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Rupture of pulmonary artery induced by balloon occlusion pulmonary angiography

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Abstract A case of pulmonary artery rupture induced by balloon occlusion pulmonary angiography (BOPA) is reported. A flow-directed pulmonary artery catheter had been inserted for hemodynamic monitoring in a septic shock patient complicated by acute respiratory distress syndrome. To check for pulmonary damage, BOPA was performed immediately after hemodynamic measurement. Just as the hand injection of contrast medium was ending, the patient began to cough and a small amount of hemoptysis was observed. The angiogram showed the extravasation of contrast medium from the distal pulmonary artery to the situation of catheter tip.

Pulmonary hemorrhage was controlled with mechanical ventilatory support with 10 cmH₂O positive end-expiratory pressure and no specific therapy was required. This complication should be kept in mind and using a power injector to avoid injurious transient high pressure pulse is recommended.

Key words Balloon occlusion pulmonary angiography (BOPA) · Pulmonary artery rupture · Swan-Ganz catheter · Adult respiratory distress syndrome (ARDS) · Mechanical ventilatory support · Positive end-expiratory pressure (PEEP)

Introduction

Balloon occlusion pulmonary angiography (BOPA) is useful for the diagnosis of pulmonary embolism [1] and also for the detection of pulmonary damage during adult respiratory distress syndrome (ARDS) [2]. BOPA is safe technique [1], easily applicable to the intensive care unit (ICU) and rarely gives rise to complications. However, in this paper, we describe a case of pulmonary artery rupture induced by BOPA.

Case report

A 68-year-old male who suffered from acute obstructive suppurative cholangitis and had undergone emergency cholecystectomy at another hospital two days before, was admitted to the ICU because of deterioration in respiration, renal function and circulation. On

admission, he was hyperthermic (40.2°C), hypotensive (mean arterial pressure 53 mmHg) and required endotracheal intubation and mechanical ventilatory support because of severe respiratory failure. Radiographic examination demonstrated pulmonary infiltrates involving all four quadrants. A size 7 Fr Swan-Ganz catheter was inserted without incident via the left subclavian vein and the chest X-ray revealed the tip of Swan-Ganz catheter to be in the right main pulmonary artery. The Swan-Ganz catheter showed a “septic profile” cardiac output of 14.0 l/min and systemic vascular resistance index of 621 dyne·s/cm⁵·m². Mean pulmonary artery pressure was 20 mmHg and wedged pressure was 10 mmHg. BOPA was performed to check pulmonary damage immediately after the above measurements. After Swan-Ganz catheter was wedged with 1.5 ml of air and wedge tracing was obtained on the oscilloscope, we injected 10 ml of contrast medium, consisting of 8 ml of 76% sodium meglumine diatrizoate and 2 ml of 2% lidocaine through the distal lumen by hand at the rate of about 2 ml/s. During the injection and the radiographic exposure, the endotracheal tube was temporarily detached from the ventilator. Just as the injection was ending, the patient began to cough. After the catheter balloon was deflated, a small amount of hemoptysis was observed. The angiogram showed the extravasation of contrast medium from the pulmonary artery

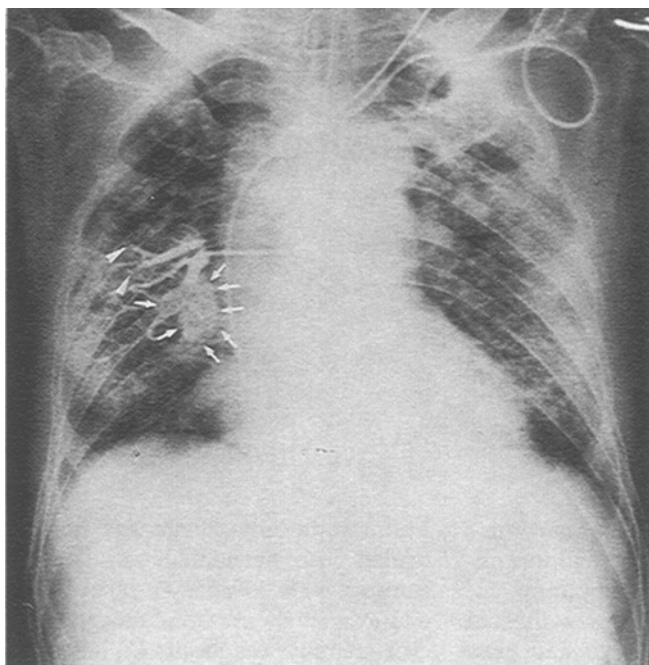


Fig. 1 Balloon occlusion pulmonary angiography (BOPA) showed the extravasation of contrast medium from the distal pulmonary artery (arrows) to the situation of catheter tip and multiple artery filling defects (triangles)

and several filling defects (Fig. 1). The $\text{PaO}_2/\text{FIO}_2$ ratio changed from 108 on 10 cmH_2O positive end-expiratory pressure (PEEP) before BOPA to 102 after, which was not a significant change. Hemoptysis disappeared within 12 h after BOPA on mechanical ventilation support with 10 cmH_2O PEEP. The patient developed multiple organ failure and died on the 23rd ICU day. An autopsy was not performed.

Discussion

Since Loop et al. [3] first reported successful bedside pulmonary angiography using the Swan-Ganz catheter, many investigators have used BOPA for the diagnosis of pulmonary embolism [1] and for the detection of pulmonary damage in ARDS [2]. This technique has stood the test of time; it is safe and effective and provides useful information for the management of critically ill patients [3]. Complications of wedged angiography only occur rarely. Some patients cough during BOPA [4], but no adverse effects have been found when the procedure is performed

correctly [1–4]. Analysis of several cases of pulmonary artery rupture secondary to pulmonary artery catheterization demonstrated 3 main causes of rupture [5]: the tip had perforated the vasculature, mis-shapen inflation by the balloon resulting in force concentration at the vessel wall and bursting at previously existing lesions on the vessel wall after balloon inflation. Cardiopulmonary bypass, anticoagulation, hypothermia, pulmonary hypertension and advanced age are also risk factors for pulmonary artery rupture by the Swan-Ganz catheter [5, 6]. Sepsis damages pulmonary endothelium and pulmonary vasculature by the combination of activated complement and granulocytes [7] and thereby predispose to pulmonary artery rupture. The rupture as in this case, appears to have been caused by combination of factors; pulmonary hypertension where mean pulmonary pressure was 20 mmHg, advanced age, septic involvement of pulmonary damages and disruption of the pulmonary artery wall by either the inflation of the balloon or high pressure pulse caused by hand injection. The possibility of pulmonary artery rupture by the inflation of the balloon or tip perforation seems to be low because BOPA demonstrated the distal pulmonary artery rupture to the situation of catheter tip. Lemen [6] experimentally demonstrated rupture when pulmonary artery pressure was over 20 mmHg. However, Lefcoe et al. [4] reported injecting the contrast medium by maximum heat pressure, and they did not notice any troubles or complications in their patients. Most investigators inject the contrast medium by hand, but Greene et al. [2] used a carbon-dioxide-powered angiographic injector in order to avoid transient and potentially injurious high pressure pulse.

Although the optimal management of pulmonary artery rupture when a small amount of hemoptysis has occurred is not defined, observation, as in our case, may be sufficient [6]. When massive hemoptysis has occurred, however, mechanical ventilation with PEEP [8], transcatheter embolization [9] or thoracotomy and lobectomy [10] should be employed. The pulmonary hemorrhage in the present case was controlled with mechanical ventilatory support with 10 cmH_2O PEEP, which was already applied for ARDS, and hemoptysis disappeared shortly after BOPA.

To our knowledge, this is the first published report of pulmonary artery rupture induced by BOPA. This complication should be kept in mind when BOPA is performed. It is recommended to use a power injector in order to avoid injurious transient high pressure pulse and to obtain uniform injection rate of the contrast medium.

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