INTRODUCTION
The regional cerebral blood volume (rCBV) is a parameter used commonly in dynamic susceptibility contrast MRI to identify abnormalities in cerebral hemodynamics. For instance, abnormal rCBV has been reported in patients with stroke, Alzheimer's disease, HIV dementia, or cocaine abuse. The measurement of the rCBV by means of MRI is typically based on the acquisition of the signal-time-course after the bolus administration of a contrast agent (1). rCBV can be determined from the concentration-time-curve, either by numerical integration or by fitting a model function (gamma-variate function). The technique most commonly used for this application is echo-planar imaging (EPI). However, EPI has a relatively low spatial resolution and is sensitive to geometric distortions due to inhomogeneities of the magnetic field. Another possibility is to determine rCBV from the static signal changes caused by the contrast agent after its distribution within the vascular system and the inner organs and muscles (2). It is based on the assumption that the contrast agent remains intravascular in the brain even after the first pass. This would allow the use of slower imaging methods with better imaging properties, higher spatial resolution and higher signal-to-noise ratios. The goal of this study is to compare the rCBV determined by the dynamic method (the first pass of a contrast agent bolus) and the static method (signal change before and after the contrast agent administration) within the same data sets.

METHODS
All measurements were performed on a 1.5 T whole body scanner (GE SIGNA 5.6, Milwaukee) equipped with a fast gradient set (SR 120). 39 repetitive scans of 13 slices where acquired with EPI (TE 30 ms, TR 2500 ms, matrix 64*64, FOV 20 cm, slth 8 mm) or of 1 slice with Turbo FLASH imaging (TE 19 ms, TR 38 ms, matrix 256*128, FOV 34*17 cm, slth 8 mm, 40 scans). After 12 baseline scans, 20 ml contrast agent (Gd-DTPA, Prohance, Squibb, Princeton, NJ) were manually injected. The scans of 35 normal subjects (7 with EPI, 28 with FLASH) and 31 HIV positive patients without any brain lesions (all with EPI) where included in this study. To evaluate the first pass effect of the contrast agent, a gamma-variate function was fitted directly to the signal-time-course of each pixel (3). The static effect was calculated from only the first and last time points of each time-course. The results of the two methods were compared by a correlation analysis, using the rCBV values of all voxels inside the automatically segmented brain. In addition, the rCBV values of manually drawn regions of interest (ROIs) of cortical gray matter, white matter and deep gray matter were determined and compared between the methods. The ROIs were drawn on high-resolution MRI scans, which were coregistered to the rCBV maps using a surface matching registration (4).

RESULTS
The rCBV maps calculated with the static and dynamic methods appear qualitatively very similar (Fig. 1).

The correlation coefficients between the rCBV values from the two methods were \( r = 0.79\pm0.06 \) for EPI, and \( r = 0.69\pm0.10 \) for FLASH. An example of the correlation between the rCBV values in one subject is shown in Fig. 2. The ROI analysis showed no significant differences between the static and dynamic method for the FLASH data and for the grey matter values in the EPI data while the static values were 10-15% lower in the white and deep gray matter in the EPI data.

DISCUSSION
Our study demonstrates that rCBV can be determined reliably using the MRI signal changes both during and after the first pass of a bolus of contrast agent. The good correlation between the two methods justifies the assumption that the contrast agent in the brain is essentially intravascular even after the first pass. With the development and clinical introduction of truely intravascular tracers, it will be possible to generate high-resolution rCBV maps using the static effect.

REFERENCES

Acknowledgements
This study was supported in part by NIH (DA00280)