from 95 percent to 85 percent at home.

At the time of his hospital admission, he was noted to be tachypneic at rest but felt subjectively he had been clinically improving. His leukemia was still in remission by laboratory analysis. Clinical examination identified decreased breath sounds over the right side of his chest. A CXR revealed a near-complete luency of the right hemithorax and a slight shift of the mediastinum to the opposite side (Fig 1).

A computed tomographic scan of the chest revealed an air-filled cavity in the right hemithorax with strands of fibrous septae spanning this cavity (Fig 2) and a marked shift of the mediastinal structures to the left.

Because of inability to distinguish between Tpx and tension from a giant bulla, the patient was taken to the operating suite where video-assisted thoracoscopy was performed under local anesthesia. This revealed complete collapse of the lung with adhesions to the parietal pleura. The patient was treated with tube thoracostomy for 7 days during which time his lung fully reexpanded and the air leak resolved.

The hospital discharge CXR revealed the lung to be fully reexpanded with minimal bullous changes. At home, the patient noted markedly improved exercise tolerance and was able to return to full-time employment.

DISCUSSION

Tension pneumothorax occurs when an injury to the lung results in a persistent air leak. Complete collapse of the lung ensues due to increasing positive intrapleural pressure. Progression results in a shift of the mediastinal structures away from the injured lung, impairment of venous return to the heart, and compression of both the ipsilateral and contralateral lung.

Tension from giant bullae generally develops in a patient with a diagnosis of chronic obstructive pulmonary disease, particularly bullous emphysema. It results from the gradual destruction of neighboring lung parenchyma that coalesce into a large intraparenchymal air sac. Chest radiography demonstrates a large luency with compression of the underlying lung parenchyma.

Development of tension bullae implies a ball-valve effect at the level of the bronchus allowing air to enter the bullae and accumulate under increasing pressure. Eventually a shift of the mediastinal structures develops away from the side with the bullae.

Treatment of these two entities is vastly different. Tension pneumothorax is usually treated urgently by tube thoracostomy. Bullous disease of the lung generally requires a limited pulmonary resection to remove the ball-valve tissue and relieve the compression on the underlying lung parenchyma. Tube thoracostomy in the treatment of tension from giant bullae has the potential risk of leading to a prolonged air leak from a bronchopleural fistula.

We elected to use video-assisted thoracoscopy, performed under local anesthesia, to establish a definitive diagnosis. This is similar to a method employed previously in differentiating between hydropneumothorax and destroyed lung with a fiberoptic bronchoscope. Response of leukemic pulmonary involvement to chemotherapy may leave a necrotic portion of lung that eventually ruptures into the pleural space. Since our patient's symptoms followed treatment for a second relapse, this possibility might be the most likely cause of the pneumothorax.

This unusual case leads us to conclude that chronic Tpx can occur. Adhesions between the visceral and parietal pleura can make chronic Tpx difficult to distinguish from tension bullae; however, the differentiation can be made safely by video-assisted thoracoscopy leading to prompt and effective therapy. Treatment of this chronic condition should not differ from the conventional treatment of an acute Tpx.

REFERENCES


Central Venous Catheter Migration to the Popliteal Artery During Total Cavopulmonary Shunt*

Mikito Kawamata, M.D.; Keiichi Omote, M.D.; Satoshi Fujita, M.D.; and Akiyoshi Nanuki, M.D.

Central venous catheter migration to the arterial system occurred due to the surgical procedure during total cavo-pulmonary shunt. The catheter seems to have crept into the portion of the vena cava that had been designated for clamping, because of the position for the surgery and the anatomic characteristics of the patient. The catheter migrated in the right popliteal artery and was removed immediately; however, it could enter the pulmonary arterial system and the other systemic arterial branches.

(Chest 1993; 104:1914-16)

Catheter embolism, which was first reported in 1954 by Turner and Sommers, is a known complication of central venous catheterization. However, catheter migration from the central vein into the arterial system has never been reported (to our knowledge). We present a patient with congenital heart disease in whom a central venous catheter was accidently cut and migrated to the popliteal artery.

CASE REPORT

A 13-year-old, 32-kg, 140-cm girl with complex cyanotic heart disease was scheduled for total cavo-pulmonary shunt. The patient had a single ventricle, a single atrium, valvular pulmonary stenosis, a common atrioventricular valve, confluent right and left pulmonary arteries, and hemiizygous continuation of the inferior vena cava. Bilateral femoral veins were obstructed due to many previous punctures for angiography during the patient's infancy. The patient lacked the right jugular vein congenitally, and had a centrally positioned liver and polysplenia. Her New York Heart Association (NYHA) functional classification was class 3. The arterial oxygen saturation at rest was 82 percent. The patient was scheduled for a total cavo-pulmonary shunt operation.

After anesthesia was induced with intravenous fentanyl (10 µg/kg) and diazepam (5.0 mg) followed by pancuronium to facilitate

*From the Department of Anesthesiology, Sapporo Medical College and Hospital, Sapporo, Japan.
Reprint requests: Dr. Kawamata, Department of Anesthesiology, Sapporo Medical College and Hospital, South 1, West 16, Chuoku, Sapporo, Hokkaido 060, Japan
endotracheal intubation, central venous catheterization was attempted before the surgery to monitor the pressure of the central vein and to assess the saturation of central venous blood and for infusion of fluids and drugs. The left internal jugular vein was punctured by a 16-gauge needle percutaneously at the level of the cricoid cartilage, and an 18-gauge nylon catheter with radiopaque line was inserted to about 10 cm. A chest radiograph showed that the catheter tip was positioned in the superior vena cava at the level 2 cm caudally from the clavicle-sternal junction. This level was safe to ligate the vena cava. Then, for the surgery, the patient was placed in the right lateral decubitus position, and the operating table was rotated to the right. The patient's head was slightly rotated to the left and elevated with a pillow. Before anastomosis of the superior vena cava to the confluent right and left pulmonary arteries, we probed the vena cava to verify the position of the catheter, but we could not detect it. We thought the catheter had not gone that far after all, and assumed that it was safe to clamp. When the vena cava was clamped and partially separated, we tugged on the end of the catheter at the insertion site and found that the catheter would not move. Once the clamp on the vena cava had been loosened, the catheter was easily withdrawn. Fearing that the catheter might have been broken by the forces of clamping and separating, we took radiographs of chest, abdomen, skull, and extremities. An image of the right lower extremity showed that the fragment of the catheter lodged in the right popliteal artery (Fig 1). The dorsal artery of the foot and the lateral plantar artery were well palpable. The original surgery was continued, and at the same time, the fragment of the catheter was removed immediately, using a basket catheter via the right femoral artery. The surgery was performed uneventfully. The patient has had no complications associated with the catheter migration postoperatively.

**DISCUSSION**

After Glenn reported an operation in which systemic venous blood was directed into the pulmonary circulation, Fontan and Baudet extended the notion to include blood returning from the inferior vena cava. Total cavopulmonary shunt, which is a modification of the procedure of Fontan and Baudet, was reported in 1982. In this surgical procedure, perioperative management is mainly aimed at minimizing pulmonary vascular resistance and optimizing ventricular function, thereby improving blood flow through the lungs and cardiac output while reducing right atrial pressure. Accordingly, the mean airway pressure should be reduced, and it is essential to keep the right atrial pressure within the correct range. Especially, for the aim of the latter, central venous catheterization is indispensable to monitor the central venous pressure.

In this patient, bilateral femoral veins were obstructed, and the right jugular vein was absent congenitally. We chose the left internal jugular vein as the approach for the central venous catheterization. Preoperative chest radiograph in the supine position showed the catheter tip was positioned in the site of the superior vena cava, which was not to be ligated. Before the beginning of the surgery, the patient was placed in the right lateral decubitus position and her head was elevated. This patient's vena cava was on her left side, and the left internal jugular vein ran straight to the vena cava.

![Image](http://journal.publications.chestnet.org/pdfaccess.ashx?url=/data/journals/chest/21678/)

Figure 2. A schematic showing how the catheter was broken and the course of migration of the fragment into the systemic arterial circulation. Ao = aortic artery; hepatocardiac v = hepatocardiac vein; hemiazygos v = hemiazygos vein; LPA = left pulmonary artery; PV = pulmonary vein; SVC = superior vena cava.

**Figure 1.** Anteroposterior view of the right knee demonstrating the catheter fragment (arrow) within the popliteal artery.
cava. Thus, the catheter seems to have crept, because of the shortening of the pathway through which it had been inserted, into the portion of the vena cava that had been designated for clamping. Since it had a hemiazygos connection with the inferior vena cava, the superior vena cava carries a high blood volume in this patient that makes it difficult to palpate. Thus, it was difficult to notice the presence of the catheter.

Since the patient had a single ventricle and a single atrium, the fragment of the catheter could easily have migrated into the pulmonary arterial system or the systemic arterial system. If the fragment had advanced to the pulmonary circulation, it would have been difficult to remove with the basket catheter, because the trunk of the pulmonary arteries were stenosed in this patient. In addition, the incision in the pulmonary arteries for removing the fragment might have resulted in distal stenosis, the danger of which was the entire reason for cavopulmonary shunt operation. In this patient, the fragment advanced into the systemic arterial circulation and eventually wound up in the popliteal artery (Fig 2), perhaps one of the most benign locations. If it had entered any of various other branches, eg, the carotid arteries, the mesenteric arteries, the renal arteries, etc, it could have caused organ insufficiency.

In conclusion, it is vital to confirm the location of the tip of the central venous catheter in the superior vena cava for total cavopulmonary shunt. As it might be difficult to feel the catheter through the vena cava in a patient scheduled for total cavopulmonary shunt, one or more radiographs should be taken to locate the catheter tip after the patient is positioned for the surgery.

References

6. Williams DB, Kiernan PD, Metke MP. Hemodynamic response to positive end-expiratory pressure following right atrium-pulmonary artery bypass (Fontan procedure). J Thorac Cardiovasc Surg 1984; 87:856-61

Beguiled by the Gallium*

Thymic Rebound in an Adult After Chemotherapy for Hodgkin's Disease

Denise F. Burns, M.D.; and Fred J. Schiffman, M.D.

*From the Department of Medicine, the Miriam Hospital, Brown University, Providence, RI

Reprint requests: Dr. Schiffman, Miriam Hospital, 164 Summit Avenue, Providence, RI 02906

An 18-year-old woman was diagnosed as having Hodgkin's disease involving the mediastinal lymph nodes and lung parenchyma. A pretreatment gallium 67 scan showed increased uptake in the mediastinum. Chest radiograph and chest computed tomographic (CT) scans after chemotherapy demonstrated resolution of disease, and a repeated gallium scan was normal. Four months later, a surveillance gallium scan showed increased activity in the mediastinal and hilar regions with corresponding chest CT and magnetic resonance imaging (MRI) showing a retrosternal mass. Prior to committing the patient to aggressive treatment for presumed disease relapse, a biopsy of the mass was performed and a specimen showed normal thymus tissue. The patient has continued in remission without further therapy 3 years after her initial treatment, with subsequent normal gallium scans and a stable mass on CT and MRI. Thymic enlargement following chemotherapy can occur with Hodgkin's disease in young adults, and interpretation of imaging studies, including gallium scanning, must be made with this consideration in mind.

(Chest 1993; 104:1916-19)

Many patients with mediastinal Hodgkin's disease demonstrate a residual mass following primary treatment. This is often of uncertain clinical significance; persistent disease or relapse often occurs in the mediastinum, but benign fibrosis may also occur here. The determination of completeness of response is critical since patients with incomplete responses have a poorer prognosis and require further radiotherapy, more aggressive chemotherapy, and/or bone marrow transplantation to improve survival.

Chest radiographs and computed tomographic (CT) scans will identify the presence of a residual mass but cannot reliably identify its nature. Magnetic resonance imaging (MRI) may be more discriminating in differentiating fibrosis from residual tumor or other mass but cannot reliably rule out the possibility of active disease. Animal studies have shown gallium-67 citrate uptake to be a good indicator of tumor viability and it is more pronounced in viable tumor than in fibrotic/necrotic tissue or tissue affected by radiotherapy or chemotherapy.

The use of gallium scanning in the management of Hodgkin's and non-Hodgkin's lymphomas has been studied and found to be useful in diagnosis, staging, and in differentiating between residual active disease or relapse and benign mediastinal enlargement after chemotherapy. However, gallium uptake in the mediastinum in adults after chemotherapy may not indicate tumor recurrence, but rather benign thymic hyperplasia, as illustrated by the case we present.

Case Report

An 18-year-old white woman had been in her usual state of good health until she presented in May 1989, with a history of 6 weeks of general malaise, back pain, and persistent cough after an upper respiratory tract infection. The physical examination revealed cervical lymphadenopathy; a chest radiograph showed mediastinal enlargement. Laboratory findings included anemia, thrombocytosis, and an elevated sedimentation rate. A right scalene lymph node biopsy specimen showed nodular sclerosing Hodgkin's disease.

A staging workup in early June 1989 revealed involvement of the mediastinal lymph nodes and the lung parenchyma demonstrated by chest radiograph, CT scan, and gallium scan (7.3 mCi "Ga

Thymic Rebound after Chemotherapy for Hodgkin's Disease (Burns, Schiffman)