

Clinical Outcomes After Endovascular and Microsurgical Treatment of Very Small Intracranial Aneurysms: Report of a Consecutive Series and Meta-analysis

Jianfeng Zheng

Department of Neurosurgery, the First Affiliated Hospital of Chongqing Medical University

Xiaochuan Sun

Department of Neurosurgery, the First Affiliated Hospital of Chongqing Medical University

Xiaodong Zhang (✉ dr_zxd@yeah.net)

Department of Neurosurgery, the First Affiliated Hospital of Chongqing Medical University

Research

Keywords: Intracranial aneurysms, Small, Coiling, Clipping, Outcomes

Posted Date: December 31st, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-137156/v1>

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Abstract

Objective: We conducted a systematic review and meta-analysis of studies evaluating endovascular coiling or microsurgical clipping of very small intracranial aneurysms (IAs), including 126 patients treated in our center.

Data Sources: The electronic database of PubMed, Embase, and Web of Science were systematically searched for studies on endovascular or microsurgical treatment of very small IAs. The search was performed by using the keywords and medical subject heading (MeSH) terms: "intracranial aneurysm," "cerebral aneurysm," "outcome," "endovascular," "coil," "embolization," "coiling," "surgical," "neurosurgical," "microsurgical," "clip," "clipping," "small," and "tiny" in both AND and OR combinations.

Study Selection: Only studies of very small (Size \leq 3 mm) ruptured or unruptured IAs patients undergoing endovascular coiling or microsurgical clipping were included.

Data Extraction: Data collection and quality assessment were conducted independently by two authors.

Data Synthesis: A total of 6 studies provided data on 362 very small UIAs and 9 studies provided data on 703 very small RIAs. Of 362 patients with very small UIAs, 6 (1.7%) cases had operation-related neurological deficits, and no patient died. Of 731 patients with very small RIAs, the morbidity and mortality were 13.0% and 4.7%, respectively. Morbidity due procedure-related complications was 8.3% (95% CI, 3.5% to 13.1%) in coiled very small RIAs patients compared with 20.6% (95% CI, 10.5% to 30.8%) in clipped very small RIAs patients. Mortality due to procedure-related complications was 5.3% (95% CI, 2.9% to 7.7%) in coiled very small RIAs patients compared with 4.7% (95% CI, 2.0% to 7.3%) in clipped very small RIAs patients. No significant differences were found in the incidence of poor outcomes observed between microsurgical and endovascular treatment for very small RIA patients (RR, 1.38; 95% CI, 0.99 - 1.93; P = 0.06).

Conclusions Very small UIAs can be treated effectively and safely with good long-term outcomes. However, very small RIAs patients are at high risk of poor outcome and the incidence of neurological complication should not be ignored.

Introduction

The prevalence of intracranial aneurysm (IA) varies from 1.8–5%^[1,2,3,4], depending on the region and the study population. With the development of imaging technology and diagnostic methods, a growing number of asymptomatic small unruptured intracranial aneurysms (UIAs) within 5 mm or even very small UIAs within 3 mm have been identified. There is no consensus on the optimal management for these IAs^[5,6,7,8], and whether conservative observation or preventive treatment for small and very small UIAs remains controversial^[8,9,10]. Previous studies have suggested that small and very small UIAs should be observed conservatively, because the risk of rupture is far lower than the risk of treatment^[9,11,12], but recent researches found that an increasing number of the aneurysmal subarachnoid hemorrhage (aSAH) is caused by small and very small ruptured intracranial aneurysm (RIAs)^[13,14]. Many studies have reported endovascular coiling or microsurgical clipping of small IAs^[15,16], but studies on the treatment of very small IAs are still rare. Although there is a high risk of treatment for very small RIAs^[17,18], however the outcome of preventive treatment for very small UIAs are satisfactory^[19,20]. To better describe the treatment outcomes of very small RIAs and UIAs, we report our center's experience and the results of a meta-analysis of the literature on coiling and clipping of very small IAs.

Materials And Methods

After the approval of the institutional research committee, a retrospective analysis was performed on all consecutive very small IAs patients treated by endovascular coiling or microsurgical clipping in our center from June 2011 to December 2018. All patients' data, such as electronic case files, radiological examinations and outpatient documents, were carefully collected and analyzed. Three-dimensional (3D) rotational angiography was used to identify the size of very small IAs in all patients, and the maximum diameter of the aneurysm measured by 3D angiography was \leq 3 mm. Aneurysms associated with cerebral arteriovenous malformations (AVMs), arteriovenous fistulas (AVFs) and other cerebrovascular diseases were excluded; traumatic, dissecting and fusiform aneurysms were also excluded. With the use of 3D rotational angiography, the shape and location of the aneurysms were determined by experienced neuroradiologists. For patients with multiple very small IAs, the most likely source of bleeding can be judged by the subarachnoid hemorrhage (SAH) distribution on a computed tomography (CT) scan.

Treatment Procedure and Outcome

Informed consent for the operation was signed after full consideration by the patient or his or her family. According to our institutional management protocol, the time and modality of treatment for aneurysms were determined by the cerebralvascular group composed of

experienced neurointerventionalists and neurosurgeons. The following high-risk factors for rupture should be considered when deciding on endovascular or microsurgical treatment for very small UIAs: young age, history of hypertension, irregular shape (e.g., lobulation, bleb), multiple aneurysms, AcomA aneurysm, bifurcation location, the size of aneurysms increased gradually, etc. After the occlusion of very small aneurysms, all patients with aSAH were managed in the neurological intensive care unit (NICU). Before discharge, the CTA or MRA was performed to evaluate the degree of small aneurysm occlusion and the patency of the parent artery. Each patient's follow-up information was supplemented by imaging reviews and telephone interviews. DSA was performed on all patients at 6 months, 1 year and 2 years after discharge. Based on the Modified Rankin Scale (mRS) at the last follow-up, the clinical outcomes of very small IAs patients were rated.

Meta-Analysis Data

Literature Search and Selection Criteria

We systematically searched the electronic database of PubMed, Embase and Web of Science for studies of either endovascular or microsurgical treatment for very small intracranial aneurysms. The study selection processes met the PICOS criteria, and the search was performed by using the keywords and medical subject heading (MeSH) terms: "intracranial aneurysm," "cerebral aneurysm," "outcome," "endovascular," "coil," "embolization," "coiling," "surgical," "neurosurgical," "microsurgical," "clip," "clipping," "small," and "tiny" in both AND and OR combinations. The present study was conducted and reported in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analysis statement issued (PRISMA) recommendations and Meta-analysis of Observational Studies in Epidemiology (MOOSE) guidelines [21,22].

Selection of Studies and Data Extraction

The inclusion criteria were as follows: (1) studies including patients with very small ruptured or unruptured intracranial aneurysms; (2) studies including patients undergoing endovascular coiling or microsurgical clipping; (3) studies reporting the morbidity and mortality (Clinical outcomes assessed using the GOS or mRS); and (4) all types of study design, including prospective cohort studies, retrospective studies, and randomized controlled trials (RCTs). We excluded (1) duplicate studies; 2) studies reporting on aneurysms associated with arteriovenous malformations, Moyamoya disease, or other vascular diseases; (3) studies reporting on very small aneurysms in specific location (such as anterior communicating artery, middle cerebral artery, or other arteries); (4) studies in which baseline characteristics of patients with very small UIAs could not be distinguished from those with very small RIAs; and (5) studies in which clinical outcome (morbidity and mortality) was not reported separately for very small UIAs and RIAs. The data extracted from each study included the author's name, publication year, research design, sample size, average age, percentage of female, number, location and status of aneurysm (rupture or unruptured), treatment modality, procedural complications, clinical outcome (morbidity and mortality) and follow-up time.

Statistical Analysis

The meta-analysis was performed with use of the Review Manager software (version 5.3 [The Cochrane IMS]) and STATA software (version 12.0 [Stata Corp., College Station, Texas]). The original data of all studies would be statistically pooled through fixed or random-effects models. The cumulative incidence (event rate) was estimated from each included study of coiling or clipping, event rates were pooled in a meta-analysis across studies by using the fixed or random-effects model. Heterogeneity across studies in the meta-analysis was evaluated through I^2 statistic, If $I^2 < 50\%$, the fixed effect model was used; if $I^2 > 50\%$, the random effect model was used. For dichotomous data from the included study of clipping versus coiling, risk ratio (RR) were used for statistical pooling. Because the included studies on endovascular or microsurgical treatment were no comparative, publication bias is not tested. Each effect quantity was expressed by 95% confidence interval (95% CI), and $P < 0.05$ indicates that the difference is statistically significant.

Result

Current Consecutive Series

Patient Characteristics

A total of 157 consecutive adult patients with very small IAs were treated in our institution, including 31 very small UIAs and 126 very small RIAs. The ages of the patients ranged from 18 to 75 years, with a mean age of 52.3 years. There was a clear female predominance: 107 (68.2%) women versus 50 (31.8%) men. Hypertension was the most common comorbidity, accounting for 52.9% of all patients. The size of very small IAs ranged from 1.2 to 3.0, with a mean of 2.7. One hundred and forty-nine aneurysms (94.9%) were located in the anterior circulation, and 8 aneurysms (5.1%) were located in the posterior circulation. Twenty-eight patients (17.8%) had small aneurysms of

irregular shape, and 16 patients (10.2%) had two or more small aneurysms. Of the 31 patients with very small UIAs, indications for preventive intervention were a previous history of SAH in 5 (16.1%) patients, a history of hypertension in 11 (35.5%) patients, and patient preference in 8 (25.8%) patients, and other high-risk factors (multiple aneurysms or irregular shape) in 7 (22.6%) patients. Of the 126 patients with very small RIAs, Hunt-Hess grade was 1 in 26 cases (20.6%), 2 in 58 cases (46.0%), 3 in 34 cases (27.0%), and 4 in 8 patients (6.3%).

Aneurysm Treatment and Outcomes

A total of 68 (43.3%) patients received endovascular therapy and 89 (56.7%) patients received microsurgical treatment in our series. Of the 31 patients with very small UIAs, 11 (35.5%) cases were embolized with detachable coils, 9 (29.0%) were embolized with stent-assisted coils, and 11 (35.5%) were treated with surgical clipping. After operation, 21 cases underwent digital subtraction angiography (DSA) reviews and 10 underwent Computed tomography angiography (CTA) reviews, and angiography results showed that showed complete or nearly complete occlusion of aneurysms in all patients. Of the 126 patients with very small RIAs, 26 (20.6%) cases were embolized with detachable coils, 18 (14.3%) were embolized with stent-assisted coils, 4 (3.2%) embolized with balloon-assisted coils, and postoperative DSA showed complete or nearly complete occlusion in 43 cases (89.6%); 75 (59.5%) were treated with clipping, 3 (2.4%) were treated with trapping, and postoperative CTA showed neck remnant in 2 cases (2.6%). All patients were followed up by telephone or clinic for at least one year after discharge. Favorable outcome (mRS 0–2) was achieved in 31 very small UIAs patients and 104 very small RIAs patients. Nineteen patients suffered from moderate to severe disability (mRS score of 3–5) and 3 patients died (mRS score of 6). Two of these deaths occurred in the patient with the poor Hunt-Hess grade; the other was related to serious ischemic complications after clipping. Except for one case of rebleeding after coiling, no other patients experienced a rebleeding after endovascular or microsurgical treatment in this series.

Meta-Analysis

Literature Search

The literature -selection flow diagram is shown in Fig. 1. A total of 1112 related studies were initially retrieved under the search keywords (PubMed, 386; EMBASE, 576; and Web of Science, 420), of which 482 were excluded because of duplication. In the remaining 630 studies, 574 were excluded after reviewing the title or abstract, and then 45 were excluded after assessing the eligibility of the full-text articles. Finally, only 11 studies met the criteria and were selected for the final meta-analysis.

Study Characteristics and Outcomes

Including the data from our series, a total of 6 studies provided data on 362 very small UIAs and 9 studies provided data on 703 very small RIAs. All studies provided information on the patient characteristics and aneurysm features, clinical outcomes, and follow-up time. Of 362 patients with very small UIAs, only 6 (1.7%) cases had operation-related neurological deficits (mRS score of 3–5), and no patient died (mRS score of 6). After preventive treatment, the good outcome was observed in 356 (98.3%) cases (Table 1). Of 731 patients with very small RIAs, the morbidity, mortality and overall favorable outcome rate were 13.0%, 4.7% and 82.4%, respectively (Table 2). According to the treatment modality, all patients with very small RIAs were further divided into coiled patients and clipped patients. Among 489 coiled patients, 35 (7.2%) cases had procedural complications including 17 (3.5%) hemorrhagic events and 18 (3.7%) ischemic events. During the follow-up period, 22 (4.5%) cases had recurrence of aneurysm and 16 (3.3%) cases were retreated through either endovascular or microsurgical treatment. Among 242 clipped patients, 37 (15.3%) cases had procedural complications including 12 (5.0%) hemorrhagic events, 22 (9.1%) ischemic events and 3 (1.2%) other complications. During the follow-up period, no recurrence of aneurysms was observed in clipped patients.

Table 1

Meta-Analysis of Studies Reporting on Endovascular or Microsurgical Treatment of Consecutive Case Series, Very Small UIAs

Study	Study Design	No. of Patients	Mean Age (Y)	Percentage Female	Total No. of Aneurysms	Located in AcomA/ACA	Treatment Modality	Follow-Up (M)	Favorable Outcomes
Raoul et al., 2019	Retrospective	67	50.6	48(71.6%)	69	17(24.6%)	Coiling	30.5	100%
Rahmanian et al., 2017	Retrospective	15	Not available	Not available	15	Not available	Clipping	6	100%
Bruneau et al., 2016	Retrospective	183	51.3	128(69.9%)	228	28(12.3%)	Clipping	1	97.3%
Hwang et al., 2011	Retrospective	15	55	10(66.7%)	20	5(25.0%)	Coiling	6	100%
Pierot et al., 2010	Prospectively	51	46.4	41(80.4%)	51	9(17.6%)	Coiling	1	98.0%
Our series	Retrospective	31	55.2	19(61.3%)	34	10(29.4%)	Coiling or Clipping	12	100%
Total	-	362	51.0	246(70.9%)	402	69(17.2%)	-	-	98.3%

Table 2

Meta-Analysis of Studies Reporting on Endovascular or Microsurgical Treatment of Consecutive Case Series, Very Small RIAs

Study	Study Design	No. of Patients	Mean Age (Y)	Percentage Female	No. of Aneurysms	Located in AcomA/ACA	Treatment Modality	Follow-Up (M)	Favorable Outcomes
Zhang et al., 2017	Retrospective	93	51.9	60(64.5%)	93	21(22.6%)	Coiling	7.5	97.4%
Rahmanian et al., 2017	Retrospective	19	Not available	Not available	19	Not available	Clipping	6	78.9%
Jian et al., 2015	Retrospective	162	49.1	92(56.8%)	162	55(34.0%)	Coiling or Clipping	12	82.1%
Dalfino et al., 2014	Retrospective	17	55.4	12(70.6%)	17	6(35.3%)	Coiling	17	94.1%
Chung et al., 2013	Retrospective	100	51.3	66(66.0%)	100	44(44.0%)	Coiling or Clipping	12	89.0%
Chalouhi et al., 2012	Retrospective	142	Not available	Not available	142	Not available	Coiling or Clipping	9.5	62.7%
Hwang et al., 2011	Retrospective	23	51	16(69.6%)	23	11(47.8%)	Coiling	0	73.9%
Hong et al., 2011	Retrospective	49	50.1	29(56.9%)	49	19(37.3%)	Coiling	0	93.9%
Our series	Retrospective	126	51.9	89(70.6%)	138	63(45.7%)	Coiling or Clipping	12	82.5%
Total	-	731	50.9	364(63.9%)	743	219(37.6%)	-	-	82.4%

Coiled Versus Clipped Patients with Very Small RIAs

Eight studies on coiling for very small RIAs and 4 studies on clipping for very small RIAs were further analyzed (Table 3). The rate of procedural complications was 6.7% (95% CI, 3.8–9.6%) in coiled patients compared with 13.6% (95% CI, 6.9–20.4%) in clipped patients. The incidence of hemorrhagic events was 2.9% (95% CI, 1.3–4.5%) in coiled patients compared with 4.8% (95% CI, 2.0–7.6%) in clipped patients. The incidence of ischemic events was 3.0% (95% CI, 1.3–4.6%) in coiled patients compared with 9.4% (95% CI, 5.6–13.2%) in clipped

patients. Morbidity due procedure-related complications was 8.3% (95% CI, 3.5–13.1%) in coiled patients compared with 20.6% (95% CI, 10.5–30.8%) in clipped patients. Mortality due to procedure-related complications was 5.3% (95% CI, 2.9–7.7%) in coiled patients compared with 4.7% (95% CI, 2.0–7.3%) in clipped patients. For coiled patients with very small RIAs, the rate of recanalization was 4.3% (95% CI, 1.3–7.3%) and the rate of retreatment was 4.9% (95% CI, 2.1–8.8%). These data are summarized in Table 3. The number of studies reporting the outcome of coiling versus clipping of very small RIAs was four. According to forest plot of pooled risk ratio, there was no significant difference in poor outcome between 279 clipped patients vs. 251 coiled patients (RR, 1.38; 95% CI, 0.99–1.93; P = 0.06; Fig. 2).

Table 3
Meta-analysis Outcomes of Patients with Very Small RIAs

	Coiled patients, (%) (95% CI)	I^2	Clipped Patients, (%) (95% CI)	I^2
Procedural complications	6.7(3.8–9.6)	33.8	13.6(6.9–20.4)	57.9
Hemorrhagic events	2.9(1.3–4.5)	0	4.8(2.0-7.6)	0
Ischemic events	3.0(1.3–4.6)	15.7	9.4(5.6–13.2)	0
Good outcomes	87.4(80.8–94.0)	82.9	73.3(62.9–83.7)	69.6
Morbidity	8.3(3.5–13.1)	76.4	20.6(10.5–30.8)	74.6
Mortality	5.3(2.9–7.7)	11.6	4.7(2.0-7.3)	0
Recanalization	4.3(1.3–7.3)	57.1	-	-
Retreatment	4.9(2.1–8.8)	26.8	-	-

Discussion

We present a single-center series as well as the systematic review and meta-analysis focusing on procedural complications, morbidity and mortality in very small IAs patients who undergoing endovascular or microsurgical treatment. With a 1.7% morbidity and a 0% mortality, our results found that very small UIAs can be effectively treated with very low neurological complication rate. However, the risk of poor outcome in patients with very small RIAs remains high, reaching 17.6%, even after effective endovascular or microsurgical treatment.

The International Subarachnoid Aneurysm Test (ISAT) ^[23] is a randomized controlled trial designed to compare the safety and efficacy of endovascular coiling and surgical clipping in SAH patients. However, these results can not be applied to very small IAs patients simply, because there are some differences in natural history, aneurysm characteristics and so on. Although no randomized clinical trial (RCT) comparing these two treatment methods, some retrospective and prospective studies ^[24,25,26,27,28] reported the outcomes of clipping or coiling in very small UIAs. Moroi et al. ^[29] reported the total morbidity and mortality of 368 cases of UIAs treated with clipping were 0.3% and 2.2% respectively, while the morbidity and mortality of small UIAs in different location of aneurysm were lower than those of large UIAs. Raoul et al. ^[24] reported the 67 very small UIAs treated by coiling, and the good outcome rate was 97.0%, and the intraprocedural perforation and neurological morbidity rate were 1.7% and 2.8%, respectively. Their study showed that the rate of procedural perforation was lower than previously reported results with technical evolution of endovascular devices. In another retrospective study of 287 patients with small UIAs ^[30], most of the patients had a favorable outcome after coiling, with the intraoperative rupture rate of 1.2% and the incidence of perioperative thrombotic events of 4.2%, morbidity and mortality of 0.9% and 2.4%, respectively. Because of incomplete occlusion of aneurysm, the recanalization rate of small UIAs within 3 mm is clearly higher than that of 3–5 mm small UIAs. Pierot et al. ^[25] reported that the failure rate of coiling in very small IAs was higher than that in large IA (13.7% vs. 3.3%), and suggested that for this very small UIAs with low risk of rupture, preventive treatment should be carried out after morphological changes in imaging follow-up. However, Hwang et al. believed coiling of very small aneurysms may be technically feasible with favorable clinical outcomes and relatively low recanalization rate. that recently, another multicenter study ^[27] reported that clipping is safe and effective in the treatment of very small UIAs. After long-term follow-up, the total morbidity decreased to 2.7% and no operation-related death occurred, and the posterior circulation is a significant risk factor for early neurological deficit. Rahmanian et al. ^[28] reported 15 cases of treatment outcome for very small UIAs, and believed that surgical clipping is a safe and effective modality of treatment associated with low mortality and morbidity. In our series, 31 patients with very small UIA have good outcomes after either coiling or clipping, with very low morbidity (1.7%) and no death. A comparative effectiveness analysis ^[31] suggested that endovascular coiling should be performed directly if annual risk of rupture of very small UIA is more than 1.7%. Therefore, the high-risk patients with very small UIAs should be identified and preventively treated.

In a meta-analysis of 1105 patients with very small IAs in 22 studies^[32], the morbidity and mortality associated with coiling were higher in very small RIA than that in very small UIA (4.0% vs. 2.0%; 3.0% vs. 2.0%), and the incidence of neurological complications was higher in very small RIAs than that in very small UIAs (6.5% vs. 5.0%). In a recent study^[28] of 52 patients treated with surgical clipping, the mortality rate was 0% in very small UIAs and 3.8% in very small RIAs. Due to the complications associated with aSAH, the morbidity and mortality of the very small RIA patients were higher than that of the very small UIA patients. For very small RIAs, either endovascular or microsurgical treatment is more difficult and challenging. Hong et al.^[33] reported 49 patients with very small RIAs treated with endovascular coiling. Among them, 44 (89.8%) cases recovered well, 4 (8.2%) had moderate and severe disability, and 1 (2.0%) died. Chung et al.^[34] considered that endovascular treatment of very small RIAs is technically feasible, but it is associated with an increased rate of intra-procedural complications. Hwang, et al^[35] reported that of 23 patients receiving endovascular coiling, 17.4% had residual neurological dysfunction and 8.7% mortality. Twenty-eight patients (77%) were followed up for more than 6 months by angiography and/or MRA. The minor recanalization rate was 6%, and the major recanalization rate was 3%. Zhang et al.^[36] suggests that stent assisted coiling can significantly reduce the recurrence of aneurysms without increasing the risk of additional operation. In a cohort study of 91 coiled patients versus 60 clipped patients, Chalouhi et al.^[37] found that surgical clipping of very small RIA was associated with a higher incidence of perioperative complications, but the overall disability outcomes were similar. In our series, the good outcome rate of 48 patients receiving endovascular therapy was 91.7%, and that of 78 patients receiving microsurgical treatment was 76.9%. The difference in outcomes was mainly due to more patients with poor Hunt-Hess grade received clipping in our center. Jian et al.^[38] reported that there was no significant difference in the outcomes of 162 patients with very small RIAs after the endovascular coiling or surgical clipping, and the Hunt-Hess poor grade are significant risk factors for poor outcomes.

This study has some limitations. First of all, most of the studies on coiling or clipping are single center retrospective analysis, and there are no RCT studies on coiling versus clipping for very small IAs. Secondly, there is a possible publishing bias, because series with more positive results may be more easily reported and published. Nevertheless, our results have certain guiding significance for individualized treatment decisions for very small IAs due to the treatment risk of UIAs or RIAs is acceptable. Based on our findings, we conclude that very small UIAs can be treated effectively and safely with good long-term functional and angiographic outcomes. However, very small RIAs patients are at high risk of poor outcome and the incidence of neurological complication should not be ignored. The morbidity and mortality of clipped patients with very small RIAs were 2% and 3%, respectively, and the morbidity and mortality of coiled patients with very small RIAs were 4% and 6.5%, respectively. The pooled results indicated that there was no significant difference in poor outcome between the endovascular and microsurgical treatment of very small RIAs. A large-scale randomized controlled trial is needed to verify the difference between clipping and coiling of very small UIAs in the future.

Declarations

Ethics approval and consent to participate:

This study was approved by Institutional Review Board and Ethics Committee of the First Affiliated Hospital of Chongqing Medical University.

Consent for publication:

Not applicable

Availability of Data and Materials:

Please contact author for data request.

Conflict of interest:

The authors declare no conflict of interest, financial or otherwise.

Funding:

This study was supported by National Key Research Development Program (grants no 2016YFC1300800).

Authors' contributions:

Zheng Jianfeng: acquisition of the data, analysis and interpretation of the data, drafting the article, and final approval of version to be published. Hong Chen, Chao Zhou, Sun Xiaochuan and Zhang Xiaodong: critically revising the article for intellectual content and final

approval of version to be published.

Acknowledgements:

Not applicable

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Figures

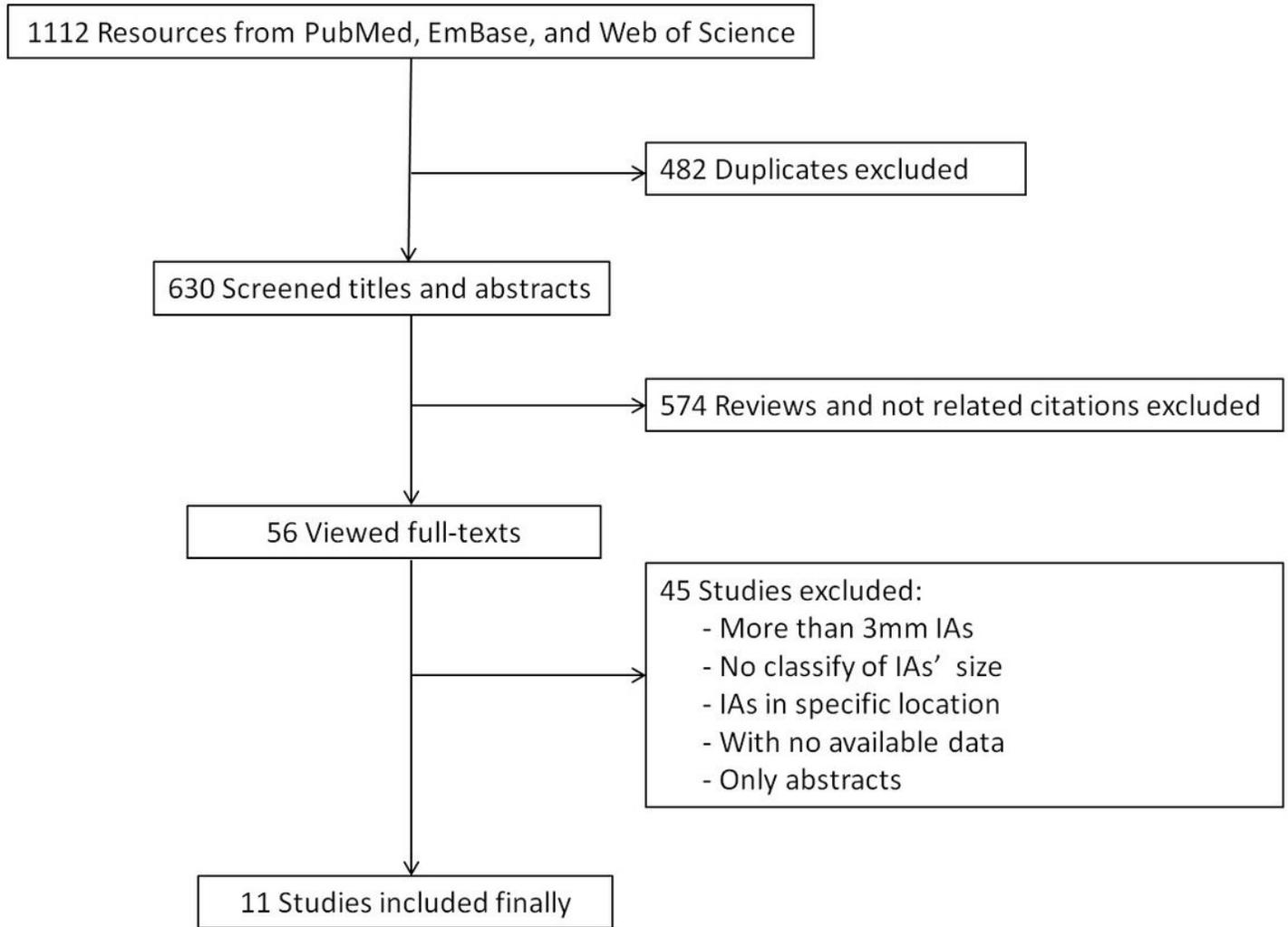


Figure 1

Flow diagram of the literature search and study selection process.

Study or Subgroup	Clipping		Coiling		Weight	Risk Ratio M-H, Fixed, 95% CI
	Events	Total	Events	Total		
Chalouhi 2012	26	60	27	82	50.3%	1.32 [0.86, 2.01]
Chung 2013	2	28	9	72	11.1%	0.57 [0.13, 2.48]
Jian 2015	17	85	12	77	27.7%	1.28 [0.66, 2.51]
Our series	18	78	4	48	10.9%	2.77 [1.00, 7.70]
Total (95% CI)		251		279	100.0%	1.38 [0.99, 1.93]
Total events	63		52			
Heterogeneity: Chi ² = 3.26, df = 3 (P = 0.35); I ² = 8%						
Test for overall effect: Z = 1.91 (P = 0.06)						

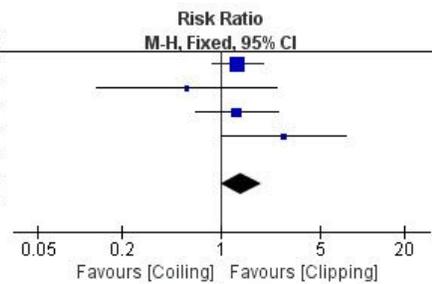


Figure 2

Forest plot of pooled risk ratio regarding poor outcomes for endovascular coiling versus microsurgical clipping in patients with very small RIAs