Introduction:
In frontal and parietal lobe epilepsy, proton magnetic resonance spectroscopic imaging (HSI) can localize the epileptogenic lobe or focus as decreased NAA/Cr (1) or NAA/(Cr+Cho) (2). These ratio changes do not reveal to what degree and direction each of these metabolites are affected. We hypothesize that evaluation of the distribution of individual metabolites will be useful in connection with traditional intra-region ratios.

Materials and Methods:
We studied 11 patients with frontal or frontoparietal epilepsy (9 female, age range 6 to 28 yrs, mean 16 yrs, age at onset 3 to 13 yrs) and 8 normal volunteers (3 female, age range 15 to 22, mean 17 yrs). Three patients had a dygenesis of Taylor-type lesion on MRI, and one a hamartoma. Seizure frequency varied from daily seizures to once a month, except in one patient who had been seizure-free for 1.5 yrs.

HSI studies were performed with a 1.5 T MR imager (Magnetom Vision, Siemens) using a standard CP head coil. A double 90° sequence with 12:10 phase encoding steps was used with TR=2600 ms and TE=135 ms with 2 acquisitions. Volume preselection was 60/80/100x60/100x15 mm with 1.5 cm voxel size. Ueda was collected from one or two 15 mm thick slices in the frontal or frontoparietal areas. Siemens software was used for postprocessing.

We divided the metabolite map data into 16 VOI:s of 4 voxels each (2). In each VOI of the controls, we determined the range of the index lOOx(VOI-contra)/contra for NAA/Cho, NAA/(Cr+Cho), and NAA/(Cho+Cr) and for NAA, Cho, and Cr. This defined the upper and lower cutoff limits for normal. In the patients, a metabolically abnormal area was defined as 3 or more anatomically connected voxels (VOI), where the metabolite intensity in at least two metabolites fell outside the cutoff limits. Presence of lactate was also noted.

Results:
Table 1. shows the results of our 11 patients. In patient 2, no lateralization was possible with HSI. Nine patients showed decreased NAA; five of them showed decreased Cho (pts 5,4,6,7,11) whereas four showed increased Cho (pts 1,5,8,10); Cr tended to parallel the Cho change. In one patient (9) metabolite map analysis did not reveal abnormality, while NAA/Cho and NAA/(Cho+Cr) were decreased. In another patient (11), the metabolite map showed decrease of all metabolites, while NAA/Cho, NAA/Cr, and NAA/(Cho+Cr) were within normal range.

In patient 9 metabolite map analysis did not reveal abnormality, while NAA/Cr and NAA/(Cho+Cr) were decreased. In another patient (11), the metabolite map showed decrease of all metabolites, while NAA/Cho, NAA/Cr, and NAA/(Cho+Cr) were within normal range.

Discussion:
Metabolite mapping lends itself into a deeper evaluation of the pathology in the different compounds, once possible error from the local field is controlled. In our controls, left-right difference in metabolites was less than 10%. This indicates that the local magnetic field in the frontoparietal brain is relatively homogeneous. This error source was controlled by our analysis.

Lateralization of the metabolic abnormality conformed with other lateralizing data in 10/11 patients. In the metabolite maps, the pathology in different compounds only partially overlapped. It can be hypothesized that the structural lesion itself may represent a certain metabolic abnormality, e.g. neuron loss and gliosis. Seizure activity spreading around the white matter tracts may lead to selective membrane damage without affecting the neurons.

The metabolite ratio changes in frontal epileptic foci have been interpreted to consist mainly of neuronal loss, with variable increase of Cho and Cr due to gliosis (2). In our material, a decrease of Cho and Cr occurred as often as an increase of these compounds. The metabolic abnormality in frontoparietal epilepsy can thus be more complicated than previously thought.

To conclude, metabolite map analysis adds to the information acquired by traditional intravoxel analysis. HSI will be a valuable tool in lateralizing the epileptogenic area and studying pathophysiology in frontoparietal epilepsy.

References: