CODEN [USA]: IAJPBB ISSN: 2349-7750

INDO AMERICAN JOURNAL OF
PHARMACEUTICAL SCIENCES

http://doi.org/10.5281/zenodo.1550922

Available online at: http://www.iajps.com *Review Article*

PEDIATRIC HYDROCEPHALUS MANAGEMENT: SYSTEMATIC REVIEW IN LITERATURE

Shorooq Alenzi[1]*, Ahad Alkenani[2], Sultan Alanazi[5], Essa Alshehri[3], Reem Almuhanna[4], Abdullah Asiri[3], Noor Bawahab[2], Sultan Albukhari[2], Fares Aljohani[5], Ahmed Alhazmi[3]

[1]Tabiah University, Medical College of Tabiah University, Madina, Saudi Arabia
[2]King Abdualziz University, Medical College of King Abdualziz University, Jeddah, Saudi Arabia
[3]King Khalid University, Medical College of King Khalid University, Abha, Saudi Arabia
[4]King Saud bin Abdulaziz university for health sciences, Medical College, Riyadh, Saudi Arabia
[5]King Saud University, Medical College of King Saud University, Riyadh, Saudi Arabia

Abstract:
This review is aiming to review and analysis the Pediatric Hydrocephalus Management. The present review was conducted by searching in Medline, Embase, Web of Science, Science Direct, BMJ journal and Google Scholar for, researches, review articles and reports, published over the past years. Books published on the Pediatric hydrocephalus Management. If several studies had similar findings, we randomly selected one or two to avoid repetitive results. Based on findings and results this review found.
Result: There is insufficient evidence to recommend a specific weight or CSF parameter to direct the timing of shunt placement in premature infants with PHH. Clinical judgment is required. There is insufficient evidence to recommend the use of endoscopic third ventriculostomy (ETV) in premature infants with PHH.
Keywords: *hydrocephalus, infant, case management, post hemorrhagic, premature infant , preterm infant , ventriculomegaly , intraventricular hemorrhage , ventricular dilation .ventriculoperitoneal shunt.*

Corresponding author:
Dr. Shorooq Alenzi,
Tabiah University,
Medical College of Tabiah University,
Madina, Saudi Arabia
Email: Shorooq.a.alenzi@gmail.com

QR code

Please cite this article in press Shorooq Alenzi et al., ***Pediatric Hydrocephalus Management: Systematic Review in Literature.,*** *Indo Am. J. P. Sci, 2018; 05(11).*

INTRODUCTION:

Hydrocephalus is a condition in which there is an accumulation of cerebrospinal fluid (CSF) within the brain.[1] This typically causes increased pressure inside the skull [1]. Older people may have headaches, double vision, poor balance, urinary incontinence, personality changes, or mental impairment[1]. In babies there may be a rapid increase in head size. Other symptoms may include vomiting, sleepiness, seizures, and downward pointing of the eyes [1].

Hydrocephalus can occur due to birth defects or be acquired later in life[1]. Associated birth defects include defects and those that result in aqueductal stenosis.[2] Other causes include meningitis, brain tumors, traumatic brain injury, intraventricular hemorrhage, and subarachnoid hemorrhage[1] .There are four types of hydrocephalus: communicating, non-communicating, ex-vacuo, and normal pressure. Diagnosis is typically made by examination and medical imaging [1].

About one to two per 1,000 newborns have hydrocephalus.[3] Rates in the developing world may be more.[4]Normal pressure hydrocephalus is estimated to affect about 5 per 100,000 people with rates increasing with age [5]. Description of hydrocephalus by Hippocrates date back more than 2000 years [4].

(BW) infants, each weighing between 401 g and 1000g, was undertaken to assess neurodevelopmental outcome [1]. More than 5000 infants died while in the hospital or before the follow-up visit. Among the 7693 children in whom follow-up studies were available, 2530 (33%) had a history of intraventricular hemorrhage (IVH). The IVH was Grade III or IV for 998 (13%) of the 7693 infants. Remarkably, in only 246 (3%) of the 7693 ELBW infants with follow-up was a shunt placed for PHH.

METHODS:

The present review was conducted November 2018 in accordance with the preferred reporting items for systematic reviews and meta-analyses (PRISMA) declaration standards for systematic reviews. We reviewed all the topics on Pediatric hydrocephalus Management, such as, etiology, epidemiology, and clinical statistics. To achieve this goal, we searched Medline, Embase, Web of Science, Science Direct, and Google Scholar for, researches, review articles and reports, published over the past 15 years. Books published on Pediatric hydrocephalus Management.
Our search was completed without language restrictions. Then we extracted data on study year, study design, and key outcome on **hydrocephalus**. The selected studies were summarized and unreproducible studies were excluded. Selected data is shown in the Table 1.

Inclusion criteria

Additional inclusion criteria included studies in which infants younger than 12 months with all forms of hydrocephalus—both congenital and acquired—were evaluated to ensure that the maximum numbers of studies were reviewed. The analysis focused on studies evaluating infants with PHH because of the treatment strategies and challenges unique to this patient population

Exclusion criteria

Because of the US National Library of Medicine's search engine functionalities, additional search terms (heart ventricles) not relevant to topics addressed in this chapter were added to the search strategy. We excluded those references because they were not relevant to the overall scope of this project or the patient population addressed in this chapter and, therefore, did not meet the article inclusion criteria specified in the methodology section of this guideline.

Data extraction and analysis

Information relating to each of the systematic review elements was extracted from the studies and collated in qualitative tables. Direct analysis of the studies of **Pediatric hydrocephalus** is made with extreme caution, as different sampling techniques can provide bias as overview of the assemblage.

RESULTS:

The criteria for the decision to treat were quite variable among different institutions and different study groups. For example, we evaluated 1 Class II study in which hydrocephalus was defined as the atrium of the lateral ventricle measuring > 10 mm on the horizontal plane of a head ultrasound (HUS) study or the body of the lateral ventricle at the level of the mid thalamus measuring > 10 mm on a sagittal ultrasound image [6].

We reviewed another Class III study in which hydrocephalus was defined as anterior cortical mantle thickness <20 mm at an average postnatal age of 21 days along with increasing occipitofrontal circumference (OFC) as an indicator of hydrocephalus that should be treated[5]. Bada et al.5 reported that of 10 infants requiring shunts, 5 (50%) experienced normal development, which was defined by physical and neurological assessment and evaluation using the Denver developmental screening

tool. Evan's ratio, which is described as the lateral measurement of the ventricle across the frontal horns divided by the lateral measurement across the brain (biparietal diameter; also known as the ventricular/parietal [V/BP] ratio) can also be used to describe the severity of PHH. The majority of studies that were evaluated based on an initial diagnosis of PHH on HUS, CT, and MRI studies were also used. Choudhury described mild hydrocephalus as a V/ BP ratio of 0.26–0.40, moderate hydrocephalus as a V/BP ratio of 0.40–0.60, severe hydrocephalus as a V/BP ratio of 0.60–0.90, and extreme hydrocephalus as a V/ BP ratio of 0.91–1.0.16 These authors also reported that the thickness of the cortical mantle was not a statistically Significant indicator of outcome because several infants with extreme hydrocephalus displayed normal motor development. 16 One Class II and 1 Class III study indicated that when ventriculoperitoneal (VP) shunts were placed, even in cases of severe or extreme hydrocephalus, there were some infants with normal development and motor outcome (50 of 82 patients in the Choudhury study) [7]. Numerous studies have reported that good neurodevelopmental outcomes may be seen if and when infants with hydrocephalus are aggressively treated and cortical mantle thickness is restored.

Table (1): Results from Sequencing Studies.

Authors	Study Description	Data Class, Quality, & Reasons	Main Results
Behjati et al., 2011 [8]	Case series study that investigated risk factors for VP shunts in infants w/ hydrocephalus following IVH in 97 consecutive preterm infants w/ IVH.	Case series of 97 infants w/ IVH associated w/ prematurity. Risks factors associated w/need for a shunt were investigated. Infants were followed for 1 yr. Morbidities & mortalities were reported in a quantitative fashion. Pts treated medically w/ acetazolamide showed no benefit; however, infants treated w/ repeated CSF drainage through LP did have a higher shunt infection rate once the shunts were placed.	Infants w/ Grade III or IV IVH are at the highest risk of PHH & hydrocephalus. 11 of 31 pts who required a shunt developed shunt infection, which was significantly associated w/repeated LPs.
Kazanet al., 2005 [9]	Single-center retrospective review of preterm & LBW infants w/ IVH diagnosed by ultrasonography (n = 42). 11 infants who required VP shunts were compared w/ 31 who did not. All pts received acetazolamide & furosemide as an initial medical treatment	Small, retrospective case series w/ grouping of pts despite variable treatments	Risk factors for VP shunt included IVH grade, later EGA at birth, & age (days) at time of IVH, but not treatment for IVH/PHH (acetazolamide, furosemide, LP, or external ventricular drainage).
Whitelaw et al., 2007 [10]	Randomized multicenter clinical trial comparing standard treatment to DRIFT. 70 infants enrolled (34: DRIFT; 36: standard treatment). Outcomes: pts at 6 mos of age or at hospital discharge: death or VP shunt surgery, secondary IVH, & infection.	Multicenter randomized controlled trial.	15 of 34 pts (44%) in the DRIFT group died or required a shunt; compared w/ 19 of 36 pts (50%) who received standard treatment. 12 of 34 pts (35%) in RIFT group had secondary IVH compared w/ 8% of pts who received standard treatment. Conclusion: DRIFT did not reduce shunt surgery or death but was associated w/ an increased rate of secondary IVH.
Whitelaw & Odd, 2010 [11]	Review & meta-analysis of 2 prospective case-control studies (Luciano et al., 1997 & Yapicioğlu et al., 2003). Both source studies included total of 12 pts: 6 cases, 6 controls.Meta-analyses.	Both sources' studies were Class II (both were small randomized, prospective Case-control studies).	No difference in mortality or VP shunt rate was observed w/ intraventricular streptokinase. Intraventricular fibrinolytic therapy cannot be recommended for infants following IVH.
Fulkerson et al., 2011[12]	Premature infants w/ PHH have a high risk of shunt obstruction & infection. Risk factors for complications include grade of IVH & age at shunt insertion. There is anecdotal evidence that the amount of red blood cells or protein levels in the CSF may also increase shunt complications. This study examined whether any relationship exists between CSF constituents & shunt malfunction or infection	Retrospective cohort study evaluating the risk factors for shunt failure in preterm infants w/ IVH & PHH. Inclusion criteria & preintervention data points (baselines) were well documented. Outcomes reported included early shunt failure or infection w/in 3 mos of shunt. "Each CSF parameter was modeled as a possible predictor of the presence or absence of shunt malfunction or infection. Statistical significance was set at a probability level < 0.05."	Authors concluded that neither CSF cell count nor protein or glucose levels were statistically related to the occurrence of shunt failure or infection in the study population. The authors recommend that placement of the shunt be timed when age, weight, & the overall stability of the infant allow.

Elgamal et al., 2011 [13]	Review of 52 consecutive ETV procedures in 49 infants w/ hydrocephalus not necessarily associated w/ preterm IVH. Most infants (n = 31) had aqueductal stenosis. The remaining infants w/ hydrocephalus had other causes for it including Chiari II, Dandy-Walker cysts, quadrigeminal lipoma, & cerebellopontine angle arachnoid cyst. Only 6 pts had PHH caused by preterm IVH.	Case series of infants treated w/ an ETV. Infants were followed up for 68 mos on average. 6 of the 7 infants w/ PHH from premature birth required a shunt.	Authors concluded that the success rate of 69.4% indicates that ETV is safe & effective in infants w/ hydrocephalus not associated w/ PHH & prematurity. Infants w/ PHH from premature birth did not benefit from ETV.
Lipina et al., 2008 [14]	Retrospective consecutive case series of 14 infants <6 mo of age presenting w/ obstructive hydrocephalus. 8 of 14 pts had PHH. ETV was considered successful when a VP shunt was not necessary.	This study included a small number of pts w/ very different etiologies for hydrocephalus.	ETV was successful in 57% of pts—the majority of them w/ primary aqueductal stenosis. In the remaining 6 pts, a VP shunt was needed.
Peretta et al., 2007 [15]	Single-institution retrospective review of 18 consecutive preterm infants w/ PHH. Pts were treated w/ placement of an Ommaya reservoir for temporizing ventricular decompression. When necessary, pts later underwent VP shunt placement (n = 5) or ETV (n = 9).	Small single-institution retrospective case series w/ variable treatment patterns. 3 of the surviving 17 infants (17.6%) treated w/ Ommayas did not require additional surgery. 14 of 17 required VP shunt (n = 5) or ETV (n = 9). While additional surgeries were required in the majority of cases, 59% of pts were shunt free at the last follow-up.	Recommended combining Ommaya placement w/ ETV. It reduces shunt dependency in this condition.

DISCUSSION:

The main purpose of this article was to determine Pediatric hydrocephalus Management. Ventricular access devices (VADs), external ventricular drains (EVDs), ventriculosubgaleal (VSG) shunts or lumbar punctures (LPs) are treatment options in the management of post hemorrhagic hydrocephalus (PHH). Clinical judgment is required. Strength of Recommendation: Level II, moderate degree of clinical certainty. The evidence demonstrates that VSG shunts reduce the need for daily CSF aspiration compared with VADs. Strength of Recommendation: Level II, moderate degree of clinical certainty. The evidence demonstrates that VADs reduce morbidity and mortality compared with EVDs. The routine use of serial lumbar puncture (LP) is not recommended to reduce the need for shunt placement or to avoid the progression of hydrocephalus in premature infants.

Intraventricular thrombolytic agents including tissue plasminogen activator (tPA), urokinase, or streptokinase are not recommended as methods to reduce the need for shunt placement in premature infants with PHH. Strength of Recommendation: Level I, high clinical certainty. Acetazolamide and furosemide are not recommended as methods to reduce the need for shunt.

CONCLUSIONS:

There is insufficient evidence to recommend a specific weight or CSF parameter to direct the timing of shunt placement in premature infants with PHH. Clinical judgment is required.

There is insufficient evidence to recommend the use of endoscopic third ventriculostomy (ETV) in premature infants with PHH.

REFERENCES:

1. "Hydrocephalus Fact Sheet". NINDS. April 5, 2016. Archived from the original on 27 July 2016. Retrieved 5 September 2016.
2. Stevenson, David K, Benitz, William E. (2003). Fetal and Neonatal Brain Injury: Mechanisms, Management and the Risks of Practice. Cambridge: Cambridge University Press. p. 117. ISBN 9780521806916. Archived from the original on 2016-12-21.
3. Kahle KT, Kulkarni AV, Limbrick DD, Warf, BC (2016). "Hydrocephalus in children". Lancet. 387 (10020): 788–99.
4. Richard G, Ellenbogenl Saleem, I Abdulrauf, Laligam N. (2012) Principles of Neurological Surgery. E Sevier Health Sciences. p. 105. ISBN 1-4377-0701-7.
5. Ferri Fred F. (2016). Ferri's Clinical Advisor 2017: 5 Books in 1. Elsevier Health Sciences. p. 621. ISBN 9780323448383. Archived from the original on 2016-12-21. Genome-wide joint analysis of single-nucleotide variant sets and

gene expression for hypertension and related phenotypes. BMC Proc. 2016, 10, 125–129. [CrossRef] [PubMed].
6. Boynton BR, Boynton CA, Merritt TA, Vaucher YE, James HE, Bejar RF. Ventriculoperitoneal shunts in low birth weight C. A. Mazzola et al. 22 J Neurosurg: Pediatrics / Volume 14 / November 2014 infants with intracranial hemorrhage: neurodevelopmental outcome. Neurosurgery 18:141–145, 1986.
7. Choudhury AR. Infantile hydrocephalus: management using CT assessment. Childs Nerv Syst 11:220–226, 1995
8. Behjati S, Emami-Naeini P, Nejat F, El Khashab M. Incidence of hydrocephalus and the need to ventriculoperitoneal shunting in premature infants with intraventricular hemorrhage: risk factors and outcome. Childs Nerv Syst 27:985–989, 2011.
9. Kazan S, Güra A, Ucar T, Korkmaz E, Ongun H, Akyuz M: Hydrocephalus after intraventricular hemorrhage in preterm and low-birth weight infants: analysis of associated risk factors for ventriculoperitoneal shunting. Surg Neurol 64 Suppl 2:S77–S81, 2005.
10. Whitelaw A, Evans D, Carter M, Thoresen M, Wroblewska J, Mandera M, et al. Randomized clinical trial of prevention of hydrocephalus after intraventricular hemorrhage in preterm infants: brain-washing versus tapping fluid. Pediatrics 119:e1071–e1078, 2007.
11. Whitelaw A, Jary S, Kmita G, Wroblewska J, Musialik-Swietlinska E, Mandera M, et al: Randomized trial of drainage irrigation and fibrinolytic therapy for premature infants with posthemorrhagic ventricular dilatation: developmental outcome at 2 years. Pediatrics 125:e852–e858, 2010.
12. Fulkerson DH, Sivaganesan A, Hill JD, Edwards JR, Shoja MM, Boaz JC, et al: Progression of cerebrospinal fluid cell count and differential over a treatment course of shunt infection. Clinical article. J Neurosurg Pediatr 8:613–619, 2011.
13. Elgamal EA, El-Dawlatly AA, Murshid WR, El-Watidy SM, Jamjoom ZA: Endoscopic third ventriculostomy for hydrocephalus in children younger than 1 year of age. Childs Nerv Syst 27:111–116, 2011.
14. Lipina R, Reguli S, Dolezilová V, Kuncíková M, Podesvová H: Endoscopic third ventriculostomy for obstructive hydrocephalus in children younger than 6 months of age: is it a firstchoice method? Childs Nerv Syst 24:1021–1027, 2008.
15. Peretta P, Ragazzi P, Carlino CF, Gaglini P, Cinalli G: The role of Ommaya reservoir and endoscopic third ventriculostomy in the management of post-hemorrhagic hydrocephalus of prematurity Childs .Nerv Syst 23:765–771, 2007.

.

Abbreviations

used in this paper: AANS = American Association of Neurological Surgeons; CDC = Centers for Disease Control and Prevention; CNS = Congress of Neurological Surgeons; ELBW = extremely low birth weight; ETV = endoscopic third ventriculostomy; EVD = external ventricular drain; HUS = head ultrasound; IVH = intraventricular hemorrhage; LBW = low birth weight; LP = lumbar puncture; OFC = occipitofrontal circumference; PHH = post hemorrhagic hydrocephalus; PHVD = post hemorrhagic ventricular dilation; tPA = tissue plasminogen activator; VAD = ventricular access device; V/BP = ventricular/biparietal; VP = ventriculoperitoneal; VSG = ventriculosubgaleal.