

Surgical treatment of simultaneous pulmonary and paradoxical embolism

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SOUHRN

Je prezentován případ pacienta s atypickými symptomy vzhledem k jeho primární diagnóze. Pacient měl primárně neurologickou symptomatiku. Při vyšetření výpočetní tomografií (CT) byla prokázána kombinovaná plicní i systémová embolie. Následná předoperační jícnová echokardiografie (TEE) prokázala perzistentní foramen ovale (PFO), které bylo patrně cestou k systémové embolizaci, jež vyvolala neurologickou symptomatiku. V kazuistice uvádíme způsob chirurgické léčby kombinované plicní a systémové embolie.

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ABSTRACT

We present a rare case of a patient with atypical symptoms regarding his diagnosis. Patient presented primarily with neurological symptoms. A computed tomography (CT) scan of this patient showed a simultaneous pulmonary and systemic embolism. A subsequent preoperative transesophageal echocardiography (TEE) revealed a persistent foramen ovale (PFO). It was apparently the way of systemic embolism which caused the neurological symptoms. In this case report we describe the therapy of a simultaneous pulmonary and paradoxical embolism.

Introduction

The term 'venous thromboembolism' (VTE) includes both deep vein thrombosis (DVT) and pulmonary embolism (PE). An annual incidence rates for PE range from 39–115 per 100 000 population and it is the third most common vascular disease following myocardial infarction and stroke.¹ The incidence of VTE increases with age and this condition accounts for a significant proportion of morbidity and mortality in European healthcare systems. The cause of VTE is usually described as multifactorial and may be the outcome of multiple prothrombotic factors such as dehydration, trauma, immobilization, smoking, hypercoagulable disorders, usage of hormonal contraceptives, and many more.¹ In the presence of PFO, a case of paradoxical embolism, a state when an embolus spreads from right atrium into systemic circulation, may be encountered.

In case of simultaneous PE and paradoxical embolism, establishing correct diagnosis and therapeutic management

plan can be a challenging task. Especially in patients who are also hemodynamically unstable or have a significant respiratory alteration. There are currently no guidelines concerning the treatment of a combined embolism so an individual approach is needed to establish an appropriate management plan. We present a case of simultaneous PE and paradoxical embolism, with embolization into the subclavian artery.

Case report

71-year-old patient was primarily examined by neurologists due to an acute paresis of his right upper extremity. The patient's history included type II diabetes mellitus, arterial hypertension, and seropositive rheumatoid arthritis. The patient had no previous history of VTE. A week prior to the onset of right upper extremity paresis, the patient suffered a fall and subsequently developed a rather large hematoma on his left lower limb.

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On admission to neurology, the patient presented mainly with right-sided symptoms. The right upper extremity paresis was significant. The Patient was only able to move his fingers slightly. There was also a light paresis of the right lower limb. Left side of the body was unaffected. The patient's tongue was deviating to the left, the pupils were even, and there was low grade dyspnoea.

Due to these findings, a CT angiography (CTAG) of the cerebral arteries was performed. The scan showed no pathology in the focused area, however, an image of no-flow in the upper lung segments was noted. Another CT scan showed a submassive pulmonary embolism and a significant blockage of the right subclavian artery which was most likely due to embolism.

Thrombolysis was not used due to large left lower limb haematoma. Due to a dilatation of the right ventricle (RV), its systolic dysfunction, and tricuspid regurgitation, an embolectomy was indicated and the patient was transported to our department. Preoperatively, the patient was breathing spontaneously, his blood saturation was 83% while on O₂ mask support of 10 l/min and was short of breath when speaking.

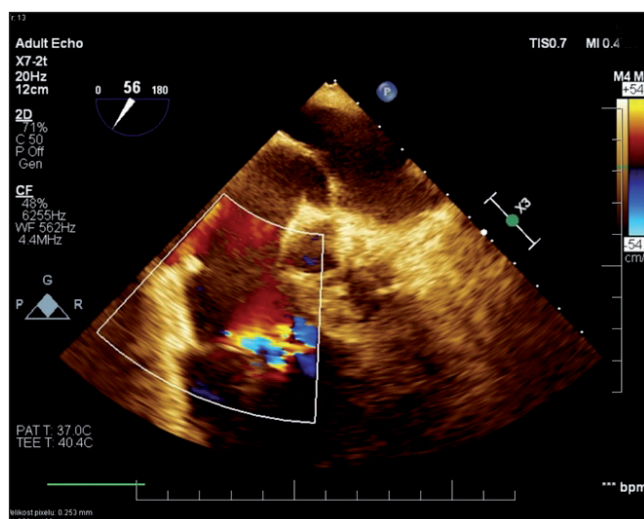


Fig. 1 – Doppler, tricuspid regurgitation.

A peroperative TEE showed a right-sided dilatation, moderate systolic dysfunction of the RV, a tricuspidal regurgitation of 1,5–2 degrees and an PFO with significant right-to-left shunting (Fig. 1). With cardiopulmonary bypass (CPB) and heart arrest, an embolectomy from both pulmonary arteries and PFO closure was performed. During an embolectomy, there was a picture of an almost complete blockage of both pulmonary arteries (Figs. 2, 3).

After the surgery, the patient had sinus rhythm, the RV showed only a mild systolic dysfunction and tricuspidal regurgitation was insignificant. Due to the increase in oxygen saturation on right upper extremity after a dose of heparin on CPB (40 → 83), it was decided not to perform an embolectomy from the subclavian artery.

The patient was extubated the 1st postoperative day (POD), but due to the decrease of saturation, non-invasive ventilation was started. The same day, due to worsening signs of right upper extremity ischaemia, the patient

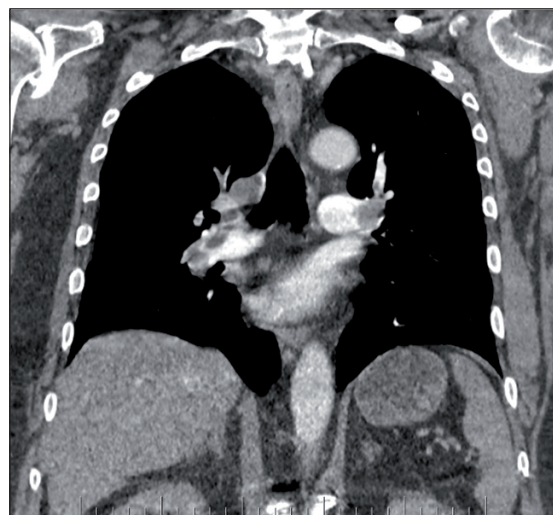


Fig. 2 – Blood clots displayed in pulmonary arteries.

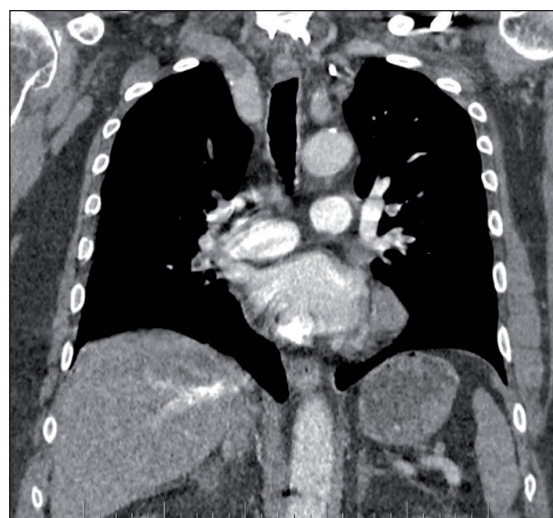


Fig. 3 – Blood clots displayed in a. subclavia l.dx.



Fig. 4 – Clots extracted from pulmonary arteries.

underwent an embolectomy via arteria brachialis. Multiple emboli were gradually removed achieving good flow (Fig. 4). After the surgery, right upper extremity perfusion was normalised. On the 2nd POD, signs of new left lower limb paresis appeared with the CT findings of extensive ischaemia of the cerebellum and the right frontal brain lobe. Conservative therapy was indicated by neurologists.

On the 3rd POD the neurological state and the right upper extremity's mobility were gradually improving and as there were no new changes in the CT images with regards to signs of brain ischaemia. Further conservative management was recommended by the neurologists.

An ultrasonography of deep veins was performed and, as expected, a left lower limb DVT was revealed. Therapeutic dose of low molecular weight heparin (LMWH) with an anti-Xa control was started. On the 6th POD, the patient in stable condition was transferred to the intensive care unit in the general medicine department in local hospital. The patient died on the 20th POD due to an infectious complication – bilateral pneumonia of unknown etiology.

Discussion

The prevalence of PFO in population is 20–34%.² Despite this relatively high prevalence, there are paradoxical emboli and cases of combined pulmonary and paradoxical embolism, described in literature as rare.^{3–8} Paradoxical emboli represent about 2% of arterial embolizations.³ Depending on the site of embolization, paradoxical embolism can cause a wide range of symptoms. Typically associated symptoms are brain stroke, migraines with aura, transient ischaemic attacks, headaches^{2,9}, acute ischemia of limbs and less often acute myocardial infarction or splanchnic ischemia.¹⁰

Paradoxical embolism happens due to an increase in pressure in the pulmonary arteries, when right to left shunt through PFO appears. That happens usually due to a Valsalva manoeuvre. One of the other mechanisms of increased pressure in the pulmonary artery is successive embolization that subsequently increases vascular resistance.⁷ It can be therefore suggested, that in a case of positive neurological presentation with an unclear source of embolism, it may be appropriate to consider the possibility of a simultaneously occurring submassive pulmonary embolism. By that, we can avoid the later consequences such as chronic thromboembolic pulmonary hypertension. Especially in young patients with an unknown origin of systemic embolization it is important to search for PFO and embolism source.

PFO closure is a highly debated issue already for many years. Earliest randomised trials of PFO closure did not demonstrate the superiority of closure compared with medical therapy for the prevention of recurrent stroke but further randomised trials with improved methods did.² Main indications for percutaneous PFO closure are cryptogenic stroke, paradoxical systemic embolisation, platypnoea–orthodeoxia syndrome and decompression illness. Nowadays the percutaneous closure is preferred. With regards to cardiac surgery, there is general agreement that intraoperative PFO closure should be performed when development of a significant right-to-left shunt is highly likely.^{2,12}

In the therapy of simultaneous embolism, there are two main treatment options: thrombolysis or surgical therapy. It is important to realize that we need to manage both conditions according to their severity. With regards to the PE, in cases of haemodynamic instability, thrombolysis is the first-line treatment due to its avail-

ability and quick reperfusion time. If this kind of therapy shows no improvement or it is contraindicated,¹³ a surgical therapy or use of extracorporeal membranous oxygenation (ECMO) is indicated. In cases of a submassive PE with signs of RV dysfunction, we can consider a surgical approach as well. This way of therapy might be chosen because of higher success rates and also to prevent onset of pulmonary thromboembolic hypertension.¹⁴ In general, however, the use of the surgical approach is limited by its availability.¹⁵ There is an ongoing discussion about the optimal treatment method in cases when the thromboemboli are trapped in the heart cavities. According to the experience of our centre, in such cases surgical therapy would be the method of choice as further embolization with possible fatal consequences is prevented.¹¹

Paradoxical embolism is treated with medication or surgery, or both, depending on the emboli location and hospital arrival time.¹⁶ In the past, caval filters were used to help prevent further embolization due to DVT. Nowadays, the indication for caval filters would be cases where there is an absolute contraindication to anticoagulation therapy and in patients of verified recurrence of PE while on effective anticoagulation therapy. In cases of known DVT where anticoagulation therapy is possible, there is currently no indication for caval filters.¹

As mentioned above, the therapy of each modality depends on various factors. As far as there are no strict guidelines in therapy of these patients,¹ we need to consider each case and modality individually, to choose the best management strategy. We should evaluate the situation and adapt the therapy according to a more critical modality.

Our patient had a traumatic hematoma on his left lower limb. That was one of the reasons why we chose surgical therapy. After embolectomy from the pulmonary arteries, there was a postoperative worsening of ischemia of the right upper extremity. Due to the hematoma and previous surgery we could not perform thrombolysis and it was an indication for a surgical approach. The standard procedure in this area is through brachial artery. Surgical embolectomy in our case was followed by a cerebrovascular event. We can't rule out, that this was caused during the procedure, so different approach to embolectomy could be an advantage. During the rest of hospitalization in our department, the patient's condition improved, which allowed us to transfer him to a local hospital. The patient died 20th POD from bilateral pneumonia of unknown etiology.

Conclusion

Combined pulmonary and systematic embolism is a rare condition. As can be seen from this case report, signs of PE can be masked by other more pronounced ones and this can then complicate the diagnostic process and delay the start of the correct treatment. If there is no clear source of systemic embolism, possibility of paradoxical embolism should be considered.

The therapy of a patient with synchronous paradoxical and PE embolism depends on various factors that need to be considered. Although thrombolysis may in many

cases appear to be the optimal first-line therapy, surgical therapy stands an important role in the decision-making process with its advantages. Because of the high possibility of increased right atrial pressure after the embolism therapy, closure of PFO in surgical therapy is important.

References

1. Konstantinides SV, Meyer G, Becattini C, et al. 2019 ESC Guidelines for the diagnosis and management of acute pulmonary embolism developed in collaboration with the European Respiratory Society (ERS): The Task Force for the diagnosis and management of acute pulmonary embolism of the European Society of Cardiology (ESC). *Eur Heart J* 2020;41:543–603.
2. Giblett JP, Williams LK, Kyranis S, et al. Patent Foramen Ovale Closure: State of the Art. *Interv Cardiol Rev* 2020;15:e15.
3. Tang CE. Paradoxical embolism: a rare life- and limb-threatening emergency. *Can J Emerg Med* 2004;6:40–44.
4. Tiryakioglu O, Tiryakioglu S, Toktas F. Simultaneous systemic and pulmonary embolism. *Indian J Thorac Cardiovasc Surg* 2007;23:208–210.
5. Ucar O, Golbasi Z, Gulel O, et al. Paradoxical and Pulmonary Embolism due to a Thrombus Entrapped in a Patent Foramen Ovale. *Tex Heart Inst J* 2006;33:78–80.
6. Vyas A, Singh A, Vyas P, et al. A rare case of simultaneous pulmonary and paradoxical emboli with a thrombus straddling a patent foramen ovale. *J Cardiol Cases* 2011;4:47–49.
7. Dixon T, Panda M, Desbiens N. The Simultaneous Occurrence of Deep Vein Thrombosis and Pulmonary and Arterial Embolization. *J Gen Intern Med* 2007;22:1040–1041.
8. Budavari AI, Glenn TJ, Will KK, et al. A case of simultaneous pulmonary embolism and acute myocardial infarction secondary to a previously undiagnosed patent foramen ovale. *J Hosp Med* 2009;4:E5–E9.
9. Hara H, Virmani R, Ladich E, et al. Patent Foramen Ovale: Current Pathology, Pathophysiology, and Clinical Status. *J Am Coll Cardiol* 2005;46:1768–1776.
10. Banana Y, Rezziki A, Kallel O, et al. Multiple paradoxical embolisms revealing a patent foramen ovale in a patient with deep venous thrombosis: A case report. *Ann Med Surg* 2021;66:102426.
11. Němec P, Uchytíl B, Černý J, et al. Surgical treatment of pulmonary embolism. *Vnitř Lék* 2009;55:779–782.
12. Sukernik MR, Bennett-Guerrero E. The Incidental Finding of a Patent Foramen Ovale During Cardiac Surgery: Should It Always Be Repaired? A Core Review. *Anesth Analg* 2007;105:602–610.
13. Contraindications to thrombolysis –UpToDate. Accessed August 17, 2021. <https://www.uptodate.com/contents/image?imageKey=PULM%2F95035>
14. Pol J, Nešpor D, Uchytíl B, et al. Pulmonary embolectomy combined with suture of a right ventricular traumatic lesion. A case report. *Cor Vasa* 2011;53:130–132.
15. Al-Bawardy R, Rosenfield K, Borges J, et al. Extracorporeal membrane oxygenation in acute massive pulmonary embolism: a case series and review of the literature. *Perfusion* 2019;34:22–28.
16. Hakman EN, Cowling KM. Paradoxical Embolism. In: StatPearls. StatPearls Publishing; 2021. Accessed August 18, 2021. <http://www.ncbi.nlm.nih.gov/books/NBK470196/>