Monitoring Cerebral Pain Processing with event-related FLASH

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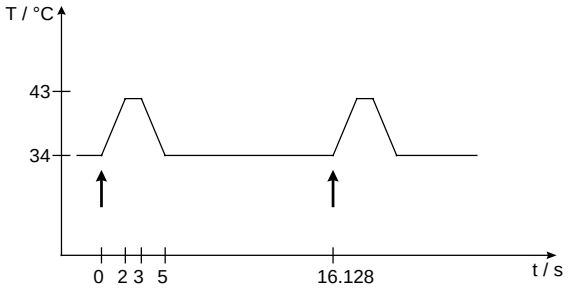
ntroduction

lthough visual and motoric areas are well investigated nly little is known about cerebral pain processing using unctional MRI. In this work we present first results on ain processing acquired with an event-related FLASH echnique.

aterials and Methods

ealthy volunteers (n=4) were examined in a circular olarized head coil of a standard 1.5 T clinical whole ody scanner (Magnetom VISION, Siemens, Germany) uring contact heat pain. An MR compatible thermode ystem (TSA2001, MEDOC, Israel) was used for timulation at the thenar (n=2) or at the ventral side of he forearm (n=2) of the subjects. The base temperature f the thermode was set to 34°C, during painful timulation it was raised 2°C above the volunteer's redetermined pain threshold (between 43°C and 46°C). he duration of the heat pain period was varied between and 7 seconds (see Fig. 1).

modified T2*-weighted FLASH sequence [1] TE/TR/α/FOV/MAT/TH = 56ms/112ms/40°/240mm/ 28^2/4 mm) was used to measure a time series of 36 mages in 4 transversal slices. In order to achieve a emporal resolution of 448 ms, a single line of k-space is cquired after the application of one stimulus. This is epeated 128 times to fill the complete matrix. The pplication of the stimulus was synchronised with the ontinuously running MR-sequence.



ig. 1: Temperature vs. time. The arrow denotes the acquisition of ne line of k-space of the first image of the time series.

n order to obtain a parametric map, the correlation oefficient between the time series and a boxcar function as calculated for each pixel. This map (cc>0.8) was uperimposed on a T1-weighted spin-echo image.

esults and Discussion

ll maps show an activation in the insula region (see ig. 2). From PET studies this region is known to take art in pain processing [2]. Also parts of the thalami and of the amygdala (in another slice) are activated. Fig. 3 shows a timecourse of the activated insula region marked in Fig. 2. The maximum is observed 5 seconds after stimulus presentation, which is the typical delay time of the BOLD effect. Therefore, the insula region is assumed to take part in the first steps of pain processing.

Conclusion

This event-related FLASH technique provides the possibility to acquire several slices with an equal temporal resolution compared to EPI sequences. Since the signal-to-noise ratio of FLASH is superior to that of EPI by a factor of 5 the complex responses to pain stimulation can be studied more efficiently with this technique. The multidimensionality of the pain experience implies multifocal cerebral pain processing, therefore several slices of functional data should be measured simultaneously.

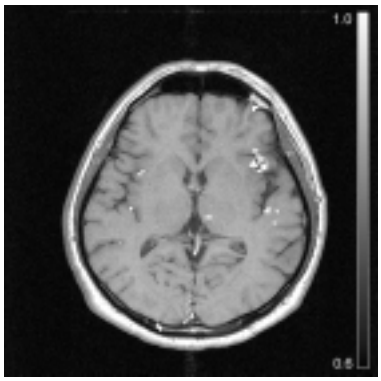


Fig. 2: Map of the correlation coefficient overlayed on a T1-weighted spin-echo image. A circular ROI indicates the area used for the plot in Fig. 3.

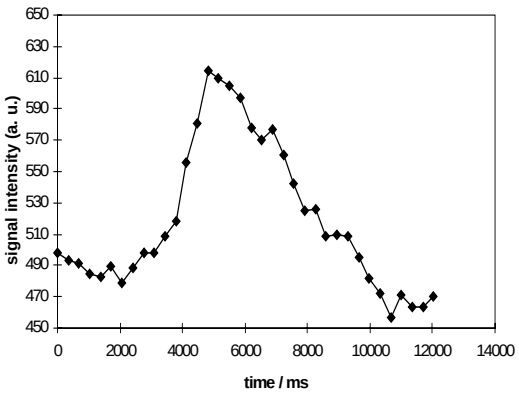


Fig. 3: Timecourse of the ROI indicated in Fig.2.

References

[1] Wiener, E. et al., Magn. Reson. Imaging, 14, 5, 477, 1996
[2] Derbyshire, S.W. et al., Pain, 73(3), 431,1997