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International Journal of Cardiology Cardiovascular Risk and Prevention

journal homepage: www.journals.elsevier.com/international-journal-of-cardiology-cardiovascular-risk-and-prevention



Rehabilitation post pulmonary embolism: Preliminary data

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ARTICLE INFO

Keywords:

Pulmonary embolism
Rehabilitation
Physical training

1. Introduction

After pulmonary embolism (PE), 60 % of patients present dyspnea and fatigue during habitual efforts [1] and may present many complications such relapse, post-thrombophlebitic syndrome if deep vein thrombosis (DVT) occurs, post-embolic pulmonary hypertension, occult neoplasia [2].

Our primary aim was to assess the symptomatic effects and safety of physical training during cardiopulmonary rehabilitation.

A secondary objective was to identify a follow-up plan that includes surveillance of the complications mentioned.

2. Materials and method

225 patients were enrolled 8 days after the acute event (Table 1) for a 4-week inpatient cardiopulmonary rehabilitation program.

On the basis of the initial 6 min walking test (6mwt), two groups of patients were identified: Group 1: 6mwt >200 m, undergoing calisthenics, respiratory rehabilitation, aerobic reconditioning with treadmill/exercise bike; Group 2: patients with 6mwt <200 m or inability to perform 6mwt treated with muscle strengthening, respiratory rehabilitation, walking training and, when possible, exercise bike.

All patients underwent an echocardiogram and pulmonary CT angiography at the end of the rehabilitation program, and on admission if necessary venous Doppler ultrasound of the lower limbs and at discharge.

The risk of recurrence was estimated according to ESC 2019 guidelines and the bleeding risk was estimated according to BARC criteria.

58 % of patients underwent a psychological support and 20 % a nutritional plan.

The search for occult neoplasia for thrombophilia were conducted during rehabilitation if not already carried out.

3. Results

All patients had improvement in dyspnea and in physical performance; the improvement in dyspnea was independent of the acute phase treatment but very dependent on the comorbidity (obesity and COPD above all). No patient had side effects related to rehabilitation program. One patient had a fatal recurrence 9 days after discharge, and one patient had cerebral hemorrhage midcourse. One patient had cerebral hemorrhage on admission.

10 patients had transient febrile episodes, 48 patients contracted COVID 19 during hospitalization without relics. A patient with dilated cardiomyopathy and AICD had recurrent ventricular tachycardia for which VT ablation was performed. None of the DVT patients had a recurrence of PE. At the pulmonary CT angiography, everyone had an improvement in the Quanadli index; all patients who underwent aerobic reconditioning had almost complete dissolution of the pulmonary thrombus; conversely, 61 % of the patients in group II had significant thrombotic residues. On the echocardiogram there was an improvement in the performance and geometry of the right ventricle (RV) starting from the first week of the cycle and at the end of the cycle 93 % of the patients had returned to normal. Patients treated with pharmacological or mechanical revascularization improved this parameter in an average of one week. None of the DVTs resolved during the hospitalization. Neoplasms were found in 3 patients (one prostate cancer, two gynecological).

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<https://doi.org/10.1016/j.ijcrp.2024.200269>

Available online 29 April 2024

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Table 1

Comparison between the patients in the ELOPE study [3] and the population of our experience characteristics present at enrollment.

Characteristics	ELOPE	Our experience
Average age	50	72
Range age	40 > 65	23 > 91
Male	57	45
BMI ≥ 30	77	45
Asthma/COPD	13	25
CAD	1	10
Neoplasia	1	–
HFrEF	–	21
Kidney failure GFR < 40 ml/min	–	40
Smokers	60	50
DVT	33	42
Obstruction index [4]	28	28
Right ventricle abnormalities	40	67
sPAP > 40 mmHg	45	55
High risk PE at presentation	–	10
Systemic Thrombolysis	2	4
Percutaneous Thrombolysis	–	6
Warfarin	78	19
DOAC	8	81
Enrollment after acute event	7 days	8 days

Abbreviations: BMI (body mass index); COPD (chronic obstructive pulmonary disease); CAD (coronary artery disease); DOAC (Direct oral anticoagulants); DVT (deep venous thrombosis); GFR (glomerular filtration rate); HFrEF (heart failure with reduced ejection fraction); PE (Pulmonary Embolism); sPAP (systolic Pulmonary Artery Pressure).

3.1. Improvement in the walking test and follow-up

On average increase of 210 m in the first group. On average 50 m in group II. A small group of patients (17) had no improvement.

Follow-up was completed in 163 patients: of these, 3 showed neoplasia (1 pleural mesothelioma and one colorectal carcinoma and 1 gastric carcinoma). In the group of patients who presented RV impairment and persistence of pulmonary hypertension, 3 were treated for pulmonary endarterectomy and 4 were followed in an ultra-specialist medical center.

At the moment no recurrence but 30 patients have had other hospitalizations during the year for non-cardiac diseases or left heart failure. It was not possible to collect data on hemorrhages. All the patients who were hospitalized belonged to group II.

Discussion Some conclusions can also be drawn from these preliminary data: in patient cardiopulmonary rehabilitation shortly after the acute event is certainly useful in patients with high or intermediate risk at presentation, for low-risk patients it could be useful, if

symptomatic, an outpatient rehabilitation cycle.

Regardless of the acute phase presentation, it is useful know if there are significant comorbidities and if the right ventricle is compromised in the acute phase. It can be defined as completely safe if well conducted, even in patients with concomitant DVT [5,6]; the general conditions and motor skills pre-existing the acute event influence the outcome of the rehabilitation cycle much more than the extent of pulmonary thrombosis.

Sources of funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Disclaimer statement

The ITACARE-P proceedings in this supplement were reviewed and accepted for presentation by the Scientific Committee of the ITACARE-P National Congress. The views and opinions expressed in these proceedings do not necessarily represent those of the **International Journal of Cardiology Cardiovascular Risk and Prevention**, or Elsevier.

Declaration of competing interest

The authors declare they have no conflict of interest.

Acknowledgments

none.

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