ESC European Society of Cardiology

European Heart Journal Open (2024) **4**, oeae092
https://doi.org/10.1093/ehjopen/oeae092

RESEARCH LETTER
Interventional cardiology and cardiac surgery

Percutaneous thrombectomy with the FlowTriever for pulmonary embolism with right heart thrombi: a retrospective two centres study

Laurent Bonello [1,*], Clément Tardivel[2], Marc Laine[1], and François Roubille[2]

[1]Unité de soins intensifs de cardiologie, Aix-Marseille University, Hôpital Nord, AP-HM, Chemin des Bourrely, 13015 Marseille, France; and [2]Service de Cardiologie, PhyMedExp, Université de Montpellier, Institut National de la Santé et de la Recherche Médicale (INSERM) U1046, Centre National de la Recherche Scientifique (CNRS) UMR 9214, 191 avenue du doyen Gaston Giraud, 34295 Montpellier, France

Received 25 June 2024; revised 5 September 2024; accepted 12 September 2024; online publish-ahead-of-print 22 November 2024

Handling Editor: Magnus Bäck

Introduction

Pulmonary embolism (PE) remains a clinical challenge with increasing prevalence and steady mortality.[1] Patients with PE and right heart thrombi (RHT) represent between 2.6 and 8.1% of all PE.[2,3] In addition, they are probably underdiagnosed because of delayed cardiac echocardiography assessment, early migration, and limited data. Patients with RHT may present with various PE severity but were shown to be at increased risk of death.[4] The guidelines advocate surgical intervention with the removal of pulmonary and RHT.[1,5] This recommendation is based on experts' consensus from case reports and series,[6] since there is little evidence supporting any strategy. In fact, we lack randomized clinical trials on patients with RHT during PE, and the current recommendation was issued in 2019 when percutaneous reperfusion was rare. Furthermore, a large number of patients for whom surgical intervention is indicated, fail to have it given their clinical precarious status and their numerous co-morbidities including neoplasia. New therapeutic strategies are therefore warranted in this clinical setting. The advent of percutaneous interventions with catheters enabling manual thrombectomy has revolutionized the care of high-risk (HR) and intermediate high-risk (IHR) PE.[6–8] Thrombectomy devices could be of potential interest for patients with PE and RHT. We report the outcome of 12 consecutive patients treated with the FlowTriever (Inari Medical, USA) for PE with RHT.

Methods

We performed a retrospective study of all PE treated with the FlowTriever in two centres between January 2022 and 2024. Both are PE centres with a dedicated PE team and an active pulmonary reperfusion team. The PE team determines the need for reperfusion based on a standardized protocol and the techniques used are systemic thrombolysis, percutaneous techniques, and surgery.

All patients admitted to these centres have a transthoracic echocardiography and a CT scan (Chest Tomodensitometry) on admission. We included patients with RHT during acute PE, whom were excluded of surgical care because of prohibitive operative risk, and undergo percutaneous intervention with the FlowTriever. Approval of the Ethics Committee was obtained to perform the present study.

In the present analysis, we present data as mean and standard deviation or number and percentages.

Procedures

Ultrasound-guided puncture of the femoral vein was performed in all but one patient where the jugular course was chosen due to inferior vena cava occlusion. Careful placement of the 24Fr sheath on a stiff wire was performed to prevent venous trauma. Unfractionated heparin was used to achieve an ACT >250 (achieved clotting time). A stiff wire was placed in the left or right pulmonary artery to enable progress of the FlowTriever toward the thrombi. Aspiration of RHT was attempted in all patients. The objective was to remove RHT first and to perform pulmonary reperfusion afterward if clinically required.

Results

Our analysis includes 12 consecutive patients. The results are depicted in *Table 1*.

Most patients had an active neoplasia at the time of diagnosis (8/12). The most common symptom was dyspnoea (83%), and the mean duration of symptoms was 7 ± 10.2 days. Three patients had HR PE, and

* Corresponding author. Tel: +33491968858, Email: laurent.bonello@ap-hm.fr

Table 1 Characteristics of the study population, echocardiographic, procedural, and outcome data

n	*n* = 12
Age (years)	66.8 ± 17.1
Male sex	7
History of DVT/PE	8
Active neoplasia	8
Clinic	
Symptoms on admission dyspnoea	10
Chest pain	4
Syncope	3
Duration of symptoms (days)	7 ± 10.2
Symptoms onset <2 days	7
Oxygen need	12
Mechanical ventilation	2
Shock	3
High-risk PE	3
Intermediate high-risk PE	9
Systemic thrombolysis	1
UFH	7
LMWH	5
Echocardiographic findings	
RV/LV ratio (mean ± SD)	1.2 ± 0.1
Systolic PAP (mean ± SD)	57.2 ± 15.2
Thrombus localization	
RA	1
RV	2
RA and RV	9
Left ventricle ejection fraction (%)	60
Procedure	
Femoral route	11
Number of aspiration (mean ± SD)	4.8 ± 0.1
Pulmonary aspiration	9
Successful in transit thrombus removal	10
Post procedure sPAP (mmHg) (mean ± SD)	42.2 ± 16
Outcome	
Death	2
Major bleeding	1
Severe tricuspid regurgitation	1
ICU stay (days) (mean ± SD)	2 ± 2.1
Hospital stay (days) (mean ± SD)	10 ± 11.8
Discharged alive	10

DVT, deep vein thrombosis; PE, pulmonary embolism; UFH, unfractionated heparin; LMWH, low molecular weight heparin; RV, right ventricle; LV, left ventricle; sPAP, systolic pulmonary artery pressure; RA, right atrium; ICU, intensive care unit.

nine had IHR PE. One patient had a failed systemic thrombolysis for HR PE before the percutaneous procedure.

On echocardiography, the mean right ventricle (RV)/left ventricle ratio was 1.2 ± 0.1. Most patients had mobile thrombus prolapsing from the right atrium into the RV. In three patients, the thrombus was located in one chamber only.

The removal of RHT was successful in 10 patients (83%). After pulmonary aspiration, the mean systolic pulmonary artery pressure decreased from 57.2 ± 15.2 to 42.2 ± 16 mmHg.

One intra-thoracic bleeding and one severe tricuspid regurgitation were observed after the procedure. The intra-thoracic bleeding was related to guide perforation and was fatal. Another patient died in-hospital in relation to an active neoplasia. During the 3-month follow-up, no event was recorded.

Discussion

Right heart thrombi during PE were effectively retrieved using the FlowTriever in the vast majority of patients. During the same procedure, pulmonary reperfusion was also performed in most cases. However, one patient suffered a fatal bleeding event related to the procedure. Overall in our experience the FlowTriever appears to be an effective device for RHT during PE with a limited adverse event risk. It may represent a new therapeutic option in this clinical setting.

Right heart thrombi during PE are not uncommon but they have a poor prognosis with a mortality ranging between 20 and 25%, more than three times the one of PE without RHT.[5–7] A recent AHA (American Heart Association) scientific statement, in line with ESC guidelines, recommends that surgical care should be preferred for PE patients with RHT, but this recommendation has a low level of evidence.[5] Similarly a meta-analysis suggested that systemic thrombolysis and surgery may lead to better outcomes than anticoagulation alone.[3] However, there are no randomized clinical trial to support this.

New tools for percutaneous reperfusion, such as the FlowTriever are advancing the care of PE. They are associated with promising results in registries.[7,8] In the Flash registry, the FlowTriever was effective and safe for pulmonary reperfusion. It was also associated with a low mortality.[7]

In our experience, PE with RHT could be treated percutaneously with the FlowTriever enabling RHT removal and pulmonary reperfusion in the majority of patients with a limited risk of procedural adverse events. It represents a simple alternative to surgical removal of RHT in these HR patients. However, tricuspid regurgitation or major bleeding may occur. Percutaneous reperfusion by the FlowTriever may be proposed for PE associated with RHT by expert teams with careful technique after patient selection. A randomized trial comparing the FlowTriever to alternative strategies including surgery is required.

Conclusion

Thrombectomy of RHT during PE using the FlowTriever could become a new therapeutic option in this challenging clinical setting. Careful patient selection and evaluation of the benefit risk ratio is required.

Lead author biography

Laurent Bonello is a cardiovascular physician and researcher working in the field of novel cardiovascular biomarkers, antithrombotic therapy, and acute cardiovascular care I. Intensive care and interventional cardiology specialist, he participated in the development of the pulmonary embolism team and the cardiogenic shock network in Marseille in 2017. He is part of the Aix-Marseille University as a cardiology professor.

Data availability

The data are not to be shared.

Funding

The current work was supported by an academic grant from the Aix Marseille University.

Conflict of interest: None declared.

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