

## The Role for Surgery in the Contemporary Management of Patients at High or Intermediate Risk of A Pulmonary Embolism-Related Death- is a Paradigm Shift Required?

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### Commentary

Presently, there remains no consensus on the optimal management of a patient with a high or intermediate-risk massive pulmonary embolism (PE). Treatment offered is varied and dependant on patient presentation, local guidelines and available local expertise. Despite the availability of various clinical parameters (blood pressure, tachycardia, hypoxia), biochemical markers (Troponin T or I, BNP), and imaging tools (echocardiographic, CT or MRI criteria) which facilitate the diagnosis and risk stratification of a PE, uniformity of treatment remains challenging. Hence treatment offered may vary and this is reflected in the published PE-related mortality registry data which report rates of 1.65-20% [1-3].

Contemporary treatment guidelines of the European Society of Cardiology (ESC), American College of Chest Physicians (ACCP) and American Heart Association (AHA) all separately recommend and relegate the role of a surgical pulmonary embolectomy to a second – line alternative therapy for high risk PE patients in whom thrombolysis is contraindicated or unsuccessful [4-6]. Interestingly, the recently published ESC 2014 guidelines acknowledges the value of a multi-disciplinary team approach, early involvement of the cardiac surgeon and the potential role for a surgical embolectomy in the high or intermediate risk PE patient [7].

A paradigm shift is required in the evaluation, stratification and approach to PE. The traditional classification divided patients into non-massive, submassive and massive on the basis of primarily haemodynamic and/or radiological criteria but has since been replaced with less confusing but prognostic nomenclature; low-risk, intermediate and high-risk PE. Prognostic scoring tools like the Pulmonary Embolism Severity Index (PESI) and Geneva score can help identify low risk patients to be managed conservatively however offer little help in identifying at-risk patients who may benefit from early aggressive intervention [8-10]. Echocardiography however can provide useful prognostic criteria to identify patients who though seemingly haemodynamically stable, have an intermediate or higher risk of an early PE-related death. The presence of right ventricular (RV) dysfunction (RV size, contractility, bowing of intraventricular septum, functional TR, etc.) correlates with a worse prognosis and a cardiothoracic opinion should be sought early for such patients regardless of the haemodynamic condition. Hence echocardiography which is portable, rapid and non-invasive should feature early in any management algorithm.

Perhaps due to the poor surgical outcomes reported historically, there remains a reticence for early surgical referral. However traditionally, a surgical pulmonary embolectomy was performed often as a rare salvage rescue operation in a near dying patient with shock or

respiratory failure. In the absence of shock, contemporary series report acceptable early mortality rates of 6-8% which reflects advances in anaesthesia, surgical techniques and post-operative care [11-15]. The advent and widespread availability of hypothermic cardiopulmonary bypass with or without concurrent cardioplegic myocardial arrest has transformed this operation from the traditional 'smash and grab' approach utilising inflow occlusion to a more refined, meticulous and controlled operation often with a quiescent and relatively bloodless operative field, depending on surgeon preference. There is evidence that the institutional site of surgical care does not have a detrimental effect on operative outcomes although admittedly the absence of an in-house cardiothoracic surgical team is less appealing [16]. If required timely and safe transfer of a patient should be feasible.

Patient selection however is crucial and CT imaging can help identify the volume and location of thrombus within the pulmonary vasculature. The presence of any large volume central thrombus located in the main pulmonary artery or proximal main branch pulmonary arteries should mandate at the very least surgical review if not aggressive early intervention. The merits of a surgical embolectomy including relatively swift and complete thrombus clearance must be weighed against the risks and sequelae (including haemorrhage, residual RV dysfunction and future pulmonary hypertension), of alternative therapies of systemic anticoagulation, systemic or catheter-directed thrombolysis due to incomplete treatment. ICOPER data suggests bleeding occurs in approximately 24% of all individuals who received thrombolysis [17].

Low or intermediate-risk PE is obviously associated with a lower mortality than a high -risk PE hence the mortality benefit for any treatment including a surgical embolectomy may be less evident. More relevant outcome measures may be residual RV dysfunction and late pulmonary hypertension. The efficacy of thrombolysis over anticoagulation alone in patients with an intermediate-risk PE was evaluated in the recently published European Pulmonary Embolism Thrombolysis (PEITHO) trial [18]. The results showed a significant reduction in death or cardiac decompensation in the fibrinolysis group however with a higher associated risk of major haemorrhage and stroke. Similarly the Tenecteplase Or Placebo: Cardiopulmonary Outcomes At Three Months (TOPCOAT) trial demonstrated more favourable patient-oriented outcomes (including survival to hospital discharge and quality of life improvement) in the thrombolysis group [19]. Hence it is not unreasonable to assume an early aggressive approach with surgery may offer similar if not greater benefit for such patients but with an attenuated risk of iatrogenic haemorrhage. Presently data to unequivocally support the role of an embolectomy in patients with an intermediate-risk PE is lacking. This coupled with the reported low mortality rates associated with anticoagulant therapy

only, may unfortunately hinder the impetus for a much needed randomised trial of thrombolysis versus surgery in this subgroup.

Early surgical intervention requires early referral to the cardiothoracic surgeon. Despite relative haemodynamic stability, in carefully selected high and intermediate-risk patients with CT-proven anatomically proximal disease (large volume central or para central PA thrombus) and echocardiographic signs of RV dysfunction or worsening oxygenation, an early albeit high-risk surgical pulmonary embolectomy, where readily available, may be the optimal first line therapy to rapidly reduce the RV afterload and completely reperfuse the pulmonary vasculature. The attending clinician must consider this treatment modality as an option and include in any discussion with the patient particularly if the latter is anticipated to have an increased risk of bleeding. Surgical embolectomy should not be relegated only to those in extremis or in whom thrombolysis is contraindicated or has failed.

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