factor, since severe coughing was evident in one of the patients in whom air was initially discovered within the fissure. Underlying pulmonary disease may predispose certain patients to produce this phenomenon. It is of interest that we have encountered an asthmatic patient without heart disease who had similar findings within the left oblique fissure (Fig 3). Pneumomediastinum and pneumothorax are well-known complications that accompany or follow an acute bout of asthma due to the rapid increase in alveolar pressure.

The roentgenographic features are fairly typical as far as location and appearance are concerned. Except for the additional presence of air, the changes are similar to those described for the usual pseudotumor of congestive heart failure. The collection tends to assume a biconvex spindle-shaped configuration and demonstrates a well-defined air-fluid level if the film is exposed with the patient in the upright position (Fig 1 and 2). The long axis of the collection lies in the plane of the fissure, and one or both edges of the lesion are continuous with the fissure.\textsuperscript{1,6,7} The lesions in both of our patients were located at the origin of the minor fissure (Fig 1B and 2B).

Findings of congestive heart failure, except for cardiomegaly, may or may not be obvious. Distended pulmonary veins are frequently present in the untreated patient with acute congestive failure; however, the absence of congestive changes in no way excludes this possibility, since the pulmonary vasculature rapidly returns to normal with therapy. The majority of interlobar effusions also disappear quickly; however, some are known to remain for indefinite periods.

The lesion must be differentiated from other lesions containing air and fluid, (eg, cavitating masses, necrotizing pneumonias, infected cysts). In general, the thin wall, the spindle-shaped configuration, and the obvious intrapleural location on the lateral projection are important characteristic features. Most other lesions are intraparenchymal, are generally spherical, and are surrounded by a thick irregular wall. The lesion may be confused with an infected cyst; however, the location is quite specific, and the roentgenographic findings are generally without symptoms.

Recognition of this unusual manifestation is necessary in order to avoid unwarranted therapy or invasive investigation. The close temporal relationship between the appearance of the air-fluid collection and congestive heart failure is usually sufficient. In cases where doubt may exist, a trial course of therapy for congestive heart failure is warranted.

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Repeated Massive Hemoptysis* Successful Control Using Multiple Balloon-Tipped Catheters for Endobronchial Tamponade

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Endobronchial tamponade with a balloon-tipped catheter (Fogarty catheter) is used to control massive hemoptysis. This case documents that recurrent massive hemoptysis can be successfully controlled with repeated use of this procedure and that the simultaneous placement of more than one catheter can be safe and effective therapy that is well tolerated by patients.

In the management of massive hemoptysis, the balloon-tipped catheter (Fogarty catheter) has been used to assist in localizing the site of bleeding,\textsuperscript{1} to control hemorrhage until surgery could be performed,\textsuperscript{2} and to definitively treat patients who continued to have copious hemoptysis but were considered unable to withstand thoracotomy.\textsuperscript{3}

Saw and associates\textsuperscript{3} reported their experience with selective endobronchial tamponade using a balloon-tipped catheter (Fogarty catheter) in ten consecutive patients with massive hemoptysis. Patient 9 from their series was recently readmitted to the hospital because of another episode of massive hemoptysis, and he is the subject of this report. This case demonstrates that the repeated use of endobronchial tamponade can control recurrent massive bronchial bleeding and that two or more catheters can be simultaneously used to successfully control hemoptysis originating in more than one area.

Case Report

A 67-year-old man with the diagnosis of coal workers' pneumoconiosis and bronchiectasis was readmitted to the Los Angeles County-University of Southern California Medical Center, Los Angeles, because of the sudden onset of hemoptysis. He had three separate episodes of hemoptysis during this admission, and his hematocrit reading dropped from 38 to 32 percent.

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The patient had had five bouts of hemoptysis during the previous seven years. All of the episodes had spontaneously subsided except the fourth episode in 1976 (reported by Saw et al)

which was controlled by endobronchial tamponade with a balloon-tipped catheter (Fogarty catheter). The patient's most recent episode of hemoptysis had occurred seven months before this admission and had spontaneously subsided.

During the first six hours of his admission, the patient coughed up 250 ml of bright red blood. Fiberoptic bronchoscopic examination localized the bleeding to the B\(a\) subsegment of the right upper lobe. A balloon-tipped catheter (Fogarty catheter) was placed in this subsegment. The balloon was inflated with 0.5 ml of meglumine diatrizoate (Renografin) and was left in place for 48 hours.

During the first 30 hours following removal of the catheter, there was no bleeding; but then the hemoptysis resumed with 225 ml measured over the next 18 hours. Fiberoptic bronchoscopic examination now localized the bleeding to the B\(b\) subsegment of the right upper lobe. A catheter was inserted into this subsegment, and 0.5 ml of meglumine diatrizoate was instilled into the balloon.

The bleeding temporarily stopped but abruptly began again 12 hours later, producing 290 ml over the next 12 hours despite the presence of the inflated balloon. Repeat fiberoptic bronchoscopic examination revealed blood stemming from the following two sites: (1) a small amount from the tamponaded B\(b\) bronchial orifice of the right upper lobe; and (2) a large amount from the B\(b\)ii subsegment of the middle lobe. The balloon tamponading the B\(b\) bronchus was reinflated with 0.75 ml of meglumine diatrizoate, and a second catheter was placed in the B\(b\)ii subsegmental orifice (Fig 1 and 2).

Both catheters remained in place simultaneously for 24 hours. The catheter in the right upper lobe was then removed, having been in place for 48 hours. The catheter in the right middle lobe was removed 24 hours later. The patient remained hospitalized for another four days, with no recurrence of hemoptysis.

**Discussion**

Several aspects of this patient's problem should be emphasized. Upon admission, the rate of bleeding was more than 40 ml/hr, well over the rate of 600 ml/16 hr that was found by Garzon et al1 to have a 78 percent mortality if not treated by resection of the involved lobe. Although the second time that this patient bled, the rate was appreciably slower, the rate of bleeding during the third time approached the 600 ml/24 hr usually used to define massive hemoptysis.

Each of the three episodes of bleeding originated from different areas. Tamponade with a balloon-tipped catheter controlled the bleeding for each episode in this patient with diffuse bilateral pulmonary disease.

It was fortunate that this patient underwent prompt bronchoscopic examination on each occasion, rather than having his condition considered a nonresectable failure of "medical treatment." During the third episode the physicians caring for the patient were of the opinion that a thoracotomy and resection would be actually required. The episode of bleeding in two lobes made surgery an even higher risk than previously assumed, since a bilobectomy would have been required. The patient most likely would have become incapacitated.

**Figure 1.** Chest x-ray film showing balloon-tipped catheter (Fogarty catheter) in both B\(b\) subsegment (anterior segment) of right upper lobe and B\(b\)ii subsegment (medial segment) of middle lobe.

The procedure itself is easy to do and seems to be safe. There was little difficulty in positioning the catheters. All of the catheters were arterial embolectomy catheters (Fogarty 12-100-4F). All were placed by the method of Gottlieb and Hillberg. The only difference in technique used between the first two bronchoscopic examinations

**Figure 2.** Close-up of right lung shown in Figure 1.
and the third was that the first two were performed via an oral endotracheal tube, while the third was done using the transnasal approach. This was in order to avoid the possibility that the intubation might dislodge the catheter that was already in place.

There were no complications. No evidence of atelectasis was noted on any of the chest roentgenograms. Bronchoscopic inspection showed no inflammation, infection, or pressure necrosis in the areas where a balloon had previously been lodged. In addition, the patient tolerated the catheters very well, even when two were in place simultaneously. He ate, drank, talked, and walked.

In conclusion, endobronchial tamponade with a balloon-tipped catheter (Fogarty catheter) is a rapid and safe procedure, which is well tolerated by patients. Although the procedure might have to be performed repeatedly in patients with recurrent massive hemoptysis and although more than one catheter might have to be placed simultaneously, such endobronchial tamponade is effective therapy which can help stave off surgical resection. The procedure certainly is a method that may be lifesaving in those patients for whom resection is not possible.

REFERENCES

Systemic-Pulmonary Arterial Supply in Pulmonary Atresia with Ventricular Septal Defect*

Postmortem Angiograms and Histologic Survey
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Postmortem angiographic and histologic studies of the pulmonary arterial circulation were performed in a patient with pulmonary atresia and a ventricular septal defect. While the left lung was supplied by a closing ductus arteriosus, the right lung was supplied by two systemic pulmonary arteries arising from the descending aorta. The examination disclosed that systemic pulmonary arteries lead into the pulmonary vascular bed and the capillaries of the alveolar walls. According to these observations, such collateral circulation is to be considered functional. The pulmonary vascular bed, supplied by the ductus arteriosus and the stenotic systemic pulmonary artery, showed a thin muscular layer in the small arteries and arterioles. On the contrary, medial hypertrophy and severe intimal proliferation were observed in the pulmonary segments perfused by the other large unobstructed systemic pulmonary artery, thus proving that asymmetric pulmonary vascular disease may complicate the natural history of this malformation.

In many patients with pulmonary atresia and a ventricular septal defect, the arterial blood supply to the lungs is entirely supported by systemic pulmonary arteries.1-4 They are often so large that an increased pulmonary blood flow occurs.5-6 Many doubts have been raised about whether these collateral vessels should be considered functional or nutritive.7 By postmortem angiograms and histologic observations, we have studied the pulmonary arterial supply in a case of pulmonary atresia with a ventricular septal defect and systemic pulmonary arteries. The results support the concept that this collateral circulation is functional.

CASE REPORT
A five-month-old boy, who was born following an uneventful gestation and delivery, was admitted for evaluation of cyanosis, a cardiac murmur, and recurrent bronchitis. The regular cardiac rate was 120 beats per minute, and the systolic blood pressure was 100 mm Hg. A continuous murmur was audible over the precordium and below the left clavicle.

Laboratory studies showed a red blood cell count of 5,140,000/cu mm, a hemoglobin level of 12.7 gm/100 ml, and a hematocrit reading of 37 percent. The chest x-ray film disclosed slightly increased arterial vascularity in the superior lobe of the right lung, as well as mild cardiomegaly with a prominent right ventricle and an absent pulmonary arterial segment. The electrocardiogram revealed sinus tachycardia, a QRS axis of +180°, and biventricular hypertrophy.

On cardiac catheterization, oximetric data demonstrated the presence of a left-to-right shunt at the ventricular level. The pulmonary trunk and arteries could not be reached. The systolic right ventricular pressure was 100 mm Hg. A pulmonary infundibulum could not be demonstrated by biplane right ventriculograms. The left ventricle was opacified through a high ventricular septal defect. Only the aorta arose from the heart, mainly from the left ventricle. The aortic arch was on the left. The left pulmonary artery was opacified by a large artery originating from the aortic arch. Two other large arteries arose from the descending aorta and entered the right hilum towards the superior and middle lobes, respectively. No pulmonary trunk or right pulmonary artery could be detected. Sudden severe arrhythmias did not allow further investigation of these collateral vessels by selective arteriograms. The child died 14 hours later.

Postmortem Examination
Situs solitus of the viscera and the atria, with levocardia, atrioventricular concordance, and a single outlet for both ventricles via a ventricular septal defect, were observed. A pulmonary infundibulum was not recognizable as a separate entity from the right ventricular sinus, because the anteriorly deviated infundibular septum was fused with the ventricular free wall. A cord-like pulmonary trunk arose from the cardiac

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