ORIGINAL RESEARCH PAPER

Neurosugery

KEY WORDS:

ANATOMICAL LOCATION OF ANEURYSMS AND THEIR RISK OF RUPTURE.

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INTRODUCTION:

Subarachnoid haemorrhage is a serious form of intracranial haemorrhage that, even with the best available medical care, leaves a majority of its victims dead or severely disabled. It is less common than other forms of intracranial haemorrhage but tends to affect younger people and thus carries a disproportionally high toll in terms of productive life years lost.

Almost all significant subarachnoid haemorrhages come from aneurysms of the proximal cerebral arteries around the circle of Willis. With the increasing use of high resolution medical imaging of the head for a wide range of conditions, aneurysms are coming to light before they rupture, thus raising the possibility of using preventative treatment. Analysing the benefits of such treatments involves careful and accurate weighing of their risks against the risks of untreated unruptured aneurysms.

Considerable work has gone into measuring the rupture risks from untreated aneurysms and in measuring the risks of treatments such that a reasonable estimate of benefit can now be made in most cases. This paper focuses on one aspect of the data on the risks of untreated aneurysms that has recently become controversial. Unruptured aneurysms have traditionally been classified in 2 ways: according to size and to anatomical location. Recent results have shown that aneurysms in persons who have never suffered a subarachnoid haemorrhage are considerably safer than those in persons who have suffered a SAH from another aneurysm previously [1]. This has led to a third classification of ''incidental'' v ''additional'' aneurysms. Most recent work has focused on the size and additional v incidental classifications.

Aneurysms are usually classified anatomically according to posterior v anterior cerebral circulations and the anterior group is sub classified into internal carotid, middle cerebral, and anterior cerebral groups. The internal carotid is the most proximal of these and contains one of the commonest sites for cerebral aneurysms generally, the posterior communicating artery. Worthy of note is that although the posterior communicating artery connects the posterior and anterior cerebral circulations, almost all of the aneurysms that affect it arise at the anterior circulation end (where it joins the internal carotid) and are thus part of the anterior circulation.

As it happens the incidental small anterior circulation aneurysms have such a low risk of haemorrhage that the risks of treating them is not usually justified whereas those of the posterior circulation are more dangerous and frequently do merit treatment [3]. The ISUIA reclassification thus has the effect of changing the recommendation from no treatment to potentially advising treatment for small incidental posterior communicating aneurysms. This abstruse reclassification would be minor issues were it noted that small incidental posterior communicating artery aneurysms are one of the commonest types.

MATERIALS AND METHODS:

This study was a retrospective study conducted on aneurysm cases seen between January 2015 to January 2019. A total of 149 cases of SAH and confirmed aneurysmal bleed were included in our study.

Rupture rates for different anatomical sub groups were calculated by dividing the number of ruptures per group by the total patient years of follow up in the group. Where possible specific follow up periods were used but more commonly only the overall average length of follow up was given and the assumption had to be made that the overall average could be applied to the subgroups individually. Patient populations included in the meta analysis were non overlapping as far as could be judged.

Although the anterior circulation is broken down into subgroups as shown in the analysis, breakdown of the posterior circulation into separate areas was not possible. Therefore posterior bleed were recorded as a single group.

Ninety five percent confidence limits were calculated from Poisson distributions. The differences between the bleed rates in different anatomical groups were tested for significance with Chi squared distributions.

RESULTS:

The 149 cases were evaluated for bleed rates in anatomical subgroups. They were classified into anterior cerebral, middle cerebral, internal carotid and posterior circulation.

There was a mild male to female preponderance (88 male) and the predominant age group was between 40-50 years of age.

Thirty seven percent of the patients had a previous history of SAH. These numbers are dominated by the ISUIA reports which cannot be used for analysis of anatomical subgroups because of lack of detail. This leaves 149 aneurysms in 517 patients with suspected aneurysm where anterior/posterior data is available. The difference between the anterior bleed rate (0.49% per patient year) and the posterior bleed rate (1.8% per patient year) was significant with $p= 5.1x10^{-14}$. All bleed rates are given per patient year not per aneurysm year.

On comparing our analysis with the analysis of different locations in the anterior circulation the report of Juvela contributed 14% of aneurysms but 47% of patient years of follow up. This report was of a Finnish population who are believed to have a high risk of SAH. There was concern that the inclusion of this study may disproportionately skew the results so the analysis was also run excluding it. These results show slightly but not significantly higher bleed rates than are calculated when the Finnish study is included.

There was no significant difference between the anterior groups but all were significantly different from the posterior circulation with $p<0.05$ (Pearson). The sensitivity of this result to the inclusion of the reports of Loxley and Juvela was examined. The lack of difference between anterior groups and the significant difference between all individual anterior groups and the posterior circulation remained when either or both of these reports was excluded. When the internal carotid artery/ posterior communicating artery is compared to the posterior circulation (without the ISUIA data but with Locksley's and Juvela's) the p value of the hypothesis that they come from the same population is p=0.00016.

Posterior communicating artery bleeds

Report	No. of aneurysms	No. to rupture	Pt. yrs	Annual rate of rupture [95% confidence range]
Wiebers 87	26	1	216	0.46 [0.09, 2.59]
Locksley 66	10	4	34	12 [2.9, 24]
Both	36	5	250	2 [0.4, 4]

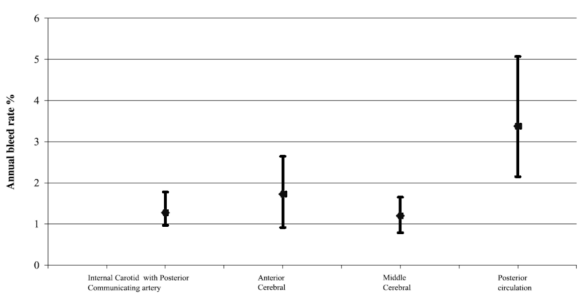
A further breakdown of internal carotid artery aneurysms to isolate data specific to the posterior communicating artery site was possible with 2 reports [5, 13]. It is perhaps surprising that such data was not presented in the ISUIA report [2] where the hypothesis that posterior communicating and posterior circulation aneurysm belong together was advanced! Locksley [13] did find that posterior communicating aneurysm appeared to be more dangerous than other anterior locations but this difference is not statistically significant. Other issues with his report are discussed below.

DISCUSSION:

A difficulty with the subject of aneurysm behaviour is the number of independent classification schemes that are in use. Aneurysms are classified according to size, anatomical location and previous history of subarachnoid haemorrhage. Certain differences in behavior based on these different classifications have been fairly reliably established such as increasing risk with increasing size and greater risk from posterior circulation aneurysms. As the condition is split up into more and more subgroups, numbers available for study in each group fall and, the number of groups from which to make post hoc selections rises. These effects combine to make hypotheses about subgroups hard to substantiate and unreliable. The three classification schemes in combination lead to numerous subgroups. ''Middle cerebral aneurysm under 7mm in diameter with a previous history of subarachnoid haemorrhage'' is just one group amongst more than 20! Because of this diversity it is neither possible nor desirable to retest the exact hypotheses put forward in the ISUIA paper: that aneurysms of the posterior communicating artery under 7mm in diameter in persons with no previous history of subarachnoid haemorrhage behaved similarly to aneurysms of the posterior circulation. What is possible and more credible is to test the hypotheses on internal carotid aneurysms.

Specific data on the internal carotid subgroup of posterior communicating aneurysms is included in Table above for completeness. It is less satisfactory as far less data is available and the issues surrounding Locksley's report potentially confound the result. Posterior communicating aneurysms comprise 60 to 70% of those affecting the internal carotid anyway.

Locksley's report dates from 1966 in the pre CT era [13]. For several reasons Locksley's population is not comparable with other studies. All his patients presented with symptomatic aneurysms. Thirty four patients out of 168 did not have surgical treatment and amongst these there was a substantial 7% haemorrhage rate per year and within the first 8 weeks following presentation it was 55% per year. Two of the 4 bleeds in the posterior communicating group were in this early period. Another unique feature of Loxley's report is that the posterior communication and anterior choroidal site are separated. Choridal aneurysms are rare and difficult to distinguish from posterior communicating on angiography so it is assumed that Loxley's posterior communicating plus choridal group is equivalent to other authors posterior communicating group. Posterior communicating artery aneurysms have the unusual feature that they may present acutely prior to haemorrhage with a painful third nerve palsy caused by rapid aneurysm expansion. Locksley's population behaved more like acutely presenting aneurysms than ''unruptured'' ones. Such presentations as well as some haemorrhagic presentations may not have been apparent with the investigation technology of the time. Because of these reservations the hypothesis of internal carotid artery aneurysm risk was tested on data both including and excluding that of Locksley.



The bleed rates observed in the ISUIA study were considerably lower than in other studies. Because of the large number of patient years in the ISUIA these figures dominate the overall rates. The reasons for the low rates of ISUIA include that more incidental than additional aneurysms were included and that 10% of the total were cavernous carotid aneurysms which are extradural and known to be safer than others. This does not fully explain the discrepancy as we estimate that the ISUIA bleed rate for additional non cavernous aneurysms was 0.7% per year, half the rate of other reports.

Another limitation of this review is that the numbers of patient years of follow up are not specifically given for may groups and we have had to estimate them.

The ISUIA assertion that posterior communicating artery aneurysm are more dangerous than others of the anterior circulation was a post hoc hypothesis based on what we estimate to be 2 observed bleeds. It has been calculated that the p value associated with this hypothesis =0.23[3] i.e. very far from being significant. As the broader hypothesis that posterior communicating and internal carotid aneurysms behave differently from other anterior locations fails on testing with other data, we prefer to reject the ISUIA assertion.

CONCLUSION:

The recent hypothesis put forward by the ISUIA authors that posterior communicating artery aneurysms should be grouped with the posterior circulation is not supported by other evidence. Aneurysms of all locations within the anterior circulation behave similarly and significantly differently from the posterior circulation. This is supported anatomically by the position of posterior communicating artery aneurysm necks which are on the internal carotid artery.

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