

LORD BROCK *ET AL.*: CASE OF LATE PULMONARY EMBOLECTOMY

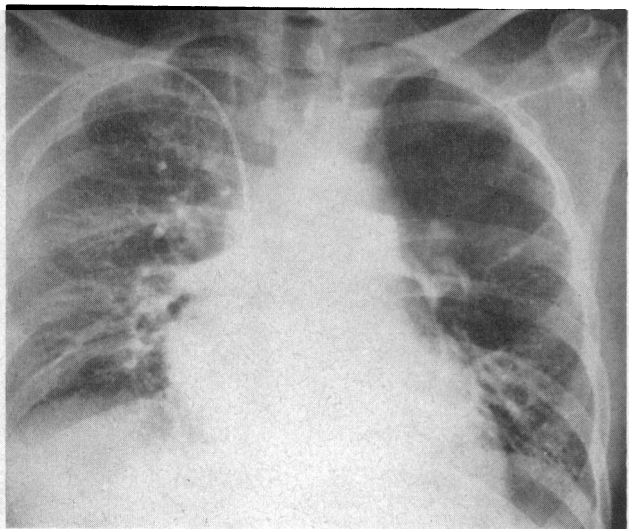


FIG. 1.—Angiocardiogram to show occlusion of main left pulmonary artery by an embolus. The small amount of lower lobe filling may be via bronchopulmonary anastomoses. A few small arterial branches in right lung are also not filled.

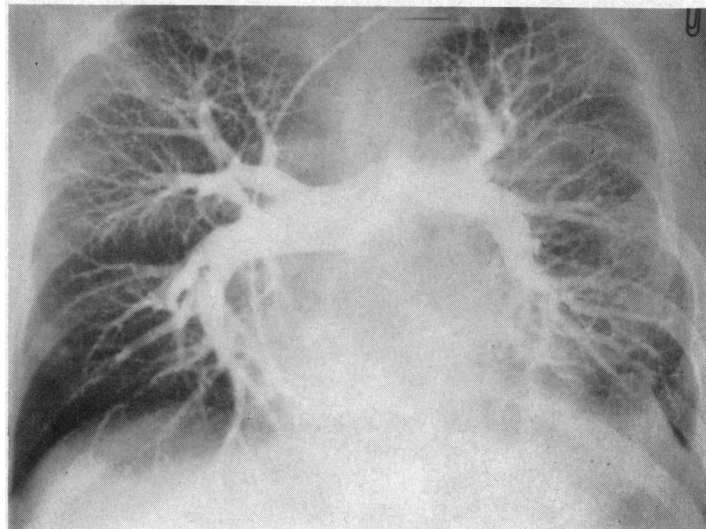


FIG. 2.—Angiocardiogram after embolectomy to show normal filling of the pulmonary arterial tree.

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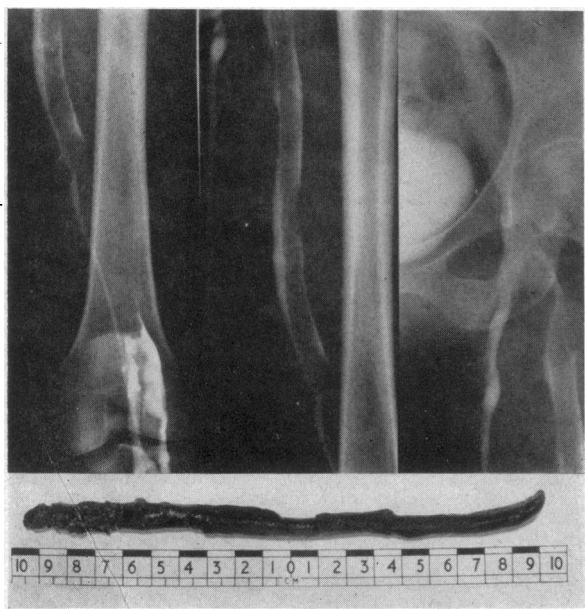


FIG. 1

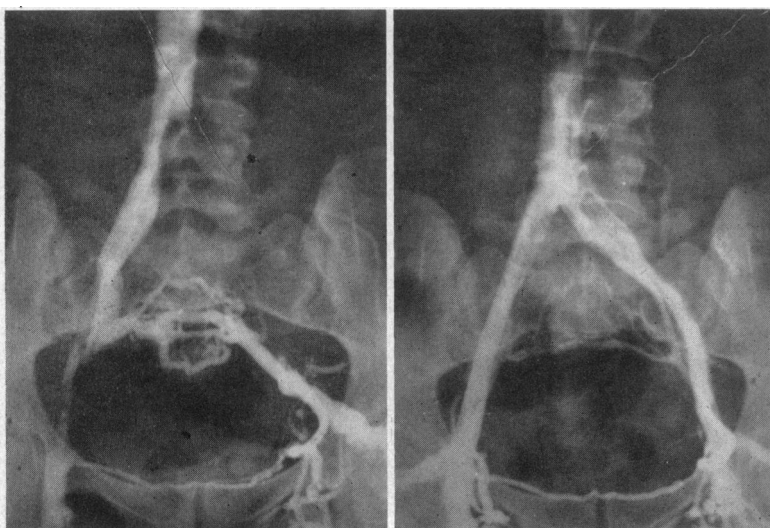


FIG. 2

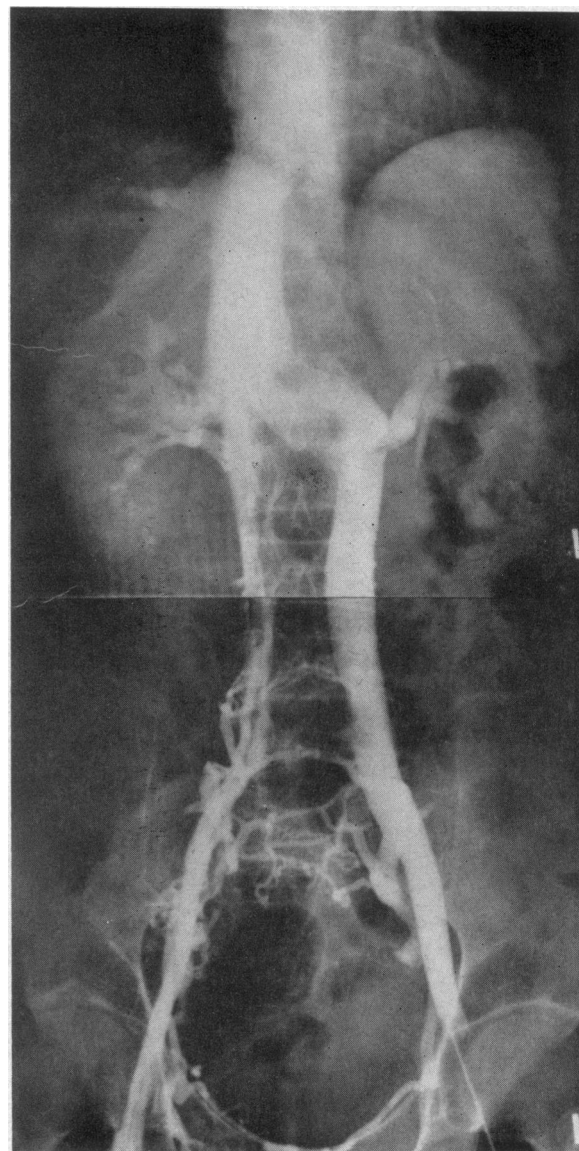


FIG. 3

## Preliminary Communications

### Management of the Source of Pulmonary Emboli: the Value of Phlebography

[WITH SPECIAL PLATE FACING PAGE 573]

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The conventional method of treating a patient who has survived a pulmonary embolus is to use anticoagulants and hope that no further emboli occur (Crane, 1957; Coon *et al.*, 1958; Barritt and Jordan, 1960). If there are further emboli most authors advocate some form of surgical blockade of the inferior vena cava (Moretz *et al.*, 1959; Spencer *et al.*, 1962; De Weese and Hunter, 1963; Miles, 1966; Lowicki, 1966). However, this type of operation has an appreciable morbidity, and if it is performed without showing either the presence or site of the peripheral thrombi it is as irrational as the blind administration of anticoagulants.

Barker and Priestley (1942), reviewing 1,665 cases of post-operative venous thrombosis, thrombophlebitis, and pulmonary embolism, found that 30% of patients who survived a pulmonary embolus had a second embolus and this was fatal in 19%. Thus after a patient has had a pulmonary embolus active treatment is urgently indicated to prevent a recurrence.

This preliminary communication describes the approach that we have developed to give patients the maximum protection from a second embolus with minimum morbidity.

#### METHODS

##### ASCENDING PHEBOGRAPHY OF THE LEGS

The patient lies on a tilting-table, the foot of the table being tilted 20 degrees downwards. A rubber tourniquet (Setoniquet, Seton Products Ltd., Oldham, Lancs.) is placed just above the ankle to distend the superficial veins of the foot. A vein on the dorsum of the foot, preferably towards the lateral side, is selected, and a small Middlesex cannula is inserted into the vein, with the use of local anaesthesia, in a distal (upstream) direction. If percutaneous puncture is not possible, a small cut-down is made.

The cannula is connected with polyethylene tubing to a 50-ml. syringe containing 40 ml. of the contrast medium Conray 280 (meglumine iothalamate) May & Baker Ltd. The foot is internally rotated to separate (radiologically) the tibia and fibula. The contrast medium is injected under television control and the tension of the tourniquet adjusted so that deep venous filling occurs. In order to fill all the calf veins it may be necessary to instruct the patient to plantar flex the foot a few times.

Split 14 by 14-in. (35.5 by 35.5-cm.) films are taken under television control during injection of the contrast medium. Films are taken of the whole venous system from the calf to the pelvis. The upper portion of the profunda vein is shown by asking the patient to perform a Valsalva manoeuvre when the common femoral vein is seen to be full of contrast medium. This technique usually shows the deep venous system from the ankle to the external iliac veins or even as high as the inferior vena cava, but if the femoral and iliac veins are not visualized percutaneous femoral vein injections are performed.

Both legs must always be examined.

If thrombosis of the iliac veins is suspected either on ascending phlebography or on clinical grounds and percutaneous

femoral puncture has not succeeded, it may be necessary to perform bilateral simultaneous peritrochanteric intraosseous pelvic phlebograms (Cockett and Lea Thomas, 1965).

After the films have been examined and regarded as satisfactory, at least 100 ml. of normal saline is injected into each leg and the legs are exercised to clear the contrast medium from the veins. This is checked by television. If the patient is not on anticoagulants 2,500 units of heparin are injected into each cannula before removal.

#### SURGICAL TECHNIQUES

*Superficial femoral vein ligation* is performed under either local or general anaesthesia. A vertical incision allows a greater length of vein to be exposed, which is of value if thrombectomy is planned.

*Thrombectomy*.—Thrombi are removed from the femoral and iliac veins through a venotomy in the common femoral vein by means of Fogarty venous thrombectomy catheters, suction, and a variety of forceps.

*Plication of the inferior vena cava* is usually performed through a right oblique flank incision, by the same retroperitoneal approach as for lumbar sympathectomy. Three or four interrupted sutures of 0000 arterial silk are passed through both walls of a flattened segment of the cava, approximately 2 mm. apart, to convert the vena cava into four or five channels (Spencer *et al.*, 1962).

#### ILLUSTRATIVE CASES

Seventeen cases of pulmonary embolus seen in the past year have been carefully studied by phlebography, and their management has been based on the radiological findings. The most striking feature was that the site of the thrombus, as demonstrated radiologically, often bore no relation to the site suspected clinically. Though the signs, when present, are usually associated with underlying thrombus, extensive thrombus may be demonstrated elsewhere—in the femoral or iliac veins of a leg with a tender calf or in a leg with no physical signs.

We concluded that the prevention of further emboli by surgical or medical means other than caval blockade could not be achieved without phlebography. The following three cases and their phlebograms demonstrate this point.

*Case 1*.—A 52-year-old woman had a simple mastectomy for carcinoma of the breast. Four days later she developed dyspnoea, pain in the chest, and haemoptysis. Anticoagulants did not prevent two further emboli. The right calf was tender and phlebography showed a small thrombus in the right common femoral vein. *The left leg was clinically normal.* Fig. 1 (Special Plate) shows that this leg contained an extensive, loose, potentially lethal thrombus. Thrombectomy and ligation of both superficial veins was performed.

*Case 2*.—This patient, a 32-year-old woman, developed chest pain, dyspnoea, and haemoptysis after two weeks of bed rest for low back pain. The left leg was swollen, painful, and blue. The clinical signs indicated a thrombosis of the iliofemoral segment. Peritrochanteric phlebograms (Special Plate, Fig. 2) showed an occluded iliac vein with fresh thrombus jutting into the vena cava. The cava was plicated.

*Case 3*.—A 45-year-old man had repeated pulmonary emboli after a femoral endarterectomy. The inferior vena cava was plicated *without* previous phlebography. He had a further embolus six months later. The phlebogram (Special Plate, Fig. 3) showed a double vena cava, not visible at operation—an unguarded route which could have been blocked at the first operation if its presence had been known.

## PHLEBOGRAPHY

**Technique.**—The technique described for ascending phlebography is a modification of techniques used by many previous authors. It is simple and can be used in the very ill patient. Retrograde (upstream) injection into a lateral foot vein, foot-down tilting, the rubber tourniquet with the Velcro fastening, and the use of television are all important.

**Interpretation of Results.**—De Weese and Rogoff (1963) described the unequivocal diagnosis of deep vein thrombosis to be based on (1) the presence of well-defined filling defects in opacified veins, and (2) the demonstration of these defects on at least two radiographs. Recent thrombus appears as a rounded or cylindrical filling defect in a contrast-filled vein giving it a "ground-glass" appearance (Special Plate, Fig. 1). The thrombus is separated from the wall of the vein by a thin white line representing contrast medium around the thrombus. Old thrombus shows as filling defects projecting directly from the walls of the veins. The intramuscular calf veins and soleal sinusoids are difficult to fill by ascending phlebography (Cotton and Clark, 1965). Failure to fill these veins cannot be taken as evidence of occlusion, and in the absence of positive evidence of thrombus within these veins non-filling should be assumed to be a technical fault. Conversely, non-filling of the popliteal, femoral, and iliac veins has been taken as evidence of total occlusion, provided contrast medium enters the deep venous system of the calf. The internal iliac veins cannot be demonstrated by ascending phlebography and if these veins are suspected as the source of a pulmonary embolus intraosseous peritrochanteric phlebography is necessary. False-positive diagnoses have not proved a problem.

## TREATMENT

By defining the site and extent of the residual thrombus we have been able to apply the various methods of treatment available in a logical manner. The policy has been to "lock-in" the thrombus as low as possible.

Of our last 17 patients, five had a plication of the inferior vena cava (two of whom should have been treated by thrombectomy and superficial femoral vein ligation, on the basis of our final policy), one had plication of both external iliac veins, two had one common femoral vein and one superficial femoral vein tied, and two had their superficial femoral veins ligated. These procedures were combined with thrombectomy in six patients, in three of whom a large potentially lethal thrombus was removed.

Seven patients were treated with anticoagulants alone, though surgical treatment, particularly thrombectomy, would have been indicated in some of these if they had been seen earlier. Thus in our experience surgical blockade of the inferior vena cava which is currently so popular is necessary in only a small proportion of patients, the remainder can be treated by a more peripheral blockade.

We suggest that the management of all patients who have had a pulmonary embolus that does not require immediate embolectomy should be as follows:

- (1) Anticoagulate with heparin.
- (2) Perform emergency bilateral ascending phlebography.

(3) If no thrombus is seen in the leg veins, and the iliac veins have not been visualized, perform a pelvic phlebogram via a percutaneous femoral vein puncture or interosseous peritrochanteric injection.

(4) Surgical treatment depends on the phlebograms. (a) For thrombus confined to the calf or popliteal vein, superficial femoral vein ligation only. (b) For thrombus extending into the femoral and external iliac veins, thrombectomy and superficial femoral vein ligation. If in such cases the profunda vein has not been displayed on the phlebogram it should be explored with a Fogarty catheter. If no thrombus is found, superficial femoral vein ligation is safe. If thrombus is present then the common femoral vein must be ligated or plicated. (c) For recent thrombus confined to the iliofemoral region above the junction of superficial and profunda veins, thrombectomy alone. (d) For irremovable thrombus above the formation of the common femoral vein, plication of the common iliac veins or inferior vena cava.

(5) Anticoagulants alone are indicated if the phlebogram shows a small amount of apparently old thrombus confined to the calf or popliteal veins or if no thrombus is seen and the diagnosis of pulmonary embolus is certain.

We continue the anticoagulants for six months to prevent the formation of fresh thrombus in the period when the residual thrombus is contracting, the vessel being recanalized, and new endothelium being formed.

No recurrent emboli have occurred since we adopted this regimen and we hope to present a long-term follow-up of these and other patients in a year's time.

## SUMMARY

A rational approach to the prevention of a second pulmonary embolism following the first, based on bilateral leg phlebography, is described. The long-term clinical value of these suggestions is under trial.

N. L. BROWSE, M.D., F.R.C.S.,  
Assistant Director, Surgical Unit.

M. LEA THOMAS, M.R.C.P., F.F.R.,  
Consultant Radiologist.

M. J. SOLAN, M.B., F.R.C.S.,  
Senior Surgical Registrar.

St. Thomas's Hospital,  
London S.E.1.

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