Ommaya reservoir for pediatric hydrocephalus

- Hydrocephalus temporisation with ventricular reservoir or trans-fontanelle ventricular taps for intraventricular haemorrhage of prematurity: A retrospective cohort study
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Indications

In pediatric patients, an Ommaya reservoir may be used as an alternative to shunt surgery or endoscopic third ventriculostomy (ETV), which are other common treatment options for hydrocephalus.

Some indications for the use of an Ommaya reservoir in pediatric hydrocephalus include:

Treatment failure: If previous treatments for hydrocephalus have failed, an Ommaya reservoir may be considered as an alternative treatment option.

Recurrent infections: Patients who have experienced multiple shunt infections or complications may be considered for an Ommaya reservoir, as it reduces the risk of infection and related complications.

Reduced risk of obstruction: Ommaya reservoirs have a lower risk of obstruction compared to shunts, which can be important in pediatric patients who may need long-term treatment.

Flexibility in treatment: An Ommaya reservoir allows for direct access to the CSF, which can help deliver medications or for monitoring the pressure of the CSF.

It is a 'time buying' procedure until the baby has sufficient weight for successful shunt surgery. It has been found very effective intermediary intervention for managing shunt infection and it also helps revive a channel in shunt obstruction [1].

A high level of CSF lactate, absence of symptomatic persistent ductus arteriosus (PDA), and a higher

CSF extraction requirement were associated with a higher likelihood of implanting a permanent CSF shunt. The authors believe these findings should be considered in future studies [2)]

Case series

Hamid et al. analyzed the efficacy of the Ommaya reservoir within all the different pediatric hydrocephalus types. At the same time, it's safe for repeated aspirations or long-term retention of the reservoir in the body. This retrospective, cross-sectional study was performed from January 2019 to December 2021, 33 consecutive cases of Ommaya reservoir implantation were taken into the study irrespective of the pediatric hydrocephalus etiology in the Neurosurgery Department of Bangladesh Medical College Hospital, Dhaka, Bangladesh. These were mostly placed along with endoscopic third ventriculostomy and some were placed as an intermediary procedure to combat shunt complications in emaciated infants. Cerebrospinal fluid (CSF) aspiration was done in case of failed endoscopic third ventriculostomy and the frequency of aspiration depended upon the production of cerebrospinal fluid. Acetazolamide was routinely administered in each patient to reduce the frequency of aspiration. Most of the patients required ventriculoperitoneal (VP) shunt while they had sufficient body weight and few required no surgery. The average age at presentation was 76.88 days. All the neonates and infants had less weight in terms of their age. 42.4% of babies needed aspiration 2 times per week. Among all cases, 9.1% developed reservoir complications. Complications were not related to the number and volume of aspiration or duration of the reservoir in the body. Two (2) patients died after one year of reservoir implantation due to unknown etiology. Out of the 31 survivors, 3 patients did not need any further aspiration and 19 patients needed a ventriculoperitoneal shunt, but the reservoir was kept in situ for a future emergency. The rest of them is waiting for a definitive shunt procedure. Other findings include low socioeconomic group was more prone to low birth weight and they carried the burden of congenital hydrocephalus and meningomyelocele. Most affected babies had their prenatal period in arsenic-affected areas in Bangladesh. Overall folic acid supplementation was started after the formation of the neural tube irrespective of socioeconomic status. Ommaya reservoir implantation along with endoscopic third ventriculostomy plays a vital role in delaying shunt in endoscopic third ventriculostomy failure. It is a 'time buying' procedure until the baby has sufficient weight for successful shunt surgery. It has been found very effective intermediary intervention for managing shunt infection and it also helps revive a channel in shunt obstruction [3)].

Forty-six patients received an Ommaya reservoir. Five patients (10.9%) were excluded due to intraventricular infection during management with an Ommaya reservoir. The average gestational age and weight for the remaining 41 patients was 27 ± 1.8 weeks and 987 ± 209 grams, respectively. Thirty patients required a permanent shunt and 11 patients did not require a permanent shunt. The conversion rate from an Ommaya reservoir to a permanent shunt was 76.1%. Symptomatic persistent ductus arteriosus (PDA) was more frequent in the nonpermanent shunt group than in the shunt group (88.9% vs 50%, $p = 0.04$). The need for extraction of more than 10 ml/kg per day of CSF through the Ommaya reservoir was lower in the nonpermanent shunt group than in the shunt group (9.1% vs 51.7%, $p = 0.015$). CSF lactate was lower in the nonpermanent group than in the shunt group (mean 2.48 mg/dl vs 3.19 mg/dl; $p = 0.004$). A cutoff value of ≥ 2.8 mg/dl CSF lactate predicted the need for a permanent shunt with sensitivity and specificity of 82.4% and 80%, respectively. There were no significant differences in gestational age, sex, weight, Papile grade, ventricular index, or other biochemical markers. After the multivariate analysis, only CSF lactate ≥ 2.8 mg/dl was associated

with a higher conversion rate to a permanent shunt.

This study showed that a high level of CSF lactate, absence of symptomatic PDA, and a higher CSF extraction requirement were associated with a higher likelihood of implanting a permanent CSF shunt. The authors believe these findings should be considered in future studies [4)]

Twenty-five infants, with a median gestational age (GA) of 26.5 (28 ± 4) weeks and a median birth weight (BW) of 980 g (1205 ± 837), were included. The median umbilical artery pH (UApH) was 7.30 (7.20 ± 0.25). The median Apgar score at 10 min was 8 (7.4 ± 2). Twenty-five peri- and postnatal adverse events were encountered preoperatively. The IVH grades were grade II (n = 1), grade III (n = 17), grade IV (n = 6), and unknown grade (n = 1). Primary treatment consisted of CSF_R (n = 18) or VPS (n = 7) placement. There was a statistically significant difference between the postnatal ages of infants with CSF_R (32.5 days; 42 ± 28) and infants with VPS (163 days; 161 ± 18). Furthermore, we found a difference regarding GA but not BW between both groups. Arrest of PHH with shunt independence occurred in two infants from the CSF_R group (11%).

Conclusions: In the present study, early insertion of CSF_R allowed stabilization of the infants and thus postponement of permanent VPS insertion. However, in a subgroup of patients, PHH develops over a more prolonged course, and VPS insertion can be performed initially without the need for CSF_R [5)]

Lin et al. analyzed the effects of Ommaya reservoir implantation in 12 children with TBMH. Intracapsular puncture of the reservoir was performed for draining the cerebrospinal fluid and the TBM was treated by intraventricular injection of isoniazid.

Results: The ideal treatment outcome was observed in nine (75 %) of the 12 children; two (16.7 %) children developed serious disabilities and one of them (8.3 %) eventually died. The treatment method was effective for all six (100 %) children with Palur grade II TBM but showed no effect in three (50 %) children with grade III and IV TBM. The number of leukocytes in the cerebrospinal fluid decreased to 20 × 10(6)/L (75 %) within 2 weeks after implantation of the reservoirs. Finally, the Ommaya reservoirs in eight children were removed but were retained in four children. Four children had to undergo ventriculoperitoneal shunt.

Ommaya reservoir implantation is effective in treating children with TBMH. This method may be largely suitable for children with early grade II TBM or partly for children with grade III TBM who have mild or moderate hydrocephalus that can alleviate after short-term treatment. Thus, a good proportion of children who undergo Ommaya reservoir implantation can avoid ventriculoperitoneal shunt surgery [6)]

Between January 1, 2003 and December 30, 2005, 15 consecutive newborn infants with IVH grades III to IV, complicated with progressive ventricular dilatation, underwent placement of an Ommaya reservoir. CSF was intermittently aspirated percutaneously from the reservoir. The amount and frequency of CSF aspiration were based on the clinical presentation and the follow-up results of serial cranial ultrasonograms or CT scans. The changes of CSF cell counts and chemistries were also followed. Patients whose progressive ventricular dilatation persisted despite serial CSF aspiration through Ommaya reservoir eventually had ventriculo-peritoneal shunts (V-P shunt) placed. All the patients were followed up in the outpatient clinic after discharge from the hospital and the

neurodevelopmental outcomes were evaluated through 18-36 months of age.

Result: A total of 15 infants were included in this series. Of them, 11 were preterm infants who were at gestational ages of 29 to 34 weeks and 4 infants were full-term. All of the 4 full term infants presented with progressive ventricular dilatation after suffering from the intra-cranial hemorrhage (3 infants were due to vitamin K deficiency and 1 was due to birth trauma). Thirteen infants had grade III IVH, and 2 had grade IV IVH based on initial cranial ultrasonographic and CT scans. The mean age when IVH was diagnosed was (9 +/- 1) days in preterm infants and (22 +/- 7) days in full-term infants; the mean age when Ommaya reservoir was placed was (18 +/- 11) days in preterm infants and (31 +/- 7) days in full-term infants. All the infants tolerated the surgical procedure well. The Ommaya reservoir was tapped for an average of (21.5 +/- 4.6) times per patient. The mean CSF volume per tap was (10.2 +/- 1.3) ml/kg. The values of CSF protein, glucose and cell counts slowly reached normal levels at approximately 3 - 5 weeks after the placement of the reservoir. The velocity of head circumference increase per week was less than 1 cm in 13 patients in 1 - 4 weeks after the placement of the reservoir and the size of ventricles decreased gradually. By 12 - 18 months, 12 infants had normal size ventricles, and 1 patient still had mild ventricular dilation at 36 months. Two infants developed progressive hydrocephalus after serial CSF aspiration through Ommaya reservoir. One infant had a V-P shunt placed at 2 months of age and another infant died at 3 months of age at home after parents refused further therapy. Complications consisted of reservoir leaking and CSF infection at 16th day of placement in one patient after repeated tapping. By the end of 18 - 36 months of follow-up, 11 of 14 infants were considered normal, two patients had mild impairment in neurodevelopmental outcome (both had spastic bilateral lower limbs paresis, and one of whom also had amblyopia) and the other had seizure disorder.

The results from this series indicate that the placement of an Ommaya reservoir is relatively safe in newborn infants and is useful in the initial management of neonates with PHH and may be beneficial in improving their neurodevelopmental outcomes. A multicenter randomized trial may be needed to further validate the results of this report [7)]

[1)], [3)]
Hamid R, Gomes VC, Huda N, Khan AR, Chowdhury M, Azam I. Role of Ommaya Reservoir in Pediatric Hydrocephalus: Experience in Bangladesh Medical College Hospital from 2019-2021. Mymensingh Med J. 2023 Apr;32(2):510-519. PMID: 37002765.

[2)], [4)]
Palpan Flores A, Saceda Gutiérrez J, Brin Reyes JR, Sierra Tamayo J, Carceller Benito F. Risk factors associated with conversion of an Ommaya reservoir to a permanent cerebrospinal fluid shunt in preterm posthemorrhagic hydrocephalus. J Neurosurg Pediatr. 2020 Jan 17:1-8. doi: 10.3171/2019.11.PEDS19320. Epub ahead of print. PMID: 31952037.

[5)]
Tröbs RB, Sander V. Posthemorrhagic hydrocephalus in extremely low birth weight infants: Ommaya reservoir vs. ventriculoperitoneal shunt. Childs Nerv Syst. 2015 Aug;31(8):1261-6. doi: 10.1007/s00381-015-2754-y. Epub 2015 May 28. PMID: 26018211; PMCID: PMC4513217.

[6)]
Lin J, Zhou H, Zhang N, Yin B, Sheng HS. Effects of the implantation of Ommaya reservoir in children with tuberculous meningitis hydrocephalus: a preliminary study. Childs Nerv Syst. 2012 Jul;28(7):1003-8. doi: 10.1007/s00381-012-1748-2. Epub 2012 Apr 15. PMID: 22526442.

[7)]
Lin ZL, Yu B, Liang ZQ, Chen XW, Liu JQ, Chen SQ, Zhang ZY, Zhang N. [Role of Ommaya reservoir in the management of neonates with post-hemorrhagic hydrocephalus]. Zhonghua Er Ke Za Zhi. 2009 Feb;47(2):140-5. Chinese. PMID: 19573462.