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# Rare Prostatic Artery Origins and the Importance of Collateral Circulation in Prostate Artery Embolization: A Pictorial Essay

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The variability of pelvic arterial anatomy has led to anatomic descriptions based on cadaveric specimens, computed tomography (CT) angiography, and digital subtraction angiography (DSA) [1-3]. This has been especially relevant in prostate artery embolization (PAE), an emerging therapy for lower urinary tract symptoms (LUTS) in men with benign prostatic hyperplasia (BPH) [4-8]. In certain patients, PAE has served as a minimally invasive alternative to more standard surgical options, such as transurethral resection of prostate (TURP) and open prostatectomy. PAE offers a more preferable safety profile with minimal adverse effects, such as a decreased risk of sexual dysfunction when compared to TURP [4]. Although the indications for PAE have not been uniformly standardized, it has been offered for patients with medication-refractory severe LUTS [4-6], with prostates  $\geq$ 80 g in which surgery carries perioperative risk [7], with chronic urinary retention [8], or with refractory hematuria of prostatic origin [9]. Contraindications to PAE vary among institutions, but include neurogenic bladder disease and active urinary tract infection [10].

The procedure is performed via transfemoral or transradial access to cannulate the PA and perform bland embolization. Thus, familiarity with variable PA anatomy is paramount to a successful procedure. The PA must also be evaluated for collateral branches to avoid nontarget embolization to the penis, bladder, and rectum. Coil embolization of collateral vessels supplying adjacent organs is often necessary for safe PA embolization [11].

De Assis et al [3] proposed an angiographic classification system for pelvic arterial anatomy based on the variable branching patterns of the inferior vesical artery (IVA) with the presumption that the PA arises from the IVA. The 4 most common origins in the classification include a common trunk with the superior vesical artery (Figure 1), anterior division of the internal iliac artery (IIA) (Figure 2), internal pudendal artery (IPA) (Figure 3), and obturator artery (OA) (Figure 4). The fifth classification included atypical or rare origins. This pictorial essay demonstrates atypical variations in PA origin and scenarios where coil embolization of the collateral branches was used to prevent nontarget embolization.

## Atypical Origins of the PA

#### Terminal Internal Pudendal Origin

The PA can arise as a terminal branch of the IPA, as shown in Figure 5. In cases in which no typical PA is identified and there is a terminal branch of the IPA directed superiorly, this branch may supply the prostate. This may lead to challenges in subselective catheterization and catheter placement in an ideal location to perform embolization. Both cases with this type of presentation lead to

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Figure 1. A 66-year-old man with several years of medication-refractory lower urinary tract symptoms. (A) Midsagittal view of T2-weighted magnetic resonance imaging depicting total prostate volume of 82 cm<sup>3</sup>. (B) Digital subtraction angiography of left internal iliac artery shows the left prostate artery (dashed black arrows) arising as a common trunk with the superior vesical artery (solid black arrow). (C) Digital subtraction angiography of the left prostate artery showing classic blush of the left hemiprostate.

filling multiple collaterals (mostly bladder and rectal) toward the end of embolization. This should be a consideration while performing embolization of these vessels. In addition, reflux of embolic particles during embolization is a concern due to the high risk of nontarget embolization of penile vasculature.

### Accessory Obturator Origin

Another variant origin of the PA arises from the accessory OA (AOA), which itself arises from the external IA (EIA)

(Figure 6). When the OA is not identified on DSA of the IIA, we have termed this appearance the "empty pelvis sign" [12]. This sign warrants evaluation for an AOA as a branch of the EIA. The patient in Figure 6 provides an example of how the pelvic arterial anatomy can vary between pelvic sides. In this patient, although the AOA arises from the EIA bilaterally, the PA arises from the AOA only on the left side but has a more typical branching pattern on the right, arising from the IVA. Additionally, Figure 6C shows significant cross-filing of the right PA from the left PA. This allows for nearly complete embolization of the prostate from one side



Figure 2. An 86-year-old man with a history of lower urinary tract symptoms affecting his quality of life and severe benign prostatic hyperplasia with prostate volume of approximately 250 cm<sup>3</sup>. (A) Digital subtraction angiography of right internal iliac artery shows the right prostate artery (dashed black arrows) arising directly from the anterior division of the internal iliac artery (solid black arrow). (B) Digital subtraction angiography after subselective catheterization of the right prostate artery shows right hemiprostatic blush.

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