Providing a comprehensive patient experience and longitudinal care in a multimodal adult hydrocephalus clinic. A single center 2 day-outpatient lumbar tap trial study

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Disclosure

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Introduction

Normal pressure hydrocephalus (NPH) is currently best treated with permanent cerebrospinal fluid diversion via ventriculo-peritoneal shunting. A major challenge confronting neurosurgeons is predicting who will benefit from shunting procedures. Neurosurgeons rely on a combination of clinical exam and adjunct procedures such as external lumbar drainage (ELD) or high volume lumbar puncture to assess the probability of shunt responsiveness. We propose the utilization of a two-day outpatient high volume lumbar tap trial (LTT) and assessment of the patient by both a neurosurgeon and board-certified specialist in neurologic physical therapy as part of a comprehensive Adult Hydrocephalus Center for evaluation of all NPH patients.
Methods

We retrospectively reviewed the electronic medical records of 99 patients with probable NPH between March 2016 and February 2020. Patients underwent a two-day outpatient lumbar tap trial (LTT) in a dedicated Adult Hydrocephalus Center. The LTT included a high volume lumbar puncture (with goal to remove greater than 30 cc CSF) by an interventional radiology team. Immediately following the tap, the patients underwent an evaluation of objective gait measurements that included timed walk (TW), timed up and go (TUG), and timed up and go with cognitive distractor (TUGCo) by a board-certified specialist in neurologic physical therapy. Each patient then returned the next day for re-evaluation of the same measurements. The decision to place a shunt was made based on objective timed gait measurements together with the patients’ and families’ reported subjective symptomatic improvement following a high volume tap trial.
Results

Our patient population had a mean age of 75 years (68 -79 years of age) with slight male predominance (55%). There were 30 patients (55.5%) with idiopathic NPH, 47 (44.4%) with secondary NPH and 22 (22%) with neurodegenerative NPH, which we characterized as patients who had clinical symptoms of NPH with an established diagnosis of Parkinson’s Disease or Alzheimer’s Disease.

103 tap trials were attempted in 97 patients. 1 patient was not able to complete the spinal tap due to anxiety prior to the procedure. 5 patients underwent 2 taps. 2 patients underwent a second tap due to minimal volume removed on the first tap (12 cc and 8 cc). 3 patients underwent a second tap: 1 patient to confirm response after developing further medical comorbidities, 1 patient underwent a second tap after developing progression of symptoms subsequent to a negative primary tap, and 1 patient underwent an additional procedure after the first tap results were confounded by a concomitant UTI. The goal of greater than 30 cc removal was met in
97 tap trials (94%). A successful tap was defined as a tap leading to subjective and objective improvement in gait regardless of volume removed. (More than 40cc were drained in only 2 (1.9%) cases, 30-40 cc in 85 (82.5%) cases, 20-29 cc in 6 (5.8%) taps, and 10-19 cc in 4 (3.8%) taps.) The lowest volume of fluid removed resulting in a successful tap was 12cc of CSF. 2 patients underwent taps with no CSF able to be drained.

No major complications were encountered during the LTT. The most common minor tap trial complication reported was headache seen in 5 patients. Other complications reported were 2 patients that developed transient nerve root irritation that subsided at the end of the procedure.

48 patients (49.5%) out of the 97 patients in our study responded positively to the LTT and underwent shunting. 95% of shunted patients demonstrated marked improvement from their pre-LTT gait measurements. Cognitive and urinary incontinence subjective improvements were seen in approximately 72% and 65%
respectively. Pre-tap TW and TUG were significantly higher compared to the first post-shunt follow-up visit testing, with p-value 0.011 and 0.016, respectively. On average, the first follow-up visit was 25 days. Pre-tap TW and TUGCo were significantly higher than compared to the third post-shunt follow-up visit. On average, the third follow-up visit occurred 123 days after shunting.

Early complications within the first 30 days after surgery included 5 cases of subdural collections (1 acute subdural hematoma (SDH) and 4 subdural hygromas). The acute subdural hemorrhage was a result of a fall at rehab. This patient also had an asymptomatic shunt tract hemorrhage on immediate post-op CT head. 3 hygroma patients clinically and radiographically improved with shunt valve adjustment. 1 hygroma patient did not improve with valve adjustment and went on to develop a symptomatic hematoma after 30 days after the initial shunt placement requiring distal catheter ligation and eventual splicing of an overdrainage regulation device into the shunt system as well as a valve change.
Late complications reported after the first 30 days in addition to the patient previously mentioned included 7 subdural collections (1 acute SDH, 2 acute/chronic SDH, 3 chronic SDH, and 1 subdural hygroma). The acute SDH was the result of a fall and the patient passed away. 1 of the acute/chronic SDH patients underwent burr hole evacuation and valve change. All others were managed by valve readjustment.

There were 8 post-operative infections unrelated to the shunting procedures occurring after 30 days (5 urinary tract infections, 1 upper respiratory tract infection, 1 ear infection and 1 flu infection). All infections resulted in the worsening of patients’ previously improved NPH symptoms.

Other reported complications included distal shunt catheter migration into the pre-peritoneal space requiring revision (1) and post-op seizures (2) that were successfully managed medically.
Discussion

Although there are no standard protocols for evaluation of NPH, high volume LTT is a generally accepted method for diagnosis and predicting favorable outcomes for shunting.

The optimal time for evaluation of the tap test has not been systematically examined. We implemented the 2-day outpatient-based LTT and comprehensive evaluation along with specialty trained physical therapists to evaluate patients with probable NPH and to analyze whether they will benefit from shunting. We were able to recommend surgeries based on subjective and objective changes in patient’s symptoms after analyzing 2-days of objective gait measurements while avoiding inpatient admission. Patients in our Adult Hydrocephalus Center had marked improvements in TUG and TUGCo at early and late follow-up visits which were statistically significant.
Summary points

We provide an integrated out-patient experience involving a multidisciplinary evaluation in a specialized Adult Hydrocephalus Clinic.

A two-day outpatient LTT in an Adult Hydrocephalus Clinic provided a unique diagnostic approach that can effectively select patients for shunt surgery, monitor treatment outcomes, and address complications.