Feasibility of Pulmonary Embolectomy

A Case Report

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Although Trendelenburg described a technic for performing pulmonary embolectomy for massive pulmonary embolization in 1908, there were few successes until extracorporeal circulation was utilized to support the patient during the operation. The purpose of this report is to describe a patient with massive pulmonary embolism treated successfully by emergency pulmonary embolectomy and to explore the feasibility of surgical intervention by reviewing a series of cases of massive pulmonary embolism seen over the past 30 years at Duke Hospital.

Case Report

The patient was a 45-year-old, obese, white woman, admitted to Duke Hospital for repair of a vesicovaginal fistula. On the second postoperative day she developed pleuritic left chest pain. Examination of the chest was unremarkable and there was no evidence of peripheral thrombophlebitis. A chest film and electrocardiogram demonstrated no change from the preoperative findings. She remained afebrile, the chest pain decreased, and she was progressing well until the fifth postoperative day at which time she developed sudden dyspnea and cyanosis. The pulse was noted to be thready with a rate of 140, and the blood pressure was unobtainable. A chest film revealed loss of vascular markings over the entire right lung field with an enlarged central pulmonary artery. The electrocardiogram demonstrated complete right bundle-branch block. Oxygen was administered and a norepinephrine infusion was necessary to maintain the blood pressure above 80 mm. Hg systolic. The patient became anuric following the onset of chest pain.

At 5:15 p.m. the decision was made to attempt removal of what was thought to be a massive pulmonary embolus. At 7:00 p.m., 8½ hours after the onset of symptoms, the femoral vessels were exposed under local anesthesia. Under “light” general anesthesia a median sternotomy was performed to expose the heart. The right atrium and ventricle were greatly dilated and black in color. Catheters were placed in the femoral artery and inferior vena cava via the femoral vein. Partial perfusion was initiated at 1,500 ml. per minute. Initiation of perfusion produced a dramatic increase in mean systolic blood pressure and improvement in the electrocardiogram. A third catheter was placed in the superior vena cava via the right atrial appendage and complete extracorporeal bypass began. The main pulmonary artery was incised longitudinally and a large saddle embolus was apparent at the bifurcation of the main pulmonary artery. Forceps removal of this clot was carried out and numerous fragments, up to 5 cm. in length and 1 cm. in diameter, were extracted from both main pulmonary arteries by means of forceps and suction (fig. 1). The arteriotomy was closed and extracorporeal circulation was discontinued. An inferior vena cava ligature was then performed. There was no evidence of thrombi in the vena cava at that time.

Postoperatively the patient underwent tracheostomy, and respiration was assisted by a mechanical ventilator. Forty hours after the embolectomy she was noted to have a cold, pulseless, cyanotic left leg. Circulation was successfully restored to the extremity by removal of clots from the femoral artery and vein. Anticoagulation with heparin was maintained, and the patient was digitalized. She had a smooth postoperative course except for some delayed healing of the groin incision and bilateral lower extremity edema, which cleared slowly. The electrocardiogram returned to a normal axis and evidence of right bundle-branch block disappeared quickly.

Three weeks following surgery the patient underwent right heart catheterization to determine if there were any residual hemodynamic abnormalities. Catheterization revealed intravascular pressures and resistances to be normal, as were the blood gas determinations except for respiratory alkalosis. Selective injection of contrast media showed no residual obstruction to flow.
media into the right and left pulmonary arteries with cineangiographic visualization failed to demonstrate any residual obstruction in the pulmonary arteries (fig. 2). Two months postoperatively the vital capacity was noted to be 72 per cent and the maximum breathing capacity 58 per cent of the predicted value. Despite these moderately low values, she has returned to normal activity, which consists of caring for her family and running a farm.

Discussion

This patient demonstrated the classical clinical and laboratory signs of massive pulmonary embolization, and surgical intervention resulted in an optimal therapeutic result. This and other reported successes prompted a review of 52 autopsy protocols of patients found to have massive pulmonary embolization. They were separated into a group of previously healthy patients, and patients with obviously terminal illnesses. The patients in each group were then divided into those surviving less than 2 hours, those surviving more than 2 hours, and those surviving more than 8 hours.

Of the previously healthy patients 55 per cent survived massive pulmonary embolization longer than 2 hours, and, indeed, 48 per cent survived longer than 8 hours. Only 32 per cent of the terminally ill patients survived longer than 2 hours and 47 per cent survived less than 2 hours. In the remaining 20 per cent, the interval between embolism and death could not be determined. The higher incidence of survival after 2 hours in the “previously healthy” patients differs from previous reports \(^2\) and is undoubtedly due to the fact that other authors have not separated “previously healthy” from terminal patients.

Since more than 50 per cent of previously healthy patients survive more than 2 hours, there is adequate time to prepare the patient and the extracorporeal circulation system if the embolization should occur in a hospital that is prepared to use cardiopulmonary bypass. Since nearly half the previously healthy patients who had a massive pulmonary embolus survive 8 hours, there is time to transport the patient from a hospital without extracorporeal circulation facilities to one that is prepared to institute cardiopulmonary bypass. Indeed, another successful pulmonary embolectomy was performed in this institution in a patient who was referred from an outside hospital 6 hours after massive embolization.

The successful outcome in this and other cases \(^3\)–\(^10\) should prompt a re-evaluation of the role of pulmonary embolectomy as the primary treatment of massive pulmonary embolus. The interval between embolization and death is greater than generally estimated in patients who were “previously healthy.” This interval is often adequate to allow surgical intervention.

References

1. Trendelenburg, F.: Ueber die operative Be-

Lord Joseph Lister (1827-1912) and Animal Vivisection

My own first investigations of any importance were a study of the process of inflammation in the transparent web of the frog's foot. The experiments were very numerous and were performed at all hours of the day in my own house. I was then a young unknown practitioner; and if the present law had been in existence, it might have been difficult for me to obtain the requisite licenses; and even if I had got them, it would have been impossible for me to have gone to a public laboratory to work. Yet without these early researches, which the existing law would have prevented, I could not have found my way among the perplexing difficulties which beset me in developing the antiseptic system of treatment in Surgery.

In the course of my antiseptic work at a later period I frequently had recourse to experiments on animals. One of these occurs to me which yielded particularly valuable results, but which I certainly should not have done if the present law had been in force. It had reference to the behaviour of a thread composed of animal tissue applied antiseptically for tying an arterial trunk. I had prepared a ligature of such material at a house where I was spending a few days at a distance from home; and it occurred to me to test it upon the carotid artery of a calf. Acting on the spur of the moment, I procured the needful animal at a neighbouring market; a lay friend gave chloroform and another assisted at the operation. Four weeks later the calf was killed and its neck was sent to me. On my dissecting it, the beautiful truth was revealed that the dead material of the thread, instead of being thrown off by suppuration, had been replaced under the new aseptic conditions, by a firm ring of living fibrous tissue, the old dangers of such an operation being completely obviated.—Lister.
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