Editorial

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Endovascular Coiling Treatment and Its Result

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Endovascular coiling is an endovascular treatment for intracranial aneurysms and bleeding throughout the body. The procedure reduces blood circulation to the aneurysm through the use of microsurgical detachable platinum wires, with the clinician inserting one or more into the aneurysm until it is determined that blood flow is no longer occurring within the space. It is one of two main treatments for cerebral aneurysms, the other being surgical clipping. Clipping is an alternative to stenting for bleeding.

Endovascular coiling is used to treat cerebral aneurysms. The main goal is prevention of rupture in unruptured aneurysms, and prevention of rebleeding in ruptured aneurysms by limiting blood circulation to the aneurysm space. Clinically, packing density is recommended to be 20-30% or more of the aneurysm's volume, typically requiring deployment of multiple wires. Higher volumes may be difficult due to the delicate nature of the aneurysm; intraoperative rupture rates are as high as 7.6% for this procedure. In ruptured aneurysms, coiling is performed quickly after rupture because of the high risk of rebleeding within the first few weeks after initial rupture. The patients most suitable for endovascular coiling are those with aneurysms with a small neck size (preferably <4 mm), luminal diameter <25 mm and those that are distinct from the parent vessel. Larger aneurysms are subject to compaction of coils, due to both looser packing densities (more coils are needed) and increased blood flow. Coil compaction renders them unsuitable as they are incapable of stemming blood flow. However, technological advances have made coiling of many other aneurysms possible as well.

A number of studies have questioned the efficacy of endovascular coiling over the more traditional surgical clipping. Most concerns involve the chance of later bleeds or other recanalization. Due to its less invasive nature, endovascular coiling usually presents faster recovery times than surgical clipping, with one study finding a significant decrease in probability of death or dependency compared to a neurosurgical population. Complication rates for coiling as well are generally found to be lower than microsurgery (11.7% and 17.6% for coiling and microsurgery, respectively). Despite this, interoperative rupture rates for coiling have been documented as being as high as 7.6%. Clinical results are found to be similar at a two-month and one year follow-up between coiling and neurosurgery.

Reported recurrence rates are quite varied, with rates between 20-50% of aneurysms recurring within one year of coiling, and with the recurrence rate increasing with time. These results are similar to those previously reported by other endovascular groups. Other studies have questioned whether new matrix coils work better than bare platinum coils.

The International Subarachnoid Aneurysm Trial tested the efficacy of endovascular coiling against the traditional micro-surgical clipping. The study initially found very favorable results for coiling, however its results and methodology were criticized. Since the study's release in 2002, and again in 2005, some studies have found higher recurrence rates with coiling, while others have concluded that there is no clear consensus between which procedure is preferred.

Given the complexity of modeling the vasculature, much research has been devoted towards modeling the hemodynamics of an aneurysm before and after an intervention. Techniques such as particle image velocimetry (PIV) and computational fluid dynamics/finite element analysis (CFD/FEA) have yielded results that have influenced the direction of research, but no model to date has been able to account for all factors present. Advantages of the in-silico research method include flexibility of selecting variables, but one comparative study has found that simulations tend to over-emphasis results compared to PIV, and are more beneficial for trends than exact values.

Medical images, particularly CT angiography, can be used to generate 3D reconstructions of patient specific anatomy. When combined with CFD/FEA, hemodynamics can be estimated in patient specific simulations, giving the clinician greater predictive tools for surgical planning and outcome evaluation to best promote thrombus formation. However, most computer models use many assumptions for simplicity, including rigid walls (non-elastic) for vasculature, substituting a porous medium in place of physical coil representations, and navier-stokes for fluid behavior. However, new predictive models are being developed as computational power increases, including algorithms for simulations of coil behavior in-vivo.