Intervention of Cerebral Aneurysms: An Update

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Modern endovascular treatment of cerebral aneurysms has rapidly evolved since the introduction of the Guglielmi detachable coil (Boston Scientific/Target, Fremont, CA) in 1992. The International Subarachnoid Aneurysm Trial (ISAT)\(^\text{1}\) posed to be a landmark study in the development of endovascular coiling for cerebral aneurysms. It was a multi-centre prospective randomised trial comparing the results of endovascular coiling verses clipping in patients with ruptured cerebral aneurysms. 2143 patients with ruptured intracranial aneurysms were enrolled in 43 European centres. They were randomly assigned to neurosurgical clipping or endovascular coiling. It showed a 23.9% relative reduction in the risk of death and dependency at 1 year in the coiling group as compared with the clipping group. There was an absolute risk reduction of 7.4% (\(p=0.0001\), favouring endovascular coiling.

Follow-up data from the ISAT showed that the risk of rebleeding from a treated cerebral aneurysm was low\(^2\). There were slightly more rebleeds from the endovascular treated group as compared with the neurosurgical clipped group. There was no difference in the number of deaths related to rebleeding in both groups. Risk of death at 5 years was significantly lower in the endovascular coiled group, while the probability of independent survival at 5 years was the same in the two groups.

The American Heart Association guideline suggested that for patients with ruptured cerebral aneurysms judged by an experienced team of cerebrovascular surgeons and endovascular interventionists to be technically amenable to both endovascular coiling and neurosurgical clipping, endovascular coiling can be beneficial (Class I, Level of Evidence B)\(^3\). However, it would be reasonable to consider individual characteristics of the patient and the aneurysm in deciding the best means of repair.

The introduction of the Pipeline embolisation device (PED; Chestnut Medical, Menlo Park, CA) marked a new page in the endovascular treatment of cerebral aneurysm. PED is a self-expanding microcatheter-delivered flow diversion device. It consists of a braided cylindrical meshwork. PED-1, the first generation of the device, was constructed with a 32-strand braiding device composed of platinum and cobalt chromium microfilaments. The device aims at diverting flow away from the cerebral saccular aneurysm. PED-2, the second generation of the device, was constructed with a 48-strand braiding device, composed of platinum and cobalt chromium microfilaments. The device aims at diverting flow away from the cerebral saccular aneurysm. On the other hand, it is intended to be porous enough to preserve the patency of any vessel branch covered by the construct.

The PED-2 is attached to a flexible delivery wire and is packaged in an introducer sheath, which can be loaded into standard microcatheters with 0.027-inch inner diameter or greater. Upon bringing the microcatheter to the desired position, the PED device could be deployed by a combination of microcatheter withdrawal together with forward pressure on the delivery wire.

53% complete aneurismal occlusion was achieved with single PED-1 deployment in aneurysms created in female New Zealand white rabbits. New intimal growth across the neck of the aneurysms was seen upon harvesting the aneurysms at 6 months\(^4\). Complete occlusion rate was raised to 94% with PED-2 deployment in similar rabbit aneurysm models. No incident of branch artery occlusion was observed. There was no distal embolic events in the downstream of the parent artery\(^5\). Parent artery neo-intimal hyperplasia was minimal in most of the cases and was significantly less in PED-2. The first human reported case of PED implantation was published in 2008\(^6\).

The introduction of PED marked a change in the concept in the treatment of saccular cerebral aneurysms. The usual practice is the placement of detachable coils into the aneurismal sac to promote thrombosis of the aneurysm, thereby excluding the aneurysm from the cerebral circulation. Neuroform stent (Target Therapeutics, Fremont, CA) placement would be necessary with the endosaccular approach in dealing with wide neck cerebral aneurysms to prevent herniation of the coils back into the parent artery.

Endoluminal reconstruction of the parent artery would be the concept in the PED deployment. Flow diversion from the cerebral aneurysm and the subsequent intimal growth across the aneurysm neck exclude the cerebral aneurysm from the circulation. The parent artery could be reconstructed with the PED even with aneurismal incorporation of part of the parent artery or a fusiform type of cerebral aneurysm. The latter was difficult to treat even with stent-assisted coiling. Besides, the procedure is technically simpler as compared with stent-assisted coiling.

Various groups have published their experience with the PED. The Argentina group headed by Professor Lylyk had treated 53 patients with 72 PEDs for the treatment of 63 intracranial aneurysms. The rate of complete occlusion of the aneurysm on follow-up digital subtraction angiography was 53% at 3 months, 93% at 6 months and 95% at 12 months in their study\(^7\).
Unruptured cerebral aneurysms, reconstituted cerebral aneurysms after previous coiling, giant cerebral aneurysm and fusiform aneurysms would be some of the indications for the use of PED.

In conclusion, endovascular therapy of cerebral aneurysms is emerging rapidly with new and innovative devices. The introduction of PED has changed the idea of endosaccular approach of aneurysm occlusion to the new endoluminal parent artery reconstruction concept.

References