Acute pulmonary embolism in COVID-19 patient: a case report of free-floating right heart thrombus successfully treated with fibrinolysis

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Background
Despite the fast-growing understanding of the coronavirus disease 2019 (COVID-19), patient management remains largely empirical or based on retrospective studies. In this complex scenario, an important clinical issue appears to be represented by the high prevalence of thromboembolic events, but the data regarding high-risk pulmonary embolism (PE) is still not available.

Case summary
A patient with COVID-19 developed sudden shortness of breath and hypoxia. Early echocardiographic diagnosis of high-risk PE related to right heart thrombus was performed. Systemic thrombolysis was administered with excellent clinical and haemodynamic response.

Discussion
Pulmonary thromboembolism is a common occurrence in severe COVID-19 infection. In our experience, systemic thrombolysis proved to be effective and for this reason may be considered for life-threatening PE in COVID-19 patients.

Keywords
COVID-19 • Acute pulmonary embolism • Thrombolysis • Case report

Learning points
- Coronavirus disease 2019 (COVID-19) can predispose patients to venous thromboembolism, even in unexpected sites such as right heart chamber.
- Bedside echocardiography can provide an early diagnostic and prognostic assessment and can guide treatment strategies in high-risk pulmonary embolism (PE).
- From our experience, reperfusion therapy with systemic thrombolysis proved effective and could be thus considered for life-threatening PE in COVID-19 patients, in the absence of other contraindication.

Introduction
The rapid spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) and the resulting coronavirus disease 2019 (COVID-19) has placed an enormous strain on the healthcare systems, with unique implications on the medical practice. Despite the fast-growing understanding of the clinical features of COVID-19, its pathophysiology is still debated and medical treatments remain largely empirical or based on retrospective studies.1 In this complex scenario, an important clinical issue appears to be represented by the high prevalence of...
thromboembolic events, but the data regarding prevalence and management of venous thromboembolism (VTE) is still not available. In a COVID-19 hospitalized patient, we report a case of high-risk pulmonary embolism (PE) related to a right heart thrombus, treated with fibrinolysis.

**Timeline**

| Time | Events |
|------|--------|
| Prior to admission | Two years before, the patient had developed low-risk pulmonary embolism (PE) following an orthopaedic elective surgery. He had started oral anticoagulation, discontinued after 6 months from the index event |
| Admission | The patient presented to the emergency department with a 10-day history of fatigue, fever, and dry cough. Chest computed tomography revealed bilateral interstitial densities consistent with coronavirus disease 2019. Continuous positive airway pressure was started with clinical benefit, but few hours later he developed haemodynamic instability and deoxygenation. Bedside transthoracic echocardiography revealed high-risk PE, with evidence of right ventricle dysfunction and a free-floating thrombus in right heart chambers. Systemic thrombolysis was administered with excellent clinical and haemodynamic response. |
| Follow-up | The patient was haemodynamically stable during his 5 days stay in the intensive care unit. After invasive ventilation weaning, the patient was transferred to the sub-intensive unit to complete the in-hospital course. No bleeding complication related to fibrinolysis occurred |

**Case presentation**

On late March 2020, a 56-year-old gentleman presented to the emergency department with a 10-day history of fatigue, fever, and dry cough. He was febrile and had a respiratory rate of 32 breaths per minute and an oxygen saturation (SaO) of 89% while breathing ambient air. Physical examination proved coarse crackles in the bilateral lower lung fields. Continuous positive airway pressure was started with clinical benefit. Intravenous crystalloid fluid and low weight molecular heparin (Enoxaparin 4000 UI) were administered. Few hours later, he developed sudden haemodynamic instability (blood pressure 74/46 mmHg, heart beats 136 per minute) and deoxygenation (SaO 78%) that required invasive ventilation.

Two years before, the patient had developed low-risk PE following an orthopaedic elective surgery. He had started oral anticoagulation, discontinued after 6 months from the index event due to the absence of other risk factors for VTE.

Laboratory investigations are reported in **Table 1**, leukopenia, increased C-reactive protein, and d-dimer were detected. The electrocardiogram was unremarkable (**Figure 1**). Chest computed tomography scan performed in the first hour after the admission in emergency department revealed bilateral interstitial densities consistent with a viral infectious process (**Figure 2**). The patient was tested for COVID-19 and on the following day the diagnosis was confirmed by real-time reverse transcriptase–polymerase chain reaction analysis. Soon after orotracheal intubation, bedside transthoracic echocardiography (TTE) revealed right ventricle (RV) dilation [RV/left ventricle (LV) ratio >1 (abnormality threshold > 1), RV basal diameter 53 mm (normal range 25–41 mm)] with reduced systolic function [tricuspid annular plane systolic excursion (TAPSE) 10 mm (abnormality threshold > 36 mm)] and pulmonary hypertension [systolic pulmonary arterial pressure 71 mmHg (abnormality threshold > 36 mmHg)]. Moreover, direct visualization of a large free-floating thrombus in the right atrium protruding through the tricuspid valve (**Figure 3A**) confirmed the PE diagnosis and no further imaging was considered necessary.

Due to haemodynamic instability, norepinephrine and intravenous recombinant tissue plasminogen activator 100 mg was administered over the following 2 h. Fibrinolytic and vasopressor therapy promptly alleviated the haemodynamic instability and 12 h later, norepinephrine was gradually withdrawn. After the rtPA infusion, unfractionated heparin infusion was used as a bridge to oral anticoagulation. The follow-up TTE (**Figure 3B**) after 48 h showed complete dissolution of the thrombus in right heart chambers, an improvement of RV dimensions [RV/LV ratio < 1, RV basal diameter 39 mm, RV end-diastolic area indexed to body surface area (BSA) 11 cm²/m² (normal range 5–12.6 cm²/m²)], systolic function [TAPSE 26 mm, S’ 16 cm/s, RV fractional area change 57% (abnormality threshold < 35%)], and pulmonary arterial pressure (35 mmHg), compared to the acute phase.

**Table 1**  

| Laboratory data | Reference range | Value on admission |
|-----------------|-----------------|--------------------|
| White cells (per μL) | 4500–11000 | 2540 |
| Haemoglobin (g/dL) | 12–16 | 13.4 |
| Platelets (per μL) | 150000–400000 | 245000 |
| Activated partial thromboplastin time (s) | 22–38 | 33 |
| International normalized ratio | 0.9–1.1 | 1.01 |
| Sodium (mmol/L) | 135–145 | 137 |
| Potassium (mmol/L) | 3.4–4.8 | 4.7 |
| Glucose (mg/dL) | 70–110 | 235 |
| AST (U/L) | 15–37 | 99 |
| ALT (U/L) | 15–37 | 130 |
| Bilirubin (mg/dL) | <1.15 | 1.4 |
| Creatinine (mg/dL) | 0.6–1.5 | 0.95 |
| D-dimer (mg/L) | <0.5 | >4 |
| C-reactive protein (mg/dL) | <0.75 | 34 |
| Hs troponin I (pg/mL) | <19.8 | 479 |

ALT, alanine aminotransferase; AST, aspartate aminotransferase; Hs, high sensitive.
The patient was haemodynamically stable during his 5 days stay in the intensive care unit. After invasive ventilation weaning, the patient was transferred to the sub-intensive unit to complete the in-hospital course. No bleeding complication related to fibrinolysis occurred.

Discussion

In a COVID-19 hospitalized patient, we described a case of high-risk PE related to a right heart thrombus, a rare life-threatening condition reported only in anecdotal case.4

Thrombotic complications, such as PE, were presented by patients with COVID-19, suggesting that SARS-CoV-2 infection could promote thromboembolic events through several potential mechanisms. First, the severe inflammatory response and disseminated intravascular coagulation could occur in COVID-19 patients predisposing to micro- and macro-vascular pulmonary thrombosis.5 Moreover, virus-induced local inflammatory reactions may affect endothelial cell function leading to vessel wall damage; finally, adverse drug–drug interactions between anticoagulant agents and experimental COVID-19 therapies could induce clinicians to substitute the oral anticoagulant with heparin causing on out of range therapeutic periods.6 On the other hand, systemic anticoagulation could attenuate COVID-19 pro-coagulant profile7 and it is associated with better clinical outcomes among hospitalized patients.8,9 Accordingly, the recommendation of pharmacological thrombotic prophylaxis in hospitalized COVID-19 patients should include high-dose anticoagulant prophylaxis.10 In COVID-19 patients with clinical suspect of PE, bedside TTE is the most useful initial imaging exam, and consequently it was immediately performed. According to the recent international PE guidelines,11 we performed systemic thrombolysis, as it represents the treatment of choice in high-risk PE. Surgical pulmonary embolectomy or percutaneous catheter-directed treatment is alternative reperfusion therapies in patients with contraindications to thrombolysis, if expertise and appropriate resources are available on-site.11 Thrombolytic therapy leads to fast improvements in pulmonary obstruction, pulmonary arterial pressure, vascular resistance, and thus to an improvement in RV function and dimension (as side effect). On these basis, systemic thrombolysis in high-risk PE demonstrated a significant reduction in mortality and VTE recurrence, but with an increased risk of severe extra- and intra-cranial bleedings,12 however, that did not occur in our case report.

Figure 1 Patient’s electrocardiogram.

Figure 2 Computed tomography scan. Bilateral interstitial dens-ities consistent with a viral infectious process.

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Conclusions

Pulmonary thromboembolism is a common occurrence in severe COVID-19 infection, and clinicians should consider all COVID-19 patients at risk of VTE, especially in the presence of clinical suspect, high-risk serum biomarker profile, and initial imaging assessments.

High-risk PE is associated with high mortality. Hence, rapid imaging exam, such as bedside TTE, can provide an early diagnostic and prognostic assessment and can guide treatment strategies.

In our experience, reperfusion therapy with systemic thrombolysis proved to be effective and thus it may be considered for life-threatening PE in COVID-19 patients, in the absence of any other contraindication.

Lead author biography

Dr Fernando Scudiero was graduated at University of Naples ‘Federico II’ and completed his cardiology residency at University Hospital of Careggi, Florence in 2018. He is an interventional cardiology and his scientific interest includes acute coronary syndrome and antithrombotic therapy. When COVID-19 outbreak has disconcerted National Italian Healthcare system, he was enrolled in support of infectious emergency.

Supplementary material

Supplementary material is available at European Heart Journal - Case Reports online.

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Slide sets: A fully edited slide set detailing this case and suitable for local presentation is available online as Supplementary data.

Consent: The author/s confirm that written consent for submission and publication of this case report including image(s) and associated text has been obtained from the patient in line with COPE guidance.

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Figure 3 (A) Transthoracic echocardiography in acute phase during haemodynamic instability; apical four-chamber view. Large right heart thrombus (red arrow). (B) Transthoracic echocardiography 48 h after reperfusion therapy; modified apical four-chamber view. TTE, transthoracic echocardiography.
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