Survival from Ruptured Intracranial Aneurysms: 120 Years of Progress

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AANS 2020
Disclosures

- None
Introduction

- Subarachnoid hemorrhage is one of the most devastating complications from a ruptured intracranial aneurysm with nearly 50% mortality rate at time of bleed and over 50% mortality rate at 6-months.

- Survival rates have improved with new medications and surgical treatments as much as 17% in the past few decades.

- Aim: Evaluate the temporal changes in short-term survival and determine specific contributors to improvements in survival rates.
Methods

- **Literature Search**: Medline and the Cochrane database were searched in June, 2018 for articles containing combinations of the following medical subject headings: “subarachnoid hemorrhage,” or “intracranial aneurysm,” plus “therapy” or “mortality” as subheadings or “outcome” in the title.

- **Data collection**: Only articles which specified subarachnoid hemorrhage secondary to ruptured aneurysm and mortality at time of hospital discharge or within 3 months of hemorrhage were included.

- **Data management**: We used the mean year of each study’s data collection as being more representative of a study’s date than year of publication. We also divided studies into three epochs, with cutoff points at 1970 (microsurgery prevalent) and 1995 (FDA approval of coils).

- **Analyses**: The primary analysis is the association between the years of treatment and survival of patients with ruptured aneurysms. Secondary analyses involve rate of improvement over different epochs, contribution of co-variates (patient age, sex, aneurysm location, proportion receiving surgical or endovascular procedures). We also analyzed separately survival over time since 1995, as measured by population-based surveys and hospital databases, such as the National Inpatient Survey. All statistical procedures used Stata.
# Results

## Table 1: Summary of Case Series

<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong># of reports†</strong></td>
<td>166</td>
<td>300</td>
<td>359</td>
</tr>
<tr>
<td><strong># of cases</strong></td>
<td>20,932</td>
<td>63,159</td>
<td>113,657</td>
</tr>
<tr>
<td><strong>Survival rate</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>pooled average</td>
<td>0.675</td>
<td>0.827</td>
<td>0.874</td>
</tr>
<tr>
<td>% improvement per year</td>
<td>0.816</td>
<td>0.127</td>
<td>0.119</td>
</tr>
<tr>
<td>significance (p value)</td>
<td>&lt;0.001</td>
<td>0.203</td>
<td>0.373</td>
</tr>
</tbody>
</table>

* - mean date study performed (not publication date)
† - when a single publication reports outcome from different time periods, different treatments, etc., it is counted > 1
Results cont.

- Figure 2: Before 1970, short-term patient survival improved at a statistically significant rate.
- By 1970, roughly 80% of hospitalized patients were surviving aneurysmal bleeds.
Results cont.

- After 1970, improvements in survival slow progressively over time and is no longer significant.
## Results cont.

Table 2: Effects of Predictive Variables on Survival after SAH

<table>
<thead>
<tr>
<th>Variable</th>
<th>Pre 1970</th>
<th>Post 1970</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>% increase survival †</td>
<td>p - value</td>
</tr>
<tr>
<td>% with surgery*</td>
<td>28.78</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>mean age of cases</td>
<td>-0.102</td>
<td>0.808</td>
</tr>
<tr>
<td>mean % female cases</td>
<td>7.39</td>
<td>0.672</td>
</tr>
<tr>
<td>% posterior circulation aneurysms</td>
<td>-0.585</td>
<td>0.642</td>
</tr>
</tbody>
</table>

† - % increased survival as a function of % increase in the named variable

* only procedures directed at aneurysm (clipping, wrapping, coiling, carotid ligation) Shunt insertion, etc. excluded
Discussion

- Time periods determined by the widespread acceptance of microsurgery in 1970 and the approval of endovascular coils for aneurysms in 1995.
- Survival rates for aneurysmal bleeds occurred in all three periods, but only at a significant rate in the early, pre-1970 time period.

- Individual factors such as surgical treatment, mean age of cases, percentage of females, and percentage of posterior circulation aneurysms could impact short-term survival.
- Review of literature both pre- and post-1970s showed that only the percent of cases undergoing surgery had a significant impact on survival.
- There was no significant association between other variables and survival.
Conclusion

‣ In-hospital survival rapidly improved up to 80% by the 1970s.

‣ After 1970, survival rates increased but at a slower and non-significant rate, likely due to high survival rates of 80%.

‣ Nonetheless, surgery, either through microsurgery or endovascular coils, was the only factor that improved survival over the different epochs.