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Commentary: Vessel wall remodeling—an ever-lurking threat

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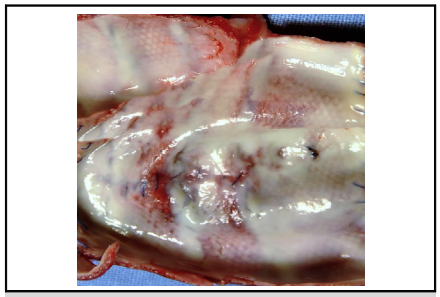

Polypropylene migration within the vascular wall causing structural damage.

CENTRAL MESSAGE

The stress shielding phenomenon is responsible for the development of vessel-wall pseudoaneurysm due to the incompatibility of synthetic and biological materials.

In their recently published article, Kikuchi and colleagues[1] report surgical repair of ascending aorta pseudoaneurysm (AAP) using thoracic endovascular aortic repair (TEVAR) and cooling. This manuscript is timely following the 2020 Society for Vascular Surgery practice guidelines of thoracic endovascular aortic repair for descending thoracic aortic aneurysms[2] in which TEVAR was classified as Grade 2 (weak) Level of recommendation and Quality of Evidence graded as C (Low) in patients at high risk of death. However, to date, there are no guidelines for the treatment of AAP. In this elegant case report, a 71-year-old man with an AAP measuring 37 × 46 × 50 mm with a referred entry point fixed at 9 mm in size received endovascular treatment combined with an Amplatzer vascular plug II and coiling.

Favorable clinical outcomes from TEVAR were in part driven by the reduced surgical risk that in this patient was not negligible and related to the position of AAP located posterior to the sternum with previous cardiac surgery 4 years earlier.[1] The dangerous location of the pseudoaneurysm lesion and the previous total arch replacement surgery with frozen elephant trunk combined with coronary artery bypass grafting surgery set the European System for Cardiac Operative Risk Evaluation II at 2.71% by adopting the criteria of thoracic surgery.[1] Negative vessel-wall remodeling with detrimental aneurysmal development, which was supported by greater systemic pressures, has been documented in animal and biomechanical studies based on finite element analysis evaluation.[3-5]

In this case study, the implantation site of the saphenous anastomosis was the origin of the ascending aortic pseudoaneurysm at 4 years, suggesting the validity of experimental data that revealed that the combination of a biological surface with a synthetic surface made of polyester (including polypropylene) is not universally applicable. The complication with relapse, due to a moderate or poor seal of the implanted biological tissue, was attributable to the incompatibility of materials used in the presence of high blood pressure levels, which must withstand mechanical stress-shielding.[4]

We have compared the response to mechanical deformation due to stress-shielding in biological tissues, in particular, the interaction between biological material and different synthetic materials.[3,4] We found that the biological substitutes guaranteed excellent vascular remodeling with the absence of aneurysmal recurrence in an animal study, as it addressed the expansion component of the vascular wall reinforced with resorbable materials even when subjected to high systemic pressure.[3-5]

We learned that the use of polypropylene placed in contact with the biological surface led to migration

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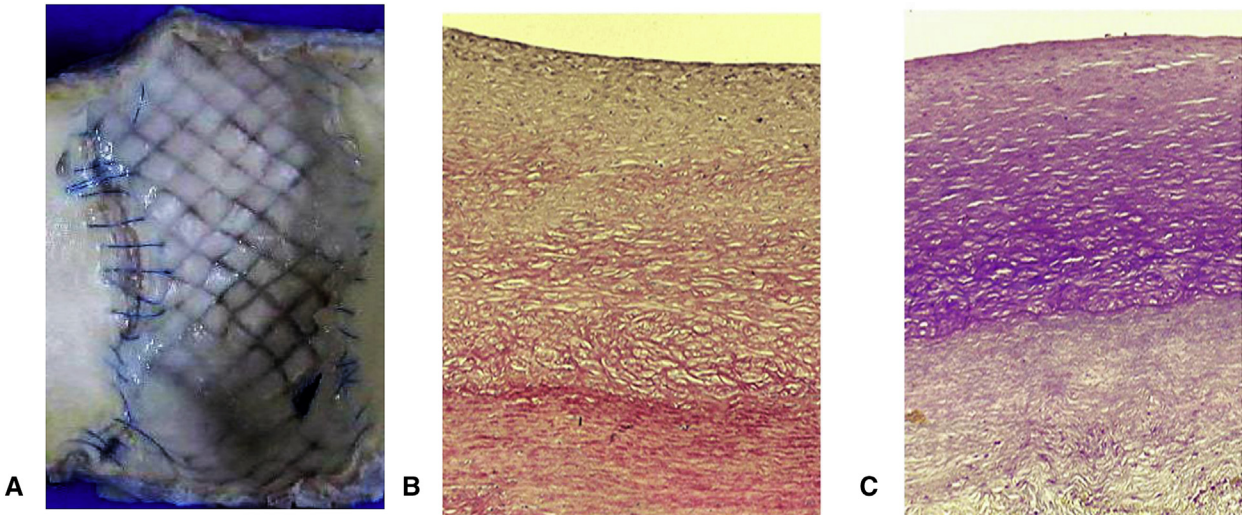

FIGURE 1. A, The polypropylene mesh is markedly visible by examining the vessel wall from the inside outwards, revealing its migration. B and C, Polydioxanone leads to favorable vessel-wall remodeling with increased content of elastin fiber. Compact collagen organization in the "elastic zone" of the vessel, and less-pronounced cellular infiltrate, are shown.

phenomena through the vessel wall, as well as accentuated tissue lesions in which the mechanical deformation sustained by the tissue was due to the application of stress-shielding forces[4] (Figure 1, *A*). In contrast, the use of a resorbable material such as polydioxanone led, through a sustained favorable histological response, to vascular remodeling with the creation of physiological tissue[3-5] (Figure 1, *B* and *C*).

So, what next? First, the use of internal thoracic artery (ITA) in situ or right ITA y-graft onto the left ITA to guarantee coronary artery bypass grafting on left-anterior descending and obtuse marginal arteries would probably have ensured better results at 4 years and second, the use of TEVAR in this complication represents the wisest choice.

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