



Original Paper

Ventriculosubgaleal shunting in the treatment of posthemorrhagic hydrocephalus of premature infants: case series

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Abstract

Introduction: Posthemorrhagic hydrocephalus (PHH) comprises the most common complication in those preterm infants (PTI) who suffered germinative matrix hemorrhage (GMH), and its treatment is still matter of controversies. These infants usually weigh less than 1,500g and a temporary CSF diversion device is needed. VSGS is preferred in those cases because it is a simple and rapid method, no need for repetitive aspiration for the evacuation of CSF, gives a permanent decompression without causing electrolyte and nutritional losses, and still protects the cerebral development of newborns with GMH.

Methods: We analyzed a series of 22 PTI who underwent VSGS for PHH, between July 2015 and April 2019, and minimum follow-up 6 months. The median gestation age was 28 weeks (range 23-32). The median weigh was 985g (range 625-1615). The mean period harboring de VSGS was 61,8 days (range 35-80). **Results:** The cases were studied for: 1) Shunt dependency: 11 children (50%) showed persistent hydrocephalus at further investigation and underwent to VP shunt after stable clinical condition. 2) Infection: 6 subjects (27,2%) showed positive cultures, and were converted to External Ventricular Device (EVD), and further VP shunt; 3) Outcome: the results were separated in Excellent/Good (GOS 5-4) 12 subjects (54%); Poor (GOS 3-2): 8 subjects (36%) and Death (GOS 1): 2 subjects (10%).

Conclusions: VSGS is a good alternative method to treat PHH, especially in a preterm infant who needs a temporary shunt device. The low rate of severe complications and encouraging results about persistent hydrocephalus should guide further investigation and larger cases series.

Key words: Ventriculosubgaleal shunting, Subgaleal shunting, Preterm infants, Intraventricular hemorrhage, Posthemorrhagic hydrocephalus

Introduction

Intraventricular hemorrhage (IVH) remains a serious complication of premature birth. Despite many treatment options, there is still no consensus on the management of post-hemorrhagic hydrocephalus (PHH) in the very low birth weight (VLBW) baby [1,2,5,8]. Preterm infants (PTI) are at risk for an extensive array of neurological complications, of which the most commonly observed and severe is intraventricular hemorrhage (IVH). Currently, IVH is seen in approximately 15%–20% of infants weighing below 1500 g and in 50% of infants weighing less than 750g. In 25%–50% of cases, progressive posthemorrhagic ventricular dilatation and posthemorrhagic hydrocephalus (PHH) develop as result of IVH. Symptomatic PHH has been associated with poor outcomes, including elevated rates of cognitive deficits, disability, and mortality [4]. Many reports have been showing VSGS as a beneficial tool in the management of PHH on premature infants before the placement of a permanent shunt and also comparing VSGS with Omayya Reservoir (OR) technique. The preference of these two techniques has been seen in different neurosurgical centers [5], although no significant statistical difference has been demonstrated in general outcomes between the both of them [6]. Since VSGS offers a less handling of the system and a constant control of intracranial hypertension, it remains to be the preferred protocol for the author, because puncturing the reservoir to control intracranial pressure daily does not seem necessary. Moreover, other authors have attempted to show that these VSGS patients were significantly older, had achieved greater weights and more optimal surgical candidacy at the time of VP shunt insertion [3,5]. We herein investigate the role of VSGS in the prognosis of the many complications it can occur.

Material and methods

We analyzed a series of 22 PTI who suffered Papile [7] grades III and IV of IVH and underwent VSGS for PHH, between July 2015 and April 2019. All

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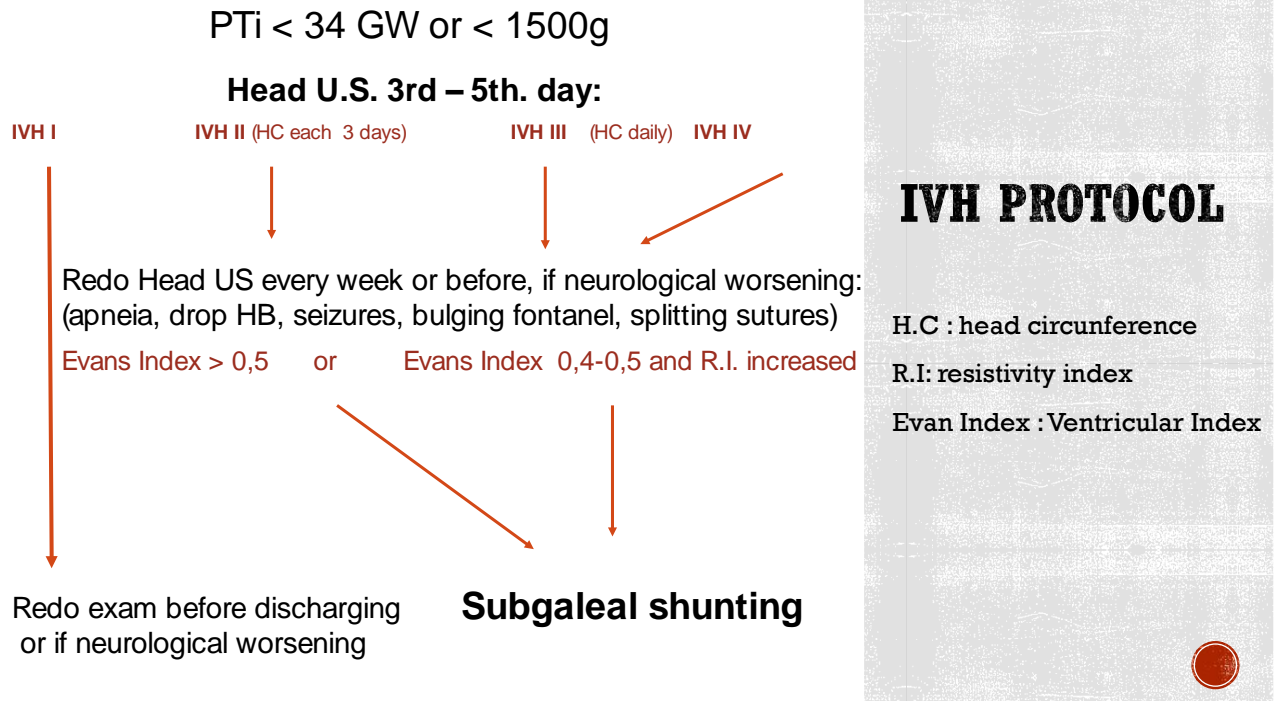


Figure 1. IVH Protocol

subjects had a minimum of 9-month follow-up. The median gestation age was 28 weeks (range 23-32). The median weight was 985g (range 625-1615). The mean period harboring de VSGS was 61,8 days (range 35-80).

Diagnosis

GMH and PHH were diagnosed upon serial head ultrasounds (HU) performed by the senior author at side bed into de Neonatal ICU. All the cases were classified into Papile et al grade groups (table 1).

Table 1. Papile's classification of preterm intraventricular hemorrhage

Papile Classification	
Grade I	Hemorrhage limited to the GM
Grade II	IVH but no ventricular dilatation
Grade III	IVH and ventricular dilatation
Grade IV	IVH and parenchymal hemorrhage

The subjects were also studied pre-operatively for: gender, gestation weeks, weight at birth, age at surgery (in days), APGAR, and post-operatively for: days harboring the system, infection and shunt dependency. The follow-up protocol for IVH is summarized in figure 1. All the grades III and IV were seek with HU weekly, or sooner as it needed, as well daily for measurements of head circumference (HC), fontanel fashion, and clinical general status. Once the patients fit the profile established by the strict protocol (figure 1), the PTI had to be operated. We discussed the clinical status and coagulation exams with the ICU

crew and if necessary, red blood cells or platelets transfusion were available.

Surgical Technique

All the PTI were transferred to the operation room and under general anesthesia, the skin was incised and subgaleal space undermined. A small trephination at Kocher point was made and the ventricular catheter inserted. A valveless system (HpBio® - neonatal) was then connected (figures 2) without a distal catheter (removing the valve). The skin was closed in one layer fashion with separated non-absorbable sutures.

Post-operative period

In the ICU, all the PTI were followed daily with HC measurements and wound inspection twice a day. We recommended the nurses to do a massage several times a day upon the system reservoir, to guarantee a good subgaleal pouch, especially in the first five days post-op. Effort was also taken not to put tight dressings over the wound, avoiding the stretch of the subgaleal pouch. Head Ultrasound continued to be done weekly to follow de ventricular size and brain arteries Doppler fashion [8].

Results/Discussion

The subjects are being followed at least for 9 months since each surgery. Every studied detail is summarized in table 2.

Table 2. Cases series numbers and results

CASE NUMBER	G.W.	PAPILE GRADE	AGE AT SGS (DAYS)	WEIGHT(G)	DAYS WITH SGS	INFECTIO N	CONVERSION TO VP SHUNT	OUTCOME
1	25	IV	20	780	50	N	Y	EXCELENT
2	28	IV	15	850	45	N	Y	EXCELENT
3	24	IV	10	683	80	N	N	REGULAR
4	23	IV	12	625	20	N	N	DEATH
5	26	IV	12	905	40	Y	Y	POOR
6	31	III	30	1105	70	N	N	EXCELENT
7	30	IV	25	1085	70	N	N	EXCELENT
8	29	III	12	890	75	N	N	POOR
9	29	IV	13	780	77	N	N	POOR
10	30	III	15	1050	63	N	N	EXCELENT
11	32	III	16	985	65	N	N	GOOD
12	28	IV	12	995	85	Y	Y	REGULAR
13	30	IV	14	1615	70	N	N	GOOD
14	26	IV	11	980	40	N	Y	GOOD
15	24	IV	11	650	60	N	N	GOOD
16	25	III	12	765	45	Y	Y	REGULAR
17	25	IV	14	960	40	N	Y	GOOD
18	27	IV	21	1050	58	N	Y	GOOD
19	29	IV	10	1105	30	Y	Y	POOR
20	26	IV	12	675	48	Y	Y	POOR
21	30	IV	15	900	70	N	Y	EXCELENT
22	28	IV	10	1010	52	Y	Y	DEATH

G.W: gestation weeks, SGS: Subgaleal Shunting, VP shunt: Ventriculoperitoneal shunt, Y: yes, N: no

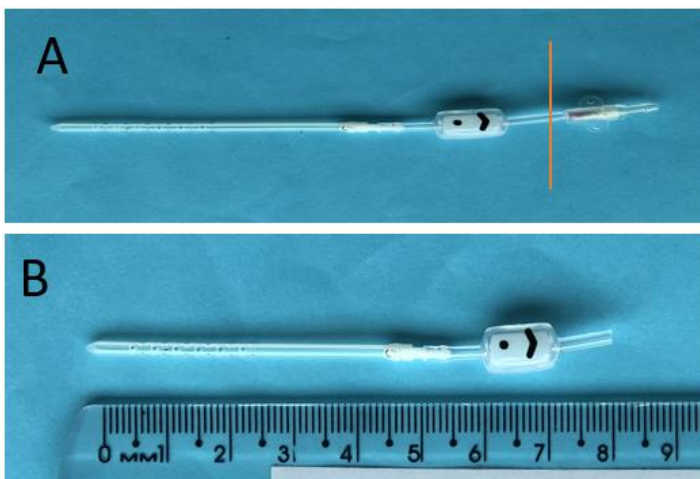


Figure 2. Ventricular catheter connected to the valve system. A. The crossing orange line shows the point the valve is cut off. B. The ready system showing the little reservoir and tinny distal end

Shunt dependency

Six children (27.2%) developed some sort of complication in which was necessary to perform

neuroendoscopic approaches such as septostomy, endoscopic third ventriculostomy, and cysts fenestrations. All of them needed to be converted to a further VP shunt. Other 6 subjects showed persistent hydrocephalus during their investigation and had to undergo a VP shunt after stable clinical condition.

To be prone to VP conversion all the following conditions were necessary: 1) weight higher than 2,000g, so that PTI's VP shunt would have its chances improved to work properly with less abdominal complications; 2) at least 2 serial negative CSF samples for bacteria, to guarantee that the CSF is free of pathogens 3) CSF protein content less than 1 g, expecting this could decrease the risk of mechanical VP shunt malfunctioning and eventually 4) persistent hydrocephalus and bulging subgaleal pouch, assuring the need of permanent shunting.

Wang et al reported surgery for permanent shunting in 10.9% at 1 month, 43.5% at 2 months, and 67.4% at 5 months after VSGS [3]. A recent meta-analysis from Fountain found 60–86 % conversion to VP shunt after VSGS [13].

Infection and complications

Six subjects (27.2%) presented positive CSF cultures. They were converted to External Ventricular Device (EVD), received intravenous antibiotics tailored by the antibiograms, and subsequent VP shunt accordingly the above-noted conditions. 3 of those 6 subjects showed leakage from the pouch and then meningitis, which lead to further EVD. The other 3 developed pulmonary infection followed by sepsis and ventriculitis, and also required temporary EVD and were converted to VP shunt.

The infection rate is variable in the literature. Tubb et al reported a 5.9% infection rate. Staphylococcus aureus and Staphylococcus epidermidis being the main culprits [9] On the other hand Willis et al. reported 66.7% of infection [10]. Infection rates seem to be related to the age and weight of children. In our series, the median weight was 985g, less than 1000g, and maybe one of the reasons in which led to being more prone to infections. In the same way, the median gestation weeks was 28 weeks, less than 30 weeks, another cut-off for poorer prognosis[11].

The most frequent complications of VSGS besides infection are: leakage, kinking of the shunt tubing, and wound breakdown with variables incidences [12].

Outcome

The results were separated among: Excellent/Good (Glasgow Outcome Scale – GOS - 5-4) 12 subjects (54%). Children who are doing well-performing, adequate or barely normal motor and cognitive skills for the age; Poor (GOS 3-2): 8 subjects (36%), in which include children who are underdeveloped, disabled, and shall be dependent to the caregivers for a significant span of life; and Death (GOS 1): 2 subjects (10%). One death occurred after severe pulmonary infection resulting in sepsis (patient n.4) and the other one (patient n.22) after respiratory distress during bronchospasms crises. Vaner et al observed 28% of mortality in the first month (25 cases of VSGS), related mainly to infection and sepsis [1]. Kutty et al found 14.2% of mortality (1 out of 7 children). The mortality is intrinsically related to the germinative matrix hemorrhage disease and related morbidly of prematurity.

Conclusions

VSGS is a safe and quick procedure and works as a good alternative method to treat PHH, moreover those PTI whose need a temporary shunt device [13,14,15,16]. A proactive IVH protocol should be conducted in each neonatal ICU in order to diagnose and treat these patients in advance these. Multidisciplinary teams should be encouraged to work on such cases since knowledge from different areas is required, as well as engagement from these professionals, who can face this common and

challenging condition. Ongoing multicenter prospective studies are being expected to answer many unsolved issues [17]. So far, we recommend VSGS as a useful tool considering its low rate of severe complications and good results about persistent hydrocephalus.

Disclosure Statement

The author reports no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

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