Ventriculoperitoneal shunt for idiopathic intracranial hypertension

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see also Lumboperitoneal shunt for idiopathic intracranial hypertension.

Shunting procedures have a high failure rate when used to treat patients who have failed medical therapy. This failure is believed to be attributable to the collapsibility of the ventricular system when exposed to increased differential pressure gradients in the cerebral spinal fluid compartments caused by ventriculoperitoneal shunts (VPS).

Lumboperitoneal shunting had been favored by many investigators for CSF diversion in IIH for decades; however, it has been associated with various side effects. Because of the small ventricular size adequate positioning of a ventricular catheter is challenging.

A slit-like ventricle pattern, typically seen in the disease, has been considered a great concern and challenge for ventricular catheter placement, primarily for freehand technique. Frameless stereotaxy, ultrasound, and endoscopy have been described to improve the accuracy of catheter insertion.

However, intraoperative image guidance is not widely accessible, especially in lower-resource countries, due to the high costs associated with its use. Techniques to improve the accuracy of the freehand VP shunt in IIH are scarce in the literature, and any effort to contribute to its development is valuable and helpful [1)].

Systematic-review and meta-analysis

A systematic-review and meta-analysis follows Preferred Reporting Items for Systematic Reviews and Meta-Analysis guidelines and includes studies about VPS and LPS patients, reporting one of the outcomes of interest. Andreão et al. searched PubMed, Embase, Web of Science, and Cochrane Library.

The analysis involved twelve studies, comprising 5990 patients. The estimated odds ratio (OR) for visual improvement was 0.97 (95% CI 0.26-3.62; I2 = 0%) and for headache improvement was 0.40 (95% CI 0.20-0.81; I2 = 0%), favoring LPS over VPS. Shunt revision analysis revealed an OR of 1.53 (95% CI 0.97-2.41; I2 = 77%). The shunt complications showed an OR of 0.91 (95% CI 0.68-1.22; I2 = 0%). The sub-analyses for shunt failure uncovered an OR of 1.41 (95% CI 0.92-2.18; I2 = 25%) and for shunt infection events an OR of 0.94 (95% CI 0.50-1.75; I2 = 0%).

The interventions showed general equivalence in complications, shunt failure, and other outcomes, but LPS seems to hold an advantage in improving headaches. Substantial heterogeneity highlights the need for more conclusive evidence, emphasizing the crucial role of further studies. The findings underscore the importance of considering a tailored decision between VPS and LPS for the management of IIH patients [2)].

Prospective cohort studies

2017

Hermann et al., investigated the usefulness of electromagnetic guided ventricular catheter placement for ventriculoperitoneal shunting in IIH.

Eighteen patients with IIH were included in this study. The age of patients ranged from 5 to 58 years at the time of surgery (mean age: 31.8 years; median: 29 years). There were 2 children (5 and 11 years old) and 16 adults. Inclusion criteria for the study were an established clinical diagnosis of IIH, lack of improvement with medication, and the presence of small ventricles. In all patients EM-navigated placement of the ventricular catheter was performed using real-time tracking of the catheter tip for exact positioning close to the foramen of Monro. Postoperative CT scans were correlated with intraoperative screen shots to validate the position of the catheter.

In all patients EM-navigated ventricular catheter placement was achieved with a single pass. There were no intraoperative or postoperative complications. Postoperative imaging confirmed satisfactory positioning of the ventricular catheter. No proximal shunt failure was observed during the follow-up at a mean of 41.5 months (range: 7-90 months, median: 40.5 months).

EM-navigated ventricular catheter placement in shunting for IIH is a safe and straightforward

technique. It obviates the need for sharp head fixation, the head of the patient can be moved during surgery, and it may reduce the revision rate during follow-up [3].

Retrospective cohort studies

A retrospective study was performed based on our database. We analyzed demographics, pre and postoperative parameters, and follow-up data on patients who had undergone either LPS or VPS between January 2007 and December 2017.

Group I consisted of 17 VPS patients, of which 16 were female, and group II consisted of 29 LPS patients, of which 26 were female. The number of surgeries performed in the LPS group was higher (due to recurrence) than that in the VPS group. Moreover, the rate of complications was higher in the LPS group.

VPS is safer and has a lower rate of complications and reinterventions compared to LPS [4]

A retrospective analysis was conducted using a national administrative database to identify idiopathic intracranial hypertension (IIH) patients who underwent LP or VP shunting from 2007 to 2014. Multivariate logistic and Cox regressions were performed to compare shunt failure rates and time to shunt failure between LP and VP shunts while controlling for demographics and comorbidities.

Results: The analytic cohort included 1082 IIH patients, 347 of whom underwent LP shunt placement at index hospitalization and 735 of whom underwent VP shunt placement. Shunt failure rates were similar among patients with LP and VP shunt (34.6% vs 31.7%; P = .382). Among patients who experienced shunt failure, the mean number of shunt failures was 2.1 ± 1.6 and was similar between LP and VP cohorts. Ninety-day readmission rates, complication rates, and costs did not differ significantly between LP and VP shunts. Patients who experienced more than two shunt failures tended to have an earlier time to first shunt failure (hazard ratio 1.41; 95% confidence interval 1.08-1.85; P = .013).

Conclusion: These findings suggest that LP and VP shunts may have comparable rates of shunt failure and complication. Regardless of shunt type, earlier time to first shunt failure may be associated with multiple shunt failures. [5]

The Nationwide Inpatient Sample database was queried for all patients with the diagnosis of benign intracranial hypertension (International Classification of Diseases, Ninth Revision, code 348.2) from 2005 to 2009. These data were stratified by operative intervention, with demographic and hospitalization charge data generated for each.

A weighted sample of 4480 patients was identified as having the diagnosis of idiopathic intracranial hypertension (IIH), with 2505 undergoing first-time VP shunt placement and 1754 undergoing initial LP shunt placement. Revision surgery occurred in 3.9% of admissions (n = 98) for VP shunts and in 7.0% of admissions (n = 123) for LP shunts ($p < 0.0001$). Ventriculoperitoneal shunts were placed at teaching institutions in 83.8% of cases, compared with only 77.3% of first-time LP shunts ($p < 0.0001$). Mean hospital length of stay (LOS) significantly differed between primary VP (3 days) and primary LP shunt procedures (4 days, $p < 0.0001$). The summed charges for the revisions of 92 VP

shunts ($3,453,956) and those of the 6 VP shunt removals ($272,484) totaled $3,726,352 over 5 years for the study population. The summed charges for the revision of 70 LP shunts ($2,229,430) and those of the 53 LP shunt removals ($3,125,569) totaled $5,408,679 over 5 years for the study population.

The presented results appear to call into question the selection of LP shunt placement as the primary treatment for IIH, as this procedure is associated with a significantly greater likelihood of need for shunt revision, increased LOS, and greater overall charges to the health care system [6].

Seventeen patients treated with ventriculoperitoneal shunt (VPS) for idiopathic intracranial hypertension (IIH) were followed up for 1.8 to 12.8 years (mean 6.5 years). The ventricular catheter was inserted without any guidance device. VPS was effective on all clinical manifestations of IIH. Seven patients required one or two (a total of nine) surgical revisions. The revision rate was significantly less than in two similar series of patients treated with lumboperitoneal shunt [7].

Retrospective case series

2015

Rizzo et al. retrospectively reviewed all cases of IIH with CSF shunting at our institution between 2004 and 2011. Perimetry was performed before and after surgery in 15 patients, and the mean deviation (MD) was compared before and after surgery to assess the effect of the intervention.

Results: Fourteen of the IIH patients were female and 1 was male. The average age was 34 years. CSF shunting resulted in significant improvement in the perimetric results with an increase in the MD of 5.63 ± 1.19 dB ($P < 0.0001$). Additionally, average retinal nerve fiber layer (RNFL) thickness measurement by optical coherence tomography decreased by 87.27 ± 16.65 μm ($P < 0.0001$), and Frisen papilledema grade decreased by 2.19 ± 0.71 ($P < 0.0001$).

The results suggest that CSF shunting results in improvement in perimetry, RNFL swelling, and papilledema grade in patients with IIH [8].

2005

Woodworth et al., describe the frameless stereotactic VP shunting technique for IIH in 32 procedures. Outcomes following shunt placement, time to shunt failure, and etiology of shunt failure are reported.

A total of 21 patients underwent 32 ventricular shunting procedures (20 VP, 10 ventriculoatrial, 2 ventriculopleural). One hundred percent of shunts were successfully placed into slit ventricles, all requiring only one pass of the catheter under stereotactic guidance to achieve the desired location and CSF flow. There were no procedure-related complications and each ventricular catheter showed rapid egress of CSF. All (100%) patients experienced significant improvement of headache immediately after shunting. Ten percent of ventricular shunts failed at 3 months after insertion, 20%

failed by 6 months, 50% failed by 12 months, and 60% failed by 24 months. Shunt revision was due to distal obstruction in 67%, overdrainage in 20%, and distal catheter migration or Cerebrospinal fluid fistula in 6.5%. There were no shunt revisions due to proximal catheter obstruction or shunt infection.

In this experience treating patients with IIH, frameless stereotactic ventricular CSF shunts were extremely effective at treating IIH-associated intractable headache, and continued to provide relief in nearly half of patients 2 years after shunting without many of the shunt-related complications that are seen with LP shunts. Placing ventricular shunts using image-guided stereotaxis in patients with IIH despite the absence of ventriculomegaly is an effective, safe treatment option [9].

1)
de Melo Junior JO, da Mata Pereira PJ, Niemeyer Filho P. Freehand Ventriculoperitoneal Shunt for Idiopathic Intracranial Hypertension: Technical Note for Slit-Like Ventricle Puncture. Cureus. 2023 Feb 3;15(2):e34583. doi: 10.7759/cureus.34583. PMID: 36883076; PMCID: PMC9985828.
2)
Andreão FF, Ferreira MY, Oliveira LB, Sousa MP, Palavani LB, Rairan LG, Tinti ISU, Júnyor FS, Batista S, Bertani R, Amarillo DG, Daccach FH. Effectiveness and Safety of Ventriculoperitoneal Shunt Versus Lumboperitoneal Shunt for Idiopathic Intracranial Hypertension: A Systematic Review and Comparative Meta-Analysis. World Neurosurg. 2024 May;185:359-369.e2. doi: 10.1016/j.wneu.2024.02.095. Epub 2024 Feb 28. PMID: 38428810.
3)
Hermann EJ, Polemikos M, Heissler HE, Krauss JK. Shunt Surgery in Idiopathic Intracranial Hypertension Aided by Electromagnetic Navigation. Stereotact Funct Neurosurg. 2017 Jan 14;95(1):26-33. doi: 10.1159/000453277. [Epub ahead of print] PubMed PMID: 28088808.
4)
de Oliveira AJM, Pinto FCG, Teixeira MJ. Comparative Study of the Effectiveness of Lumboperitoneal and Ventriculoperitoneal Shunting with Neuronavigation in the Treatment of Idiopathic Intracranial Hypertension. Neurol India. 2020 Sep-Oct;68(5):1061-1064. doi: 10.4103/0028-3886.294549. PMID: 33109853.
5)
Azad TD, Zhang Y, Varshneya K, Veeravagu A, Ratliff JK, Li G. Lumboperitoneal and Ventriculoperitoneal Shunting for Idiopathic Intracranial Hypertension Demonstrate Comparable Failure and Complication Rates. Neurosurgery. 2020 Feb 1;86(2):272-280. doi: 10.1093/neuros/nyz080. PMID: 30937428.
6)
Menger RP, Connor DE Jr, Thakur JD, Sonig A, Smith E, Guthikonda B, Nanda A. A comparison of lumboperitoneal and ventriculoperitoneal shunting for idiopathic intracranial hypertension: an analysis of economic impact and complications using the Nationwide Inpatient Sample. Neurosurg Focus. 2014 Nov;37(5):E4. doi: 10.3171/2014.8.FOCUS14436. PMID: 25363432.
7)
Bynke G, Zemack G, Bynke H, Romner B. Ventriculoperitoneal shunting for idiopathic intracranial hypertension. Neurology. 2004 Oct 12;63(7):1314-6. doi: 10.1212/01.wnl.0000140699.43019.48. PMID: 15477563.
8)
Rizzo JL, Lam KV, Wall M, Wilson MD, Keltner JL. Perimetry, retinal nerve fiber layer thickness and papilledema grade after cerebrospinal fluid shunting in patients with idiopathic intracranial hypertension. J Neuroophthalmol. 2015 Mar;35(1):22-5. doi: 10.1097/WNO.0000000000000181. PMID: 25295682; PMCID: PMC5017247.
9)
Woodworth GF, McGirt MJ, Elfert P, Sciubba DM, Rigamonti D. Frameless stereotactic ventricular shunt placement for idiopathic intracranial hypertension. Stereotact Funct Neurosurg. 2005;83(1):12-6. PubMed PMID: 15724109.