THE ENDOVASCULAR MANAGEMENT OF PERICALLOSAL ARTERY ANEURYSMS

P. KESTON, P.M. WHITE, L. HORRIBINE, R. SELLAR

Department of Neuroradiology, Western General Hospital, Edinburgh.

SUMMARY

Aim: to describe our experience with a series of 18 patients with pericallosal artery aneurysms, in whom endovascular coil insertion was attempted.

Method: the CT and angiographic appearances, coiling techniques and patient outcomes are discussed.

Results: we encountered a higher than expected level of technical difficulty and procedure related complication than when coiling aneurysms in more common locations. In particular the distal position of the aneurysms lead to poorer control over the microcatheter position. Procedure related rupture occurred in three cases. Coiling was not possible in one case only. An association between an angulated bifurcation of the anterior cerebral artery and a sidewall aneurysm configuration was noted.

Conclusion: despite the technical difficulties and high procedure related rupture rate, coiling of pericallosal aneurysms is feasible and has good outcome.

Key words: intracranial, aneurysm, embolization.

RÉSUMÉ

Traitement endovasculaire des anévrismes de l’artère péricalleuse

But : décrire notre expérience à propos d’une série de 18 patients porteurs d’un anévrisme de l’artère péricalleuse traité par spires endovasculaires.

Méthodes : les aspects scanographiques, angiographiques ainsi que les techniques d’embolisation et l’évolution clinique sont discutés.

Résultats : nous avons rencontré un taux de difficultés techniques et de complications plus important que lors du traitement endovasculaire d’anévrismes de topographie habituelle. En particulier, en cas d’anévrismes de siège très distal, le contrôle de la position du microcathéter était difficile. Une rupture en rapport avec le traitement est survenue dans 3 cas. Un traitement endovasculaire n’a pas été possible dans un cas. Une association entre une bifurcation angulée de l’artère cérébrale antérieure et une configuration anévrismale et un collet large de l’anévrisme a été notée.

Conclusion : malgré les difficultés techniques et le taux de rupture élevé, le traitement endovasculaire des anévrismes de l’artère péricalleuse est réalisable et l’évolution post-thérapeutique est bonne.

Mots-clés : anévrisme intracranien, embolisation.

INTRODUCTION

The recent ISAT trial has shown endovascular coiling to be the safest method of treating intracranial aneurysms in cases where there was clinical equipoise about the optimal treatment [8, 9]. Aneurysms of the distal anterior cerebral territory are unusual and constitute approximately 4% of those that rupture. They were similarly represented in the ISAT study population, accounting for 95 of the 2,143 randomised patients (4.4%). The most common presentation is with subarachnoid haemorrhage. This tends to have a distinctive, superior interhemispheric distribution. There are several reports of subdural haemorrhage associated with this aneurysm location [5] and intraparenchymal bleeds are not uncommon.

The particular difficulties encountered when attempting to coil pericallosal aneurysms were described by Pierot et al. in 1996 [11]. Menovsky et al. have described a series of 12 coiled pericallosal aneurysms [7]. In light of the relatively small numbers of coiled pericallosal aneurysms recorded in the literature we describe our institutional experience with a series of 18 cases, provide a pictorial review and detail the particular technical difficulties we encountered.

METHOD

Coiling Technique

Procedures were performed by, or under supervision of, experienced interventional neuroradiologists (RS and PW). Before 2002 single plane angiography (Advantix, GE, Milwaukee) was available. More recent cases were imaged using biplane angiography (Axiom Artis, Siemens, Erlagen, Germany) and 3D angiographic reconstruction for treatment planning.

A 6Fr guide catheter was introduced into the relevant internal carotid artery and a microcatheter, most commonly a Prowler 10 (Cordis Corporation, Miami, Florida) was navigated to the anterior cerebral artery with the aid of an appropriately shaped guidewire.
The distal location of these aneurysms reduces control over the movements of the microcatheter/wire combination. Use of a soft microcatheter and wire is postulated to reduce the risk of rupture on entering the aneurysm sac but does decrease the system stability.

Method of patient assessment

A research nurse, who was not directly involved with the patient’s management, assessed the clinical status of all patients. Modified Rankin [6] scores (table I) were recorded for each patient at their last follow-up appointment. The packing percentages were estimated visually by consensus reading by two interventional neuroradiologists (RS, PW). Angiographic follow up was undertaken at six, eighteen and thirty-six months in most patients. This protocol was modified if the patient’s age or other co-morbidity made formal angiography inappropriate. Angiographic follow up is not yet available for 3 recent cases.

RESULTS

The results are summarised in tabular form (table II). In total 18 patients with pericallosal aneurysms were considered for endovascular treatment. Of these 17 were successfully treated by endovascular coiling. 7 Male: 10 Female. Age range=36–72 (Median age=52). They were generally of good WFNS grade, with 15 at grade 2 or better on admission. In five cases the coiling was delayed (>5 days). This was for a variety of reasons including delayed referral from local hospital, patient condition and initial difficulty in identifying the aneurysm. One patient had an unruptured aneurysm but, due to concern about his family history, insisted on treatment despite the relatively small sac diameter (4mm). All other patients were considered to have bled from their pericallosal aneurysm.

The treated pericallosal aneurysms were divided into two groups by their configuration. 8/17 (47%) patients had true bifurcation aneurysms, 7/17 (41%) had sidewall aneurysms and the remaining three were ‘atypical’ (see below). Cannulation of a true bifurcation aneurysm was generally straightforward due to the straight line of approach (figure 1).

It was more difficult to cannulate and maintain a stable position in a sidewall aneurysm configuration (figure 2). In one case it was only possible to enter the aneurysm by leading with a coil, as it was not possible to pass the guide wire into the sac. This technique has been described previously [12].

The procedure was well tolerated in all cases. Fourteen patients had satisfactory initial occlusion (90% or greater). Three patients had additional aneurysms treated. One patient (figure 3) was considered unsuitable for coil insertion due to a combination of an azygous anterior cerebral artery, broad necked aneurysm with vessels arising from the aneurysm sac and pulmonary comorbidity. This patient could tolerate angiography only under general anaesthesia and this was performed with the intention to treat the aneurysm. This was not possible. The vascular neurosurgeons also felt that surgical treatment was not possible.

Three aneurysms ruptured during the procedure. In the first case (figure 1) the aneurysm ruptured on removal of the first coil, which was oversized. The other two ruptures occurred during cannulation.

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**Table I.** Modified Rankin outcome scoring scale.

<table>
<thead>
<tr>
<th>Score</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>No symptoms</td>
</tr>
<tr>
<td>1</td>
<td>No significant disability: able to carry out all usual duties despite symptoms</td>
</tr>
<tr>
<td>2</td>
<td>Slight disability: unable to carry out all previous activities but able to manage own affairs without assistance</td>
</tr>
<tr>
<td>3</td>
<td>Moderate disability: requires some help but able to walk without assistance</td>
</tr>
<tr>
<td>4</td>
<td>Moderately severe disability: unable to walk and unable to attend to own bodily needs unassisted</td>
</tr>
<tr>
<td>5</td>
<td>Severe disability: bedridden, incontinent and requires constant nursing attention</td>
</tr>
</tbody>
</table>

a | b | c

**Fig. 1.** Acutely ruptured 2mm aneurysm – patient 7. This small aneurysm (a) was associated with gentle curvature at the bifurcation and appears to arise from the true bifurcation site. An initial attempt at packing with a 2mm diameter, 4cm soft helical coil was unsuccessful and the aneurysm ruptured following coil removal (b). A 2cm coil was then inserted with good angiographic and clinical results (c).

**Fig. 1.** Anévrisme rompu de 2 mm (patient 7). Ce petit anévrisme (a) est associé à une courbure modérée de la bifurcation et semble se développer à partir de la vraie bifurcation. Une tentative initiale de packing avec une spire de 2 mm de diamètre, 4 cm de long (soft) n’a pas été possible et une rupture de l’anévrisme après le coïling est survenue (b). Une spire de 2 cm a été alors placée avec des bons résultats angiographique et clinique.

partly due to instability and forward pressure in the microcatheter/wire combination. Fortunately in all three cases it was possible to complete the coiling with no significant morbidity to the patients.

Four aneurysms required recoiling due to aneurysm neck regrowth or incomplete initial packing. Follow up angiography was available for ten patients (last follow up angiogram timing: range 1-4 years, median 3 years) and showed satisfactory final results in all but one case, where no further treatment was thought possible. The clinical outcome was good in all 17 treated cases (Modified Rankin score of 0 or 1).

**DISCUSSION**

**Diagnosis**

Clinical presentation is not unusual, with typical sudden onset severe headache. The site of the aneurysm may be revealed by the typical distribution of subarachnoid blood or by the presence of a medially located superior frontal lobe haemorrhage (figure 4). Spontaneous subdural haematoma in the anterior fossa may also occur.

CT angiography (figure 5) is valuable in confirming the origin of the bleed and in aiding treatment planning. It is important to ensure that this area is included in the image volume as it is easily excluded by low placement or under angulation of the planning block [13, 14]. Multislice CT with near isotropic, sub millimeter resolution and greater anatomical coverage, shows great promise in the evaluation and preoperative workup of all subarachnoid haemorrhage patients.

Although it is possible to image acutely ruptured aneurysms with MR angiography we have found it less satisfactory than CT due to patient movement artifact and logistical problems with scanning acutely unwell patients. We use MR angiography extensively in follow up of patients with coiled aneurysms where formal angiography is no longer thought to be necessary.

### TABLE II. – Summary of results.

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>WFNS Grade</th>
<th>Initial % occlusion</th>
<th>Last angiogram</th>
<th>Recoiled?</th>
<th>Final % occlusion</th>
<th>Outcome (Modified Rankin)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>42</td>
<td>M</td>
<td>1</td>
<td>100</td>
<td>N/A</td>
<td>no</td>
<td>N/A</td>
<td>0</td>
<td>Only clinical follow up available</td>
</tr>
<tr>
<td>2</td>
<td>59</td>
<td>F</td>
<td>1</td>
<td>100</td>
<td>5 years</td>
<td>no</td>
<td>&gt;95</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>54</td>
<td>M</td>
<td>1</td>
<td>100</td>
<td>3 years</td>
<td>yes</td>
<td>95</td>
<td>0</td>
<td>Rupture on cannulation</td>
</tr>
<tr>
<td>4</td>
<td>52</td>
<td>M</td>
<td>1</td>
<td>100</td>
<td>&lt;90</td>
<td>yes</td>
<td>&gt;95</td>
<td>0</td>
<td>Associated AVM</td>
</tr>
<tr>
<td>5</td>
<td>36</td>
<td>F</td>
<td>2</td>
<td>90</td>
<td>3 years</td>
<td>yes</td>
<td>&gt;95</td>
<td>0</td>
<td>Rebleed 2yrs post coiling</td>
</tr>
<tr>
<td>6</td>
<td>50</td>
<td>F</td>
<td>2</td>
<td>&lt;90</td>
<td>4 years</td>
<td>no</td>
<td>95</td>
<td>1</td>
<td>3 additional aneurysms clipped/ coiled</td>
</tr>
<tr>
<td>7</td>
<td>47</td>
<td>F</td>
<td>1</td>
<td>&gt;95</td>
<td>1 year</td>
<td>no</td>
<td>&gt;95</td>
<td>1</td>
<td>Rupture after coil removal Mild leg weakness</td>
</tr>
<tr>
<td>8</td>
<td>49</td>
<td>M</td>
<td>1</td>
<td>100</td>
<td>4 years</td>
<td>no</td>
<td>100</td>
<td>0</td>
<td>Aneurysm entered with coil loop</td>
</tr>
<tr>
<td>9</td>
<td>56</td>
<td>M</td>
<td>1</td>
<td>100</td>
<td>N/A</td>
<td>no</td>
<td>N/A</td>
<td>1</td>
<td>Clinical follow-up at 2 years only</td>
</tr>
<tr>
<td>10</td>
<td>43</td>
<td>F</td>
<td>2</td>
<td>90</td>
<td>N/A</td>
<td>no</td>
<td>N/A</td>
<td>1</td>
<td>Developed pulmonary oedema requiring ITU care</td>
</tr>
<tr>
<td>11</td>
<td>39</td>
<td>F</td>
<td>3</td>
<td>90</td>
<td>2 years</td>
<td>yes X2</td>
<td>&gt;95</td>
<td>0</td>
<td>Aneurysm entered with coil loop</td>
</tr>
<tr>
<td>12</td>
<td>58</td>
<td>F</td>
<td>4</td>
<td>&lt;90</td>
<td>1 year</td>
<td>no</td>
<td>&lt;90</td>
<td>1</td>
<td>Fusiform (?dissecting) aneurysm</td>
</tr>
<tr>
<td>13</td>
<td>62</td>
<td>F</td>
<td>1</td>
<td>100</td>
<td>N/A</td>
<td>no</td>
<td>N/A</td>
<td>N/A</td>
<td>Recent case. Not yet followed up</td>
</tr>
<tr>
<td>14</td>
<td>67</td>
<td>F</td>
<td>1</td>
<td>100</td>
<td>1 year</td>
<td>no</td>
<td>100</td>
<td>0</td>
<td>Recent case. Unruptured aneurysm</td>
</tr>
<tr>
<td>15</td>
<td>58</td>
<td>M</td>
<td>0</td>
<td>100</td>
<td>N/A</td>
<td>no</td>
<td>100</td>
<td>0</td>
<td>Rupture on cannulation</td>
</tr>
<tr>
<td>16</td>
<td>44</td>
<td>M</td>
<td>1</td>
<td>&gt;95</td>
<td>N/A</td>
<td>no</td>
<td>N/A</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>64</td>
<td>F</td>
<td>1</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>1</td>
<td>Coiling not feasible Azygous A2 with spasm</td>
</tr>
<tr>
<td>18</td>
<td>72</td>
<td>F</td>
<td>1</td>
<td>100</td>
<td>N/A</td>
<td>no</td>
<td>N/A</td>
<td>N/A</td>
<td>Recent case. Not yet followed up</td>
</tr>
</tbody>
</table>
appropriate. Whilst the resolution is poor in comparison to DSA it is possible to visualise significant coil compaction or aneurysm recurrence, which may require re-treatment [2].

Formal angiography remains the mainstay of diagnosis and treatment planning (figure 6). Newer three dimensional reconstruction capabilities have considerably enhanced the visualisation and characterisation of aneurysm morphology. This feature allows more accurate measurement of aneurysm size and enables rapid selection of optimal coiling projection(s).

Aneurysm Morphology

In our experience there are two distinct morphological patterns of pericallosal aneurysm. Firstly are sidewall aneurysms, arising close to the bifurcation and often based on the callosomarginal artery origin. These are frequently associated with marked angulation of the vessels at this point (figure 2). Secondly are true bifurcation aneurysms. These are usually related to more gentle curvature of the vessels, with the sac lying in the line of the anterior cerebral artery. The relationship between sidewall aneurysm and acute angulation of the parent vessel at the bifurcation has not been described at other aneurysm sites and may be a feature of the haemodynamics in this more distal arterial location. In general the true bifurcation aneurysms are more favourable for endovascular treatment. They often have a narrow neck in relation to the dome diameter and the direct line of approach from the parent vessel aids cannula-
tion. In contrast sidewall aneurysms are more difficult to treat. The indirect line of approach often necessitates the use of a complex “S” curve to the microcatheter which may lead to greater difficulty in advancing into the A1 segment of the anterior cerebral artery. Once the aneurysm has been cannulated the catheter position is often less stable. The generally broader neck also leads to difficulty in obtaining stable coil position without compromise of the narrow parent vessel.

There were three “atypical” aneurysms. This is a higher number than would be expected in a similar group of aneurysms in more typical locations. In one case the aneurysm appeared to be related to a dissection of the anterior cerebral vessel. The pericallosal origin has recently been described as a common site for dissection [10]. In another case there was a fusiform aneurysm of the distal anterior cerebral with a small associated lobule that was felt to be the bleeding point, this may also represent dissection of the parent vessel. The other atypical aneurysm was large and irregular and had arisen secondary to an arteriovenous malformation in the distal circulation. The association of AVM and aneurysm of the feeding vessel is well known. This aneurysm was considered to be the source of bleeding and was therefore treated (figure 7).

Treatment

Endovascular coiling is more technically demanding than in the more common proximal aneurysm sites. This is reflected in our results (table II). We experienced higher rupture and incomplete coiling rates than we would expect for aneurysms closer to the Circle of Willis. In this group aneurysmal rupture occurred in 3 of the 17 coiled patients (18%) in comparison to our overall departmental five year (1999-2003 inclusive) rupture rate of 9/651 (1.4%), or 7/640 (1.1%) if pericallosal aneurysms are excluded over this same five year period. Other than their location, the three aneurysms that ruptured did not have any particular features to suggest that they were higher risk.

Satisfactory initial packing (≥90%) was achieved in only 14/17 (82%). This is low in comparison to the systematic review by Bilstra et al. [1] in which >90% packing was reached in 89% of cases. Complete (100%) packing was achieved in 9/17 (53%) – similar to the 54% in Bilstra’s study. Our experiences are similar to those described by Menovsky et al. [7] although this group had no significant procedure related complications and only one incomplete coiling. One patient in their series had significant coil compaction. The number of patients in whom treatment was not attempted was not given.

Neurosurgical treatment of distal anterior cerebral aneurysms has been reported to be difficult [4], with higher morbidity and mortality in comparison to other aneurysm locations [3]. The surgeon may opt for either an interhemispheric or a pterional...
approach. There is limited access with the interhemispheric approach due to the narrow interhemispheric space and the depth of the aneurysm. Adequate visualization may require the sacrifice of bridging veins and consequent cortical damage. Partial resection of the corpus callosum is advocated in some cases to improve operative access. Despite these problems there is variation in the reported surgical outcome of these cases, with several series describing good outcomes, although it is not clear if these patients were independently assessed. Our clinical outcomes were very encouraging, with all patients at 0 or 1 on the Modified Rankin scale at last recorded follow up. Menovsky et al describe similarly good outcomes and both clipping series compare favourably with deSousa’s large surgical series. They describe 5 deaths from a group of 72 patients with 74 pericallosal aneurysms as opposed to no mortality in the 29 described coiled patients. In addition this group quotes a 90% good outcome for clipping of Grade I or II patients in comparison to 100% good outcome in the coiled cases reviewed.

CONCLUSION

Endovascular treatment of pericallosal aneurysms is feasible and successful. The clinical outcomes in this series are in line with other published results. The coiling procedure is more technically challenging, particularly due to the distal location of the aneurysms and the associated tortuous approach. This leads to instability of the catheter/wire combination. Despite the technical difficulties, both our series and that of Menovsky et al. suggest significantly better clinical outcomes when compared to clipping of these aneurysms.

There is an apparent association between acute angulation of the anterior cerebral bifurcation and the formation of a sidewall pattern aneurysm. The sidewall configuration aneurysms are more difficult to treat by endovascular coil insertion.
RÉFÉRENCES


