Thoracic surgery during the coronavirus disease 2019 (COVID-19) pandemic in Madrid, Spain: single-centre report

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Abstract

OBJECTIVES: We reviewed the incidence of coronavirus disease 2019 cases and the postoperative outcomes of patients who had thoracic surgery during the beginning and at the highest point of transmission in our community.

METHODS: We retrospectively reviewed patients who had undergone elective thoracic surgery from 12 February 2020 to 30 April 2020 and were symptomatic or tested positive for severe acute respiratory syndrome coronavirus 2 infection within 14 days after surgery, with a focus on their complications and potential deaths.

RESULTS: Out of 101 surgical procedures, including 57 primary oncological resections, 6 lung transplants and 18 emergency procedures, only 5 cases of coronavirus disease 2019 were identified, 3 in the immediate postoperative period and 2 as outpatients. All 5 patients had cancer; the median age was 64 years. The main virus-related symptom was fever (80%), and the median onset of coronavirus disease 2019...
was 3 days. Although 80% of the patients who had positive test results for severe acute respiratory syndrome coronavirus 2 required in-hospital care, none of them were considered severe or critical and none died.

CONCLUSIONS: These results indicate that, in properly selected cases, with short preoperative in-hospital stays, strict isolation and infection control protocols, managed by a dedicated multidisciplinary team, a surgical procedure could be performed with a relatively low risk for the patient.

Keywords: Coronavirus disease 2019 • Severe acute respiratory syndrome coronavirus 2 • Thoracic surgery • Postoperative • Incubation period

INTRODUCTION

Since the outbreak of the novel coronavirus disease 2019 (COVID-19) caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) in Wuhan, China [1], over 4.9 million cases have been diagnosed around the world [2]. With no known treatment or effective vaccine available in the near future, health care providers have been forced to manage growing waiting lists, especially for oncology patients. The risk of tumour progression due to the delay of definitive surgery cannot be ignored [3].

As of 10 March 2020, there have been more than 235,000 cases of COVID-19 confirmed in Spain and more than 28,000 deaths [4]. On 26 February, the first case of COVID-19 infection was diagnosed in our centre. After that first case, the figures escalated substantially, as occurred elsewhere in the city; the hospital was crowded with patients with positive test results, and intensive care units (ICUs) were fully occupied by patients on ventilators. Nevertheless, our surgical team and hospital managers were able to keep a SARS-CoV-2-free circuit and provided surgical procedures for selected cases based on necessity. Current, the clinical characteristics and outcomes of patients undergoing surgery, particularly thoracic surgery, are scarce. Lei et al. [5] were the first to report a postoperative series of 34 cases. However, only 3 of those were thoracic patients, with extremely high mortality. We thought that COVID-19 might complicate the perioperative course with diagnostic challenges and a high impact on survival, given that surgery itself provokes an immediate impairment of cell-mediated immunity, one of the primary mechanisms that brings the viral infection under control [3, 6–8]. Additionally, according to preliminary data from China and Italy, cancer, along with other comorbidities, occurs frequently in thoracic surgery patients and may increase deaths of COVID-19.

Our goal was to describe the clinical presentations and outcomes of patients who had elective thoracic surgical procedures performed during the SARS-CoV-2 outbreak in a single centre in Madrid, Spain.

MATERIALS AND METHODS

We retrospectively reviewed patients who had undergone elective thoracic surgery from 12 February 2020 to 30 April 2020, the early stage of the COVID-19 epidemic in Madrid, Spain. Postoperative clinical, laboratory and radiological records and timelines of clinical courses were summarized. Potential prognostic factors were evaluated.

For accuracy, 3 researchers independently recorded data using a standardized data collection form.

Consent from the COVID-19 patients analysed in this report was waived due to its retrospective nature and because the data would be de-identified at publication.

The study population included all patients admitted for thoracic surgery procedures to the department of thoracic surgery of the Hospital Universitario Puerta de Hierro Majadahonda, Madrid, Spain, between 12 February and 30 April.

Patients were included, considering the time frame of 14 days before the first confirmed case was admitted to our centre. Follow-up was performed within 14 days after discharge from hospital, based on published incubation and asymptomatic carrier time frames [9]. For postoperative patients about to be discharged from the hospital, oropharyngeal swabs were used to test for SARS-CoV-2 using a real-time reverse transcriptase polymerase chain reaction (RT-PCR) test if the patient had suggestive symptoms or epidemiological risk factors. In contrast, patients who were already discharged were called and their electronic medical records checked for the presence of coronavirus symptoms, hospital admission related to a possible infection, or confirmation of COVID-19 based on the results of the RT-PCR test.

Patients were defined as ‘critical’ if they met any of the following criteria: respiratory failure requiring mechanical ventilation, septic shock or multiple organ dysfunction in the ICU. Patients were defined as ‘severe’ if they had dyspnoea with a respiratory rate >30/min, a PaO2/FiO2 ratio <300 mmHg or blood oxygen saturation <93% or lung infiltrates >50% within 24–48 h.

A descriptive analysis was performed using the absolute and relative frequencies for categorical variables and mean (standard deviation) or median (percentiles 25 and 75) for numerical variables. Univariable analysis was done with the Mann–Whitney U-test. The significance level was established at 0.05. We used Stata/IC v.16 (Stata Statistical Software: Release 16: 2019) (StataCorp LLC, College Station, TX, USA).

RESULTS

A total of 101 interventions were performed in our centre during this period, represented by 81 individual patients, including 57

| ABBREVIATIONS |
|----------------|
| COVID-19 | Coronavirus disease 2019 |
| HCW | Health care worker |
| ICU | Intensive care unit |
| RT-PCR | Real-time reverse transcriptase polymerase chain reaction |
| SARS-CoV-2 | Severe acute respiratory syndrome coronavirus 2 |

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oncological surgical procedures, 6 lung transplants and 18 emergency procedures (Table 1). The median age was 61 years (17–82 years), 45% women and 55% men, with a median in-hospital stay of 3 days for non-transplant patients.

Meanwhile, all of the lung transplants were performed between the first and the third week of the study period. During the highest point of hospital occupancy due to patients with COVID-19, between the 5th and the 10th weeks, our surgical activity was further reduced to 44% compared with the same period the year before.

The main postoperative complications were prolonged air leak in 9 cases, followed by bacterial pneumonia in 4 cases and by 1 case each of haemothorax and atrial fibrillation.

In the postoperative period, only 5 patients (5%) were diagnosed with COVID-19. All 5 patients with positive test results had cancer: 4 had non-small-lung cancer, 2 of whom had open resections (lobectomy and right pneumonectomy) and 2 of whom had video-assisted thoracoscopic surgical resections and 1 had a rebiopsy for a lymphoma (Table 2). There were no severe and no critical cases of SARS-CoV-2 among our patients. However, there was 1 recorded death of an 82-year-old man with a massive pleural effusion and metastatic disease, who 8 days after a pleural biopsy and insertion of an indwelling pleural catheter, developed dyspnoea and died under at-home care, without an autopsy or RT-PCR confirmation. Hence, he was not included in this case-series due to the uncertainty of the cause of death.

The most predominant symptom was a low-grade fever in 4 patients (80%), followed by dyspnoea and cough (25%). The onset of symptoms after surgery ranged from 2 to 10 days, with a median of 3 days, whereas the diagnosis occurred between 5 and 15 days (mean 12.5 days). One patient had postoperative decompression of severe aortic stenosis after an open lobectomy; while remaining in hospital care, he developed COVID-19 symptoms 44 days postoperatively. Three days later, RT-PCR test results were positive; he was discharged from the hospital 57 days after the initial oncological surgery (Table 2).

Only 3 patients were diagnosed with COVID-19 while in the hospital; the remaining 2 patients were diagnosed after discharge. A total of 80% of our patients infected with SARS-CoV-2 required hospitalization after diagnosis, for a median of 5 days. Nevertheless, COVID-19 infection does not represent a statistically significant factor for a prolonged postoperative in-hospital stay in our series \((P = 0.13)\).

All patients had normal complete blood counts and clinical biochemical values preoperatively. Two patients (40%) experienced reductions in the white blood count in concurrence with a low lymphocyte count. D-dimer levels were remarkably higher in those infected close to the time of the operation (patients 2, 3) (Fig. 1). Finally, the most significant changes in liver enzymes were seen in the oldest patient in the series, although they were not related to any other severity criteria.

All patients received hydroxychloroquine and azithromycin, whereas only 2 patients received additional treatment with lopinavir/ritonavir. Prophylactic fractioned heparin during convalescences was also prescribed as recommended [10, 11].

### Table 1: Operations performed during the pandemic

| Operations                  | Number |
|-----------------------------|--------|
| Lobectomy                   | 25\(^a\) |
| Sleeve resection            | 2      |
| Pneumonectomy               | 1      |
| Sublobar resection          | 19\(^b\) |
| Mediastinal tumour          | 7      |
| Pleural tumour              | 6      |
| Chest tumour                | 2      |
| Mediastinoscopy             | 15     |
| Lung transplant             | 6 (bilateral) |
| Urgent surgery              | 18     |
| Total                       | 101    |

\(^a\)88% VATS procedure.  
\(^b\)90% VATS procedure.  
VATS: video-assisted thoracoscopic surgery.

### Table 2: Summary of clinical characteristics of the 5 patients with positive test results for coronavirus disease 2019

| Patient | 1 | 2 | 3 | 4 | 5 |
|---------|---|---|---|---|---|
| Age (years) | 77 | 68 | 25 | 34 | 70 |
| Sex | Male | Female | Female | Male | Male |
| Smoking history | Yes | No | No | No | Yes |
| Comorbidity | HT DM | CC | No | NHL | HT, DM |
| Tumour location | LUL | LUL | RLL | Mediastinum | RUL |
| Operation | Lobectomy | Lobectomy | Pneumonectomy | Mediastinoscopy | Lobectomy |
| Approach | Open | VATS | Open | No | VATS |
| Histological type | SCC | Adeno | Blastoma | NHL | SCC |
| Tumour stage | pTaN0M0 | pT1bN0M0 | T4N0 | ypT1bN0 |  |
| Main symptom | Fever | Fever | Fever | Fever | Dyspnoea |
| Onset of symptoms | 44 | 3 | 2 | 3 | 10 |
| RT-PCR, positive results | 47 | 12 | 9 | 13 | 16 |
| Neg/pos ratio, RT-PCR | 0:1 | 0:1 | 1:1 | 2:1 | 0:1 |
| Severity | Mild | Mild | Mild | Mild | Mild |
| Discharged day of surgery | 75 | 19 | 24 | 1 | 3 |
| Discharged day post COVID | 10 | 7 | 15 | 10 | 5 |

CC: cancer; DM: diabetes mellitus; HT: hypertension, LUL: left upper lobe; neg/pos ratio: number of negative RT-PCR test results before a positive result; NHL: non-Hodgkin lymphoma, RLL: right lower lobe; RT-PCR: real-time reverse transcriptase polymerase chain reaction; RUL: right upper lobe; SCC: squamous cell carcinoma; VATS: video-assisted thoracoscopic surgery.
DISCUSSION

This report, to the best of our knowledge, is the first retrospective cohort study to describe the clinical characteristics and outcomes of patients infected with SARS-CoV-2 after thoracic surgical procedures in Europe.

Since the first case of COVID-19 was diagnosed at our centre, the hospital general management decided to change many divisions into COVID wards, leaving some surgical services operational, including the thoracic oncology surgery division. The rationale was then, as it is now, to cancel all elective surgical procedures during the global pandemic and create a tiered system for prioritizing other surgical procedures [12, 13]. Therefore, we selected the more advanced oncological cases, which we believed could not afford a delay in the surgery. We then concentrated on well-established, clear paths of surgical cases and ward isolation during this period. These actions allowed us to provide a high standard of care during the highest rate of infection in the country, and one of the highest worldwide [2]. We had an overall reduction of 25% of operative cases in this period compared to the same period last year and a further reduction of 44% during the highest point of the wave.

In the last 2 weeks of our study, our hospital implemented a mandatory preoperative RT-PCR screening programme no more than 24h before the procedure, for all surgical procedures. Hence, only 4 patients were tested; none of them had positive test results or developed an infection in the postoperative period. Before that, our primary screening strategy was based on clinical-epidemiological criteria. During the studied phase of 12 weeks, our infection rate after surgery was 5%, compared with 5% and 9% reported by other groups over shorter periods [14, 15]. There was no established protocol for screening patients scheduled to have a lung transplant until right after the national state of emergency was declared on 15 March. As of 15 March, every potential lung donor must be screened using an RT-PCR assay of lower airway samples at least 24h before the donation. Although lung transplantation completely halted nationwide from the 13 of March until the middle of May, this screening protocol was followed when the transplantation activities re-started.

Whereas 3 cases of COVID-19 infections were identified during the in-hospital postoperative period, the remaining 2 cases (20%) were diagnosed 10 and 13 days after the patients were discharged. Two of the early patients with positive test results (cases 1 and 3) (Table 2) were suspected of having acquired the disease nosocomially because they occurred during the early phase of implementation of the isolation circuits and visit-restriction policies and had long in-hospital stays before the operation. Although our centre’s policy for scheduling thoracic surgical procedures is to avoid hospitalization before the scheduled date, these 2 patients were in the hospital for 37 and 44 days before the surgery, which may have contributed to the increased risk of infection, as suggested by previous reports [5] with a median stay of more than 2.5 days. The third case is suspected to be due to an operation performed during the incubation period. The COVID-19 symptoms manifested 3 days after the operation, although the SARS-CoV-2 infection was suspected and laboratory-confirmed more than a week later. The time from the operation to the onset of infection was shorter than the median incubation
time of 5 days obtained from a study of patients with confirmed SARS-CoV-2 infections in Wuhan [9] and also shorter than the overall incubation time [median time, 4.0 days (interquartile range 2.0–7.0)] derived from a study of patients with COVID-19 from 552 hospitals in China [14]. It is essential to consider that the overlap between symptoms of COVID-19 and the usual thoracic postoperative clinical course may result in a delayed diagnosis. Fever and cough are common reactions after pleural manipulation [15] as are effusions and atelectasis. Although many suffer chest tightness and fatigue, loss of appetite and nausea due to postoperative analgesics, these symptoms are usually self-limiting, and dyspnoea may be secondary to lung resection and chronic obstructive pulmonary disease. Therefore, a high level of suspicion and a well-established diagnostic protocol should be considered.

In the reported cohorts of non-surgical patients with SARS-CoV-2 in China, the proportion of severe and critical disease was 2–6.1% and 13.8%, respectively [16–18], and reports of surgical patients and the subpopulation of thoracic patients were not better. A report from 4 hospitals in Wuhan published by Lei et al. [5] included 34 postoperative patients who were infected with SARS-CoV-2, where 44% received care in the ICU, 32% developed acute respiratory distress syndrome and 20.6% died of the disease. Surprisingly, if we look at the group of thoracic patients included 34 postoperative patients who were infected with SARS-CoV-2 in China, the proportion of severe and critical disease was 100%. Cai described that after the first patient had a positive test result, not even after the first cases were diagnosed. In comparison, Cai described that after the first patient had a positive test result, 3 HCW had positive test results and 6 more patients and 5 workers followed [19]. Therefore, our procedures may have contributed to reducing the risk of nosocomial transmission among the rest of the ward.

Limitations

There are some methodological limitations in this case series. Due to the retrospective nature of this analysis, the presumed date of symptom onset from medical records and personal statements may be affected by recall bias. The different types of surgical procedures may have variable impacts on clinical course and outcomes. In addition, the baseline characteristics of the patients varied with respect to underlying comorbidities. The small sample size and the lack of severe complications linked with COVID-19 infection prevented us from identifying causality or associated risk factors. All enrolled patients acquired COVID-19 infection in the Madrid area during the beginning and highest points of the outbreak, and they were operated on in a high-volume surgical centre with plentiful resources, so generalizability may be limited to similar settings as opposed to all operating settings.

CONCLUSION

In conclusion, according to preliminary data from China and Italy, cancer and other comorbidities may increase the number of deaths of patients with COVID-19. However, much uncertainty remains because the observations may be the result of malignancy, treatment effects or both. For thoracic surgery patients, the risk of tumour progression with the delay of definitive surgery cannot be ignored. These results indicate that surgery in properly selected cases, with short preoperative in-hospital stays, strict isolation and infection control protocols and a dedicated multidisciplinary team, could be performed with relatively low risk for the patient.

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Reviewer information

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