Is intracranial aneurysm rupture related to solar activity?


Objective:
A number of intrinsic and extrinsic risk factors for the rupture of intracranial aneurysms have been identified. Still, the cause precipitating aneurysm rupture remains unknown in many cases. In addition, it has been observed that aneurysm ruptures are clustered in time but the trigger mechanism remains obscure. As solar activity has been associated with cardiovascular mortality and morbidity we decided to study its association to aneurysm rupture in the Swiss population.

Methods:
Patient data was extracted from the Swiss SOS database, at time of analysis covering 918 patients with angiography-proven aSAH treated at seven Swiss neurovascular centers between 01/01/2009 - 12/31/2011. The number of aneurysm rupture per day, week, month (Daily/Weekly/Monthly Rupture Frequency = RF) was measured and correlated to the absolute amount and the change in various parameters of interest representing continuous measurements of solar activity (radioflux (F10.7 index), solar proton flux, solar flare occurrence, planetary K-index/planetary A-index) using Poisson regression analysis.

Results:
Of a consecutive series of 918 cases of SAH, precise determination of the date of symptom onset was possible in 816 (88.9%). During the period of interest there were 517 days without recorded aneurysm rupture. There were 398, 139, 27 and 12 days with 1, 2, 3, and 4 ruptures per day. Five or 6 ruptures were only noted on a single day each. Poisson regression analysis demonstrated a significant correlation of F10.7 index and aneurysm rupture (incidence rate ratio (IRR) = 1.006303; standard error (SE) 0.0013201; 95% confidence interval (CI) 1.003719 - 1.008894; p<0.001), according to which every 1-unit increase of the F10.7 index increased the count for an aneurysm to rupture by 0.63%. As the F10.7 index is known to correlate well with the Space Environment Services Center (SESC) sunspot number, we performed additional analyses on SESC sunspot number and sunspot area. Here, a likewise
statistically significant relationship of both the SESC sunspot number (IRR 1.003413; SE 0.0007913; 95%CI 1.001864 - 1.004965; p<0.001) and the sunspot area (IRR 1.000419; SE 0.0000866; 95%CI 1.000249 - 1.000589; p<0.001) emerged. All other variables analyzed showed no correlation with RF.

Conclusion:
Using valid methods, we found higher radioflux, sunspot number and sunspot area to be associated with an increased count of aneurysm rupture. Since we were using rupture frequencies rather than incidences and because we cannot explain the physiological basis of this statistical association, the clinical meaningfulness of this statistical association must be interpreted carefully. Future studies are warranted to rule out a type-1 error.

keywords
intracranial aneurysm; aneurysmal subarachnoid haemorrhage; solar activity; rupture risk; temporal clustering; geomagnetic energy

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