



The Resolution of Oculomotor Nerve Palsy Caused by Unruptured Posterior Communicating Artery Aneurysms: A Cohort Study and Narrative Review

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■ **OBJECTIVE:** Recovery of oculomotor nerve palsy after microsurgical and endovascular treatment has been studied in numerous small series of predominantly ruptured aneurysms. Little consideration has been given to the distinction between ruptured and unruptured aneurysms. This study examines the influence of treatment modality on oculomotor palsy recovery as a result of unruptured posterior communicating artery aneurysms.

■ **METHODS:** Patients who presented between 2003 and 2015 with an oculomotor palsy secondary to an unruptured posterior communicating artery aneurysm were identified from the hospital database. A keyword search for “posterior communicating artery aneurysm” and “oculomotor nerve palsy OR third nerve palsy” using the PubMed database was performed for the narrative review.

■ **RESULTS:** The cohort study and narrative review identified 15 and 179 eligible patients, respectively. Surgically treated patients in the cohort study did not have a significantly better rate of complete palsy resolution than those who had been coiled ($P = 0.08$). In the review, clipping of the aneurysm resulted in a higher rate of complete palsy resolution (70.0%; 95% confidence interval [CI], 60.7%–79.3%) than did coiling (46.5%; 95% CI, 36.0%–57.0%). Patients who presented with an aneurysm <7 mm had a higher rate of complete palsy resolution compared with aneurysms >7 mm (68.6%; 95% CI, 57.7%–79.5% vs. 44.3%; 95% CI, 32.7%–55.9%). Patients presenting with a complete palsy (49.4%; 95% CI, 38.6%–60.2%) had a lower rate of recovery than did those with a partial palsy (71.4%; 95% CI, 60.2%–82.6%).

■ **CONCLUSIONS:** In this narrative review, surgical clipping of unruptured posterior communicating artery aneurysms was associated with a higher rate of associated oculomotor palsy recovery than was endovascular treatment.

INTRODUCTION

The development of oculomotor nerve palsy (ONP) as a result of an unruptured posterior communicating artery (PCoA) aneurysm is a well-recognized finding that has been reported to occur in between 7%¹ and 23%² of PCoA aneurysms. It is widely accepted that this condition is a sign of aneurysm expansion and therefore, unlike asymptomatic aneurysms that may have otherwise been managed conservatively, treatment is urgently indicated to prevent the presumed impending subarachnoid hemorrhage (SAH).

There are several proposed theories regarding the pathogenesis of ONP secondary to PCoA aneurysms, including direct compression from the aneurysm sac, the transmission of arterial pulsations, and nerve edema caused by venous obstruction.³ Mechanisms such as irritation from subarachnoid blood and direct trauma from a jet of blood are limited to ONP associated with ruptured aneurysms and have no role in the unruptured setting.

The literature on outcome of ONP with treatment of PCoA aneurysms has largely considered ruptured and unruptured aneurysms as a single group, ignoring their potentially different pathogenesis and ONP resolution. The data in these mixed series have been conflicting because of small sample

Key words

- Cerebral aneurysm
- Oculomotor nerve palsy
- Posterior communicating artery aneurysm

Abbreviations and Acronyms

- CI: Confidence interval
 ONP: Oculomotor nerve palsy
 PCoA: Posterior communicating artery
 SAH: Subarachnoid hemorrhage

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sizes, with some suggesting that surgical and endovascular treatment have similar outcomes^{4,7} and others suggesting that surgical treatment is superior.⁸⁻¹⁰ However, 2 recent reviews on ONP including all PCoA aneurysms concluded that there were higher rates of ONP resolution among surgically treated patients.^{11,12} They also performed subgroup analyses and although both concluded that surgical clipping had better complete ONP response rates for ruptured PCoA aneurysms, neither reached any statistically significant conclusions regarding the influence of treatment modality in unruptured aneurysms. This finding is counter to what may be expected on mechanistic grounds. Either ONP in ruptured and unruptured cases has similar pathogenesis and would be expected to respond similarly to treatment, or in SAH, the ONP is related to the rupture itself, in which case it might be expected that the treatment modality has less effect on recovery. The only small series,⁹ which specifically considered unruptured cases, found a nonsignificantly higher rate of recovery in surgically treated patients.

We therefore reviewed our experience, focusing on the outcome of ONP after treatment of unruptured PCoA aneurysms. Because this is a rare condition, it was anticipated that a single series would be at high risk of a type 2 error and we therefore also performed a narrative review of the current literature.

METHODS

Cohort Study

All patients who presented to a single tertiary neurosurgical center over a 12-year period (January 2003 to December 2015) with a PCoA aneurysm and associated ONP were retrospectively identified using a key word search of the hospital electronic medical records. The date range was limited based on the availability of electronic patient records. The search terms used were “posterior communicating artery,” “oculomotor nerve palsy,” and “third nerve palsy.” The returned documents, and any other documents for every identified patient, were screened by the first author for applicability for this study.

The electronic records, and associated case notes, which included discharge summaries, operation notes, and clinic letters, were all reviewed to collect data on demographic characteristics, comorbidities, severity of the palsy, duration of palsy, treatment received, and extent of palsy resolution. The PACS (Picture Archiving and Communication System) was reviewed for the neuroradiologist's report on the size of the aneurysm.

All patients with a radiologically confirmed unruptured PCoA aneurysm and an associated ipsilateral ONP were included in the local retrospective cohort analysis. Patients were excluded if they did not have a complete set of the above information or if they had less than 6 months follow-up (unless a complete palsy resolution was documented before then).

The criteria used for a complete ONP were the presence of all 3 of 1) complete ptosis, 2) pupil deviation/diplopia, and 3) mydriasis/impaired pupil response to light. An incomplete palsy was recorded if only 1 or 2 of these criteria were present. A complete resolution of the palsy was diagnosed if none of these 3 criteria remained after intervention.^{4,13,14}

Narrative Literature Review

Study Inclusion Criteria. The criteria for including a journal article in the review matched the cohort study. Only articles with adult patients who were identified as having both a radiologically confirmed PCoA aneurysm and an ipsilateral ONP were selected. These patients had to have undergone either endovascular coiling or surgical clipping of their PCoA aneurysm and to have been followed up for at least 6 months, or shorter follow-up if the palsy had fully resolved. Patients whose aneurysm was treated by parent vessel occlusion were excluded. Only articles that recorded palsy resolution as full, partial, or none were included. Series that contained a mixture of both ruptured and unruptured aneurysms had only the latter patients included in the final analysis.

Search Methods. A literature search was performed on PubMed using the search term; “posterior communicating artery aneurysm AND oculomotor nerve palsy OR third nerve palsy.” All English language articles published up to December 2015 were screened for relevance. The reference lists of those articles deemed relevant were also screened until no further articles were uncovered. The abstracts of all articles detailing case reports/series, comparisons between treatment options, and previous meta-analyses were reviewed by 2 authors (S.R.H. and A.R.S.) for eligibility and any discrepancy was resolved by consensus. Data on demographics, palsy severity, palsy duration, treatment modality, and palsy resolution were extracted from the selected articles either directly from patient characteristic tables or from details in the prose. Where palsy duration was reported in months, this was converted into days, assuming 30 days per month.

Statistical Analysis

The primary outcome measure in both the local series and narrative review was the degree of palsy resolution (recovery), which was dichotomized into complete and partial/no resolution. Data were analyzed by descriptive statistics (e.g., mean, standard deviation) and frequency (percentage), with 95% confidence intervals (CIs). In particular, in the local cohort, the differences were analyzed by χ^2 or Fisher exact test, as appropriate.

In the literature review, the rate of recovery by initial palsy severity, duration of palsy, aneurysm size, and treatment modality were analyzed using frequency (percentage) distributions. The treatment groups' baseline characteristics were tested for normality and parametric data presented as a mean value and compared with an unpaired t test, and nonparametric data presented as a median and compared using a Mann-Whitney U test. Statistical significance was assumed at $P < 0.05$. Nonoverlapping 95% CIs confirmed a statistically significant difference between the rates of complete and incomplete recoveries. The P values were used only to determine differences in the baseline characteristics of the treatment groups but not to show statistical significance in outcomes because of either unknown statistical power or unknown sources of bias in the reviewed publications, or both. The narrative literature review was conducted and reported in accordance with the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines.

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