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IMPLANT TECHNOLOGY FOR ENDOVASCULAR REPAIR OF CEREBRAL ANEURYSMS: REQUIRED MATERIAL CHARACTERISTICS

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INTRODUCTION: Cerebral aneurysms are potentially life-threatening vascular defects. Besides the classical neurosurgical repair of aneurysms using clip devices, endovascular minimally invasive methods have become increasingly accepted alternative treatments for intracranial aneurysms. If feasible, repair of the artery is obtained by excluding the aneurysm from the circulation in order to prevent growth and rupture causing haemorrhage. The purpose of this poster is to present the principal types of aneurysm pathologies, the current endovascular repair strategies, and establishing the list of requirements for current and future implants.

CEREBRAL ANEURYSM TYPES: An undue widening of an artery is addressed as aneurysm. Such increase of the lumen may occur due to a focal defect of the arterial wall structures or in relation with a more extensively diseased arterial segment. Such a viewpoint allows for classifying in two basic types of intracranial aneurysms that are either in relation with a **focal wall defect** (e.g. blister-like, saccular aneurysms) or in relation with a **segmental wall disease** (e.g. fusiform aneurysms). The most frequent lesions are saccular aneurysms that typically arise from arterial bifurcation points due to focal defect and grow in relation with hemodynamical stress. They present by haemorrhage, mass effect or incidentally. The small blister-like lesions are rare, and are associated with a focal defect and a very thin wall. Fusiform aneurysms are pathological dilatations of a whole arterial segment and most frequently occur with atherosclerosis. Each aneurysm type requires a specific repair strategy.

ANEURYSM REPAIR STRATEGIES: Aneurysmal cavities can be excluded from the circulation by introducing a filling material, what is in the current clinical practice feasible for the repair of saccular aneurysms. The treatment of aneurysms by repair of the arterial wall is a more recent development at the level of cerebral arteries and this involves use of stent devices (endovascular prosthesis), what may be applied for blister-like lesions, fusiform aneurysms, or large necked saccular aneurysm.

IMPLANT TYPES: Implants for **filling the aneurysm** are currently mostly metallic coils what allows for a 20-30% filling of the volume of an aneurysm. Such coils form a random network within the aneurysm cavity but are leaving 70-80% of the space filled by clot formation. Overproduction of clot may lead to complication by thromboembolic events, a risk that increases with the size of the focal defect in the arterial wall. On the other hand, clot seals immediately the rupture point and prevents thus re-haemorrhage from happening. However, clot is not permanent and will be resorbed within weeks of time. For a permanent result, tissue repair is required. This is observed in over 90% at follow-up examination in aneurysms treated with coils under the condition that the neck size was smaller than 4 mm. Additional filling implants under development are liquid polymers that polymerise or precipitate when introduced into the cavity. Preformed polymers dissolved in a water-miscible organic solvent allow for a filling of up to 100% of the aneurysm cavity and are currently under clinical evaluation.

Implants for **wall reconstruction** are more difficult to introduce to the cerebral circulation due to the tortuous vascular access route. Early clinical experience shows that the use of endovascular prosthetic material (stent) may be the solution for treating the other types of aneurysms, i.e. blister-like, fusiform and wide necked saccular lesions. Stent porosity and strut size herald the hemodynamical impact and tissue repair induced by such implants.

GENERAL IMPLANT REQUIREMENTS: Future progress in endovascular aneurysm treatment will depend largely on implant improvement, including device and delivery system design. Increased safety and simplicity of such procedures will depend on the method and the control of implant application. Visibility and compatibility with modern imaging methods (DSA, CT, MRI) are key characteristics as are the biological and biomechanical properties of an

implant in order to avoid undue thrombus formation and to induce lasting tissue repair.