Letters to the Editor

Environmental Temperature and the Risk of Subarachnoid Hemorrhage

To the Editor,

Like Lejeune and associates,1 we have found an association between low environmental temperature and the risk of subarachnoid hemorrhage.2 In our study, which was carried out in King County, Wash, the meteorologic variable with the strongest relation was dew point. Dew point is the temperature to which a given parcel of air must be cooled at a constant pressure and constant water vapor content for saturation to occur.3 We hypothesize that exposure to cold was the actual risk factor, probably because of changes in blood pressure, but that people were more likely to expose themselves to low temperatures on clear days when the dew point was lower on rainy or overcast days when the temperature was the same but the dew point was higher. Thus, low dew point would be associated more strongly than temperature alone with an increased risk of subarachnoid hemorrhage. We wonder whether the investigators from France also found an association of subarachnoid hemorrhage with dew point.

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References

Response

We are very pleased to learn that other researchers corroborate our findings on the influence of weather conditions on aneurysmal bleeding.1 The relation of dew point to subarachnoid hemorrhage was not evaluated in our study; in our opinion, the humidity level, to which the dew point is closely related, is a more independent variable. The publication of more studies on this subject will perhaps help us better understand these yet mysterious correlations.

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The Challenge of Characterizing Emboli by Transcranial Doppler Sonography

To the Editor,

We read with great interest the recent article by Bunegin et al1 presenting a transcranial Doppler (TCD) technique for detecting and sizing air emboli by spectral analysis and signal power measurements. Their article raises a number of issues on which we would like to comment.

1. It is interesting that Bunegin et al1 find no significant power spectrum feature above 500 Hz, for either intrinsic blood flow (expected peak Doppler shifts, 700 to 2000 Hz diastolic/systolic) or air bubbles, for which they expected frequencies of over 2500 Hz. It would be very helpful if Bunegin et al were to specify more details of the ultrasound and signal processing parameters, the fast Fourier transform (FFT), and the sampling rate from the audio signal in particular. The maximum measurable Doppler frequency is half the sampling frequency because of the Nyquist restriction. This sampling frequency is reported as 1024 Hz for the filtered signal studies but is not specified for the broad-spectrum studies without filtering.

The authors claim that analyzing a longer sample segment increases spectral resolution and give the impression that the full 4-second sample is used. However, there are further factors to be considered. The pulse length of the Doppler system will ultimately limit the spectral resolution achievable,2 so there is no point in increasing the sample time indefinitely. Furthermore, caution is needed in assessing spectral features and shapes because the FFT on the sample segment provides only one estimate of the true underlying power spectrum. Without averaging over similar samples, even in the best case the variance of the estimate increases or decreases with the square of the true spectrum. Finally, the transit time of the embolic event needs to be considered in terms of the total sample time of the FFT. If the time is very short, the long sample approach will favor lower-frequency features, which occupy a greater proportion of the sample segment.

2. The authors discuss the reasons for the 10-fold difference in slope between the in vivo and in vitro calibration curves of signal power against emboli volume. Another factor would be the attenuation caused by the overlying tissue, which is unlikely to be matched by the laboratory model. Therefore, their technique would require some means of establishing a reference level to make measurements of bubble size comparable between subjects.

3. Their lower limit of bubble size for reliable detection is approximately 1 μL, which corresponds to a diameter in excess of 1 mm. It would certainly be useful to detect and size smaller bubbles to deal with the more subtle (but still significant) effects of large numbers of small bubbles. A spherical bubble of 50 μL would have a diameter greater than that of the middle cerebral artery, and there are likely to be problems analyzing this situation from both the fluid dynamics and ultrasound points of view.

4. There is clearly a positive power law relation between the (filtered) TCD signal power and bubble volume, not a negative exponential one as Bunegin et al1 suggest.

5. The signal power approach views bubbles simply as strong scatterers. The Doppler spectral features obtained therefore provide more a description of the ultrasound and analysis systems and the translational motion through the beam than of the composition of the scatterer itself. This approach does not really discriminate
The challenge of characterizing emboli by transcranial Doppler sonography.
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