Angiografia Pulmonar

Dr. Renato Sanchez Antonio

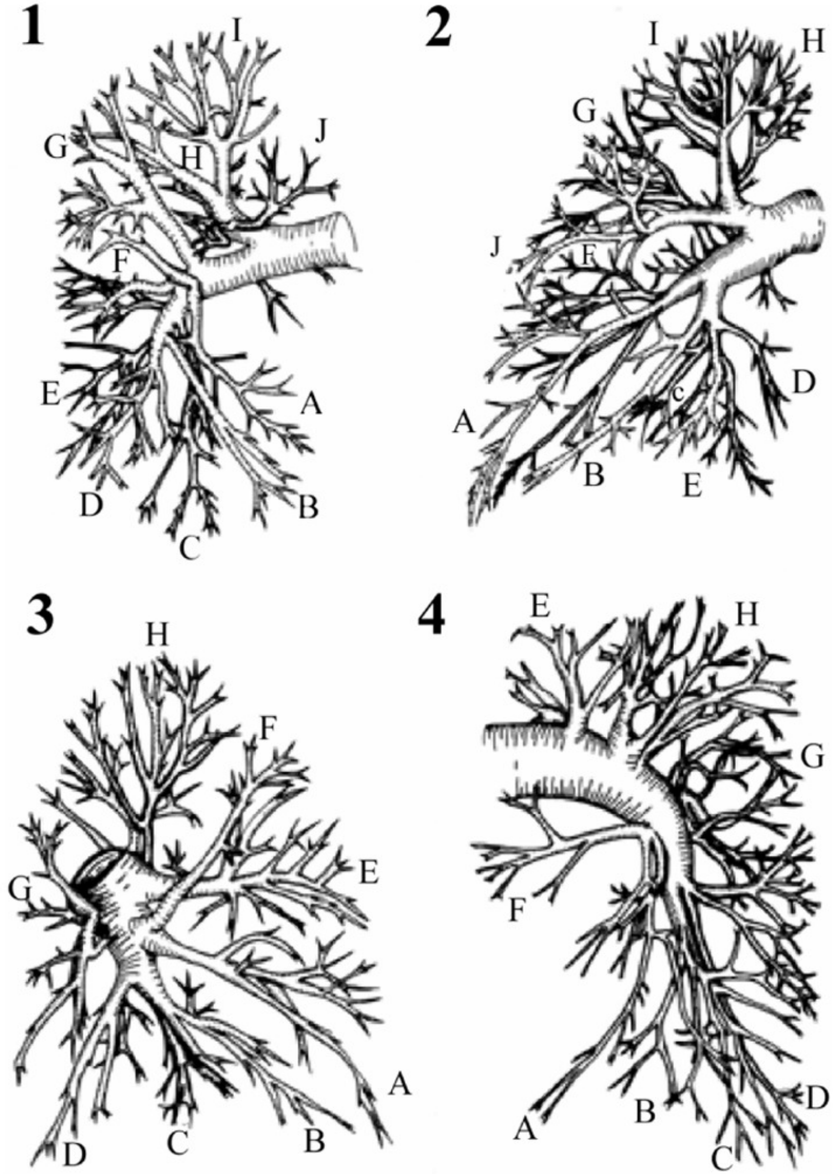


Figure 13.1 Segmental pulmonary arterial anatomy. Right lung, right anterior oblique view **(1)** and left anterior oblique view **(2).** A, right middle lobe medial segmental artery; B, right lower lobe anterior basal segmental artery; C, right lower lobe lateral basal segmental artery; D, right lower lobe posterior basal segmental artery; E, right lower lobe medial basal segmental artery; F, right middle lobe lateral segmental artery; G, right lower lobe superior segmental artery; H, right upper lobe posterior segmental artery; I, right apical segmental artery; J, right upper lobe anterior segmental artery. Left lung, right anterior oblique view **(3)** and left anterior oblique view **(4).** A, lingula, inferior segmental artery; B, left lower lobe anteromedial basal segmental artery; C, left lower lobe lateral basal segmental artery; D, left lower lobe posterior basal segmental artery; E, left upper lobe anterior segmental artery; F, lingula, superior segmental artery; G, left lower lobe superior segmental artery; H, left upper lobe apical-posterior segmental artery. (Reprinted with permission from Kandarpa K, ed. *Handbook of Cardiovascular and Interventional Radiology,* Little Brown and Company, 1988)

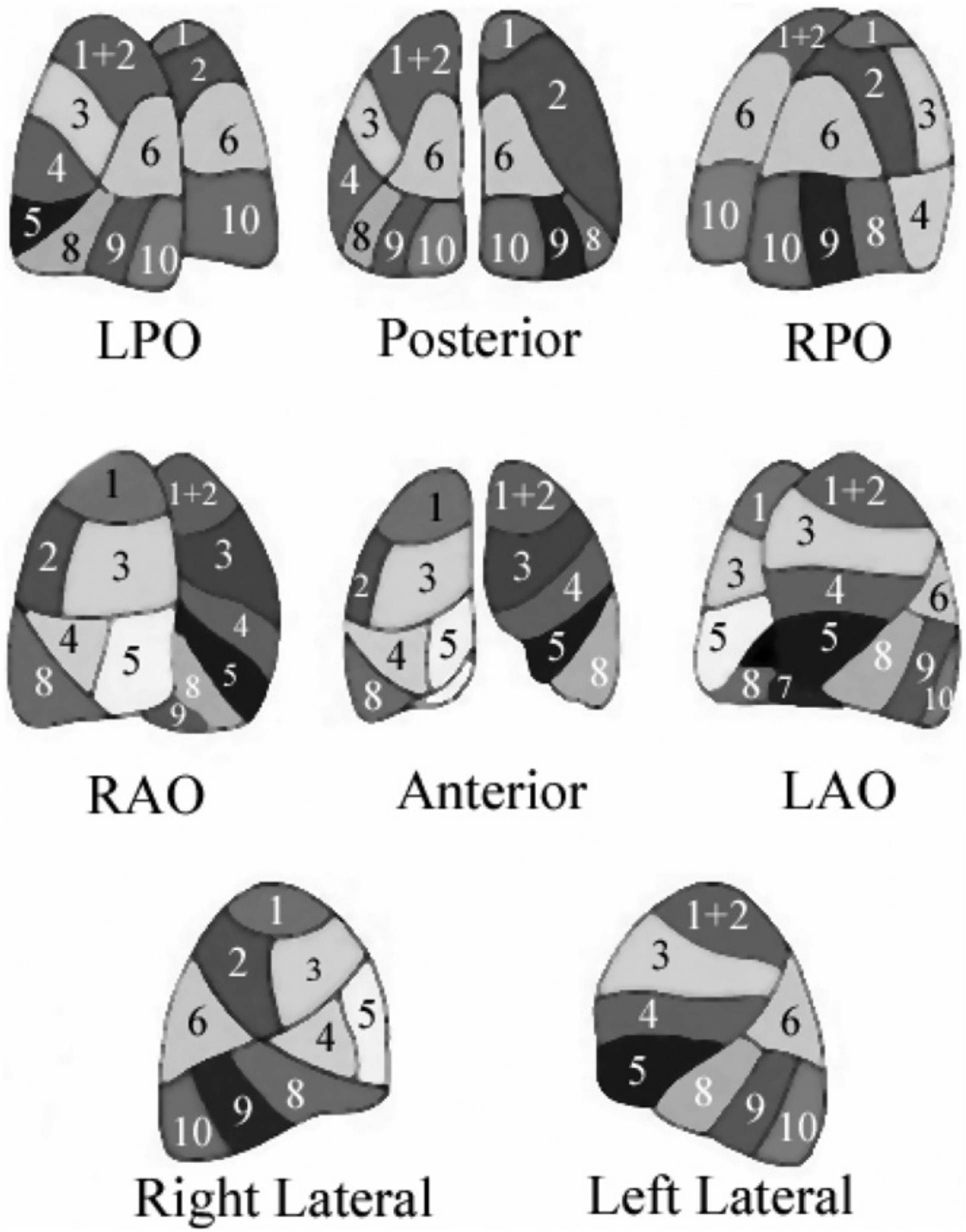


Figure 13.2 Pulmonary artery perfusion segments. **Top.** Left posterior oblique (LPO), posterior, and right posterior oblique (RPO) views. **Center.** Right anterior oblique (RAO), anterior, and left anterior oblique (LAO) views. **Bottom.** Right and left lateral views. Left lung, upper lobe: S1+2, apical posterior; S3, anterior; S4, superior lingular; S5, inferior lingular. Left lung, lower lobe: S6, superior; S8, anterior medial basal; S9, lateral basal; S10, posterior basal. Right lung, upper lobe: S1, apical; S2, posterior; S3, anterior. Right lung, middle lobe: S4, lateral; S5, medial. Right lung, lower lobe: S6, superior; S7, medial basal; S8, anterior basal; S9, lateral basal; S10, posterior basal.

Indicações

- Excluir ou confirmar embolia pulmonar
- Estenose de tronco pulmonar ou malformação arteriovenosa (shunt direita-esquerda)
- Tratamento dos shunts com material trombogênico
- Ressecção de blebs

Indicações

- Implantar tronco ou balão de oclusão pulmonar em pequenas artérias hipertróficas para reverter reações pulmonares devido as doenças congênitas
- Confirmar mixoma atrial
- Inserção anômala de veias pulmonares
- Choque cardiogênico por cor pulmonale para embolectomia

Indicações

- Auxiliar no diagnóstico diferencial para outras causas de choque (hemorragia, sepse, IAM)
- Identificar causas de alteração de ventilação-perfusão do parênquima pulmonar (pneumonia, atelectasia)

Contraindicações

- Reação alérgica ao contraste (relativa)
- Realizar muitas vezes é melhor do que tratar EP empiricamente

Complicações

- Complicações de CATE direita (perfuração cardíaca, arritmias) ou reações ao contraste (hipotensão, edema pulmonar), diurese osmótica
- Complicações pulmonares com injeções que excedem 25-30 ml

Avaliações hemodinâmicas

- Medida das pressões, coleta de gasometrias associados aos dados antropométricos permitem avaliar débito cardíaco, tipo de choque e auxiliar no tratamento
- Causas: depressão do VE, tamponamento cardíaco, pericardite constritiva e cor pulmonale secundário a DPOC

Acesso Vascular

- Via braquial
- Veia subclávia, jugular interna e femoral por punção percutânea devem ser utilizadas com cautela devido a presença de trombos nesses vasos ou em pacientes que fizeram trombólise química e uso de anticoagulantes podendo haver risco de sangramento

Técnica

- Fluxo 10-20 ml/seg (5-8 F), volume 20-40 ml
- Eppendorf, Berman, Grollman
- Para regular a angiografia pulmonar, o cateter é normalmente posicionado na artéria com a sua ponta de 1 a 2 cm proximal à saída do lobo superior do ramo da artéria pulmonar direita e 1 a 2 cm distais à origem da artéria pulmonar direita

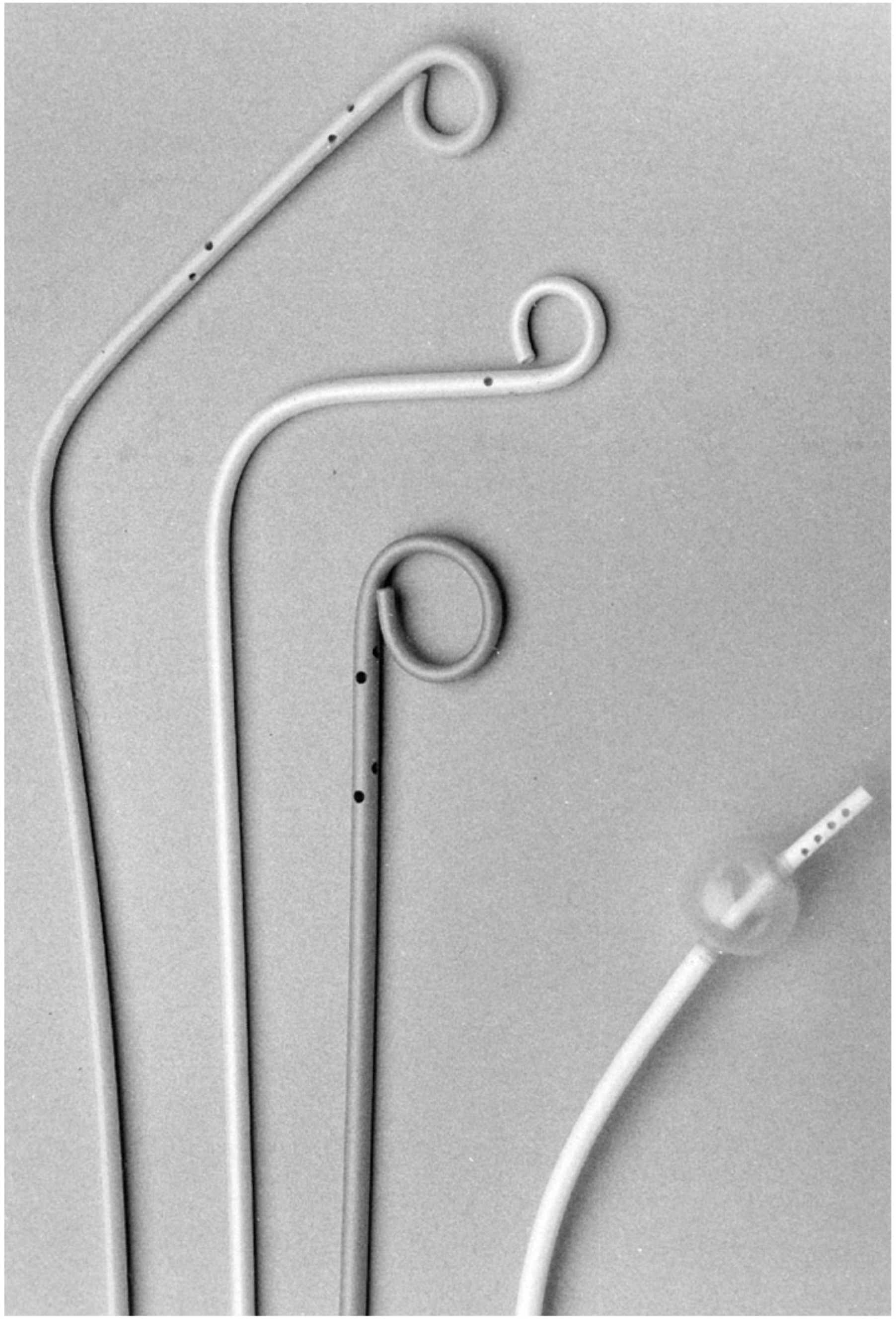


Figure 13.4 Catheters for pulmonary angiography. **Left to right.** Nyman, Grollman, and straight pigtail catheters (Eppendorf type), and the balloon occlusion catheter with side holes distal to the balloon (Berman type).

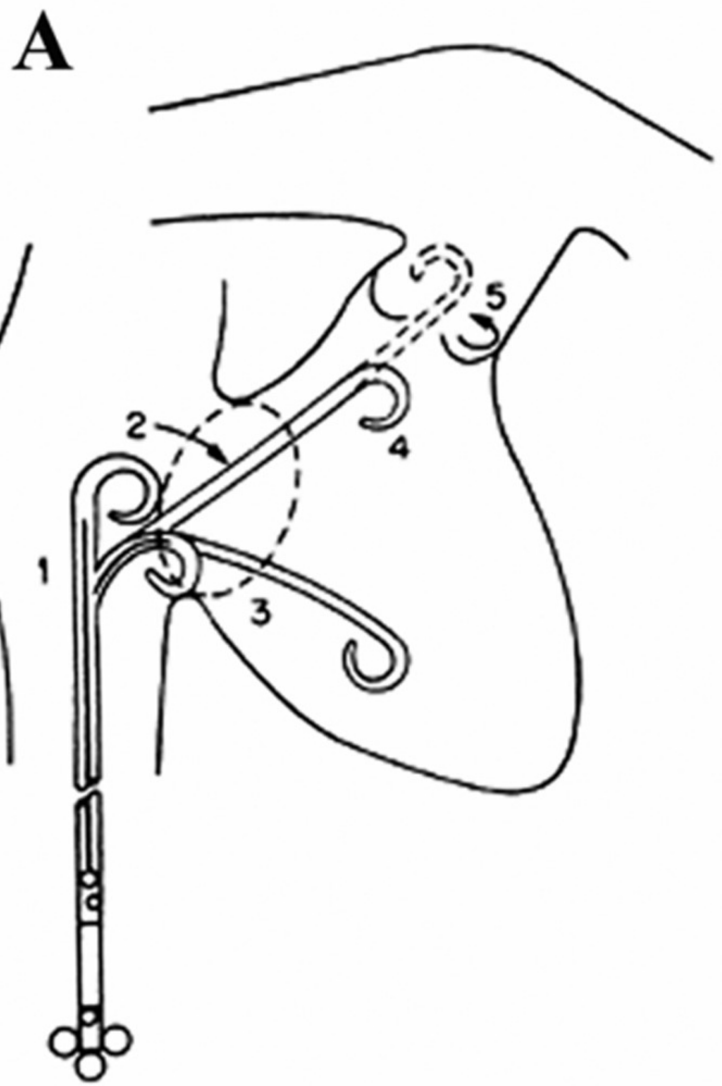


Figure 13.3A Techniques for pulmonary artery catheterization. **A.** Straight body pigtail catheter and tip-deflecting wire. The pigtail catheter is placed in the right atrium (1). The wire is deflected to point toward the right ventricle (2). The wire is fixed, and the catheter is advanced over it into the right ventricle (3). The tip deflection is released (4). Counterclockwise rotation of the catheter swings the pigtail anteriorly (5). Simultaneous advancement of the catheter places it into the main pulmonary artery. Advancing the catheter farther usually takes it into the left main pulmonary artery. The tip-deflecting wire is used to direct the catheter downward and to the right for right main pulmonary artery catheterization. **B.** Grollman pulmonary artery catheter. The pigtail catheter is placed in the right atrium (1). The anteromedial portion of the right atrium is probed to facilitate catheter entry into the right ventricle (2). The catheter is then slightly withdrawn and rotated counterclockwise to allow entry into the right ventricular outflow tract and main pulmonary artery (3). **C.** Balloon-tipped catheter. The balloon is inflated under fluoroscopic guidance in the common iliac vein, and the catheter is advanced under observation into the right atrium (1). The catheter is then rotated anteromedially to facilitate direct entry into the right ventricle (2). As soon the tricuspid valve is passed, documented by a right ventricular pressure waveform, the catheter is rotated to point the balloon tip cranially toward the right ventricular outflow tract before advancing it farther (3). Deep inspiration of the patient may facilitate flow-directed entry of the balloon tip from the outflow tract into the main pulmonary artery, with a preference to enter the left pulmonary artery.

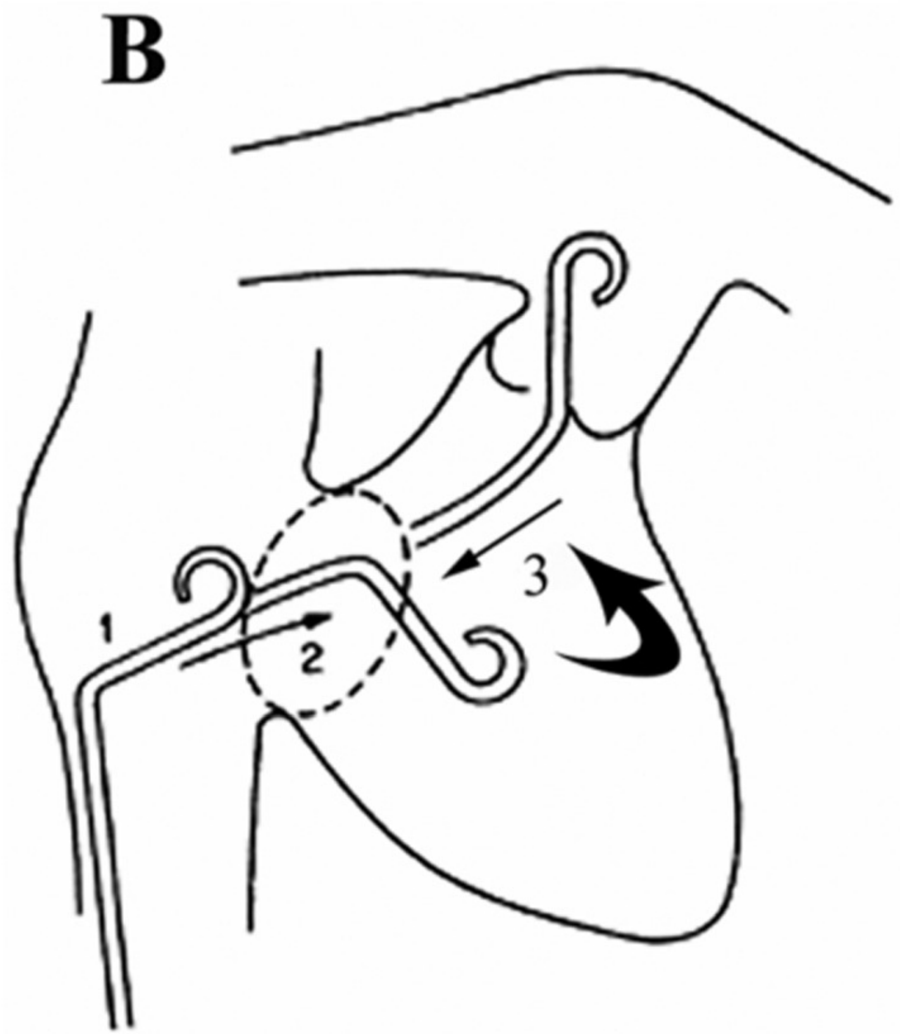


Figure 13.3B Techniques for pulmonary artery catheterization. **A.** Straight body pigtail catheter and tip-deflecting wire. The pigtail catheter is placed in the right atrium (1). The wire is deflected to point toward the right ventricle (2). The wire is fixed, and the catheter is advanced over it into the right ventricle (3). The tip deflection is released (4). Counterclockwise rotation of the catheter swings the pigtail anteriorly (5). Simultaneous advancement of the catheter places it into the main pulmonary artery. Advancing the catheter farther usually takes it into the left main pulmonary artery. The tip-deflecting wire is used to direct the catheter downward and to the right for right main pulmonary artery catheterization. **B.** Grollman pulmonary artery catheter. The pigtail catheter is placed in the right atrium (1). The anteromedial portion of the right atrium is probed to facilitate catheter entry into the right ventricle (2). The catheter is then slightly withdrawn and rotated counterclockwise to allow entry into the right ventricular outflow tract and main pulmonary artery (3). **C.** Balloon-tipped catheter. The balloon is inflated under fluoroscopic guidance in the common iliac vein, and the catheter is advanced under observation into the right atrium (1). The catheter is then rotated anteromedially to facilitate direct entry into the right ventricle (2). As soon the tricuspid valve is passed, documented by a right ventricular pressure waveform, the catheter is rotated to point the balloon tip cranially toward the right ventricular outflow tract before advancing it farther (3). Deep inspiration of the patient may facilitate flow-directed entry of the balloon tip from the outflow tract into the main pulmonary artery, with a preference to enter the left pulmonary artery.

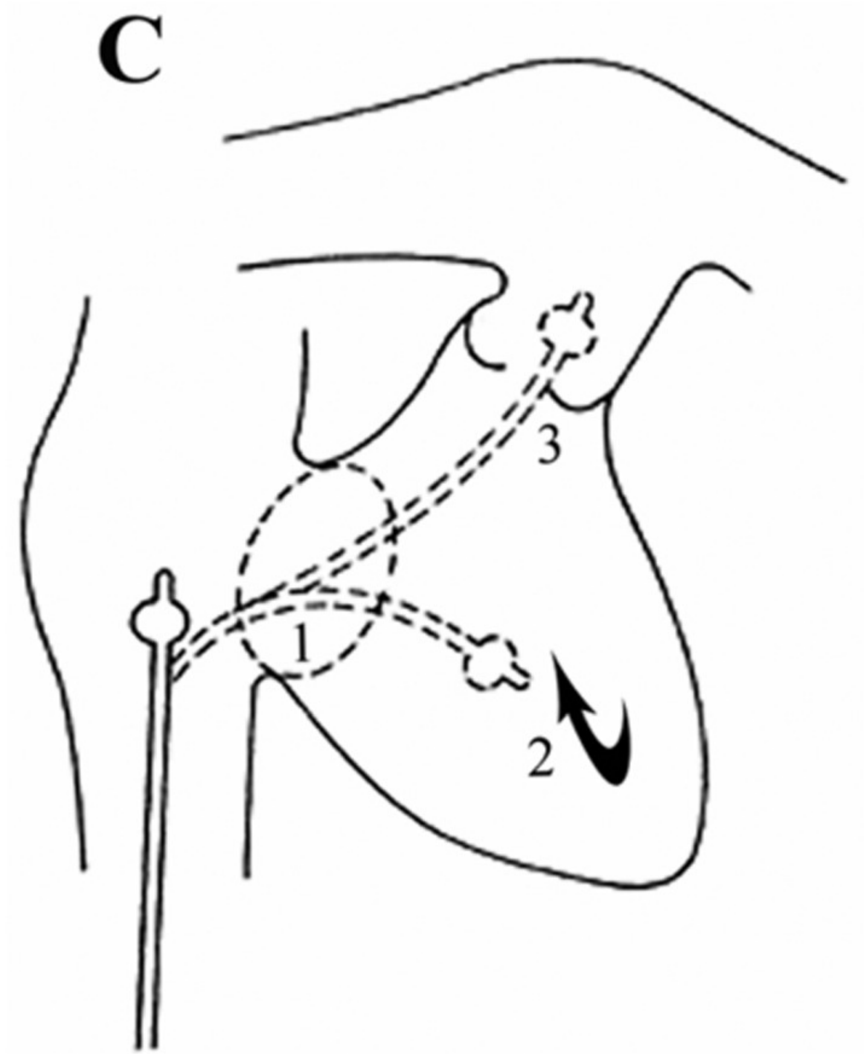
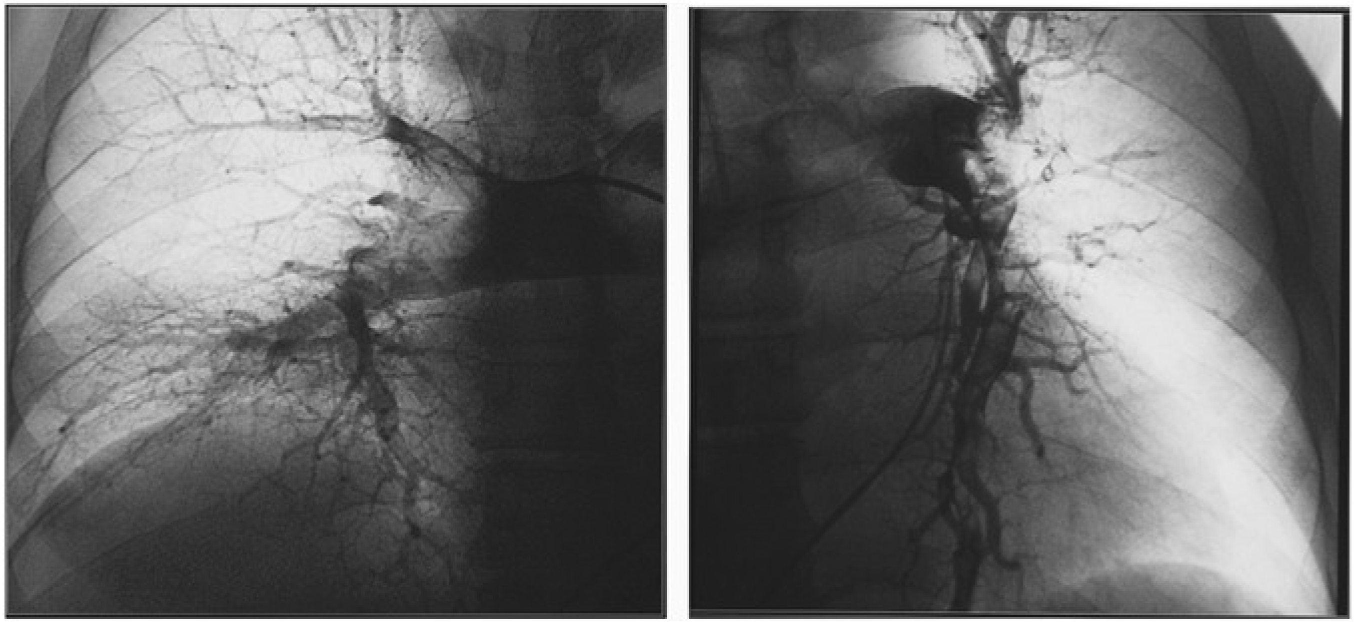


Figure 13.3C Techniques for pulmonary artery catheterization. **A.** Straight body pigtail catheter and tip-deflecting wire. The pigtail catheter is placed in the right atrium (1). The wire is deflected to point toward the right ventricle (2). The wire is fixed, and the catheter is advanced over it into the right ventricle (3). The tip deflection is released (4). Counterclockwise rotation of the catheter swings the pigtail anteriorly (5). Simultaneous advancement of the catheter places it into the main pulmonary artery. Advancing the catheter farther usually takes it into the left main pulmonary artery. The tip-deflecting wire is used to direct the catheter downward and to the right for right main pulmonary artery catheterization. **B.** Grollman pulmonary artery catheter. The pigtail catheter is placed in the right atrium (1). The anteromedial portion of the right atrium is probed to facilitate catheter entry into the right ventricle (2). The catheter is then slightly withdrawn and rotated counterclockwise to allow entry into the right ventricular outflow tract and main pulmonary artery (3). **C.** Balloon-tipped catheter. The balloon is inflated under fluoroscopic guidance in the common iliac vein, and the catheter is advanced under observation into the right atrium (1). The catheter is then rotated anteromedially to facilitate direct entry into the right ventricle (2). As soon the tricuspid valve is passed, documented by a right ventricular pressure waveform, the catheter is rotated to point the balloon tip cranially toward the right ventricular outflow tract before advancing it farther (3). Deep inspiration of the patient may facilitate flow-directed entry of the balloon tip from the outflow tract into the main pulmonary artery, with a preference to enter the left pulmonary artery.

Filmagem

- **Método Filme Grande**
- - porcentagem da obstrução vascular
- **Cineangiografia Pulmonar**
- -análise dinâmica (utilização de balão-oclusão)
- - áreas de oligoemia
- - análise seletiva
- - injeções que excedem PCP>20, causam infiltrado pulmonar



A B

Figure 13.9 Selective cut-film angiograms in a 65-year-old man with recurrent attacks of dyspnea and syncope who presented with preserved systemic arterial pressure and right ventricular dysfunction on the echocardiogram. The angiogram demonstrates extensive intraluminal filling defects in both pulmonary arteries.

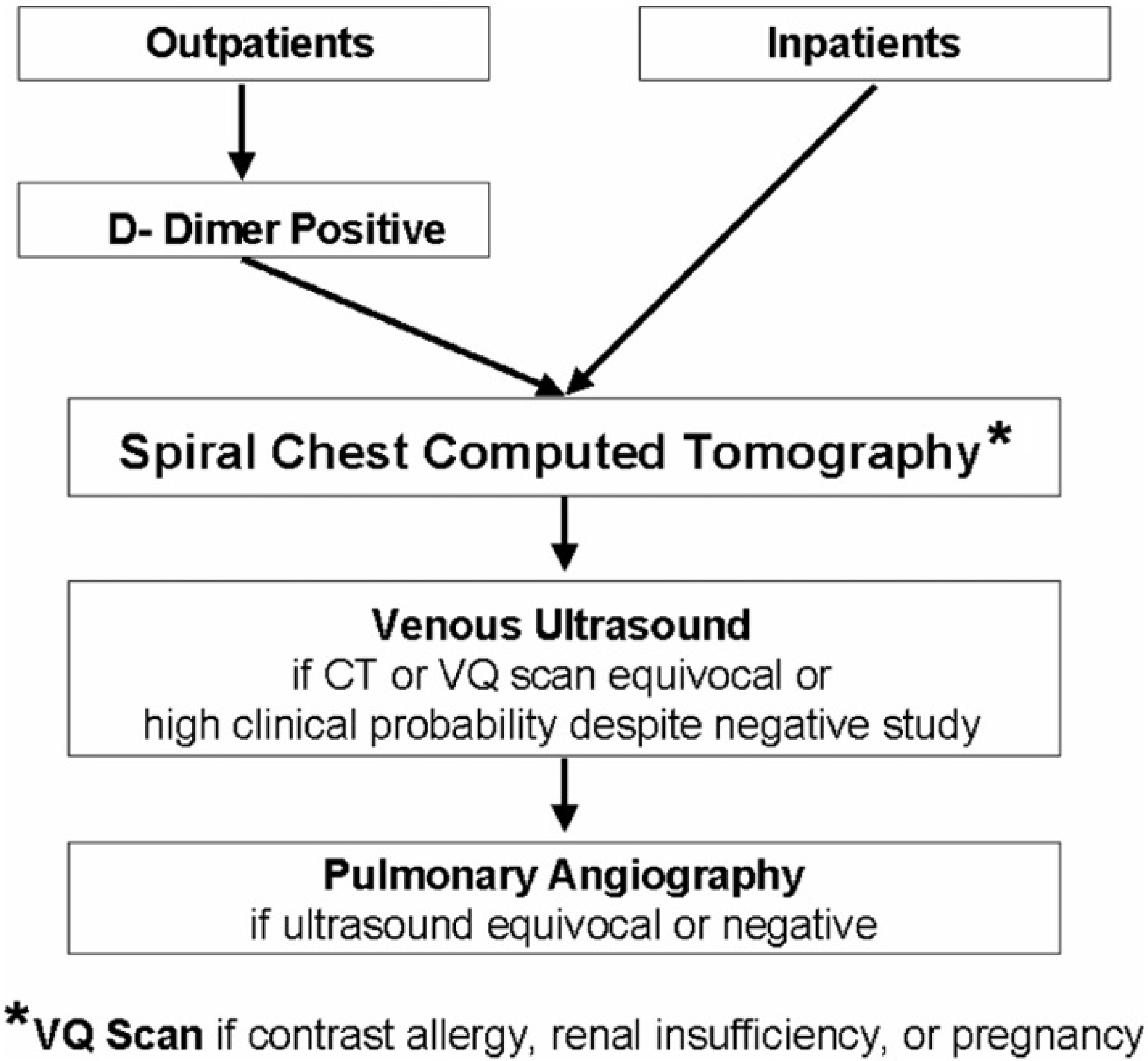


Figure 13.6 Suggested diagnostic strategy for patients with suspected pulmonary embolism without cardiogenic shock. VQ, ventilation perfusion.

Figure 13.5 Contrast enhanced multirow (16-slice) detector chest CT in a patient with acute pulmonary embolism. In the coronal reconstructed view, multiple segmental emboli can be visualized *(arrows)*. (Figure kindly provided by Joseph Schoepf, MD, Department of Radiology, Brigham and Women's Hospital, Boston, MA.)

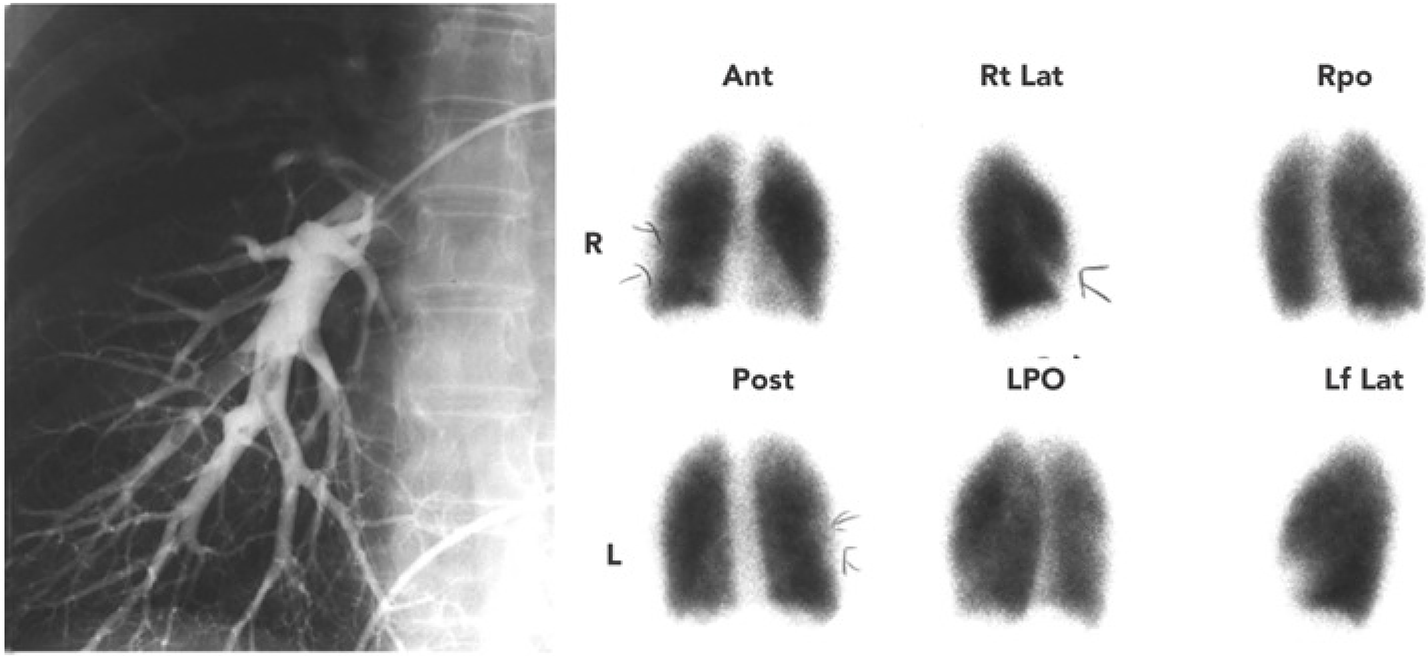


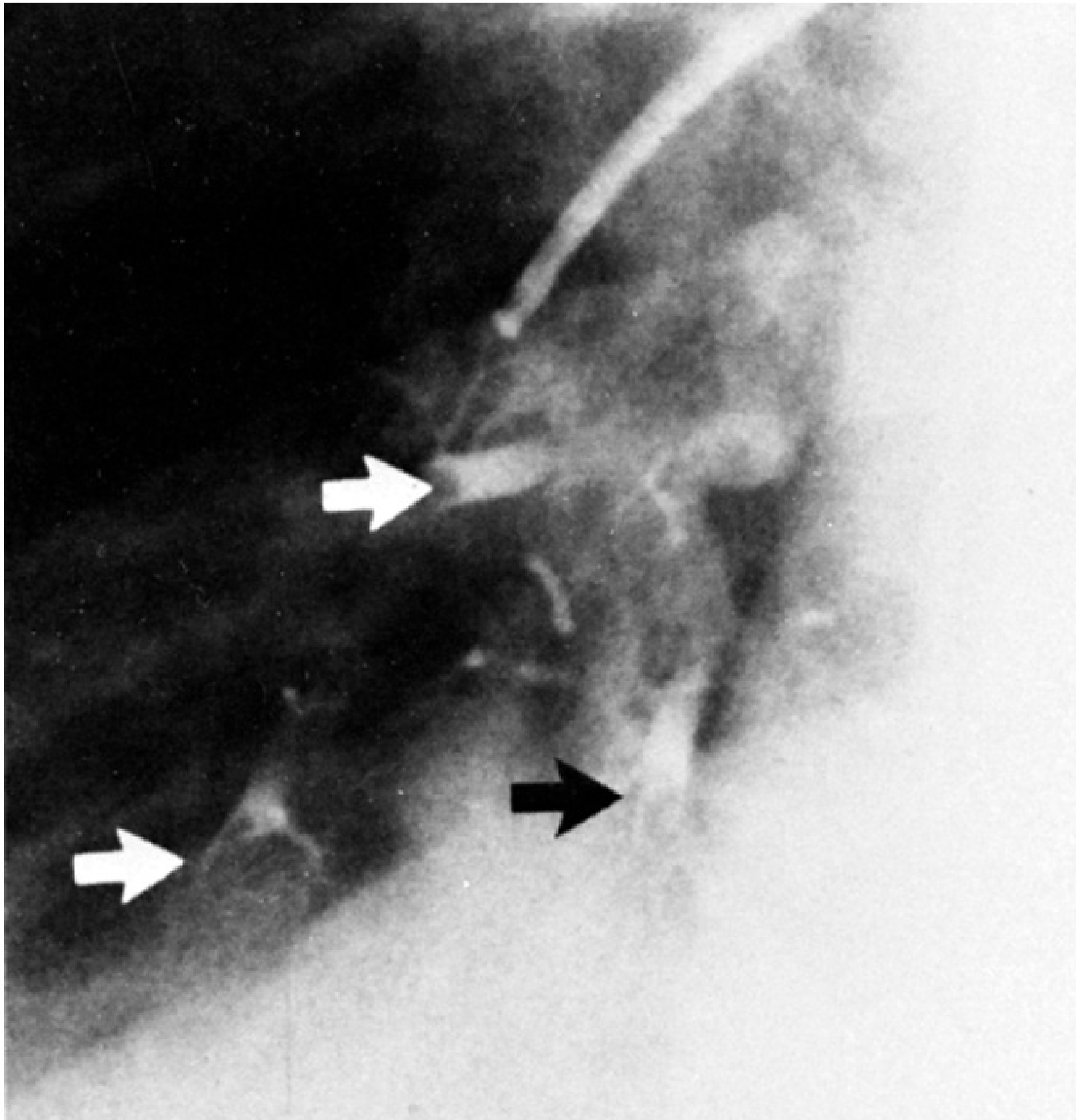
Figure 13.7 Primary evidence of acute pulmonary embolism. Selective cut-film angiogram of the right lower lobe pulmonary artery with multiple intraluminal radiolucencies, almost completely outlined by contrast **(left)**. Corresponding segmental perfusion defects of the right lower lobe **(right)**.

Diagnóstico Angiográfico de Embolia Pulmonar

- Angiografia normal contraste flui simetricamente do seu local de entrada proximal uniformemente para preencher vasos de segunda, terceira e quarta ordem que se tornaram progressivamente menores em calibre
- Embolia incluem defeitos de enchimento intraluminal e cortes abruptos dos vasos

Diagnóstico Angiográfico de Embolia Pulmonar

- Quando o contraste flui lentamente sobre o perímetro de um êmbolo quase completamente oclusivo na artéria lobar ou segmentar dando origem a "ferrovia", o diagnóstico de embolia pulmonar pode ser feito com um elevado grau de confiança



B

Figure 13.8B A. Right lower lobe balloon occlusion pulmonary cineangiogram demonstrates multiple vessels "cut off" *(arrows)*. **B.** Balloon deflation facilitated distal contrast distribution, with a visible trailing edge of a thrombus *(arrows)*.

Achados Hemodinâmicos na Embolia Pulmonar

- Depende da extensão do comprometimento pulmonar vascular transversal por material embólico e do estado cardiopulmonar do paciente
- Pós-carga oposta de ejeção do ventrículo direito aumenta a tensão da parede gerando dificuldades para ejetar seu volume sistólico
- Caso ausência de doença pulmonar ou cardíaca (PMAP>25 mmgh)
- Comprometimento de VD pressões de 35-45 mmHg

Achados Hemodinâmicos na Embolia Pulmonar

- Aumento da resistência vascular sistêmica e FC
- Vasodilatação venosa e aumento da pressão no AD
- Evolução para *Cor Pulmonale* e falência de VD
- Pacientes crônicos toleram de pressão pulmonar maiores

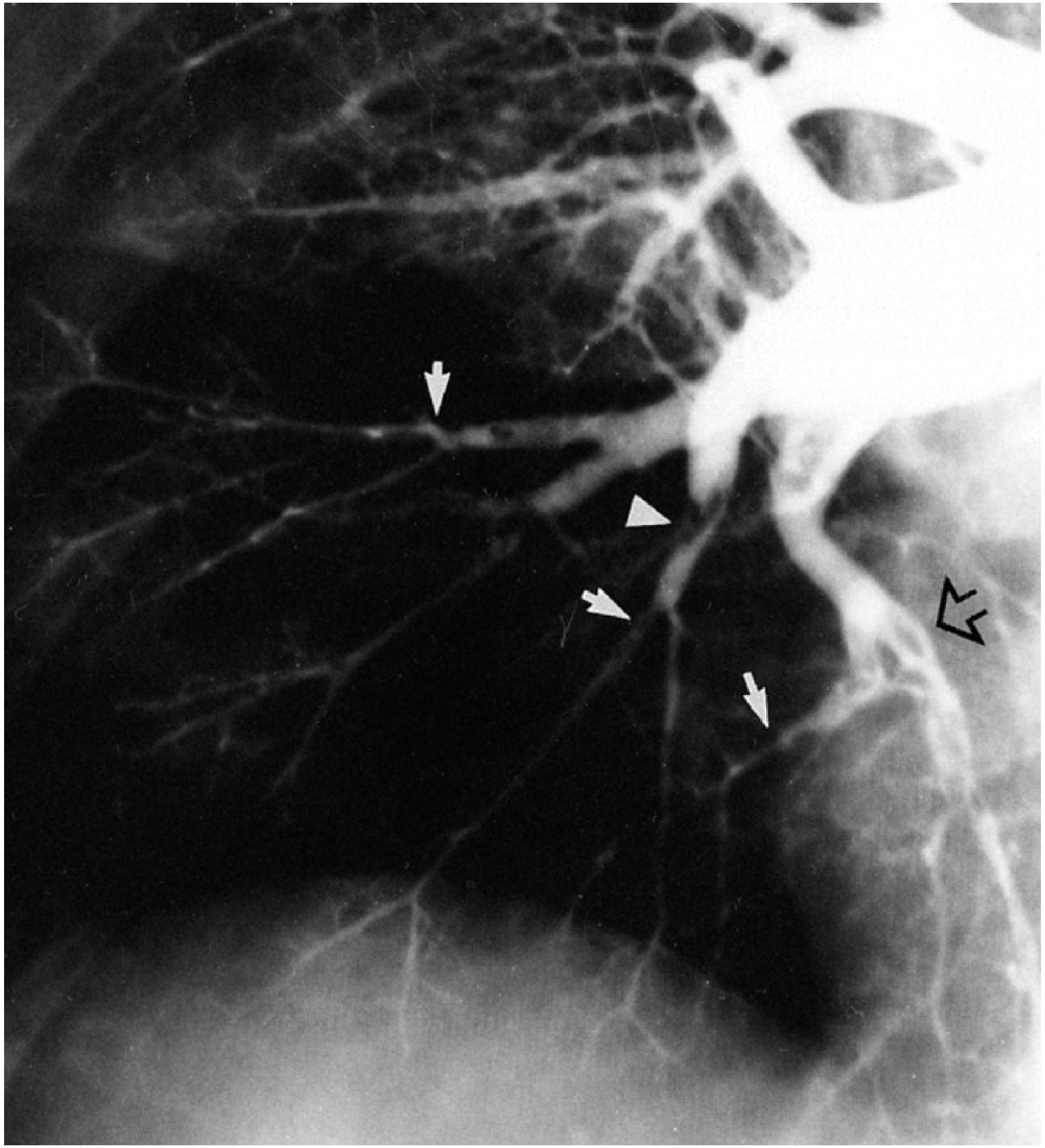


Figure 13.14 Chronic pulmonary thromboembolism. Frontal view of right pulmonary angiogram in a 42-year-old female still dyspneic after an acute pulmonary embolus was documented 6 months earlier and treated. The proximal pulmonary arteries are dilated. The distal vessels taper rapidly and are irregular *(arrows)*. Eccentric stenoses are present *(arrowheads)*, as are intraluminal webs *(open arrow)*.

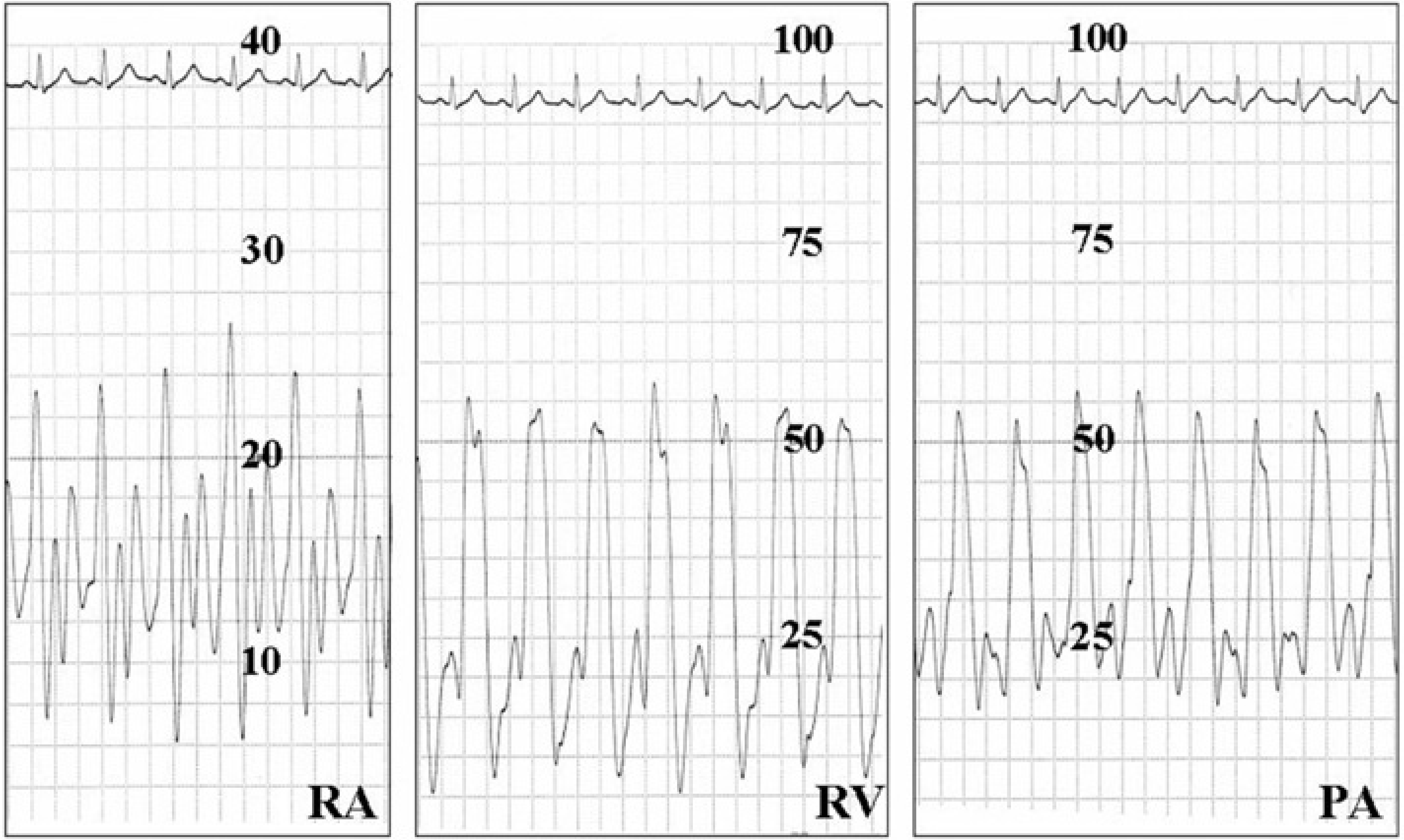


Figure 13.10 Right heart pressure tracings in the patient with acute pulmonary embolism from Fig. 13.9. RA, right atrium; RV, right ventricle; PA, pulmonary artery.

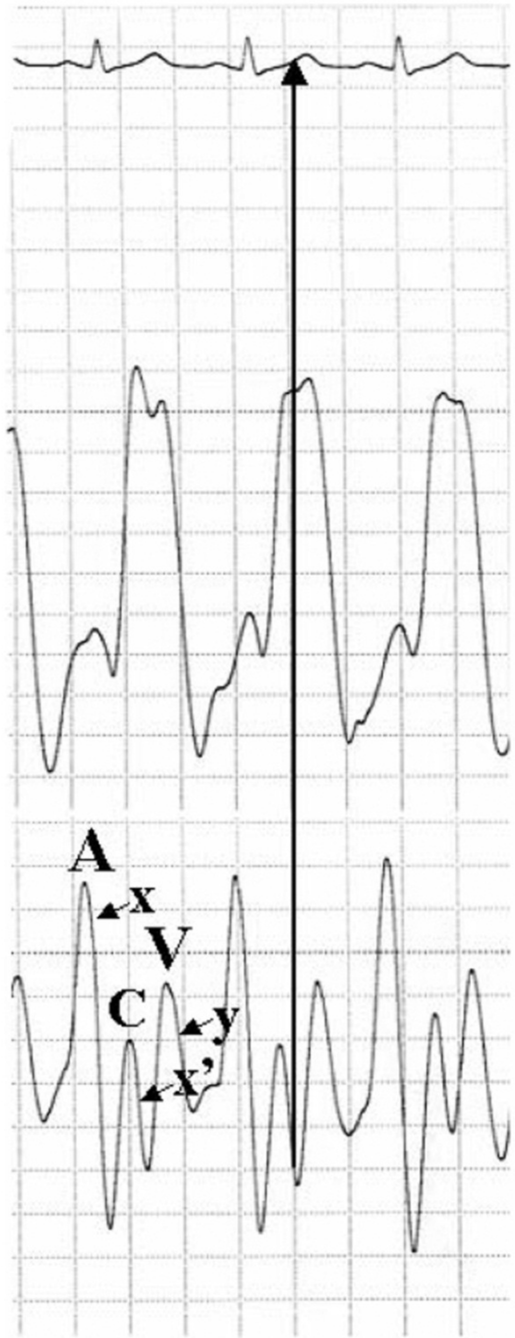


Figure 13.11 Simultaneous right atrial *(lower tracing)* and right ventricular *(upper tracing)* pressure curves from the patient with acute pulmonary embolism from Fig. 13.9. The atrial A wave is most prominent and coincides with the rapid rise in right ventricular diastolic pressure. The C wave is smaller than the V wave and coincides with the rapid rise in systolic right ventricular pressure. The nadir of the prominent right atrial x-descent coincides with systolic peak right ventricular pressure just before the beginning of the T wave *(arrow)*. The nadir of the y-descent coincides with the dip in right ventricular diastolic pressure.

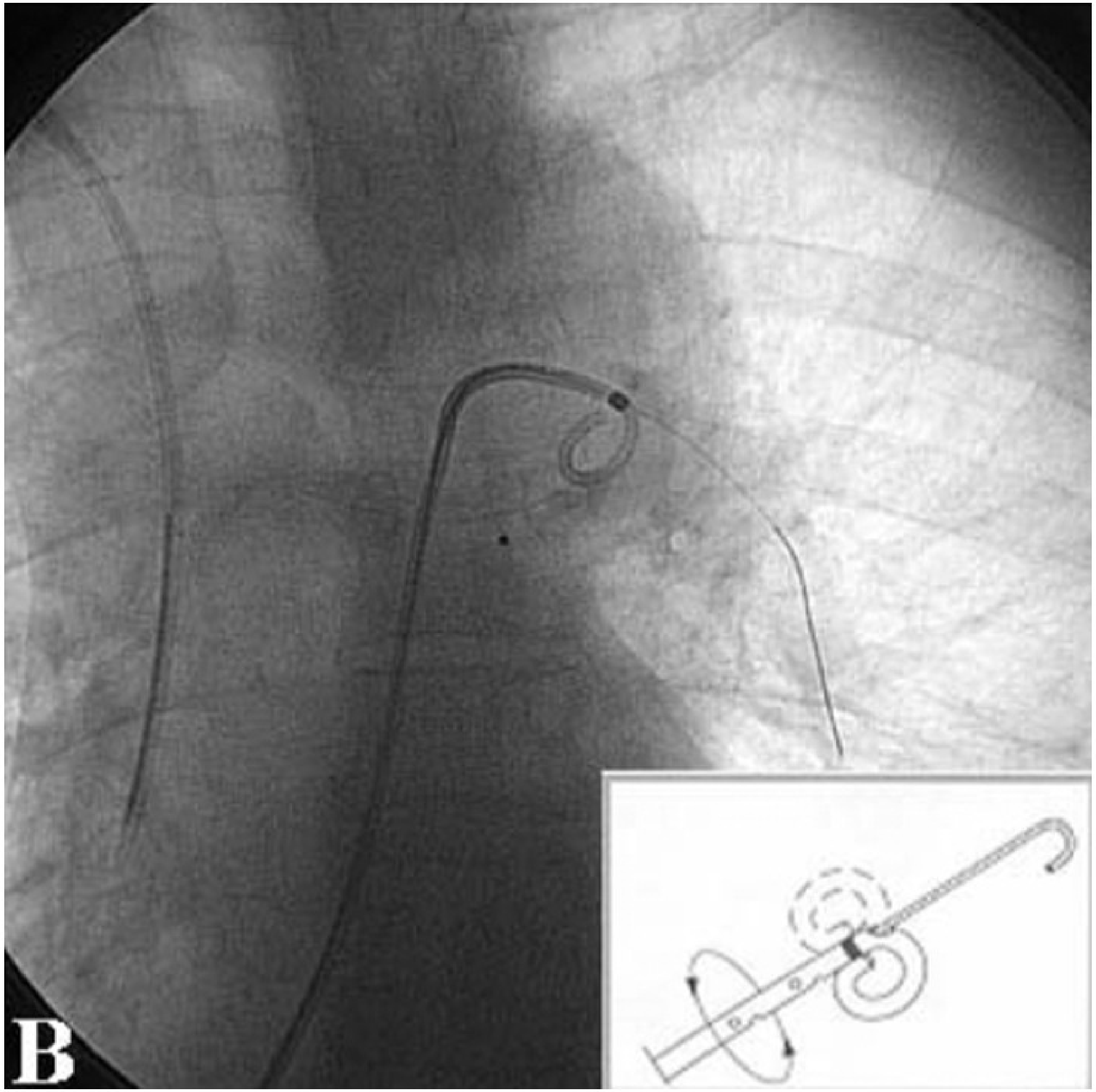


Figure 13.12B Catheter fragmentation in combination with a continuous systemic infusion of 100 mg alteplase over 2 hours in a 64-year-old female with massive pulmonary embolism and cardiogenic shock. **A.** Frontal view demonstrating subtotal filling defects in both main pulmonary arteries. **B.** Catheter thrombus fragmentation in the left pulmonary artery (pars superior) using a pigtail rotational catheter. **C.** Following catheter fragmentation, improved flow in the left upper lobe pulmonary arteries *(arrow)* was accompanied by a prompt increase in systemic arterial pressure from 70 mm Hg to 95 mm Hg. **D.** Lateral view demonstrating a significant proximal stenosis of the right coronary artery approximately 7 seconds after nonselective injection of 40 mL contrast into the main pulmonary artery *(arrow)*.

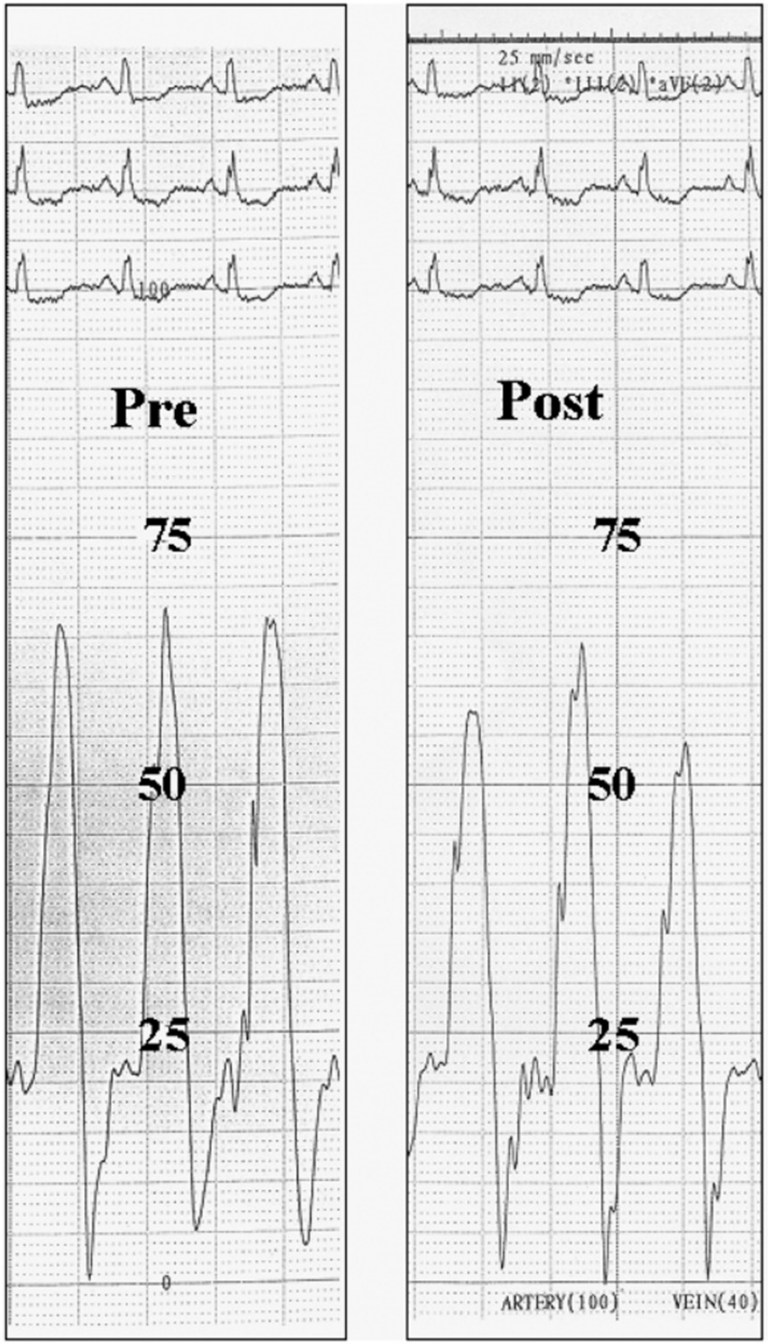
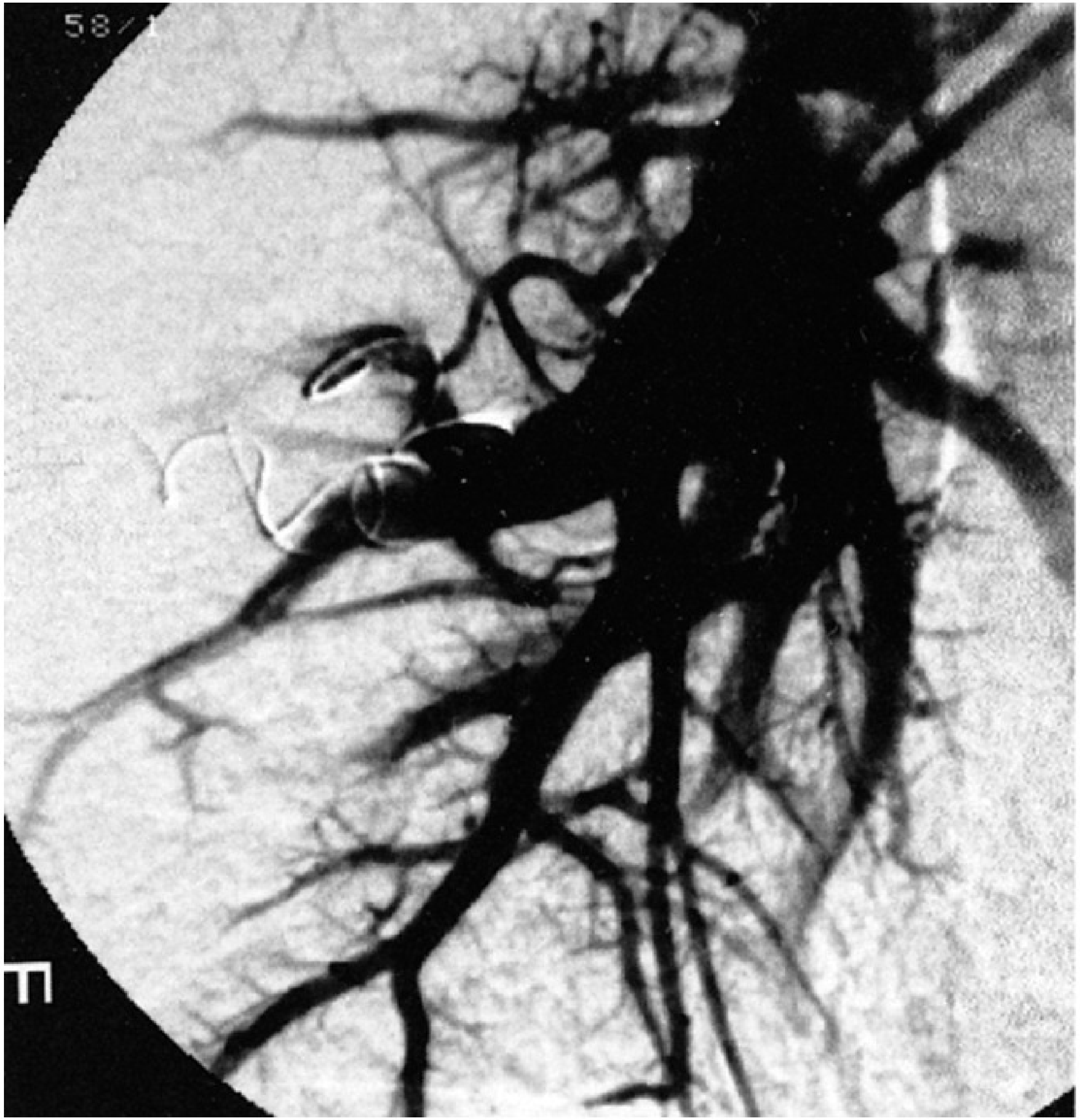


Figure 13.13 Right ventricular pressure curves pre and post catheter fragmentation in the patient from Fig. 13.12. Despite rapid clinical improvement, there was only a mild decrease in right ventricular systolic pressure following catheter fragmentation.



B

Figure 13.17B Pulmonary arteriovenous malformation with percutaneous embolization. **A.** Digital image displaying Amplatz spider vascular occlusion device *(arrows)* trailed by multiple coils. **B.** Right pulmonary angiogram confirms occlusion of the fistula.

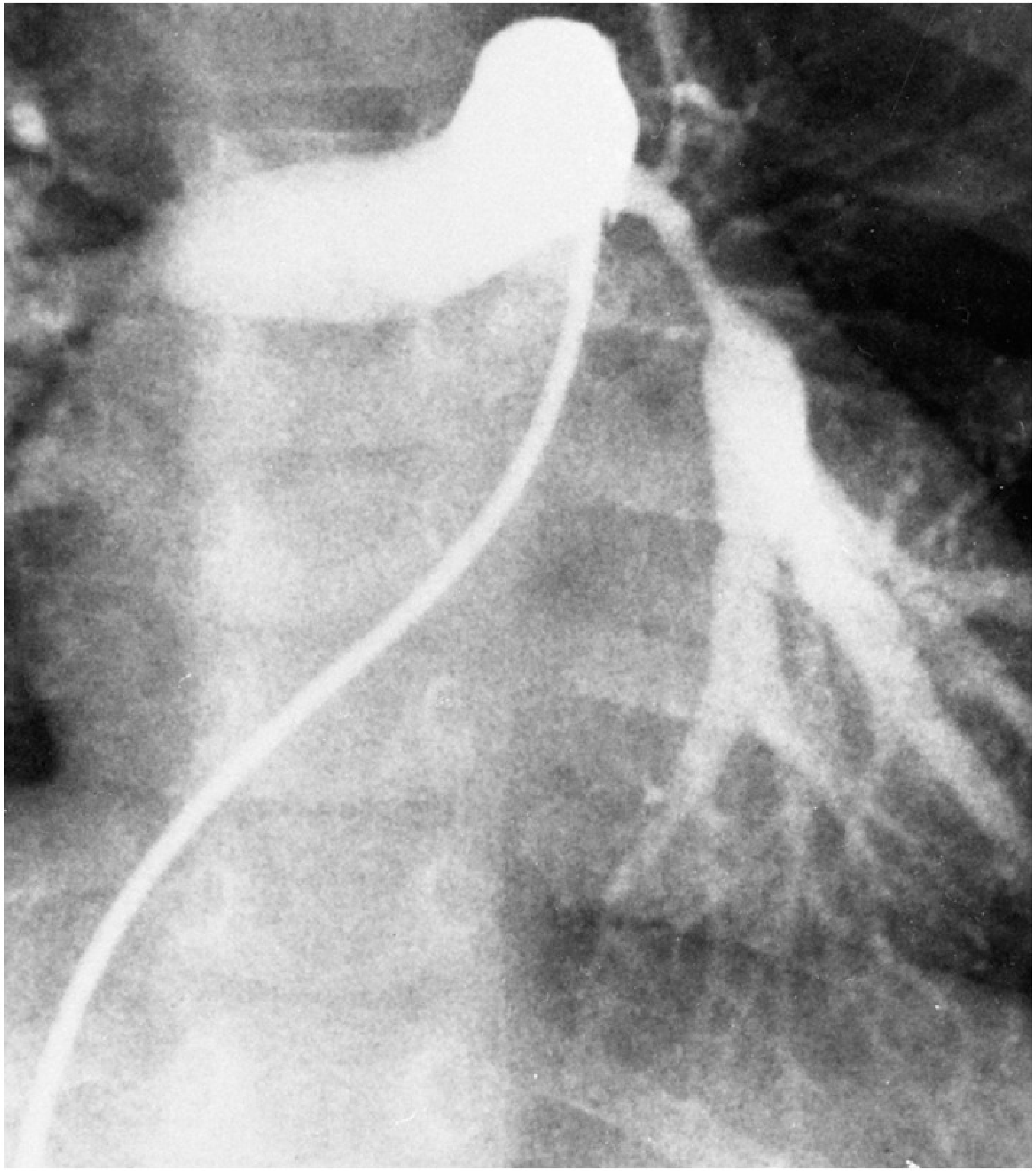


Figure 13.18 Left interlobar pulmonary artery stenosis. Left pulmonary angiogram of isolated pulmonary arterial stenosis in an adolescent male.

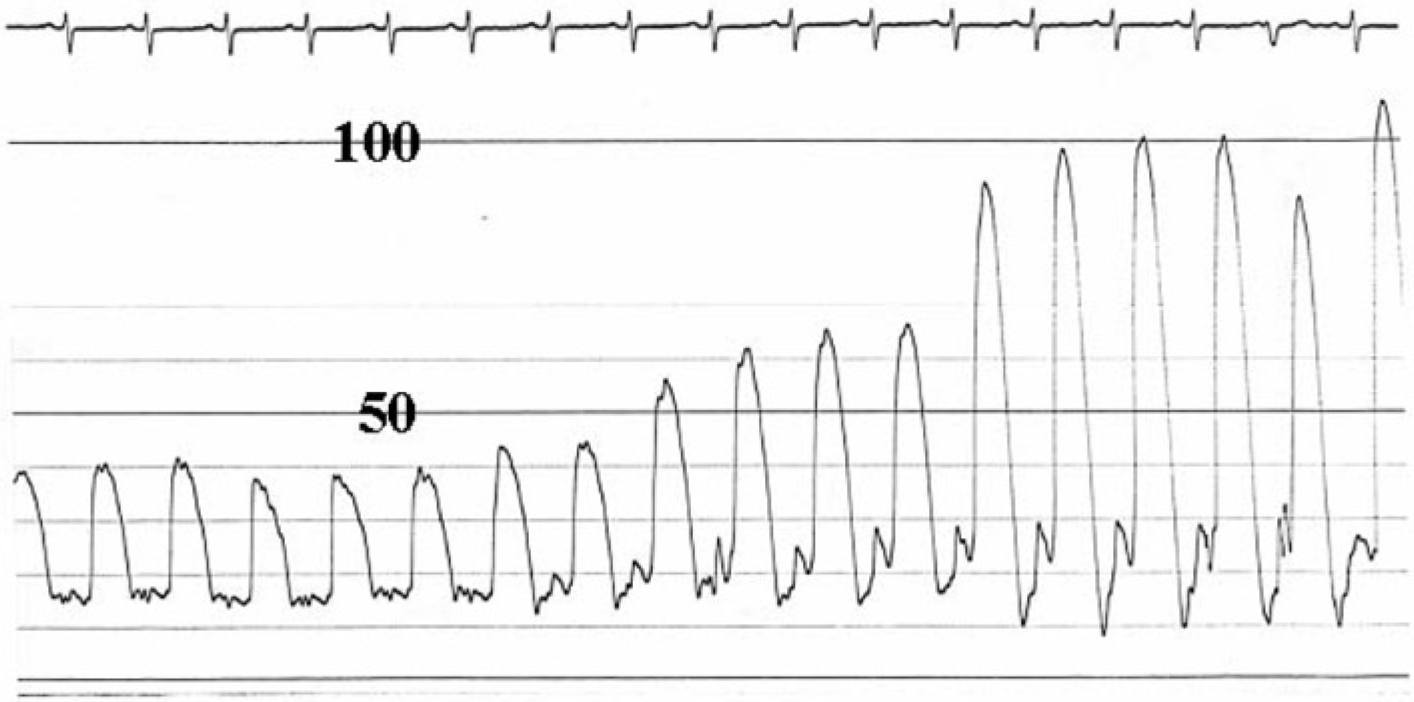


Figure 13.20 Pulmonary artery pressure tracing from the patient in Fig. 13.19. During catheter withdrawal from the left into the main pulmonary artery trunk, hemodynamic significance of the stenosis was confirmed. (Courtesy of Richard Baum, MD, Department of Radiology, Brigham and Women's Hospital, Boston, MA.)