Original Research Article

Endovascular Treatment of Cerebral Aneurysm: Early Experience in a Malaysian Tertiary Centre

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Abstract

Universiti Kebangsaan Malaysia Medical Center (UKMMC) started neurointerventional service in August 2008. In this study, we aimed to evaluate the immediate and short term outcome of endovascular treatment (EVT) of cerebral aneurysm during early period of the services. A retrospective study for cerebral aneurysm treated by endovascular technique, from the Neurosurgical and Radiology Department from September 2008 till February 2010 was performed. Patient's demographic data, initial clinical presentation and assessment of the aneurysm were performed. The immediate results and short term assessment post EVT were evaluated based on standard criteria. Recurrence and complications during and following EVT procedures, were recorded. Twenty one patients with total of 22 aneurysms were treated. The mean age was 54.52 years with 57% being males and 43% females. The majority (81%) had single aneurysm. The most common site was anterior communicating artery (28 %). Mean aneurysm sac size was 6.19 mm and 2.55 mm for aneurysm neck. At follow-up, 3 (27.2%) had a small residual neck. Four patients (37.2%) had residual aneurysm filling, but three of them were treated with stent aiming to achieve flow diversion effect instead of complete occlusion during initial treatment. There was no rebleed or rupture from the immediate to follow-up. Significant complications up to 30-days was observed in 4 patients (20%) whereby 2 patients showed improvement and 2 patients died (10 % mortality rate). Endovascular treatment of cerebral aneurysms performed in our centre had early outcome, morbidity and mortality compared to other higher volume centres. Longer term follow up is needed to evaluate the long term outcome/occlusion rate, morbidity and mortality.

Keywords: Endovascular, treatment, brain, aneurysm, coiling, Asian aneurysm, experience

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Introduction

The treatment choice for cerebral aneurysm using endovascular technique as an alternative for neurosurgical clipping has grown rapidly over the years all over the world. In Malaysia, endovascular treatment (EVT) of cerebral aneurysm is a relatively new approach. Collective data regarding incidence of cerebral aneurysm in Malaysia is limited. The annual incidence of subarachnoid hemorrhage estimated to be 3 to 4 per 100,000 population, with aneurysm accounting for 1.1-1.7 per 100,000 population (1). Chee (1998) reported that 37 per 100,000 hospital admissions were due to subarachnoid hemorrhage (SAH), in which 9 per 100,000 admissions were due to aneurysm (2). It is noted that in this study these figures were likely to be underestimated.

The EVT of cerebral aneurysm has been proven to have a favorable outcome in both ruptured and unruptured aneurysm. The International Subarachnoid Aneurysm Trial (ISAT) is a prospective randomized large multicentric study in comparing between EVT and neurosurgical outcome for ruptured aneurysm, shows significant improvement of the chance of independent survival using EVT in ruptured aneurysm (3). The relative risk of death or significant disability at 2 months post procedure is 26.1% and at 1 year 22.6% which is lower than that of patients who underwent neurosurgical treatment (36.9% and 30.6% respectively) (4). However, most studies emphasized that rate of re-rupture is higher among patients treated with EVT and long term outcome might not be significantly different compared to surgical clipping (5,6).

We aimed to evaluate the immediate and short term outcome based on clinical and angiographic result of endovascular treatment of cerebral aneurysm for both ruptured and unruptured aneurysm at a tertiary referral centre in Malaysia.

Material and Methods

This retrospective study was performed in all patients with cerebral aneurysm treated by endovascular technique, either completely by EVT or those who subsequently converted to neurosurgery. The study was performed in the Neurosurgical and Radiology Department of Universiti Kebangsaan Malaysia Medical Center (UKMMC) from September 2008 till February 2010.

Patient's demographic data, initial clinical presentation based on World Federation of Neurosurgeons (WFNS) were obtained. Assessment of the aneurysm included the location, number, size of the sac, dome and neck whether ruptured or unruptured aneurysm. Data for assessment of aneurysm were taken from pre-embolization angiographic studies, which were either performed as a separate procedure or performed concurrently with the EVT.

All EVT cases were performed under general anesthesia. Arterial accesses were from the femoral arteries using 6Fr sheath unless indicated otherwise. Guiding catheter with continuous heparinised flushing used with tip placed at the proximal internal carotid artery whenever possible. Bolus of intravenous Heparin 2500U were given at the start of procedure and after the first coil placed. Baseline diagnostic runs followed by 3D rotational angio were performed whenever possible. In some cases 3D road map (Philips Allura Xper FD 20/10) were used to assist cannulation of the aneurysm. Working projections were identified with assistance from 3D reconstruction images. Aneurysm was cannulated using microcatheter and microwire of operator's choice. Intraarterial GTN or Nimodipine for procedure related vasospasm and vital signs management during procedure performed by operator with consultation with attending anesthetist.

Analysis of the EVT procedure included the duration of the procedure; that was from the start of puncture for vascular access until the completion of the procedure, consumables used and if any assisted technique employed. The immediate results of the post EVT occlusion were classified to complete, near complete (dog-ear) or incomplete occlusion of the aneurysm.

Short term assessment post EVT in which the subsequent first follow-up of the patient was usually planned between six weeks to six months and it was based on post EVT neuroimaging findings. However, in some cases earlier follow-up angiogram were performed due to various reasons. Neuroimaging assessments of these patients were primarily aimed to assess whether the aneurysm had been successfully occluded or if there was any recurrence. Recurrence of aneurysm was considered when there was presence of recanalization of the aneurysm neck or when there was significant remnant or regrowth of the aneurysm. Complications which included aneurysm rupture, thromboembolism, coil migration and arterial dissection during and after EVT procedure, were recorded.

Results

A total of 21 patients were included in this study. The mean age was 54.5 with the youngest being 15 years and the eldest being 76 years. There were 12 males (57%) and 9 females (43%). Most patients presented with Grade 1 SAH (38%). The more severe presentation at grade 4 and 5 constituted 28.6% and 14.4%, respectively. Eleven patients (52.4%) presented with ruptured aneurysm while the rest were unruptured aneurysm.

There were 26 aneurysms in 21 patients where 17 patients (81%) had single intracranial aneurysm. Four patients had multiple aneurysms (19%), in which 3 patients had 2 aneurysms, and 1 patient had 3 aneurysms, making the total number of aneurysms to 26. Fifty-nine percent (59%) were anterior circulation and 41% posterior circulation. Anterior communicating artery aneurysms were the commonest (27%), followed by internal carotid artery and

posterior communicating artery constituted of 23% each (Figure 1).

Twelve aneurysms were smaller than 5 mm in diameter, 6 aneurysms were 5-9 mm and 4 large aneurysm measuring 10-25 mm, with overall mean size of 6.19 mm. Eighteen cases had neck size of 4 mm or less while 4 cases had wide neck of more than 4 mm.

Only 22 aneurysms were subjected to EVT, in which only 20 aneurysms were treated (91%). Two cases (both patients with single aneurysm) were subjected to EVT procedure but were later abandoned and converted to microsurgical clipping. One case was due to inability to place the coil safely after successful cannulation and another case due to inability to negotiate microcatheter into the aneurysm because the aneurysm neck was too tight.

Average procedure duration was 4 hours 33 minutes (range between 1 to 7 hours 40 minutes). Coils were the only embolic materials used in 13 aneurysms, stent-assisted coiling in 5 aneurysms and 2 aneurysms used stent alone. There were 4 patients in whom the operator opted for flow diversion effect during EVT. In these patients, if stent-assisted coiling performed, the packing of aneurysm was intentionally loose instead of achieving complete angiographic obliteration of the aneurysm sac and neck.

Immediate angiographic outcome post EVT of the 16 aneurysms treated showed 3 incomplete occlusion, representing 18%. While the other 4 patients incomplete occlusion was intentional. First follow-up at 3 months showed 2 aneurysms with incomplete occlusion out of the 16 aneurysms, however only 14 aneurysms managed to be followed up and 2 aneurysms defaulted. No re-rupture of aneurysm were observed from the immediate up to the first follow-up in this study.

Thromboembolic event was the main complication, which occurred in 4 patients (20%). One patient was observed to develop small thrombus during the procedure but resolved after intra-arterial thrombolysis, without any subsequent neurological effect. In another patient, coil loop prolapse into the parent artery resulting in formation of small thrombus resulted in reduced flow. Two patients (10%) became worse and developed severe infarct and died within 30 days of EVT, while the other 2 improved (Figure 2). All illustrated cases were shown in Figure 3, Figure 3A, Figure 4 and Figure 4A.

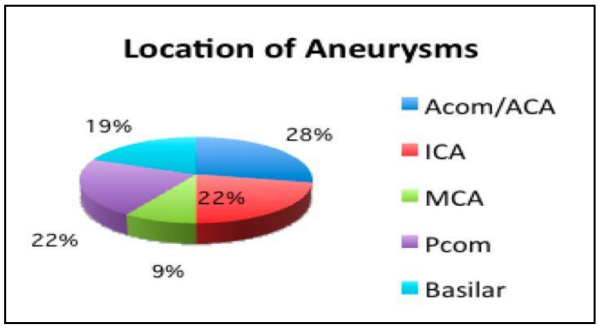

Figure 1: Location of aneurysms.

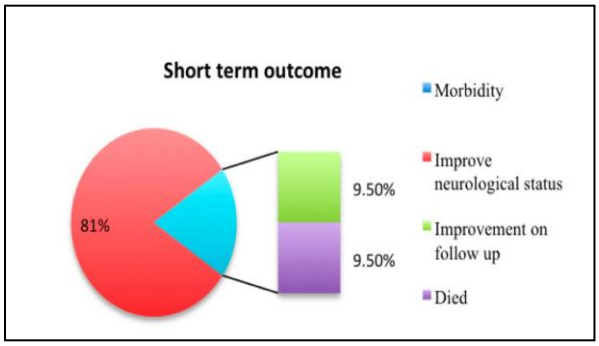

Figure 2: The short-term outcome showing about 10% mortality rate

Discussion

We began to offer EVT at our centre from August 2008 when we started the interventional radiology services and completed the installation of new biplane FD angiography. All cerebral aneurysm cases planned for EVT were discussed with multidisciplinary team for the best treatment option.

The locations of the aneurysms in our series were kept with other series and the most common location was in the anterior communicating artery, which accounted for 27% of cases. Previous Malaysian data, Chee et al. (1998) reported highest incidence of aneurysm in the internal carotid-posterior communicating artery region at 50% (2). Most of the cases encountered are small aneurysms which are less than 5mm (54.5%) and small neck which are less than 4mm. This finding is also in concordance with other studies, with ISAT which reported 51% of cases of small aneurysm (3).

The immediate post EVT occlusion rate showed higher near-complete occlusion rate for aneurysms 9 mm or less but less in larger aneurysm. It was noted that the complete occlusion rate for these groups of aneurysm in this study was lower than international studies with higher near complete and incomplete occlusion.

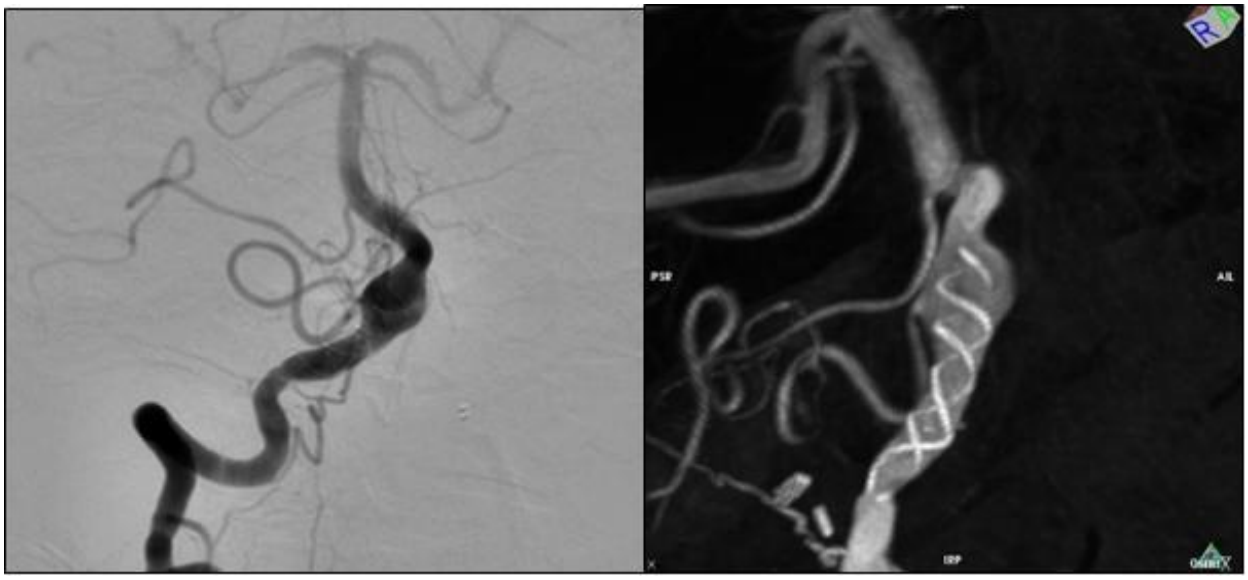

Figure 3: 43 year-old lady with ruptured fusiform vertebral artery aneurysm, presented with GCS 3/15. She had LEO+ stent placed over the fusiform aneurysm to achieve flow diversion effect. No coiling done. She was managed in ICU for 14 days and discharged well 2 weeks later with long-term dual anti-platelet.

Figure 3A: Follow-up angiogram at 3 months showed reduction of the aneurysm size with patent PICA. Irregular outline with filling defects within the aneurysm indicating partial thrombosis of the fusiform aneurysm.

However, this could be due to technique of occlusion opted during the procedure. In 4 patients, the operator opted for loose packing of the aneurysms with flow diversion effect using stent rather than dense packing of the aneurysm to achieve occlusion. Two of these patients had aneurysms within the basilar artery and 2 in the distal ICA at the supraclinoid and intracavernous portion in which stent and balloon-assisted coiling were used.

There were two patients, who had been subjected for endovascular treatment but were abandoned and went for neurosurgical clipping. The first case was a wide neck posterior communicating artery aneurysm, the coil placement was difficult even with balloon assistance, as we did not prepare the patient for stenting, we decided for neurosurgical clipping. The second patient was a mid basilar aneurysm, with a very small and tight neck. We used SL-10 (Boston

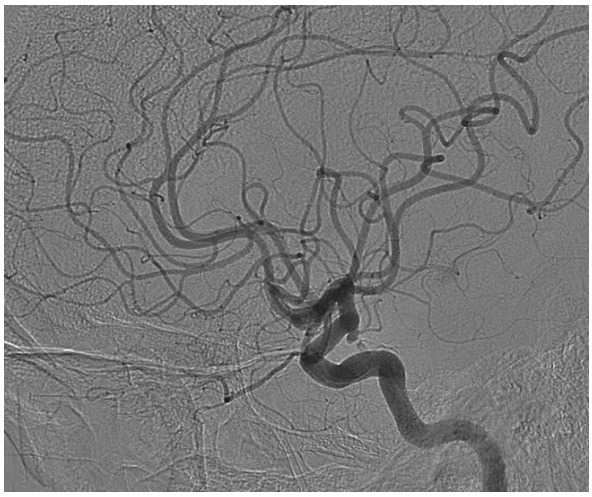

Figure 4: 57 year-old male presented with SAH. Cerebral angiogram confirmed right Pcom aneurysm. Endovascular treatment performed to secure the aneurysm.

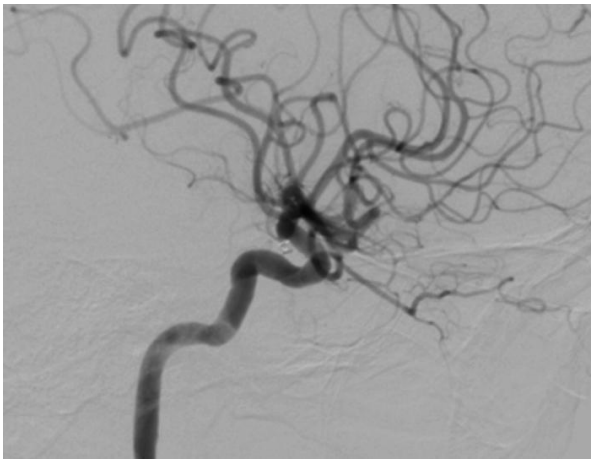

Figure 4A: Follow-up angiogram at 3 months showed thrombosed Pcom aneurysm with coil loops within.

Scientific 10 system), which was the smallest tip microcatheter available in our country but were unable to cross the catheter into aneurysm, even then we were able to cross the tight neck with microwire.

During our study, the first follow-up angiogram varied between few days to 6 months. The reason for this wide gap could loosely be multifactorial. However, based on each case notes available, depends mainly on the patient overall condition and operator's discretion. After this initial review, we changed our follow-up regime to 3 months from the initial procedure, followed by 6 months and subsequently 1 and 2 years. Patient had at least one angiogram throughout the follow-up period.

Out of 20 aneurysms that underwent initial EVT treatment, 4 were chosen to have flow diversion effect. While 16 aneurysms treated to achieve complete occlusion. There were 3 aneurysms which showed incomplete occlusion at the end of procedure, representing 18% (out of 16 aneurysms). On initial follow-up, only one showed improvement to become complete. The other 2 aneurysms still showed residual aneurysm. Only 14 aneurysms out of 16 could be evaluated on initial follow-up. Two aneurysms defaulted follow-up, thus unable to establish if there was recurrence or rupture. There were no recurrence or coil compactions seen of the 14 aneurysms, on initial follow-up. All the 4 aneurysms treated to achieve flow diversion effect showed residual. However, there was no increase in the aneurysm size and evidence of rupture.

Our findings were similar to other studies which suggested that thrombotic events were not frequent but an important sequel of endovascular treatment of cerebral aneurysms (7,8). Two patients developed small thrombus during the procedure, in which one resolved after intraarterial thrombolysis was given. The other patient developed significant thrombus however no significant change in clinical assessment of the patient post procedure. In Asian patients, the immediate or periprocedural complication rate varies between 10% to 29.7% in Hongkong and 15.7% in China. Overall mortality rate in Hong Kong studies are between 10-15% and 6.3% in ISAT studies.

The overall complication is 20% and mortality of 10% encountered throughout the study period, with 2 deaths due to severe infarct secondary to thromboembolic phenomenon. In both patients, death occurred within 30 days from EVT. This outcome compares favorably with results obtained from previous studies of endovascular occlusion of cerebral aneurysm (4,7,9,10). Our overall complication rates were in concordance with ISAT study, in which mortality in our center is predominantly due to thromboembolic phenomenon (3,4). ISAT reported overall morbidity and mortality of 26.1% at 2 months (4). Simon et al. 2004 reported overall morbidity rate of 16.6% and 12.7% mortality rate (9). Ng et al. reported morbidity of 8.6% and mortality of 2.5% with ruptured aneurysms (11). We did not encounter rebleed or rupture of aneurysm between immediate to follow-up angiogram throughout our tenure of study.

One patient had large aneurysms in the cavernous portion of both internal carotid artery, which presented with bleeding from the right side. Surgical intervention in which bilateral aneurismal bypass was done in 2008

in which subsequent angiogram revealed patent bypass and patient was then discharged well. After a year, this patient then presented with left sided aneurismal rupture and near complete occlusion was obtained post EVT. Since there was significant length of duration from the initial bypass to the current presentation, the case was considered as a new aneurismal rupture rather than a re-bleed. During the latest admission, this patient also presented with unfavorable WFNS score at 4 and grade 4 Fischer scale. Patient underwent 2 separate endovascular procedure with approach from external carotid artery branches, which was tortuous. Coiling was done successfully with near complete occlusion. However, the patient deteriorated after uncomplicated endovascular procedures. Simon et al. 2004 reported that out of 11.3% periprocedural complication arising from EVT, all of cases occurred in small aneurysm less than 5 mm (9). In our study, we noted that both complications occurred in patient with larger aneurysmal sac (more than 5mm). The rest of the complications encountered were generally not associated with permanent neurological deficit.

Conclusion

In our series, thromboembolic complications were the most important cause of morbidity and mortality. This risk necessitates the need to develop strategies to minimize the complications, which includes proper heparinazation and monitoring during the procedure. Endovascular treatment of cerebral aneurysms done in our center has shown short-term outcome, morbidity and mortality rate in keeping with other high volume and more established centres. However, further evaluation needed to ascertain the long term outcome and complication.

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