Catheter-induced pulmonary artery haemorrhage resulting from a pneumothorax

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We present a case of pulmonary artery perforation in a patient who developed a pneumothorax after cardiac surgery. In the process of inserting a chest tube the patient became tachypnoeic, and developed haemoptysis. The trachea was intubated, and right bronchial intubation was performed with persistent bleeding. The pulmonary artery catheter was gently withdrawn and the balloon inflated, with cessation of bleeding. The patient was taken to the operating room, a bronchial blocker was placed in the right lower lobe bronchi, and the pulmonary artery catheter was removed. The bronchial blocker was removed the following day with no bleeding. The aetiology of perforation was secondary to the pneumothorax, which caused a shift of the mediastinum to the right, elevated pulmonary artery pressures, and the distal migration of the catheter through the pulmonary artery. It is recommended that treatment include tracheal intubation, inflation of the pulmonary artery catheter balloon, and the placement of a right lower lobe bronchial blocker.

Nous décrivons une perforation de l'artère pulmonaire survenue à la suite d'un pneumothorax après chirurgie cardiaque. Au moment de l'insertion d'un drainage thoracique, le patient devient tachypnéique et hémoptysique. La trachée est intubée et comme l'hémorragie persiste, la bronche droite est canulée. On amène le patient en salle d'opération et un bloqueur bronchique est introduit dans la bronche du lobe inférieur droit et on retire

le cathéter de Swann-Ganz. Avec l'arrêt de l'hémorragie, le bloqueur bronchique est retiré le lendemain. La perforation de l'artère pulmonaire est secondaire au pneumothorax qui a provoqué un déplacement du médiastin vers la droite, une augmentation de la pression artérielle pulmonaire et une migration distale du cathéter à travers l'artère pulmonaire. Le traitement proposé consiste en l'intubation de la trachée, l'insufflation du ballonnet du cathéter de Swann-Ganz et le placement d'un bloqueur dans la bronche inférieure droite.

Pulmonary artery rupture resulting in endobronchial haemorrhage is an uncommon but potentially fatal complication of pulmonary artery catheterization.¹⁻⁵ Risk factors include pulmonary hypertension, hypothermia, anticoagulant, advanced age, female sex, high pulmonary artery to wedge pressure gradient, peripheral placement of the catheter (facilitated by a redundant loop of catheter in the heart), prolonged balloon inflation, and multiple catheter manipulations.¹⁻⁷ The literature reports an incidence of 0.016% to 0.2%,^{8,9} and a mortality greater than 50%.^{5,10,11}

We report a case of pulmonary rupture and haemoptysis associated with a pneumothorax, and its successful management utilizing a combination of therapeutic manoeuvres. This is the first report of catheter-induced pulmonary artery perforation as a result of a pneumothorax. We suggest that if pulmonary artery rupture occurs, proper aggressive management as illustrated by this case with a combination of manoeuvres may be lifesaving.

Case report

A 69-yr-old, 163 cm woman with a history of congestive heart failure, acute anterior wall myocardial infarction, chronic obstructive pulmonary disease, and transient ischaemic attacks was admitted to the intensive care unit after aortocoronary artery bypass surgery. The patient required the infusion of epinephrine and dobutamine, and an intraaortic balloon pump to facilitate separation from the cardiopulmonary bypass machine. The postoperative CXR revealed a 40-50% left pneumothorax that necessitated placement of a chest tube. The trachea was ex-

Key words

ANAESTHESIA: cardiac;

COMPLICATIONS: pulmonary haemorrhage, pneumothorax;

EQUIPMENT: catheters, pulmonary artery;

LUNG: haemorrhage.

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tubated on the first postoperative day without problems. The chest tube was removed on the second postoperative day. On the third day, her respiratory rate was 18 breaths per minute, pulmonary artery pressure was 33/22 mmHg, and cardiac output $5.0 \text{ L} \cdot \text{min}^{-1}$. She became acutely tachypnoeic with sternal retractions. The pulmonary artery pressure was 50/35 mmHg. Repeat CXR revealed a recurring left 50% pneumothorax and left subcutaneous air. A 14-gauge catheter was placed in the second intercostal space and mid-axillary line which drained the air, but the catheter was accidentally removed. In the process of inserting a chest tube, the patient started coughing up copious amounts of blood (estimated about $200 \text{ ml} \cdot \text{min}^{-1}$). The oropharynx was suctioned, and laryngoscopy revealed copious amounts of blood coming from the trachea. Intubation was performed with an 8.0 mm tracheal tube, and a massive amount of blood was suctioned. The tube was advanced to 28 cm to accomplish right mainstem intubation. However, bleeding continued despite advancement of the tube. The pulmonary artery catheter was cautiously pulled back 2 cm, and the balloon was gently inflated with 1.5 ml air. The bleeding stopped. The tracheal tube was taped at 21 cm at the patient's lip, and auscultation of the chest revealed no left breath sounds. A chest tube was then placed in the left pleural space with return of left breath sounds. The blood pressure was 160/80 mmHg, with heart rate of 130 beats per min. Repeat CXR revealed an opacity in the right lower lobe. The pulmonary artery tracing revealed a pulmonary artery occlusion pressure of 35 mmHg. Laboratory evaluation demonstrated haematocrit of 30.6%, bleeding time of 8 min, prothrombin time 14.2 sec, partial thromboplastin time 37.5 sec, sodium $140 \text{ mEq} \cdot \text{L}^{-1}$, potassium $4.3 \text{ mEq} \cdot \text{L}^{-1}$, and normal arterial blood gas values after intubation.

The patient was taken to the operating room for bronchoscopy and placement of bronchial blocker under fluoroscopy in the segment of lung where bleeding was visualized by bronchoscopy. The patient was given 100 mg ketamine and 100 mg succinylcholine *iv*. Omnipaque (Winthrop Pharmaceuticals, New York, N.Y.) 10 ml was injected through the distal port of the pulmonary artery catheter. Fluoroscopy showed the pulmonary artery catheter tip in a small pulmonary artery vessel with the balloon inflated and contrast present around it. Flexible bronchoscopy revealed blood in the right lower lobe bronchi, but the balloon and tip of the pulmonary artery catheter were not visible. The trachea was extubated and rigid bronchoscopy was performed. A #7 Fogarty catheter (American Edwards, Irvine CA) with the proximal part connected to a three-way stopcock was used as a bronchial blocker and, with the aid of fluoroscopy and bronchoscopy, the bronchial blocker was placed in the right

lower lobe bronchus. The balloon of the bronchial blocker was inflated with 2.5 ml contrast which occluded the lumen of the bronchus, as verified with flexible bronchoscopy. The pulmonary artery catheter balloon was then deflated, and the catheter was removed without bleeding. The trachea was then reintubated, the bronchial blocker was taped to the tracheal tube, and the patient was returned to the intensive care unit. A repeat CXR showed good position of the tracheal tube, and the bronchial blocker in place. Two units of fresh frozen plasma were administered to the patient postoperatively. The bronchial blocker was removed the following day without bleeding. The trachea was accidentally extubated three hours later, but the patient did not require reintubation. She was discharged from the intensive care unit on the fifth postoperative day without any further problems.

Discussion

This is a report of a pneumothorax-induced pulmonary artery rupture from a Swan-Ganz catheter. The pneumothorax resulted in right mediastinal shift and probably, in combination with hypoxic pulmonary vasoconstriction, caused acute elevation of the pulmonary artery pressures. Consequently, perforation of the right pulmonary artery resulted from the distal migration of the catheter. Tracheal and bronchial intubation did not alleviate the bleeding in our patient, but inflation of the pulmonary artery balloon proved to be effective. In the operating room, bleeding was verified by flexible bronchoscopy to be in the right lower lobe, and a bronchial blocker was placed. The deflation and removal of the pulmonary artery catheter balloon resulted in no further bleeding. We cannot rule out spontaneous resolution of haemorrhage, although haemorrhage of this magnitude has not resolved spontaneously. The mild coagulopathy in this patient may decrease the likelihood that haemorrhage would have spontaneously ceased.

Catheter-induced pulmonary artery haemorrhage, while infrequent, is a fatal complication¹⁻⁵ with an incidence less than 0.2%.^{8,9} Therapeutic procedures for controlling pulmonary haemorrhage include: bronchial intubation,^{3,12} use of high levels of positive end expiratory pressure,^{14,15} occlusion of the involved bronchus with a bronchial blocker,^{5,6,13} embolization,⁷ internal balloon tamponade of the affected pulmonary artery with a pulmonary artery catheter,^{2,7} and resection of the affected area of lung segment.⁵ This is an iatrogenic problem, related to an imperfect technique in the positioning of the pulmonary artery catheter.¹⁵ The incidence of this complication is low if guidelines are followed.^{16,17} However, even though rigid protocols are followed, rupture of the pulmonary artery will continue to occur from other factors.¹⁻²⁶

Barash *et al.*¹ showed that the balloon can disrupt the pulmonary artery. An eccentric or distorted balloon inflation can cause the tip to be propelled through the vessel wall. With a deflated balloon the catheter tip can be advanced too far distally and perforate the vessel. We believe that the pneumothorax and elevated pulmonary artery pressure distended the pulmonary vessel, causing the catheter to be displaced more peripherally, and the tip to protrude through the wall of the distended and non-compliant vessel.¹⁸

In conclusion, we report a case of a perforated pulmonary artery associated with a pneumothorax resulting in a shift of the mediastinum, and catheter migration through the arterial wall. Inflation of the pulmonary artery catheter balloon protected against continued haemorrhage, and use of a bronchial blocker in the right lower lobe segment prevented further bleeding. This case illustrates that patients can be managed effectively with a combination of techniques to treat a potentially fatal complication of the pulmonary artery catheter. By having the patient in the operating room, emergency surgical intervention was available if haemoptysis had recurred.

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