access to the cutoff switch is imperative [1]. However, in most cases the speed of air passage is too fast, leaving not enough time to clamp the arterial line nor to pass the information to the perfusionist for a prompt pump stop. Automatic tubing occlusion in response to air bubble detection is not used routinely [2].

Additional reasons for massive arterial air embolism are mainly iatrogenic due to surgical procedures. Cardiomyotomy suction tubing wedged deep into the pulmonary artery resulting in air being drawn into the left atrium had been documented, as well as inadvertent reversal of left ventricular vent suction tubing [1]. Furthermore, one case has been reported in which a communication had been created accidentally between the adherent lung parenchyma and the left atrium. This caused a massive influx of air from the lung into the systemic circulation causing fatal cerebral embolization [3].

As opposed to venous air embolism, in cases of arterial air embolism no clinical signs such as electrocardiographic changes, increase in pulmonary pressure, decrease in systemic blood pressure, decrease in end-tidal carbon dioxide concentration (CO2), increase in arterial CO2, or decrease in arterial oxygen tension occur intraoperatively. Arterial air bubble detection using transesophageal echocardiography or intracranial Doppler and EEG are not yet routine procedures during open heart surgery [4, 5].

Statistical data from Kol and colleagues [6] showed that out of 6 patients only 2 recovered completely; 2 patients died immediately [6]. Data from Mills and Ochsner [1] confirm the high risk of arterial air embolism (mortality rate, 31%; 4/13 patients). Neither deep barbiturate anesthesia nor use of hyperbaric oxygenation was employed in any of the 13 patients in that report [1]. It is obligatory for each open heart team to be prepared to deal with this situation should it arise. Considering our management we need to discuss if retrograde cerebral perfusion in a head-down Trendelenburg position will increase the risk of coronary artery air embolism. Further it is advisable to monitor the venous pressure of the innominate vein to adjust the retrograde perfusion rate. Additionally, it is beneficial to temporarily compress the carotids during retrograde perfusion so that the vertebral arterial system is purged of air.

However, we conclude that our case demands special attention, since a proven arterial air embolism was treated successfully (complete recovery with no permanent neurologic sequelae) with a combination of retrograde cerebral perfusion, deep barbiturate anesthesia, and hyperbaric oxygenation.

References


Bronchioloalveolar Carcinoma Arising in a Bronchogenic Cyst

Chiaki Endo, MD, Tadashi Imai, MD, Hideyuki Nakagawa, MD, Akio Ebina, MD, and Mitsuomi Kaimori, MD

Departments of Respiratory Diseases and Pathology, Aomori Prefectural Central Hospital, Aomori, Japan

We report the case of a 37-year-old woman with a radiographically cystic lung lesion. Lobectomy was performed. Histopathologic examination showed a bronchioloalveolar carcinoma arising in a bronchogenic cyst. This suggests that epithelial cells of bronchogenic cysts can undergo malignant transformation. It may be prudent to recommend complete resection of any bronchogenic cyst.


Bronchioloalveolar carcinoma is a subtype of pulmonary adenocarcinoma occurring as an isolated nodule, multiple nodules, or a relatively diffuse lesion. Cytation in bronchioloalveolar carcinoma is unusual. We report a rare case of a bronchioloalveolar carcinoma arising in a bronchogenic cyst.

A 37-year-old woman with no history of smoking had no previous medical history before a radiologic lung abnormality was found in an industrial medical examination. Computed tomographic scans showed a cystic lesion in the right lung (Fig 1). Right posterolateral thoracotomy on July 2, 1997 showed a soft cystic lesion at the right lower lobe. A right lower lobectomy was performed with hilar and mediastinal lymphatic dissection.

In the pathology report, the cystic lesion was 2.7 × 2.5 × 2.0 cm with a 1.8-cm cavity. Microscopic examination showed only one cyst; carcinomatous foci composed of large, well-differentiated, mucus-secreting columnar cells lined the intact alveolar septa and the cyst wall. Many alveoli were filled with macrophagic cells and...
mucus, typical of mucinous bronchioloalveolar carcinoma (Fig 2). Part of the cavity was lined by ciliated respiratory epithelium close to carcinomatous columnar cells (Fig 3). The wall also contained a small cartilage plate and chronic inflammatory infiltration (Fig 4). The conclusion was bronchioloalveolar carcinoma arising in a bronchogenic cyst. One year later, the patient was in good condition, with no signs of metastasis.

Comment

Cavitation in bronchioloalveolar carcinoma is unusual. Preexisting lung cysts may antedate the development of malignancy, or pseudocavitation may occur due to distended alveoli filled with abundant mucus [1].

Bronchogenic cysts are congenital and can be either extrapulmonary or intrapulmonary [2]. They typically are spherical and unilocular. They are lined by the ciliated columnar epithelium and their walls may also contain cartilage plates, seromucinous glands, and fibromuscular connective tissue. The most reliable criterion of intrapulmonary bronchogenic cysts is thought to be the presence of cartilage in the wall [3].

In our case, the cyst was unilocular, and the wall contained a small cartilage plate. Part of the wall was lined by ciliated columnar epithelium. These findings indicated the cyst was a bronchogenic cyst. Carcinomatous columnar cells were adjacent to ciliated respiratory epithelium lining the wall, suggesting bronchogenic cyst epithelial cells developed into bronchioloalveolar carcinoma.

Stocker described many of bronchogenic cysts representing examples of type 1, congenital cystic adenomatoid malformations (CCAM) [4]. Sheffield and associates, described premalignant changes in type 1 CCAM containing mucus cells [5]. Several case reports showed an association between CCAM and bronchioloalveolar carcinoma [5, 6]. However, in our case, the cyst was unilocular, in contrast to CCAM type 1, which consists of multiple large epithelial-lined cysts. Our cyst was diagnosed as a bronchogenic cyst, a rare case of association between a bronchogenic cyst and bronchioloalveolar carcinoma.

St-Georges and associates recommended all presumed bronchogenic cysts seen in the adult be resected because
the majority will ultimately become symptomatic or complicated [2]. Based on our experience, bronchogenic cysts have the potential for malignant changes. In conclusion, it may be prudent to recommend complete resection of any bronchogenic cyst.

References


The Ross Operation in a Jehovah’s Witness: a Paradigm for Heart Surgery in Children Without Transfusion

Kagami Miyaji, MD, Robert L. Hannan, MD, Jorge W. Ojito, CCP, Jeffrey A. White, MS, and Redmond P. Burke, MD

Division of Cardiovascular Surgery, Miami Children’s Hospital, Miami, Florida

A 3-year-old 18 kg male child of the Jehovah’s Witness faith presented with severe aortic regurgitation. A successful Ross procedure was performed using a pulmonary autograft, without the use of blood or blood product transfusion. Blood conservation strategy included: (1) preoperative treatment with recombinant human erythropoietin; (2) intraoperative strategies, including technical modifications to the Ross procedure, and the prophylactic use of fibrin glue; (3) utilization of a heparin-bonded cardiopulmonary bypass circuit and assisted venous drainage; and (4) the use of prebypass phlebotomy, cell-saving device and autotransfusion. The patient was discharged home on postoperative day 7 with a hemoglobin level of 11.9.

Accepted for publication July 10, 1999.

Address to reprint requests to Dr Burke, Division of Cardiovascular Surgery, Miami Children’s Hospital, 3200 SW 60 Court, Suite 102, Miami, FL 33155-4069.

© 2000 by The Society of Thoracic Surgeons
Published by Elsevier Science Inc

Blood conservation techniques, such as blood scavenging with a cell-saving device, autotransfusion in a closed-loop system, or the preoperative use of recombinant human erythropoietin now allow cardiac operations in patients of the Jehovah’s Witness faith who are unwilling to undergo blood transfusions [1–3]. These children present an extraordinary dilemma for surgeons trained to strive for early complete repairs. We report a successful Ross operation [4] for severe aortic regurgitation, without the use of homologous blood or blood products, in a Jehovah’s Witness child.

A 3-year-old boy of the Jehovah’s Witness faith, weighing 18 kg, was referred to us with diagnoses of severe aortic regurgitation. He was diagnosed with severe congenital aortic stenosis and a bicuspid aortic valve with dysmorphic valve leaflets by echocardiography at birth. At 8 months of age he underwent transcatheter balloon dilation of the aortic valve with improvement in his stenosis, and the creation of aortic insufficiency. He has been followed by echocardiography and noted to have increasing left ventricular dimensions and worsening aortic regurgitation. To prevent progression of left ventricular dysfunction, elective surgical repair was recommended. There was good match of the pulmonary valve annular size and the size of the aortic annulus (16 mm and 17 mm, respectively). After discussing the potential options with the parents, we elected to proceed with a Ross aortic root replacement to allow for the child’s growth and avoid the risk of a mechanical valve. The patient was in good hemodynamic condition at the time of operation. His parents were adamant that he should not be given blood or blood products. Recombinant human erythropoietin (2550 u/week) was given to the patient for 4 weeks preoperatively and resulted in an increase in his hemoglobin level from 12.1 to 13.2 g/dL before admission.

The patient then underwent repair using cardiopulmonary bypass with hypothermia at 20°C. At the beginning of bypass, 500 mL of undiluted heparinized whole blood, which had not been exposed to cardiopulmonary bypass, was reserved in a closed circuit connected to the venous drainage of the bypass circuit. This blood was reinfused after bypass was terminated. One million units of aprotonin were administered before bypass, and another one million was administered during bypass. The cardiopulmonary bypass circuit was completely heparin coated (Carmeda Bioactive Surface; Minneapolis, MN), consisting of a centrifugal pump (Bio-Medicus, Eden Prairie, MN), and membrane oxygenator (Medtronic, Inc, Minneapolis, MN) with active venous drainage from the centrifugal pump. Heparin (300 IU/kg) was given before cannulation and activated clotting time was maintained above 480 seconds throughout the bypass. After cross-clamping of the aorta, the aorta was transected about 1 cm above the coronary ostia. The previous valvuloplasty had created a tear into the anterior leaflet, and the valve was not repairable. The left ventricular outflow tract was examined endoscopically, using a 4-mm, 30 degree face angled endoscope. No subvalvar obstruction was detected. The pulmonary valve cylinder was in-