Surgical pulmonary embolectomy: Should we extend its role?

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In this issue of the *Journal*, Keeling and associates¹ present their institutional experience and a retrospective analysis on the outcome of surgical pulmonary embolectomy (SPE). In their article, Keeling and associates¹ emphasize the beneficial effect of surgical clot removal on right ventricular function, with the consequence of improved midterm survival.

This article brings to mind several considerations about the role of SPE in the light of thrombolysis and catheter clot removal.¹ Pulmonary embolism (PE) is a life-threatening disease and is a major cause of mortality, morbidity, and hospitalization.² Clinical presentation of acute PE varies from no symptoms to severe hypoxemia, right ventricular failure, shock, and death. When a patient presents with acute submassive or massive PE (Figure 1), systemic anticoagulation is started promptly, typically with intravenous heparin. Mechanical removal of the embolic load can be performed by catheter intervention or open surgery. SPE with the aid of extracorporeal circulation became the treatment of choice after being described by Cooley in the 1960s.³ The introduction of thrombolytic agents into clinical practice was extended to PE as well, and this had the effect of relegating SPE the treatment of choice to cases of massive embolic obstruction and severe critical conditions. Both systemic and local administration of the lytic agent through a catheter has been carried out. Other catheter-induced techniques of clot removal have been advocated so far, but results are limited.

Unfortunately, numerous reports on PE have appeared in the literature during the last decade, and all indicate bleeding as the major and often fatal complication of thrombolysis.⁴⁻⁶

To date, candidates for SPE have mostly been patients with massive embolic obstruction, those with low output syndrome as a result of severe right ventricular dysfunction possibly with cardiac arrest before surgery, or those for whom thrombolysis is contraindicated or has failed. SPE cannot be considered as the last option when other treatments have failed. In the literature, the rate of failed thrombolysis varies between 5% and 10%, whereas the mortality of SPE after failed thrombolysis reaches 27% to 38%.^{4,5}

CT image of massive pulmonary emboli treated with surgical pulmonary embolectomy.

Central Message

An algorithm including medical treatment, ECMO, and surgical embolectomy may improve results in patients with acute pulmonary emboli.

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For the presentation of cardiogenic shock with cardiac arrest, Dauphine and Omari⁷ reported an overall 57% mortality for patients requiring cardiopulmonary resuscitation, compared with 12% for those who did not. Takahashi and colleagues⁷ found that survival after SPE was 100% if preoperative cardiac arrest could be avoided.

Moreover, long-term results of thrombolysis are not satisfactory. Kline and coworkers⁸ reported that a significant proportion of patients had echocardiographic and functional evidence of pulmonary hypertension 6 months after intermediate-risk PE was managed with heparin alone or with heparin and alteplase. They also postulated that the persistent elevation of right ventricular systolic pressure is maladaptive, particularly when associated with tricuspid regurgitation, leading to a complex of right ventricular damage, pulmonary vasospasm, and inflammation related to erythrocyte hemolysis. The current echocardiographic data presented by Keeling and associates¹ on right ventricular remodeling after SPE are of further support to these previous observations. An aggressive surgical approach to intermediate-risk PE with right ventricular dysfunction seems to offer a means of preventing this maladaptive response.

On the other hand, if one looks at the latest reports on SPE, there is an overall picture that encourages the surgeon to reconsider the role of SPE to the point of extending its

FIGURE 1. Computed tomographic image of massive pulmonary emboli treated with surgical pulmonary embolectomy.

indication beyond the severely sick patients. Let us start to consider the positive aspects. It is an easy surgical technique. The use of extracorporeal circulation with or without cardioplegic arrest allows heart decompression. The surgeon has a direct access to the pulmonary trunk and its main branches and can remove the clot under direct visualization and suction. Immediate beneficial effects on right ventricular function and patient condition are achieved.

Leacche and colleagues⁹ extended the indications for surgical intervention beyond the traditional application for massive PE to include hemodynamically stable patients with a massive clot burden and signs of right ventricular dysfunction. They reported an operative mortality of 6% in their series of 47 patients. The failure of thrombolysis would critically affect patients with PE by delaying surgical treatment. The indication for SPE should therefore be extended.

Consequently, early indicators would be of critical value for decision making and primary treatment allocation. Several criteria of classification of clot dimension as well as right ventricular failure have been proposed through

the years. Contrast-enhanced computed tomography and echocardiography can provide in a short time all the necessary information to apply these criteria to the morphology and extent of the obstructing clot and the right and left ventricular strains.⁵ Signs of right ventricular dysfunction should be taken into account more than clot size in the decision making for primary treatment, keeping in mind the good results of SPE and the fate of the right ventricle.

Conventional treatment with heparin and thrombolysis still has a role in PE. Recently, however, numerous hospitals have established a PE response team with backup of an extracorporeal membrane oxygenation device. Each team includes a cardiac surgeon in addition to chest physicians and cardiologists. We encourage this team approach, and we are all looking forward to the outcome of their work with the aim to add more substantial evidence regarding the role of SPE.

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