lesion due to fluid shift at the time of menstruation. Diagnosis of pulmonary endometriosis usually is suspected by the patients’ typical clinical history with recurrent cyclic hemoptysis synchronous to their menstruation and corroborated by a demonstrable parenchymal lesion or consolidation seen on a chest CT scan that changes in appearance during the menstrual cycle. MRI has been reported to be a useful diagnostic tool in patients with suspected pelvic endometriosis. To the best of our knowledge, there is, however, no previous report on the value of MRI in thoracic endometriosis. This case shows that MRI has the same accuracy as CT in detecting such lesions in the chest cavity and that it is in fact superior over CT in distinguishing a parenchymal from a pleural lesion. The typical findings at MRI consist of a hypointense lesion on T2-weighted spin-echo images that increases in size at the time of menstruation and shows a more pronounced uptake of intravenous MRI contrast agent as compared with that in the intermenstrual period.

The option of hormonal therapy with danazol or gonadotropin-releasing hormone agonists was considered, but the local extent of the disease and additionally the often observed side effects of a hormone treatment led us to perform surgery as the treatment of first choice. The follow-up in this patient supports this therapeutic approach, although the symptom-free observation period is still relatively short.

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REFERENCES

Immediate Transcatheter Embolization of Swan-Ganz Catheter-Induced Pulmonary Artery Pseudoaneurysm*

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Digital subtraction angiography is an indispensable complement to cut film studies for the detection of pulmonary artery injury. Immediate transcatheter embolization of catheter-induced pulmonary artery pseudoaneurysm is a safe, minimally invasive, fast, and cost-effective alternative to surgical treatment.

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Key words: pseudoaneurysm; pulmonary embolization; Swan-Ganz catheter

Rupture of the pulmonary artery is an uncommon complication of Swan-Ganz catheter placement with a reported incidence of 0.05 to 0.2%. Mortality from this complication, however, is considerable with a reported occurrence rate as high as 50%. We report a case of emergency embolization of a Swan-Ganz catheter-induced pseudoaneurysm detected by digital pulmonary arteriography and review of the literature.

CASE REPORT

A 56-year-old woman was admitted to the University of Alabama at Birmingham Hospital with severe cerebral anoxia secondary to cardiopulmonary arrest. Prior to admission, the patient had required resuscitation including cardioversion. The patient’s past medical history was significant for hypertension and cardiomegaly. She was not receiving steroid or anticoagulant therapy. The event precipitating the patient’s cardiopulmonary arrest was not determined. Prior to nursing home discharge, the patient underwent insertion of a Swan-Ganz catheter via right internal jugular venous approach in the ICU. This catheter was to be placed for purposes of monitoring pulmonary arterial pressures during general anesthesia for placement of a tracheostomy and percutaneous gastrostomy tube. Immediately during the insertion of the Swan-Ganz catheter, the patient experienced an episode of hemoptysis of 30 to 40 mL from the endotracheal tube. The pulmonary arterial pressure was normal (30/12 mm Hg with a mean of 18 mm Hg). The possibility of an arterial injury was considered clinically, and pulmonary arteriography was requested.

Initial anteroposterior cut film angiography of the right lung was performed with a 7.1F pigtail catheter with 50 mL of low osmolar contrast medium (Hexabrix; Mallinckrodt Medical, St. Louis) injected at 25 mL/sec. No abnormality was initially disclosed. A selective right descending pulmonary digital angiogram in a slight right anterior oblique position then clearly demonstrated a small persistent collection of contrast medium arising from the anterior basal segmental artery (Fig 1). No contrast extravasation into the airways, pulmonary emboli, or early venous filling was identified. Retrospective examination of the initial cut film study revealed a rounded

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home showed no evidence of parenchymal or pleural abnormality and no change in the coil placement. The patient died in the nursing home approximately 6 weeks after embolization. There was no hemoptysis or any clinical evidence that there had been adverse sequelae from embolization.

**Discussion**

Major complications of Swan-Ganz catheter insertion have been reported to occur in 3 to 17% of cases. These include pneumothorax, puncture of the carotid or subclavian arteries, atrial and ventricular arrhythmias, intracardiac knotting, balloon rupture, pulmonary embolism, pulmonary hemorrhage, pulmonary artery rupture, bacteremia, and death. Rupture of the pulmonary artery has been reported in 0.05 to 0.2% of cases. The mortality rate is as high as 50%, secondary to pulmonary aspiration and asphyxia following pulmonary hemorrhage.

The exact mechanism of arterial wall injury is unknown, but possibilities include balloon inflation in a position too peripheral, hyperinflation of the balloon, repeated wedgings in the same position, and vigorous flushing while wedged.

Risk factors for pseudoaneurysm formation include age greater than 60 years, pulmonary arterial hypertension, and concomitant anticoagulant therapy. Reported cases also carry a female preponderance (69%). Cadaveric studies of pressures required to rupture the pulmonary artery have shown that these vessels in patients greater than 60 years of age have increased risk of rupture. Pulmonary arterial hypertension has been postulated to create a pressure gradient across the balloon which carries a catheter too peripheral into the smaller and more fragile arterioles and thereby increases the likelihood of vascular injury. Anticoagulant therapy, while not increasing the risk of injury per se, may inhibit the ability of the coagulation system to seal the defect.

**Figure 1.** Right descending digital pulmonary arteriogram showing a small pseudoaneurysm of anterior basal segmental artery (top) better seen in parenchymal phase (bottom).

persistent opacity over the right descending pulmonary artery which blended almost imperceptibly into the background parenchymal blush.

The pigtail catheter subsequently was exchanged over an exchange wire for a 5F Berenstein catheter. This catheter was subselectively advanced over an angled 0.035-inch glide wire (Medi-Tech; Watertown, Mass) into the right anterior basal segment pulmonary artery. Two 3-mm and two 5-mm 0.038-inch coils (Cook; Springfield, Ind) were used to embolize the pseudoaneurysm and vessel giving rise to it. Postembolization digital descending pulmonary arteriogram showed successful occlusion of the right anterior basal segmental artery (Fig 2).

Following embolization, the patient had no further hemoptysis. Pulmonary artery pressures remained constant. Portable chest x-ray films taken prior to the patient’s discharge to the nursing
Our patient was a 56-year-old woman who had a pseudoaneurysm of the right anterior basal pulmonary artery with normal pulmonary artery pressures and who had not received anticoagulant therapy.

The lower and middle lobe branches of the right pulmonary artery are injured in the majority of cases (92%). The right-sided preferential involvement coincides with the usual anatomical distribution of flow-directed catheters. Initial presentation may be hemoptysis, parenchymal consolidation, or a pulmonary nodule evidenced on a chest x-ray film. Hemoptysis may be immediate or may be delayed up to 72 h. Fifty percent of patients present within 24 h and 90% present within 3 days after placement of the pulmonary artery catheter. The nodule, on a chest x-ray film, may have sharp margins, which correspond in size to the pseudoaneurysm. Two thirds of those cases with consolidation may evolve into a mass or nodular lesion. This may represent intra-alveolar hemorrhage which then resolves to reveal the underlying pseudoaneurysm.

Treatment options for pulmonary artery pseudoaneurysm include positive end-expiratory pressure, an emergency thoracotomy for pulmonary artery ligation, segmentectomy, or lobectomy. Positive end-expiratory pressure, while theoretically decreasing hemorrhage by increasing airway pressure, has little reported success. Emergency transcatheter embolization is a safe and cost-efficient treatment which may be performed on an emergency basis with the patient under local anesthesia.

To our knowledge, transcatheter embolization as treatment for pulmonary artery pseudoaneurysm has received little attention in the medical literature and has been reported only in six patients to date. Of these patients, only one was treated on an emergency basis following development of hemoptysis during Swan-Ganz catheter placement. The other five patients were managed conservatively, but they all presented later with recurrent hemoptysis or pulmonary nodule on a chest x-ray film or both. Review of the medical literature shows a time interval between the initial episode of hemoptysis and embolization varying between 56 h to 7 months. This delay may expose the patient to considerable risk of subsequent rupture and fatal hemorrhage. We, in agreement with Jondeau et al., strongly favor immediate embolization as the best therapeutic approach to avoid risk of significant mortality (50%). Considering the low morbidity associated with embolization of pulmonary arteriovenous malformations which is oftentimes more complicated than pulmonary arterial embolization for pseudoaneurysm, the risk of significant morbidity associated with embolization of a single pulmonary artery with pseudoaneurysm is negligible.

Our case is intriguing in that conventional magnification cut film pulmonary angiography failed prospectively to reveal the pseudoaneurysm, whereas digital angiography easily revealed the lesion. The slight obliquity of the digital study may have contributed to the lesion’s conspicuity in the arterial phase, but the lesion was particularly more visible on the parenchymal and venous phases of the digital study when there were no superimposed vessels to obscure the lesion. This was clearly due to the superior contrast resolution of digital subtraction.

In summary, we feel that digital subtraction angiography under these circumstances is an indispensable complement to cut film studies for the detection of pulmonary artery injury. We feel that immediate transcatheter embolization of catheter-induced pulmonary artery pseudoaneurysm is a safe, minimally invasive, fast, and cost-effective alternative to surgical treatment.

References

Management of Bronchopleural Fistula with a Variable-Resistance Valve and a Single Ventilator*

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Independent lung ventilation with two ventilators is sometimes used in the management of bronchopleu-

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