Avicenna Anatolian Journal of Medicine

Orginal Article

Microsurgical Management of Middle Cerebral Artery Aneurysms: Clinical Features and Outcomes

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Submitted at: 23.11.2025 - Accepted at: 17.12.2025 - Published at: 19.12.2025

Avicenna Anatol J Med. Year; 2025, Volume: 2, Issue: 3
doi 10.5281/zenodo.17965684

Abstract

Background: Middle cerebral artery (MCA) aneurysms are a frequent cause of spontaneous subarachnoid hemorrhage (SAH) and pose distinct surgical challenges because of their anatomical location and association with intracerebral hematomas. This study analyzed the clinical features, microsurgical management, and outcomes of MCA aneurysms to identify prognostic factors and optimal surgical timing.

Methods: We retrospectively reviewed 107 patients with MCA aneurysms who underwent microsurgical clipping at a single neurosurgical center between 1992 and 2002. Demographic characteristics, risk factors, clinical presentation, radiological findings, aneurysm morphology and location, and surgical details were evaluated. All patients were treated using a standard pterional transsylvian approach. Clinical severity was graded using a modified Hunt and Hess/Yasargil classification, and hemorrhage extent was assessed with Fisher CT grading. Outcomes at discharge and follow-up (≥6 months, up to 5 years) were categorized as good recovery, moderate disability, severe disability, or death.

Results: MCA aneurysms accounted for 29.2% of all intracranial aneurysms treated during the study period. The cohort included 107 patients (60.7% female) with a mean age of 52.3 years; 80% were between 40 and 70 years old. Thunderclap headache was the most common presenting symptom (72.8%), followed by sudden loss of consciousness (13.1%) and focal neurological deficits (11.2%). Hypertension was the predominant risk factor (62.6%). A total of 116 MCA aneurysms were identified: 94% were located at the bifurcation, 5.2% at the distal M1 segment, and 0.8% at the M2 segment. Nineteen patients (17.7%) had multiple aneurysms, including bilateral or multiple MCA aneurysms in 7.4%. Among 133 total aneurysms, 129 (97%) were successfully clipped in single or staged procedures; four were not clipped (three in elderly poor-grade patients and one small aneurysm treated with coagulation). Temporary arterial occlusion was required in 17.8% of cases. Overall outcomes were favorable in 81.3% of patients, while 11.2% had moderate disability, 1.8% severe disability, and mortality was 5.6%. All patients presenting with Grade 0–IIa achieved good recovery, whereas poor-grade patients (Grades IV–V) had a mortality rate of 66.6%. Patients younger than 50 years had better outcomes than those aged ≥50 years (92.6% vs 74.2% good recovery). Optimal outcomes were observed when surgery was performed 8–21 days after SAH.

Conclusion: Microsurgical clipping of MCA aneurysms yields excellent outcomes, particularly in younger patients and those presenting with good neurological grade. Preoperative clinical status and age are the strongest predictors of outcome. Carefully timed surgery after the acute phase of SAH appears to reduce complications related to vasospasm and rebleeding, supporting meticulous microsurgical management as a durable and effective treatment strategy.

Keywords: Middle Cerebral Artery Aneurysm; Subarachnoid Hemorrhage; Intracranial Aneurysm; Microsurgical Clipping; Vasospasm; Surgical Outcome

INTRODUCTION

Rupture of intracranial saccular aneurysms remains one of the leading causes of spontaneous subarachnoid hemorrhage (SAH), with an estimated prevalence of 1–2% in autopsy series (1,2). Middle cerebral artery (MCA) aneurysms account for approximately 20–30% of all intracranial aneurysms, making the MCA one of the most frequent sites of aneurysm formation (3). Clinically, MCA aneurysms are of particular importance because rupture often results not only in SAH but also in intracerebral hemorrhage within the lateral Sylvian region, frequently producing focal neurological deficits (4). Previous surgical series have demonstrated lateralizing signs such as hemiparesis, aphasia, and

visual field deficits in up to 80% of patients with ruptured MCA aneurysms, a higher rate than that observed with aneurysms in other locations (5,6). Most MCA aneurysms arise at the bifurcation of the MCA (M1–M2 junction), although proximal and distal variants are also encountered (7,8).

Several risk factors contribute to aneurysm formation and rupture, including hypertension, cigarette smoking, excessive alcohol consumption, and genetic predisposition (9). Hypertension is consistently identified as the most significant risk factor and was present in more than 60% of patients in our serie. Additional contributors, such as blood pressure variability, smoking, and hormonal influences, have also been implicated (9). Although the overall incidence of aneurysmal SAH does not differ markedly between sexes, a slight female predominance has been reported, with peak incidence occurring in the sixth decade of life (9,10).

Clinically, approximately 90% of intracranial aneurysms become symptomatic only after rupture (11). The hallmark presentation of aneurysmal SAH is a sudden, severe "thunderclap" headache, frequently accompanied by loss of consciousness, vomiting, or seizures. In MCA aneurysm rupture, focal neurological deficits are common due to associated intracerebral hematoma, vasospasm-related ischemia, or direct compression of adjacent brain tissue. Secondary complications (including cerebral vasospasm, rebleeding, hydrocephalus, and seizures) play a major role in determining morbidity and mortality (7-11). Symptomatic vasospasm develops in up to one-third of SAH patients and remains a leading cause of delayed neurological deterioration.

Microsurgical clipping has historically been the primary treatment modality for MCA aneurysms and continues to be favored for many bifurcation aneurysms due to its durability and anatomical accessibility (12). The standard pterional transsylvian approach allows early proximal control and preservation of perforating vessels while minimizing cortical injury. This study presents our experience with 107 surgically treated MCA aneurysms, focusing on anatomical characteristics, surgical strategy, timing of intervention, and clinical outcomes, with the aim of identifying key prognostic factors and optimizing management strategies for this common and challenging cerebrovascular pathology.

METHODS

Patient Population: This retrospective study included 107 patients diagnosed with middle cerebral artery (MCA) aneurysms who underwent surgical treatment at the Neurosurgery Clinic of SSK Ankara Training and Research Hospital between January 1992 and December 2002. Both ruptured and unruptured MCA aneurysms requiring operative management were analyzed. Only saccular aneurysms were included; fusiform or mycotic aneurysms were not identified in this cohort. In patients with multiple intracranial aneurysms, cases were included only if at least one MCA aneurysm was present and surgically treated.

Data Collection and Clinical Assessment: Medical records, operative reports, and radiological studies were reviewed. Demographic variables (age and sex), medical history (hypertension, diabetes mellitus, cardiac disease, prior cerebrovascular disease, pulmonary disease), and family history of aneurysms were recorded. Clinical presentation was documented, including headache severity, loss of consciousness, seizures, and focal neurological deficits at admission. Neurological status was graded using the Hunt–Hess classification and additionally categorized according to Yasargil's modified grading system, which accounts for unruptured aneurysms and focal neurological deficits. This system ranges from Grade 0 (unruptured aneurysm) to Grade V (deep coma or decerebrate posturing).

All patients underwent cranial computed tomography (CT) at admission. CT scans were evaluated for subarachnoid hemorrhage, intracerebral or intraventricular hematoma, and hydrocephalus. The extent of subarachnoid hemorrhage was graded using the Fisher classification. Four-vessel cerebral angiography was performed in all cases to assess aneurysm location, size, neck configuration, lobulation, presence of multiple aneurysms, and vasospasm. In patients with multiple aneurysms, the presumed ruptured aneurysm was identified based on hemorrhage distribution and angiographic characteristics. Sylvian fissure hematoma or temporoparietal intracerebral hemorrhage was considered suggestive of an MCA source.

Surgical Technique: All patients underwent microsurgical clipping via a standard pterional craniotomy using a transsylvian approach. The head was positioned with approximately 10–20° extension and 15–30° contralateral rotation to optimize Sylvian fissure exposure. Fixed retractors were generally avoided, and dynamic retraction was used as needed. After dural opening, Sylvian fissure dissection was performed under the operating microscope, typically beginning proximally to identify the M1 segment and secure proximal vascular control. Early opening of basal cisterns facilitated cerebrospinal fluid drainage and brain relaxation.

Aneurysms were clipped using appropriate straight or curved clips. In wide-necked or multilobed aneurysms, multiple clips or limited bipolar coagulation of the neck were employed. Temporary arterial occlusion was used selectively in 19 cases (17.8%), with efforts made to minimize occlusion duration and avoid intraoperative hypotension. Large or partially thrombosed aneurysms were decompressed when necessary after temporary proximal control. Intraoperative rupture, when encountered, was managed with prompt tamponade and temporary clipping.

Patients with multiple aneurysms underwent either single-stage clipping of accessible lesions or staged procedures, prioritizing treatment of the ruptured aneurysm. All surgeries were performed under general anesthesia using total intravenous anesthesia. Postoperatively, patients were monitored in the neurosurgical intensive care unit

Table 1. Patient Demographics

Variable	n (%)	Mean
Total patients	107	—
Female	65 (60.7%)	55.2 ± —
Male	42 (39.3%)	49.5 ± —
Age range	32–72	52.3 ± —
Peak age group	51–60 years	—
Hypertension	67 (62.6%)	—
Diabetes mellitus	18 (16.8%)	—
Ischemic heart disease	11 (10.3%)	—
Family history of aneurysm	4 (3.7%)	—

for vasospasm, hydrocephalus, and other complications.

Follow-Up and Outcome Assessment: Patients were followed for a minimum of 6 months and up to 5 years. Outcomes were categorized as good (independent), moderate disability, poor disability, or death, corresponding to standard Glasgow Outcome Scale and modified Rankin Scale definitions. New postoperative neurological deficits and medical complications were recorded. Symptomatic vasospasm was diagnosed based on clinical deterioration with supporting radiological or Doppler findings.

STATISTICAL ANALYSIS

Statistical analysis was performed using standard descriptive and comparative methods. Continuous variables, including age, are presented as mean ± standard deviation, while categorical variables are expressed as frequencies and percentages. Clinical and radiological characteristics were summarized descriptively for the entire cohort. Clinical outcomes were analyzed according to age group (<50 vs ≥50 years), preoperative neurological grade (modified Hunt–Hess/Yasargil classification), timing of surgery after subarachnoid hemorrhage, and presence of multiple aneurysms. Comparisons between categorical variables were performed using the chi-square test or Fisher's exact test, as appropriate. Continuous variables were compared using the Student's t test when normally distributed. Functional outcome was categorized as good recovery, moderate disability, severe disability, or death, and for selected analyses dichotomized into favorable (good recovery or moderate disability) and unfavorable (severe disability or death) outcomes. Statistical significance was defined as a p value < 0.05. Due to the retrospective design and limited sample size, multivariate regression analysis was not performed.

RESULTS

Patient Demographics and Clinical Presentation: During the 11-year study period, 107 patients with MCA aneurysms underwent microsurgical clipping. The cohort included 65 women and 42 men (female-to-male ratio, 1.56:1). Patient age ranged from 32 to 72 years, with a mean age of 52.3 years. The mean age

Table 2. Aneurysm Distribution and Characteristics

Category	Subcategory
Total aneurysms	133
MCA aneurysms	116 (87.2%)
Non-MCA aneurysms	17 (12.8%)
MCA location	Bifurcation: 109 (93.9%) M1 distal: 6 (5.2%) M2: 1 (0.9%)
Laterality	Right MCA: 72 (62.1%) Left MCA: 44 (37.9%)
Size	Small <12.5 mm: 29 (25%) Large 12.5–25 mm: 81 (70%) Giant > 25 mm: 5 (4.4%)
Morphology	Single-lobed 63 (54.3%) Bilobed 28 (24.1%) Trilobed 14 (12.1%) Multilobed 11 (9.5%)
Fundus orientation	Lateral 56 (48.2%) Inferior 34 (29.4%) Superior 17 (14.6%) Posterior 7 (6.1%) Medial 2 (1.7%)

was higher in women than in men (55.2 vs 49.5 years). Most patients were between 40 and 70 years of age, with a peak incidence in the 51–60 year group (26% of all cases) (Table 1 and Figure 1).

Aneurysmal subarachnoid hemorrhage (SAH) was present in 100 patients (93.5%), while 7 patients (6.5%) had unruptured MCA aneurysms detected incidentally or due to mass effect. Among patients with SAH, sudden severe headache was reported in 97%, loss of consciousness at ictus in approximately 20%, and vomiting in 30%. On admission, 14 patients (13.1%) were stuporous or had acute loss of consciousness, 12 patients (11.2%) presented with hemiparesis or monoparesis, and 3 patients (2.8%) presented with syncope. Seizures occurred in approximately 20% of patients during presentation or hospitalization.

Hypertension was the most common comorbidity (67 patients, 62.6%), followed by diabetes mellitus (18 patients, 16.8%) and ischemic heart disease (11 patients, 10.3%). A family history of aneurysm or SAH was present in 4 patients (3.7%).

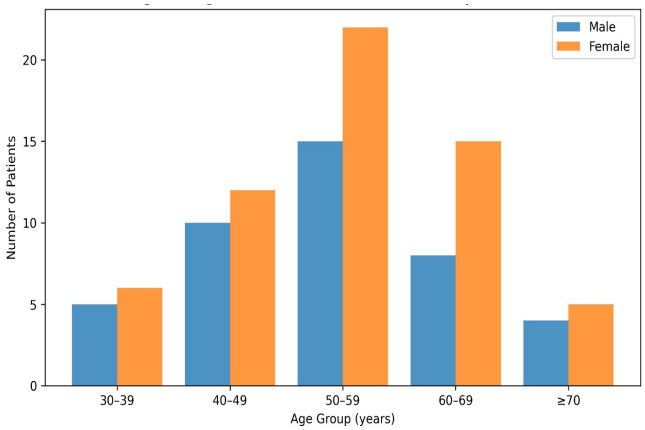

Figure 1. Age and sex distribution of the 107 MCA aneurysm patients in our series.

Table 3. Summary of Major Complications

Complication	n (%)	Management	Permanent Deficit (%)
Vasospasm (clinical)	27 (25%)	Medical therapy	3 (2.8%)
Hydrocephalus	11 (10.3%)	EVD/Shunt	2 (1.8%)
Intraoperative rupture	7 (6.5%)	Temporary clip	0
Myocardial infarction	1 (0.9%)	Supportive	1
Rebleeding pre-surgery	11 (10.3%)	Surgical	2
Total deaths	6 (5.6%)	—	—

According to Hunt–Hess grading, 4 patients (3.7%) were Grade 0, 8 (7.5%) Grade I, 49 (45.8%) Grade II, 21 (19.6%) Grade III, 18 (16.8%) Grade IV, and 7 (6.5%) Grade V. Using the modified Yasargil classification, 50.5% of patients presented in good grade (Grade I–IIa), 26.7% in intermediate grade (IIb–IIIa), and 18.7% in poor grade (IIIb–V) (**Table 1**).

Aneurysm Characteristics: A total of 133 aneurysms were identified in 107 patients. Eighty-eight patients (82.2%) had a single aneurysm, while 19 patients (17.8%) had multiple aneurysms (2–4 aneurysms per patient). Of all aneurysms, 116 (87.2%) were located on the MCA and 17 (12.8%) were located at other intracranial sites. Bilateral MCA aneurysms were present in 8 patients (7.5%) (**Table 2**).

Among the 116 MCA aneurysms, 109 (93.9%) were located at the MCA bifurcation, 6 (5.2%) at the distal M1 segment, and 1 (0.9%) at the M2 segment. No aneurysms arose from distal cortical branches. Based on size, 25% were small (<12.5 mm), approximately 70% were large (12.5–25 mm), and 5% were giant (>25 mm). Five patients (4.7%) harbored giant MCA aneurysms, all of which were successfully clipped.

Morphologically, 63 aneurysms (54.3%) were single-lobed, 28 (24.1%) bilobed, 14 (12.1%) trilobed, and 11 (9.5%) multilobed. Fundus orientation was lateral in 48.2%, inferior in 29.4%, superior in 14.6%, posterior in 6.1%, and medial in 1.7% of bifurcation aneurysms.

Surgical Timing and Intraoperative Findings: Among 100 patients with SAH, surgery was performed within 0–3 days in 12 patients (12%), 4–7 days in 14 (14%), 8–14 days in 33 (33%), 15–21 days in 41 (41%), and after 21 days in the remaining cases. All aneurysms were clip-secured; no bypass or trapping procedures were required. Temporary arterial occlusion was used in 19 patients (17.8%), predominantly for less than 5 minutes. Intraoperative rupture occurred in 7 cases (6.5%) and was successfully controlled in all cases without procedure-related mortality.

Postoperative Complications and Outcomes: Symptomatic vasospasm occurred in approximately 25% of patients; 3 patients (2.8%) developed vasospasm-related cerebral infarction, and 1 patient (0.9%) died due to refractory vasospasm. Acute hydrocephalus developed in 11 patients (10.3%); 2 required permanent ventriculoperitoneal shunting. Overall mortality was 5.6% (6 patients), all of whom presented with Hunt–Hess Grade IV–V and were predominantly over 50 years of age (**Table 3**).

At last follow-up, 87 patients (81.3%) achieved good recovery, 12 (11.2%) had moderate disability, 2 (1.8%) had severe disability, and 6 (5.6%) had died. No deaths occurred among patients presenting in good neurological grade (Grade 0–IIa). Favorable outcomes (good or moderate recovery) were more frequent in patients younger than 50 years (92.6%) compared with those aged ≥50 years (78.8%) (**Table 4**).

DISCUSSION

Middle cerebral artery (MCA) aneurysms constitute a substantial proportion of intracranial aneurysms and continue to represent a distinct surgical entity because of their anatomical characteristics, rupture patterns, and associated neurological morbidity. In this series of 107 surgically treated MCA aneurysms, we evaluated epidemiological features, aneurysm morphology, surgical strategies, timing of intervention, and outcomes, and compared our findings with established large series in the literature.

In our institutional experience, MCA aneurysms accounted for 29.2% of all intracranial aneurysms treated surgically, a proportion slightly higher than that reported in several classical series. Yaşargil reported an MCA aneurysm incidence of 18.2%, Flamm approximately 20%, and Suzuki approximately 25%, whereas Rinne reported a higher proportion (43%)

Table 4. Clinical Grade and Functional Outcome

Preoperative Grade	n	Good (%)	Moderate (%)	Poor (%)	Death (%)
Grade 0a	4	100	0	0	0
Grade 0b	12	75	16.7	0	8.3
Grade I–IIa	51	95	5	0	0
Grade IIb–IIIa	29	83	10	3	3
Grade IIIb–V	11	36	18	0	46
Total		81.3	11.2	1.8	5.6

in a series specifically focused on MCA aneurysms (13,14). The relatively elevated incidence in our cohort may reflect referral bias to a tertiary neurosurgical center and improvements in angiographic detection over time, including more widespread use of modern imaging techniques. Nevertheless, our data reinforce the consistent observation that the MCA is among the most common sites for intracranial aneurysm formation.

The demographic characteristics of our cohort were largely comparable to other reports (15,16). Women constituted 60.7% of patients, closely matching Yaşargil's reported female predominance (61.4%). The majority of patients were between 40 and 70 years of age, consistent with the known epidemiology of aneurysmal SAH (12,15,16). We observed a higher proportion of female patients over 50 years of age, whereas Yaşargil reported increased male predominance in older age groups. Although the reasons for this discrepancy remain unclear, regional, genetic, and sample-size differences may contribute. Overall, our findings support the view that aneurysmal SAH is predominantly a disease of middle-aged and early elderly adults, with only modest sex-related differences.

Multiple aneurysms were identified in 17.7% of our patients, with 7.4% harboring bilateral or multiple MCA aneurysms. These rates fall within the wide range reported in the literature but are lower than those reported by Yaşargil and Rinne (13,14,17). Differences in angiographic screening intensity and population characteristics may explain this variation. Importantly, the presence of multiple aneurysms necessitates a comprehensive treatment strategy (18). In our practice, we prioritized treatment of the ruptured aneurysm and attempted to secure additional aneurysms during the same hospitalization, either in a single session or in staged procedures. Our outcomes in patients with multiple aneurysms were favorable, with 84% achieving good recovery, a rate higher than that reported by Rinne. This suggests that with careful staging, meticulous technique, and modern perioperative care, multiple aneurysms can be managed without a disproportionate increase in neurological risk.

Consistent with prior series, nearly 94% of MCA aneurysms in our cohort were located at the MCA bifurcation. Both Rinne and Yaşargil similarly reported bifurcation involvement in approximately 80–92% of cases (13-17). Our data did not demonstrate a significant impact of aneurysm location (bifurcation vs non-bifurcation) on surgical outcome, supporting previous observations that location alone does not independently predict prognosis.

We observed no fusiform aneurysms, in agreement with reports that such morphology is rare in the MCA territory (19). The distribution of lobulation was also comparable to classical series, although we observed a slightly higher proportion of multilobed aneurysms. While multilobulation can complicate clip placement, it did not adversely affect outcomes in our experience when meticulous microsurgical techniques were applied.

Giant MCA aneurysms were present in 4.4% of patients, an incidence intermediate between previously reported series (20). All giant aneurysms in our cohort were treated successfully, with no mortality, likely reflecting the fact that they were addressed prior to rupture. This finding indicates the importance of early detection and treatment of giant aneurysms before hemorrhagic presentation. Although contemporary practice increasingly considers bypass or flow-diversion strategies for such lesions, our results confirm that direct clipping with or without thrombectomy can still yield excellent outcomes in selected cases.

All patients in our series were treated via a standard pterional transsylvian approach. Although alternative approaches, such as transcortical or trans–superior temporal gyrus routes, have been advocated in selected situations, we found that the transsylvian approach provided sufficient exposure in all cases. Its advantages include early proximal control, superior visualization of lenticulostriate perforators, access to basal cisterns for cerebrospinal fluid drainage, and flexibility in addressing additional aneurysms through the same craniotomy. Importantly, this approach avoids deliberate cortical incision and may reduce the risk of postoperative seizures.

Sylvian fissure anatomy remains a critical determinant of technical difficulty. Thickened arachnoid membranes, particularly in patients with prior hemorrhage, prolonged dissection time but did not translate into increased permanent morbidity in our series. These findings highlight that even anatomically challenging Sylvian fissures can be managed safely with patience and careful microsurgical technique.

Temporary arterial occlusion was used selectively in 17.8% of cases. We deliberately minimized the duration of temporary clipping and avoided routine use, particularly in high-grade SAH or vasospastic patients. Although some authors report excellent results with liberal use of temporary clips, experimental and clinical data indicate that even short occlusions can compromise cerebral perfusion in vulnerable patients (21,22). In our series, transient neurological deficits occurred in two patients following temporary clipping, reinforcing the need for judicious application. Our findings support a conservative approach to temporary clipping, emphasizing brief duration, avoidance of hypotension, and careful patient selection.

Vasospasm emerged as a major contributor to morbidity and mortality, consistent with prior reports. Symptomatic vasospasm accounted for permanent deficits in 2.8% of patients and one death. These findings demonstrates the importance of aggressive vasospasm monitoring and management, including hemodynamic optimization and pharmacological prophylaxis.

Preoperative neurological grade was the strongest predictor of outcome. Patients presenting in good clinical grade (Hunt–Hess I–II or Yasargil 0–IIa) experienced

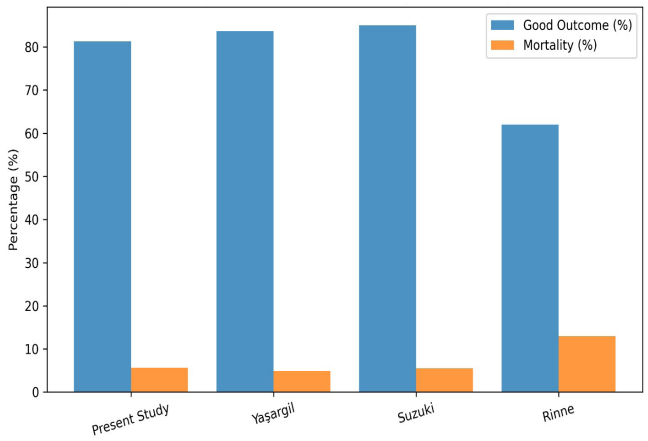

Figure 2. Comparison of the outcomes.

excellent outcomes with no mortality, whereas poor-grade patients had significantly worse prognosis (23). Age also influenced outcome, with patients over 50 years exhibiting higher morbidity and mortality, although age alone was not a contraindication to surgery.

The optimal timing of surgery remains debated. In our historical cohort, the best outcomes were observed in patients operated during the 8–21 day interval after SAH (24). This likely reflects avoidance of the peak vasospasm period. However, rebleeding risk during delayed treatment cannot be ignored, and two deaths in our series were attributable to rebleeding while awaiting surgery. In contemporary practice, early aneurysm securing (often within 24–48 hours) has become standard, facilitated by advances in both microsurgical and endovascular techniques. Our data support individualized timing, balancing rebleeding risk against vasospasm severity and overall patient stability.

Our outcomes (81.3% good recovery and 5.6% mortality) compare favorably with major surgical series and are similar to those reported by Yaşargil and Suzuki (13-18) (**Figure 2**). Differences between series often reflect variations in patient selection, grading definitions, and perioperative care. When considering independent survival (good plus moderate outcome), our rate of 92.5% underscores the effectiveness of microsurgical management for MCA aneurysms in experienced centers**.**

This study is limited by its retrospective, single-center design, which may introduce selection bias and restrict the generalizability of the findings. Although clinical, radiological, and surgical data were systematically reviewed, some variables could not be uniformly documented. In addition, the study period (1992–2002) predates the widespread use of contemporary endovascular techniques, intraoperative angiography, and modern neurocritical care protocols, which may limit direct applicability of the results to current treatment paradigms.

Furthermore, the analysis was primarily descriptive, and no multivariate modeling was performed, precluding definitive assessment of independent predictors of outcome. Functional outcome was evaluated using standard clinical scales, without systematic assessment of quality of life or neurocognitive performance. Follow-up duration varied among patients, and very late complications or subtle deficits may therefore have been underestimated. Despite these limitations, the relatively large cohort, detailed anatomical characterization, and long-term clinical follow-up provide a robust assessment of microsurgical outcomes in MCA aneurysm treatment.

CONCLUSION

In this single-center retrospective series, microsurgical clipping of middle cerebral artery aneurysms via the pterional transsylvian approach resulted in favorable outcomes in the majority of patients. Preoperative neurological grade and patient age emerged as the most important predictors of outcome, with excellent recovery observed in good-grade and younger patients. Carefully selected surgical timing, particularly outside the peak vasospasm period, was associated with improved results. Despite advances in endovascular therapy, microsurgical management remains a durable, effective, and safe treatment option for MCA aneurysms when performed in experienced centers with meticulous technique and appropriate patient selection.

DECLARATIONS

Ethics Committee Approval: This study was conducted in accordance with the principles of the Declaration of Helsinki. As this research represents a retrospective analysis of previously collected clinical data obtained during routine clinical practice between 1992 and 2002 and was retrieved from the graduation thesis of ***Aymer Coşar, M.D. (2003; Thesis No.)***, formal approval from an institutional ethics committee was not required at the time of data collection.e was not required at the time of data collection. **Informed Consent:** Written informed consent was obtained from all patients or their legal representatives prior to surgical intervention as part of standard clinical care. Due to the retrospective nature of the study, additional informed consent for data analysis was waived. **Conflict of Interest:** The authors declare no conflicts of interest, including financial, personal, or institutional relationships that could influence the work reported in this manuscript. **Funding**: This study did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors. **Author Contributions:** All authors contributed to the study conception, data collection, analysis, and interpretation. All authors critically revised the manuscript and approved the final version. **Data Availability:** The data supporting the findings of this study are available from the corresponding author upon reasonable request, in accordance with institutional and ethical regulations.

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