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Paradigm Shift of Treating Wide Neck Aneurysm

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Background: The treatment of intracranial aneurysm has undergone very significant paradigm shifts in the recent decades. The continuous advancement in treatment and management have changed physician's ability to make decisions. We reported a case of a 51-year-old male presenting with subarachnoid hemorrhage with intraventricular extension with generalized brain edema.

Key Words: Aneurysm, Endovascular Treatment, Stroke, Wide Neck Aneurysm

The treatment of intracranial aneurysm has undergone very significant paradigm shifts in the recent decades. The continuous advancement in treatment and management have changed physician's ability to make decisions. The major goal of therapy is to completely occlude the affected area while maintaining blood flow in the parent, branching, and perforating arteries.

Previously all of the wide neck aneurysms were treated surgically by either wrapping or clipping techniques. However, the more recent advance in intracranial aneurysm treatment has been the advent use of safe and effective endovascular techniques.

Conventional treatment options for intracranial aneurysms are either surgical or endovascular. In 1993, Norman Dott performed the first surgical treatment for a ruptured intracranial aneurysm[1]. In 1938, the first obliterative clipping of an intracranial aneurysm was performed by Walter Dandy[2]. Yasargil and Fox described the classical microscopic assisted open approaches in 1975 for intracranial aneurysm clipping[3].

Although it is found that surgical as well as endovascular occlusion technologies are effective in selected patients, improved technology for endovascular devices and techniques has shifted the balance towards these less invasive techniques which have the advantages of shorter operating times, patient preference and tolerability in less healthy patients, and shorter lengths of hospital stays[4].

Here, described is a patient presented who had a cerebral aneurysm and who was treated with endovascular intrasaccular device placement.

Case Description:

A 51-year-old male with no known medical illness, brought to the emergency room of IGMH by his sister. According to the bystander he was on the motorbike with her when suddenly his consciousness decreased and he fell and hit his head on the ground. He was wearing a helmet when the incident occurred. On arrival at the emergency room, his GCS was E4V2M6 with pupils bilaterally sluggish. CT brain showed subarachnoid hemorrhage with intraventricular extension with generalized brain edema. On the initial CT angiogram, a posteriorly directed berry aneurysm

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arising from anterior communicating artery was noted measuring about 4.4 x 3.0 mm in size. The size of neck measures about 3.1 mm.

Patient was brought to our hospital in an intubated state and shifted to our ICU. The case was discussed with the endovascular team, and the patient was opted for endovascular treatment. Patient underwent endovascular intrasaccular placement.

Discussion

Cerebral aneurysms are defined as dilations that occur at weak points along the arterial circulation. Intracranial aneurysms are relatively common. They are classified based on the size and additional parameters such as neck diameter and dome to neck ratio[5]. These can vary in size, small being less than 0.5 mm, medium being 6 to 25mm, and large being greater than 25mm. Dome to neck ratio less than 2 is the cut off for wide neck aneurysms, and more than 2 is the cut off for small neck aneurysms. Saccular aneurysms also known as berry aneurysms are the most common type, they are located at the site of maximum hemodynamic stress in a vessel. Fusiform aneurysms are more common in the vertebrobasilar system, and mycotic aneurysms are peripheral aneurysms which are associated with infections. The infection causes the weakening of the artery walls causing the artery walls the aneurysm. A false or "pseudo-aneurysms" are brain aneurysms which are an expansion of a blood vessel wall that does not involve all layers of the wall. Treatment options have undergone a major development in recent years. These are based on clinical as well as anatomic factors of the patient such as the patient's age, family history, associated conditions, symptomatic aneurysms, aneurysm size and location[6].

Simple coiling was one of the initial steps of endovascular treatment with controlled detachable systems. The purpose of coiling is to limit blood flow to the intracerebral aneurysm lumen by achieving dense packing by the administration of detachable platinum wires, which causes an unorganized thrombus and granulation development[6]. Some of the shortcomings of coiling include post treatment surveillance imaging, and may require retreatment, or it may also recur. Some of the complications associated with coil embolization include: thromboembolism, perforation of the intracerebral aneurysm, early rebleeding, parent artery obstruction, collapsed coils, coil malposition and even coil migration[7]. Other challenges include, aneurysms being too large, and the durability of aneurysm coil embolization not being achieved. This led to more advancement and the creation of novel methods and technology, including balloon-assisted coiling and stent assisted coiling[6].

Moret et al. initially described the balloon-assisted coiling or balloon remodeling for expansion of endovascular treatment to wide-neck intracerebral aneurysms[8]. A nondetachable balloon is temporarily inflated in the parent vessel lumen of the aneurysm during each coil placement. Allowing the coil to frame inside the intracerebral aneurysm and preventing it from herniation[7]. Initially, it was developed for the treatment of wide-neck aneurysms. However, in recent series it has shown that during an intraoperative rupture, they were associated with higher probability of unchanged or improved clinical outcome compared to standard coiling[6].

To overcome some of the limitations of standard coiling, such as treatment to difficult- to access areas, stent- assisted coiling was introduced[9]. However, there are additional risks associated with stent placement compared to coiling alone. It is found that the periprocedural risk of hemorrhage and thromboembolic events, especially in ruptured aneurysms, is higher than with standard coil embolization[7].

In terms of engineering design, flow diverters are a novel class of Neuroendovascular devices that are made of very flexible tubular constructions with mesh and are quite similar to stents and they are less porous than typical stents[10]. The main objective is to shunt blood flow away from an intracranial aneurysm by positioning a mesh device resembling a stent on the intra-aneurysm neck along the parent artery[7].

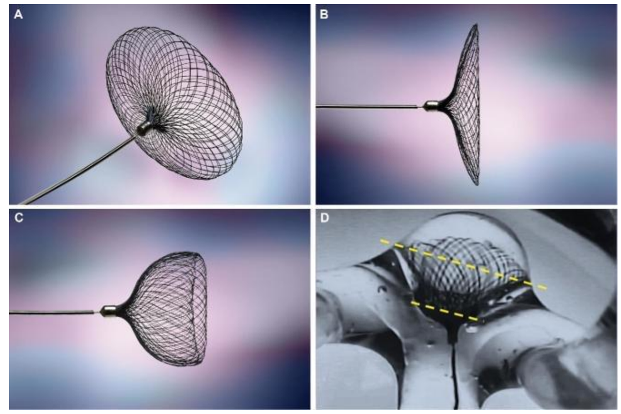
The introduction of flow diverters and intrasaccular devices being the most recent techniques for the treatment of intracranial aneurysms represents a major paradigm shift in the treatment of aneurysms. The main reason being the decreased rate of recurrence as well as decreased morbidity and mortality with the achievement of stasis in blood flow along with neointimal endothelialization they have revolutionized the treatment of intracranial aneurysms, representing both a safe and efficacious alternative to open microsurgery and other endovascular modalities.

Intrasaccular flow disruption is a device made such that it targets the aneurysm's neck and causes flow disruption which promotes thrombosis and neo-endothelialization at the neck. They are intended to create a doubling effect with intra-aneurysmal flow disruption and induction of thrombosis followed by a remodeling of the parent artery[11].

Following is a summary of the devices currently available: Firstly, the Woven EndoBride, WEB (Microvention) device disrupts local flow by being placed completely within the aneurysm sac and span the ostium[12]. Secondly the Medina Embolic Device, also known as the Medna (Medtronic) is a disruptor and coil system consisting of a 3 dimensional, layered structure made from a radiopaque shape set core wire, and shape- memory alloy filaments that form a self-expanding mesh.[12] The Artisse also previously known as LUNA: Medtronic is a self-expanding braided implant made from a double layer of nitinol wire mesh secured at proximal and distal ends and clearly marked with radiopaque platinum markers[12].

The Contour Neurovascular system (Cerys Endovascular). This is made out of a radio opaque shape memory mesh. Figure below shows an image of (**a, b**) fully unconstrained configuration, it has a flat disc like shape, (**c, d**) after deployment they for a tulip like configuration.

The device is purposefully oversized to the neck and the aneurysm's greatest measured equatorial diameter. This constricts from opening further from any pressure applied at the device base[12].



The Cerus Intrasaccular stent is derived from the design of Contour. As seen in **Figure C**, they have a larger diameter of wires in its double layer mesh. They are designed in such a way that it prevents movement down into the parent artery as the aneurysm is being filled with coils. This is because the device is only oversized to the neck opening of the aneurysm to provide coverage across aneurysm neck[12]. It has also been found in literature that the above-mentioned devices are easily deployed, less invasive, have a reduced operative time and have a shorter learning curve.

Conclusion:

There are a variety of treatment options for intracerebral aneurysm, however patient's comorbidities, patient's preference, and the experience of the operator and involvement of a multidisciplinary team are some of the points to consider when choosing a treatment option. The treatment of intracranial aneurysm has undergone a very significant development in the recent decades, from going from clipping to endovascular techniques which then entered an era of intrasaccular devices. With the introduction of new technique's, the learning as well as the clinical experiences grows. This will continue to prevail with further technological advancements. Latest era of endovascular techniques is flow diverters and disruptors which actually brings about the treatment of wide neck aneurysms a paradigm shift.

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