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CORRESPONDENCE

Simplifying adrenal vein sampling for cardiologists "In the New Era of Catheter Treatment for Hypertension"

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Primary aldosteronism (PA) is the chief cause of secondary hypertension (HT), and is a relatively common disease [1]. Currently, the only curative therapy is adrenalectomy. PA can be caused by aldosterone-producing adenomas, which can be diagnosed by computed tomography (CT) and can also be caused by aldosterone-producing microadenomas and idiopathic hyperaldosteronism. When localization is solely based on imaging, the incorrect adrenal gland is removed in 40% of patients. Therefore, performance of adrenal vein sampling (AVS) before surgical adrenalectomy is essential [2].

Physicians, especially cardiologists, are often involved in managing PA, and they often hesitate to perform AVS for various reasons. First, physicians may be reluctant to employ invasive AVS and adrenalectomy for treatment of a benign disease like HT. Second, relatively few physicians have experience with AVS compared with the number of PA patients. Third, AVS has a high failure rate [3]. Fourth, AVS is positioned as the final preoperative diagnostic procedure, which imposes a responsibility on the operator to avoid failure. Fifth, assuming that the prognosis is the same with surgical treatment or medical treatment, it is easier to offer antihypertensive therapy. For these reasons, cardiologists are often unenthusiastic about the screening and investigation of PA.

However, we sometimes encounter PA patients for whom adrenalectomy should be strongly recommended, such as younger patients with treatment-resistant HT, patients with target organ damage, and patients who have survived cardiac arrest due to hypokalemia [4]. In such cases, if a radiologist capable of performing AVS is not available, a cardiologist may have to perform the procedure instead.

It was recently reported that renal sympathetic denervation (RDN) is effective for lowering blood pressure [5], suggesting that catheter intervention will become an option for treatment of HT. RDN will be introduced for screening of secondary HT in the near future, and this will likely result in cardiologists encountering many PA patients. Therefore, we propose a catheter system for AVS similar to that of coronary intervention that can be safely and reliably applied by cardiologists.

One of the major sources of difficulty with AVS is unstable catheter engagement in the right adrenal vein, because this vein drains directly into the inferior vena cava. While catheters of various shapes are available, a catheter with weak backup will easily come out of the adrenal vein due to respiratory movements. Conversely, a catheter that provides strong backup tends to cause vascular complications: adrenal hemorrhage and adrenal vein dissection have occasionally been reported as complications of AVS [6, 7]. A microcatheter is necessary for detailed AVS, and stable engagement of the guiding catheter is required before advancing the microcatheter into the adrenal gland. The close proximity of the microcatheter to the vein walls makes blood aspiration difficult; to avoid failure, selection of a microcatheter with semicircular holes on both sides of the tip is helpful. We encourage the use of a 6 French (Fr) or larger guide catheter rather than a 5 Fr catheter. When a guide wire or microcatheter is inserted through a 5 Fr guiding catheter, most of the catheter lumen is occupied; as a result, the contrast medium cannot be injected for adrenal vein enhancement, and blood samples cannot be collected (Fig. 1a). Accordingly, repeated insertion and removal of the system is required for blood collection, and a 5 Fr guiding catheter can easily come out of the right adrenal vein.

Therefore, for AVS, we propose the use of the same catheter system as that employed for percutaneous coronary intervention (PCI). The AVS procedure is much easier with

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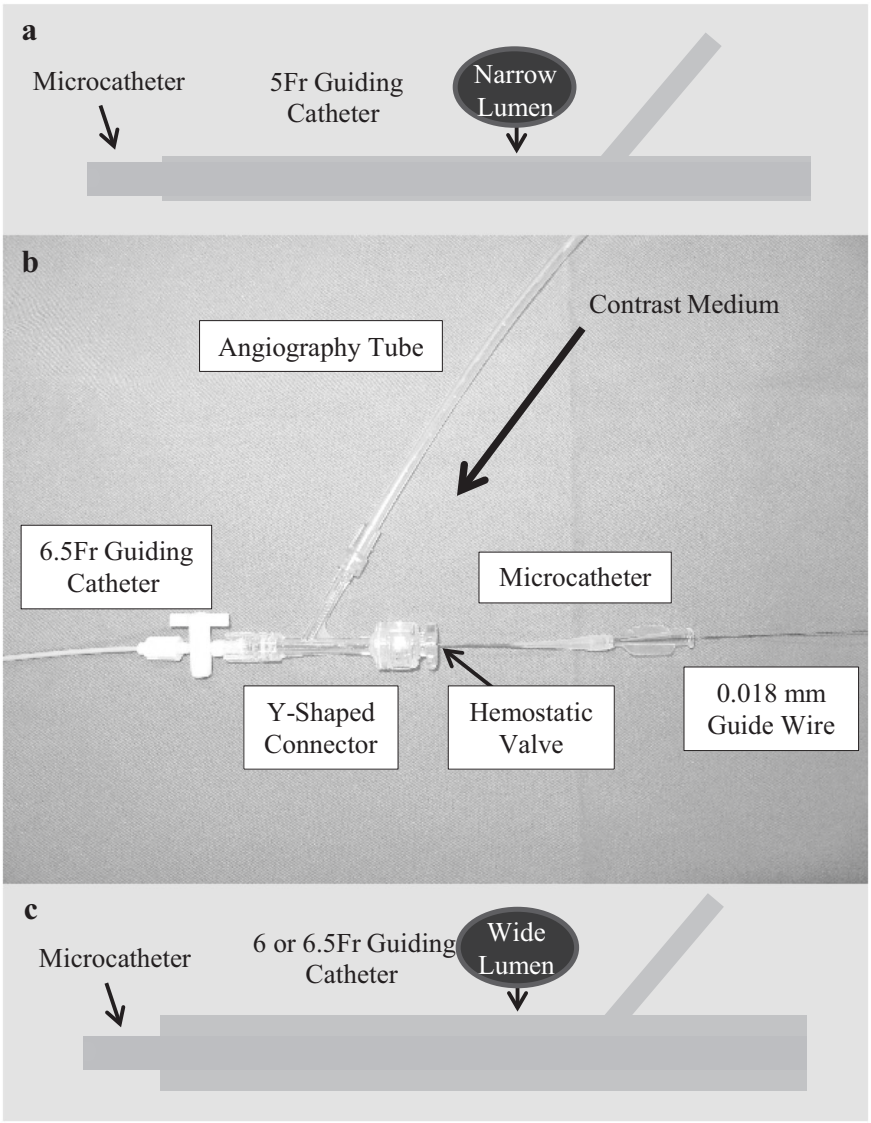

Fig. 1 Comparison of 5 French (Fr) and 6 Fr or larger guiding catheters. **a** Because the lumen inside the 5 Fr catheter is narrow, the contrast medium cannot flow past the microcatheter. **b** As with percutaneous coronary intervention, a system combining a ≥ 6 Fr guiding catheter and a Y-shaped connector allows the microcatheter to be advanced to the segmental adrenal vein branch using a 0.018-mm guide wire while employing contrast enhancement. **c** The lumen of the ≥ 6 Fr guiding catheter is sufficiently wide to allow the contrast medium to flow past the microcatheter

a system that includes a 6 Fr or a larger guiding catheter and a Y-shaped connector (Fig. 1b, c). With this system, it is possible to advance the microcatheter to a segmental adrenal vein branch using a 0.018-mm guide wire while injecting the contrast medium for enhancement (Fig. 2a–c). This improves the stability and safety of AVS. Use of this system also improves backup, which is the same as PCI. Furthermore, cardiologists are familiar with this system, so a higher success rate is expected, which could have considerable impact on the overall management of PA. Segmental-AVS (S-AVS) [8] has been performed at several hospitals to allow for partial adrenalectomy in patients with PA, including those with adrenal tumors. Deep advancement of a microcatheter is necessary for S-AVS and requires a stronger guiding catheter backup; thus, our proposed system could be effective for S-AVS.

In addition to selecting the appropriate catheter system, there are several strategies to improve the success rate of AVS. Preoperative CT is essential [3], because coronal scans provide anatomical images of the adrenal vein. Especially with the right AVS, it is easier to use biplane cineangiography and switch between the front and side views when advancing the catheter. Judgment of whether or not engagement has been successfully achieved is important. Therefore, intravenous infusion of a synthetic adrenocorticotropic hormone is essential. Rapid cortisol measurement during AVS is effective for confirming cannulation of the adrenal vein [9]. Cone beam CT rotational angiography is also effective, since it can display three-dimensional retrograde venography images during AVS [10]. However, this is not available at all institutions.

It is appropriate to number the blood tube labels and write the blood collection numbers in the procedure record, because additional blood sampling is often performed during AVS.

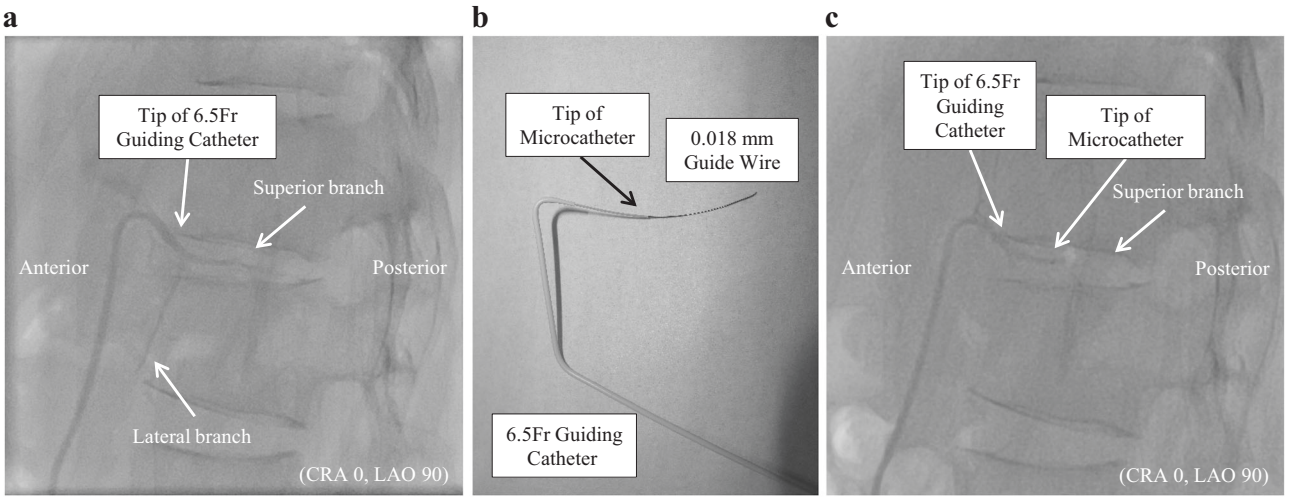

Fig. 2 Right adrenal vein sampling procedure. **a** The guiding catheter is engaged in the right adrenal vein, and the detailed venous anatomy is confirmed by injection of the contrast medium. **b** The microcatheter is advanced along the guide wire. By using a 6 Fr or 6.5 Fr guiding catheter, simultaneous contrast enhancement of the adrenal vein is possible. **c** After withdrawing the wire from the microcatheter, the catheter position can be confirmed with contrast injection before blood sampling is performed

Although the above points seem to be common sense, there is currently no standardized procedure for AVS. Performance of AVS using a 6 Fr or larger catheter and a Y-shaped connector with contrast imaging is both simple and effective. Although cardiologists may be able to easily devise a similar method, none of them have been previously reported. This may be because AVS has mainly been developed by radiologists. If cardiologists utilize recent cardiovascular intervention techniques for AVS, we believe that progress in the stability and safety of this procedure could be dramatic. Increased use of easier AVS techniques may increase the frequency of performance of partial adrenalectomy for adrenal adenoma and may aid in the development of transcatheter ablation therapy for adrenal adenoma in the future.

Many cardiologists have been reluctant to perform AVS, but this may change with employment of a cardiologist-friendly catheter system.

Compliance with ethical standards

Conflict of interest The authors state that they have no conflict of interests.

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