Selective Pulmonary Embolectomy Without Cardiopulmonary Bypass

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Although Trendelenburg8 first demonstrated the feasibility of pulmonary embolectomy in 1908, difficulties of diagnosis and the magnitude of operation limited successful application to scattered patients during the ensuing fifty years. Pulmonary angiography and cardiopulmonary bypass as employed by Sharp7 in 1961 helped obviate these difficulties and led to numerous successes. Pulmonary arteriography confirms the clinical diagnosis and localizes the embolic obstruction. Cardiopulmonary bypass permits interruption of pulmonary flow and approach to the embolus through the main pulmonary artery.

The use of cardiopulmonary bypass in Sharp's first case and in subsequent cases led to the belief that bypass was desirable in all cases of pulmonary embolectomy1 until the report of Bradley, Bennett and Lyons2 in 1964, in which an embolus obstructing the right pulmonary artery was extracted through that vessel without interrupting flow to the left lung. Recently Prater et al.4 reported three successful cases and raised the possibility that selective unilateral embolectomy without bypass may be the procedure of choice for certain selected pulmonary emboli.

The following is a report of an additional case of selective pulmonary embolectomy without cardiopulmonary bypass.

Case Report

C. F., a 25-year-old soldier, became ill with malaria in the Republic of Vietnam on October 28, 1965 and was transferred to the U. S. Army Hospital Camp Zama, Japan for treatment. On admission on November 4, 1965, physical examination was normal except for an oral temperature of 38.9° C. and questionable splenomegaly. Hematocrit was 44%. WBC was 6,100 and urinalysis and chest x-rays (Fig. 1) were negative. A blood smear was positive for ring forms of Plasmodium falciparum.

He received a 10-day course of quinine therapy and he became asymptomatic and afebrile after the fourth hospital day. On November 15, 1965 after completion of drug therapy, he was transferred from the active hospital ward to a convalescent unit.

He was next seen on November 25 for massive left iliofemoral thrombophlebitis which had developed spontaneously on the preceding day. On readmission, temperature was 38.3° C. The left leg was massively swollen and cyanotic in patches but there was no evidence of arterial insufficiency. He was given intravenous heparin without improvement, until November 29 when surgical consultation was requested. Thrombectomy was advised and carried out on the same day with restoration of venous flow and prompt subsidence of edema. Heparin was discontinued one week postoperative. Ambulation was started 72 hours postoperative and recovery was excellent until the evening of the 12th postoperative day when he suddenly developed right chest pain, dyspnea, and tachycardia. He was again given intravenous heparin and placed at bed rest. During the ensuing 12 hours, his general condition deteriorated with the appearance of considerable apprehension, increased tachycardia and dyspnea. Blood pressure declined from 120/80 to approximately 100/60, but never reached shock level. The right hemithorax was almost immobile during the respiratory cycle.

A single-film pulmonary arteriogram utilizing bilateral simultaneous injection of 30 cc. of 50% Hypaque into each cephalic vein showed total obstruction of the right pulmonary artery (Fig. 3).
Since cardiopulmonary bypass was not available the safest course seemed to be pulmonary embolectomy without bypass.

Accordingly, under moderate hypothermia to 31° C. and general anesthesia the chest was opened through a median sternotomy. Tapes were placed about both venae cavae, but not tightened. The main pulmonary artery and ascending aorta were mobilized intrapericardially. The right pulmonary artery was mobilized throughout its course beneath the aortic arch, and occluded at its origin from the main pulmonary artery with a vascular clamp. The ascending aorta was retracted laterally exposing approximately 3.5 cm. of right pulmonary artery for arteriotomy. Incision in the artery disclosed a completely obstructing soft embolus and no back flow. Back flow was brisk after extraction of the embolus.

The right pleural space was then opened and the right lung was manually compressed forcing out a few more fragments of clot. The arteriotomy was closed with a running vascular suture and the occluding clamp released. There had been no change in pulse rate or blood pressure during the occlusion. Following closure of the sternotomy, the infrarenal vena cava was ligated through a right flank extraperitoneal approach. Postoperatively, the patient did well until the 4th postoperative day when massive iliofemoral thrombo-phlebitis appeared in the right leg. Thrombectomy was performed with restoration of flow. Five days later on December 24, 1965, despite heparin therapy, re-occlusion with propagation of clot in the right leg required a second thrombectomy.
Flow was again established and heparin therapy sufficient to maintain coagulation time at approximately 30 minutes was continued. Following the second thrombectomy, the patient had an essentially uneventful course and was discharged on January 8, 1966.

Discussion

Although embolectomy was performed of necessity without bypass, the case is similar to others reported in the literature and confirms the impression of Bradley, Ben nett and Lyons, later supported by Prater et al., that selective embolectomy may be the procedure of choice for unilateral occlusion without shock following pulmonary embolism.

As indicated by Prater, unilateral occlusion with or without partial occlusion of the other side is encountered in patients considered 12 to 24 hours following embolization, as patients with bilateral occlusion usually do not survive. For patients in shock, the need for operation with cardiopulmonary bypass is clear-cut.

Some patients who survive massive pulmonary embolism will, by recanalization, establish normal pulmonary circulation within a short time. Others may stabilize for a brief period then deteriorate suddenly and die of right heart failure. At present the most reliable guide for the need for operation besides shock, is occlusion of 50% or more of the pulmonary circulation as demonstrated by pulmonary arteriography. Selection of patients for operation may

Fig. 4. Embolus (fixed specimen).

Fig. 5. Chest film at time of discharge from hospital.

Fig. 6. Drawing of exposure from cadaver dissection. Inset shows closeup of arteriotomy in each main branch. Note tape retracting ascending aorta.
be further facilitated by studies of right heart hemodynamics as developed by Del Guercio et al.3

Summary and Conclusions

A case of unilateral pulmonary embolectomy without cardiopulmonary bypass is presented. The experience supports the concept that unilateral embolectomy is feasible without cardiopulmonary bypass and may even be the procedure of choice for selected cases of pulmonary embolism. Use of this method presupposes arteriography for localization of the embolus.

References


