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BRAIN SPECT IMAGING FOR THE BLADDER OF NORMAL PRESSURE HYDROCEPHALUS (NPH) - RESULTS OF TWO ANALYSES

Hypothesis / aims of study

Normal-pressure hydrocephalus (NPH) is a well-recognized elderly gait disorder, first described by Hakim and Adams in 1965 [1]. NPH is characterized by a clinical presentation of gait disturbance, memory deficit, and bladder disorder (originally described as urinary incontinence, but urinary urgency/ frequency [also called an overactive bladder, OAB] often precedes it), all of which tend to ameliorate after shunt surgery [2]. We attempted to obtain brain single photon emission computed tomography (SPECT) imaging for the bladder of NPH; results of two analyses are shown herein.

Study design, materials and methods

1) The first analysis comprised 100 NPH patients who underwent a brain perfusion imaging using 123IMP-SPECT before shunt surgery [3]. 2) The second analysis comprised 75 NPH patients who repeated SPECT before and one year after shunt surgery. Both studies are a part of the Study of Idiopathic Normal Pressure Hydrocephalus on Neurological Improvement (SINPHONI), a nation-wide multi-center study. 1) Bladder condition is defined as 0-3 grades of JNPHGS-R (normal to loss of bladder control); divided into mild (grade 0-1) and severe (grade 2-3). 2) After surgery, bladder condition is defined as improved (>1 grade decrease), no change, and worsened (>1 grade increase).

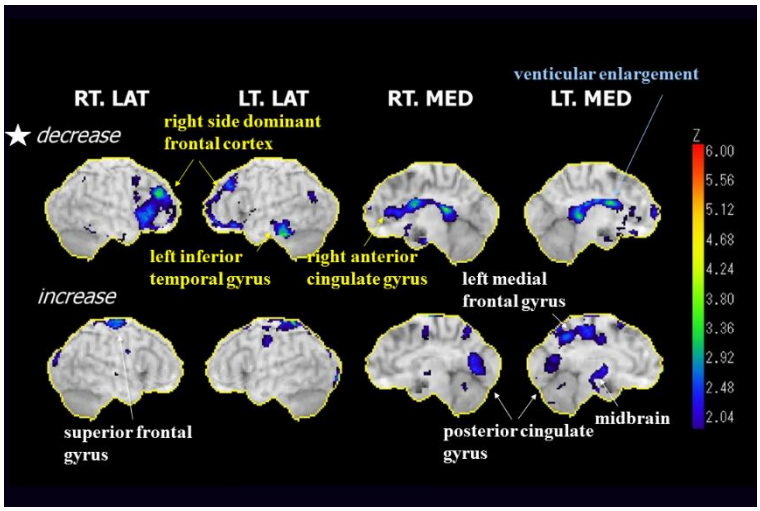

Figure 1 3D-SSP statistical analysis results of brain SPECT scan of NPH patients between severe versus mild/no bladder dysfunction. Before shunt surgery N=100.

There was a significant decrease in tracer activity in the right-side-dominant bilateral frontal cortex and the left inferior temporal gyrus in the severe bladder dysfunction group ($p<0.05$).

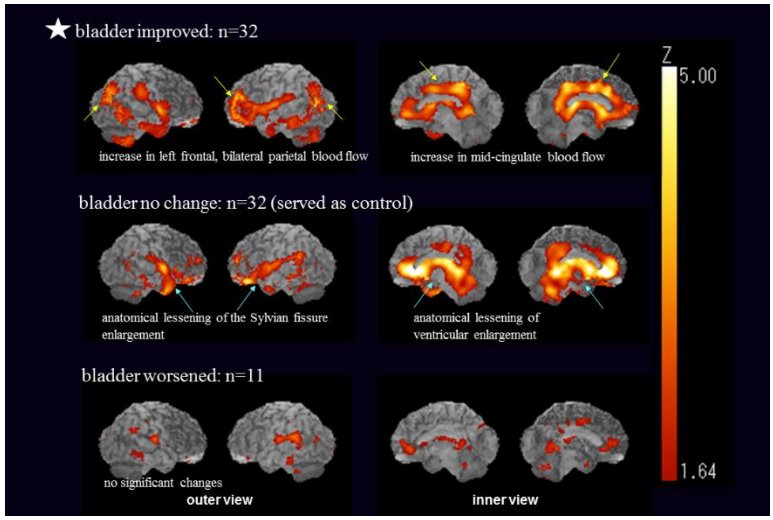

Figure 2 3D-SSP statistical analysis results of brain SPECT scan of NPH patients between post versus pre shunt surgery. N=75.

In the bladder improved subgroup (32 cases) there was a significant increase in bilateral mid-cingulate, parietal, and left frontal blood flow in post shunt surgery group ($p<0.05$).

Results

1) Comparing mild versus severe bladder dysfunction groups, there was a significant decrease in tracer activity in the right-side-dominant bilateral frontal cortex and the left inferior temporal gyrus in the severe bladder dysfunction group ($p<0.05$) **(Figure 1)**. In order to minimize the effects of gait and cognitive dysfunction, we performed similar analysis among subjects with little or no such dysfunction, and obtained the same results ($p<0.05$) as described above.
2) Comparing pre versus post surgery, in the bladder no change subgroup (32 cases) there was an increase in blood flow which is regarded as reversal of enlargement in the Sylvian fissure and lateral ventricles (served as control). In contrast, in the bladder improved subgroup (32 cases) there was a significant increase in bilateral mid-cingulate, parietal, and left frontal blood flow in post shunt surgery group ($p<0.05$) **(Figure 2)**. In the bladder worsened subgroup (11 cases) no such blood flow change was observed.

Interpretation of results

1) The first study results indicate that severe bladder dysfunction in NPH is predicted by right frontal hypo-perfusion before shunt surgery. 2) The second study results indicate that bladder recovery in NPH is predicted by mid-cingulate perfusion increase after shunt surgery. If we assume that the prefrontal and mid-cingulate cortices actively participate in higher control of micturition (both thought to be mainly inhibitory), hypo-function and restoration of these brain area seem to be fundamental as the brain mechanism of bladder disorder in NPH. Since SPECT images can change dynamically, it becomes a useful tool to assess brain control of micturition.

Concluding message

The underlying mechanism of bladder disorder in NPH might be hypo-function and restoration of the right frontal and mid-cingulate cortices, which normally inhibits the micturition reflex. Since bladder disorder is a significant burden in patients with NPH and their caregivers, further studies to elucidate factors of the brain-bladder relationship in NPH are warranted.

References

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Disclosures

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