



## Research Brief

# Large arteriotomies closure using a combination of vascular closure devices during TEVAR/EVAR: A single centre experience

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## ABSTRACT

In this case series, we share our experience of total percutaneous closure of large arteriotomies using combination of vascular closure devices (VCD). A total of six patients with seven sites for endovascular repair were taken for total percutaneous endovascular aortic repair. Ten femoral arteriotomies (26 French (F) = 2, 24 F = 1, 22 F = 3, 20 F = 1, 18 F = 1 & 16 F = 2) were successfully closed with 26 Perclose™ and 07 Angio-seal™ devices. There were no local site complications or VCD failure in any of our patients.

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## 1. Introduction

Owing to lower immediate morbidity, mortality & comparable long-term results, endovascular aortic repair (EVAR) is now the standard of care for thoracic aortic aneurysms (TAA), abdominal aortic aneurysms (AAA) and complicated type B aortic dissections. The less invasive total percutaneous endovascular aorta repair (PEVAR) as we call it; when the arteriotomy is also closed percutaneously, reduces the procedural time, wound size, chances of wound infection and hospital stay.<sup>1,2</sup> A recent review by National Surgical Quality Improvement Program revealed that more than half of EVARs are now being closed using total percutaneous technique.<sup>1,2</sup>

Data suggests that total PEVAR is preferable<sup>3</sup>; however larger arteriotomies required in repair of thoracic aorta are still closed surgically. Largest arteriotomy which has been reported to be closed percutaneously using more than one Perclose™ is 22 French (F)<sup>4</sup> whereas hybrid technique using one Perclose™ and one Angio-seal™ has been described in 19 F arteriotomy.<sup>5</sup> We hereby present our experience of closing large arteriotomies (largest being 26 F) using combination of suture based (Perclose™) and collagen based (Angio-seal™) VCDs.

## 2. Methodology

We assessed a total of 06 consecutive patients who required aortic repair for total PEVAR. In addition to detailed pre-procedural

evaluation of aortic pathology, we evaluated the bilateral femoral arteries (FA) for feasibility of total PEVAR using CT angiogram which included the size, anatomy and calcification of bilateral FA. Endovascular graft size dictated the sheath size required for procedure. If there was a discrepancy between the sizes of two FAs, the side with larger diameter was considered the primary access site and the other side was considered secondary site. In case the size of both FAs was comparable; right FA was preferred for primary access as per operator's comfort. The choice of anaesthesia (local or general) was decided depending upon anticipated duration and complexity of procedure.

### 2.1. Technique of placement of VCDs (Perclose™ and Angio-seal™)

All femoral punctures were done under fluoroscopic guidance. The puncture used for primary access was made after angiography from the contralateral side to ensure the site of arteriotomy above the bifurcation of FA (Video: 1, 2). Standard technique of deployment of VCDs as directed by the manufacturer was followed. For any access site requiring a sheath size more than 8.5 F, two Proglide Perclose™ (Abbot Vascular) were placed at 10° clock and 2° clock position, prior to placement of sheath. After completion of procedure, the effect of heparin was reversed with protamine and the access site was closed using preplaced Perclose™ sutures. If hemostasis was not achieved with two preplaced Perclose™ sutures, either one more Perclose™ was deployed at 12° clock position and/or additional Angio-seal™ (Terumo Interventional Systems) was used to achieve hemostasis.

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### 3. Results

Six patients of aortic pathologies (AAA = 3, TAA & AAA = 1, Type B aortic dissection = 2) were taken for total PEVAR. Table 1 describes the detailed anatomy of aortic pathology and the access vessels. Ten femoral arteriotomies (26 F = 2, 24 F = 1, 22 F = 3, 20 F = 1, 18 F = 1 & 16 F = 2) were successfully closed with a total of

26 Perclose™ and 07 Angio-seal™ VCDs. More than two Perclose™ devices were used to close six groins while hybrid technique combining Angio-seal™ with Perclose™ was used in seven groins. Angio-seal™ was used with more than one Perclose™ system in all hybrid closures; in four groins it was used along with three Perclose™ devices. A third Perclose™ or Angio-seal™ were used if hemostasis was not achieved after deployment of two pre-placed Perclose™ devices.

There were no local site complications, no device failure, nor was any surgical assistance required to close any of the access sites.

**Table 1**  
Anatomy of Aortic Pathology and Access vessels (CT Angiography).

|                                 | Patient 1<br>AAA       | Patient 2<br>AAA       | Patient 3<br>Type B Aortic<br>Dissection   | Patient 4<br>TAA & AAA   | Patient 5<br>AAA       | Patient 6<br>Type B Aortic Dissection   |
|---------------------------------|------------------------|------------------------|--|--|------------------------|---|
| <b>Right (mm)</b>               |                        |                        |  |  |                        |   |
| CIA                             | 14.5                   | 8.7                    | 13 (TL)  | 16.5   | 10                     | 12  |
| EIA                             | 9.24                   | 7.95                   | 9.4  | 7.4  | 8.3                    | 10.1  |
| CFA                             | 10                     | 6.83                   | 8.6  | 8.2  | 8.3                    | 8.4   |
| <b>Left (mm)</b>                |                        |                        |  |  |                        |   |
| CIA                             | 12.4                   | 8.13                   | 4.6 (TL)   | 13.9   | 7.0                    | 11.1  |
| EIA                             | 10.1                   | 7.38                   | 9.3  | 8.8  | 8.3                    | 8.1   |
| CFA                             | 8.74                   | 6.72                   | 8.5  | 7.9  | 7.69                   | 7.9   |
| Tortuosity of Access Vessels    | NIL                    | NIL                    | Mild   | Mild   | NIL                    | Mild  |
| Calcification of Access Vessels | NIL                    | NIL                    | NIL  | Mild   | Mild                   | Mild  |
| Aortic Pathology                | AAA<br>Avg Size: 63 mm | AAA<br>Avg size: 45 mm | Dissection of DTA<br>after left SCA<br>Aorta size at<br>proximal landing<br>zone: 29–30 mm | TAA & AAA<br>TAA avg size: 90–100 mm<br>AAA avg size: 60–70 mm | AAA<br>Avg Size: 70 mm | Dissection of DTA after left<br>SCA<br>Aorta size at proximal<br>landing zone: 26–27 mm |

AAA, Abdominal aortic aneurysm; Avg, Average; CFA, Common Femoral Artery; CIA, Common Iliac Artery; CT; Computed Tomography; DTA, Descending thoracic aorta; TAA, Thoracic aortic aneurysm; TL, True lumen; VA, Vertebral Artery.

**Table 2**  
Procedural details of total percutaneous endovascular aorta repair (PEVAR).

| S. No     | Right FA sheath size | Left FA sheath size | Site of intervention                        | Total number of grafts placed                                 | Size of graft and site of graft  | Anesthesia | Device for Right FA repair | Device for Left FA repair     | Complications if any   |
|-----------|----------------------|---------------------|---|---|--|------------|----------------------------|-------------------------------|--|
| Patient 1 | 22 F                 | 18 F                | AAA   | 1 main graft from Right FA.<br>1 accessory limb from Left FA. | Main limb:<br>25 × 16 × 166 mm<br>Accessory limb:<br>16 × 16 × 124 mm  | GA         | 3 Perclose                 | 2 Perclose and 1 Angioseal    | None   |
| Patient 2 | 22 F                 | 16 F                | AAA extending to iliac                      | 1 main graft from Right FA.<br>1 accessory limb from Left FA. | Main limb:<br>25 × 13 × 166 mm<br>Accessory limb:<br>16 × 20 × 124   | LA         | 3 Perclose                 | 2 Perclose                    | None   |
| Patient 3 | 26 F                 | 7 F                 | Dissection of DTA after left SCA            | 1 graft for Thoracic aorta.                                   | 36 × 32 × 150 mm   | LA         | 3 Perclose and 1 Angioseal | Local site manual compression | None   |
| Patient 4 | 26 F                 | 20 F                | TAA & AAA                                   | 3 grafts for DTA and 2 grafts for AAA.                        | Thoracic grafts:<br>40 × 40 × 200 mm,<br>40 × 36 × 150 mm,<br>42 × 38 × 150mm<br>Abdominal grafts<br>Main limb:<br>28 × 16 × 145 mm<br>Accessory limb:<br>16 × 16 × 124 mm | GA         | 3 Perclose and 1 Angioseal | 3 Perclose and 1 Angioseal    | VA stroke 08 h after procedure<br>Death on day 8 of procedure due to secondary complications of stroke |
| Patient 5 | 22 F                 | 16 F                | AAA extending to iliacs                     | 1 main graft from Right FA and 1 accessory limb from Left FA. | Main limb:<br>32 × 16 × 166 mm<br>Accessory limb:<br>16 × 13 × 124mm   | LA         | 3 Perclose and 1 Angioseal | 2 Perclose and 1 Angioseal    | None   |
| Patient 6 | 24 F                 | 6 F                 | Dissection of DTA just proximal to left SCA | 1 graft for Thoracic aorta.                                   | 36 × 32 × 150 mm   | LA         | 2 Perclose and 1 Angioseal | Local site compression        | None   |

AAA, Abdominal aortic aneurysm; Angioseal, Angio-seal™(Terumo Interventional Sytems); DTA, Descending thoracic aorta, FA, Femoral artery; F, French; GA, General anesthesia; LA, Local anesthesia; Perclose, ProglidePerclose™ (Abbot Vascular); S.no, Serial Number; SCA, Subclavian artery; TAA, Thoracic aortic aneurysm; VA, Vertebral Artery.

Four out of six procedures were performed under local anaesthesia. There was one death; due to posterior circulation stroke in a patient with extended aneurysm involving thoracic and abdominal aorta after 7 days of procedure but not related to access site complication. The rest five patients have been asymptomatic with normal Doppler studies of lower limb vessels. The last patient intervened has completed six months of follow up. The procedural details of total PEVAR in 06 patients and 10 sites have been summarized in Table 2.

#### 4. Discussion

EVAR is now the standard of care for TAA, AAA and type B complicated aortic dissection<sup>1,2</sup>; however, surgical cut down and closure of access site still remains a concern.<sup>6</sup> Larger wounds, more local site infections, delayed recovery and increased procedural time; along with requirement of a vascular surgeon somehow negated the advantages of EVAR.<sup>6</sup> The total PEVAR on other hand doesn't require a vascular surgeon to be present on site; results in smaller wound with no skin sutures, lesser infections & lesser procedural time without any increase in major complications.<sup>1,3,7–9</sup> The cost of devices has been a concern; however it is compensated by lesser procedure & anaesthesia time, lesser man hours, lesser complications and length of stay in hospital.<sup>8</sup>

VCDs, especially the suture based systems have been used extensively and found safe to close moderate size arteriotomies in various studies and meta-analysis.<sup>1,3,7,8</sup> We share our experience on percutaneous closure of larger arteriotomies where three sites were 22 F, one site was 24 F & two sites were 26 F. We either used three Perclose™ and/or hybrid percutaneous closure technique i.e. combined Perclose™ (which is suture based) & Angio-seal™ (which creates a mechanical seal by sandwiching the arteriotomy between a bioabsorbable anchor and collagen sponge) in closing larger arteriotomies. The data on use of two types of devices to close access sites has been so far rewarding with no higher risk of bleeding or vascular complications.<sup>5,10</sup> However the maximum size of arteriotomy where the hybrid technique has been tried is 19 F and they have used one Angio-seal™ along with one Perclose™ device.<sup>5</sup> The concern underlying the use of Angio-seal™ with Perclose™ system is acute thrombosis/occlusion of the artery.<sup>5,10</sup> We successfully used Angio-seal™ along with Perclose™ for closing arteriotomies as large as 26 F and have used Angio-seal™ with

three Perclose™ systems to close 04 groins & with two Perclose™ devices to achieve hemostasis in 02 groins. The pulses in all limbs were present post procedure and there was no acute limb ischemia in any of our cases.

To conclude: Total PEVAR of thoracic and abdominal aortic pathology is feasible with combined use of 2 different types of VCDs using hybrid technique, even if the arteriotomy is as large as 26 F. We can safely use Angio-seal™ system with more than one Perclose™ devices without compromising the artery.

#### Declaration of competing interest

All authors have none to declare.

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