

Case Report

## Physiotherapy Management for Complete Right Lung Collapse- is there role of mechanical insufflation and exsufflation? -A Case Report

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### ABSTRACT

We are reporting, a case of 52 year old male, with obstructive uropathy who underwent cystolithotripsy surgery associated with chronic kidney disease presented with respiratory distress, tachypnea and hypoxia on 3<sup>rd</sup> post-operative day. He was on maintenance hemodialysis. Examination revealed absent air-entry on right side, dull percussion note on right side and positive trail sign. Chest X-ray and HRCT showed complete collapse of right lung with ipsilateral shift of trachea with mediastinum. Conventional physiotherapy postural drainage, breathing exercises, active cycle of breathing technique, forced expiratory techniques, spirometry, nebulization given for a day, no improvement seen because patient had strong cough reflex but unable to expectorate; any effort to cough caused more distress and breathing difficulty. Mechanical insufflation-exsufflation, a therapy in which the device which inflates the lungs (Insufflation pressure start at 15-20 cmH<sub>2</sub>O and increase to give an inspiration to total lung capacity, last for 2 second) followed by an immediate and abrupt change to negative pressure (exsufflation pressure same as the insufflation, then increase up to 10–20cmH<sub>2</sub>O, held for 3-6 second), which produces rapid exhalation, simulates cough and thus moves secretions cephaladly. Thus device helps patient cough out effectively. Lung collapse resolved within 1 day, regular physiotherapy was given to prevent recurrent lung collapse until discharge, X-ray and auscultation findings and oxygen saturation improved. It concludes, successful utilization of chest physiotherapy and mechanical insufflators-exsufflators aids in the resolution of lung collapse in an urgent situation.

**KEYWORDS:** Mechanical insufflator-exsufflator, Atelectasis, chronic kidney disease, cystolithotripsy.

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### INTRODUCTION

Atelectasis describes a state of collapsed and non-aerated region of the lung parenchyma. Atelectasis may occur in three ways: (i) airway

obstruction; (ii) compression of parenchyma by extra thoracic, intrathoracic, chest wall processes; and (iii) increased surface tension in alveoli and bronchioli. The treatment of

atelectasis varies depending on duration and severity of the causal disease from chest physiotherapy to postural drainage, bronchodilator and anti-inflammatory therapy. Persistent mucous plugs should be removed by bronchoscopy [1]. Atelectasis was early suspected as a cause of impaired oxygenation during general anaesthesia [2]. Pulmonary gas exchange is regularly impaired during general anaesthesia with mechanical ventilation. This results in decreased oxygenation of blood [3]. Cough is an important component of airway clearance, particularly in individuals with intrinsic pulmonary disease, weakness of respiratory muscles, or central nervous system disease that impairs breathing. Periodic insufflation of the lung above a reduced vital capacity is also important, to maintain range of motion of the thoracic cage and avoid progressive respiratory disability. Mechanical insufflation-exsufflation is a therapy in which the device (the Cough Assist In-Exsufflator is the only currently marketed insufflation-exsufflation device) gradually inflates the lungs (insufflation), followed by an immediate and abrupt change to negative pressure, which produces a rapid exhalation (exsufflation), which simulates a cough and thus moves secretions cephalad [4]. Mechanical insufflation-exsufflation (MI-E) devices are frequently used in patients with respiratory muscle weakness to increase their cough peak flow and assist them in improving cough effectiveness and clearing mucus from the airways [5].

Endoscopic transurethral cystolithotripsy is among the most well-known procedures for the majority of urologists. However, disintegrating and extracting stones from the bladder, particularly in cases of large stones, take a considerable amount of time with usual cystolithotripsy [6].

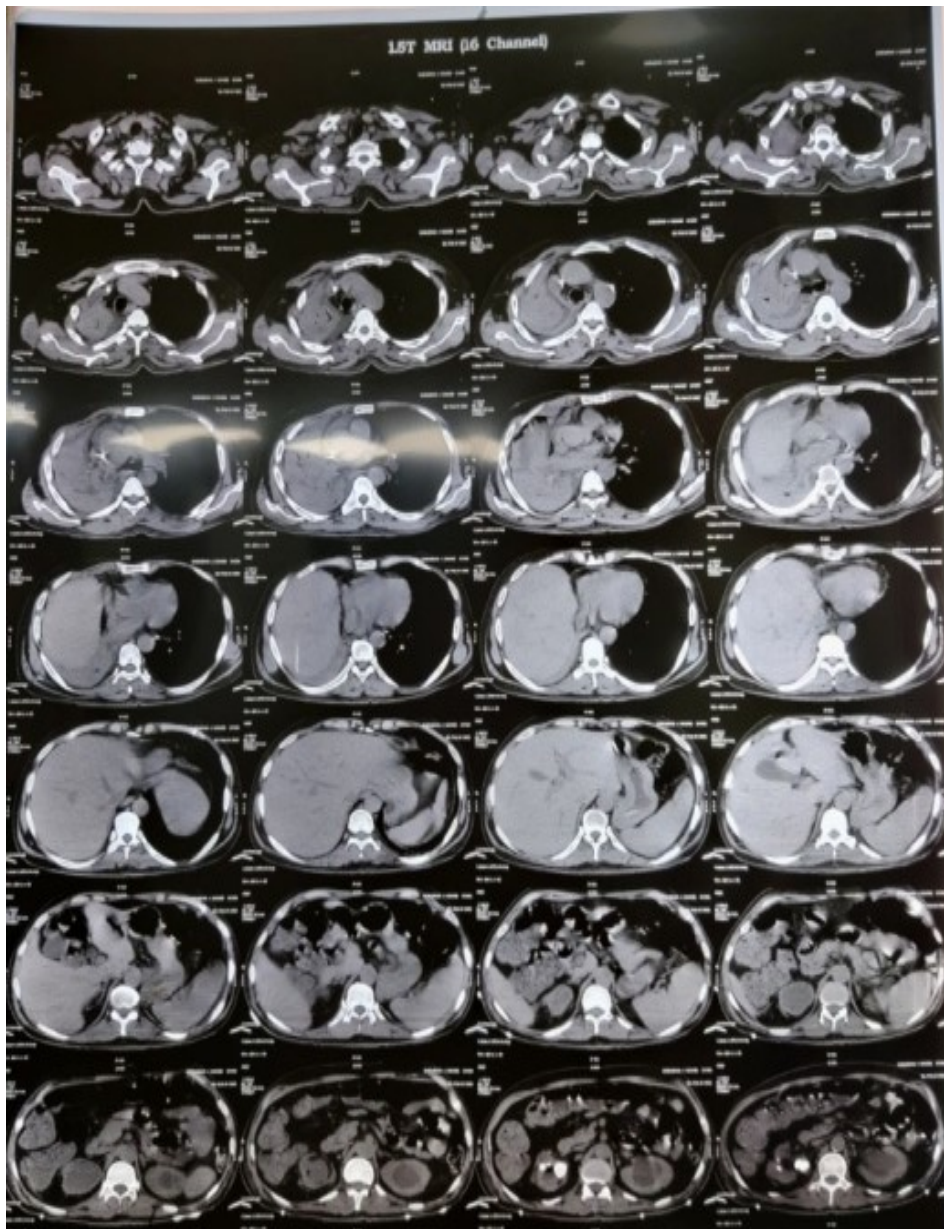
## CASE REPORT

38 year old male underwent bilateral percutaneous lithotripsy (Jan'22) and Cystolithotripsy (Feb'22) surgery with significant respiratory distress and tachypnea was referred to physiotherapist for airway clearance therapy after suspicion of acute mucous obstruction.

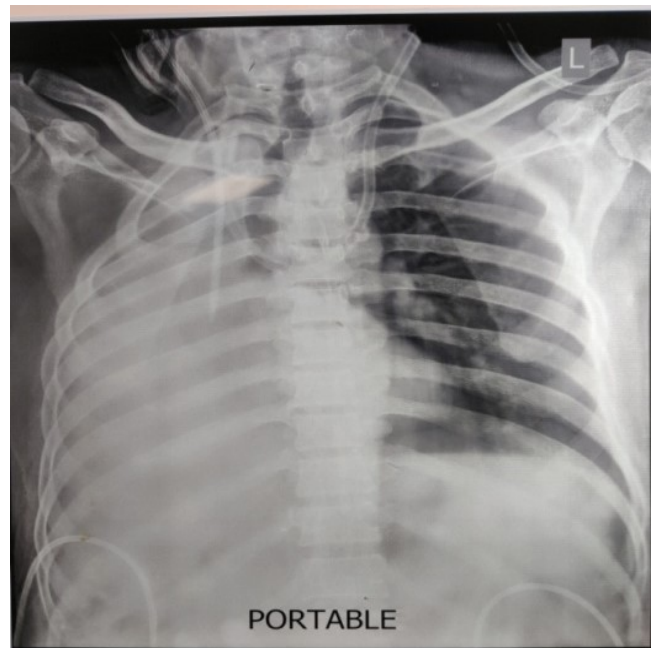
Patient history and general examination: Patient was known case of obstructive uropathy, staghorn calculus and chronic kidney disease-5D on maintenance hemodialysis (twice/week) via double lumen catheter. He underwent Cystolithotripsy surgery. On the third post-operative day as he had significant respiratory distress and tachypnea and hypoxia, chest X-ray was done. Chest X-ray and HRCT revealed complete collapse of right lung with ipsilateral shift of trachea with mediastinum and was referred for physiotherapy on the same day. The patient didn't have any known cardio-respiratory co-morbidities before that however, he was chronic bidi smoker (20 packs/year) and stopped just before 3 months. He was conscious, oriented but agitated due to distress. He had surgical drains in situ on both sides. He was also complaining of pain at the incision site. After checking hemodynamic parameters, the patient was transferred from room air to O<sub>2</sub> mask. respiratory rate was 32 breaths per minute, Heart rate was 110 beats per minute, Blood pressure was 130/70 mmHg and saturation was 62% (on room air) and 97% (on O<sub>2</sub> mask) He was immobile after surgery ( for 2 days ). He had exertional dyspnea (dyspnea on ordinary activity) (Grade III according to mMRC scale)

## DISCUSSION

Patient with complete hemithorax collapse is not routine finding in clinical practice. Sometimes complete ossification of hemithorax on X-ray is confused with pleural effusion. But in this case, X-ray findings and CT scan were in the Favor of complete right lung collapse. The probable reason and justification in this case for development of collapse maybe the more intense surgical pain and patient was kept immobile 2 days after surgery. However, PFT was not done pre- and post-surgery, but according to smoking history the patient may have COPD. Yvette R. B. M. van Gestel, Michel Chonchol, et al in 2009, demonstrates that the presence of COPD is moderately associated with CKD. Tobacco smoking plays an important role in both the development and progression of COPD and kidney disease [7]. Assisted cough therapy is critical to achieve maximum insufflation of the lungs and increase the



**Fig. 1:** HRCT shows Complete collapse of right lung with ipsilateral shift of trachea & mediastinum.



**Fig. 2:** Chest X-ray show Complete collapse of right lung with ipsilateral shift of trachea.

Special test	
ECHO	Normal LV size & fair LV systolic function
	Normal LV compliance
	LVEF = 55%

Physiotherapy evaluation and treatment			
Inspection	Palpation	Percussion	Auscultation
-Use of Accessory Muscle: Present (Sternocleidomastoid ) and unilateral (left-side Sternocleidomastoid prominent)	-Tracheal Position: Deviated to right side (collapse side)	-Dull note on right upper , middle and lower zones in lung field.	-Air entry was absent in right upper, middle, lower lobe.
-Type of Breathing: asymmetrical and strenuous breathing pattern	--Jugular Venous Pressure: 3 cm	-Resonant note on left side but cardiac dullness present.	-No added sound present except occasional fine crep's.
	-Trail Sign : Present		-Air entry present on left side.
-No signs of clubbing and cyanosis.	-Chest Asymmetry:was present on right side.		
	-Tactile Vocal Fremitus : Absent on right side		

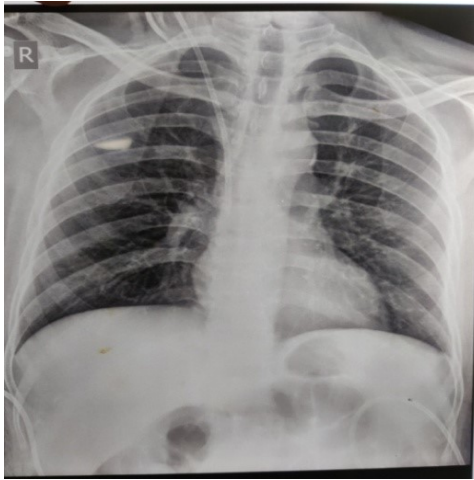


Fig. 3: normal chest X ray on post operative day

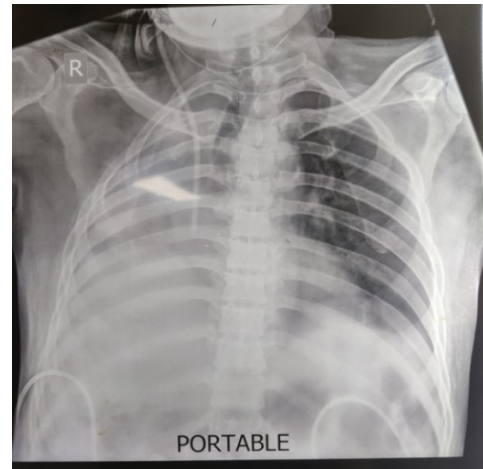


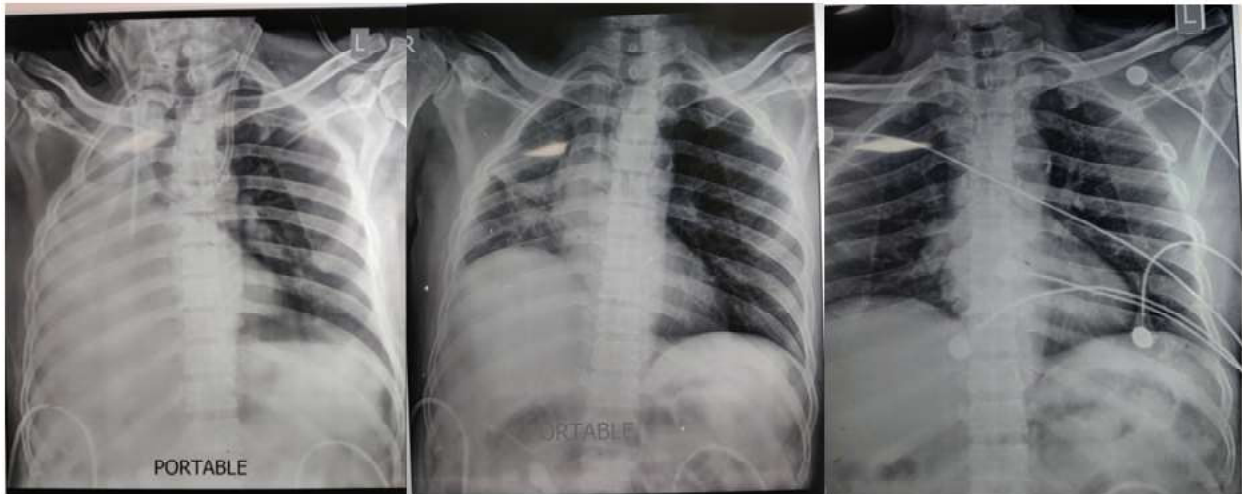
Fig. 4: Chest X-ray show Complete collapse of right lung with ipsilateral shift of trachea on 3<sup>rd</sup> POD.

3 <sup>rd</sup> POD	<p>On auscultation: AE absent in Right basal &amp; middle lobe, upper lobe and Oxygen saturation was 98% on 5 L O<sub>2</sub></p> <ul style="list-style-type: none"> <li>Bronchodilator and Mucolytic nebulization in modified postural drainage positions (in ward) with cubes for upper middle and lower zone with Deep breathing exercise and vigorous chest physiotherapy with percussion/ vibration (3 sessions a day)</li> </ul>
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Fig. 5: Modified postural drainage position with cubes.

4 <sup>th</sup> POD	<p>On auscultation: AE absent in Right basal &amp; middle lobe, upper lobe and Oxygen saturation was 93% to 98% on 5 L O<sub>2</sub></p> <p>He was not able to cough out effectively so we used Mechanical insufflation exsufflation machine with conventional physiotherapy (3 sessions a day) (MIE used once)</p> <p>(For cough assist mechanical insufflation and exsufflation device is used in which the initial pressure is 15-20 and increased till +40 and further with sudden expiration pressure is reduced to -20 to -40 . This sequence is repeated 4 times 1 set. Patient is given rest in between sets, so if patient was desaturated, oxygenation is provided and if cough initiations it can be coughed out.)</p>
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**Fig. 6:** chest X-ray of 4<sup>th</sup>, 5<sup>th</sup> and 7<sup>th</sup> Post operative day. On 5<sup>th</sup> POD opacity on right side had decrease and on 7<sup>th</sup> POD normal chest x-ray.

<p><b>5<sup>th</sup> POD</b></p>	<p>On auscultation: air entry reduced in Right middle and lower lobe. He was shifted to ICU for continue monitoring and kept on nasal canula 2 L O<sub>2</sub></p> <ul style="list-style-type: none"> <li>-Mucolytic(BD), 3% NS(TD) nebulization</li> <li>-Postural drainage with vigorous chest physiotherapy percussion &amp; vibration</li> <li>-diaphragmatic breathing exercise</li> <li>-Segmental breathing exercise</li> <li>-Thoracic expansion exercise</li> <li>-Incentive Spirometer</li> <li>-Active cycle of breathing technique</li> <li>-Forced expiratory technique</li> <li>-Active limb physiotherapy</li> </ul> <p>(2 sessions a day)</p>
<p><b>6<sup>th</sup> to 12<sup>th</sup> POD</b></p>	<p>On auscultation: bilateral air entry present with no added sound Patient was shifted to ward and regularly seen by physiotherapist until discharge. Patient was maintaining saturation(on room air) with no complaints of breathlessness and coughing.</p> <ul style="list-style-type: none"> <li>NS(BD) nebulization</li> <li>-Diaphragmatic breathing exercise</li> <li>-Segmental breathing exercise</li> <li>-Incentive spirometer</li> <li>-Thoracic expansion exercise</li> <li>-Active limb physiotherapy</li> </ul>

expiratory flow in respiratory care of patients with ineffective cough. Mechanical insufflation-exsufflation (MIE) helps to increase expiratory flows for the effective removal of secretions in airways. Many evidences have been recommended in the management of the patients with neuromuscular disorders (NMD) and respiratory muscle weakness<sup>(8)</sup> but in our case patient cannot cough out effectively as he get tired, so this device was used for this patient. He was stable throughout the procedure. It improves chest wall asymmetry and movement; it also improves respiratory mechanics in short term. thus, dyspnea

reduces. It is better technique to improve lung compliance compare to other technique. SunMi Kim, Won Ah Choi et al. 2016, carried out a study in which they compare cough assisted techniques in patient with respiratory muscle weakness. And they concluded that in patient with neuromuscular disease and respiratory muscle dysfunction, MI-E alone was more effective than manual assistance following a maximum insufflation capacity maneuver [9].

Roberto Martínez-Alejos, Joan-Daniel Martí et al. 2021, suggested that In mechanically ventilated subjects, MI-E combined with

ERCC (expiratory rib cage compressions) increased the sputum volume cleared without causing clinically important hemodynamic changes or adverse events [10]. Márcio Luiz Ferreira de Camillis, Augusto Savi, et al. 2018, the implied that Among the general ICU subjects receiving mechanical ventilation, use of an MI-E device during respiratory physiotherapy resulted in a larger amount of airway mucus clearance than respiratory physiotherapy alone [11].

However, Respiratory muscle strength was not assessed, but he may have reduced respiratory muscle strength. In this patient postural drainage positions were partially sufficient, and the patient was not able to expectorate. So, we used mechanical insufflation-exsufflation machine after proper nebulization with mucolytic inhalation. As the patient attained full aeration, he was advised to practice incentive spirometer and breathing exercises regularly to prevent further atelectasis and regularly follow up is taken by our team.

## CONCLUSION

Cough assist device (mechanical insufflation-exsufflation) can be used as an adjuvant to conventional chest physiotherapy to facilitate cough and expectoration. So, successful utilization of chest physiotherapy and mechanical insufflation-exsufflation aids in the resolution of lung collapse.

**Future recommendation:** further studies related to mechanical insufflation-exsufflation device can be done which can broaden the scope of treatment in the patient with lung collapse.

**Competing interests:** The authors declare to have no conflict of interest.

**Authors' contributions:** All authors contributed equally.

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**Conflicts of interest: None**

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