Ventriculoperitoneal shunt (VP)

Ventriculoperitoneal shunt is a type of cerebrospinal fluid shunt.
Ventriculoperitoneal shunting is one of the most commonly performed neurosurgical procedures.
A shunt is placed in a ventricle of the brain and threaded under the skin to the abdomen.
Ventriculoperitoneal shunt placement has routinely been performed since the 1950s following the first working shunt valve developed by John Holter and Eugene Bernard Spitz the Spitz Holter valve.

Indications

Ventriculoperitoneal (VP) shunt is the standard therapy for hydrocephalus in the presence of an aqueductal stenosis or other passage obstacles in the CSF pathway. For example, it is frequently required after subarachnoid hemorrhage, trauma, or infection of the neurocranium or for congenital conditions. The most common treatment for hydrocephalus remains the ventriculoperitoneal shunt.

Technique

The traditional operative approach for peritoneal catheter insertion is minilaparotomy. In recent years, laparoscopy-assisted insertion has become increasingly popular. It seems likely that use of an endoscope could lower the incidence of shunt malfunction. However, there is no consensus about the benefits of laparoscopy-assisted peritoneal catheter insertion.

A systematic search was performed using the PubMed, Embase, ScienceDirect, and Cochrane Library databases. A manual search for reference lists was conducted. The protocol was prepared according to the interventional systematic reviews of the Cochrane Handbook, and the article was written on the basis of the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) guidelines.

Eleven observational trials and 2 randomized controlled trials were included. Seven operation-related outcome measures were analyzed, and 3 of these showed no difference between operative techniques. The results of the meta-analysis are as follows: in the laparoscopy group, the rate of distal shunt failure was lower (OR 0.41, 95% CI 0.25-0.67; p = 0.0003), the absolute effect is 7.11% for distal shunt failure, the number needed to treat is 14 (95% CI 8-23), operative time was shorter (mean difference [MD], -12.84; 95% CI -20.68 to -5.00; p = 0.001), and blood loss was less (MD -9.93, 95% CI -17.56 to -2.31; p = 0.01). In addition, a borderline statistically significant difference tending to laparoscopic technique was observed in terms of hospital stay (MD -1.77, 95% CI -3.67 to 0.13; p = 0.07).

To some extent, a laparoscopic insertion technique could yield a better prognosis, mainly because it is associated with a lower distal failure rate and shorter operative time, which would be clinically relevant.

Typically, for insertion of the peritoneal catheter, a mini-laparotomy technique is used. Although generally safe, it can be cosmetically undesirable and time consuming. Complications include malpositioning, bowel injury, and delayed hernias. Laparoscopic techniques have been advocated to address these issues, but have been slow to gain traction with neurosurgeons.
Single port optical access laparoscopy is a fast and minimally invasive technique that allows direct visualization of the layers of the abdominal wall as they are traversed and visualization of the peritoneal catheter during placement. It uses a small cosmetic incision and obviates the need for postoperative abdominal radiographic studies. The procedure has a modest learning curve, but can be safely used without the assistance of an assist surgeon after the skills are acquired ⁴.

Intermediate incisions are considered necessary to pass a catheter tube from the head to the abdomen in ventriculo-peritoneal (VP) shunting via a frontal bur hole. However, an intermediate incision can sometimes become dehiscent, resulting in CSF leakage or infection of the shunt system in the early period after shunt implantation, particularly in infant patients. In a article, the authors describe a novel method of VP shunt insertion that does not require an intermediate incision. This nonintermediate-incision VP shunt procedure was performed in 3 infant patients with hydrocephalus and was not associated with any complications. This method can eliminate the intermediate incision, which is a disadvantage of VP shunt insertion via a frontal bur hole ⁵.

**VP shunt, post-op orders (adult)**

1. flat in bed (to avoid overshunting and possible subdural hematoma) with gradual mobilization
2. if the peritoneal end is new or revised, do not feed until bowel sounds resume (usually at least 24 hrs, due to ileus from manipulation of peritoneum)
3. shunt series (AP & lateral skull, and chest/abdominal X-ray) as a baseline for future comparison (some surgeons obtain these films immediately post-op in case some immediate revision is indicated, e.g. ventricular catheter tip in temporal horn).

**Complications**

see Ventriculoperitoneal shunt complications.

**Case series**

**2017**

VP shunts were placed in 3,984 patients either as an initial placement (n = 1,093) or as a revision (n = 2,891). Compared to the initial-placement group, the revision group was significantly more likely to experience shunt failure (14 vs. 8%, p < 0.0001). In the initial-placement group, congenital hydrocephalus was independently associated with shunt failure (OR 1.83; 95% CI 1.01-3.31, p = 0.047). In the revision group, cardiac risk factors (OR 1.38; 95% CI 1.00-1.90, p = 0.047), a chronic history of seizures (OR 1.33; 95% CI 1.04-1.71, p = 0.022), and a history of neuromuscular disease (OR 0.61; 95% CI 0.41-0.90, p = 0.014) were independently associated with shunt failure.

**2016**

Iglesias et al., undertook a retrospective study in pediatric patients treated with ventriculoperitoneal shunts between 2000 and 2015.

Surgical outcome was assessed, and different shunt survival curves were studied with Kaplan-Meier. Complications related to each shunt failure were examined and compared.

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A total of 166 patients underwent 425 procedures, with a mean follow-up period of 93 months. The median number of shunt revision surgeries was 2. Shunt survival rates were better with the first shunt compared to those with the subsequent shunts. The main complication necessitating system revision surgery was overdrainage, the frequency of proximal and distal dysfunctions was similar in all the shunt failures, and isolated ventricle and infection were more frequent in younger patients. Shunt-related infections accounted for 7% of the procedures, and the shunt independence rate was 10%.

The frequency of complications related to shunt failure in pediatric patients changes during follow-up. A strict protocol of overdrainage detection and active treatment could explain the need for repeat surgeries and the progressively shorter shunt survival time in this series ⁶).

Identifying the factors associated with VP shunt failure may allow the development of interventions to decrease failures. Further refinement of the collected variables in the ACS National Surgical Quality Improvement Program (NSQIP) Pediatric specific to neurosurgical procedures is necessary to identify modifiable risk factors ⁷).

A single-institutional, retrospective study was conducted by reviewing 124 patients who had ventriculoperitoneal shunting (VPS) including revisions and subgroup analysis was done in 109 patients less than 18 years old classified as children who had first-time shunt placement; between January 2011 and December 2013. Data analysis was done using Microsoft Excel and SPSS (Version 20.0).

The mean age at shunt insertion of the subgroup was 5.35 ±1.264 SD years. Shunt-related complications were identified in 37 of the patients (33.9%). Infections were the most common form of complication occurring in 16 patients (14.6%). The overall mortality of the 109 patients was 4.59%.

The most common indications for shunt insertions were tumoural and congenital lesions and that may offer us benefit with the use of endoscopic third ventriculostomy. Comprehensive follow-up of these patients may give a better picture of the magnitude of the problem; hence the need for properly designed prospective studies to improve the current outcomes ⁸).

2011

Adult patients who underwent ventriculoperitoneal shunt placement for hydrocephalus from October 1990 to October 2009 were included. Medical charts, operative reports, imaging studies, and clinical follow-up evaluations were reviewed and analyzed retrospectively for clinical outcome in adult hydrocephalus patients.

A total of 683 adult patients were included in the study. The most common etiologies of hydrocephalus include idiopathic (29%), tumors and cysts (20%), postcraniotomy (13%), and subarachnoid hemorrhage (13%). The overall shunt failure rate was 32%, and the majority (74%) of shunt revisions occurred within the first 6 months. The median time to first shunt revision was 9.31 months. Etiology of hydrocephalus showed a significant impact on the incidence of shunt revision/failure and on the median time to shunt revision. Similarly, the type of hydrocephalus had a significant effect on the incidence of shunt failure and the median time to shunt revision.

A large proportion of patients (32%) experience shunt failure after shunt placement for hydrocephalus. Although the overall incidence of shunt revision was comparable to previously
reported studies, the fact that a large proportion of adult populations with shunt placement experience shunt failure is a concern 9).


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