Aneurysm

Endovascular internal trapping of traumatic pericallosal pseudoaneurysm with hydrogel-coated self-expandable coil in a child: a case report

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Abstract

Background: Traumatic intracranial pseudoaneuysms in children must be completely secured from the parent artery because of significant morbidity and mortality from the high risk of rebleeding. However, the trapping of the parent artery involves the risk of ischemia changes distal to the trapped artery and the perforator injury. We describe a first case in the literature of successful trapping in the short segment with hydrogel-coated self-expandable coil in a child with a traumatic pericallosal pseudoaneurysm.

Case Description: A 5-year-old boy was admitted to our institution after enduring a blunt trauma with a stuporous mentality. Initial neuroimaging revealed a small hemorrhage in the corpus callosum with subarachnoid hemorrhage. Two weeks later, computed tomogram showed new callosal hemorrhage and a 4.7 × 5-mm pseudoaneurysm of the right pericallosal artery with mental deterioration and weakness of lower extremity. An endovascular short segmental internal trapping (5 mm) of the right pericallosal artery was conducted to save collateral blood flow, using 2 hydrogel-coated self-expandable coils. The cerebral angiogram of immediately after the trapping and at 3 months’ follow-up revealed that the aneurysm had been completely obliterated, with successful maintenance of the distal collateral flow from the contralateral pericallosal artery. The patient recovered with good clinical outcome.

Conclusion: We suggest that short-segment occlusion by a hydrogel-coated self-expandable coil has become a good alternative for the treatment of traumatic pseudoaneurysms in the distal anterior cerebral artery, although the safety and reliability of this procedure is as yet not definitely proven.

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1. Introduction

Intracranial traumatic aneurysm (ITA) occurring during childhood is a fairly rare condition but often results in severe neurologic deficits or death from its rupture. In histopathologic terms, ITA classified as either intracranial traumatic true aneurysms (ITTAs) formed by incomplete injury to the vessel wall or intracranial traumatic pseudoaneurysms (ITPAs), which are accompanied by subarachnoid hemorrhages formed by pseudowall, developed from the blood clots after the complete disruption of the vessel wall. However, it is difficult clinically to distinguish between an ITPA and ITTA [1,4,6,11,13,17]. Therefore, in diagnosing and treating ITAs, the literature does not differentiate between ITPAs and ITTAs, and a series of techniques have been previously used for both conditions, such as surgical trapping or excision [1-3,6,18], clipping [16,18], endovascular coil embolization [13], or internal trapping [14,17]. However, although it is possible to perform clipping or...
intraaneurysmal coil embolization for ITTAs, which have true walls, it is impossible to perform clipping of the aneurysmal neck and coil embolization for ITPAs, which only have pseudowalls [1].

Therefore, the primary objective in the treatment of ITPA is the complete obliteration of the lesions from the parent artery by means of surgical trapping or endovascular internal trapping to prevent its further growth and disastrous bleeding. We present in this study what we believe is the first description in the literature of a procedure in which an ITPA was managed successfully by very short segmental internal trapping of the parent artery with 2 hydrogel-coated self-expandable coils for maintaining the collateral flow of the anterior cerebral artery (ACA).

2. Case report

A 5-year-old boy was admitted to our hospital after suffering from blunt trauma associated with a motor vehicle–related pedestrian accident. The patient presented with a stuporous mental state and had a Glasgow Coma Scale score of 6, with no definitive localized weakness. Computed tomography (CT) revealed a small hemorrhage in the corpus callosum and a small quantity of subarachnoid hemorrhaging at the anterior skull base (Fig. 1A). However, the 3-dimensional reconstruction of the 16-channel multislice CT and magnetic resonance imaging (MRI) disclosed neither definitive arterial injury nor any underlying abnormalities in the intracranial vasculature (Fig. 1B). The follow-up CT scans at 1 week revealed...
gradual resolution of the previously observed clot in the corpus callosum. The boy evidenced a stable clinical course during the next 2 weeks spent in the intensive care unit. At 2 weeks, the boy showed sudden mental deterioration to a deep stuporous mental state and mild weakness of lower extremities accompanied with a seizure attack. The 3-dimensional reconstruction of the 16-channel multislice CT scan revealed an aneurysm of the right pericallosal artery with a newly developed hematoma located in the corpus callosum (Fig. 2). Cerebral angiography was then immediately conducted, revealing an aneurysm, measuring $4.7 \times 5$ mm, on a nonbranched site in the right pericallosal artery (Fig. 3A). The aneurysm exhibited an irregular wall and a conical tapered neck, consistent with a pseudoaneurysm with irregularity and luminal narrowing of the aneurysm site. Under local anesthesia with intravenous administration of lorazepam, an Excel microcatheter (Boston Scientific Target Corp, Fremont, Calif) covering a tapered 0.014-in Transend guidewire (Boston Scientific Target Corp) was advanced through the parent artery of ITPA, and the lumen of the parent artery was selectively microcatheterized using a 6F guiding catheter (Envoy; Cordis, Miami Lakes, Fla) positioned within the right internal carotid artery. Two hydrogel-coated self-expandable coils (HydroCoil Embolic System [MicroVention, Aliso Viejo, Calif], $4 \text{ mm} \times 4 \text{ cm}$ and $4 \text{ mm} \times 6 \text{ cm}$) were used in the 5-mm internal trapping...
of the ACA, including the origin of the pseudoaneurysm. After the internal trapping, angiography revealed complete exclusion of the aneurysm from the cerebral blood flow, with preservation of the distal collateral flow from the contralateral ACA (Fig. 3B). The patient exhibited good tolerance of the procedure. After the intravascular trapping procedure, we confirmed that there was no ischemic signal change in the distal ACA territories by the MRI (Fig. 3C).

The cerebral angiogram at 3 months’ follow-up revealed that hydrocoil trapping had completely excluded the aneurysm from the circulation, with successful maintenance of the distal collateral flow from the contralateral pericallosal artery. A follow-up examination by 3-dimensional reconstruction of the 16-channel multislice CT scan and magnetic resonance angiogram conducted 2, 6, and 12 months later revealed no interval change, with complete trapping of the aneurysm and maintenance of the right distal ACA flow from the contralateral pericallosal artery (Fig. 4). At 1 year of follow-up, the neurologic examination showed that he was alert and independent in all daily activities, and had no limitation of the face and hand movement, and no limitation in running or walking, except for a mild subjective dysarthria.

3. Discussion

Intracranial traumatic aneurysm comprises less than 1% of all intracranial aneurysms and is normally detected within the anterior circulation [2,14,18]. Intracranial traumatic aneurysms tend to occur on the distal ACA, distal middle cerebral artery, or intracavernous internal carotid artery, secondary to an impact against the falcine or bony edge [2,3,13,17]. Intracranial traumatic aneurysm can develop even after mild closed head injury and more commonly in children.

Intracranial traumatic aneurysm is classified as ITTA or ITPA according to the presence or absence of a true wall, but this is not feasible clinically. If there is extensive, recurrent or severe subarachnoid hemorrhage after the initial injury, then ITPA rather than ITTA may be suspected. Considering the assumption in previous reports that in arterial injuries should be evaluated for the development of traumatic aneurysms, via angiography, within 2 to 3 weeks of the injury [17]. When detected, it is strongly recommended that such lesions be resolved by active treatment.

Intracranial traumatic pseudoaneurysms are considered quite difficult to treat, either by direct clipping or by endovascular aneurysmal embolization, because of the absence of a true collaginous layer in the aneurysm wall. Therefore, surgical or endovascular trapping or occlusion of the proximal parent artery has proven to be a fairly reliable option for most patients with ITPA [17,18]. However, with regard to microsurgical trapping of ACA-related pseudoaneurysms in a young child, surgical trapping is considered to be more risky compared with true aneurysm because of the fragility of the lesion and higher possibility of a premature rupture during surgical dissection in a limited surgical field and anatomical variations, particularly in a swollen brain after subarachnoid hemorrhage [4,5]. For these reasons, the surgical mortality rate for ITA has been reported to be higher (18%-22%) than that for aneurysms in general [3,12]. Thus, the endovascular approach has been considered a preferred option, owing to its minimal invasiveness and increased safety to avoid premature rupture from no dissection of adjacent vessels and structures [12,14]. Over the last decade, advances in endovascular techniques and development of the microcatheter have enabled much safer approaches to traumatic pseudoaneurysms [13,17], even in cases in which the lesions are ensconced in distal locations, such as the pericallosal or callosomarginal arteries [4,13,14]. In reality, endovascular treatment of ITA showed negligible mortality [8,13,17].

Endovascular parent arterial occlusion involves the permanent elimination of blood flow from the parent artery to the pseudoaneurysm, attenuating the risks of recanalization, compaction, and regrowth resulting from hemodynamic influence exerted by the blood flow from the parent artery. The only and major concern in this procedure is the risk of ischemia at level or distal to the trapped artery. The complication rate of persistent ischemia after the endovascular treatment has been reported to be 0% to 4.6% in ITPA [7,13]. However, occlusion of the parent artery is considered to be relatively safe in the distal ACA, in which there is no important cortical perforator with possible collateral back flow from the distal to the trapped segment, especially when the procedure is conducted in a short-segment fashion [4,13-15,17].

The hydrogel-coated self-expandable coils (HydroCoil Embolic System) was first used in 2002 as a method for aneurysm embolization [10] and subsequently accredited as a safe and efficacious procedure for patients with parent artery occlusion [9]. This coil enables the operator to occlude a short segment of artery even of a 6-mm length. We used only 2 hydrogel-coated self-expandable coils to achieve a 5-mm short-segment occlusion for the ITPA arising from ACA and achieved a good clinical outcome.
with maintaining the collateral blood flow and avoiding ischemic sequelae.

There have been several reports on parent arterial occlusion or endovascular trapping in patients with ITPA [4,14]. However, this is the first description of short-segmental internal trapping using hydrocoils in a ITPA at distal ACA. To obtain complete obliteration of the aneurysm and minimize the risk of procedure related ischemia, we suggest that short segmental internal trapping with hydrogel-coated self-expandable coils is a favorable option for the management of ITPA.

4. Conclusion

Intracranial traumatic pseudoaneurysm of the pericallosal artery tend to rupture and should be managed by aggressive treatment. We suggest that short-segment endovascular trapping with a hydrogel-coated self-expandable coil may be the most technically feasible and safest alternative modality especially for the treatment of ITPA occurring in the distal ACA.

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References


Commentary

Sim et al present a difficult and beautiful treatment of a traumatic true or pseudoaneurysm of the pericallosal artery with hydrogel-coated coils. In spite of trapping of the artery, the distal collateral circulation has been preserved. Having chosen endovascular technique rather than surgery was reasonable.

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