INTRODUCTION
Hydrocephalus (HC) represents the leading cause for brain surgery in children in the US. While treatment of HC with ventriculoperitoneal shunting is a well-established technique with marked improvement in patient outcome, there are still numerous complications and the mean lifetime of a shunt before needing revision surgery is only a little over one year (1). The disruption of normal CSF flow and drainage in hydrocephalus is assumed to be the primary "pathology" of this disease and thus the reestablishment of CSF drainage with the shunt is the logical treatment of choice. However, with the complications associated with shunting and the lack of a clear understanding of the source of CSF blockage in many cases it may be beneficial to study other aspects of the disease. For example, it is well established that there are alterations in cerebral blood flow patterns in the brain in hydrocephalus (2). It has been hypothesized that changes in intracranial pulsations, which in turn can lead to increased pulsations at the capillary level and alterations in the integrity of the blood-brain barrier (BBB) (3). It has recently been shown that transfer rates of gadolinium into normal brain can be detected using slow gadolinium infusions (4). In this study, we utilized slow-infusion, dynamic contrast enhanced MRI (DCE-MRI) to study subtle changes in the BBB in a rat model of communicating hydrocephalus.

METHODS
Hydrocephalus was induced in Sprague-Dawley rats (female, n = 6, wt = 200-220 g) by injection of kaolin into the basal cistern (5). In most cases, this induction leads to mild-to-severe ventriculomegaly within a few days. At between 4-5 weeks post induction, DCE-MRI was performed on a Bruker Biospec 9.4T animal microMRI system. Animals were maintained under isoflurane anesthesia while inside the MRI scanner, lying with their head on a 3-cm surface coil. DCE-MRI was collected with a 3D spoiled gradient echo sequence with the following parameters: FOV = 4x3cm, matrix 128 x 96, TE/TR = 1.6/60 ms, FA = 40, ST = 1 mm, 50 slices. Total acquisition time was 4.8 minutes. Infusions into the tail vein were 5 ml/hr of 125 mM gadolinium (diluted in physiological saline), with the infusion lasting 45-60 minutes. Prior to and during the infusion DCE-MRI images were collected every 5 minutes, and after the infusion stopped they were collected every 10 minutes. Total acquisition time ~ 120 min.

RESULTS
Overall input and output rates of the CA in the blood, exchange rates, ktrans, of the CA between the blood and the tissue through the BBB and the fractional volumes of the tissue compartments assumed: blood, parenchyma and the intracellular space were calculated by fitting the blood and tissue CA concentration curves over time to the corresponding models (3,4).

CONCLUSIONS
Results in this study show that DCE-MRI provides quantitative information on the permeability of the BBB (ktans, vb) and/or B-blood (kblood) and thus the reestablishment of CSF drainage with the shunt is the logical treatment of choice. However, with the complications associated with shunting and the lack of a clear understanding of the source of CSF blockage in many cases it may be beneficial to study other aspects of the disease. For example, it is well established that there are alterations in cerebral blood flow patterns in the brain in hydrocephalus (2). It has been hypothesized that changes in intracranial pulsations, which in turn can lead to increased pulsations at the capillary level and alterations in the integrity of the blood-brain barrier (BBB) (3). It has recently been shown that transfer rates of gadolinium into normal brain can be detected using slow gadolinium infusions (4). In this study, we utilized slow-infusion, dynamic contrast enhanced MRI (DCE-MRI) to study subtle changes in the BBB in a rat model of communicating hydrocephalus.

REFERENCES