

Case Report

A Novel Technique of Balloon Pulmonary Angioplasty for the Treatment of Total Occlusion Lesions

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ABSTRACT

Balloon pulmonary angioplasty (BPA) has been recognized as an alternative therapeutic approach for patients with inoperative chronic thromboembolic pulmonary hypertension and those with residual pulmonary hypertension after pulmonary endarterectomy. However, the safe and successful treatment rate for a total occlusion lesion (TOL) using BPA is low, mainly because vessels distal to the occlusion are invisible by angiogram. Here, we present the case of a 53-year-old woman with chronic thromboembolic pulmonary hypertension with successfully recanalization of a TOL by use of BPA with the aid of intracardiac echocardiography. The intracardiac echocardiography–assisted wire passage technique may be a promising method for safe and reliable TOL treatment using BPA.


RÉSUMÉ

Il est reconnu que l'angioplastie pulmonaire par ballonnet (APB) est une alternative thérapeutique chez les patients atteints d'hypertension pulmonaire thromboembolique chronique inopérable et chez les patients atteints d'hypertension pulmonaire résiduelle après l'endartériectomie pulmonaire. Toutefois, le taux d'innocuité et de réussite du traitement d'une occlusion totale (OT) à l'aide de l'APB est faible, principalement en raison de l'invisibilité des vaisseaux distaux de l'occlusion à l'angiographie. Dans cet article, nous présentons le cas d'une femme de 53 ans atteinte d'hypertension pulmonaire thromboembolique chez qui la recanalisation de l'OT par l'utilisation de l'APB à l'aide d'une échocardiographie intracardiaque a été réussie. La technique de passage du fil assistée par échocardiographie intracardiaque peut constituer une technique prometteuse pour traiter de façon sûre et fiable l'OT à l'aide de l'APB.

In balloon pulmonary angioplasty (BPA) for chronic thromboembolic pulmonary hypertension (CTEPH), the treatment for a total occlusion lesion (TOL) is the most challenging among various morphology types because vessels distal to the occlusion are invisible.¹ The identification of vessels distal to the occlusion is the key to successful treatment of TOLs.² Herein, we present the case of a 53-year-old woman with CTEPH who underwent successful recanalization of a TOL by BPA with the aid of intracardiac echocardiography (ICE).

Case

A 53-year-old woman was referred to our hospital with exertional dyspnea. After detailed examinations, she was

diagnosed with operable CTEPH and received pulmonary endarterectomy in another hospital. Postoperative catheterization revealed that she had residual pulmonary hypertension with reocclusion of the right lower lobe artery. After BPA sessions for residual stenotic lesions, we attempted to treat the TOL with the conventional method, without success² (Fig. 1, A–D). We therefore devised a method to evaluate the vessel distal to the occlusion under ICE assistance based on previous reports.³ For the ICE procedure, an AcuNav (Biosense Webster, Irvine, CA) was inserted through the femoral vein via the right ventricle into the pulmonary artery and brought close to the occlusion, and the vascular structures distal to the occlusion were assessed in real time during the BPA procedure. After confirming the vascular structure distal to the occlusion using ICE (Video 1  view video online), a guidewire with a load of 30 g was inserted (Fig. 1E). After confirming that the guidewire did not perforate the vessel, using both ICE and intravascular ultrasonography (Eagle Eye Platinum, Volcano, San Diego, CA; Fig. 2, A and B), the vessel was dilated (maximum diameter of 6.0 mm: Fig. 1F). Intravascular ultrasonography

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Novel Teaching Points

- In chronic thromboembolic pulmonary hypertension, the rate of successful treatment for a TOL by balloon pulmonary angioplasty is low because vessels distal to the occlusion cannot be confirmed by angiography.
- There is no established method to confirm whether there are vessels distal to the occlusion, during procedure.
- Using intracardiac echocardiography (ICE), we were able to confirm that there were vessels distal to the occlusion and have successfully recanalized the TOL using BPA.
- The ICE-assisted wire-pass technique has the potential to be a promising method for TOL treatment using BPA.

was used to ensure that the guidewire was accurately placed in the distal part of the occluded vessel, which ICE could not confirm, and to determine the balloon size based on the vessel diameter. Post-procedure blood flow improved to the same level as that in the other vessels, without complications (Fig. 1, G and H; Video 2 [view video online](#)). The ICE images after dilatation are shown in Figure 2C. Hemodynamics and other clinical data are presented in Supplemental Table S1.

Discussion

We report the case of a patient with CTEPH whose TOL was successfully treated with BPA with the aid of ICE. CTEPH patients with TOL are suitable for treatment with pulmonary endarterectomy; however, BPA has been recognized as an alternative therapeutic approach for patients with inoperative CTEPH, those with residual pulmonary hypertension after pulmonary endarterectomy, and high-risk surgical patients.^{1,4} However, the treatment success rate for a TOL by BPA is low compared with that for other angiographic lesion types, because vessels distal to the occlusion are invisible by angiogram, and the occluded organized thrombi are hard and thick. Standard guidewires can barely pass through the target lumen, and heavy tip-loaded wires are at risk of passing outside the vessel and causing lung injury.^{1,2} Therefore, visualization of vessels distal to the occlusion would be optimal. The application of ICE to the pulmonary artery has been reported to be useful for the visualization of the left atrial appendage,³ and ICE imaging was successfully applied to the lumen detection of pulmonary TOLs in this study. The ICE-assisted wire passage technique might be a promising method for safe and reliable TOL treatment using BPA as well as intravascular ultrasound.

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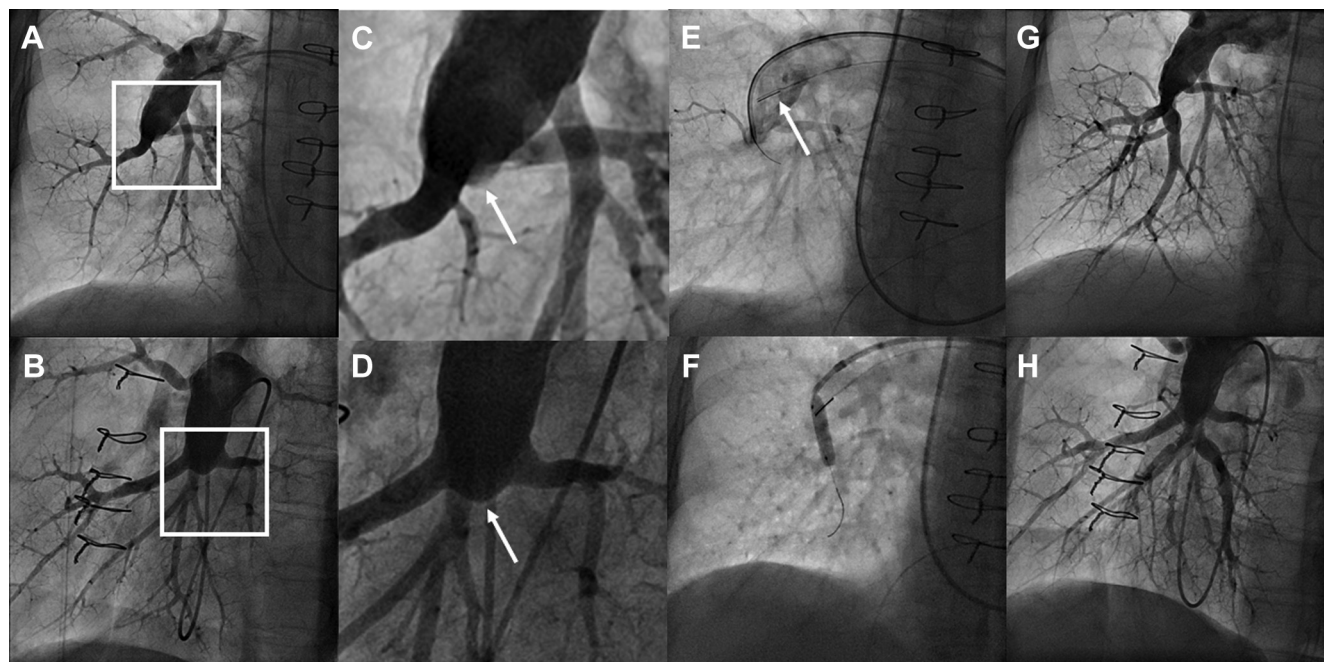


Figure 1. Angiogram during balloon pulmonary angioplasty session. (A, B) Preprocedural angiogram of (A) anteroposterior (AP) and (B) left anterior oblique (LAO) view. (C, D) Magnified image of total occlusion lesion for (C) AP and (D) LAO views. **Arrows** indicate the TOL. (E) Guidewire crossing (arrow: intracardiac echocardiography). (F) Balloon dilation. (G, H) Postoperative angiogram of (G) AP and (H) LAO view.

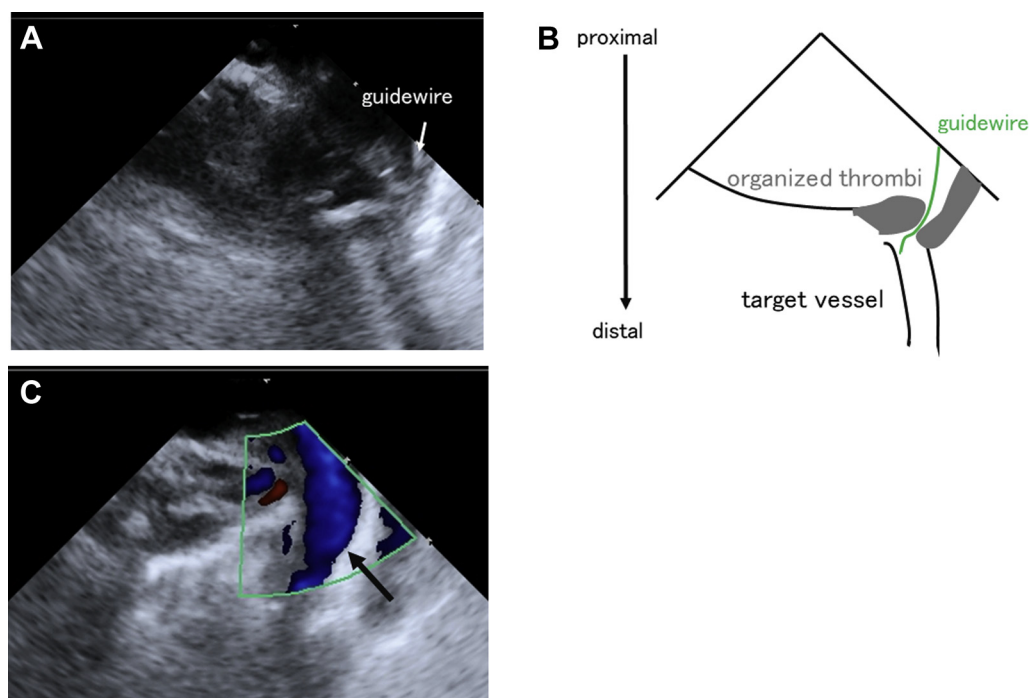


Figure 2. Intracardiac echocardiography (ICE) image during balloon pulmonary angioplasty session. **(A, B)** Preprocedural ICE **(A)** image **(A)** and **(B)** schema. **(C)** Postoperative ICE image with Doppler (**arrow**: recanalized vessel).

Disclosures

The authors have no conflicts of interest to disclose.

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Supplementary Material

To access the supplementary material accompanying this article, visit *CJC Open* at <https://www.cjcopen.ca/> and at <https://doi.org/10.1016/j.cjco.2021.07.009>.