Cerebrospinal fluid tap test case series

A retrospective study, conducted between October 2012 and January 2017, involved 39 patients with suspected Idiopathic Normal Pressure Hydrocephalus (iNPH). Matsuoka et al., analyzed their Mini Mental State Examination (MMSE), Frontal Assessment Battery (FAB), and Trail Making Test (TMT) scores on tests conducted before and 1 day and 1 week after the Cerebrospinal fluid tap test (CSFTT).

Changes in MMSE scores were negligible 1 day after the CSFTT but began to appear 1 week later. Changes in FAB scores were observed from 1 day to 1 week after the CSFTT. Although no statistically significant differences in TMT scores were observed at either time point, the execution time for the test tended to be shorter on the day after the CSFTT. Changes in cognitive function were not associated with demographic or morphological parameters. More severe impairments at baseline, however, were associated with greater changes in cognitive function.

Performing several reevaluations using each test may enable more accurate assessment of cognitive function in patients with suspected iNPH. The results highlight the need for long-term follow-up, regardless of the severity of cognitive impairment [1].

2016

Eighty-three patients (45 men and 38 women, mean age 76.4 years) underwent lumboperitoneal shunt surgery, and outcomes were evaluated until 12 months following surgery. Risks for poor quality of life (Score 3 or 4 on the modified Rankin Scale [mRS]) and severe gait disturbance were evaluated at 3 and 12 months following shunt surgery, and the tap test was also conducted. Age-adjusted and multivariate relative risks were calculated using Cox proportional-hazards regression.

Of 83 patients with iNPH, 45 (54%) improved by 1 point on the mRS and 6 patients (7%) improved by ≥ 2 points at 3 months following surgery. At 12 months after surgery, 39 patients (47%) improved by 1 point on the mRS and 13 patients (16%) improved by ≥ 2 points. On the gait domain of the iNPH grading scale (iNPHGS), 36 patients (43%) improved by 1 point and 13 patients (16%) improved by ≥ 2 points at 3 months following surgery. Additionally, 32 patients (38%) improved by 1 point and 14 patients (17%) by ≥ 2 points at 12 months following surgery. In contrast, 3 patients (4%) and 2 patients (2%) had worse symptoms according to the mRS or the gait domain of the iNPHGS, respectively, at 3 months following surgery, and 5 patients (6%) and 3 patients (4%) had worse mRS scores and gait domain scores, respectively, at 12 months after surgery. Patients with severe preoperative mRS scores had a 4.7 times higher multivariate relative risk (RR) for severe mRS scores at 12 months following surgery. Moreover, patients with severe gait disturbance prior to shunt surgery had a 46.5 times greater multivariate RR for severe gait disturbance at the 12-month follow-up. Patients without improved gait following the tap test had multivariate RRs for unimproved gait disturbance of 7.54 and 11.2 at 3 and 12 months following surgery, respectively. Disease duration from onset to shunt surgery was not significantly associated with postoperative symptom severity or unimproved symptoms.

Patients with iNPH should receive treatment before their symptoms become severe in order to achieve an improved quality of life. However, the progression of symptoms varies between patients so specific timeframes are not meaningful. The authors also found that tap test scores accurately predicted shunt efficacy. Therefore, indications for shunt surgery should be carefully assessed in each patient with iNPH, considering the relative risks and benefits for that person, including healthy life

expectancy [2].

During 2010-2011, Yamada et al. recruited and then followed 93 patients with possible iNPH for 12 months after shunt. Among them, 82 patients were finally enrolled in this study. The modified Rankin Scale, iNPH grading scale, and several quantitative measurements were evaluated at entry, after the tap test, before and after shunt. Area under the receiver-operating characteristic curves (AUCs), sensitivities, and specificities of the tap test for predicting shunt effectiveness were calculated for each measurement. They were additionally assessed after stratification by disease duration since the initial presentation of iNPH symptoms.

The gait disturbance on the iNPH grading scale had the highest accurate scale at the tap test for predicting effectiveness 12 months after shunt: AUC 0.74, sensitivity 56.5%, specificity 91.7%. This AUC increased to 0.76, 0.91 and 0.94 in the subgroup of disease duration <24, <12, and <6 months, respectively. The sensitivity and specificity of the gait disturbance on the iNPH grading scale in the subgroup of <12 months' duration were 92.3% and 90.0%.

The shorter period of clinical symptoms, for example, <12 months, made the tap test sufficiently accurate examination for predicting improvement 12 months after shunt surgery. The findings imply that the tap test should be applied to patients being considered for shunt surgery as soon as possible [3].

Sixty-eight consecutive patients with suspected iNPH were prospectively evaluated. Preoperative assessment included clinical tests, overnight intracranial pressure (ICP) monitoring, lumbar infusion test (LIFT), and ELD for 24-72 hours. Simple and multiple linear regression analyses were conducted to identify predictive parameters concerning the outcome after shunt therapy. RESULTS Positive response to ELD correctly predicted improvement after CSF diversion in 87.9% of the patients. A Mini-Mental State Examination (MMSE) value below 21 was associated with nonresponse after shunt insertion (specificity 93%, sensitivity 67%). Resistance to outflow of CSF (ROut) > 12 mm Hg/ml/min was false negative in 21% of patients. Intracranial pulsatility parameters yielded different results in various parameters (correlation coefficient between pulse amplitude and ICP, slow wave amplitude, and mean ICP) but did not correlate to outcome. In multiple linear regression analysis, a calculation of presurgical MMSE versus the value after ELD, ROut, and ICP amplitude quotient during LIFT was significantly associated with outcome ($p = 0.04$). Despite a multitude of invasive tests, presurgical clinical testing and response to ELD yielded the best prediction for improvement of symptoms following surgery. The complication rate of invasive testing was 5.4%. Multiple and simple linear regression analyses indicated that outcome can only be predicted by a combination of parameters, in accordance with a multifactorial pathogenesis of iNPH [4].

2014

A retrospective review of 66 patients with iNPH was conducted. All patients underwent 4-day ELD trial. ELD-positive patients were offered ventriculoperitoneal shunt (VPS) surgery. The primary outcome evaluation parameters were gait and mini mental status examination (MMSE) assessment. The family and patient perception of improvement was accounted for in the outcome evaluation.

There were 38 male and 28 female with mean age of 74 years (range 45-88 years). ELD trial was positive in 86% (57/66) of patients. No major complications were encountered with the ELD trial. A total of 60 patients (57 ELD-positive, 3 ELD-negative) underwent VPS insertion. The negative ELD trial (P = 0.006) was associated with poor outcomes following shunt insertion. The positive ELD trial predicted shunt responsiveness in 96% patients (P < 0.0001, OR = 96.2, CI = 11.6-795.3). A receiver operating characteristic (ROC) curve analysis revealed that the ELD trial is reasonably accurate in differentiating shunt responder from non-responder in iNPH patients (area under curve = 0.8 ± 0.14, P = 0.02, CI = 0.52-1.0). The mean follow-up period was 12-months (range 0.3-3 years). The significant overall improvement after VPS was seen in 92% (55/60). The improvement was sustained in 76% of patients at mean 3-year follow-up. The number of comorbid conditions (P = 0.034, OR = 4.15, CI = 1.2-9.04), and a history of cerebrovascular accident (CVA) (P = 0.035, OR = 4.4, CI = 1.9-14.6) were the predictors of poor outcome following shunt surgery.

The positive ELD test predicted shunt responsiveness in 96% of patients. With adequate technique, maximal results with minimal complications can be anticipated. The number of comorbidities, history of CVA and negative ELD test were significantly associated with poor shunt outcomes [5].

2013

115 patients were included in a European multicentre study on the predictive values of resistance to CSF outflow and the CSF Tap Test in patients with idiopathic normal pressure hydrocephalus. Diagnosis was based on clinical symptoms and signs, and MRI changes. All patients were treated with programmable ventriculoperitoneal shunts and re-examined 12 months after surgery. Outcomes were measures with a newly developed iNPH Scale and the modified Rankin Scale (mRS). Before surgery, a CSF TT and measurement of Rout was performed, with the results blinded to all caregivers. The 12 month outcome was correlated with Rout and the result of the CSF TT.

Rout and the results of the CSF TT showed no correlation with outcome measured by either domain, or with total iNPH score or mRS score. Only an increase in the gait task (10 m of walking at free speed) of the CSF TT correlated significantly (r=0.22, p=0.02) with improvement in iNPH score. The positive predictive value of both tests was >90% and the negative predictive value <20%. Rout >12 had an overall accuracy of 65% and the CSF TT 53%. Combining both tests did not improve their predictive power. No correlation was found between Rout and the results of the CSF TT.

Rout and the results of the CSF TT did not correlate with outcome after 12 months. Rout and CSF TT can be used for selecting patients for shunt surgery but not for excluding patients from treatment [6].

2012

Among 21 patients investigated with both tap test (TT) and phase contrast magnetic resonance imaging (PC-MRI), El Sankari et al identified two groups, with either (1) a positive TT (PTT) or (2) a negative one (NTT), and compared their aqueductal stroke volume (ASV) as measured by PC-MRI. ASV cutoff value was set at 70 µL/cardiac cycle (mean value +2 standard deviations in age-matched healthy subjects).

In the PTT group (n = 9), the mean ASV was 175 ± 71 µL. Among these patients, four were shunted, and improved after surgery. In the NTT group, two patients were finally diagnosed with aqueductal stenosis and excluded. Among the remaining patients (n = 10), the mean ASV was 96 ± 93 µL (p < 0.05). However, three of these patients presented with hyperdynamic ASV, and an associated

neurodegenerative disorder was diagnosed. Two patients had ventriculoperitoneal shunting despite their NTT, and improved.

In the patient population, the noninvasive measurement of hyperdynamic ASV correlated with PTT, suggesting PC-MRI could be utilized to select those patients who would benefit from shunting. ASV may therefore be an interesting supplemental diagnosis tool [7)].

2005

Twenty-seven patients with presumed NPH were admitted to the department and CSF drainage was carried out by a temporary (ELD) with CSF outflow controlled by a medium pressure valve for five days. All patients received a ventriculoperitoneal shunt using a medium pressure valve based upon preoperative clinical and radiographic criteria of NPH, regardless of ELD outcome. Clinical evaluation of gait disturbances, urinary incontinence and mental status, and radiological evaluation with brain CT was performed prior to and after ELD test, as well as three months after shunting.

Twenty-two patients were finally shunted and included in this study. In a three-month follow-up, using a previously validated score system, overall improvement after permanent shunting correlated well to improvement after ELD test (Spearman's rho = 0.462, p = 0.03). When considering any degree of improvement as a positive response, ELD test yielded high positive predictive values for all individual parameters (gait disturbances 94%, 95% CI 71%-100%, urinary incontinence 100%, 95% CI 66%-100%, and mental status 100%, 95% CI 66%-100%) but negative predictive values were low (< 50%) except for cognitive impairment (85%, 95% CI 55%-98%).

This study suggests that a positive ELD-valve system test should be considered a reliable criterion for preoperative selection of shunt-responsive NPH patients. In case of a negative ELD-valve system test, further investigation of the presumed NPH patients with additional tests should be performed [8)].

2002

Between January 1994 and December 2000, 49 presumed NPH patients from three institutes were included. Forty three had idiopathic, and the remaining six had secondary NPH. Forty eight patients were shunted; 39 had an ELD of whom 38 completed the test. After 2 months 35 of the 48 (73%) shunted patients had improved. The predictive value of a positive ELD was 87% (95% confidence interval (95% CI) 62-98) and that of a negative ELD 36% (95% CI 17-59). In two patients serious test related complications (meningitis) occurred without residual deficit.

The study suggests that although the predictive value of a positive ELD is high, that of a negative ELD is deceptively low because of the high rate of false negative results. The costs and invasiveness of the test and the possibility of serious test related complications further limits its usefulness in managing patients with presumed NPH [9)].

1988

In a prospective study on the effect of shunting, 22 patients diagnosed as suffering from normal pressure hydrocephalus (NPH) were investigated by means of temporary external lumbar drainage

(ELD). Five patients had to be excluded from the study because of complications of ELD or definitive shunting. ELD correctly predicted the outcome of shunting in all of the remaining 17 patients. The value of external lumbar drainage in NPH is discussed on the basis of personal experience and data from the literature. It seems to be a safe and valuable tool for predicting the outcome of definitive shunting procedures [10].

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