Catheter-tip embolectomy in the management of acute massive pulmonary embolism
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CRD summary
This review assessed the efficacy and safety of catheter-tip devices in patients with acute massive pulmonary embolism. The authors suggested that aspiration, fragmentation, and rheolytic techniques could be useful in the management of acute massive pulmonary embolism. These conclusions have to be viewed with caution given the small size and poor quality of the studies included.

Authors' objectives
To review the evidence on the efficacy and safety of catheter-tip devices in patients with acute massive pulmonary embolism (PE).

Searching
MEDLINE and the Cochrane Library were searched; the search terms were reported. The reference lists of relevant articles and reviews were checked for additional studies. Abstracts, letters, comments, reviews, animal studies and in vitro studies were excluded.

Study selection
Study designs of evaluations included in the review
Inclusion criteria for the study designs were not explicitly stated.

Specific interventions included in the review
Studies evaluating catheter-tip devices for removing PE or decreasing clot burden were eligible. The interventions considered were: aspiration using the Greenfield/pulmonary embolectomy catheter; the fragmentation technique with the Pigtail or other angiographic catheters, or the Amplatz catheter; and the rheolytic technique with the rheolytic angiojet catheter or the hydrolyser catheter. Catheter devices were used either alone or in combination with thrombolytic agents given systemically and/or locally.

Participants included in the review
Studies of patients with acute massive PE were eligible for inclusion.

Outcomes assessed in the review
Inclusion criteria for the outcomes were not explicitly stated. The main outcome assessed was clinical success, which was defined as an improvement in haemodynamic parameters immediately after the procedure.

How were decisions on the relevance of primary studies made?
The authors did not state how the papers were selected for the review, or how many reviewers performed the selection.

Assessment of study quality
The authors did not state that they assessed validity.

Data extraction
The authors did not state how the data were extracted for the review, or how many reviewers performed the data extraction. Data on mean systemic blood pressure, mean pulmonary artery pressure, mean partial arterial oxygen pressure, and angiographic assessment score before and after the procedure were extracted and used to determine clinical success.
Methods of synthesis
How were the studies combined?
The studies were described narratively and the data were tabulated. Pooled rates of clinical success were calculated by adding together success rates from different studies with similar interventions (catheter type and thrombolytic regimen).

How were differences between studies investigated?
Differences in study interventions and outcomes were discussed in the text and presented in more detail in the tables.

Results of the review
Thirty-three studies (348 participants) were included: 25 case series and 8 case-reports.

Aspiration technique.
Embolectomy with the Greenfield catheter was evaluated alone (7 studies, 89 patients) and in combination with thrombolytic agents (4 studies, 19 patients). Clinical success was achieved in 81% of patients when the Greenfield catheter was used alone and 100% of cases when used in combination with thrombolytic agents. Six major bleeding events occurred with the Greenfield catheter without thrombolysis, whereas no major bleedings were reported for the combination with thrombolytic agents. Perforation of the right ventricle and tricuspid insufficiency each occurred in one patient treated with the Greenfield catheter.

Fragmentation technique.
Embolectomy with fragmentation was evaluated without (4 studies, 11 patients) and with thrombolysis (18 studies, 178 patients). Fragmentation alone was used in only 3 patients, with clinical success reported in 2 of them. In combination with systemic and local thrombolytic agents, angiographic catheters obtained clinical success in 71% and 95% of patients, respectively. Embolectomy with the Amplatz catheter was associated with clinical success in 88% of cases when used alone, and in 100% when used in combination with thrombolytic agents (6 patients). Overall, 6 major bleedings were reported for the fragmentation technique. Right femoral nerve injury was reported in 1 patient after fragmentation embolectomy and thrombolytic therapy.

Rheolytic technique.
Embolectomy with the rheolytic technique was evaluated without thrombolysis in 3 studies (8 patients) and in combination with thrombolysis in 5 studies (43 patients). Clinical success was observed in 75% of patients treated with the rheolytic Angiojet alone. No studies evaluated the hydrolyser catheter alone. In combination with thrombolytic agents, the clinical success rate was 87% with the Angiojet catheter and 92% to 100% with the Hydrolyser catheter. No major bleeding events were reported for the rheolytic technique.

Overall, catheter-tip devices were associated with minor bleeding at the insertion site in 29 of 348 patients (8%), and with major bleeding at the insertion site in 8 of 348 patients (2%). There was no case of a pulmonary artery perforation.

Authors' conclusions
All the catheter devices evaluated appear useful in the management of acute massive PE.

CRD commentary
This review addressed a well-defined question in terms of the study participants and interventions, while it used a broad definition of study design and outcomes. Two relevant databases were searched and efforts were made to find further published and unpublished studies, thus reducing the potential for publication bias; however, publication bias was not assessed. The precise timeframe of the search strategy was not reported and it was not stated whether language restrictions were applied, therefore language bias cannot be ruled out. It was also not stated whether the study selection and data extraction processes were performed in duplicate by two independent reviewers, so reviewer error and bias might have been introduced. Since no quality assessment of the included studies was reported, the potential impact of methodological flaws in the primary studies upon the reliability of the review findings cannot be assessed.
The inclusion of only small case series and case reports represented a major limitation of the evidence available for this review. The authors' conclusions have to be considered with caution because of the relatively low number of patients enrolled in the included studies, as well as the methodological and reporting weaknesses of the review.

**Implications of the review for practice and research**

Practice: The authors stated that catheter embolectomy should be performed only in the main and lobar pulmonary arteries, or in the segmental pulmonary arteries. Embolectomy should be stopped upon achieving haemodynamic improvement in order to reduce the risk for perforation or dissection of the vessels or the cardiac chambers. It is unclear whether these recommendations were derived from the evidence presented in the review.

Research: The authors did not state any implication for further research.

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