

## **Abstract**

Despite decades of research of normal pressure hydrocephalus (NPH), a clear pathophysiological mechanism of the disease is still unknown. This results in the absence of an unambiguous diagnostic biomarker. Moreover, NPH in contrast to similar neurodegenerative diseases is curable by insertion of a ventriculo-peritoneal shunt. Now the diagnostics is based on invasive functional testing, on the contrary, imaging methods play only a supporting role. This work is processed with an effort to find a sufficiently sensitive and specific biomarker of MRI imaging using advanced analytical methods. For this reason, the structural volumetry and the phase contrast method were tested. The individual partial results of both of these modalities have already been described in the literature, but the conclusions were controversial. The main contribution of this work is the range of tested parameters and their to date untested advanced analysis - accurate automatic segmentation in volumetric study and machine learning algorithms in phase contrast study. In a volumetric study, we segmented a total of 26 structures in 74 patients (29 with diagnosed NPH, 45 without NPH). In the case of preoperative examination, we demonstrated statistically significant differences in the size of the left hippocampus, corpus callosum, left globus pallidus internus, gray and white matter and in the size of the ventricular system. In the postoperative follow-up we found changes in the size of the ventricles, telencephalus, and right putamen. In the phase contrast study, we examined a total of 30 patients with NPH and found significant differences in 47 of the 85 functions examined. Using the machine learning method, we achieved an accuracy of 80 % for the method as a whole.

The volumetric study revealed several statistically significant changes in the volume of examined structures within preoperative diagnostics and in postoperative development. Despite these partial results, however, it must be stated that it does not provide an unambiguous biomarker to the diagnosis of NPH. In the phase contrast study we have demonstrated the effectiveness of the machine learning approach, which significantly simplifies the use of this method and increases its predictive value. Phase contrast MRI enhanced with machine learning can distinguish NPH patients from healthy controls with more than 80% specificity and sensitivity. Further addition of patients to the testing population would further refine the results of the method.