Original Article

Interventional pulmonology during COVID times: A look back at the year gone by

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ABSTRACT

Background: The COVID-19 pandemic has created an unprecedented crisis, affecting every sphere of human life. A major challenge for health care workers (HCWs) is to care for patients with a highly contagious airborne disease, while making sure of their own safety. Interventional pulmonology (IP) procedures, like bronchoscopy, are particularly risky due to significant aerosol generation. Guidelines by several scientific bodies were framed on the precautions to be taken while performing IP procedures. We evaluated the IP procedures performed during the COVID-19 pandemic, and whether the precautions adopted proved adequate in preventing transmission amongst the HCWs involved in these procedures. **Method:** We performed a retrospective analysis of all patients who underwent IP procedures between March 2020 and November 2020, at a tertiary cancer hospital. We also evaluated the proportion of HCWs, who were involved in these procedures, and were affected by COVID-19, through their health care records. **Results:** We performed a total of 506 IP procedures. Two of the 18 HCWs, working in that unit, suffered from COVID-19 and recovered after a mild illness. Three HCWs were isolated with suspected infection but proved to be negative. The procedures in our IP unit were uninterrupted for the entire duration of the study period. **Conclusion:** IP procedures can be safely performed even in the presence of a highly contagious viral pandemic with adequate precautions.

KEY WORDS: Interventional pulmonology, SARS-CoV-2, bronchoscopy

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INTRODUCTION

In March 2020, the World Health Organization declared the coronavirus infectious disease 2019 (COVID-19) as a pandemic. In India, an emergent national lockdown was announced on March 22nd, 2020 alerting the public to the imminent danger due to this virus. Of date, according to the "worldometer" website, nearly 106 million people have been infected, with about 2.3 million deaths globally.[1] Many health-care professionals over the past 1 year have also succumbed due to the illness. The SARS-CoV-2 is transmitted through the droplet/aerosol route, causing significant person-to-person transmission. The mode of transmission is a big challenge for health-care professionals, who work closely with these patients. In pulmonology units, the risk is even higher, as the staff is performing and assisting in various aerosol-generating procedures (AGPs) such as bronchoscopy on a daily basis.[2] The adoption of appropriate protective equipment, including gowns, N-95 particulate masks, and face shields

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enables the protection of the health-care workers (HCWs). Several international and Indian guidelines have laid down detailed instructions for performing bronchoscopy during the COVID pandemic.[3-8] We adopted many of these suggestions, while continuing to perform diagnostic and therapeutic interventions to help patients. Herein, we audit our interventional bronchoscopy procedures and evaluate the effectiveness of the personal protective equipment (PPE) and other protective measures adopted by our unit.

METHODS

This was a retrospective analysis of interventional pulmonology (IP) procedures done at a tertiary care cancer hospital from March 2020 to November 2020. The study protocol was approved by the Institute Ethics Committee. Due to the retrospective nature of the study, we were granted consent waiver. The protocol for the IP procedures was per the guidelines laid down by the scientific committee of the hospital. We noted the number of IP procedures and the demographic data of patients who underwent these procedures. The number of HCWs in the IP unit affected by the SARS-CoV-2 infection, while performing or assisting these procedures was recorded. Finally, the extra cost due to COVID screening and disposable PPE per procedure was calculated.

Elective procedures

Patients, both out and inpatients, with indications for elective interventional procedures, were assessed clinically along with their recent imaging data. Patients were divided into two categories depending on the procedure required, namely, bronchoscopic and pleural.

1. Patients requiring bronchoscopy (flexible or rigid) were referred for COVID screening with a reverse transcriptase polymerase chain reaction (RTPCR) test. The turnaround time for the test was 24 hours. If the patient required the procedure, the same day, then a cartridge-based nucleic acid amplification test (CBNAAT) was done with equal sensitivity as the RTPCR but with a shorter turnaround time of 2 hours. If the patient's test by either of the two methods came positive, the procedure was deferred for a minimum of 2 weeks. If the patient was negative for COVID-19, the procedure was done with standard precautions as outlined below
2. Patients requiring pleural procedures were again divided into two categories depending on the possible duration of the procedure. Short procedures were those likely to take <30 min, including thoracentesis, intercostal tube drainage, and pleurodesis. For these procedures, no COVID screening was done. The procedure was completed using standard precautions. Wherever possible, the procedure was done at the bedside. For longer procedures such as medical thoracoscopy and indwelling pleural catheter placement, we performed COVID screening as described above. For patients who were negative on the screening, the procedure was carried out in the bronchoscopy suite with standard precautions. We deferred the procedure for 2 weeks in COVID-positive patients. Meanwhile, the patients were managed conservatively or with a short intervention like a thoracentesis or intercostal tube drainage for palliative relief [Figure 1].

Emergency procedures

For patients presenting with emergencies, a rapid clinical assessment was made for the possibility of COVID-19. Those already diagnosed as COVID-19 were admitted to a designated separate area in the hospital. All others were admitted as COVID suspects in another area. The emergency was dealt with at the bedside or in a dedicated isolation rooms for both the categories.

Standard precautions

The following precautions were observed in the bronchoscopy suite and in the isolation rooms where emergency procedures for COVID-positive or suspect cases were performed.

1. Health-care personnel – The number of HCWs were kept to a minimum. The personnel performing or assisting the procedure had to don a sterile gown, cap, N-95 mask, a surgical mask over the N-95 mask, face shield, and gloves [Figure 2c]. Handwashing was done before donning and after doffing the PPE. When there were multiple elective procedures in a single session, gloves were changed after each procedure, but the rest of the protective equipment remained the same and was doffed finally after the last procedure. For emergency procedures, the PPE was changed after the procedure. All HCWs were instructed to report any breach in protocol. They were also asked to self-monitor for symptoms such as fever, cough, breathlessness, and loss of taste or smell. We isolated symptomatic HCWS and tested them for COVID-19 with an RTPCR. They could return after symptoms subsided and the RTPCR for COVID was negative
2. Patient – Patients undergoing pleural procedures were asked to wear a triple layer surgical mask. For patients in whom flexible bronchoscopy was to be done, an indigenously designed acrylic protective box was placed over the head and upper torso. This allowed the procedure to be performed minimizing the contact of aerosol jet generated by the patient with HCWs doing the procedures [Figure 2a and b]. The initial local anesthesia spray to the throat was done after box placement
3. Disinfection and sanitation – The usual protocols for high-level disinfection and sterilization were followed for all reusable instruments as in the non-COVID times before the pandemic. Health personnel handling instruments after the procedure wore the same PPE described above. The bronchoscopy suite was cleaned, and all exposed surfaces were sanitized with 1% sodium hypochlorite solution every day after the procedures for the day were over. The protective box was also sanitized with the same solution after each procedure. Similar precautions were taken in the isolation rooms in the

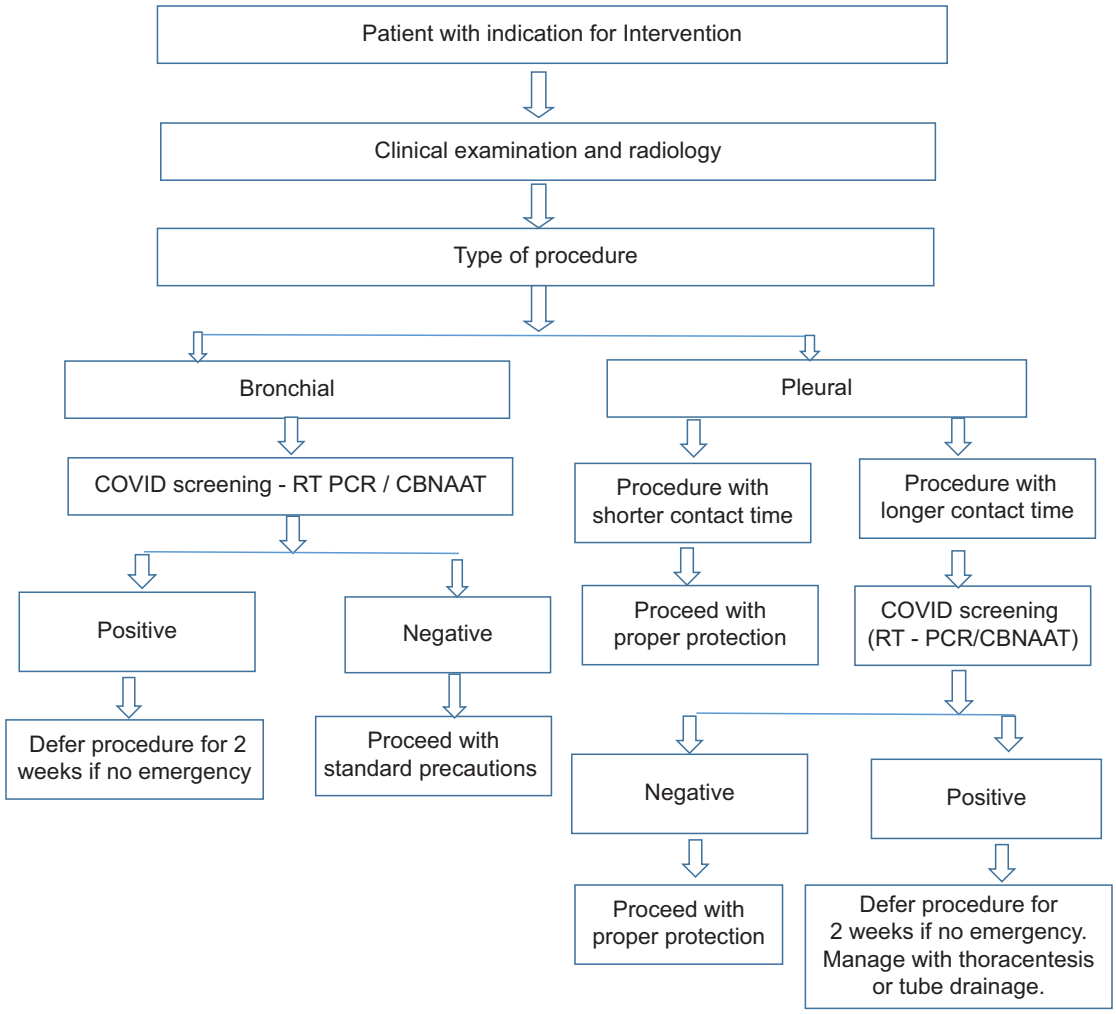

Figure 1: Methodology for elective procedures

Figure 2: (a and b) Protective Aerosol box used during bronchoscopic procedure. (c) Pulmonologist with protective gears while performing bronchoscopy

suspect COVID and the designated COVID area of the hospital

4. Ventilation – The bronchoscopy suite where most of the elective procedures were performed did not have negative pressure air conditioning. The isolation rooms for COVID positive and suspect patients had negative pressure air conditioning with HEPA filters for decontaminating the air going out. The same was true for the operation theaters where rigid bronchoscopy was carried out
5. Protocols – The following protocols were used for various bronchoscopy procedures.

Bronchoscopy

All elective bronchoscopies were done in the bronchoscopy suite under local anesthesia, with conscious sedation using I/V Midazolam. Flexible videobronchoscopes of different sizes from the Olympus 190 series were used as per requirement. The oral route was used to minimize discomfort and shorten the procedure. A protective box described above was placed around the head, and the procedure was performed through the ports. Disposable accessories such as suction trap bottles and biopsy forceps were used in all cases.

Convex probe endobronchial ultrasound

Convex probe endobronchial ultrasound was done in the bronchoscopy suite, with moderate sedation using I/V Midazolam and pentazocine. Endoscopic ultrasound via esophageal route (EUSB) was performed using the same

EBUS scope, where feasible and necessary. The protective box over the patient's head was used in all cases. Rapid onsite evaluation on material obtained from transbronchial needle aspirates was performed in every case.

Radial probe EBUS (RP EBUS) – This was done for peripheral lesions not visible on conventional flexible bronchoscopy. During bronchoscopy, done under conscious sedation and local anesthesia with a protective box, a radial EBUS probe was passed through the working channel of the bronchoscope to locate the lesion. In those cases where fluoroscopy was used for additional assistance, the protective box over the patient's head was not used. After localization, bronchial lavage specimens, transbronchial biopsies, and bronchial brushings were collected as per indication in each case.

Rigid bronchoscopy

These were performed in the operation theater under general anesthesia. A protective box could not be used in these cases. The personnel performing these procedures used PPE as described above.

The number and the outcome of procedures performed by the same unit during COVID times were compared with those performed during March 2019 to November 2019, before the COVID-19 pandemic.

RESULTS

From March 2020 to November 2020 we performed a total of 506 IP procedures. Of these, 326 procedures were done in men with an average age of 55.8 years, 180 procedures in women with an average age of 53.7 years. A total of 397 elective bronchoscopic airway procedures were performed under conscious sedation. Of these, 167 were flexible bronchoscopies, 186 linear probe EBUS-TBNA, 20 RP EBUS procedures, and 17 direct flexible laryngoscopies. A positive diagnostic yield from bronchoscopies was obtained from 91 of 102 cases, where biopsies were done, i.e. 89%. For 186 patients in whom CP EBUS was performed, adequate yield was obtained in needle aspirates and/or cell blocks in 177 patients, i.e. 95%. The diagnostic yield for RP EBUS was 70% in 14 out of 20 cases, and for direct laryngoscopies, it was 76% in 13 out of 17 cases.

Seven rigid bronchoscopy procedures were done under general anesthesia, for tracheal stenting and/or tumor debulking procedures [Table 1].

A total of 98 pleural procedures were done, out of which 86 were of shorter contact time, which included ICD insertion in 41 patients, thoracentesis in 10 patients, and pleurodesis in 35 patients. In all shorter time procedures, no COVID screening was done, but basic personal protection measures including surgical gown, surgical cap, surgical gloves, N-95 mask, surgical mask over N-95 mask, and face shield were used. Twelve long contact time pleural procedures were done which included

Table 1: Elective bronchoscopic procedures

Procedure	Gender (mean age)		Total
	Male	Female	
Bronchoscopy under conscious sedation			
Bronchoscopy (with BAL and or biopsy)	116 (54.4)	51 (49.6)	167
EBUS-TBNA	124 (52.9)	62 (46.1)	186
Direct laryngoscopy	15 (59.1)	2 (57.5)	17
RP-EBUS	11 (57.9)	9 (62.4)	20
Bronchoscopy under general anesthesia			
Rigid bronchoscopy	7		7
Total	273	124	397

RP-EBUS: Radial probe endobronchial ultrasound, EBUS-TBNA: Endobronchial ultrasound transbronchial needle aspiration, BAL: Bronchoalveolar lavage

Table 2: Elective pleural procedures

Procedure	Gender (mean age)		Total
	Male	Female	
With short contact time			
Intercostal drainage	18 (52.6)	23 (58.1)	41
Thoracentesis	3 (51.5)	7 (50.5)	10
Pleurodesis	18 (59)	17 (60)	35
With long contact time			
Indwelling pleural catheter	1 (59)	2 (55)	3
Medical thoracoscopy	5 (61.3)	4 (70.3)	9
Total	45	53	98

Table 3: Emergency procedures

Procedures	Gender (age in average)		Total
	Male	Female	
Bronchoscopy	5 (53.6)	2 (49.3)	7
Intercostal drainage	3 (52.1)	1 (32)	4

three indwelling pleural catheter insertions and nine medical thoracoscopies after COVID screening as described above [Table 2]. The diagnostic yield for thoracoscopy procedures was 89% with a positive diagnosis in 8 out of 9 patients.

Eleven emergency procedures including seven bronchoscopies and four ICD tube insertions were done in COVID-suspected and COVID-affected patients. Out of the seven bronchoscopies, three were done in COVID-suspected patients in whom clinical and radiological suspicion for COVID was high. Remaining four bronchoscopies were done in COVID-positive patients also suffering from malignancy to rule out secondary bacterial infection. Four intercostal tube insertions were done out of which 3 were done for pneumothorax in patients on positive pressure ventilation and one for a symptomatic, rapidly refilling, massive malignant pleural effusion [Table 3].

In a breach of the above protocol, one patient was taken up for an EBUS procedure without waiting for the COVID screening report. The patient was subsequently found to be COVID positive on the RTPCR test. On questioning of all the health personnel present during the procedure, one nurse admitted to not wearing her face shield at that time. She was asked to isolate herself and monitor for

symptoms. She underwent a COVID RTPCR after 5 days of exposure. Although she was found negative, she could resume her duties only after 14 days of home isolation. All other personnel who had attended the above procedure with appropriate protection were asked to self-monitor for symptoms while continuing to work as before.

Out of a total of 18 health personnel working in the bronchoscopy unit, during the 8-month period mentioned above, one technician and a nurse were detected to have developed COVID-19. Both had mild disease and responded to symptomatic treatment. They both resumed duties after completion of the quarantine period and testing negative. One doctor and another technician had short episodes of fever and were asked to isolate themselves. Both, however, showed up as negative on testing for COVID-19 and responded to symptomatic treatment.

Patients who underwent screening for COVID-19 by RTPCR spent INR 2400/-, while those who opted for the CBNAAT test incurred an extra expenditure of INR 4500/-. Approximately INR 1000/-per procedure was charged by the hospital for expense on disposable masks, gloves, gowns, and sanitation.

Comparison with similar procedures done from March 2019 to November 2019 showed the following results: a total of 708 IP procedures were performed during this period with 492 bronchoscopies and 216 pleural interventions. From the 178 bronchoscopic biopsies performed, the positive diagnostic yield was 91% in 162 cases. The CP EBUS which was done in 202 patients had adequate yield in 190, i.e. 94%. RP EBUS was done in 22 patients with a diagnostic yield of 68% in 15 cases, and flexible direct laryngoscopy in 16 patients had a diagnostic yield of 75% in 12 cases. Of the pleural procedures during this period, thoracoscopy was done in 11 patients and had a diagnostic yield in 10, i.e. 91% [Table 4].

DISCUSSION

This retrospective analysis of IP procedures performed during the COVID pandemic period showed that, by taking simple and effective precautions, it was possible to continue performing all procedures with minimum risk to the health personnel involved. We believe this is among the first reports from India on the performance of pulmonology units doing highly risky AGPs on a regular basis. We were able to access one other report from a high volume center, where it appears that the IP services were severely impacted due to the COVID crisis, so only 29 IP procedures could be carried out in 3 months.[7]

As was mentioned earlier, 506 IP procedures were carried out over a period of 8 months. In the initial 2 months, after the national lockdown was announced, the number of procedures was very low due to the severe restrictions on movement and also the prevailing atmosphere of fear of infection among the general public and the hospital staff. However, the pace picked up subsequently, and barring a few all procedures was carried out taking the precautions outlined above. For comparison, 708 IP procedures were carried out by the same unit in the previous year from March 2019 to November 2019. Hence, although the numbers were about 30% fewer than those carried out in a normal year, they were still substantial. Furthermore, a comparison of the diagnostic yield of various procedures performed in 2019 and 2020 also showed consistent results for all procedures with no decline in yield despite the extra precautions.

The precautions that were observed were as per guidelines laid out by various international and national pulmonology/bronchology societies with adaptation to the local conditions.[2-6] In the initial months, COVID screening by the RTPCR/CBNAAT tests was not easily available, so only clinical and radiological screening was possible. From the month of May, in-house testing with a fast turnaround time became available, so all patients for elective procedures could be screened. The PPE was standard but donning and doffing were done only at the start and at the end of the shift. Where emergency procedures were performed for suspect or confirmed COVID-19 patients, the protective equipment was discarded after use.

An aerosol protection box was indigenously designed by fusing acrylic sheets with holes on the sides and on the proximal head end to allow flexible bronchoscopy to be done. The box was made to fit comfortably over the patients' head and chest after he/she lay down supine on the operating table. We believe that this substantially minimized the spread of droplets and aerosol during the procedure. The box was cleaned and sanitized after each procedure with hypochlorite solution. However, this box

Table 4: Table of comparison

Year	2020 (March-November)		2019 (March-November)	
	Number	Diagnostic yield (%)	Number	Diagnostic yield (%)
Bronchoscopies Total	167		241	
Bronchoscopic biopsy (EBB, TBLB)	102	91 (89)	178	162 (91)
CP EBUS	186	177 (95)	202	190 (94)
RP EBUS	20	14 (70)	22	15 (68)
Direct laryngoscopy	17	13 (76)	16	12 (75)
Medical thoracoscopy	9	8 (89)	11	10 (91)

CP EBUS: Convex probe endobronchial ultrasound, RP EBUS: Radial probe endobronchial ultrasound, EBB: Endoscopic bronchial biopsy, TBLB: Transbronchial lung biopsy

could not be used when fluoroscopy was needed for the RP EBUS for peripheral lesions. It also could not be used when rigid bronchoscopy was done or during long pleural procedures. The fabrication cost of the box was only INR 7000 equivalent to about 100 US dollars. Although there is no firm evidence regarding the usefulness of this barrier device, we felt that it provided a measure of safety without interfering too much with the procedure.[9,10]

During this pandemic, the hospital had a total of 2252 health personnel working in shifts and 367 (16%) of them contracted COVID-19, for which many were hospitalized. Our staff in the bronchoscopy unit, despite doing work fraught with more risk, had only 2 cases out of a total of 18 (11%) over an 8-month period. Gao *et al*. and Torego *et al*. have also reported that performing AGPs with proper precautions, ensures enough protection to health-care workers.[11,12] Our results and these reports does seem to indicate that strict adherence to a simple protocol helps to protect HCWs.

The patients undergoing these procedures had to undergo an extra cost of about INR 3500–5500 per procedure. This was approximately 10%–30% over and above what they would have spent in normal circumstances. For the poorer patients, this was indeed an extra burden and conscious effort was made to waive of some or all charges wherever deemed appropriate.

This study has limitations in that no antibody testing was done on the staff in the unit to find out how many were actually infected and may have been asymptomatic carriers. It is also difficult to say whether the two workers who developed COVID-19, got infected during work or from the community. Only one negative COVID RTPCR test was required in the worker who was exposed to a positive patient during her isolation before returning for duty, and the same was the case in the two workers who had COVID-19 infection. In retrospect, we could have asked for two tests done a few days apart to increase the probability that they were indeed negative before allowing them to return to work. Finally, a study of this nature could not have a comparative arm to analyze the individual contribution of various precautionary measures such as the protective box used in bronchoscopy.

CONCLUSION

When a new virus causes a pandemic, knowledge about the virus is limited, and in the absence of specific treatment and vaccine, the prime focus has to be on protection. We adopted simple and practical ways of protection for health-care workers while performing IP procedures. We believe that we were reasonably successful in achieving our twin objectives of continuing to serve our patients, while maintaining personal safety and recommend the same for other units doing similar work.

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Conflicts of interest
There are no conflicts of interest.

REFERENCES

1. Available from: https://www.worldometeres.info. [Last accessed on 2021 Feb 07].
2. Jackson T, Deibert D, Wyatt G, Durand-Moreau Q, Adisesh A, Khunti K, *et al*. Classification of aerosol-generating procedures: A rapid systematic review. BMJ Open Respiratory Research 2020;7:e000730.
3. Wahidi MM, Shoajee S, Lamb CR, Ost D, Maldonado F, Eapen G, *et al*. The use of bronchoscopy during the the coronavirus disease 2019 pandemic: CHEST/AABIP Guideline and Expert Panel Report. Chest 2020;158:1268-81.
4. Sommerstein R, Fux CA, Vuichard-Gysin D, Abbas M, Marschall J, Balmelli C, *et al*. Risk of SARS-CoV-2 transmission by aerosols, the rational use of masks and protection of health workers from COVID-19. Antimicrob Resist Infect Control 2020;9:100.
5. Guedes F, Boleo-Tome JP, Rodrigues LV, Bastos HN, Campainha S, De santis M, *et al*. Recommendations for interventional pulmonology during COVID-19 outbreak: A consensus statement from the Portuguese Pulmonology Society. Pulmonol 2020:26:386-97.
6. Prashant C, Amita N, Goyal R, Agarwal R, Pattabhiraman VR, Dhar R, *et al*. Conventional flexible bronchoscopy during the COVID Pandemic: A consensus statement from the Indian Association of Bronchology (accepted for publication) Lung India 2021;38:105-15.
7. Rajesh KP, Bhalla A, Myatra SN, Yaddanpuddi LN, Gupta S, Sahoo TK, *et al*. Procedures in COVID-19 Patients: Part-I. Indian J Crit Care Med 2020;24(Suppl 5):S263-71. doi: 10.5005/jp-Journals-10071-23597.
8. Tyagi R, Mittal S, Madan K, Mohan R, Hadda V, Guleria R, *et al*. Assessment of the impact and reorganization of interventional pulmonology services at a tertiary care centre during nationwide lockdown for COVID-19 pandemic. Monaldi Arch Chest Dis 2021;91:1615.
9. Sorbello M, Rosenblatt W, Hofmeyr R, Grief R, Urdanets F. Aerosol boxes and barrier enclosures for airway management in COVID-19 patients: A scoping review and narrative synthesis. Br J Anesth 2020;125:880-94.
10. Sehgal IP, Dhooria S, Prasad KT, Muthu V, Aggarwal AN, Agarwal R, *et al*. Experience with barrier enclosure device during flexible bronchoscopy. J Bronchol Intervent Pulmonol 2021;28:2, e26-8.
11. Gao C, Bailey J, Walter J, Coleman J, Malsin E, Argento A, *et al*. Bronchoscopy on Intubated COVID-19 Patients is Associated with Low Infectious Risk to Operators. Ann Am Thoracic Soc 2021;18:1243-46.
12. Torrego A, Pajares V, Fernández-Arias C, Vera P, Mancebo J. Bronchoscopy in Patients with COVID-19 with Invasive Mechanical Ventilation: A Single-Center Experience. Am J Respir Crit Care Med 2020;202:284-7.