Endovascular Treatment of Intracranial Aneurysms: A Minimally Invasive Approach with Advantages for Elderly Patients

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Summary
An endovascular approach, embolizing intracranial aneurysms with electrolytically detachable coils, is a new minimally invasive treatment of aneurysms. Reviewing our experience with 13 patients aged 70 years or more, 12 patients were treated successfully. Over an average follow-up period of 8 months, there was only one death which might be attributed to an intracranial aneurysm. This compares favourably with mortality rates approaching 50% for either conservative or traditional surgical management of aneurysms presenting with subarachnoid haemorrhage in this age group. Coil embolization, avoiding craniotomy, may offer particular advantages in managing intracranial aneurysms in the elderly patient.

Keywords: Coil embolization, Intracranial aneurysms, Elderly patients, Subarachnoid haemorrhage.

Introduction
Managing intracranial aneurysms in elderly patients is difficult, and the dilemmas faced by practitioners concerned with their care are well recognized [1, 2]. Most patients present with ruptured aneurysms causing subarachnoid haemorrhage (SAH), and a minority with an enlarging but unruptured aneurysm causing pain or a progressive neurological deficit.

The natural history of SAH has been extensively studied. Its incidence rises with increasing age, reaching 78 per 100 000 in people in their eighth decade [3]. If aneurysms are left unsecured after SAH, approximately 50% of aneurysms rebleed within 3 months, and a significant number of patients rebleed later [4]. Second haemorrhages are frequently fatal. Reflecting this, the mortality of managing SAH conservatively (with bed-rest and gradual mobilization) has been reported as 49% at 2 months [5]. The alternative treatment, however, has hitherto necessitated major surgery—a craniotomy at which the aneurysm is hopefully clipped. The mortality of this is considerable for all patients, but increases markedly in the elderly, exceeding 48% in patients over 70 years [6]. As surgery in the elderly carries similar risks to the natural history of the disease, it is frequently considered kinder and more appropriate to manage these patients conservatively, rather than to subject them to invasive diagnostic procedures and the trauma of a craniotomy.

In contrast to SAH, the natural history of symptomatic yet unruptured aneurysms is poorly documented. The symptoms are believed to be due to the aneurysm enlarging, and therefore such lesions are generally treated both to prevent haemorrhage, and to prevent further neurological deterioration. Optimal therapy has until now required a craniotomy, a significant undertaking in an elderly patient.

Recently a minimally invasive method of treating aneurysms, using the endovascular route and electrolytically detachable coils, has been developed [7, 8]. This allows aneurysms to be excluded from the circulation, whilst preserving blood flow through the parent artery. To date we have used this method to treat more than 200 patients, many of whom were considered unsuitable surgical candidates for various reasons, including age. Here we present our experience of treating patients with symptomatic aneurysms aged 70 years or more, as we believe that this approach offers particular advantages to this age group.

Method of Aneurysm Treatment
This sequence of events is illustrated in the Figure. The procedure may be performed either under sedation or general anaesthesia. A guide catheter is placed in the extracranial internal carotid or vertebral artery. This is generally done via the femoral artery, but if the proximal vessels are tortuous it may be done by direct puncture of the cervical carotid artery. With the patient heparinized and using fluoroscopic control, a fine microcatheter (Tracker catheter, Target Therapeutics,
Figure. A radiographic sequence illustrating an initial vertebral angiogram with an aneurysm of the terminal basilar artery: selective catheterization of the aneurysm: deployment of the first coil: the end result, four coils being used to occlude the aneurysm sac completely.

Fremont, CA) is passed through the guide catheter, into the cerebral circulation, and is used to catheterize the aneurysm sac. A platinum coil, mounted on its steel control wire (Guglielmi detachable coil [GDC], Target Therapeutics), is deployed through the microcatheter. The coil fills, or embolizes, the aneurysm sac, excluding it from the circulation. Check angiography is performed during the procedure, to verify that the coil is in a satisfactory position and does not compromise the parent artery. If the artery is compromised, the coil can be withdrawn or repositioned. When the position of the coil is satisfactory, it is detached electrolytically from its control wire. Multiple coils may be needed to fill the aneurysm sac completely.

After the procedure, heparin is generally continued for 48 hours, and low-dose aspirin may be given for 3 months, to minimize the risk of thrombo-embolic complications.

Patients and Follow-up

We present our experience of treating patients aged 70 years or more between August 1993 and November 1994. Treatment was attempted in 13 patients, ten female and three male, with a mean age of 73 years (Table). The mean follow-up period was 8 months (range 2–17). Ten of the 13 patients presented with subarachnoid haemorrhage. Of these, six were treated acutely (i.e. within 3 weeks of the haemorrhage) and four were treated electively a mean of 7 weeks after the most recent haemorrhage. These patients were generally in a good clinical condition (grades I or II, according to the Hunt and Hess scale [9]), and hence their referral for treatment. Two patients were in grade III, but were embolized to permit more active treatment of hydrocephalus (both patients), and because of the increased risk of further haemorrhage in one patient who had already bled twice. Eight of the 13 patients had significant pre-existing medical conditions, most commonly hypertension.

Follow-up was conducted by reviewing the notes, and by sending all surviving patients the postal IST simple questions to assess outcome after stroke form [10]. A postal questionnaire was used because of geographical problems which precluded a more direct outpatient follow-up. In cases 8 and 12 (where the questionnaire was not returned), and in case 7, additional information was sought from the patients’ general practitioners.
### Table. Patient details

<table>
<thead>
<tr>
<th>Case</th>
<th>Age</th>
<th>Sex</th>
<th>Aneurysm Site</th>
<th>Presentation</th>
<th>Timing</th>
<th>PMH</th>
<th>Procedure</th>
<th>Comments/Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>73</td>
<td>F</td>
<td>R ICA</td>
<td>Visual failure—chiasmal compression</td>
<td>Elective</td>
<td></td>
<td>Sed: femoral</td>
<td>Acuity better, but partially sighted, living independently at home</td>
</tr>
<tr>
<td>2</td>
<td>72</td>
<td>F</td>
<td>Pericallosal</td>
<td>SAH, hydrocephalus, Gd I</td>
<td>Elective</td>
<td></td>
<td>Sed: femoral</td>
<td>Asymptomatic, living independently at home</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
<td>F</td>
<td>L ICA</td>
<td>SAH, Gd II</td>
<td>13/7 post SAH</td>
<td></td>
<td>Sed: femoral</td>
<td>Aneurysm not treated, Died 4 months later</td>
</tr>
<tr>
<td>4</td>
<td>70</td>
<td>F</td>
<td>Basilar</td>
<td>Brainstem compression—giant aneurysm</td>
<td>Elective</td>
<td></td>
<td>Sed: femoral</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>79</td>
<td>F</td>
<td>L ACA</td>
<td>Visual failure—chiasmal compression</td>
<td>Elective</td>
<td></td>
<td>Sed: femoral</td>
<td>Acuity better, but partially sighted living independently at home</td>
</tr>
<tr>
<td>6</td>
<td>80</td>
<td>F</td>
<td>R ICA</td>
<td>SAH, Gd II, painful III CN palsy</td>
<td>3/52 post SAH</td>
<td></td>
<td>GA: femoral</td>
<td>Full recovery, moved to residential nursing home</td>
</tr>
<tr>
<td>7</td>
<td>70</td>
<td>F</td>
<td>Basilar</td>
<td>SAH, Gd I</td>
<td>Elective</td>
<td></td>
<td>GA: femoral</td>
<td>Died 5 months later</td>
</tr>
<tr>
<td>8</td>
<td>71</td>
<td>F</td>
<td>Basilar</td>
<td>SAH, hydrocephalus, Gd III</td>
<td>3/52 post SAH</td>
<td></td>
<td>GA: femoral</td>
<td>Neurological improvement, but in hospital with medical problems</td>
</tr>
<tr>
<td>9</td>
<td>71</td>
<td>F</td>
<td>R MCA</td>
<td>SAH, Gd I</td>
<td>2/52 post SAH</td>
<td></td>
<td>GA: Carotid puncture</td>
<td>Living at home with some help</td>
</tr>
<tr>
<td>10</td>
<td>71</td>
<td>M</td>
<td>L PICA</td>
<td>SAH, hydrocephalus, Gd II</td>
<td>7/7 post SAH</td>
<td></td>
<td>GA: femoral</td>
<td>Living independently at home</td>
</tr>
<tr>
<td>11</td>
<td>76</td>
<td>F</td>
<td>L ophthalmic</td>
<td>SAH, Gd I</td>
<td>8/7 post SAH</td>
<td></td>
<td>GA: carotid puncture</td>
<td>Self-caring, but moved to ground floor flat</td>
</tr>
<tr>
<td>12</td>
<td>74</td>
<td>M</td>
<td>ACoA</td>
<td>SAH with 2nd haemorrhage</td>
<td>Elective</td>
<td></td>
<td>GA: femoral</td>
<td>Lost to follow-up</td>
</tr>
<tr>
<td>13</td>
<td>72</td>
<td>M</td>
<td>Basilar</td>
<td>SAH, Gd I</td>
<td>Elective</td>
<td></td>
<td>Sed: femoral</td>
<td>Living independently at home</td>
</tr>
</tbody>
</table>

Aneurysm site: ICA internal carotid artery, ACA and MCA are anterior and middle cerebral arteries, PICA posterior inferior cerebellar artery, and ACoA is the anterior communicating artery. Grades (Gd) refer to Hunt and Hess grades at the time of treatment, grade I being asymptomatic or minimal meningism, grade II moderate or severe meningism but no neurological deficit excepting cranial nerve palsies, and grade III drowsy, confused, or a mild focal deficit. Timing of embolization is relative to the ictus of subarachnoid haemorrhage (SAH). III CN refers to the oculomotor nerve. Past medical history (PMH) or coincidental conditions include ischaemic heart disease (IHD) and non-insulin-dependent diabetes mellitus (NIDDM). Procedures were carried out either under sedation (Sed) or under general anaesthesia (GA), via femoral or carotid puncture.

### Clinical Results

Of the 13 patients, 12 were successfully treated. One patient (case No. 3) had a large posterior communicating artery arising from the fundus of the aneurysm sac. Embolization would have occluded this vessel and risked precipitating a stroke in posterior circulation. Considering this the aneurysm was left untreated.

Of the 12 treated patients, nine had uncomplicated procedures. One patient developed a transient hemiparesis which resolved over 2 hours, and a second patient experienced dysphasia recovering over 24 hours. One patient (case 4) had a temporary exacerbation of the mass effect of a giant aneurysm, which resolved on corticosteroids (see below). No patient developed a persistent neurological deficit from the embolization procedure.

Two deaths occurred in the follow-up period. One of these cases (No. 4) was unusual. The initial presentation was with subarachnoid haemorrhage from a basilar aneurysm some 17 years previously. At that time a craniotomy was performed, but the aneurysm could not be clipped, and was therefore wrapped. She re-presented with a progressive hemiplegia, due to the aneurysm compressing the brainstem. Her general medical condition was poor due to long-standing emphysema. Considering her progressive deficit, she elected to undergo endovascular treatment. Acutely, after embolization of the aneurysm, her symptoms worsened. This resolved rapidly on a short course of corticosteroids, and was attributed to an exacerbation of the mass effect of the aneurysm. Two months later her general medical condition deteriorated. At this time there was no progression of her neurological symptoms or signs. She died 4 months after the embolization procedure, permission for a post-mortem examination not being granted.
The other death (case No. 8) occurred suddenly, 5 months after the embolization procedure. This patient lived outside our Region, and unfortunately no further details could be ascertained. Of note there was a significant past medical history of ischaemic heart disease. Whether this was the cause of her sudden death, or whether the aneurysm had only been partially occluded and had rebled, remains unanswerable.

Of the ten surviving patients, eight completed the postal questionnaire. Of these, six were living in their own homes, one had moved to a ground-floor flat, and one, an eighty-year-old who had made a full recovery from her haemorrhage, had moved to a residential nursing home. Of the eight responders, seven were self-caring. Of the two patients who did not reply, one was in hospital with cardiac disease, and one patient (from an ethnic minority) was lost to follow-up.

Discussion

Aneurysmal SAH is associated with a high mortality in patients aged over 70 years, whether managed conservatively or surgically. Formal comparisons between different series are difficult to make, because the patients recruited for these studies vary considerably. Additionally, if conservative management is undertaken, angiography is frequently not performed, raising questions about the accuracy of the diagnosis of aneurysmal SAH. Conservative treatment in elderly subjects (defined as over 60 years) has however been reported with a mortality of 49% within 2 months of the presenting haemorrhage [3]. This agrees well with the findings of the Cooperative Study [4] (an international study performed in the 1960s which collected over 3000 patients with intracranial aneurysms) and suggested that left untreated, 37% of aneurysms rebled within 1 month, more than 50% doing so within 3 months of the presenting SAH. The outlook of patients with unsecured ruptured aneurysms is therefore grave.

How does modern surgery alter the natural history of this disease? Perhaps the best general data reflecting recent standards of neurosurgical practice come from the International Study on the Timing of Aneurysm Surgery [6]. This study amassed over 3500 patients from 68 centres world-wide. Only patients transferred to neurosurgical centres with an intention to treat were entered into the study. This pre-selection may well introduce a bias: elderly patients in poor clinical grades or with other co-existent medical conditions, possibly not being transferred and entered into the study. Despite this pre-selection, the overall management mortality in patients aged over 70 years was 48.5%.

The patients referred for endovascular treatment in our series are similarly pre-selected. Unfortunately, being a tertiary referral centre, we have no accurate way of retrospectively ascertaining the incidence of symptomatic aneurysms, or of defining the population from which these patients were selected. Our series also differs in that only ten of the 13 cases presented with subarachnoid haemorrhage, three patients presenting with mass effects from their aneurysms. Less is known of the risks of leaving or attempting to treat enlarging but unruptured aneurysms in the elderly. Such aneurysms are regarded as being unstable, and the neurological disability they cause (in this series progressive visual failure in two patients and hemiplegia in a third), alone may warrant treatment. Furthermore, whilst an unruptured aneurysm may be easier to treat than a ruptured one, aneurysms presenting with mass effects are generally large, which poses particular surgical problems and risks. Allowing for these considerations, our mortality rates are striking. Only one of the 12 successfully treated patients (8%) died from a complication which might be related to the aneurysm.

Mortality has the advantage that it is an easy end-point to ascertain. Retrospectively assessing morbidity in this age group, and furthermore attributing it to the aneurysm and its therapy, or to coincidental disease, is more difficult. Nevertheless, seven of the eight respondents to the postal questionnaire were self-caring. This compares with a figure of 25% for patients over 70 years of age making a good recovery in the International Study on the Timing of Aneurysm Surgery [6].

Whilst the formal conclusions which can be drawn from our series are limited by its retrospective nature and by the pre-selection of patients, our experience suggests that coil embolization appears to be a relatively safe procedure in the elderly, and may offer particular advantages over craniotomy and conservative treatment in the management of intracranial aneurysms in this age group. One of the authors (A.J.M.) is the chief investigator in a multi-centre prospective trial randomizing patients between conventional surgery and GDC embolization. It is hoped that this study will allow more definitive conclusions to be drawn regarding the role of this new treatment in managing aneurysms.

Conclusions

Aneurysmal subarachnoid haemorrhage in elderly patients has posed difficult management decisions. Our experience with coil embolization suggests that, at least in selected good-grade patients, the procedure is a relatively safe way of securing aneurysms. Given its minimally invasive nature, this may prove an attractive alternative, avoiding the trauma of a craniotomy and the uncertainties of conservative management with the attendant risks of further haemorrhage.

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References


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