H.-G. Schlosser, F. Doepp, C. H. Nolte, M. Brock, S. J. Schreiber
Does Routine Transcranial Duplex Ultrasound Heat Up the Patient Brain?
Ultraschall in der Medizin, 2009, 30:37-41

The effect of transcranial duplex ultrasound on the intraventricular temperature in 14 patients was analyzed. Different scanning modes were applied for 3 minutes each (total 9 min) and the outcome was that routine transcranial duplex ultrasound did not show any significant increase of intraventricular temperature in patients.

Methods
The investigations were performed on patients who had an intraventricular probe implanted and needed intracranial pressure monitoring or ventricular drainage. The probe was inserted through a frontal left or right burr hole at the Kocher’s point and allowed the measurement of temperature from 15-45 degrees Celsius with an accuracy of ± 0.3 dgC using a thermistor. The thermal sensor was placed behind the bellows region at the tip of the catheter. A total of 9 patients with 26 scans where the tip was visible were included in this study. The examinations were performed using a 2 MHz transcranial probe of conventional US systems (Siemens Elegra, Toshiba Powervision 6000). The catheter and its thermal sensor was visualized using B-mode and correct identification and proper sonication confirmed using a routine rinse manoeuvre (slow flush of 0.1 ml saline) to introduce flow at the intraventricular tip. Tip position was documented on video or hard disk before the measurements started. The visualized tip of the intraventricular probe was insonated for 3 minutes in each of the following modes: B-mode, combined B-/color mode and combined B-/color mode plus Doppler scan. The MIs went up to 1.5, while the TIs reached 0.7 (TIS), 3.1 (TIB) and 3.0 (TIC) during scans. The intracranial temperature and body temperature (bladder catheter or rectal probe) were recorded at the beginning and end of each of the 3 scan modes.

Results
The cerebral temperatures ranged between 35.1 and 38.7 degC and in only 3 different patients a cerebral temperature increase of 0.1 degC above body temperature during US scan was measured. This increase is within the accuracy range of the thermistor. During the other scans no significant increase was detected at all 4 time points (before and after US in each of the three modes) or the body temperature increased slightly with increasing cerebral temperature resulting in compensational effect.

The authors concluded from their investigations that routine transcranial duplex US lasting in total 9 min does not increase the intracranial temperature in patients.

Comment on reporting/conduct of biology techniques
While the procedure for locating the catheter probe within the brain is described in detail and is clinically routine, there are missing information about the type, size and design of the catheter used. However, for this investigation of temperature changes the composition of the probe is important for evaluating US interaction implications. Unfortunately there is no image to show the placement of the sample gate and its size, during Doppler [spectral] scan. Accurate targeting of the thermistor tip is essential, but was said only to be checked only by a routine rinse manoeuvre with no further information being given.
Comment on reporting/measurement of US exposure parameters
There is no information about the specific center frequencies used for B-mode nor Doppler mode scanning; from the images it appears that tissue harmonic imaging mode was chosen but this not stated in the text. No further information is given about the emitting power settings, pulse repetition frequencies or other console settings for the 2 US systems used. It is difficult for the reader to get an idea of what the authors claim is a routine transcranial duplex scan when only a maximum TIC value of 3.0 is reported, and not the measured range for all examinations.

What is the relevance of the results to humans?
The most important relevance stated by the authors is the fact that routine transcranial US duplex settings using a static probe do not increase the intracranial ventricle temperature in patients during a scan duration of 9 minutes. This duration is longer than normally used in such examinations. They concluded therefore that such thermal effects are unlikely to occur in the routine clinical setting in perfused tissue. The risk of cerebral thermal heating is low.

Future work needed
The most critical aspect of such a study is to obtain optimal targeting of the thermal thermistor within the catheter in order to be able to measure any temperature changes; this is especially critical for the sample gate positioning in Doppler scans. More detailed information would therefore be useful to address this problem, as well as more details of the catheter’s inherent thermal characteristics. Complimentary in-vitro studies to characterize the catheters used is required.

Conclusions
The article focuses on a specific neurological examination. It gives only a limited information on the temperature increase in a specific region of interest, and agrees with other publications on this topic. The paper title is misleading as the question it poses is not answered fully.