JVIN Journal of Vascular and Interventional Neurology
OFFICIAL JOURNAL OF THE ZEENAT QURESHI STROKE INSTITUTE

Endovascular treatment of intracranial aneurysms by interventional neurologists: first year single-center experience

Alberto Maud, MD[1], **Gustavo J Rodriguez, MD**[2], and **Miguel A Barboza, MD**[3]

[1]*Department of Neurology and Radiology, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, El Paso, TX, USA*

[2]*Department of Neurology, Paul L. Foster School of Medicine, Texas Tech University Health Sciences Center, El Paso, TX, USA*

[3]*Texas Tech University Health Sciences Center, Universidad de Costa Rica, El Paso, TX, USA*

Abstract

Background—Endovascular embolization of ruptured intracranial aneurysms provides an adequate treatment and long-term results with less morbidity and mortality (M&M) compared with surgical treatment. Since the last decade more and more ruptured and unruptured intracranial aneurysms (IA) undergo endovascular embolization in the United States. We present our experience of the initial one year periprocedural M&M at Paul L. Foster School of Medicine (PLFSM), Texas Tech Health Science Center (TTUHSC) in El Paso, Texas.

Methods—Demographics, technical aspects of the endovascular procedure and clinical assessment, including several commonly used scales to assess the severity in case of subarachnoid hemorrhage were collected. Perioperative complications were classified as minor and major. All data is prospectively collected in a local database. Only endovascular treated aneurysms were included in the study

Results—During the first year of opening of the interventional neurology program at our school of medicine (March 2011 and March 2012), a total 45 ruptured and unruptured intracranial aneurysms were treated with endovascular embolization. Two thirds of the patients (n = 27) presented with a ruptured IA. Within those with a ruptured aneurysm, the most median Hunt and Hess grade was 3. By large the vast majority of treated IA were in the anterior circulation and more than half measured 7–12 mm. Only three unruptured IA were <7 mm (average 5.5 mm). Complications occurred in seven patients (15%), four of them were minor without any clinical sequelae. The remaining three included; intracranial dissection and aneurysmal rupture resulting in both hemorrhagic or ischemic stroke and death in only one patient.

Conclusion—The first year experience of interventional neurology services at Paul L. Foster School of Medicine in El Paso, Texas demonstrates successful treatments with comparable national rates of morbidity and mortality.

ACA	Anterior cerebral artery
Acomm	Anterior communicating artery
ESN	Endovascular surgical neuroradiology
H&H	Hunt and Hess scale
IA	Intracranial aneurysm
ICA	Internal carotid artery
MCA	Middle cerebral artery
M&M	Morbidity and mortality
SAH	Subarachnoid hemorrhage

Published June, 2014.

*Correspondence to: Alberto Maud, Tel.: +1 915-545-6662, alberto.maud@ttuhsc.edu

Journal of Vascular and Interventional Neurology

Pcomm Posterior communicating artery

PLFSM Paul L. Foster School of Medicine

TTUHSC Texas Tech University Health Science Center

VA Vertebral artery

Keywords

subarachnoid hemorrhage; endovascular treatment; intracranial aneurysm; aneurysm coiling; cerebral angiography

Introduction

The prevalence of intracranial aneurysms (IA) accounts for 5% in the general population.[1–4] Fortunately, the majority of intracranial aneurysms do not rupture over time, but the risk is size dependent. In the International study of unruptured intracranial aneurysms, the 5-year cumulative risk of rupture was negligible for those measuring <7 mm. Whereas the risk was 2.6% and 14.5% for those sized 7–12 mm, located in the anterior and posterior circulation, respectively. Higher rates were found with larger sizes.[5,6]

Subarachnoid hemorrhage (SAH) due to a ruptured IA represents one of the worst diseases neurologists and neurosurgeons encounter in their practices. The annual rate of SAH is approximately six to eight per 100,000 or about 25,000–27,000 SAH cases a year in the United States[2,7]. Since the results of the International Subarachnoid Aneurysm Trial (ISAT) were published in 2002 endovascular treatment has become an important treatment option in the management of ruptured intracranial aneurysms.[8–10] The purpose of this study is to evaluate and share our first year experience in the endovascular treatment of ruptured and unruptured intracranial aneurysms at PLFSM.

Patients and methods

The data was retrospectively elicited from a prospective collected database of all neurointerventional cases performed by the interventional neurology team at PLFSM. The database include demographic information; age, sex, and ethnicity. Clinical characteristics including the Hunt and Hess grading scale, Fisher grade, and Glasgow coma scale (GCS) were prospectively collected in patients with SAH. Procedural features such as date of the procedure, aneurysm size and location, amount of contrast material used, total time of radiation exposure, and endovascular devices were also collected. Complications were classified as minor and major type and included; intraprocedural, and periprocedural (48 h) events. All consecutive patients that underwent endovascular treatment of a ruptured or unruptured IA were enrolled in the above-mentioned database and incorporated in our retrospective analysis.

Table 1. Population and lesion characteristics.

	Ruptured (%)	Unruptured (%)
No. cases	27 (60)	18 (40)
Male/female	7/20	5/12
Age range (mean)	35–92 (55, 96)	37–80 (60, 29)
Size of aneurysm		
<7 mm	14 (51, 85)	3 (16, 66)
7–12 mm	12 (44, 44)	13 (72, 22)
13–25 mm	1 (3, 70)	1 (16, 66)
>25 mm	–	1 (16, 66)
Localization		
MCA	11 (40, 74)	1 (5, 55)
ACA	3 (11, 11)	2 (11, 11)
Acomm	3 (11, 11)	3 (16, 66)
Pcomm	5 (18, 51)	5 (27, 77)
ICA	4 (14, 81)	6 (33, 33)
VA	2 (7, 40)	–

Endovascular procedure

All patients undergoing endovascular embolization were treated under general anesthesia. The femoral artery approach was used for access. After placement of the standard guiding catheter (usually 6 French) in the cervical artery, a tapered flexible microcatheter (1.7–2.1 French) was used to select the aneurysmal sac over a 0.014 in flexible microwire. All ruptured and unruptured IA were embolized using detachable coils. Some ruptured IA were treated using the balloon remodeling coil embolization technique and some of the unruptured IA were treated using the stent-assisted coil embolization technique. All unruptured aneurysm were anticoagulated during the procedure using intravenous heparin and intermittent boluses were then used to maintain an activated clotting time (ACT) around two times the baseline and preferentially less than 300 s.

Results

Between March 2011 and March 2012, a total of 45 intracranial aneurysms were treated with endovascular

Table 2. Procedural and periprocedural complications

Age	Status	Localization	H&H/Fisher	Size (mm)	Complication
57	Unruptured	ICA	–	7.5	ICA dissection
46	Unruptured	ACA	–	9	Pericallosal artery dissection and ACA cortical infarct
62	Ruptured	Pcomm	1/II	11.5	Posterior cerebral artery infarct
61	Ruptured	MCA	4/III	4	Large intracranial hemorrhage, vasospasm, death
55	Ruptured	ACA	4 /III	7.2	Intra operative rupture
61	Unruptured	Pcomm	–	7.6	Left carotid cavernous fistula
80	Unruptured	Pcomm	–	18	Coil migration

embolization. Overall, 27 were ruptured representing 60% of the sample. The mean age was 57 years (range 35–92 years) and 73% patients were women (n = 33). Approximately 80% of the treated patients were Hispanic/Latino ethnic group. The most common associated comorbidities were arterial hypertension (44%), diabetes mellitus (15%), dyslipidemia (9%), and chronic obstructive pulmonary disease (6%).

The vast majority of the treated IA were located in the anterior circulation: MCA (26%) and internal carotid artery (22%), and posterior communicating artery (20%) in case of ruptured aneurysm (Table 1). The mean aneurysm diameter was 8.5 mm (2.5–28 mm), for the ruptured group the mean diameter was 7.1 mm and for the unruptured group was 9.8 mm. Regarding the severity of the SAH, 45% of the ruptured aneurysm that underwent to endovascular treatment had a Hunt and Hess grading score equal or less than III and almost 70% of the patients had a Fisher scale equal or less than 3. The mean fluoroscopic time for both groups (ruptured and unruptured aneurysms) was 32 min and the mean amount of iodine contrast material used was 180 ml.

Complications during the procedure

Procedural and periprocedural complications occurred in seven patients (15%), four of them were minor. They were endovascular technical complications and led to no adverse neurological or other clinical consequences. One was a cervical internal carotid artery catheter-induced dissection in a patient with known fibromuscular dysplasia that was successfully treated with acute primary stent placement. The second one was a coil migration into the distal aspect of the parent vessels without restriction of the blood flow or clinical stroke. The third one was transient short intraoperative aneurysmal dome perforation with angiographic contrast extravasation without hemodynamic changes that was rapidly controlled with further coil embolization. The last minor complication was a transient asymptomatic carotid cavernous fistula the resolved spontaneously and it did not required further treatment. The remaining three complications were major complications (6.5%) and it included a cerebral infarct due to an intraprocedural intracranial dissection during embolization of an anterior communicating artery aneurysm, a posterior cerebral artery infarct in a ruptured posterior communicating artery aneurysm and an intraprocedural aneurysmal rupture during embolization of a ruptured aneurysm resulting in hemorrhagic stroke and death.

Discussion

Patients with ruptured intracranial aneurysms carry high rates of morbidity and mortality. The risk of re-rupturing during the first days to weeks is high enough to warrant an early treatment.[11] Unruptured intracranial aneurysms of a certain size, location and morphological characteristics are at higher risk for future rupture and treatment is warranted. The justification for treatment of unruptured IA has been more complex and dependent predominantly on the assessment of risk of future spontaneous rupture (between 0.05% and 3.2% per annum for aneurysms less than 10 mm and up to 5.5% per annum for large aneurysms)[12,13] compared with the risks and efficacy of treatment. In the International Study of Unruptured Intracranial Aneurysm, endovascular morbidity and mortality ranged from 7.1% to 9.8%, whereas surgical morbidity and mortality ranged from 10.1% to 12.6%.[14,15,1,17]

The rate of intraprocedural complications including intraprocedural rupturing of the aneurysm and thromboembolic complications is higher in case of ruptured IA. The data from our population shows acceptable rates of embolization-related complications, according to clinical trials.[18] Moreover, the presence of acute SAH, additional intracerebral or intraventricular hemorrhage makes the management of thromboembolic complications and intraprocedural rupturing of aneurysm or arterial dissection more challenging.[19,20] In our condition, endovascular treatment shows good outcomes and some advantages over surgical treatment, at discharge and later survival even compared with other studies.[21]

Conclusions

The first-year experience of the interventional neurology program at Paul L. Foster School of Medicine (PLFSM), Texas Tech Health Science Center (TTUHSC) in El Paso, Texas demonstrates that intracranial ruptured and unruptured aneurysms can be successfully treated with

Journal of Vascular and Interventional Neurology

endovascular embolization technique, and with rates of morbidity and mortality comparable with those described in previous studies.

References

1. Schievink WI, Schaid DJ, Michels VV, et al. 1995;Familial aneurysmal subarachnoid hemorrhage: a community-based study. *J Neurosurg* 83:426–9.
2. Grobelny TJ. 2011;Brain aneurysms: epidemiology, treatment options and milestones of endovascular treatment options. *Dis Mon* 57:647–55.
3. Winn HR, Jane JA, Taylor JA, et al. 2002;Prevalence of asymptomatic incidental aneurysms: review of 4568 arteriograms. *J Neurosurg* 96:43–9.
4. Connolly ES, Rabinstein AA, Carhuapoma JR, et al. 2012;Guidelines for the management of aneurysmal subarachnoid hemorrhage: a guideline for healthcare professionals from the American Heart Association/American Stroke Association. *Stroke* 43:1711–37.
5. Wiebers DO, Whisnant JP, Huston J, et al. 2003;Unruptured intracranial aneurysms: natural history, clinical outcome, and risks of surgical and endovascular treatment. *Lancet* 362:103–10.
6. Seibert B, Tummala RP, Chow R, et al. 2011Intracranial aneurysms: review of current treatment options and outcomes. *Frontiers in Neurol* 10.3389/fneur.2011.00045
7. Wirth FP. 1986;Surgical treatment of incidental intracranial aneurysms. *Clin Neurosurg* 33:125–35.
8. Molyneux AJ, Kerr RS, Stratton I, et al. International Subarachnoid Aneurysm Trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised trial. (in press)
9. Molyneux AJ, Kerr RS, Birks J, et al. 2009;Risk of recurrent subarachnoid haemorrhage, death or dependence and standardised mortality ratios after clipping or coiling of an intracranial aneurysm in the International Subarachnoid Aneurysm Trial (ISAT): long-term follow-up. *Lancet Neurol* 8:427–33.
10. Molyneux AJ, Kerr RS, Yu LM, et al. 2005;International subarachnoid aneurysm trial (ISAT) of neurosurgical clipping versus endovascular coiling in 2143 patients with ruptured intracranial aneurysms: a randomised comparison of effects on survival, dependency, seizures, rebleeding, subgroups and aneurysm occlusion. *Lancet* 366:809–17.
11. Suarez JI, Tarr RW, Selman WR. 2006;Aneurysmal subarachnoid hemorraghe. *N Engl J Med* 354:387–96.
12. Krings T, Mandell DM, Tim-Rasmus K, et al. 2011;Intracranial aneurysms: from vessel wall patholoogy to the therapeutic approach. *Nat Rev Neurol* 7:547–59.
13. Brisman JL, Song JK.; Newell, DW. 2006;Cerebral aneurysms. *NEJM* 355:928–39.
14. Minn R, Wiebers D.; Whisnant, J., et al. 1998;Unruptured Intracranial aneurysms - risk of rupture and risks of surgical intervention. the International Study of Unruptured Intracranial Aneurysms. *NEJM* 339:1725–33.
15. Johnston SC, Wilson CB, Halbach VV, et al. 2000;Endovascular and surgical treatment of unruptured cerebral aneurysms: comparison of risks. *Ann Neurol* 48:11–9.
16. Loewenstein JE, Gayle SC, Duffis EJ, et al. 2012The natural history and treatment options for unruptured intracranial aneurysms. *Int J Vascular Med* 10.1155/ijvm.2012898052
17. Meyers PM, Schumacher HC, Higashida RT, et al. 2010;Reporting standards for endovascular repair of saccular intracranial cerebral aneurysms. *J Neuro Intervent Surg* 2:312–23.
18. Qureshi AI, Janardhan V, Memon MZ, et al. 2009;Initial experience in establishing an academic neuroendovascular service: program building, procedural types, and outcomes. *Journal of Neuroimaging* 19:72–9.
19. Hae-Kwah P, Horowitz M, Jungreis C, et al. 2005;Periprocedural morbidity and mortality associated with endovascular treatment of intracranial aneurysms. *Am J Neuroradiol* 26:506–14.
20. Cho YD, Lee JY, Seo JH, et al. 2012;Intra-arterial tirofiban infusion for thromboembolic complication durign coil embolization of ruptured intracranial aneurysms. *Eur J Radiology* 81:2833–8.
21. Qureshi AI, Janardhan V, Hanel RA, Lanzino G. 2007;Comparison of endovascular and surgical treatments for intracranial aneurysms: an evidence-based review. *Lancet Neurol* 6:816–25.

Journal of Vascular and Interventional Neurology