

# Portable Chest Radiography Immediately after Post-Cardiac Surgery; an Essential Tool for the Early Diagnosis and Treatment of Atelectasis: a Case Report

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Received: 4 January 2020

Accepted: 16 June 2020

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Atelectasis after endobronchial intubation (ETT) is a known complication of general anesthesia. In-bed auscultation of lungs and use of the 21/23 rule are the two suggestive, but not reliable, methods for the early detection of this event; however, none of them guarantees its prevention. The portable chest radiograph (CXR) is a simple, quick method to detect atelectasis and proper placement of the endotracheal tube in the intensive care unit (ICU).

A case of postsurgical, ICU-admitted patient was presented in the report, demonstrating left (LT) lung atelectasis in immediate portable CXR without any evidence of respiratory or hemodynamic abnormality. Portable CXR showed that the tip of the endotracheal tube was located in the lumen of the right main bronchus, leading to LT lung total atelectasis. After repositioning of ETT to the lumen of the trachea, atelectasis was disappeared in early follow-up CXR.

**Key words:** Intubation, Pulmonary Atelectasis, Cardiac Surgical Procedures, Portable CXR, Intensive Care Units

## INTRODUCTION

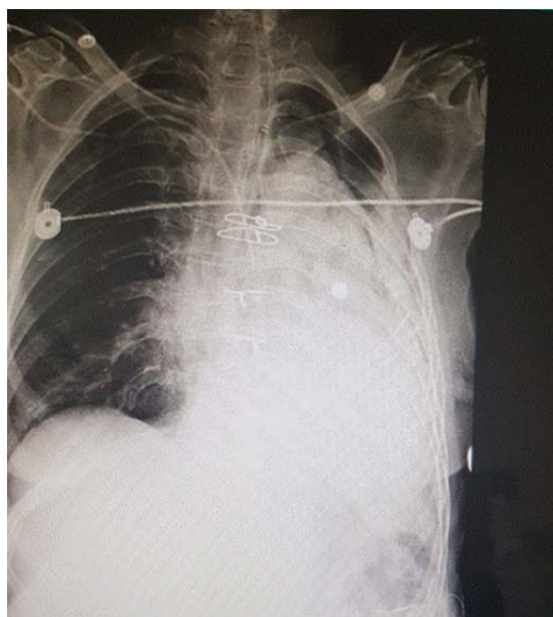
Atelectasis is still a significant challenge for physicians in general anesthesia and intensive care unit (ICU). The undiagnosed or late-diagnosed atelectasis can cause significant morbidity or mortality (1). Inadvertent endobronchial intubation is one of the common reasons for atelectasis in general anesthesia and ICU. Endobronchial intubation accounts for 5%–28% of all tracheal intubation attempts. The detected inadvertent endobronchial intubation accounts for about 93.5% of the cases in the operating theatre and 77.9% in the maintenance of anesthesia (2,3). The portable CXR is a simple, quick method to detect atelectasis and proper placement of the endotracheal tube in ICU. The present study reports a case of post-cardiac surgery atelectasis due to inadvertent

endobronchial intubation, detected with portable CXR and treated successfully.

## MATERIALS AND METHODS

A 69-year-old, short neck, toothless female patient (weight=43 kg, height = 154 cm) was referred to the operative theatre for ASD (atrial septal defect) repair. Preoperatively, the transthoracic echocardiography revealed a reduced systolic function (ejection fraction=45%), a large (2.1 x 2.3 cm) secundum ASD, left to right shunt, and pulmonary hypertension (pulmonary arterial pressure=55-60 mmHg). Coronary angiography also reported ASD and recommended ASD closure surgery. After induction of anesthesia and tracheal intubation, the position of the disposable classic cuffed endotracheal tube

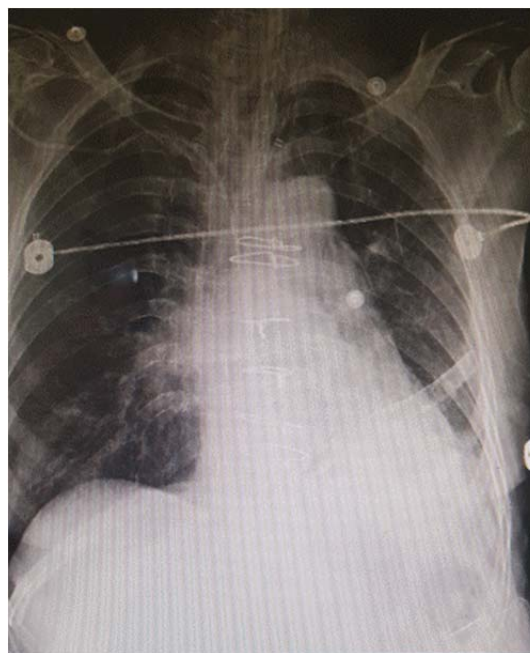
(a PVC, sterile, oral endotracheal tube, size 7 mm) was verified by bilateral auscultation of lungs. Due to her allergy to adhesive tape, the ETT (endotracheal tube) was secured with a dressing bandage at 21 cm of the incisor teeth level. During CPB (cardiopulmonary bypass) technique in surgery, the respiratory ventilator was off. The ABG (arterial blood gas), capnography, and SpO<sub>2</sub> (oxygen saturation) remained in the normal range during the surgery. The operation course was uneventful, and she was transferred to ICU, where a portable chest radiograph (CXR) was immediately obtained. Apart from SPO<sub>2</sub> of 98 with 100% oxygen, the portable CXR revealed a large pulmonary opacity (atelectasis) on the left side (Figure 1).



**Figure 1.** Post-operative portable CXR (after one hour), depicting LT lung atelectasis.

Following chest auscultation, the position of the tracheal tube was rechecked, and the bronchial intubation was recognized. Therefore, the tracheal tube was pulled out from 22 to 19 cm, where the air entry on chest auscultation was equal on both sides. Prior to connection to the ventilator, intermittent manual recruitment maneuver was done every five minutes with Ambu bag and O<sub>2</sub> (sustained lung inflation with positive pressures for about 30 seconds) for 30 minutes. The positive end-expiratory pressure (PEEP) level was also raised from 5 to 8 cmH<sub>2</sub>O

during respiratory ventilation. The tracheal tube was also suctioned. The blood pressure and SPO<sub>2</sub> were monitored that were in the normal range. Then another portable CXR was obtained, and no atelectasis in the left lung was observed (Figure 2). Finally, the patient was extubated after six hours with a good health condition in the open heart ICU.



**Figure 2.** Follow up CXR: Re-positioning of ETT to the tracheal lumen, atelectasis is sub totally resolved.

## DISCUSSION

Atelectasis is derived from a Greek word, meaning incomplete expansion (4). About 2%-4% of the elective thoracic and 20% of urgent surgeries are associated with postoperative pulmonary complications (1). Atelectasis is one of the most common respiratory complications. Atelectasis and pulmonary edema account for about 15% of surgical readmissions to critical care units (1). General anesthesia is known to boost atelectasis formation (5). The most plausible mechanisms of atelectasis in general anesthesia are as follows: 1) Compression: reduction in residual functional capacity and lung compliance, the collapse of the small airways during expiration in the lower parts of the lung, the muscular block of the diaphragm, loss of intercostal muscle tone, and positive

thoracic pressure as a result of mechanical ventilation. 2) Absorption of alveolar gas: complete occlusion of the small airways and high inspired oxygen fraction (FiO<sub>2</sub>). 3) Alteration of the surface-active agent: general anesthesia with mechanical ventilation leads to the deactivation of the surface-active agent (1). The risk factors for the development of atelectasis during surgery are: obesity, type of anesthesia (general anesthesia), chronic obstructive pulmonary disease, and surgery type (laparoscopy) (1). Types of atelectasis, according to etiology, are: obstructive (tumor, tuberculosis, sarcoidosis, foreign body, malpositioned tracheal tube, mucus plugs, bronchopneumonia, bronchitis, and bronchiectasis), and non-obstructive (sarcoidosis, emphysema, lymphoma, pneumothorax, pleural effusions, diaphragmatic hernia, and CBP) (4, 6). Eventually, inadvertent bronchial intubation is one of the most common causes of atelectasis during general anesthesia. Inadvertent bronchial intubation accounts for about 3.7% of the total incidents reported. The majority of incidents occurred in the operating room (93.5%) and during emergency tracheal intubation. One-third of the incidents were associated with surgery to the head and/or neck, while most patients were in the supine position. The reasons for inadvertent bronchial intubation during general anesthesia are repositioning of the patient, movement of the patient head or neck (head and neck flexion), and use of RAE (nasal ring-Adair-Elwyn) endotracheal tubes (3). Some precautions, such as bilateral auscultation of the chest, observation, and palpation of symmetrical chest movements, use of the 21/23 rule (the endotracheal tube is secured at 21 cm mark at the incisor teeth for females and 23 cm mark for males), and external palpation of the inflated endotracheal cuff at the sternal notch, may minimize the risk of inadvertent bronchial intubation in general anesthesia. However, the standard and recommended method for early diagnosis of inadvertent bronchial intubation is still bilateral auscultation (in five areas at bilateral 5th intercostal space, bilateral axillae, and the epigastrium) of the chest (2,7). Some conditions, such

as large breasts, obesity or barrel chests, high ambient noise, auscultation in emergency situations, use of endotracheal tubes with a Murphy eye, and auscultation of lungs during mechanical ventilation may make the assessment of chest expansion difficult (3, 7). Lung auscultation is a highly skill-dependent practice (2). Some studies stated that auscultation could be missing in almost two-thirds of inadvertent bronchial intubations and approximately 60% of all endobronchial intubations in the intensive care, despite equal breath sounds (7, 8). The signs of inadvertent bronchial intubation in general anesthesia are changes in the peak inspiratory pressure, changes in end-tidal CO<sub>2</sub> concentration or waveform, and arterial oxygen desaturation. However, these changes are not always specific; they may be minor, and the earliest manifestations may not be the reason for the warning of endobronchial intubation existence (3). Eventually, portable CXR is a simple, quick method to detect inadvertent bronchial intubation in post-anesthesia care. The ETT tip should be positioned below the interclavicular line, nearly 2 cm above the carina. The portable CXR is also used for the early detection of atelectasis in ICU. Radiographic features of atelectasis can be a white-out (complete opacification of a hemithorax) or increased opacification of the atelectasis area (4).

If inadvertent bronchial intubation remains uncorrected, it can cause overinflation of the intubated (ipsilateral) lung, partial to complete atelectasis of the contralateral lung. The other complications can be hypoxemia, barotrauma, cardiac arrhythmias, hypotension, or tension pneumothorax (2). The mainstay of the treatment of endobronchial intubation is to pull out the endotracheal tube until breath sounds are auscultated bilaterally, and then confirm the correct position by CXR. The appropriate treatment of atelectasis is resolving the underlying cause; some studies also recommend the recruitment maneuver (5). The risk factors for inadvertent bronchial intubation and development of atelectasis in the reported case were: the small stature of the patient, short neck, edentulism, positioning for sternotomy, CPB, and

securing of the endotracheal tube with a dressing bandage. Although all respiratory and hemodynamic parameters were within the normal range during the procedure, portable CXR was the only reliable tool for the early diagnosis of atelectasis, following inadvertent bronchial intubation.

## CONCLUSION

Atelectasis following inadvertent bronchial intubation is a complication with favorable early and long-term outcomes if recognized timely and managed properly. Portable CXR is still an acceptable option for its early diagnosis.

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