

Purpose

To examine factors that may lead to failure to occlude previously treated & recanalized pulmonary arteriovenous malformations (PAVMs) with a polytetrafluoroethylene-covered (PTFE) nitinol microvascular plug (MVP).¹

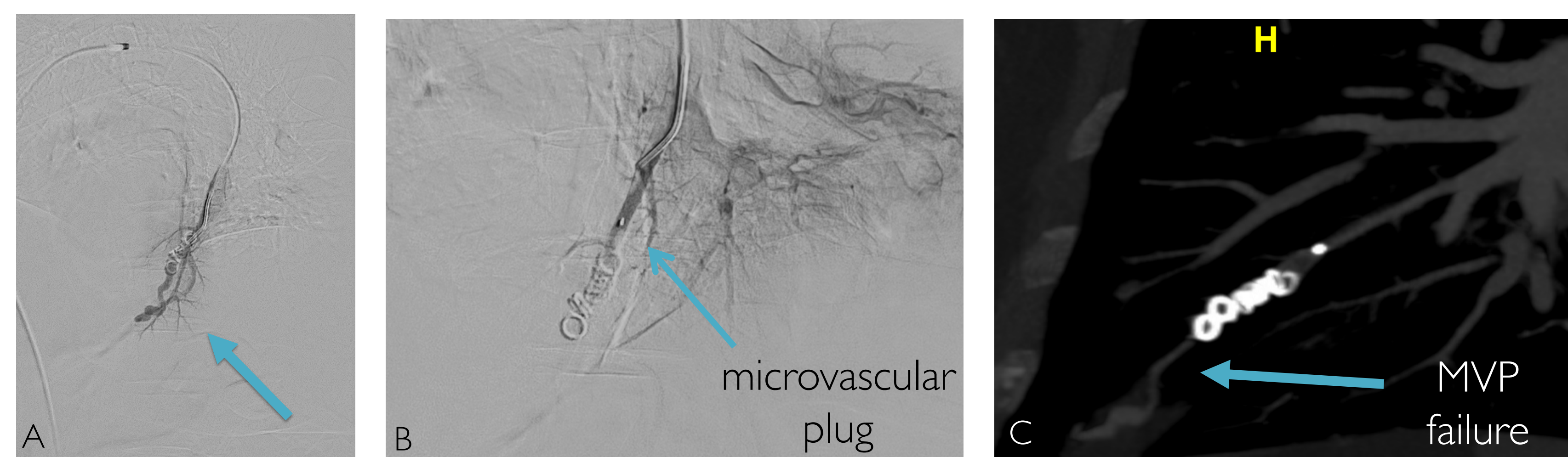
Methods

PTFE-covered nitinol MVP deployment and occlusion was studied in an in vitro embolization model. The model was designed using a complex of plastic tubing, a pulsatile pump, and a c-arm to radiographically evaluate successful vessel occlusion. The MVPs and coils were deployed through a 5 Fr catheter into the model vessel under radiographic guidance. Contrast injection under fluoroscopy was used to evaluate flow within in the tubing pre and post embolization.

The presence of coils prior to MVP deployment was examined to simulate a previously treated PAVM as a potential factor limiting microvascular plug efficacy. 1, 2, and 3 coils were deployed distal to the MVP.

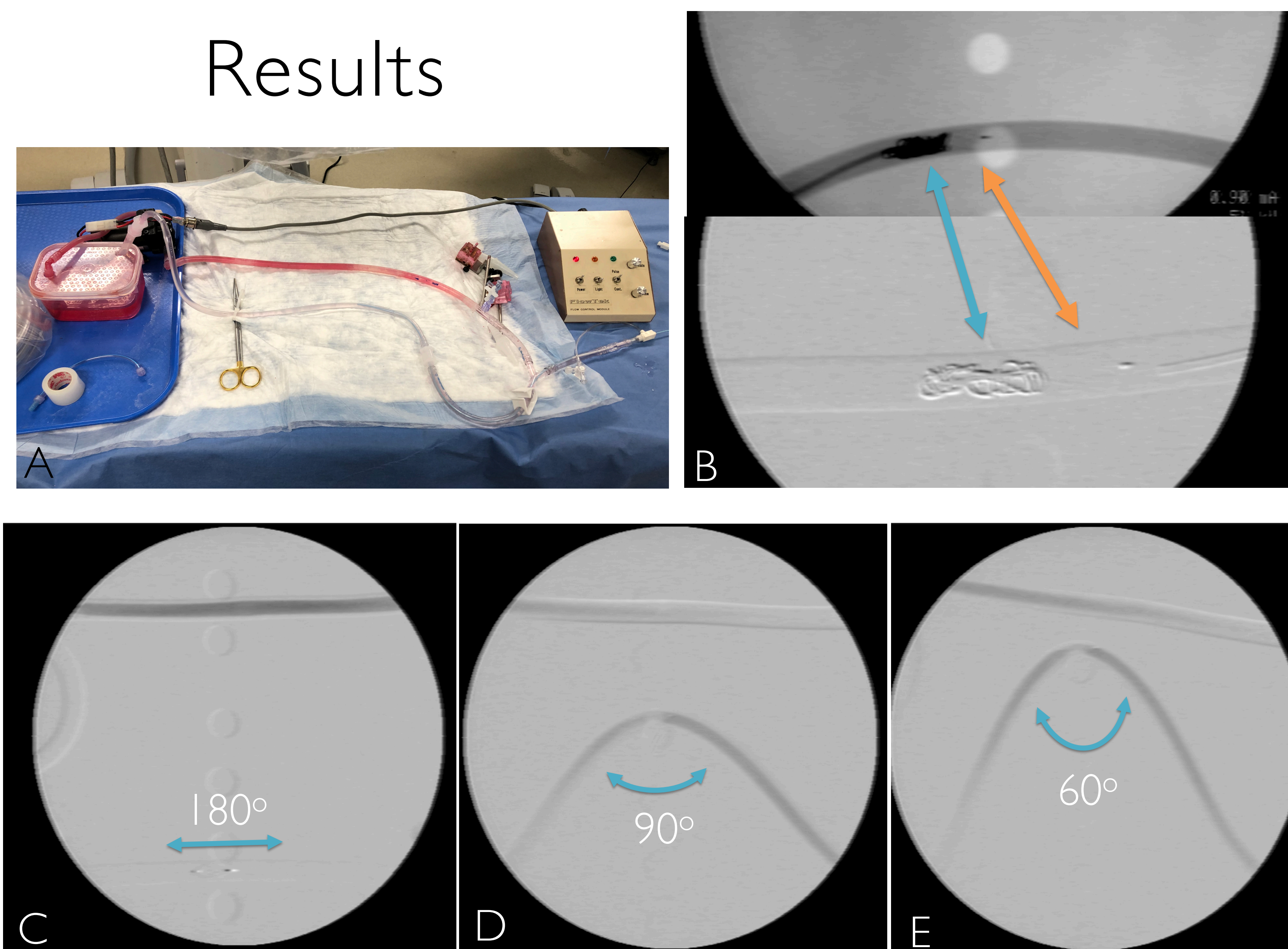
Feeding artery tortuosity was also examined to simulate complex anatomy as a potential factor limiting MVP efficacy. "Tortuosity angle" is measured as the smallest arc between the proximal and distal ends of vessel mimic. Assessment of tortuosity effect on MVP occlusion was done in 30° increments, starting at 180°. Device failure was assessed by visually determining presence of leak flow across MVP device. All tests were done in duplicate.

MVP Failure: a case



A. PAVM previously treated by coiling recanalizes. B. MVP deployed proximal to coils occludes PAVM during treatment. C. Later, PAVM recanalizes again, implying MVP failure.

Results



A. Experimental setup. Pulsatile pump feeds two parallel vessel mimics. B. MVP (orange) deployed proximal to coils (blue) C. Tortuosity angle of 180° demonstrates no leak flow, (D) 90° shows minimal leak, (E) and 60° shows significant MVP failure.

Tabular Results

Tortuosity Angle (deg)	Leak Flow
180	-/-
150	-/-
120	-/-
90	+/-
60	+ /++
30	++ /++

Duplicate results are coded as: ++ high leak flow, + low leak flow, - no leak flow.

Results

Coils previously deployed prior to MVP placement alone did not diminish vessel occlusion. Progressively acute vessel angulation diminished the efficacy of vessel occlusion. Angles smoother than the 'critical angle' (empirically determined to be 60°) did not produce any leak despite distal devices.

Discussion

Prior coil embolization had no demonstrable effect on MVP-mediated occlusion, while vessel tortuosity diminished MVP effectiveness in an in vitro embolization model.

References

- Ratnani R, Sutphin PD, Koshti V, Park H, Chamarthy M, Battaile J, et al. Retrospective Comparison of Pulmonary Arteriovenous Malformation Embolization with the Polytetrafluoroethylene-Covered Nitinol Microvascular Plug, AMPLATZER Plug, and Coils in Patients with Hereditary Hemorrhagic Telangiectasia. *J Vasc Interv Radiol.* 2019 Jul 1;30(7):1089-97.