

## EDITORIAL COMMENT

# Vascular Injury During Balloon Pulmonary Angioplasty

## Prepare for the Rare\*

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**B**alloon pulmonary angioplasty (BPA) for inoperable or residual chronic thromboembolic pulmonary hypertension following open surgical endarterectomy has rapidly evolved from a procedure carrying significant risk for serious complications and of uncertain benefit to a mainstay in the management of patients with this challenging condition. This evolution is further supported by findings of the RACE (Balloon Pulmonary Angioplasty vs Riociguat for the Treatment of Inoperable Chronic Thromboembolic Pulmonary Hypertension) study demonstrating greater reduction in pulmonary vascular resistance and greater improvement in functional class with BPA vs riociguat.<sup>1</sup> In this issue of *JACC: Asia*, Ejiri et al<sup>2</sup> report the frequency and management of vascular injury during BPA within their extensive experience of nearly 1,000 BPA procedures in more than 200 patients with chronic thromboembolic pulmonary hypertension treated between 2012 and 2015.

Several aspects of this report in the context of previous world experience are important to bear in mind. First, as previously reported, there can be a learning curve regarding the frequency and consequences of lung injury (13.3% in the initial period vs 5.9% in the later period in the French experience).<sup>3</sup> Ejiri et al<sup>2</sup> also note that in their initial experience, the incidence of lung injury detected by high-resolution computed tomography along with clinical

symptoms was 22% and the necessity of invasive ventilator support was 13%. In their current series, vascular injury requiring treatment occurred in 140 of 956 (14.6%) procedures and in 81 of 207 (39%) patients. Notably, the 30-day mortality was 0, only 1 patient required invasive cardiopulmonary support, and only 4 patients required invasive positive pressure ventilation. Second, more than one-half of the injuries improved with reversal of heparin and administration of high-flow oxygen alone. Third, being prepared to expeditiously proceed with additional measures is critical to avoiding more severe consequences. A total of 26% of vascular injuries required treatment with balloon occlusion, and 24% required gelatin sponge embolization. The authors nicely provide useful video links, including stepwise information regarding the reconstitution and administration of gelatin sponge. Given the relatively rapid adoption of BPA at centers across the world, these tutorials provide a useful service to the interventional community and, hopefully, will result in better preparedness for and reduced incidence of the more serious consequences of vascular injury during BPA. In this regard, it is also important to be aware that in the rare circumstance of a major vascular perforation, placement of a covered stent may avert catastrophic consequences.<sup>4</sup> As the limit of approachable lesions begins to be pushed,<sup>5</sup> preparation for complications is particularly important.

Finally, it is intriguing to note that the RACE study demonstrated significantly fewer serious adverse events (14% vs 42%) in patients who were randomized to riociguat and subsequently underwent BPA during the extension study than in patients who randomized to the initial strategy of BPA.<sup>1</sup> Although there may have been some effect of the learning curve, there is also a rationale that lowering pulmonary artery pressure with riociguat before BPA may improve the safety of BPA by lessening sudden loading of the distal vasculature

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following BPA. This practice is endorsed by the current European Society of Cardiology/European Respiratory Society pulmonary hypertension guidelines stating that in patients with CTEPH undergoing BPA who have pulmonary vascular resistance  $>4$  WU, medical therapy should be considered before the intervention.<sup>6</sup> A mean pulmonary artery pressure  $>35$  mm Hg is another accepted indication for pretreatment before proceeding with BPA.

As the adoption of BPA broadens, it is incumbent on practitioners to rehearse with their interventional teams a stepwise expeditious process for dealing with vascular injury so that when the unexpected happens, the expected outcome is satisfactory. Ejiri et al

are to be commended for providing their expertise regarding best practices in this regard.

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