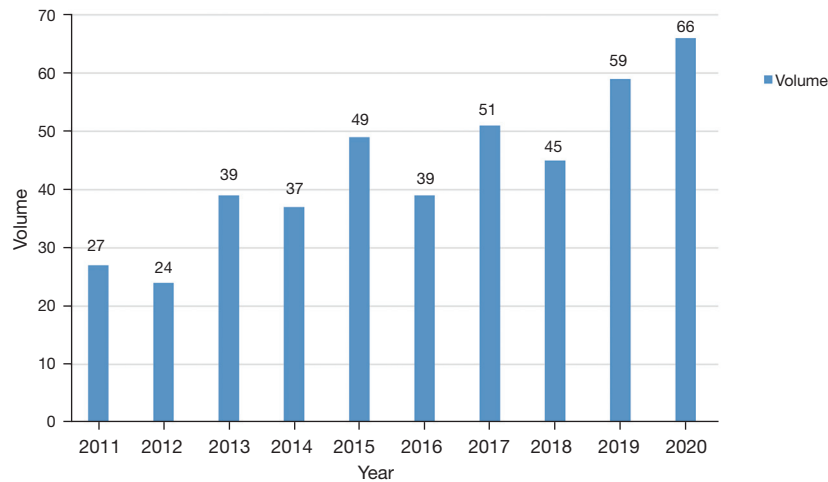


Figure 15 Case volume of tracheal surgery in Shanghai Chest Hospital.

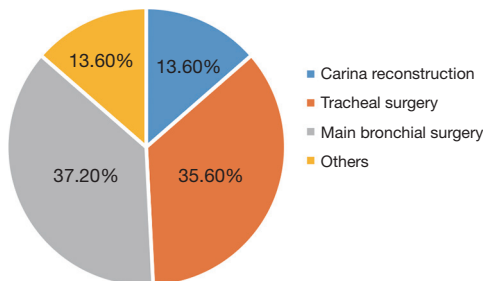
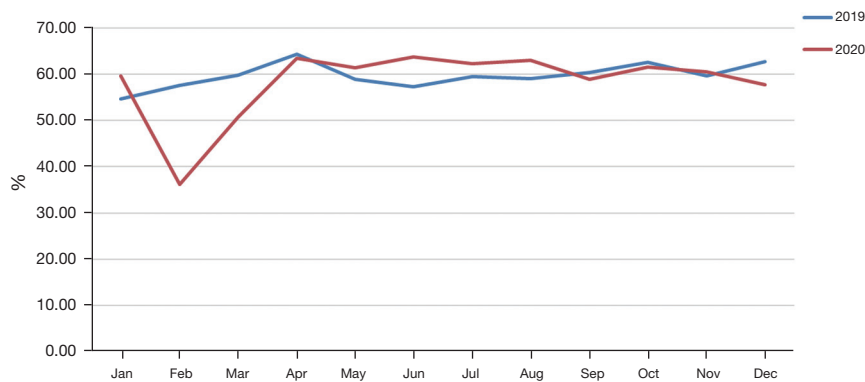


Figure 16 Surgical approaches of tracheal diseases in Shanghai Chest Hospital.

largest thoracic surgery centers in China, the annual volume of thoracic surgery at the Shanghai Chest Hospital has exceeded over 10,000 cases for the past 5 consecutive years. During the peak of the COVID-19 pandemic last year, the surgical volume in February and March largely decreased, especially for pulmonary surgeries. This is mainly because of the strict restriction of surgical indications for patients with small subcentimeter pulmonary lesions or pure ground glass opacities (GGOs) at the Shanghai Chest Hospital so as to minimize potential hospital infection of COVID-19.





**Figure 17** The ratio of non-local patient per month between 2019 and 2020 in Shanghai Chest Hospital.

Another reason is the stringent prevention strategies including city lockdown, travel restriction, and personal quarantine. This is largely represented by a sharp drop in non-local patients in February and March 2020 compared with the previous year (*Figure 17*). Nevertheless, treatment of patients with severe or advanced disease needing surgical care were never delayed. Timely and radical surgical treatment was never compromised by the unexpected pandemic (3). When the COVID-19 situation in Shanghai and China became well under control by quick and efficient emergency responses and strategies, thoracic surgery services at the Shanghai Chest Hospital rapidly returned to normal. The volume of thoracic surgery, especially for non-local patients, continuously increased month by month after April. Fortunately, no patient or medical staff was ever infected by COVID-19, showing an effective prevention strategy (*Figures 8,17*).

Minimally invasive thoracic surgery represents the advance of modern thoracic surgery and now plays a central role in our services, with over 90% of all thoracic procedures being completed by MIS approaches, which was even higher than in 2019. There was a tripling of minimally invasive segmentectomies, mainly because of the increased early detection of pulmonary lesions due to the screening for COVID-19 during the pandemic in 2020. Compared to standard lobectomy, anatomical segmentectomy demonstrated similar oncological results along with better pulmonary function preservation for those patients with peripheral small-size lung cancers according to the Japan Clinical Oncology Group 0802 (JCOG 0802) trial (4). However, both the JCOG 0802 and Cancer and Leukemia Group B 140503 (CALGB 140503) trials have limitations in their study design. Further evidence is needed to answer the question as to whether minimally invasive segmentectomy is superior to traditional

lobectomy in terms of perioperative outcomes for patients with peripheral small-size early-stage lung cancers. Therefore, a multi-institutional, prospective, open-label, randomized phase III trial comparing VATS segmentectomy versus lobectomy for GGO-containing early-stage invasive lung adenocarcinoma is ongoing at the Shanghai Chest Hospital. We truly hope that this clinical trial can prove the superiority of minimally invasive segmentectomy so that more patients can benefit from the advent of modern surgical skills and technology.

Being one of the leading cardiothoracic surgery centers in China, the Shanghai Chest Hospital has not only focused on the management of complex and difficult chest diseases, but has also made great efforts in ERAS procedures in 2020. Through close cooperation and joint effort with the Department of Anesthesiology and the nursing staff, the average LOS at the Shanghai Chest Hospital has continuously decreased. The LOS after pulmonary surgery has shortened from 4.23 days in 2019 to 3.82 days in 2020, and from 12.58 days in 2019 to 10.96 days in 2020 after esophageal surgery, and from 4.95 days in 2019 to 4.18 days in 2020 after mediastinal surgery. This shortened LOS also reflected continuing advances in surgical skills as well as improved medical service and care.

In summary, the thoracic surgery team at the Shanghai Chest Hospital has successfully come through the unprecedented COVID-19 pandemic and continuously provided high-level medical care and services for our patients in the year 2020. Hopefully, this year's annual report from the Shanghai Chest Hospital can again serve as a useful reference for colleagues worldwide.

## Acknowledgments

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## Footnote

*Data Sharing Statement:* Available at <https://shc.amegroups.com/article/view/10.21037/shc-2021-04/dss>

*Conflicts of Interest:* All authors have completed the ICMJE uniform disclosure form (available at <https://shc.amegroups.com/article/view/10.21037/shc-2021-04/coif>). QL serves as an unpaid Associate Editor-in-Chief of *Shanghai Chest*. WF serves as an unpaid Executive Editor-in-Chief of *Shanghai Chest*. The other authors have no conflicts of interest to declare.

*Ethical Statement:* The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. The study was conducted in accordance with the Declaration of Helsinki (as revised in 2013). The individual consent for this retrospective analysis was waived.

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