

Pulmonary Arteriovenous Fistula, Pulmonary Artery Aneurysm, and Other Vascular Changes of the Lung From Penetrating Trauma

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Pulmonary arteriography was performed in 22 patients with penetrating injury of the lung(s) within the first 72 post-injury hours and no vascular lesion directly attributable to the injury was found. Pulmonary arteriovenous fistula or pulmonary artery aneurysm secondary to penetrating pulmonary injury, are extremely rare lesions, but they should be suspected in a patient with penetrating wound of the chest with signs and symptoms of pulmonary arteriovenous fistula or with chronic residual well circumscribed density on chest roentgenogram. The treatment of these lesions should be excision of the lesion with preservation of the lung, whenever possible, or resection of the involved lobe.

PULMONARY ARTERIOVENOUS FISTULA, and pulmonary artery aneurysm from penetrating injury to the lung very rarely occur. The purpose of this communication is to describe the acute pulmonary arteriographic findings in patients with penetrating injury to the lung and to report a case with traumatic pulmonary arteriovenous fistula and another with traumatic pulmonary artery aneurysm seen at Grady Memorial Hospital over a fifteen year period from July 1964 to June 1979.

Clinical Material

During a ten month period (February to November 1975) all patients with penetrating wound(s) of the lung admitted to Grady Memorial Hospital were requested to undergo pulmonary arteriography. They were informed that the purpose for the arteriography was investigative, to determine the acute pulmonary vascular changes that occur from a penetrating wound of the lung, and were also informed about the risk of the pro-

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cedure. All patients who accepted to undergo pulmonary arteriography signed an informed consent form. Only 23, 19 males and four females, ranging in age from 13 to 55 years (mean:27) consented to participate in the study. In 15 patients the penetrating injury was due to a gunshot wound and in the remaining eight the injury was due to a stab wound.

All patients who underwent arteriography were treated in a manner similar to the other patients with such injuries who had been admitted in our hospital. Their hemothorax, pneumothorax, or hemopneumothorax was drained as soon as possible with a thoracostomy tube connected to a bottle containing sterile normal saline.

When the patients were stable and in no distress, pulmonary arteriography was performed within 72 hours of admission, via a polyethylene catheter which was percutaneously inserted through a femoral vein into the right or left pulmonary artery. Because some patients had injury to both lungs, a total of 15 right and 12 left pulmonary arteriograms were performed. One patient developed an atrial arrhythmia during the arteriography which responded to medical therapy, so the arteriogram was not performed and he was excluded from the study.

The pulmonary arteriograms showed loss of lung volume with clustering of the pulmonary artery branches and a delay in blood flow through them in 11 of the 22 studied patients. These changes were seen at the base of the lung and not at the site of the injury

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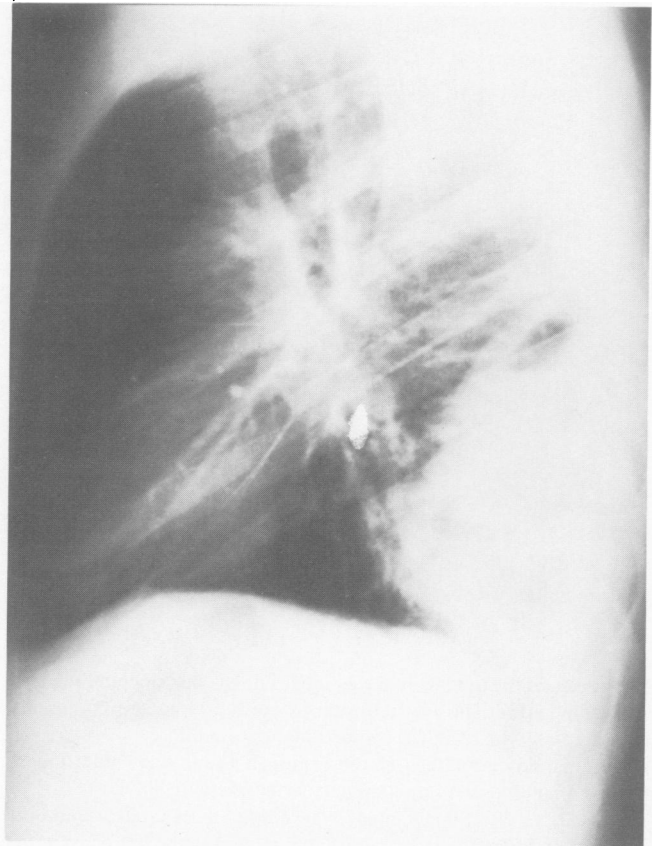
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in seven of these patients and the loss of lung volume was appreciated on the frontal chest roentgenograms only in two of the patients. In one patient, a bullet was shown to be embedded in the superior segmental artery of the lingula. In the remaining ten patients, no vascular pulmonary abnormalities were demonstrated and no pulmonary arteriovenous communications or pulmonary artery aneurysm was demonstrated in any of the studied patients.

Case Reports

Case 1. A 17-year-old boy, sustained two stab wounds in his right chest on 10/2/74. He was admitted elsewhere, a right tube thoracostomy was performed through the fifth intercostal space midaxillary line for hemopneumothorax and he was transferred to our institution. On admission to our hospital, he complained of hemoptysis, abdominal pain and right chest pain. The previously inserted chest tube had drained 800 ml of blood since insertion. One stab wound was noted in the posterior chest at the right eleventh intercostal space, about 6.5 cm from the midline, and another in the anterior chest about 2.5 cm above the right costal margin at the mid-clavicular line. His blood pressure was 150/100 mmHg and the pulse was 98 beats/min and he had moderate abdominal tenderness in the right upper quadrant and decreased bowel sounds. Exploratory laparotomy shortly after his admission to our institution showed neither diaphragmatic nor intraperitoneal injury. During the operative procedure, he developed considerable bleeding in the orotracheal tube which required repeated suctioning. Postoperatively, he continued to have occasional hemoptysis until two days later when he coughed up 300–400 ml of bright red blood, and the hemoptysis stopped spontaneously. Following this episode, he became dyspneic with a PO_2 of 46 mmHg, a PCO_2 of 33 mmHg, and the pH was 7.43, and he had decreased breath sounds in the right lower lung field but no murmur was heard. Chest roentgenography showed a radiodensity in the right lower lung field posteriorly (Fig. 1). He periodically continued to cough up small amounts of old blood, to be tachypneic and dyspneic and his blood gases failed to improve. On 10/8/74, he again coughed up 450 ml of bright red blood. At bronchoscopy, a few hours later, some blood clots were found in the right bronchii but no active bleeding was noted. His chest roentgenogram remained unchanged and on 10/12/74, thoracentesis was performed which yielded only 50 ml of old blood. He continued to have low grade fever and dyspnea but sputum, pleural fluid, and urine cultures were negative. On 10/18/74, because of the unexplained dyspnea and low PO_2 , pulmonary arteriogram was done which showed a pulmonary arteriovenous fistula at the site of his previous injury (Fig. 2). He continued having scanty hemoptysis which stopped on 10/22/74, and he became afebrile but continued to be dyspneic and tachypneic with arterial PO_2 ranging from 48 to 52 mmHg. He was advised to have decortication of the right lower lung and excision of the arteriovenous fistula but he refused and was discharged.

On 12/4/74, because of his dyspnea and unimproved blood gases, he was readmitted and underwent a right thoracotomy. At operation the lower lobe was densely adherent to the parietal pleura and was encased, in part, with a fibrous peel. After the thickened parietal pleura and fibrous peel were removed, the lung segment corresponding to the old chest wound appeared indurated. The lower lobe arteries were dissected and encircled with #2 silk suture and snared down. The indurated posterior basilar segment of the lung at the



FIGS. 1a and b. (a top, b bottom) Chest roentgenograms showing a radiodensity with a suggestive air fluid level in the right lower lung field posteriorly.

site of the arteriovenous fistula was incised and a mass of enlarged vessels were exposed and ligated using ligaclips for hemostasis. The silk suture which encircled the lower lobe arteries was then

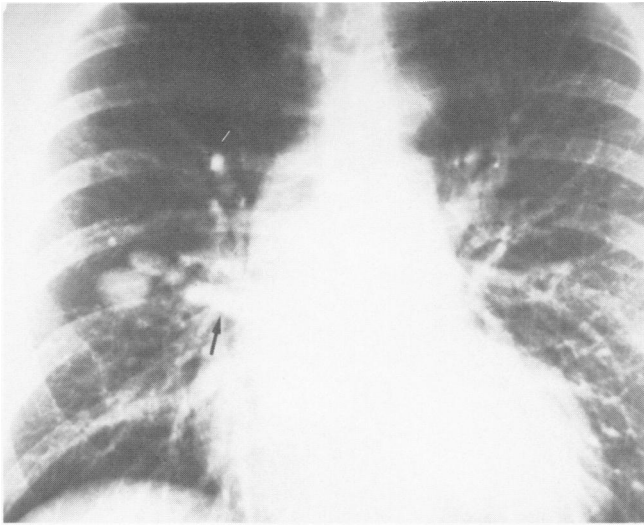


FIG. 2. Pulmonary arteriogram—Note the early opacification of the right pulmonary vein.

removed and the lung wound was repaired. His postoperative course was uneventful. The PO_2 returned to normal level and pulmonary arteriography on 12/13/74, showed no abnormality.

The histologic findings of the removed tissue were reported as being compatible with a pulmonary arteriovenous fistula.

Case 2. A 29-year-old man, was admitted to Grady Memorial Hospital in February 1979, with a stab wound to the left chest at the fifth intercostal space in the anterior axillary line. The patient arrived at the surgical emergency clinic with a systolic blood pressure of 60, which returned to normal limits after he received three liters of intravenous fluids. The remaining physical examination and review of systems were negative. Chest roentgenograms revealed a left hemothorax with probable left lung hematoma, and thoracostomy tube drainage was established which immediately drained 1600 cc of blood (Fig. 3). Admission white blood cell count was 21,900/mm³, hematocrit 24.6%, and arterial blood gases were adequate on a 25% face mask. The patient received four units of packed red blood cells to raise the hematocrit to 35.5%, and his overall hospital course was uneventful. The chest tube drainage decreased, the thoracostomy tubes were removed on the seventh postinjury day, and the chest roentgenogram at this time revealed a radiodensity in the left lower lung field which was felt to be residual loculated hemothorax and pulmonary hematoma (Fig. 4). It was elected to observe this density on an outpatient basis and the patient was discharged on the ninth postinjury day. In the follow-up period the patient remained relatively asymptomatic, except for periodic episodes of coughing up small amounts of blood-tinged sputum, but his left lower lung density persisted, and in May 1979 he was admitted for evaluation of this lesion. On admission the breath sounds were noted to be decreased over the left lower lobe and no murmur, rales, rhonchi, or egophony were noted. Repeat chest roentgenogram then again revealed the left lower lung field densities (Fig. 5). Chest fluoroscopy showed a nonpulsatile 4 × 3.5 cm mass and selective left pulmonary angiography demonstrated a traumatic aneurysm of the superior segmental branch of the lingula artery (Fig. 6). On 5/30/79, the patient was operated on and a 4 cm firm, nonpulsatile mass was palpated in the superior lingular segment and lingulectomy was performed. The findings of the histologic examination of the resected lung were consistent with a false aneurysm of the pulmonary

artery. His postoperative course was complicated by atelectasis, which cleared after vigorous pulmonary physiotherapy and a therapeutic bronchoscopy. The patient was discharged on the seventh postoperative day and since then he has had no difficulty.

Discussion

Pulmonary arteriovenous fistula is usually a relatively rare congenital anomaly associated with hereditary teleangiectasia. Acquired pulmonary arteriovenous fistulas are very rare and are due to metastatic thyroid carcinoma, cirrhosis of the liver, pulmonary schistosomiasis and penetrating lung trauma.^{1,3-5} The latter form is extremely rare and we could find only two cases reported in the English literature.^{1,4} In one case, the diagnosis was made ten years after the chest injury, the arteriovenous fistula was between the right main pulmonary artery and the right superior pulmonary vein and it was treated with division and suture of the fistula. In the other case, the arteriovenous fistula was in the right lower lobe and was diagnosed and treated with a right lower lobectomy, 31 years after the injury.

The clinical manifestations of traumatic arteriovenous fistula are similar to the fistulas that are congenital in origin. Its diagnosis should be suspected in a patient with penetrating injury to the lung with any of these clinical manifestations or when the patient is complaining of dyspnea and has decreased arterial PO_2 , which are unexplained by the chest roentgenographic findings.

Pulmonary intraparenchymal artery aneurysm is also a very rare clinical entity which may be congenital, mycotic, or may be due to syphilis, tuberculosis, and very rarely, to trauma.^{2,6} We could find only five

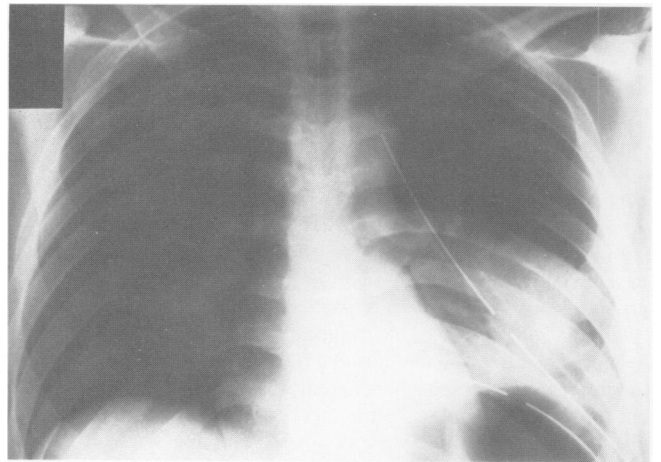


FIG. 3. Chest roentgenogram showing elevation of the left diaphragm and the density in the left lower lung field.

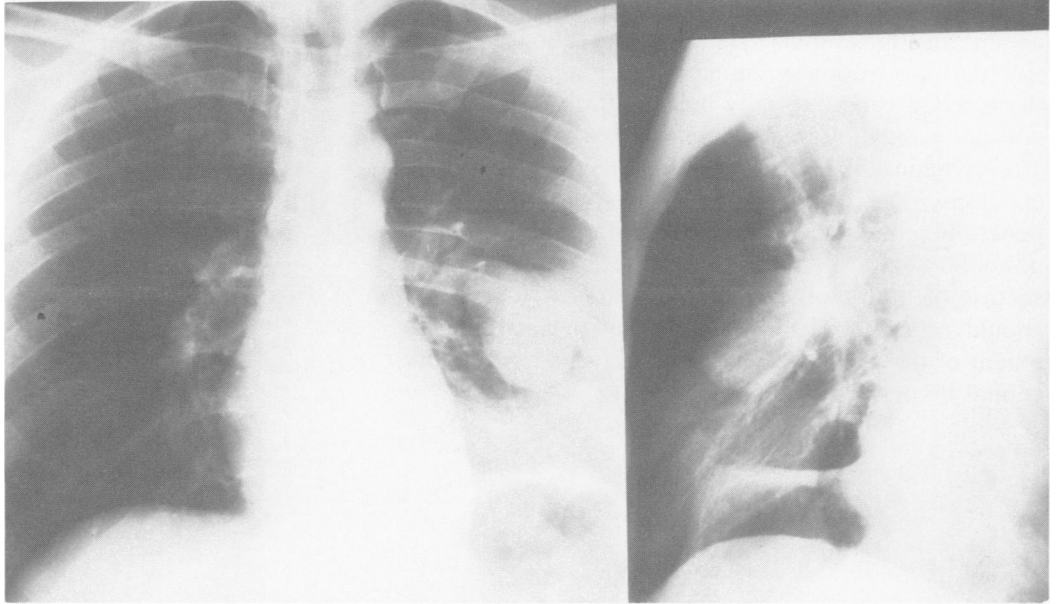


FIG. 4. Chest roentgenogram showing two left lower lung field densities one posteriorly and another in the lingular area.

reported cases in the English literature of the latter variety.⁶ Traumatic pulmonary artery aneurysms may manifest with hemoptysis, dyspnea or chest pain, or they may be asymptomatic. Although they occur very rarely they should always be considered in a patient with a penetrating wound of the lung and a persistent well circumscribed radiodensity in the lung at the site of injury.

The diagnosis of traumatic pulmonary arteriovenous

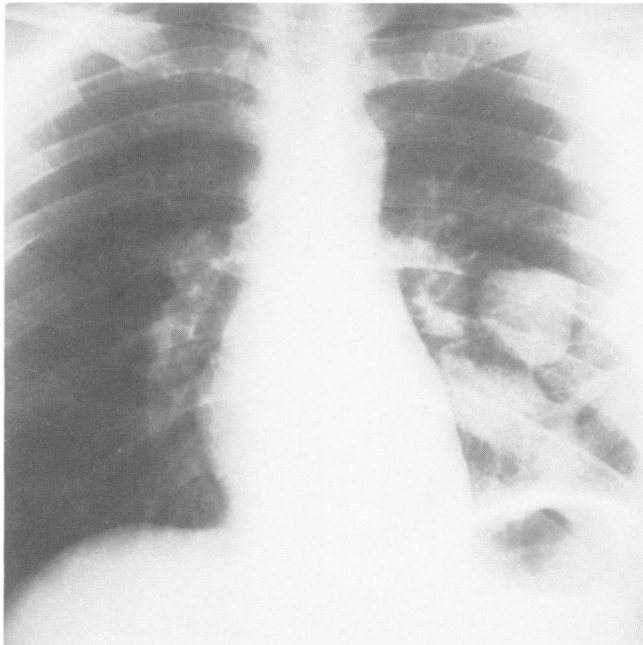


FIG. 5. Chest roentgenogram showing some resolution of the previously noted posterior radiodensity but persistence of the radiodensity in the lingular area.

fistula or pulmonary artery aneurysm can be readily established by pulmonary arteriography.

Although penetrating injury of the lung is very common in war, as well as in peace time, traumatic pulmonary vascular abnormality, *i.e.*, arteriovenous fistula or aneurysm very rarely occur. This may be due, as has been suggested earlier,^{4,6} to the physiologically low pressure differential between the pulmonary artery and vein and the low pulmonary artery pressure. The pulmonary arteriographic abnormalities found in our 22 patients studied within 72 hours after their injury were due to the lack of expansion of the lung secondary to



FIG. 6. Pulmonary arteriogram showing an aneurysm involving the superior segmental branch of the lingular artery.

atelectasis or chest wall splinting rather than to the penetrating lung injury. These observations suggest that the penetrating pulmonary vascular injury, once the bleeding stops, usually heals without residual abnormality and only in extremely rare cases, pulmonary arteriovenous fistula or pulmonary artery aneurysm develops. The treatment for these very rare post-penetrating trauma pulmonary vascular lesions, if at all possible, should be resection of the lesion itself. Resection of the involved lobe with the vascular lesion should be reserved only for the cases in whom the extent of the lesion is such that the former procedure cannot be performed.

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