A technique to facilitate blood sampling from the right adrenal vein is described. Between May 2012 and February 2015, 148 adrenal vein sampling (AVS) procedures were attempted. In 72 procedures, a simple 5-F end-hole catheter was employed. In 76, a coaxial guide wire technique was used when blood could not be aspirated, whereby a 0.018-inch guide wire was passed through the catheter and into a branch of the right adrenal vein and the sample was drawn around the wire by using a side-arm adaptor. Successful sampling was achieved in 71 of the 72 catheter-only procedures (98.6%) and in 75 of the 76 coaxial wire-assisted procedures (98.7%). This simple technique may eliminate the need for multiple catheter exchanges during AVS.

Adrenal vein sampling (AVS) is a critical tool in the subtype evaluation of the patient with primary aldosteronism. Successful sampling of both adrenal veins is necessary to differentiate between a unilateral aldosterone-producing adenoma, which is treated with surgery, and bilateral hyperplasia, which is medically managed. Reported success rates for bilateral AVS range from 42% to 96%, with most failures caused by an inability to catheterize or successfully draw blood from the right adrenal vein (1–3). Here we present a simple technique to facilitate the aspiration of blood during right AVS.

**MATERIALS AND METHODS**

Between May 2012 and February 2015, 148 AVS procedures were performed in 147 patients. Of these, 142 had biochemical evidence of hyperaldosteronism, three had hyperandrogenism, and two had corticotropin-independent Cushing syndrome. All procedures were performed on an outpatient basis with conscious sedation following written informed consent. This retrospective review was approved by the institutional review board. All procedures were performed by a single operator.

The right common femoral vein was accessed under ultrasound guidance, and a 5-F sheath was placed. For patients with primary aldosteronism, cosyntropin 50 μg/h was infused intravenously for a minimum of 30 minutes before the procedure and was continued until after the last sample was obtained. Our protocol is to sample the veins sequentially, usually the right adrenal vein followed by the left adrenal vein and then the right external iliac vein as the inferior vena cava (IVC). Heparinized saline solution (2 U/mL) was used to flush the catheters, but no additional heparin was administered. A variety of 5-F catheter shapes were employed, each with a 0.035-inch or 0.038-inch end hole. Most commonly, a Chuang B catheter (Cook, Bloomington, Indiana) was employed. Catheters with side holes were not employed. Satisfactory catheter position was confirmed with a limited venogram, and the sample (5 mL) was obtained with gentle, intermittent aspiration. A second limited venogram was obtained after the sample was obtained to confirm continued satisfactory catheter position. After the three samples were obtained, the sheath was removed and hemostasis was obtained with manual compression.
For patients in whom the right adrenal vein could be catheterized but blood could not be aspirated, a coaxial guide wire technique was employed. With the catheter tip seated in the right adrenal vein, a 0.018-inch guide wire (Transend; Boston Scientific, Natick, Massachusetts) was advanced through the catheter and into a branch of the right adrenal vein to deflect the end hole away from the wall of the vein. Contrast medium was injected around the wire by using a side-arm hemostatic valve (Passage Hemostatic Valve; Merit Medical Systems, South Jordan, Utah) for limited venography (Fig). When the catheter tip had been confirmed to be in the adrenal vein, the blood sample was aspirated around the wire, and a second venogram was obtained to confirm continued satisfactory catheter position.

Samples were assayed for cortisol and aldosterone for patients with primary aldosteronism or for cortisol plus epinephrine, norepinephrine, testosterone, or dehydroepiandrosterone sulfate as indicated. Successful sampling was defined as an adrenal vein–to–IVC cortisol ratio of greater than 5:1 for patients receiving cosyntropin or greater than 3:1 for patients not receiving cosyntropin.

RESULTS
Seventy-six procedures employed the coaxial guide wire technique, and 72 employed an angiographic catheter alone. Successful sampling was achieved in 146 of 148 patients (98.4%) as defined as a satisfactory adrenal vein–to–IVC cortisol ratio. Success rates were 98.7% (75 of 76) for the coaxial guide wire group and 98.6% (71 of 72) for the catheter-alone group. In the two failures (one from each group), blood samples were obtained but the adrenal vein–to–IVC cortisol ratios were 1.0 and 1.5, indicating that the wrong site was sampled.

One complication was encountered (adrenal infarct, 0.7%), and it occurred in the coaxial guide wire group. This patient experienced significant back and chest pain with the contrast medium injection but not the wire placement, and computed tomography (CT) identified a new right adrenal hematoma. Aldosterone production lateralized to the right adrenal gland, and the systemic aldosterone levels decreased to normal levels 24 hours after the procedure. The patient was then lost to follow-up.

DISCUSSION
The greatest challenge in AVS is obtaining the sample from the right adrenal vein. One must first identify and catheterize the right adrenal vein, and second successfully aspirate the blood sample. Techniques to identify the right adrenal vein include its characteristic branching pattern, its location just inferior to the origin of the accessory right hepatic vein, posterior chest pain during venography, or staining of the gland when C-arm CT is combined with venography (4–6). Some centers employ a rapid cortisol assay in the procedure room to confirm sample adequacy. The cost and complexity of maintaining the quality control of such an assay prevents it use in our institution.

Techniques to facilitate aspiration of blood from the adrenal vein include the use of a variety of catheter shapes to direct the end hole down the lumen of the vein, creation of a small side hole adjacent to the catheter tip, and the use of a coaxial microcatheter advanced into the adrenal vein. Although the use of a variety of catheter shapes may be effective, it is often frustrating and time-consuming. Use of a side-hole catheter runs the risk of drawing the majority of the sample from the IVC if the vein is not catheterized deeply enough. If a microcatheter is used, the sample may be obtained too selectively, and venous effluent from the proximal adrenal gland not sampled, leading to a potential false-negative result.

Buckley et al (7) described this coaxial catheter/guide wire technique to facilitate selective parathyroid venous sampling, and we have applied the same technique to the problem of AVS. The coaxial guide wire deflects the catheter tip away from the vein wall, and the blood sample is then easily obtained with gentle intermittent aspiration. A similar technique was described in 1983 by Bookstein (8), who used a custom reverse-tapered guide wire; however, the technique described here employs stock, off-the-shelf supplies. In addition to facilitating aspiration of the sample, the guide wire appears to provide some stability for the catheter position. In none
of the 76 patients in the coaxial guide wire group was the catheter dislodged from the adrenal vein by respiratory motion during the time required to draw the sample. Our current practice is to proceed directly to the coaxial guide wire technique if blood return cannot be obtained from the first catheter employed. Although the creation of a side hole immediately adjacent to the catheter tip is an inexpensive potential solution, in our experience, it is not as reliable as the coaxial guide wire technique. We have also applied this technique to venous sampling in the parathyroid and gonadal veins, with a similar decrease in the frustration that these procedures can generate.

In the present study population, the coaxial guide wire technique did not change the overall success rate for AVS. However, this is an additional tool to apply to a challenging procedure. This may be especially useful for interventional radiologists who are infrequently asked to provide this service.

REFERENCES

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