3 Cheitlin MD, DeCastro CM, McAllister HA. Sudden death as a complication of anomalous left coronary origin from the anterior sinus of Valsalva. Circulation 1974; 50:780-87
14 Griffith L, Grunwald L, Aschuff S. Electrocardiographic changes in single vessel disease (abstract). Circulation 1978; 58: (Suppl II) 238
15 Roberts JT, Lowbe SD. The congenitally single coronary artery. Anat Rec 94:81, 46
16 Allen GL, Snider TH. Myocardial infarction with single CA. Arch Intern Med 1966; 117:261
17 Proudfit WL, Bruschke AVG, Sones FM. Clinical course of patients with normal or slightly or moderately abnormal coronary arteriograms. Circulation 1980; 62:712

Duplication of the Inferior Vena Cava In Thromboembolic Disease*  
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Recurrent pulmonary embolism from the lower extremities or pelvis, despite anticoagulation, often requires interruption of the inferior vena cava (IVC). We report two patients in whom interruption of the IVC failed to ameliorate symptoms. Both patients demonstrated a previously unrecognized duplication of the IVC. We stress the importance of excluding abdominal venous anomalies prior to interrupting the IVC using surgical or percutaneous methods.

Pulmonary embolism is a life-threatening disease. When pulmonary emboli recur even though the patient has been adequately anticoagulated or when there is a contraindication to anticoagulation after pulmonary embolus, interruption of the IVC may be required.14 This may be accomplished using either a percutaneously placed filtering device such as a Greenfield umbrella or the IVC may be cross clamped at surgery.14 Once accomplished, the threat of recurrent emboli from the lower extremities or the pelvis is obviated in the majority of cases.1 If a large diameter collateral route of blood return from the lower body exists, however, patients may continue to present with episodic pulmonary embolus. This often creates a confusing clinical picture. Recanalization of the IVC or failure of the interruption device often is blamed for the recurrent pulmonary embolus. We report two patients with duplication of the inferior vena cava and recurrent pulmonary embolus despite adequate interruption of the IVC.

CASE REPORTS

Case 1

A 51-year-old woman presented to our institution with a six-year history of recurrent episodes of hemoptysis and acute chest pain. Her IVC had been clipped on her initial presentation to an outside hospital after obtaining a high probability ventilation-perfusion scan (V/Q scan). She was placed on anticoagulation. Over the following six years, the patient had experienced many episodes of chest pain associated with hemoptysis.

On presentation to our institution, an inferior vena cavaogram was performed, and it demonstrated a left-sided IVC (Fig 1), which crossed back to its expected position on the right side at the level of the renal veins. A V/Q scan obtained on admission was low probability for embolus despite a recent episode of chest pain and hemoptysis of greater degree than usual. Because of this, a pulmonary angiogram was also performed which showed no evidence of embolus or other vascular anomaly. Her pulmonary artery pressures were normal with a mean of 13 mm Hg and 14 mm Hg on the right and left side respectively.

Bronchoscopic examination revealed fresh hemorrhage emanating from the orifice of the superior segment bronchus of the right lower lobe, but no other abnormality could be found. A CT scan showed no

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evidence of pulmonary neoplasm and confirmed the presence of a left IVC. Anticoagulation was stopped without recurrence of hemoptysis.

Case 2

A 66-year-old white man presented to another hospital in December, 1980 complaining of chest pain. The patient's history was remarkable for hypertension, prior myocardial infarction, and two strokes which left him with residual right-sided weakness. An electrocardiogram done at that time revealed questionable change from prior examinations. An acute myocardial infarction was excluded by negative CPK-MB bands. During this admission, an abdominal aortic aneurysm was diagnosed and resected. The patient's postoperative course was complicated by deep vein thrombophlebitis, documented by venography. Because of the recent surgery and an active gastric ulcer, the patient was not felt to be a candidate for anticoagulant therapy. Instead, a Mobin-Uddin filter was placed in the IVC.

The patient was discharged, but had to be readmitted (to our hospital) several days later when he experienced sudden onset of left-sided pleuritic chest pain and shortness of breath. Arterial blood gas determinations at the time revealed pH = 7.51, $P_{CO_2}$ = 28, and $P_O_2$ = 63. A V/Q scan was indeterminate for pulmonary embolus. A pulmonary angiogram demonstrated multiple pulmonary emboli (Fig 2). In addition, an inferior venacavogram was performed to explain the patient's recurrent embolus despite Mobin-Uddin filter replacement (Fig 3). This study demonstrated duplication of the IVC. The filter was in place in the right IVC, the left IVC was widely patent and reanastomosed to the right IVC at the level of the renal veins, above where the filter had been placed. The patient was anticoagulated, and recovered uneventfully.

Discussion

The IVC develops from several embryologic sources. The prerenal portion develops from the hepatic and subcardinal veins, while the postrenal segment develops from the right supracardinal vein. The renal segment develops via anasto-

Figure 1. Inferior venacavogram demonstrating a patent left IVC crossing over to the right IVC at the level of the renal veins. Note the ligation clip in the region of the right IVC (arrows).

Figure 2. Selective left pulmonary angiogram demonstrating multiple pulmonary thromboemboli.

mosis of the subcardinal veins. During fetal development, a number of anastomoses develop and disappear among the post-cardinal, subcardinal, supracardinal, and hepatic veins. Duplication of the IVC results from persistence of the left supracardinal vein and at least one of the normal development midline anastomoses between it and its contralateral mate. This persistent anastomosis which usually occurs at the level of the renal veins may cross either anterior or posterior to the aorta.

Figure 3. Inferior venacavogram injected from left common iliac vein shows opacification of the left sided IVC. The Mobin-Uddin filter can be seen in the position of the normal right sided IVC (arrows). A catheter could be passed into the right IVC.
Placement of an IVC filter or IVC ligation for refractory thromboembolic disease has proven successful therapy in the majority of cases of recurrent pulmonary embolus. Greenfield, in his experience with 156 patients who had placement of a Greenfield filter, documented recurrent embolism in 2 percent. Recurrent pulmonary embolization despite IVC ligation or filter placement is a serious problem. It may imply development of a collateral route for embolism or, in the case of IVC ligation, recanalization of the original lumen. Another etiology, not often considered, is a congenital anomaly of the IVC.

We have presented two patients with duplicated IVCs. One went unrecognized despite placement of a Greenfield filter and abdominal aortic aneurysm resection. Failure to diagnose the duplication led to disastrous consequences for this patient. The other patient had surgical ligation of the IVC, but the duplication was not recognized. Whether or not the latter patient’s problems in fact related to pulmonary embolus may be questioned. Even so, this issue is irrelevant since duplication surgical ligation of one IVC without the other is inadequate therapy for pulmonary embolus.

The prevalence of duplication of the IVC may be as high as 3 percent of the population.4-7 This, coupled with grave implications of recurrent pulmonary embolus, suggests that a congenital venous anomaly such as duplication of the IVC or azygous continuation of the IVC should be excluded prior to therapy. When filter placement is the selected therapy, an inferior venacavogram performed from bilateral pelvic vein injections may be done just before filter placement. Recently, safe Greenfield filter placement from a percutaneous femoral approach not requiring a cutdown has been described.8 Identification of a venous anomaly prior to surgical therapy would require a separate inferior venacavogram. While the yield of positive cases will be small, the significance of a missed venous anomaly cannot be overlooked.10

REFERENCES
7 Royal SA, Callen PW. CT evaluation of anomalies of the inferior vena cava and left renal vein. AJR 1979; 132:793-9
8 Faer MJ, Maj MC, Lynch RD, Evans HO, Chin FK. Inferior vena cava duplication: demonstration by computed tomography. Radiology 1979; 130:707-09
10 Novelline RA. Practical points on transvenous insertion of inferior vena cava filters. Cardiovasc Intervent Radiol 1980; 3:319-34

Pleurodesis in Metastatic Pneumothorax*

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A 57-year-old woman with bilateral pneumothoraces secondary to pulmonary metastases from leiomyosarcoma of the uterus was treated successfully by intrapleural instillation of tetracycline.

Spontaneous pneumothorax is a rare complication of pulmonary metastatic disease which often has required surgical intervention. Sarcomas are the most common group of neoplasms associated with spontaneous pneumothorax. We report a case of leiomyosarcoma of the uterus with metastasis to the lungs and bilateral recurrent spontaneous pneumothoraces treated effectively by intrapleural instillation of tetracycline. We are not aware of a similar case report in the literature.

CASE REPORT

A 57-year-old woman was admitted to Booth Memorial Medical Center for evaluation of acute onset of shortness of breath from bilateral pneumothoraces. Seven weeks prior to admission she was found to have leiomyosarcoma of the uterus with multiple pulmonary metastatic nodules and underwent total hysterectomy. On the 8th postoperative day, a routine chest roentgenogram revealed a 20 percent spontaneous pneumothorax on the right side, for which no active measures were instituted. She received 100 mg of dexamethasone intravenously on the 10th day. On the day of admission, the chest roentgenogram showed 80 percent pneumothorax on the right and a 40 percent pneumothorax on the left side. A Cook percutaneous pneumothorax catheter was inserted on the left side with underwater seal drainage resulting in complete expansion of the lung. The catheter was removed on the third day. On the 6th day she was noted to have recurrent left pneumothorax requiring reinsertion of the Cook catheter with partial re-expansion of the lung and persistent air leak. The following day she developed a large pneumothorax on the right side requiring Cook catheter placement. On the 9th hospital day, Argyle chest tubes were inserted on both sides because of persistent air leaks. There was complete re-expansion of the lungs and no air leaks could be detected after three days on the right and four days on the left side.

Chemical pleurodesis was attempted using 1 gram of tetracycline hydrochloride dissolved in 50 ml normal saline solution along with 5 ml of 2 percent lidocaine (Xylocaine) instilled into the pleural cavity via chest tube on the right side. The chest tube was clamped for one hour and the patient's position was changed at 15-minute intervals to ensure uniform distribution. The tube was unclamped and allowed to drain with gentle suction set at minus 15 cm of water. There was 50 ml of fluid drainage and the chest tube was removed after 24 hours. The following day a similar procedure was performed on the left side and there was 75 ml of fluid drainage; the chest tube was removed after 24 hours. Follow-up over the next months revealed no recurrence of pneumothorax.

DISCUSSION

Primary and secondary lung tumors are a rare cause of

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