

THE ICE-WATER NOMOGRAM: A NOVEL TOOL FOR QUALITATIVE INTERPRETATION OF NEUROGENIC BLADDER DYSFUNCTION

Hypothesis / aims of study

The ice water test was first described in 1957 and is utilised since then as provocation test to identify neurogenic bladder dysfunctions and to verify the integrity of the upper motor neuron.[1] It is performed by rapid instillation of cold water into the urinary bladder and is considered positive if an involuntary detrusor contraction occurs. The reflex can be provoked in children by five years of age at the latest and become then suppressed by maturation of the nervous system in neurologically normal infants and adults.[2] The recurrence of the reflex indicates a potential spinal cord lesion or lesion of the central motor neuron. Till this day, the ice water test is interpreted in a dichotom manner. In the current study, we developed an ice water nomogram for qualitative interpretation of the ice water test. Furthermore, we investigated the so far largest cohort of ice water test in patients with multiple sclerosis.

Study design, materials and methods

We retrospectively analysed a total of 201 ice water tests of patients with multiple sclerosis. The ice water test was performed standardised according the 'Good Urodynamic Practice' of the International Continence Society' after routine cystometry by filling the bladder with 100ml/min of sterile saline solution with a temperature of 4°C. The test was stopped if involuntary detrusor contraction occurred or 200ml were instilled. The data were analysed by IBM SPSS® Statistic and Microsoft Excel®. For characterisation of the detrusor contraction in accordance with physical comprehension to the definition of power (power = work / time), the detrusor gradient was calculated by the formula: 'detrusor gradient = $\Delta P_{det} / \Delta t_{sec}$ '. Furthermore, the "area under the curve"(AUC) was calculated to include the duration and magnitude of the detrusor contraction. The detrusor gradient at time of the maximum detrusor pressure (P_{max}) as well as the value of AUC were inserted in a diagram and the results were critically evaluated. Resultant, a nomogram with classification of eight severity degrees was developed. Additionally, randomly therapeutic interventions and controls over time were analysed separately.

Results

A clinically positive ice-water test ($P_{detmax} > 15\text{cmH}_2\text{O}$) was present in 75 patients (37.3%). According the ice-water nomogram, the distribution of severity degrees of the patients were: category 1 (141), 2 (26), 3 (12), 4 (7), 5 (3), 6 (7), 7 (1) and ≥ 8 (4) (Figure 1). Furthermore, the severity degree correlated positively with the incontinence frequency. Additionally, therapeutical interventions such as detrusor botulinum toxin injections (Figure 2) could be verified in the nomogram as well as progressions over time could be identified.

Interpretation of results

For the first time, neurogenic detrusor dysfunction can be classified into severity by the novel ice-water-nomogram. The severity degree in the nomogram correlates positively with the incontinence frequency. Furthermore, the effect of therapeutical interventions can be verified and controls over time can be evaluated. Additionally, the current study presents the so far largest investigation of ice water test in patients with multiple sclerosis. About 37.3% of the patients demonstrated a positive ice-water test in our cohort.

Concluding message

The ice-water nomogram could provide severity-classification, prognosis of neurogenic bladder dysfunctions, therapeutic control and follow-up of neurogenic bladder dysfunctions in the near future.

References

1. Bors EH, Blinn KA (1957) Spinal reflex activity from the vesical mucosa in paraplegic patients. A.M.A. archives of neurology and psychiatry 78:339-354
2. Al-Hayek S, Abrams P (2010) The 50-year history of the ice water test in urology. J Urol 183:1686-1692

Figure 1 Ice-water-nomogram of 201 patients with multiple sclerosis

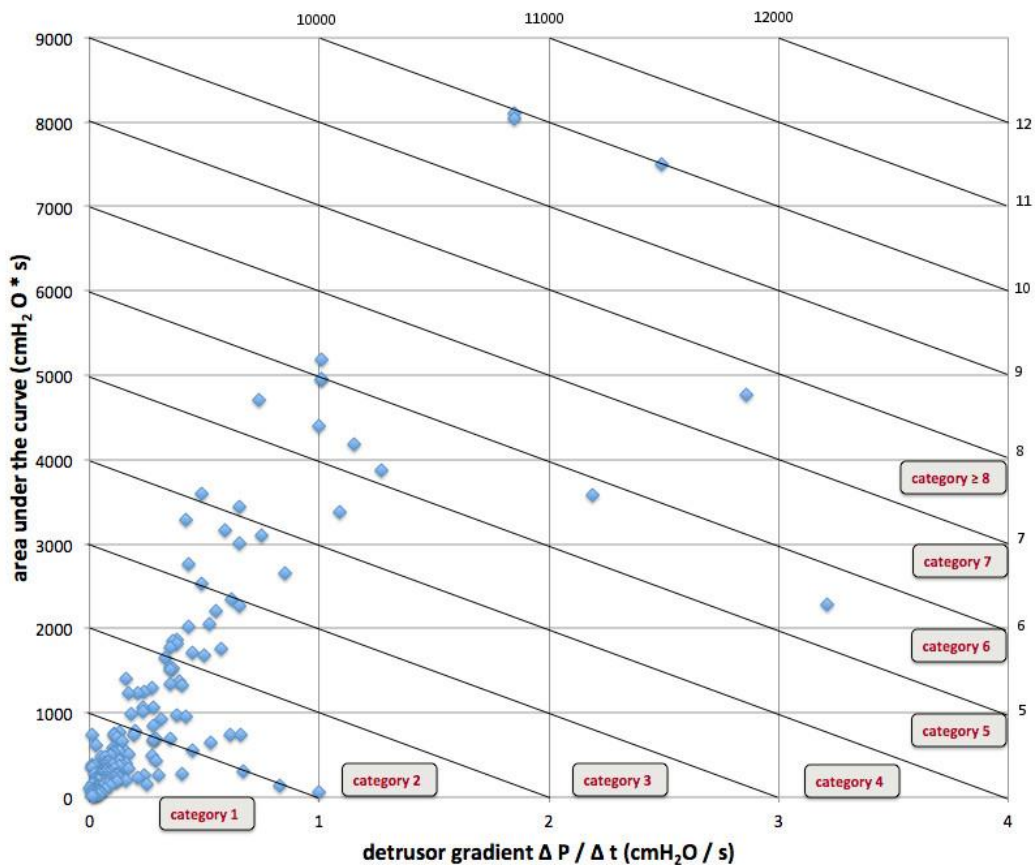
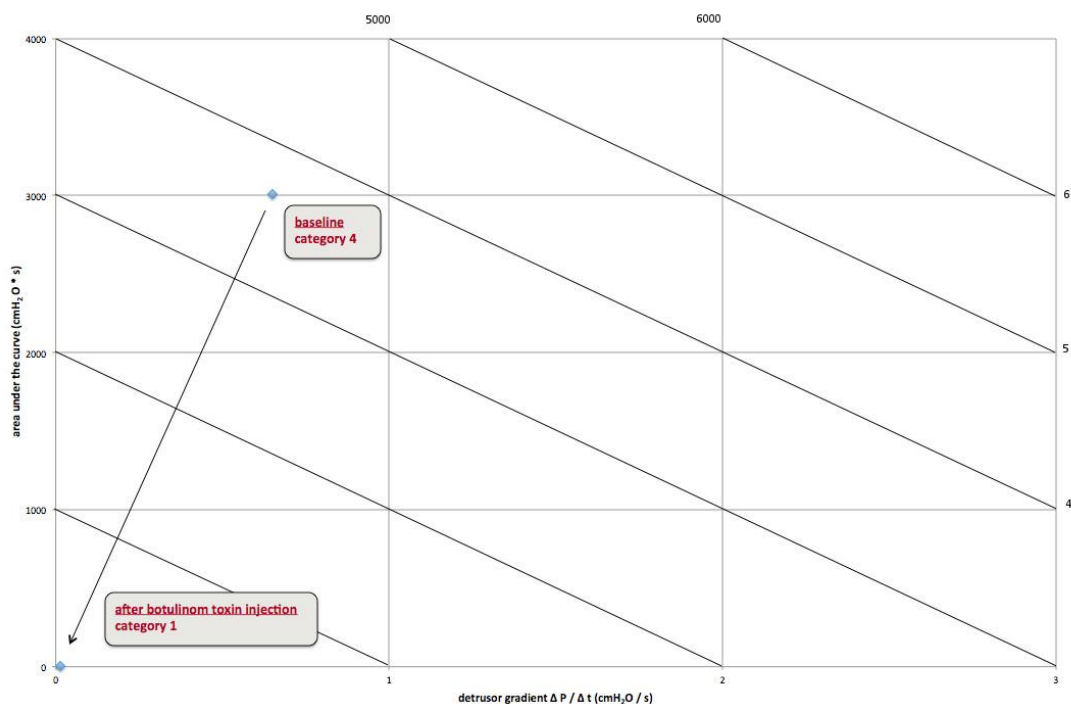


Figure 2 Therapeutic control before and after botulinum-toxin injection of the detrusor according the ice-water-nomogram



Disclosures

Funding: None. **Clinical Trial:** Yes **Public Registry:** No **RCT:** No **Subjects:** HUMAN **Ethics not Req'd:** It was considered of no need of ethic approval because of the retrospective character of the study and furthermore anonymous analysis of the data. Additionally, every patients signed an inform consent for anonymous evaluation of the urodynamic examination prior of the urodynamic examination. The urodynamic examination was performed in the patients due to neurogenic bladder dysfunction (Multiple sclerosis). The written decision of the ethic committee can be send separately if needed. **Helsinki:** Yes **Informed Consent:** Yes