

# The Effect of COVID-19 Pandemic on the Number and Pattern of Major Thoracic Surgical Cases in Hayatabad Medical Complex, Peshawar

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## Keywords:

COVID-19 pandemic; Thoracic surgical procedures; Empyema thoracis; Esophagectomy; Pakistan

## Abbreviations:

2019-nCoV: 2019 novel coronavirus; COVID-19: Corona Virus Disease-2019; CA esophagus: Esophageal carcinoma; CA stomach: Gastric carcinoma; HMC: Hayatabad Medical Complex; OT: Operation theatre; OPD: Out-patient department; SARS-CoV-2: Severe acute respiratory syndrome coronavirus 2

## 1. Abstract

**1.1. Introduction:** COVID-19 pandemic affected the activities of every department, but most significantly the health department. It is essential to understand and quantify any such effects on the healthcare for better future planning.

**1.2. Objective:** We used de-identified retrospective data to 1) quantify the prevalence of common surgeries in the thoracic surgery department, 2) investigate the impact of COVID 19 on the patients' characteristics, and number and proportion of the thoracic surgeries in our department, and 3) search for the possible causes for any such effects.

**1.3. Materials and Methods:** We used a HIPPA complaint retrospective data of the patients who had surgery in the Thoracic Surgery division of Hayatabad Medical Complex, between December 2018 to July 2021 to work out the effects of the pandemic on the amount and kinds of surgeries in the thoracic department during the pandemic.

**1.4. Results:** Our data consisted of a total of 242 cases. During the pandemic, the total number of thoracic surgeries increased by 53%. The top five most common thoracic surgeries during the pandemic identified by prevalence were decortication (34.2%), hydatid cystectomy (10.8%), emergency thoracotomy (7%), esophagectomy (5.7%), and feeding jejunostomy (5.7%). During the pandemic,

thoracic surgeries were generally more prevalent among males, and among relatively younger patients (age  $\leq 10$  years). We saw a significant drop in the proportion of surgeries for oncologic indications. However, no significant change was seen in the baseline characteristics, complications and mortality of the cases.

**1.5. Conclusion:** Although the pandemic had no significant effect on the baseline characteristics and the safety and efficacy of our procedures, the unplanned diversion of patients from other hospitals resulted in a sudden increased burden on our unit. We recommend a close communication between the different healthcare facilities, under a strict monitoring body, to prevent over burdening of the departments and smooth delivery of care to patients.

## 2. Introduction

Near the end of 2019, a new disease started spreading in the Hubei province of China [1, 2]. The disease was spreading rapidly, and soon became a worldwide pandemic [3]. The causative agent was a virus from the coronavirus family, initially termed as 2019 novel coronavirus (2019-nCoV), but later named severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the disease was called COVID-19 (Derived from Corona Virus Disease-2019) [2]. Aggressive actions were taken to tackle the disease, including immediate surveillance, isolation of any diseased individuals, limiting local and international traveling, obligating the utilization

of face masks, hand washing, and even worldwide precautionary quarantining of healthy individuals. Nonetheless, it spread like a wildfire in almost every country of the planet [3]. It spreads via respiratory droplets and contact, and mainly affects the respiratory system. However, the disease can affect many other systems of the body, causing symptoms of gastroenteritis to arterial and venous thrombosis [3-5].

The socioeconomic implications of the pandemic were even worse than the medical implications. The pandemic resulted in a worldwide halt in travel and trade, extreme economic recessions, and complete disruption of our routine lives. This affected the work of each department generally, but the health department in particular as hospitals had to divert most of their workforce and material resources towards the treatment of the drastically growing number of COVID-19 patients [6]. This inversely affected the management of other diseases due to reduction in available resources. Elective services were limited in most and even stopped completely in some hospitals. Even the treatment of emergency cases was affected due to shortage of vacant beds in the hospitals. This must have affected and continues to affect the cases of every unit, but particularly the cases of pulmonology and thoracic surgery departments due to the increasing number of viral and secondary bacterial infections of the respiratory tract [7].

However, the amplitude of the effects on healthcare was not the same everywhere. We saw a wide range of effects on healthcare round the globe. These depend on various factors like the economy of the country, quick actions, material resources, human resources in healthcare, patient load, and former experience of handling such crises [8]. The effects on the work of individual departments also varied widely including thoracic surgery which, in some areas, came to a complete stop, at other places thoracic surgeries continued with the same pace as ever [9].

Developing nations like Pakistan with a fragile healthcare system were struck hard by the crisis. Other than factors like a weak economy, scarcity of hospitals, and lack of resources, one major problem was poor communication and inadequate planning. Pakistan has been through other epidemics in the past including the small pox pandemic, the H1N1 pandemic, the Dengue fever epidemic, etc. However, we usually fail to effectively evaluate the impact of those crises, and to plan for the future. We believe every department should timely assess the impact of any crises on their activities for better handling of similar situation in the future [6].

Hayatabad Medical Complex (HMC) is a 1300 bedded tertiary care hospital in the city of Peshawar which receives an outsized number of patients from across the province of Khyber Pakhtunkhwa, other provinces, and even the neighboring country Afghanistan. It has three general surgical units. Thoracic surgery subspecialty is a rapidly growing division in one of these surgical departments which was established in 2018. Currently, it has two consultants and a number of residents, providing out-patient services (OPD) 2

days a week, elective surgeries, and 24/7 emergency On-call services. With a limited workforce and heavy workload, our work is highly susceptible to such health crises. A regular study of our cases is vital for future planning and triaging, especially in times of such health crisis.

### 3. Objectives

The main goal of our research was to study the effects of the COVID-19 pandemic on the major thoracic surgical cases at our division. Other goals were to evaluate any relation of these effects with patient and procedure variables like age, sex, emergency status, oncologic indications, etc. and its effect on the complications and mortality of the procedures. Furthermore, we tried to find out the possible reasons for those changes to help us reach a logical conclusion for future recommendations.

### 4. Materials and Methods

A retrospective, comparative descriptive study was performed on all the major thoracic surgical cases in the Thoracic Surgery subspecialty of HMC from 1st December 2018 to 31st July 2021. Data were collected from the hand written Operation Theatre (OT) records of our division after a written approval from the Hospital Research and Ethical Committee. Although the COVID-19 pandemic started back in December 2019, it was only in March 2020 that the disease started spreading in Pakistan. The country implemented its first nationwide lockdown on 1st April 2020 [10, 11]. Hence, we considered this as the cut-off date for our analysis. A 16 month period from 1st December 2018 to 31st March 2020 was represented as 'before pandemic' and a 16 month period from 1st April 2020 to 31st July 2021 was labeled as 'during pandemic'.

We included all the patients who underwent any major thoracic procedure at our division, during the reference period. This included both the elective and emergency procedures, of any age or sex. Those cases were excluded from the study which had poorly documented bio-data or procedure details. We also excluded procedures performed under local anesthesia, due to poor documentation of most of these cases, thus limiting our study only to the major cases done under general anesthesia.

### 5. Analysis

We performed a descriptive comparative analysis of our data using IBM SPSS statistics software, version 25. Data were fed manually from hand written registries into the software. The independent sample t-tests were administered for the comparison of quantitative variables like age, whereas the categorical variables were tested using the Pearson Chi-square test and the Fisher's exact test. The level of statistical significance was defined as a two-sided p-value of less than 5 percent ( $< 0.05$  %). We derived and compared the frequencies and percentages for the categorical variables like case categories, diseases, procedures, gender, age groups, elective and emergency status, post-op complications and in-hospital mortality of the cases both before and during the pandemic, whereas, we

presented the continuous variables as mean and its confidence intervals. Tables were constructed using Microsoft Excel 2013.

## 6. Results

Our data included a total of 242 major thoracic surgical procedures performed in our thoracic division. We saw an overall increase of 53% in the sum of procedures from 84 cases before to 158 cases during the pandemic. Table 1 compares the two groups based on different variables like baseline characteristics, complications, mortality, etc. The age range in the first group was 3 to 85 years, whereas this range was 2 months to 76 years during the pandemic. We found no statistically significant difference between the groups based on baseline variables like gender, elective and emergency status, etc. However, after dividing the cases into age groups, we observed a significant increase in the proportion of surgical patients 10 years or younger, with a corresponding decrease in the number of patients older than 50 years (p-value= 0.042). The proportion of patients age 11 to 50 remained constant.

Coming to the case categories, we observed a significant difference in the two groups, with an overall increase in the pleural, pulmonary, chest wall and mediastinal cases, with a decrease in the number and percentage of other cases. Video Assisted Thoracoscopic Surgeries (VATS) also increased significantly during the pandemic, as illustrated in table 1.

Similarly, we saw significant changes in both the groups based on

**Table 1:** Comparison of the Baseline Characteristics of Patients who underwent Major Thoracic Surgery

	Before pandemic (n=84)		During pandemic (n=158)		p-value
AGE (years)					
Mean (CI)	37.79 (33.4 - 42.19)		31.19 (27.98 - 34.40)		0.017
Minimum	3		0.2		
Maximum	85		76		
Age Group	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)	0.042
Children (<10)	9	10.7	34	21.5	
Young (11-50)	49	58.3	92	58.3	
Old (>50)	26	31	32	20.3	
GENDER					
Male	54	64	102	64	1
Female	30	35	56	35	
Elective/Emergency status					
Elective and Urgent cases	76	90.5	145	91.8	0.811
Emergency cases	8	9.5	13	8.2	
Oncologic indication for surgery					
Oncologic indications	36	42.90%	34	21.50%	0.001
Non-oncologic indications	48	57.10%	124	78.50%	
In-hospital mortality	0	0	3	1.9	0.553
Morbidity (Complications)	3	3.6	11	7	0.39
Diseases Category					
Pleural	26	31	71	44.9	<0.001
Esophageal	25	29.8	17	10.8	
Pulmonary	19	22.5	37	23.4	
Diaphragm	7	8.3	2	1.3	
Chest Wall	3	3.6	15	9.5	
Stomach	3	3.6	1	0.6	
Mediastinal	1	1.2	6	3.8	
Cardiac	0	0	1	0.6	
Thoracostomy	0	0	3	1.9	
VATS	0	0	5	3.2	
TOTAL (n)	84	100	158	100	

CI= Confidence Interval, VATS= Video Assisted Thoracoscopic Surgery.

Note: Percentages may not total 100 based on rounding.

the disease of indication. This included a significant decrease in the proportion of surgeries for oncologic indications, like esophageal Carcinoma (CA esophagus), gastric carcinoma (CA stomach) and other suspicious or confirmed tumors, with a corresponding increase in the surgeries for non-oncologic indications (p-value= 0.001). The most common disease undergoing a major thoracic surgery before pandemic was esophageal carcinoma, followed by empyema thoracis and hydatid cyst of the lung. Whereas, the most common diseases undergoing surgery during the pandemic were empyema thoracis, followed by hydatid cyst and esophageal carcinoma, the detailed analysis is illustrated in table 2. The total number of procedures also increased. The most common procedures before pandemic were decortication, esophagectomy and hydatid cystectomy. A significant change was also observed in the pattern of procedures during the pandemic with an increase in the frequency and percentage of both the open and VATS decortication cases, however we saw a drop in the proportion of most of other procedures, as depicted in table 3.

Importantly, we saw no statistically significant increase in either the complications or mortality, indicating no effect of the pandemic on the safety and efficacy of the thoracic surgical procedures (table 1). This was consistent with our clinical observation of a very low number of complications in our procedures, both before and during the pandemic.

**Table 2:** Comparison of the Disease of Indication of Major Thoracic Surgeries in the Thoracic Surgery Subspecialty of Hayatabad Medical Complex Before and During the COVID-19 Pandemic.

	Before pandemic (n=84)		During pandemic (n=158)		p-value
<b>AGE (years)</b>					
Mean (CI)	37.79 (33.4 - 42.19)		31.19 (27.98 - 34.40)		0.017
Minimum	3		0.2		
Maximum	85		76		
<b>Age Group</b>					
	Frequency (n)	Percent (%)	Frequency (n)	Percent (%)	0.042
Children (<10)	9	10.7	34	21.5	
Young (11-50)	49	58.3	92	58.3	
Old (>50)	26	31	32	20.3	
<b>GENDER</b>					
Male	54	64	102	64	1.000
Female	30	35	56	35	
<b>Elective/Emergency status</b>					
Elective and Urgent cases	76	90.5	145	91.8	0.811
Emergency cases	8	9.5	13	8.2	
<b>Oncologic indication for surgery</b>					
Oncologic indications	36	42.90%	34	21.50%	0.001
Non-oncologic indications	48	57.10%	124	78.50%	
<b>In-hospital mortality</b>					
In-hospital mortality	0	0	3	1.9	0.553
<b>Morbidity (Complications)</b>					
Morbidity (Complications)	3	3.6	11	7	0.39
<b>Diseases Category</b>					
Pleural	26	31	71	44.9	<0.001
Esophageal	25	29.8	17	10.8	
Pulmonary	19	22.5	37	23.4	
Diaphragm	7	8.3	2	1.3	
Chest Wall	3	3.6	15	9.5	
Stomach	3	3.6	1	0.6	
Mediastinal	1	1.2	6	3.8	
Cardiac	0	0	1	0.6	
Thoracostomy	0	0	3	1.9	
VATS	0	0	5	3.2	
TOTAL (n)	84	100	158	100	

CI= Confidence Interval, VATS= Video Assisted Thoracoscopic Surgery.

Note: Percentages may not total 100 based on rounding.

**Table 3:** Comparison of the Frequency and Proportions of Major Thoracic Surgical Procedures in the Thoracic Surgery Subspecialty Before and During the Pandemic

PROCEDURES					p-value
PROCEDURES	Before pandemic		During Pandemic		
	Frequency	Percent	Frequency	Percent	
Decortication	19	22.6	54	34.2	
Esophagectomy	16	19	9	5.7	
Hydatid Cystectomy	10	11.9	17	10.8	
Feeding Jej	9	10.7	9	5.7	
Open Lung Biopsy	4	4.8	2	1.3	
Open Pleural Biopsy	4	4.8	7	4.4	
Diaphragmatic Hernia Repair	3	3.6	0	0	
Elective Thoracotomy	2	2.4	0	0	
Emergency Thoracotomy	2	2.4	11	7	
Hiatal Hernia Repair	2	2.4	1	0.6	
Tube Thoracostomy Under GA	2	2.4	3	1.9	
BPF Repair	1	1.2	0	0	
Bullectomy	1	1.2	2	1.3	
Diaphragm Plication	1	1.2	0	0	
Diaphragmatic Repair	1	1.2	0	0	
Lung Mass Resection	1	1.2	0	0	
Mediastinotomy	1	1.2	1	0.6	
Partial Thoracoplasty	1	1.2	3	1.9	
Pleural Mass Excision	1	1.2	1	0.6	
Proximal Gastrectomy	1	1.2	0	0	
Reexploration	1	1.2	0	0	
Tension Sutures	1	1.2	0	0	
Abscess I/D	0	0	4	2.4	
Blebectomy	0	0	1	0.6	
Bronchial Repair	0	0	1	0.6	
Chest Wall Mass Biopsy	0	0	1	0.6	
Chest Wall Sinus Excision	0	0	1	0.6	
Chest Wall Tumor Excision	0	0	3	1.9	
Claggett Window	0	0	3	1.9	
Cystectomy	0	0	1	0.6	
Diaphragm Tear Repair	0	0	1	0.6	
Emergency Sternotomy	0	0	1	0.6	
Evacuation of Clots	0	0	3	1.9	
Lobectomy	0	0	3	1.9	
Mediastinal Biopsy	0	0	4	2.5	
Pleurectomy	0	0	4	2.5	
Pneumonectomy	0	0	1	0.6	
VATS Decortication	0	0	5	3.2	
Wedge Resection	0	0	1	0.6	
Total (n)	84	100	158	100	

0.006

BPF= Broncho Pleural Fistula, CA esophagus= Carcinoma esophagus, CA stomach= Carcinoma stomach, Feeding jej= Feeding jejunostomy, GA= General Anesthesia, I/D= Incision and Drainage, VATS= Video Assisted Thoracoscopic Surgery. Note: Percentages may not total 100 based on rounding.

## 7. Discussion

The pandemic altered our activities in every department, but it particularly affected the healthcare sector as the number of patients outgrew the available resources to handle them.

We performed a comparison of the thoracic surgeries done in our department before and during the pandemic and found out a significant (53%) increase in the overall number of cases. This increase in the surgical burden of our department is in contrast to other hospitals and thoracic units in the world who experienced a decrease in the number of thoracic procedures [8, 9], attributable to multiple factors. Firstly, our division is a relatively new subspecialty, established in 2018 with only one consultant at the time. In the mid of

the COVID-19 crisis, this division was joined in by another consultant and a number of residents, thus increasing the efficiency of the division. Secondly, most other hospitals of the province first decreased and later declared a complete pause on elective surgeries to dedicate those hospitals for management of the COVID-19 patients. This diverted the massive number of desperate-to-breath thoracic patients to our department for treatment. We were in the same boat as them, and stopped elective surgeries initially. However, looking at the rapidly deteriorating condition of the stage 3 empyema and cancer patients, we were left with no choice but to operate on them on a semi-elective basis. Thirdly, the pandemic itself, and the socioeconomic implications it carried, resulted in a

rise in a number of diseases like infections, infestations, etc. resulting in an increase in the procedures for these cases.

Importantly, we saw a significant decrease in the proportion of cancer related surgeries. These included cancer of the esophagus and stomach, suspicious pleural or chest wall thickening, mesotheliomas, lung masses, mediastinal masses, and metastasis to the lung from other tumors. The total number of oncologic surgeries reduced from 42.9% to 21.5%. An important oncologic indication was esophageal carcinoma which used to be the most common disease undergoing surgery at our department (26.2%) before the pandemic. This included both operable and inoperable cancers, requiring either an esophagectomy or a feeding jejunostomy, respectively. This also dropped to 9.5% in contrast to other studies where the proportion of cancer related surgeries increased. This was mostly attributable to cessation of other elective surgeries in those hospitals [8, 9]. For instance, a multicenter study from Italy revealed an increase in the open resections of esophageal cancer from 21.7% to 40% [12]. A study on robotic surgeries from France reported an overall increase in the proportion of cancer surgeries from 65.9% to 85.6%, [13].

Although, multiple factors might have contributed to the decrease in oncologic surgeries at our division, including the intercity travel bans, strict lockdowns, and the fear of catching the COVID-19 at the beginning of the pandemic, the more logical explanation for these results can be as follows: A lot of cancer patients from Afghanistan come to seek treatment in Pakistan since the 1990s, and being a bordering city, Peshawar receives a large number of these cancer patients [14, 15]. With the border shut down during the pandemic, this patient flow reduced, resulting in a decrease in cancer-related surgeries as well.

On the contrary, we saw a significant increase in both the number and proportion of the surgeries for non-oncologic indications. The second most common disease to undergo thoracic surgery before pandemic was empyema thoracis (the collection of pus in the pleural cavity around the lung). Both the empyema and the surgical procedures for it, including decortications, lobectomies, and pleurectomies increased during the pandemic. In contrast to this, a study from China reported insignificant changes in these procedures [9]. This can be attributed to the shutdown of the large cardiothoracic units in our city which used to take a huge load of thoracic patients previously, most of them being empyema patients [16, 17]. That load of patients now seek care at our hospital. Secondly, the health and socioeconomic effects of the pandemic may have contributed to this increase in empyema cases, as these factors lead to poor nutrition, poor hygiene, and overall immunosuppression-known risk factors for infections [18, 19]. In addition, although the COVID-19 infection status was not documented in our data, viral infections are a known predisposing factors to secondary bacterial infections which might have played a role in the above finding [7].

Similarly, Hydatid cyst has been a common disease in our country since long [20]. However, our results revealed a significant increase in both the number and proportion of hydatid cysts and hydatid cystectomies during the pandemic. The explanations for this possibly are the same as for empyema.

Lastly, our study shows an insignificant change in the baseline characteristics, complications and mortality of our procedures. This indicates an overall safety of thoracic surgeries during the pandemic, consistent with the results from other studies [8]. However, a significant increase in the thoracic surgery cases in children less than 10 years is concerning and needs further study to identify the possible causes of this observation.

Just like any retrospective study, the accuracy of our study also depends on proper documentation and correct data collection. Although, we took extreme care in data collection, data entry, and analysis, the documentation of such a data is not in our hand and is subject to influence the quality of the study. Secondly, such a study can be subject to selection bias as well since surgery always depends on multiple factors, including severity of the disease of indication, response to conservative treatment, prognosis of the planned surgery, availability of resources, choice and expertise of the operating surgeons. Naturally, these factors might play a role in the change in pattern of the surgeries. Finally, a limited amount of data from only one center limits the generalizability of our study. However, it can be used in meta-analysis, combined with other studies, which will improve its generalizability and help in future planning.

Although, our study gives a lot of valuable information in terms of the overall effects of the pandemic on the thoracic surgeries and even on the pattern of the diseases, there always is room for improvement in scientific research. Further studies to quantify the effects of the pandemic on these individual diseases and procedures will be highly valuable. Furthermore, unlike empyema which can develop even during a bacterial lung infection, infestations like hydatid cysts usually take months to years to develop and become symptomatic. Hence, further study is needed to ascertain the causes of this increase in the number of hydatid cysts surgeries during the pandemic [20]. The significant effects on the oncologic surgeries and on the age groups will also benefit from additional research.

A sudden surge in elective cases at one department can be a big problem, especially in times of crises. Hence, for better handling in the future, we recommend close communication between health-care facilities, good regulation of these hospitals by a monitoring body, and a standby workforce in all these facilities. Therefore, understanding the overall shift of the load of work on the different departments within the hospital during the pandemics is important that will aid us in taking steps and making policies that will help us in preventing and/or more effectively addresses the work load and need of hiring man power.

## 8. Conclusion

Our study concludes that the top most common diseases undergoing surgery in our subunit during the pandemic were Empyema thoracis, hydatid cyst and CA esophagus. Although there was no significant difference in the baseline characteristics, mortality, and post-op complications before and during the pandemic, we noticed a rise in the surgeries within the pediatric age group. We experienced a significant decrease in the oncologic surgeries, with corresponding increase in the surgeries for infections and infestations. Although, the pandemic hasn't had any significant effect on the safety and efficacy of our procedures, the unplanned diversion of patients definitely resulted in an increased burden on our unit.

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