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Review article

CSF tap test — Obsolete or appropriate test for predicting shunt responsiveness? A systemic review

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ABSTRACT

Objectives: There is no accurate test for diagnosing normal pressure hydrocephalus or for screening for patients who will benefit from shunt surgery. Additional tests, such as cerebrospinal fluid tap test (CSF-TT), are often used in practice to provide further predictive value in detecting suitable patients for shunting. We performed a systematic review of the literature to evaluate the CSF-TT's effect on the outcome of main symptoms and on validity parameters in screening patients suitable for shunting.
Methods: In February 2015 we searched electronic databases from their inception to the current date, using the following key words: normal pressure hydrocephalus, idiopathic normotensive hydrocephalus, shunt operation, CSF tap test, predictive value, validity. The search retrieved 8 articles explicitly addressing the topic.
Results: There was a very high positive predictive value of CSF-TT: 92% (range from 73% to 100%) but a low negative predictive value: 37% (18%–50%). Also, the CSF-TT has high specificity: 75% (33%–100%) but average sensitivity: 58% (26%–87%). The overall accuracy of the test was 62% (45%–83%).
Conclusions: This systematic review did not provide unambiguous validity of the CSF-TT in the screening of patients for shunting. The validity of the CSF-TT is good for patient inclusion for shunting due to the fact that the positive response to the test is very reliable. Unfortunately, the negative response to the test does not reliably make these patients ineligible for shunting. Further studies are needed to improve and standardize the methodology in order to optimize the detection power of the test.

Contents

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1. Introduction

In 1965, Hakim and Adams described the syndrome of gait disturbance, cognitive deterioration and urinary incontinence — a clinical triad associated with ventricular enlargement disproportional to any sulcal enlargement (distinguishing it from atrophy), in the absence of elevated cerebrospinal fluid (CSF) pressure during lumbar puncture [1,2]. Normal pressure hydrocephalus (NPH) in patients without known precipitants is termed primary or idiopathic iNPH (iNPH). When it occurs after other diseases, such as meningitis, traumatic brain injury, subarachnoid hemorrhage, cerebral infarction, this syndrome is called secondary NPH [3,4]. Some authors point to a hereditary predisposition towards iNPH [5,6]. There is variation in the clinical presentation, severity and progression of these symptoms, and it is not necessary for the entire triad to be present in order to consider diagnosing iNPH. Gait and balance impairment appear either before or concurrently with urinary incontinence or the onset of dementia. Symptoms are developed insidiously, and generally occur between the sixth and eighth decade of life [7,8]. Gait disturbances are the first signs of iNPH, and described as apraxic, glue-footed, magnetic, bradykinetic, and shuffling gait [9,10,11]. They are often misinterpreted as symptoms of Parkinson's disease [12]. Urinary incontinence usually follows gait abnormalities and almost always includes urinary urgency [13,14]. Dementia is rarely the first and foremost symptom of NPH, although it is often present [9,13]. The impairment is mainly cognitive and subcortical in type, characterized by inattention, delay in responding and remembering, lack of spontaneity but without cognitive decline as in cortical dementia [13,15]. Although NPH is commonly referred to as a treatable form of dementia, cognitive deficits and memory loss are the symptoms less likely to respond to shunting [16,17,18]. Neuroimaging with CT or MRI is an essential part of the evaluation of patients with suspected NPH/iNPH and ventricular enlargement is necessary to establish the diagnosis of NPH for patients with appropriate symptoms. A frontal horn ratio (Evans' index), defined as the maximal frontal horn ventricular width divided by the transverse inner diameter of the skull, indicates ventriculomegaly if it is 0.3 or greater [10,18].

Diagnosis based on clinical and radiological signs alone can be problematic and additional diagnostic testing may be required to determine which patients could benefit from shunting.

A transient, favorable clinical effect in three NPH patients after removal of 15 ml of fluid was first described by Adams et al. [2]. CSF-TT was later modified by Wikkelso et al. by introducing the removal of larger quantities of fluid (40–50 ml) and quantitative testing of the main symptoms [19,20]. Although inexpensive, readily available and safe (without serious complications), there are controversial opinions about CSF-TT's detection power and validity in screening patients suitable for shunting.

We searched the Cochrane Database of Systematic Reviews (CDSR), but no systematic review on this topic was found. Therefore, a systematic review was conducted to determine clinical impact and validity of CSF-TT in the prediction of response to shunting.

2. Methods

2.1. Study design

The methods of this systematic review were decided a priori and adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines [21]. The PRISMA statement includes a 27-item checklist designed to improve reporting of systematic reviews and meta-analyses.

2.1.1. Search strategy

Several online databases (PubMed, OvidMedline, Current Contents, Science Direct, Ebsco, and Web of Science) were searched from their inception to February 30, 2015. Authors (M.M., K.D., K.K.,V.L.) typed keywords independently from one another using the Boolean operator OR & AND and searched the online databases. The search strategy was as follows: ((normal pressure hydrocephalus) OR (normotensive hydrocephalus) OR (idiopathic normal pressure hydrocephalus)) AND (shunt operation) AND ((CSF tap test) OR (spinal tap test)) AND predictive value. A total of 2898 published articles were searched by abstract or full text.

Retrospective and prospective studies were also searched. There were no language restrictions. Any published article that explicitly addressed CSF-TT was included, particularly if the article provided numerical data that could be included in a systematic review. A meta-analysis could not be performed because most of the articles were not designed as a randomized controlled trial.

The search strategy is shown in Fig. 1. A complementary manual search of reference lists and personal resources was also performed to identify any relevant articles missed in the electronic searches. Finally, we searched for associated publications of retrieved articles to obtain the most complete and up-to-date study results. Papers that did not present clinical data were excluded, and any duplicate presentation of clinical data was identified.

2.2. Study selection

Two authors (M.M. and K.D.) reviewed the electronic database search results (title and abstract) independently. Any titles and abstracts that appeared to meet inclusion criteria were selected for full text review. The reference lists of the identified studies were reviewed to discover additional potentially eligible studies. Unpublished data and conference proceedings were excluded from this review. Abstracts were excluded when both investigators agreed they were not relevant.

Any disagreements were resolved within discussion between the two authors. The same two authors independently conducted the full text review of the retrieved articles in regard to the inclusion and exclusion criteria. Any disagreements were resolved by discussion, with a third and fourth author (K.K., V.L.) consulted if resolution was not achieved, to produce the final articles for inclusion.

A data extraction form was prepared, with two authors (M.M., K.D.) independently extracting data from the selected studies. Authors (M.M., K.K.) reviewed the completed form for accuracy, with any disagreements resolved by the fourth author (V.L.).

2.2.1. Inclusion and exclusion criteria

In our analysis, we included studies that met the following prespecified criteria: a diagnosis of NPH (iNPH) based on clinical examination and neuroimaging (CT/MRI), outcome data for at least for two of the three main symptoms (gait, cognition, continence) after CSF-TT and shunting, follow up and reevaluation of outcomes (at least once and not earlier than three months after shunting). NPH (iNPH) was defined as a symmetrical quadriventricular enlargement (Evans' Index ≥ 0.3) without clinically significant cortical and parenchymal lesions (atrophy, infarcts) with free communication between the ventricular system and the subarachnoid space ("communicating"