

# Angioplasty-Induced Cephalic Arch Rupture

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Stenosis within the cephalic arch, the central most portion of the cephalic vein, occurs in up to 77% of dysfunctional brachiocephalic arteriovenous fistulas (AVFs).<sup>1</sup> Though angioplasty is the first-line treatment, subsequent patency is low, estimated to be 25% at 1 year.<sup>2</sup> Additionally, angioplasty at this site is more commonly complicated by vessel rupture than at other sites within arteriovenous (AV) accesses.<sup>3</sup>

The authors describe a case of a 76-year-old woman with a past medical history of end-stage renal disease (ESRD) secondary to hypertension who had a left upper arm brachiocephalic fistula created 60 weeks prior to the procedure. The AVF was first used 7 weeks after its creation. The AVF continued to work well for another 51 weeks but then subsequently developed low flows, poor clearance, and prolonged bleeding. She was therefore referred to interventional radiology for fistulogram and possible intervention. Initial antegrade angiogram (→**Fig. 1**) showed moderate cephalic arch stenosis. After sizing the balloon to match the diameter of the adjacent normal cephalic vein, angioplasty was performed with a 7-mm-diameter high-pressure balloon (Conquest Bard PV) (→**Fig. 2**). No sheath was placed to decrease procedural time and costs. Because no sheath was placed, the balloon and wire were then intentionally pulled back to perform a repeat angiogram. This showed significant extravasation at the site of angioplasty consistent with vessel disruption (→**Fig. 3**). Using a Kumpe (Cook Medical) catheter, a Glidewire and balloon were successfully renegotiated with only mild difficulty across this site of disruption where low-pressure inflation was done for 5 minutes (→**Fig. 4**). Repeat angiogram showed cessation of contrast extravasation and good flow through the cephalic arch (→**Fig. 5**). The fistula remains patent and well functioning 10 months after this intervention.

In the United States, approximately 65% of ESRD patients dialyze through an AVF.<sup>4</sup> The second most preferred type of AVF is the brachiocephalic fistula that has a connection between the side of the brachial artery to the end of the

cephalic vein above the elbow.<sup>5</sup> Stenosis inevitably develops within any AV access. For the brachiocephalic fistula, it most commonly occurs within the cephalic arch, occurring in up to 75% of dysfunctional brachiocephalic fistulas.<sup>1</sup> Multiple factors contribute to the development of stenosis at this site including turbulent flow, given its arching configuration, high concentration of venous valves, and extrinsic compression by surrounding clavipectoral fascia.<sup>6</sup>

Cephalic arch stenosis leads to typical signs of outflow stenosis, including elevated venous pressures, abnormal increased pulsatility, prolonged bleeding after dialysis, and slow flow, and, if severe enough, it can cause access thrombosis. Standard treatment consists of balloon angioplasty, although patency after this is 23% at 1 year,<sup>2</sup> below KDOQI target and patency at other sites.<sup>5</sup> Other potential treatments include stent graft placement, intentional flow reduction, and surgical turndown of the cephalic vein to the axillary vein.<sup>3</sup>

In addition to being an obstinate site to treat, a significantly higher rate of vessel rupture after angioplasty occurs at this site. Vessel disruption has been reported to occur in up to 15%<sup>7</sup> of angioplasties at this site, compared with less than 2% at other sites.<sup>8</sup> This higher rate of rupture is possibly due to the need for higher-pressure balloons at this site.<sup>6</sup> Initial treatment of angioplasty-induced venous rupture is prolonged (3–5 minutes), low-pressure (2–5 atmospheres) balloon inflation.<sup>9</sup> If extravasation persists after the first inflation, this can be repeated two more times or consideration can be given to stent graft placement.<sup>10</sup> Essential to using either technique is maintaining a guidewire across the site of stenosis/extravasation. “Sheath-less” technique, as used here, necessitates loss of guidewire access and should be avoided for all fistulograms, especially when treating sites prone to rupture such as the cephalic arch. If a guidewire is not maintained and cannot be regained across a site of extravasation, surgical ligation or coil embolization may become necessary.

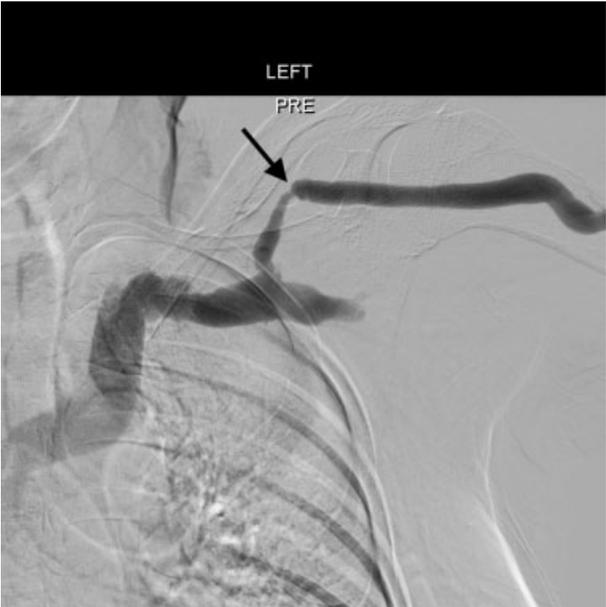
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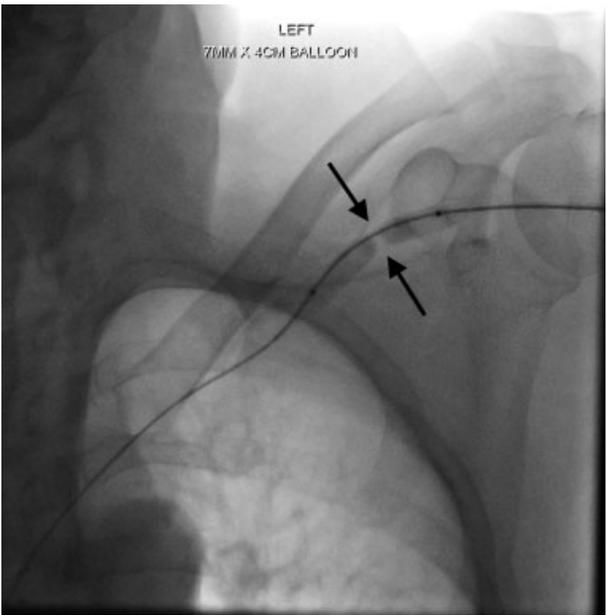
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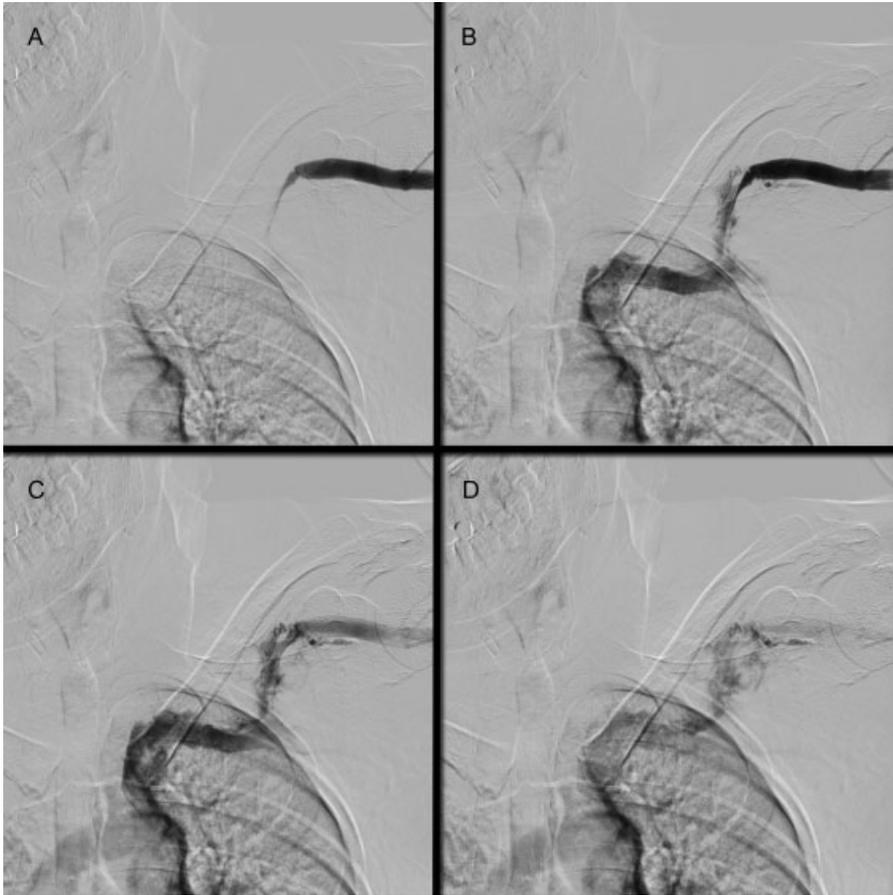




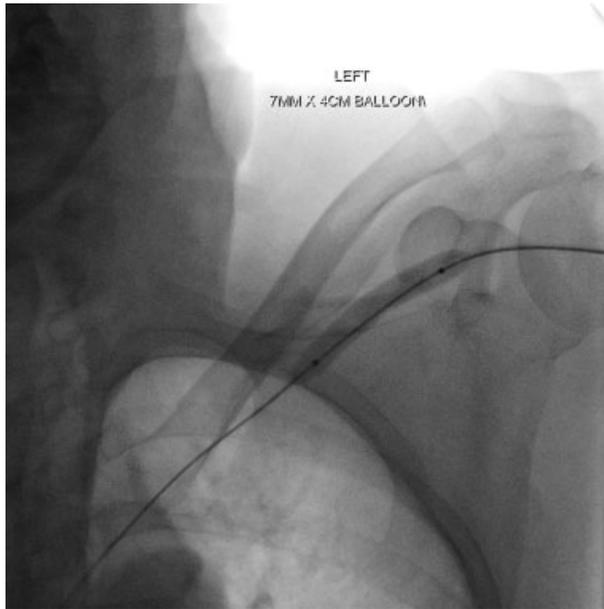
**Fig. 1** Initial angiogram shows focal moderate stenosis in the cephalic arch (black arrow).



**Fig. 2** Spot fluoroscopic image during insufflation showing focal waist in the balloon at the site of stenosis.



**Fig. 3** Four sequential angiographic images after balloon dilation show significant luminal narrowing within the cephalic arch (A) followed by significant extraluminal contrast accumulation consistent with extravasation and vessel rupture (B–D).



**Fig. 4** A wire was then renegotiated through the site of extravasation and into the SVC. Over this wire, a 7-mm balloon was inflated at low pressure for 5 minutes.



**Fig. 5** Repeat angiogram now shows resolution of the contrast extravasation and interval improvement in luminal diameter from the initial angiogram.

## Conclusion

The cephalic arch is a frequent site of stenosis in brachiocephalic fistulas, and although first-line treatment is angioplasty, patency rates are lower and rates of vascular rupture are higher than at other sites. The two mainstays of angioplasty-induced vessel rupture during fistulograms are prolonged balloon inflation and, if necessary, the placement of a covered stent across the site of extravasation. This case illustrates this known complication of cephalic arch angioplasty and how to treat it. One lesson to be learned is to always maintain guidewire access until repeat angiogram is performed. “Sheath-less” technique for fistulograms, especially when treating the cephalic arch, should be avoided.

## Conflict of Interest Statement

Neither author has relevant conflict of interest.

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