



A Longitudinal Analysis of Complications in Coiling vs. Clipping for Ruptured Intracranial Aneurysms

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Introduction

Several landmark clinical trials have assessed complication profiles associated with surgical clipping and endovascular coiling of ruptured intracranial aneurysms (RIAs). However, few studies have evaluated the two procedures in a large cohort of patients outside the clinical trial setting. We aimed to compare post-operative complications, mortality, and associated costs in patients undergoing clipping vs. coiling for RIAs throughout the United States (US) over the past decade in real-world practice.

Methods

We utilized the Truven MarketScan database examining patients who underwent clipping or coiling for RIAs from 2000-2012. The impact of clipping versus coiling on post-operative complications, reoperation, mortality, and cost within 90 days and one year of the index procedure was assessed using unadjusted comparisons and adjusted models in a propensity score matched population. The adjusted models comprised linear mixed models and a conditional logistic regression.

Results

Demographics

The two patient cohorts were propensity score matched prior to analysis. A total of 5,254 patients underwent a clipping or coiling procedure for a ruptured aneurysm between the years 2000 and 2012. Of these patients, 2,627 underwent endovascular coiling and 2,627 underwent neurosurgical clipping. The average (SD) age for the entire

There were many more female patients (71.8%) than males in the study population. The distinct patient cohort with at least 365 days of follow up consisted of a total of 3,827 patients with 1,925 undergoing coiling and 1,902 surgical clipping. The average (SD) age for the cohort was 52 (11) years, 66.4% of which were between 45-64 years of age. Females accounted for 71.6% of this total patient population.

Complications and Outcomes

Neurosurgical clipping was associated with statistically significant higher rates of infection (Odds Ratio [OR] 2.21; 95% CI 1.49, 3.28), PE (OR 1.51; 95% CI 1.04, 2.21), and vasospasm (OR 1.34; 95% CI 1.10, 1.64) than coiling within the first 90 days. At one year, clipping was associated with significantly higher rates of infection (OR 1.58; 95% CI 1.08, 2.32) and PE (OR 1.60; 95% CI 1.06, 2.42). There was no statistically significant difference in vasospasm at one year between the cohorts. There was no statistically significant difference in hemorrhage at 90 days or one year following the index procedure. Undergoing surgical clipping was associated with fewer instances of angioplasty within 90 days relative to coiling (OR 0.56; 95% CI 0.38, 0.83). This trend remained significant at one year (OR 0.43, 95% CI 0.29, 0.65). There was no statistically significant difference for shunting procedures within 90 days or at one year. The coiling group had a significantly higher rate of reoperation at 90 days (18.5% vs. 6.7%,  $p < 0.0001$ ) and at one year (21.2% vs. 7.4%,  $p < 0.001$ ).

Patients who underwent clipping spent more time in the ICU at 90 days ( $p = 0.0303$ ); however, this difference vanished at one year ( $p = 0.9271$ ). Undergoing surgical clipping was associated with fewer instances of reoperation within 90 days and one year compared to coiling (OR 0.32; 95% CI 0.27, 0.39 at 90 days; OR 0.29; 95% CI 0.24, 0.36 at one year). At 90 days post index procedure, clipping was associated with significantly more time spent in the ICU (OR 1.33; 95% CI 1.03, 1.72). There was no difference at one year. A total of 1.4% of patients with 90 days of follow up expired, while 0.39% of patients with one year of follow up expired. The mortality rate was similar between the two cohorts at 90 days ( $p = 0.3490$ ) and one year ( $p = 0.4240$ ).

Complication and Procedure Related Costs

At 90 days following the index procedure, the total average (SD) cost related to complications and procedures for all patients ( $n = 5,254$ ) was \$24,355 (\$49,413). The cost incurred by coiling patients ( $n = 2,627$ ) was \$22,347 (\$49,413), which was significantly lower than the cost incurred by clipping patients ( $n = 2,627$ ) of \$26,364 (\$52,870) [ $p = 0.0007$ ]. At one year, the total cost for all patients ( $n = 3,827$ ) was \$164,444 (\$136,589). The difference in cost between the groups was non-significant ( $p = 0.1908$ ). No significant differences were found for costs between the two cohorts related to each of the individual covariates at both 90 days and one year.

Conclusions

As practiced in the US over the last decade, patients who underwent endovascular coiling experienced significantly lower rates of infection, vasospasm, and pulmonary embolism, while spending less time in the ICU within the first 90 days following operation. The difference in incidence of infection and pulmonary embolism between the treatment groups remained significant after one year. Conversely, at both 90 days and one year, clipping patients experienced significantly lower rates of reoperation and angioplasty. Costs were lower for coiling patient at 90 days, although this difference became non-significant at one year.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) Gain an understanding of the complication profiles of clipping vs. coiling as practiced in the United States over the last decade in real-world practice , 2) Learn how the current findings fit into the overall literature such as in the clinical trial setting, 3) make more informed decisions in the treatment of patients with ruptured intracranial aneurysms.