Surgical Treatment of Previously Coiled Aneurysms: Meta-analysis of 466 Patients

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Introduction

Recurrence of the aneurysm after coil embolization is not infrequent and surgical treatment of previously coiled aneurysms is necessary in some patients. The best neurosurgical strategy and technique continues to be debated. We conducted a systematic review of the literature to evaluate the safety and efficacy of surgical treatment of previously coiled aneurysms.

Methods

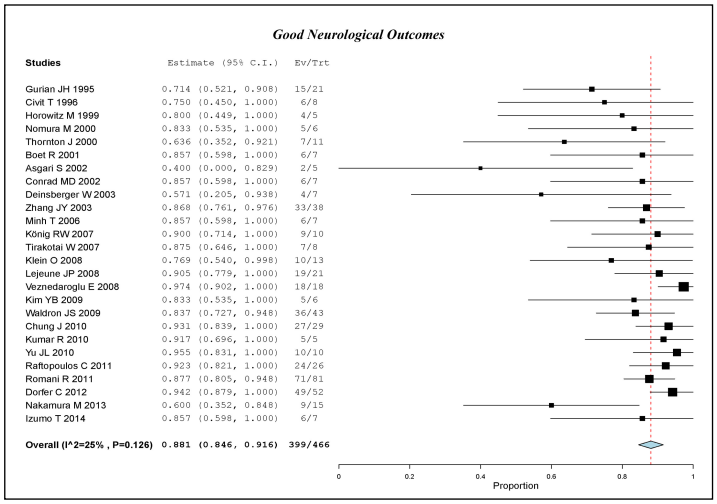
Comprehensive review of the literature for studies on surgical treatment of previously coiled aneurysms. For each study, the following data were extracted: patient demographics, initial clinical status, location and size of aneurysms, time interval between initial/last endovascular procedure and surgery, surgical indications and microsurgical technique. We performed subgroup analyses to compare direct clipping versus coil removal and clipping versus parent vessel occlusion, early (<4 weeks post-coiling) versus late surgery and anterior versus posterior circulation.

Results

26 studies with 466 patients and 471 intracranial aneurysms were included. Patients undergoing direct clipping had lower perioperative morbidity (5.0%, 95%CI=2.6%-7.4%) when compared to those undergoing coil removal and clipping (11.1%, 95%CI=5.3%-17.0%) or parent vessel occlusion (13.1%, 95%CI=4.6%-21.6%) (P=0.05). Patients receiving early surgery (<4 weeks post-coiling) had significantly lower rates of good neurological outcome (77.1%, 95%CI=69.3%-84.8%) when compared to those undergoing late surgery (92.1%, 95%CI=89.0%-95.2%) (P<0.01). There were higher rates of long-term neurological morbidity in posterior circulation group (23.1% versus 4.7%, P<0.01) as well as long-term neurological mortality (4.4% versus 2.8%, P<0.01).

Outcomes by Type of Treatment

	Direct Clipping			*Coil Removal and Clipping*			*Parent Artery Occlusion*			
	Overall % (95%CI)	Raw Proportion	I^2	Overall % (95%CI)	Raw Proportion	I^2	Overall % (95%CI)	Raw Proportion	I^2	P
Aneurysm Rebleed	0.024 (0.007, 0.040)	1/277	0%	0.040 (0.003, 0.077)	0/89	0%	0.079 (0.015, 0.142)	1/49	0%	0.22
Aneurysm Recurrence	0.023 (0.006, 0.040)	0/277	0%	0.040 (0.003, 0.077)	0/89	0%	0.073 (0.010, 0.137)	0/49	0%	1
Coil Extrusion	0.332 (0.143, 0.521)	50/181	95%	0.855 (0.775, 0.936)	50/58	0%	0.410 (0.192, 0.628)	13/42	76%	<0.01
Complete Occlusion	0.975 (0.958, 0.992)	274/277	0%	0.960 (0.923, 0.997)	89/89	0%	0.882 (0.805, 0.960)	45/49	0%	<0.01
Long-term Good Neurological Outcome	0.884 (0.838, 0.929)	243/277	34%	0.832 (0.761, 0.904)	73/89	0%	0.758 (0.650, 0.866)	37/49	8%	0.06
Long-term Neurological Morbidity	0.048 (0.024, 0.071)	16/277	0%	0.099 (0.042, 0.156)	6/89	0%	0.141 (0.054, 0.228)	7/49	8%	0.09
Long-term Neurological Mortality	0.027 (0.009, 0.045)	6/277	0%	0.043 (0.004, 0.081)	4/89	0%	0.150 (0.063, 0.238)	5/49	0%	0.02
Perioperative Morbidity	0.050 (0.026, 0.074)	13/277	0%	0.111 (0.053, 0.170)	9/89	0%	0.131 (0.046, 0.216)	6/49	9%	0.05
Perioperative Mortality	0.023 (0.006, 0.040)	0/277	0%	0.041 (0.003, 0.078)	1/89	0%	0.073 (0.010, 0.137)	0/49	0%	0.16
Perioperative Stroke	0.023 (0.006, 0.040)	0/277	0%	0.043 (0.005, 0.080)	2/89	0%	0.073 (0.010, 0.137)	0/49	0%	0.03
Technical Success	0.976 (0.960, 0.993)	276/277	0%	0.960 (0.923, 0.997)	89/89	0%	0.847 (0.747, 0.948)	45/49	34%	<0.01



Conclusions

Our meta-analysis demonstrated that surgical treatment is safe and effective. Our data suggest that direct clipping is superior to other surgical techniques. Late surgery was also associated with superior clinical outcomes. Surgery of recurrent posterior circulation aneurysms was associated with high rates of morbidity and mortality.

Our meta-analysis of 466 patients receiving surgical treatment following endovascular coiling of intracranial aneurysms demonstrated suggests that in general, surgical treatment is safe and effective. Our data suggest that aneurysms that are amenable to direct clipping have superior outcomes.

Outcomes by Location

	Anterior			*Posterior*			
	Overall % (95%CI)	Raw Proportion	I^2	Overall % (95%CI)	Raw Proportion	I^2	P
Aneurysm Rebleed	0.020 (0.006, 0.035)	1/353	0%	0.046 (0.001, 0.091)	1/61	0%	0.68
Aneurysm Recurrence	0.020 (0.006, 0.035)	0/353	0%	0.043 (−0.002, 0.088)	0/61	0%	1
Coil Extrusion	0.475 (0.307, 0.643)	98/244	92%	0.425 (0.258, 0.592)	15/37	40%	0.97
Complete Occlusion	0.980 (0.965, 0.994)	352/353	0%	0.954 (0.909, 0.999)	60/61	0%	0.68
Long-term Good Neurological Outcome	0.876 (0.840, 0.912)	298/353	10%	0.706 (0.535, 0.877)	41/61	72%	0.002
Long-term Neurological Morbidity	0.047 (0.026, 0.068)	26/353	0%	0.231 (0.081, 0.382)	17/61	64%	<0.01
Long-term Neurological Mortality	0.028 (0.012, 0.045)	13/353	0%	0.044 (−0.002, 0.089)	1/61	0%	<0.01
Perioperative Morbidity	0.051 (0.029, 0.073)	26/353	0%	0.239 (0.097, 0.382)	18/61	55%	<0.01
Perioperative Mortality	0.020 (0.006, 0.035)	0/353	0%	0.043 (−0.002, 0.088)	0/61	0%	1
Perioperative Stroke	0.021 (0.006, 0.035)	2/353	0%	0.043 (−0.002, 0.088)	0/61	0%	0.56
Technical Success	0.980 (0.965, 0.994)	352/353	0%	0.951 (0.905, 0.998)	59/61	0%	0.68

Delayed surgery was also associated with better clinical outcomes. Surgical treatment of recurrent posterior circulation aneurysms was associated with high rates of morbidity and mortality. These findings should be considered when deciding the best therapeutic strategy for treatment of large recurrences following endovascular coiling. Ultimately, the decision regarding whether to treat the recurrence with endovascular or surgical therapy should be taken on a case-by-case basis considering anatomical factors such as aneurysm location, feasibility of coiling and local neurosurgical and endovascular expertise.

References

Title: *Safety and Efficacy of Microsurgical Treatment of Previously Coiled Aneurysms: A Systematic Review and Meta-Analysis*
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Outcomes by Timing of Surgery

	Early Surgery (<4 weeks)			*Late Surgery (>4 weeks)*			
	Overall % (95%CI)	Raw Proportion	I^2	Overall % (95%CI)	Raw Proportion	I^2	P
Aneurysm Rebleed	0.041 (0.011, 0.071)	1/145	0%	0.019 (0.003, 0.035)	1/262	0%	0.68
Aneurysm Recurrence	0.041 (0.011, 0.070)	0/145	0%	0.019 (0.003, 0.035)	0/262	0%	1
Coil Extrusion	0.441 (0.268, 0.614)	40/116	85%	0.423 (0.227, 0.619)	71/159	90%	0.11
Complete Occlusion	0.948 (0.914, 0.981)	140/145	0%	0.979 (0.963, 0.995)	258/262	0%	0.36
Long-term Good Neurological Outcome	0.771 (0.693, 0.848)	112/145	31%	0.921 (0.890, 0.952)	235/262	0%	<0.01
Long-term Neurological Morbidity	0.094 (0.046, 0.143)	14/145	16%	0.068 (0.039, 0.098)	16/262	0%	0.27
Long-term Neurological Mortality	0.074 (0.035, 0.112)	9/145	0%	0.021 (0.005, 0.038)	5/262	0%	0.04
Perioperative Morbidity	0.084 (0.043, 0.125)	16/145	0%	0.058 (0.031, 0.085)	17/262	0%	0.16
Perioperative Mortality	0.041 (0.011, 0.070)	0/145	0%	0.019 (0.003, 0.035)	0/262	0%	1
Perioperative Stroke	0.041 (0.011, 0.070)	1/145	0%	0.019 (0.004, 0.035)	1/262	0%	1
Technical Success	0.959 (0.929, 0.990)	137/138	0%	0.980 (0.964, 0.996)	260/262	0%	1