10th IFNE World Congress of Neuroendoscopy

KK Women's and Children's Hospital SingHealth

National Neuroscience Institute SingHealth

Neuroendoscopic lavage for neonatal intraventricular haemorrhage: experience from a Singapore children's hospital

Authors: Felicia HZ Chua, Lee Ping Ng, , Sharon YY Low
Neurosurgical Service, KK Women's and Children's Hospital, Singapore
Department of Neurosurgery, National Neuroscience Institute

INTRODUCTION

We look at intraventricular hemorrhage (IVH) in neonates and assess their outcomes following neuroendoscopic lavage (NEL) in Singapore, with a comparison to international cohort studies.

OBJECTIVE

Germinal matrix (GM) hemorrhage resulting in IVH occurs mainly in premature infants, with its prevalence increasing with decreasing gestational age. Severe IVH causes damage to brain parenchyma with resultant degrees of neurodevelopmental delay, motor impairment, and even death.

Traditional management strategies such as serial lumbar punctures and/or ventricular aspiration followed by temporary/permanent cerebrospinal fluid (CSF) diversion have their own limitations. To date, no standardised intervention has shown superiority over another. NEL has emerged as a safe surgical intervention to manage infants with IVH. We seek to look at the effectiveness of NEL in existing literature and compare them to our institution's experience.

MATERIALS AND METHODS

Literature review was carried out with data collected from PubMed, Cochrane Library and Google Scholar. Data collection from our institution (KK Women's and Children's Hospital) was also gathered for infants with GM hemorrhage requiring neurosurgical intervention (Table 1).

	Age at birth	GM Grade	Intervention(s)
1	26 weeks 5 days	3-4	Serial LPs Rickham reservoir insertion Endoscopic washout and septostomy VPS insertion
2	24 weeks 0 days	3	Serial LPs Rickham reservoir insertion Endoscopic washout and septostomy VPS insertion Wound dehiscence and repair
3	37 weeks 2 days	3	Endoscopic washout and ommaya reservoir insertion Repeat endoscopic lavage VPS insertion
4	37 weeks 4 days	3	Endoscopic washout and rickham reservoir insertion VPS insertion
5	26 weeks 4 days	3	Endoscopic washout and rickham reservoir insertion VPS insertion

Table 1: Singapore case series of infants with IVH and NEL

RESULTS

Nine retrospective cohort studies (from 2014-2022) were reviewed (Table 2). Outcomes of immediate complications were lower in the NEL population compared to treatment without NEL: Ventriculoperitoneal shunt (VPS) conversion (54.5-87% vs 77.2-100%), infection (3.6-21.7% vs 10.3-36.6%), re-bleed (0-8.9% vs 5.8-20%) and mortality (0-6.52% vs 10.3-25%). With improved overall motor (56-77.8%) and cognitive function (46.7-53.3%).

For our preliminary study, a total of 5 infants (3 preterm and 2 term) with IVH/GM hemorrhage required the use of NEL (from 2020-2022), and had 100% VPS conversion but 0% infection, re-bleed and mortality. Long term follow-up is still ongoing to evaluate motor and cognitive function.

Authors	Year	Country	Number of patients	Intervention	Complications/ Outcome of NEL cohort					
					VP shunt conversion (%)	Infection (%)	Re-bleed (%)	Mortality (%)	Motor outcome (%)	Cognitive disability (%)
Schulz et al.	2014	Germany	19	NEL followed by VAD	54.5%	10.5%	0%	-	-	-
d' Arcanguez et al.	2018	Germany	56	NEL followed by EVD or VAD	56.6%	3.6%	8.9%	5.3%	-	-
Etus et al.	2018	Turkey	23	NEL followed by EVD (23) or VSgS (22) or other CSF diversion (29)	60.8%	4.3%	0%	-	-	-
Tirado-Caballero et al.	2020	Spain	46	NEL only	58.7%	21.7%	6.52%	6.52%	[1]Good 65.79% Poor 34.21%	[2]Good 53.3% Poor 46.7%
Behrens et al.	2020	Germany	42	NEL followed by EVD or VAD	61.9%	14.3%	-	-	[1]Good 77.8% Poor 22.2%	[3]≥85: 30% 70-84: 15% 55-69: 11% <55: 44%
Schaumann et al.	2021	Germany	80	NEL followed by VAD	58.8%	3.75%	-	-	-	-
Frassanito et al.	2021	Italy	14	NEL (14) or VSgS (49)	87%	4.2%	-	4.2%	-	-
Honeyman et al.	2022	United Kingdom	26	NEL ± ETV/CPC	65.4%	7.7%	3.8%	-	[1]Good 56% Poor 44%	[2]Good 46.7% Poor 53.3%
Dvalishvili et al.	2022	Georgia	19	NEL (19) or VAD/EVD (36) or direct VPS (5)	78.94%	15.78 %	-	0%	[4]Mild 26.6% Severe 13.3%	[4]Mild 20% Severe 20%

Table 2: Retrospective cohort studies of infants with IVH and NEL. EVD: external ventricular drain, VAD: ventricular access device, VSgS: ventriculosubgaleal shunt, ETV: endoscopic third ventriculostomy, CPC: choroid plexus cauterisation, [1]Gross Motor Function Classification System: GMFCS Scale (Good defined as GMFCS grade I or II, poor as GMFCS grade III, IV or V), [2]Neurocognitive analysis was grade 1 to 4 based on adaptation to school (Grade 1 and 2: good, Grade 3 and 4: poor), [3]Bayley Scales of Infant Development, 2nd Edition, Mental Development Index: BSID II MDI score, [4]Motor outcome and cognitive disability score is based on Denver Developmental Screening

CONCLUSIONS

While international studies have shown positive results of NEL as a safe and beneficial tool to evacuate IVH in neonates, patient cohorts have been small and randomized controlled trials to evaluate this condition lacking. Data from our institution has been promising and long term follow-up will be required to validate this data, and evaluate cognitive and motor function outcomes.

REFERENCES

Schulz M, Bührer C, Pohl-Schickinger A, Haberl H, Thomale UW. Neuroendoscopic lavage for the treatment of intraventricular hemorrhage and hydrocephalus in neonates. J Neurosurg Pediatr. 2014 Jun;13(6):626-35. doi: 10.3171/2014.2.PEDS13397. Epub 2014 Apr 4. Erratum in: J Neurosurg Pediatr. 2014 Jun;13(6):706. PMID: 24702621.
d'Arcangues C, Schulz M, Bührer C, Thome U, Krause M, Thomale UW. Extended Experience with Neuroendoscopic Lavage for Posthemorrhagic Hydrocephalus in Neonates. World Neurosurg. 2018 Aug;116:e217-e224. doi: 10.1016/j.wneu.2018.04.169. Epub 2018 May 3. PMID: 29729459.
Etus V, Kahiloğullari G, Karabagli H, Unlu A. Early Endoscopic Ventricular Irrigation for the Treatment of Neonatal Posthemorrhagic Hydrocephalus: A Feasible Treatment Option or Not? A Multicenter Study. Turk Neurosurg. 2018;28(1):137-141. doi: 10.5137/1019-5149.JTN.18677-16.0. PMID: 27759873.
Tirado-Caballero J, Rivero-Garvia M, Arteaga-Romero F, Herreria-Franco J, Lozano-Gonzalez A, Marquez-Rivas J. Neuroendoscopic lavage for the management of posthemorrhagic hydrocephalus in preterm infants: safety, effectivity, and lessons learned. J Neurosurg Pediatr. 2020 May 15;26(3):237-246. doi: 10.3171/2020.2.PEDS2037. PMID: 32413865.
Behrens P, Tietze A, Walch E, Bittigau P, Bührer C, Schulz M, Aigner A, Thomale UW. Neurodevelopmental outcome at 2 years after neuroendoscopic lavage in neonates with posthemorrhagic hydrocephalus. J Neurosurg Pediatr. 2020 Aug 7;26(5):495-503. doi: 10.3171/2020.5.PEDS20211. PMID: 32764179.
Schaumann A, Bührer C, Schulz M, Thomale UW. Neuroendoscopic surgery in neonates - indication and results over a 10-year practice. Childs Nerv Syst. 2021 Nov;37(11):3541-3548. doi: 10.1007/s00381-021-05272-y. Epub 2021 Jul 3. PMID: 34216233; PMCID: PMC8578165.
Frassanito P, Serrao F, Gallini F, Bianchi F, Massimi L, Vento G, Tamburrini G. Ventriculosubgaleal shunt and neuroendoscopic lavage: refining the treatment algorithm of neonatal post-hemorrhagic hydrocephalus. Childs Nerv Syst. 2021 Nov;37(11):3531-3540. doi: 10.1007/s00381-021-05216-6. Epub 2021 May 20. PMID: 34014368; PMCID: PMC8578166.
Honeyman SI, Boukas A, Jayamohan J, Magdum S. Neuroendoscopic lavage for the management of neonatal post-haemorrhagic hydrocephalus: a retrospective series. Childs Nerv Syst. 2022 Jan;38(1):115-121. doi: 10.1007/s00381-021-05373-8. Epub 2021 Nov 10. PMID: 34757453.
Dvalishvili A, Khinikadze M, Gegia G, Khutsishvili L. Neuroendoscopic lavage versus traditional surgical methods for the early management of posthemorrhagic hydrocephalus in neonates. Childs Nerv Syst. 2022 Oct;38(10):1897-1902. doi: 10.1007/s00381-022-05606-4. Epub 2022 Jul 13. PMID: 35831711; PMCID: PMC9522780.