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CASE REPORT

Scissoring of a Cobalt Alloy Aneurysm Clip causing Slippage during Cerebral Aneurysm Surgery

Case report and review of literature

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انزلاق مشابك سبائك الكوبالت أثناء جراحة تمدد الأوعية الدموية الدماغية

تقرير حالة ومراجعة المنشورات

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الملخص: انزلاق المشابك ظاهرة نادرة الحدوث، وتداخل أو التواء مشابك تمدد الأوعية الدموية ما يزال نادرا. وقد نتجت معظم هذه الحالات من مشابك التيتانيوم. واصفو التقرير أبلغوا عن حدوثه أثناء استخدام مشابك سبيكة الكوبالت المنخلة في جراحة تمدد الأوعية الدموية في الشريان السباتي الداخلي التي تم تحديدها خلال العملية باستخدام الأشعة المصبغة للأوعية وتصحيحه من خلال إعادة وضع مشبك سبيكة الكوبالت الغير المنخل. الآلية المحتملة لهذه المضاعفات، والتدابير التي قد تحول دون حدوثه، بما في ذلك التشريح الحذر، إزالة أو تخفيف الضغط عندما يكون ذلك ممكنا، اختيار المشبك المناسب، والأشعة المصبغة أثناء العملية.

مفتاح الكلمات: تمدد الأوعية الدموية الدماغية، فشل المشبك؛ الأشعة المصبغة ؛ تقرير حالة؛ الهند.

ABSTRACT: Clip slippage is a rare occurrence, and the scissoring or torsional failure of aneurysm clips is rarer still. Titanium clips have been implicated in a few such reported cases. The authors report its occurrence while using a fenestrated cobalt alloy clip for an internal carotid artery aneurysm which was identified by intraoperative angiography and rectified by re-applying a non-fenestrated cobalt alloy clip. The possible mechanism of this complication, and measures that may prevent its occurrence, including meticulous dissection, decompression when possible, proper clip selection, and intraoperative angiogram are described.

Keywords: Cerebral aneurysm; Clip failure; Intra-operative angiogram; Case report; India.

Secure clip placement is the key to successful aneurysm surgery. Clip failure after application, caused by twisting of the blades or scissoring rarely has been described in the literature.[1–3] The failures that have been reported have followed the use of titanium clips. In these cases, the tensile property of the metal itself was suspected to be the main cause.

However, other factors related to the aneurysm itself and clip application techniques may play an equally important role.

Case Report

A 53-year-old hypertensive male presented with a good grade sub-arachnoid haemorrhage (SAH) of 3 days' duration. A computed tomography (CT) scan of the brain showed a Fischer grade 4 SAH with ventriculomegaly. A digital subtraction angiogram (DSA) showed a 1.47 cm trilobed internal carotid artery (ICA) aneurysm of the communicating segment with a 2.7 mm wide neck. There was irregular narrowing of the ICA, suggestive of atherosclerosis [Figure1].

The patient was admitted to Amrita Institute of Medical Sciences, Cochin, India, for clipping of the aneurysm through a right pterional approach. Exposure of the region showed the ICA to have

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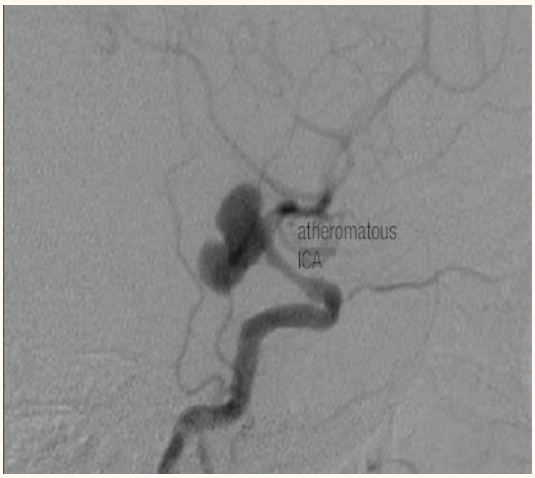

Figure 1: Preoperative angiogram showing internal carotid artery (ICA) aneurysm.

Figure 2: Intraoperative angiogram showing scissoring of clip and filling of aneurysm.

atheromatous changes extending into the aneurysm neck and sac. After the neck was sufficiently exposed, a parallel clipping was achieved with a 10 mm bayonet-shaped fenestrated cobalt alloy Yasargil aneurysm clip (B. Braun Melsungen AG, Meslungen, Germany) with the fenestra enclosing the middle cerebral artery (MCA). There was evidence of parent vessel compromise which was corrected by readjusting the clip distally along the neck. The dome was aspirated to confirm satisfactory clipping.

An intraoperative angiogram was then performed. The initial fluoroscopy images showed scisssoring of the blades and the angiogram showed refilling of the aneurysm [Figure 2]. On returning back to the operative field, it was found that the aneurysm had refilled with blood, which was leaking through the puncture site. Additionally, the clip was found to have rotated clockwise with the inner surface of one of the blades exposed [Figure 3].

Temporary clipping was not considered due to the extensive atheromatous changes in the ICA. Instead the clip was gently de-rotated and removed. There was considerable distortion of the aneurysm neck, ICA, and MCA during this manoeuvre. Clipping was then achieved after a more complete dissection around the aneurysm neck, with a perpendicularly placed 9 mm curved cobalt alloy Yasargil aneurysm clip. The check angiogram was found to be satisfactory [Figure 4].

The postoperative course was complicated by a delayed left sided hemiparesis due to multiple MCA territory infarcts secondary to vasospasm, which

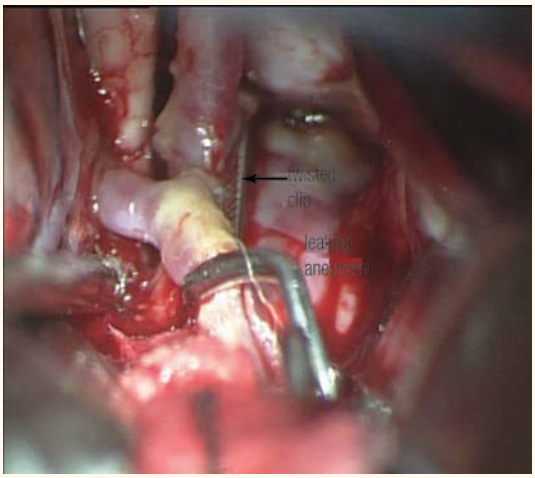

Figure 3: Intraoperative view showing rotated clip.

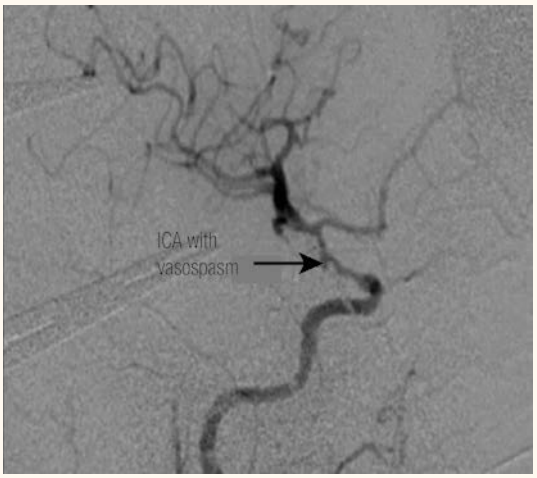

Figure 4: Final intraoperative angiogram showing complete clipping and vasospasm

improved with medical measures.

Discussion

The phenomenon of a "slipped" aneurysm following routine postoperative angiograms, although first described by Charles Drake, has been documented infrequently in the literature, and failure due to twisting of the blades or scissoring is rarer still.[1–5]

The stability of an aneurysm clip during surgery depends on various factors operating simultaneously, most of which cannot be predicted based on the mechanical properties of the clip alone. Additionally, the current data are from *in vitro* testing and hardly mimic the real life situation.[6-12] Of these, only one study shows the effect of torque on the twisting of clip blades.[11]

Of the several factors that are responsible for the stability of the clip, the one most commonly reported is that of the clip's mechanical properties. Pure titanium and titanium alloy clips have been implicated in all the reported cases of scissoring malfunction so far.[1–3] Although there are several studies which show reliable closing forces and the stability of these clips, one of these showed inferior stability of titanium clips to torque forces compared to cobalt alloy clips.[9–13] There are also concerns in using titanium clips for larger aneurysms due to the decreased opening of the clip blades.[14]

For cobalt alloy clips, the make, length, and geometry of the clips have all been shown to influence the closing forces.[7,8,10] In particular, bayonet and fenestrated clips have been shown to have weaker closing forces when compared to standard straight clips.[8] The clip used in our patient was a fenestrated bayonet-shaped cobalt alloy clip. This is an alpha-type clip with a single box lock mechanism for stability. Other similar clips like the Sugita (Mizuho Medical Co., Tokyo, Japan) have stabilisation bars to prevent scissoring.

The next most important factor is aneurysm-related. Large complex aneurysms, especially those with a neck wider than 2 mm, require greater closing forces, which is often not achievable with a single clip. The presence of atherosclerosis further adds to the complexity by increasing wall thickness and stiffness.[2,3,14] Both these factors were present in this case. But the nature of failure, (i.e. the rotation and scissoring occurring in a slightly delayed manner), cannot be explained by size and wall thickness alone. However, if the atheroma is non-uniformly distributed around the neck, one of the clip blades may gradually slide over a rigid part of the plaque, resulting in their scissoring over a short period of time after the clip placement, as occurred in this patient.

The third—and probably most important factor—is procedure-related. A good neck exposure freeing all adhesions, decreasing intra-luminal pressure, and choosing the right clip and final placement, all contribute to clip stability.[14] Torsional forces created while re-adjusting a clip in a large atheromatous neck can also result in scissoring, especially if the plaque is hard and eccentric, thereby preventing proper apposition of the blades. Temporary clip occlusion of the ICA and aspiration of the aneurysm provide the best conditions for a satisfactory clipping in such circumstances; however, these were not considered due to the presence of gross atheromatous changes in the parent vessel as seen in the angiogram as well as during surgery. Parallel clipping was initially performed to avoid kinking of the ICA. An additional clip, parallel and distal to the first after collapsing the sac, might have prevented the slipping. In the end, a simpler clipping solution with a standard clip in a perpendicular direction was found to be effective.

The role of the intraoperative angiogram in achieving satisfactory clipping has been highlighted previously and cannot be over-emphasised.[15,16]

Conclusion

Clip failure is a rare but distinct possibility and occurs when the clip is made to function in situations beyond its design parameters, irrespective of its make and mechanical properties. A good technique adhering to the basic principles of aneurysm surgery and choosing the right clip(s) for the right aneurysm are the keys to a successful outcome.

The intraoperative angiogram is a valuable tool in identifying various unexpected and correctable problems, especially in complex aneurysms.

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