

## CASE REPORT

# Pneumothorax caused by anesthesia circuit misconnection

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## ABSTRACT

Preoperative checking of the anesthetic equipment which is the primary responsibility of the nurse anesthetist is crucial for patient safety. There are many misconnection possibilities with circle system that can contribute to as highly as 35% of adverse anesthetic outcomes. A 32-year old man was admitted to the operating room (OR) for appendectomy. After the induction of anesthesia and beginning mask ventilation the anesthesiologist noticed that ventilation was not effective, therefore performed endotracheal intubation. The tracheal tube was connected to the Y piece and the mechanical ventilation was started by anesthesia machine. The lungs were not expanding effectively, therefore manual ventilation was began by an ambu bag. Beginning the manual ventilation the anesthesiologist realized an increased resistance against ventilation and an elevated airways pressure. The SpO<sub>2</sub> fell to 79% and tachycardia was evident. Physical examinations were suggestive of pneumothorax that occurred within the first 4-5 minutes of starting machine ventilation. Rechecking the anesthesia machine revealed an error in the connection of the anesthesia circuit. We briefly review the current literature and give suggestions to eliminate these mismanagements in the operating room which can be life threatening.

**Keywords:** Pneumothorax; Anesthesia circuit; Complication; breathing circuit obstruction

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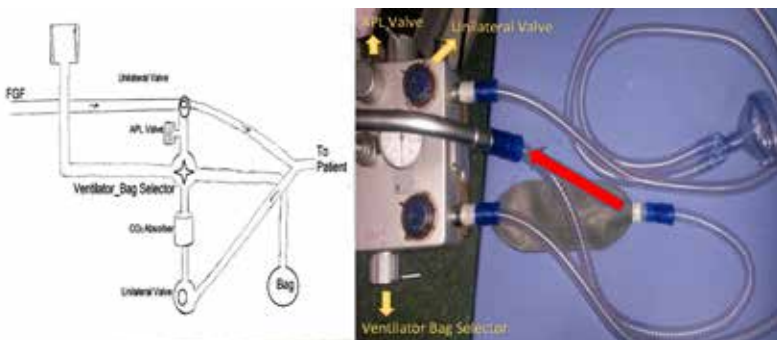
## INTRODUCTION

Preoperative checking of the anesthetic equipment which is the primary responsibility of the nurse anesthetist is crucial for patient safety.<sup>1</sup> There are many misconnection possibilities with circle system that can contribute to as highly as 35% of adverse anesthetic outcomes, some of these adverse outcomes can be life-threatening.<sup>2</sup> We present a case of anesthesia circuit misconnection that caused the development of pneumothorax within minutes.

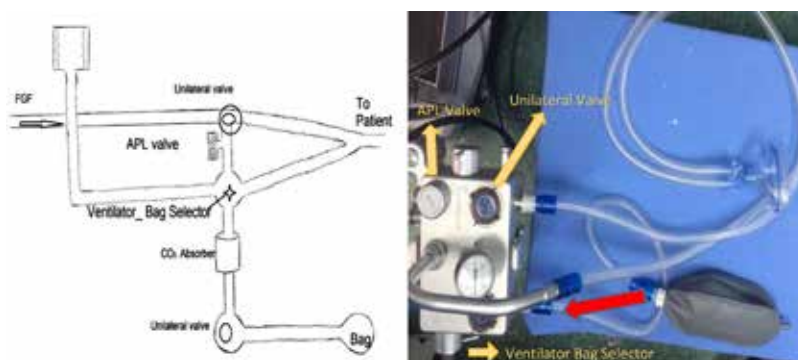
## CASE REPORT

A 32-year old man was admitted to the operating room (OR) for appendectomy. Except for leukocytosis, his initial laboratory findings were normal. In the OR preoperative blood pressure, electrocardiogram, and

peripheral capillary oxygen saturation (SpO<sub>2</sub>) were normal. Anesthesia circuit tubes were connected to the old anesthesia machine (ALPHA DELTA®, Siare, Italy, 1975), circle system, and after a leak test by closing the adjustable pressure limiting (APL) valve, occluding the Y-piece, and pressurizing the circuit to 25 cmH<sub>2</sub>O with the oxygen flush valve, the induction of anesthesia was started by giving 2 mg midazolam, 150 µg fentanyl, 400 mg thiopentone, and 40 mg atracurium intravenously. Beginning mask ventilation the anesthesiologist noticed that ventilation was not effective, therefore performed endotracheal intubation. The tracheal tube was connected to the Y piece and the mechanical ventilation was started by anesthesia machine. The lung expansion was not adequate, so manual ventilation was started by an Ambu® reanimation bag. During the manual ventilation the



**Figure 1:** The correct connection of the breathing circuit, the Y piece and the bag (red arrow) are correctly connected to the machine.



**Figure 2:** The incorrect connection of the breathing circuit (this case), the expiration tube is incorrectly connected to the connection point of the bag, and the bag is incorrectly connected the connection point of the expiration tube (red arrow).

anesthesiologist realized an increased resistance against ventilation and an elevated airways pressure (40 cmH<sub>2</sub>O). The SpO<sub>2</sub> fell to 79% and tachycardia was evident. Physical examination was suggestive of pneumothorax that occurred within the first 4-5 minutes of starting machine ventilation, therefore tube thoracostomy tube was inserted into the chest wall at the 5th intercostal space in the left mid axillary line which resulted in reducing the airway resistance and obtaining an acceptable ventilation. Rechecking the anesthesia machine revealed an error in the connection of the anesthesia circuit. The expiration tube and the bag were connected incorrectly to the machine (Figures 1 and 2).

The anesthesia was continued by mechanical ventilation using 100% O<sub>2</sub> and 1% isoflurane. After operation the patient was awakened normally after injection of neostigmine + atropine for reversal of muscle relaxant with an uneventful recovery. Postoperative chest x-ray showed an air rim of more than 1 cm occupying almost 30% of the hemithorax. The chest tube was removed after 3 days when no air was escaping from it and the chest x-ray confirmed re-expansion of the lung.

## DISCUSSION

There are many misconnection possibilities with circle system that can contribute to up to 35% of adverse anesthetic outcomes.<sup>2</sup> Some of these complications occur after cleaning the anesthetic equipment and cannot be totally eliminated by positive pressure test.<sup>3,4</sup> Eckhout and Bhatia reported a case of mechanical obstruction of the expiratory limb of anesthesia circuit which remained undetected until the induction of anesthesia. Although a check of the circuit was performed before the addition of circuit extensions in that case, the obstruction was missed.<sup>4</sup>

The mechanism causing pneumothorax in this case seems to be barotrauma; airways overpressure due to technical problems can progress to pneumothorax and cardiovascular collapse.<sup>3,5</sup> The diagnosis of pneumothorax rests on thinking of the possibility whenever circulatory or respiratory compromise develops in the presence of high risk situations.<sup>3,5</sup> In this situation flush valve should not be used because

inappropriate use of flush valve can accelerate barotrauma and pneumothorax, thus leading to cardiovascular collapse.<sup>3</sup>

To eliminate these mismanagements we recommend performing the two bag test,<sup>1</sup> after checking the breathing system, vaporizers and ventilator, as the following: Attach the patient end of the breathing system to a test lung or bag. Set the fresh gas flow to 5 l/min and start manual ventilation. Check the whole breathing system and pay attention to the movements of the patient and unidirectional valves. Squeeze both bags to check the function of the APL valve. Turn on the ventilator to ventilate the test lung. Turn off the fresh gas flow or reduce to minimum. Open and close each vaporizer in turn. No loss of volume in the system should be noticed. To prevent intrusion of foreign bodies the breathing systems must be protected with a test lung or bag when not in use.

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### **MY MOST UNGORGETTABLE EXPERIENCE**

## **Real stories from ICU: "bad luck"**

**Dr Muhammad Haroon**

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Pupils fixed, dilated, nonreactive. GCS 3/15. Carotid pulse absent. No respiratory effort.

The intensivist shook his head "Call off CPR"

Dr A jumped up from chair, drenched in sweat, panting, climbed the bed & started chest compressions.

Dr A was the best surgeon in hospital. He was one of the very few doctors who enjoyed so much success in a very short time. It was a fine sunny day. Dr A was taking his tea with one hand in pocket looking as handsome as ever in his light brown coat suite and off white shirt. All doctors of surgical team 2 were discussing about the patient he operated yesterday - whipple procedure. The patient was doing well. He stepped into OT. Nurse handed over his surgical gown. He scrubbed and washed his hands. He had long slender fingers like artists & had a graceful personality. He was admired by all young doctors and medical students, many of whom idealized him. He went inside theatre as confident and determined as always. He was going to do appendectomy on one very close family relative. The anesthesiologist had already sedated the patient who was sleeping peaceful and comfortably. Dr A was popular in anesthesia department for his extraordinary speed of surgeries. Patient was draped. He took his scalpel and gave a small incision. A medical student asked "how would you get appendix out from this small hole". He smiled and said "keep watching for 7min".

"His temperature is rising" said anesthetized with a grim expression on his face. "I'm giving paracetamol 1g"

Dr A's hands started racing the procedure.

"Temperature's not coming down; it's 104° F now."

"Bring ice packs immediately" anesthetist was screaming, his face went dark just like he saw a ghost.

"His abdomen is getting stiff like a wooden board. What's happening sir" the surgeon asked.

The temperature rose to 106° F. Monitors were beeping continuously.

"OH MY GOD. He's seizing. It's malignant hyperthermia. Call ICU. Abort the procedure immediately," said anesthesiologist.

All doctors were shocked. Surgeon's hands were trembling. He wiped his sweat from his forehead and called the intensivist.

About 4 hours passed. The surgeon was standing outside ICU with his back against the wall when he saw his wife rushed towards him.

"Kia hua hai inko. Ap ne kia kiya hai. Ap ne to kaha the ye chhoti see surgery hai. Inko ventilator pe kyun dala hai." She was crying like hell.

"Beta ham nay to jisko ventilator pe jatay dekha woh bacha nahin. Ye to bach jay ga Na????"

So many questions. He had no answer. He looked towards the roof with fingers crossed.

The anesthesiologist intervened "your patient is suffering from a very rare disease.1 in million people could have it. It had nothing to do with surgery. He had a disease in which patient can't tolerate anesthesia drugs. His body kind of reacted to medicines

due to enzyme deficiency in his body"

Family members asked "why this happened to him? He is a healthy man, he runs a mile every morning. How could he be deficient. Why you people didn't diagnose this enzyme problems before surgery?"

"What are his chances of survival?"

"When he'll wake up???"

ICU doctor came in a hurry. "Sir we need more dantrolene injections. There were only 5 injections; we gave him all; his temperature and hemodynamics improved, but in next 2 hours he'll deteriorate if we don't get dantrolene". Dr A rushed along with family and friends. All pharmacies and hospitals of Rawalpindi-Islamabad were checked. His phone was ringing, it was the intensivist.

"Any progress? Did you get dantrolene?"

"No? Isn't there any alternative for dantrolene?"

"Dear A we are giving ice cold saline and using cold pleural and gastric lavage but still temperature rising. We have sedated him with benzodiazepines."

From where u got the dantrolene in ICU in first place? (Dr A)

We got a few in European Aid for 2005 earthquake victims. But all are used on him. He got better but now he's deteriorating again. Try from Lahore or Karachi." (Intensivist)

The search was started again.

No dantrolene was found even after 24 hours. He was talking to AKUH pharmacy when intensivist called.

"Dr A, please come to ICU"

"Why what happened? Is he alright"

He was shouting on top of his voice.

Phone was cut. He rushed towards ICU.

He saw CPR was going on his patient.

".... charge 200 joules all clear?? Give epinephrine 1mg stat with IV push.... continue compressions..."

His legs were numb, tears flowing in his cheeks, he stumbled. The nurse offered him a chair. Biting his lip he was silently staring at the cardiac monitor.

"60 minutes have passed, there is asystole on ECG sir. Pupils are fixed dilated nonreactive. GCS 3/15 carotid pulse absent no respiratory effort."

The intensivist shook his head "Call off CPR"

Dr A jumped up from chair, drenched in sweat, panting, climbed the bed and started chest compressions.

Dr A! he is gone. Leave him now. But he didn't stop and continued violent forceful chest compressions.

Other doctors dragged him towards doctors room. Sir please try to control yourself. We did all that was possible but ....He was in denial.

"Don't leave him alone" said intensivist, and asked other team members to accompany him to break the bad news to family...