Re-interventions after endovascular aortic repair: Clinical and experimental studies

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av

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Avhandlingen baseras på följande delarbeten:

I. Roos H, Djerf H, Brisby Jeppsson L, Fröjd V, Axelsson T, Jeppsson A, Falkenberg M. Re-interventions after endovascular aortic repair for infrarenal abdominal aneurysms: A retrospective cohort study. Submitted

II. Roos H, Sandström C, Koutouzi G, Jeppsson A, Falkenberg M. Predisposing factors for re-interventions with additional iliac stent grafts after endovascular aortic repair. Submitted

III. Roos H, Ghaffari M, Falkenberg M, Chernoray V, Jeppsson A, Nilsson H. Displacement forces in iliac landing zones and stent graft interconnections in endovascular aortic repair: an experimental study. Eur J Vasc Endovasc Surg. 2014;47:262-7

IV. Roos H, Tokarev M, Chernoray V, Ghaffari M, Falkenberg M, Jeppsson A, Nilsson H. Displacement forces in stent grafts - influence of diameter variation and curvature asymmetry. Eur J Vasc Endovasc Surg. Accepted for publication

V. Falkenberg M, Roos H, Lepore V, Svensson G, Zachrisson K, Henrikson O. Endovascular closure of chronic dissection entries in the aortic arch using the Amplatzer vascular plug II as a sealing button. J Endovasc Ther. Feb 2016;23:378-83

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ABSTRACT

Background: Endovascular aortic repair (EVAR) has lower morbidity and mortality than open surgery. Late complications and re-interventions are more common, however, and the timing of different re-interventions and their respective underlying causes are not fully understood.

Aims: The overall aim was to describe re-interventions after EVAR and to identify possible underlying causes. Specific aims were as follows: 1. To describe re-interventions after EVAR, including incidence, indications, procedures, and outcome, concentrating especially on non-access-related re-interventions. 2. To determine underlying causes and to identify anatomical factors associated with additional iliac stent grafting. 3. To study flow-induced displacement forces in iliac limb stent grafts and the influence of stent graft angulation, fluid pressure, pulsation frequency, distal diameter of the stent graft, and asymmetric graft curvatures in an experimental aortic model. 4. To describe a new endovascular technique to close small entries that persist in the aortic arch.

Materials and methods: Studies 1 and 2 were retrospective single-centre cohort studies of re-interventions after standard EVAR, focusing especially on non-access-related re-interventions. In Study 1, incidence, indications, procedures, and outcome were analyzed in 405 patients. In Study 2, 24 patients with additional iliac stent grafts after EVAR were studied. Computed tomography examinations were reviewed in detail regarding causes of re-intervention and underlying anatomic factors. These patients were compared with 420 patients treated with bifurcated EVAR during the same time period who did not require additional iliac stent grafts during follow-up, regarding patient characteristics and preoperative anatomic measurements.
Studies 3 and 4 involved investigation of flow-induced displacement forces in iliac limb stent grafts in an experimental flow model mimicking physiologic conditions. In Study 3, the forces on a tubular stent graft with symmetric curvature were studied in relation to graft angulation, fluid pressure, and stroke rate. In Study 4 tapered, non-tapered, and bell-bottom grafts were studied at symmetric graft curvature and non-tapered grafts were studied at asymmetric curvature. Study 5 involved a new endovascular technique for closure of persistent small entries in selected patients with aneurysmal dilatation of chronic aortic dissections.

Results: Study 1 showed that embolization of endoleak type II and placement of additional iliac stent grafts were the most common re-interventions after EVAR. These interventions were performed long after the initial intervention. Medium-term outcome in patients with re-intervention was comparable to that in patients without re-intervention. Study 2 showed that a considerable number of additional iliac stent graftings were caused by rupture. Migration at the distal landing site or graft interconnections was the most common cause, followed by disease progression. Study 3 demonstrated that flow-induced displacement forces were of similar magnitude at both ends of a non-tapered iliac stent graft, and the force increased with increasing graft angulation and fluid pressure but not with increasing pulse frequency. There was a high correlation between pulsatile graft movement and displacement forces. Study 4 showed that there were particularly high displacement forces in bell-bottom grafts, and that the forces were dependent on distal graft diameter and shape of the curvature. Study 5 showed that endovascular closure of persistent entries in chronic dissections is feasible, and in selected patients it may be an alternative to open surgery.

Conclusions: Re-interventions are still common after EVAR, but most are percutaneous procedures and outcomes are generally good. Additional iliac stent grafting is one of the more frequent re-interventions, and in most cases it is related to stent graft migration, with a higher risk in patients with large iliac diameters and short attachment zones. Flow-induced displacement forces may have a role in the increased risk of migration. Patients with EVAR landing zones in wide iliac arteries may need improved graft fixation and more vigorous surveillance.

Key Words: Stent graft, EVAR, Blood flow, Displacement force, Aortic aneurysm, Angulation, Reoperation.
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