Geometry and renal flow in chimney-Endovascular Aneurysm Repair and chimney-Endovascular Aneurysm Sealing

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Chimney-endovascular aortic repair (ch-EVAR) and chimney-endovascular aneurysm sealing (ch-EVAS) are on-demand techniques to treat juxtarenal abdominal aortic aneurysm. A mismatch in material properties between stent grafts can result in gutter formation or chimney stent graft compression, which can increase the risk of type Ia endoleak or chimney stent graft thrombosis. Seven identical flow phantoms of a juxtarenal aneurysm (Elastrat Sàrl, Geneva, Switzerland) were used to study geometry and renal flow in different double chimney stent graft configurations, including EVAR and EVAS combined with self-expanding or balloon-expandable chimney stent grafts. Gutter formation and chimney stent graft compression were determined at a computed tomography scan of each model with use of 3-dimensional vascular planning software. Gutter was defined by volume and chimney stent graft compression by the diameter-ratio; the ratio of maximum and minimum lumen diameter measured in the plane perpendicular to the stent centerline. Renal flow was studied under physiologic resting conditions in an in-vitro cardiovascular setup and compared to an aneurysm control. Gutter volume was less than 1 mL in all configurations. Radial compression of EVAR and EVAS stent grafts had more effect on the lumen geometry of self-expanding than balloon-expandable chimney stent grafts in all configurations (average diameter ratio of 2.02 vs. 1.39). Chimney stent graft compression did not influence renal flow, and this suggests that there was no severe outflow obstruction at the compression ratios that were found in this study (maximum diameter-ratio of 2.5). Numbers on the clinical incidence of type Ia endoleak and occlusion of chimney stent grafts are needed to validate these outcomes. In clinical practice, stent graft geometry may be influenced by the patient anatomy, including the number of branches involved, and stent sizing.

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