Artificial CO_2 Pneumothorax for Diaphragmatic Plication

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PATIENT INFORMATION

68 year old male with hypertension, GERD, BPH, osteoarthritis, and left phrenic nerve palsy presented for laparoscopic diaphragmatic plication. History of chest pain and exertional shortness of breath. Echocardiogram demonstrates “dextrocardia.” Vital signs within normal limits.

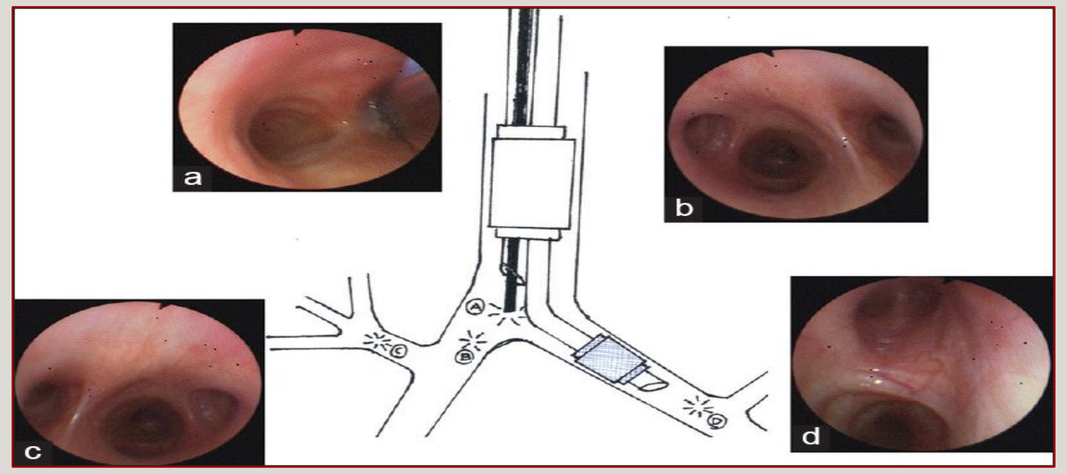
CASE PRESENTATION

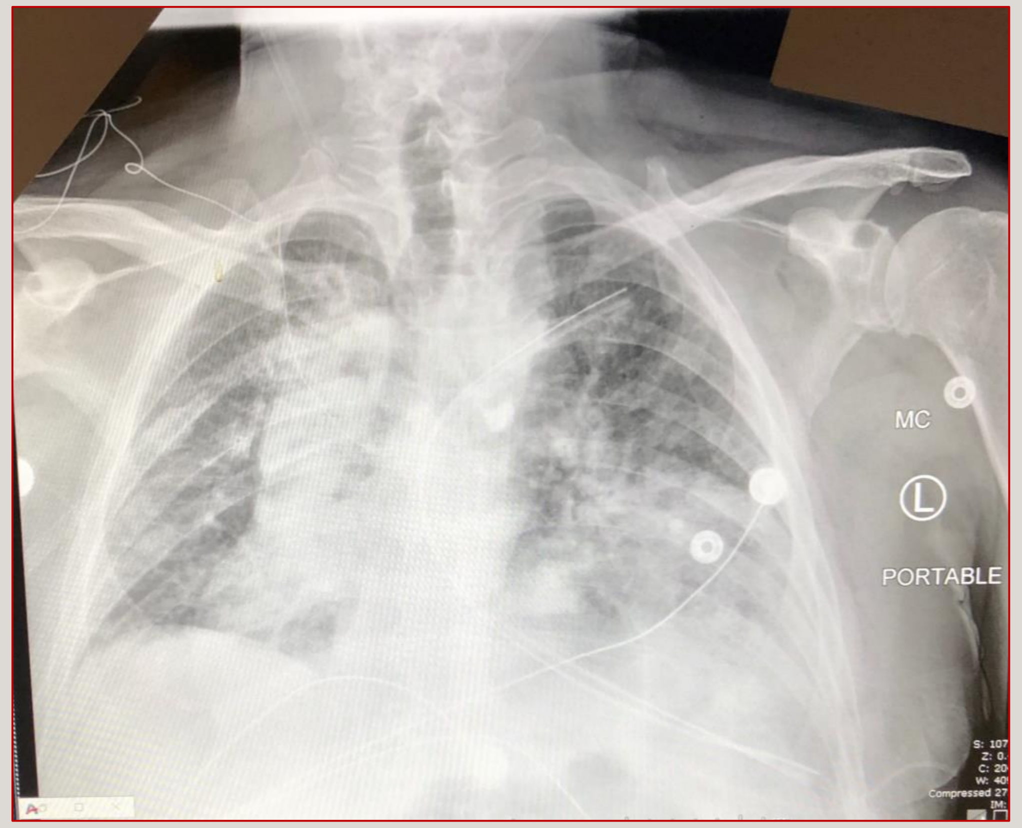
The patient received midazolam and fentanyl for placement of a thoracic epidural preoperatively for post-operative analgesia.

Induction was uneventful with lidocaine, propofol, and rocuronium.

A 37 French left-sided double lumen tube was placed. Fiberoptic bronchoscopy down the bronchial lumen demonstrated right mainstem placement. Multiple attempts were made to manipulate the fiberoptic bronchoscope and the double lumen tube into the left mainstem bronchus. Attempts were met with resistance and retroflexion of the bronchoscope.

The patient was extubated and reintubated with an 8.0 ETT. Multiple attempts were made to place a bronchial blocker in the left mainstem bronchus. Despite adequate visualization of the left mainstem bronchus, the fiberoptic bronchoscope was unable to advance.



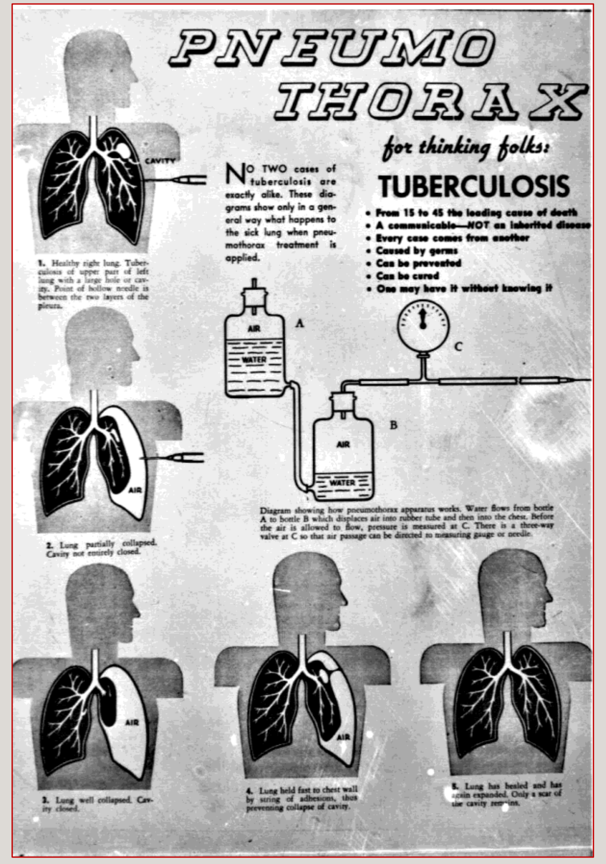


Post-operative chest x-ray.

ARTIFICIAL CO_2 PNEUMOTHORAX

After discussion, the thoracic surgeon induced artificial pneumothorax by transdiaphragmatic puncture and insufflation of the left pleural cavity. In addition, an intercostal red rubber catheter was placed and clamped. In the event of tension pneumothorax physiology, it would be unclamped to release the pressure.

Surgery was successfully performed with two lung ventilation with CO_2 artificial pneumothorax. The patient was extubated successfully and taken to the recovery room without issue.



No two cases of tuberculosis are exactly alike. These diagrams show only in a general way what happens to the sick lung when pneumothorax treatment is applied.

- From 15 to 45 the leading cause of death
- A communicable—NOT an inherited disease
- Every case comes from another
- Caused by germs
- Can be prevented
- Can be cured
- One may have it without knowing it

1. Healthy right lung. Tuberculosis of upper part of left lung with a large hole or cavity. Point of hollow needle is between the two layers of the pleura.

2. Lung partially collapsed. Cavity not entirely closed.

3. Lung well collapsed. Cavity closed.

4. Lung held fast to chest wall by string of adhesions, thus preventing collapse of cavity.

5. Lung has healed and has again expanded. Only a scar of the cavity remains.

Diagram showing how pneumothorax apparatus works. Water flows from bottle A to bottle B which displaces air into rubber tube and then into the chest. Before the air is allowed to flow, pressure is measured at C. There is a three-way valve at C so that air passage can be directed to measuring gauge or needle.

DISCUSSION

One lung ventilation via a double lumen endotracheal tube or bronchial blocker is routinely utilized for unilateral surgical exposure during intrathoracic procedures.

In 1882, Carlo Forlanini introduced the idea of insufflating nitrogen into the pleural space to collapse the lung to treat pulmonary tuberculosis. This was the first known therapeutic use for creating an artificial pneumothorax.

A study in 2005 reported six cases of diaphragmatic plication using artificial pneumothorax with CO_2 at 4 mmHg. Another study in 2018 with 461 patients demonstrated that two lung ventilation with CO_2 artificial pneumothorax in minimally invasive esophagectomy was safe.

CONCLUSION

Our patient had a tortuous trachea that made placement of a double lumen tube and bronchial blocker difficult. In this scenario, CO_2 artificial pneumothorax was a viable alternative to achieve operating conditions for diaphragmatic plication. Communication and coordination between anesthesiologists and thoracic surgeons contributed to a successful patient outcome.

REFERENCES

1. Dean Knepp. (Photographer). Pneumothorax for thinking folks [digital image]. Retrieved from: http://www.feltondesignanddata.com/cressontbsanatoriumremembered/id19.html.

2. Lin, M., Shen, Y., Wang, H., Fang, Y., Qian, C., Xu, S., Ge, D., Feng, M., Tan, L., & Wang, Q. (2018). A comparison between two lung ventilation with CO2 artificial pneumothorax and one lung ventilation during thoracic phase of minimally invasive esophagectomy. Journal of thoracic disease, 10(3), 1912–1918.

3. Purohit A, Bhargava S, Mangal V, et al. (2015). Lung isolation, one-lung ventilation and hypoxaemia during lung isolation. Indian J Anaesth. 2015; 59: 606-617

4. Sakula, A. (1983). Carlo Forlanini, Inventor of artificial pneumothorax for treatment of pulmonary tuberculosis. Thorax 1983; 38:326-332.

5. Sato, M., Hamada, Y., Takada, K., Tanano, A., Tokuhara, K., & Hatano, T. (2005). Thoracoscopic diaphragmatic procedures under artificial pneumothorax. Pediatric surgery international, 21(1), 34–38.

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