

L. Marissa Stumbras, M.D., Mark Chesnutt, M.D., John Kaufman, M.D. M.S.
Department of Interventional Radiology, Oregon Health and Science University, Portland, OR

PURPOSE

- To report initial experience with a foam-based embolization plug (IMPEDE, Shape Medical) in the treatment of pulmonary arteriovenous malformations (PAVMs).

BACKGROUND

Pulmonary arteriovenous malformations (pAVM's) are an abnormal and direct connection between an artery and a vein that can pose various complications if left untreated. These complications may include: stroke, transient ischemic attack, intracranial abscess and lung hemorrhage^{1,2}. These malformations are frequently described in those with Hereditary Hemorrhagic Telangiectasia. The mainstay of treatment for pAVM's requires embolization of the 'feeding artery'¹.

There are many different techniques available to embolize pAVM's. The three main technologies for embolization are coils, vascular plugs, and in the past detachable balloons². Recently, an embolization device combining a shape memory polymer and an anchoring coil has become available³. This device is a combination of a porous, biocompatible and non-inflammatory material that expands after deployment to fill the intravascular space. In pre-clinical animal studies the polymer was resistant to recanalization³. The polymer is attached to an anchoring coil that is deployed first to stabilize the device. The plug is then exposed by withdrawing the delivery catheter while stabilizing the device with a pusher wire or catheter. The top of the polymer is indicated by a radio-opaque marker. Currently the device is not provided in a detachable format. There are no clinical publications reviewing the outcomes of these new plugs.

MATERIALS & METHODS

- Retrospective chart review of all PAVM patients treated with the IMPEDE foam plug at a single center
- The following data was collected: number of PAVMs embolized, size of foam plug used in the procedure, additional embolic devices used, time elapsed until complete occlusion visualized, change in oxygen % saturation pre-and post-procedure, reported intraprocedural neurologic events, number of months until follow up, findings on repeat imaging, and need for re-embolization of the target vessel.
- Analyses were performed in Microsoft Excel

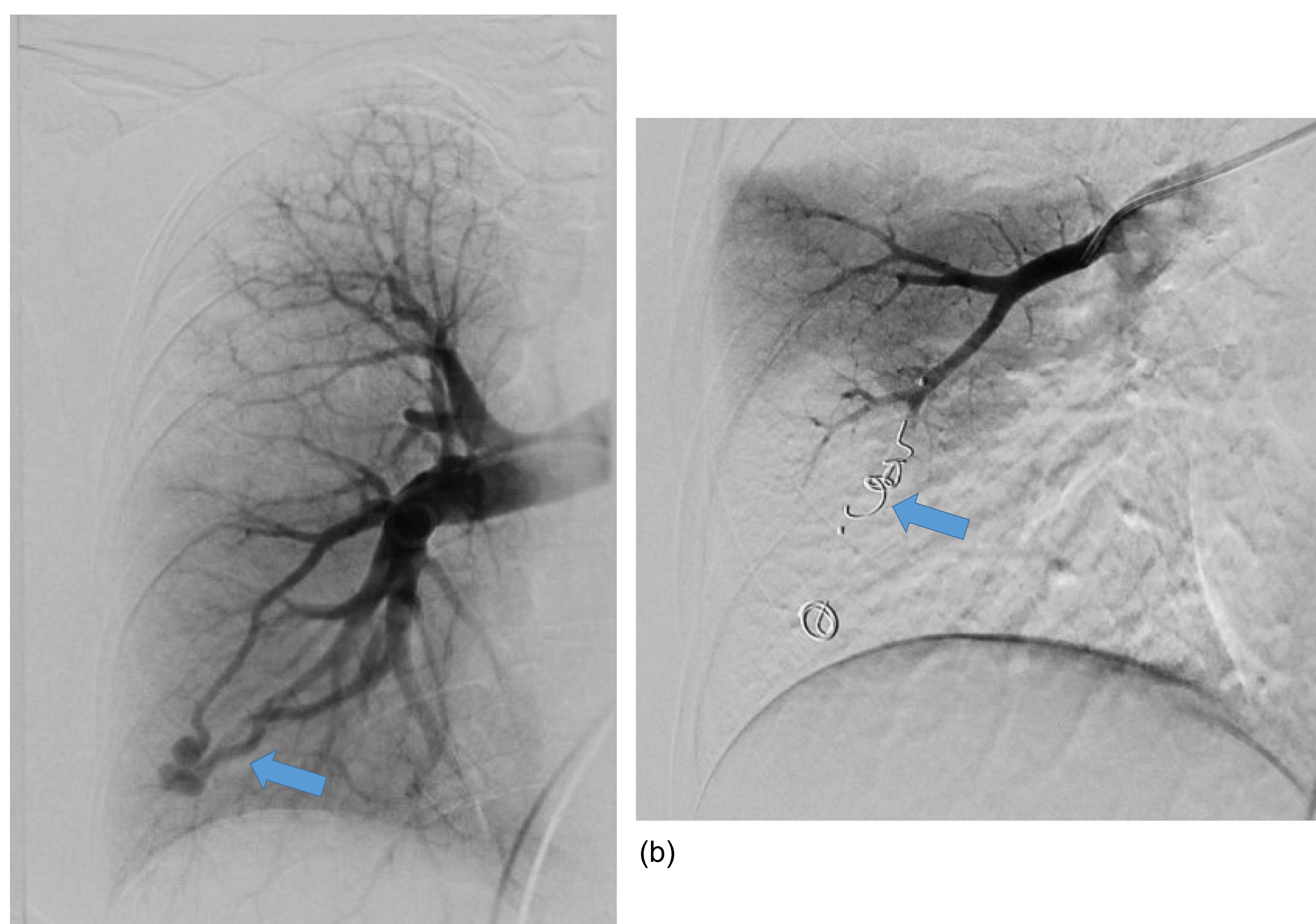
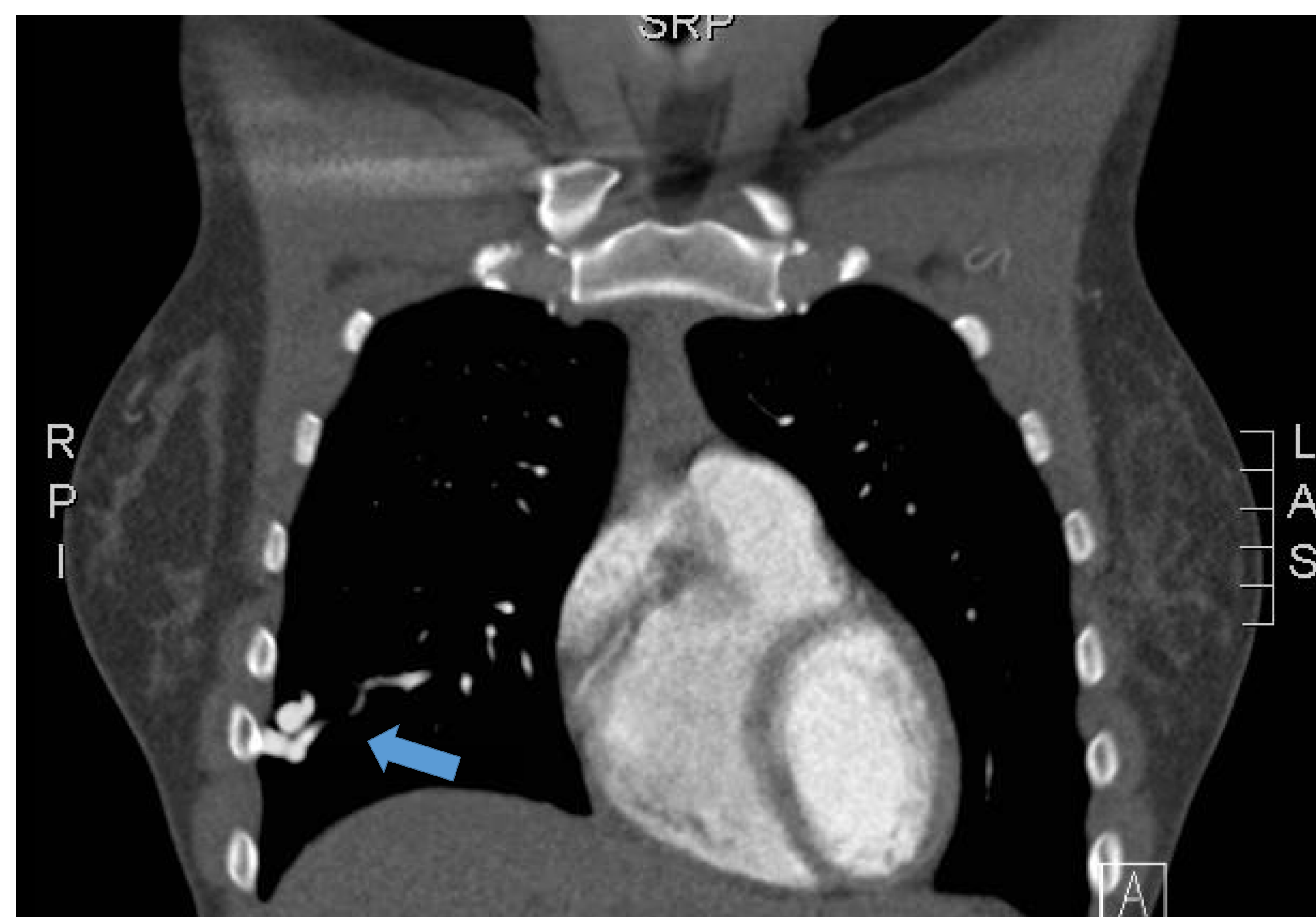
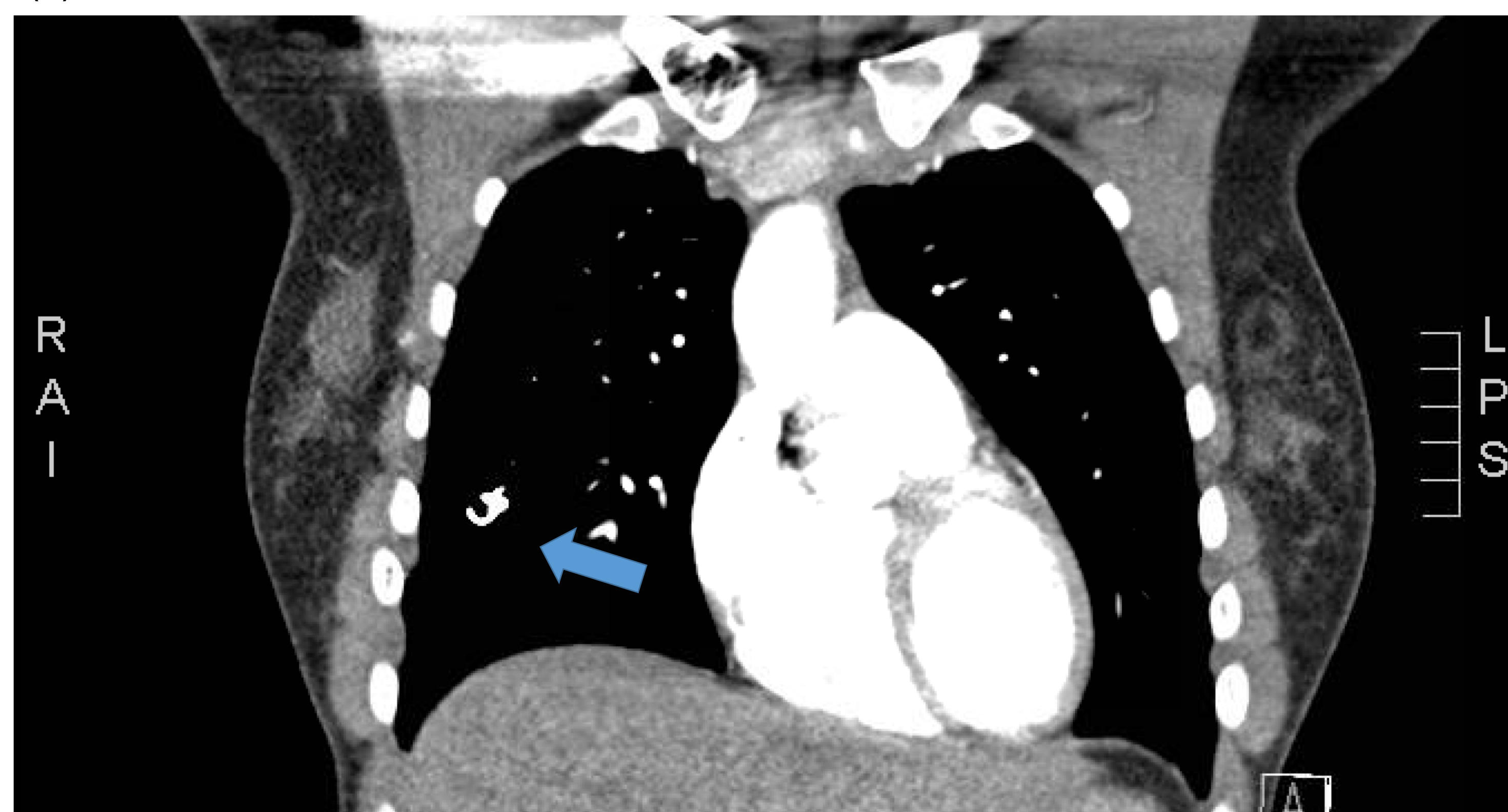


Image (a) shows a patient with a pAVM before embolization, and (b) demonstrates post-embolization with two 5mm IMPEDE plugs. Follow up CTA five months later shows the previous AVM is now resolved, with posttreatment changes in the right lung laterally without residual abnormal enhancement around this region.



(c)

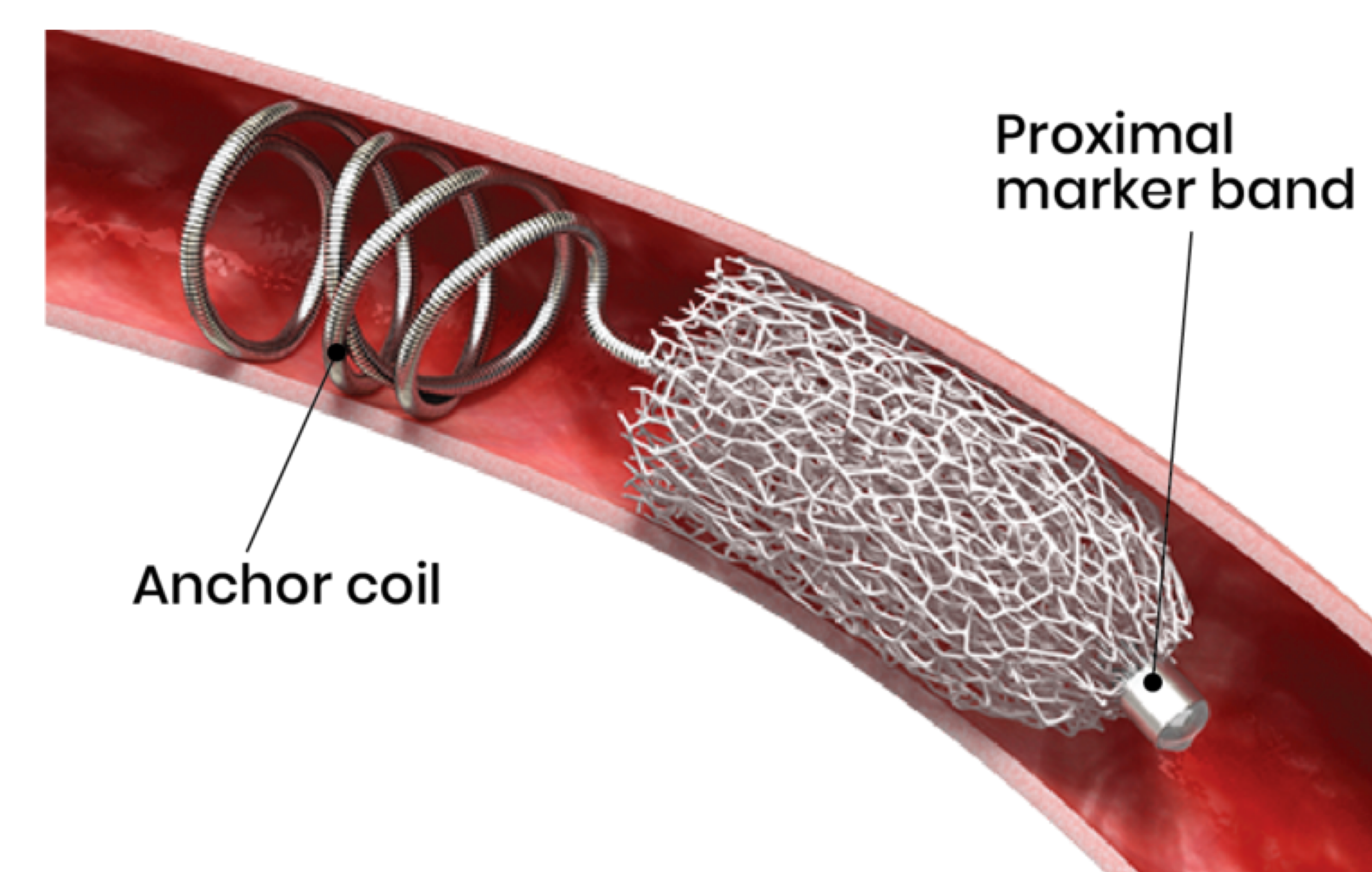


(d)

Image (c) shows initial CTA chest showing large right pAVM. Image (d) demonstrates follow up CTA five months later with the previous AVM now resolved, with posttreatment changes in the right lung laterally without residual abnormal enhancement around this region.

RESULTS

- A total of 12 patients had 15 PAVMs embolized with foam plugs.
- The most frequently used plug size was 5mm, with a range of 5-10mm.
- One plug was used per PAVM in 13 PAVMs, and two plugs were used in 2 PAVMs. Additional nitinol plugs were used in 3 PAVMs. Additional coils were used in 6 PAVM's.
- Time during the procedure until complete occlusion of the foam plug ranged from 10-30 minutes, but this was recorded in only 3 patients.
- No neurologic events were reported during the embolization procedures.
- Change in oxygen saturation was noted to improve in most cases, though the average was nearly a 2% increase, with a range from 0-7%.
- Follow up imaging was available in 50% of patients an average of 8 months post-procedure.
- No reperfusion of the PAVMs was reported thus far.



(e)

Image (e) demonstrates a model of the IMPEDE plug with its foam based plug and anchor coil in a blood vessel³.

CONCLUSIONS

Initial experience with foam-based embolic plugs in PAVM embolization demonstrates satisfactory early procedural and clinical outcomes. Additional experience and long-term follow-up is necessary.

REFERENCES:

1. Tellapuri S, Park HS, and Kalva SP (2018). Pulmonary Arteriovenous Malformations. *The International Journal of Cardiovascular Imaging* 35:1421-1428.
2. Hsu CC, Kwan GN, Thompson SA, Evans-Barns H and van Driel ML (2015). Embolisation for Pulmonary Arteriovenous Malformation. *Cochrane Database of Systematic Reviews, Issue 1*. Art. No.: CD008017
3. Shape Memory Medical: <https://www.shapemem.com/impede>