Observer Agreement in the Assessment of Minor and Major Cerebral Aneurysm Recurrence

HARRY J. CLOFT, DAVID F. KALLMES

Department of Radiology, Mayo Clinic; Rochester, MN, USA

Key words: aneurysm; endovascular therapy; cerebral angiography

Summary

We studied the use of minor and major recurrence classifications with regard to observer variability, which directly affects validity of these terms as outcome measures.

Recurrences at the time of a three to six month follow-up angiogram were assessed independently by two experienced observers in 83 cases. Intra- and interobserver concordance is approximately 90% for assessment of minor and major recurrence.

Introduction

Scales for angiographic success of endovascular aneurysm therapy are commonly used in the literature¹⁻⁷.

These scales are meant to assess completeness and durability of aneurysm therapy and are used to judge the relative efficacy of such new technology in clinical trials.

Change in degree of aneurysm occlusion on follow-up angiography is of interest because the major weakness of endovascular therapy relative to surgery is aneurysm recurrence. Raymond et al.³ defined a recurrence as "any increase in size of the remnant" and defined a recurrence as "major" if "it was saccular and its size would theoretically permit re-treatment with coils".

Because of the subjective nature of such a description of aneurysm recurrence, we undertook a study of observer agreement for the classifications of "minor" and "major" recurrence.

Methods

Aneurysms Studied and Readers

Angiograms from a total of 125 aneurysms obtained immediately before and following endovascular therapy and 83 angiograms obtained three to six months following endovascular therapy were assessed using the scales described below.

These angiograms were obtained in the course of the Hydrocoil for Endovascular Aneurysm Occlusion (HEAL) registry⁸.

Each angiogram was assessed by two readers who were interventional neuroradiologists (HJC and DFK) each with more than 12 years of experience with endovascular aneurysm therapy.

Assessments were made by each reader on two occasions separated by at least 30 days in an attempt to diminish recall bias.

Each reader was blinded to the other observer's assessments and to his own previous assessments.

Assessment Scales

Each initial post-treatment angiogram and each three to six month follow-up angiogram was compared, and an assessment was made of "no recurrence", "minor recurrence", and "major recurrence".

A recurrence was defined as "any increase in size of the remnant" and defined a recurrence as "major" if "it was saccular and its size would theoretically permit re-treatment with coils"³. Any recurrence that did not meet the definition for "major" was categorized as "minor".

Figure 1 Anterior communicating artery aneurysm demonstrated on angiography prior to coil therapy (A), immediately after coil therapy (B), and follow-up 5 months after coil therapy (C). The follow-up angiogram was interpreted as both “minor” and “major” recurrence, by the same observer as well as by different observers.

Statistical Analysis

The proportion of concordant readings (p) and kappa statistics were calculated to determine the relative inter- and intraobserver agreement of the aneurysm recurrence scale. The proportion of concordant readings was calculated as the number of concordant readings divided by the total number of readings. Weighted kappa values were determined.

Results

The kappa values obtained were interpreted relative to the criteria of Fleiss⁹. According to Fleiss, values ≤ 0.40 represent poor agreement, values between 0.40 and 0.75 represent fair to good agreement, and values > 0.75 represent excellent agreement.

Intraobserver concordance for Observer 1 was 0.90 (75 of 83 cases), with a kappa statistic

of 0.83. Intraobserver concordance for Observer 2 was 0.92 (76 of 83 cases) with a corresponding weighted kappa statistic of 0.86. Comparing the two observers, the mean interobserver concordance was 0.88 (73 of 83 cases), with a mean weighted kappa of 0.81. A typical discordant case is shown in Figure 1.

Discussion

Our study demonstrates acceptable inter- and intraobserver variability in the angiographic assessment of “minor” vs. “major” recurrence following endovascular cerebral aneurysm therapy. Inter- and intra-observer concordance was approximately 90%. The kappa statistics were 0.83 and 0.86 for intra-observer variability and 0.81 for inter-observer variability, which are above the threshold for “excellent” agreement defined by Fleiss as being >0.75 ⁹. While Fleiss somewhat arbitrarily designates these kappa statistics as “excellent”, investigators using “major” and “minor” recurrence rates as outcome measure in studies need to evaluate and decide for themselves if concordance rates of 90% are adequate for their study. For investigators hoping to measure a small change in recurrence (e.g. $<10\%$) as a treatment effect, this amount of variability might be a major problem. Also, when comparing studies using “major” and “minor” recurrences as endpoints, it is important to realize that there is potential for observer variability that could easily change the proportions of “major” and “minor” recurrences by 10%.

The degree of aneurysm occlusion following endovascular therapy is a continuous variable. Therefore, commonly used scales for grading degree of aneurysm occlusion apply an ordinal scale on what is really a continuous variable, which is a subjective exercise prone to inter- and intra-observer variability. To assess the inter- and intra-observer variability of such scales, Cloft et al. ¹⁰ evaluated the observer agreement for scales of completeness of aneurysm treatment (“complete”, “neck remnant” and “incomplete”), and change at follow-up angiography (“same”, “better”, and “worse”).

The decision to retreat is generally quite subjective. The risk of treating a recurrent aneurysm relative to the risk of not treating it can

be quite difficult to ascertain in many cases because the risk of future rupture of a given partially treated aneurysm is often not known. Physicians vary tremendously in how aggressively they would treat an aneurysm recurrence ¹¹. With increasing use of balloon remodeling and adjunctive stent, the interpretation of the definition of “major” recurrence as “it was saccular and its size would theoretically permit retreatment with coils” could be seen as changing over time. Coils of 1.5 mm diameter are now available, so one could argue that nearly any remnant or recurrence ≥ 1.5 mm would be *theoretically* treatable with stent assistance. As such, the definition of “major” recurrence can be interpreted more and more broadly over time.

It is commonly thought that an important marker of failure of aneurysm therapy is the need for retreatment of the aneurysm. The need for retreatment is taken so seriously that it is being used as a primary end point in the Matrix and Platinum Science trial ¹² and the HydroCoil Endovascular Aneurysm Occlusion and Packing Study (HELPS) ¹³. In the HELPS trial, the “major” recurrence rate was 24% for patients treated with HydroCoil vs. 34% for those treated with bare platinum, yet the retreatment rate was 3% for aneurysms treated with HydroCoil and 3% for those treated with bare platinum ¹³. Because only about 10% of “major” aneurysm recurrences in the HELPS trial were actually treated, there is clearly a disconnection between what is interpreted angiographically to be potentially treatable and what is actually treated. We feel that the need for aneurysm retreatment is not something that can be objectively measured as an endpoint for scientific research.

Our study used two readers of very similar training and practice background. It is possible that interobserver variability between readers with more varied backgrounds might be even higher.

Conclusions

Both inter- and intra-observer variability are inherent to assessment scales of completeness of cerebral aneurysm therapy. Intra- and inter-observer concordance is approximately 90% for assessment of minor and major recurrence.

References

- 1 Raymond J, Roy D, Bojanowski M, et al. Endovascular treatment of acutely ruptured and unruptured aneurysms of the basilar bifurcation. *J Neurosurg.* 1997; 86: 211-219.
- 2 Roy D, Raymond J, Bouthillier A, et al. Endovascular treatment of ophthalmic segment aneurysms with Guglielmi detachable coils. *Am J Neuroradiol.* 1997; 18: 1207-1215.
- 3 Raymond J, Guilbert F, Weill A, et al. Long-term angiographic recurrences after selective endovascular treatment of aneurysms with detachable coils. *Stroke.* 2003; 34: 1398-1403. Epub 2003 May 1329.
- 4 Murayama Y, Nien YL, Duckwiler G, et al. Guglielmi detachable coil embolization of cerebral aneurysms: 11 years' experience. *J Neurosurg.* 2003; 98: 959-966.
- 5 Cognard C, Weill A, Spelle L, et al. Long-term angiographic follow-up of 169 intracranial berry aneurysms occluded with detachable coils. *Radiology.* 1999; 212: 348-356.
- 6 Byrne JV, Sohn MJ, Molyneux AJ, et al. Five-year experience in using coil embolization for ruptured intracranial aneurysms: outcomes and incidence of late rebleeding. *J Neurosurg.* 1999; 90: 656-663.
- 7 Thornton J, Debrun GM, Aletich VA, et al. Follow-up angiography of intracranial aneurysms treated with endovascular placement of Guglielmi detachable coils. *Neurosurgery.* 2002; 50: 239-249; discussion 249-250.
- 8 Cloft HJ. HydroCoil for Endovascular Aneurysm Occlusion (HEAL) study: 3-6 month angiographic follow-up results. *Am J Neuroradiol.* 2007; 28: 152-154.
- 9 Fleiss JL. *Statistical Methods for Rates and Proportions.* New York: Wiley; 1981.
- 10 Cloft HJ, Kaufmann T, Kallmes DF. Observer agreement in the assessment of endovascular aneurysm therapy and aneurysm recurrence. *Am J Neuroradiol.* 2007; 28: 497-500.
- 11 Daughtery W, Lanzion G, Fiorella D, et al. Observer agreement regarding the necessity of retreatment of previously coiled recurrent cerebral aneurysms. *Am J Neuroradiol.* 2011; 32: 566-569.
- 12 Hets SW. MAPS Trial: Overview and update. 7th Annual Meeting of the Society of Neurointerventional Surgery. Carlsbad, CA; 2010.
- 13 White PM, Lewis SC, Gholkar A, et al. Hydrogel-coated coils versus bare platinum coils for the endovascular treatment of intracranial aneurysms (HELPS): a randomised controlled trial. *Lancet.* 2011; 377: 1655-1662.

Harry J. Cloft, MD, PhD,
Department of Radiology
Mayo Clinic, 200 First Street SW
Rochester, MN 55905, USA
Tel.: (507)255-9164
Fax: (507)255-4068
E-mail: cloft.harry@mayo.edu