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HYDROCEPHALUS WITH VENTRICULOPERITONEAL SHUNT IN INFANTS: OUR EXPERIENCES AND CLINICAL OUTCOMES

Hristina Mandzukovska [1,2], Aspazija Sofijanova [1,2], Silvana Naunova Timovska[1,2],Tamara Voinovska[1], Mica Kimovska Hristov[1], Spasija Neskova Jankovic[1], Besim Vejseli[1], Olivera Jordanova[1]

[1] University Children's Hospital - Skopje, North Macedonia

[2] Faculty of Medicine in Skopje, Ss. Cyril and Methodius University in Skopje, North Macedonia

Abstract

Hydrocephalus is a condition resulting from disorder in absorption and circulation of the cerebrospinal fluid (CSF). It leads to a progressive ventricular dilatation and need of ventriculoperitoneal shunt (VP) placement.

The aim of our study was to present our experience with infants with hydrocephalus, ventriculoperitoneal shunt placement, and early postoperative follow-up. A retrospective study was conducted comprising infants with hydrocephalus born between January 2019-January 2022 with ventriculoperitoneal shunt placement performed at the University Clinic for Neurosurgery in Skopje, Macedonia.

Demographic and clinical characteristics, complications and the need for ventriculoperitoneal shunt were documented. Of twenty-three infants with hydrocephalus, 14 (60.8%) were preterm infants (median birth weight 2120 g; mean gestational age 33.1 weeks), 9 (39.1%) were term infants (mean birth weight 3600 g; mean gestational age 38.4 weeks).

The etiology of hydrocephalus was: congenital hydrocephalus in 5 infants (21.7%), prematurity in 6 infants (26.08%), spina bifida in 2 infants (8.7%), systemic infection in 4 infants (17.3%), and intraventricular hemorrhage in 6 infants (26.08%).

Ventriculoperitoneal shunt was placed in all 23 infants, at the mean age of 33.5 (30-43) days. Postoperative complications as a result of ventriculoperitoneal shunt placement were: ventriculitis manifested in 3 preterm (13%) infants, of which 2 (8.6%) died; five term infants (21.7%) had postoperative seizures, of which 2 infants (8.6%) died. Nineteen infants (82.6%) were discharged and transferred to the neonatology department. Ventriculoperitoneal shunt placement is a treatment of choice for infants with hydrocephalus, although postoperative complications in preterm infants increase the percentage of morbidity and mortality.

***Keywords**:* hydrocephalus, ventriculoperitoneal shunt, newborns, postoperative complications.

Introduction

Hydrocephalus is a clinical condition defined as abnormal build up, flow, and absorption of cerebrospinal fluid (CSF). According to the International Hydrocephalus Working Group, hydrocephalus is an active distension of the ventricular system of the brain resulting from inadequate passage of CSF from its point of production within the cerebral ventricles to its point of absorption into the systemic circulation [1, 2].

Infantile hydrocephalus prevalence is between 1 and 32 per 10,000 births [3] .

There is no difference between genders; generally both genders are equally affected.

In normal condition, CSF flows through the ventricles and spinal cord and is reabsorbed into the bloodstream. The infant body produces enough CSF each day and absorbs the same amount. However, when flow or absorption of CSF is disturbed as a result of the fluid buildup in the brain tissue, the intracranial pressure is increased [4], causing a hydrodynamic CSF disorder, brain damage and in some cases death.

Several conditions such as prematurity, congenital hydrocephalus, spina bifida, intraventricular hemorrhage, infection are risk factors associated with hydrocephalus and require ventriculoperitoneal shunt (VPS) placement [5].

Ventriculoperitoneal shunting is a common surgical procedure for treatment of hydrocephalus. A shunt is a tube, with a valve, which starts in the ventricular system and and ends in the peritoneum [6, 7].

The goal of VP shunting is to reduce intracranial pressure in the brain.

There are several clinical outcomes of hydrocephalus: surgical complications - shunt failure, intracranial bleeding, postoperative infections, neurological and cognitive disorders, epilepsy, inadequate school adaptation and social communications [8, 9].

The aim of our study was to present our experience with operated infants with hydrocephalus, and early postoperative follow-up.

Materials and methods

A retrospective study was conducted comprising infants with hydrocephalus in a period between January 2019 and May 2022 at the University Children's Hospital in Skopje, N. Macedonia. All infants were operated on at the University Clinic for Neurosurgery in Skopje and transferred in the Neonatal intensive care unit at the University Children's Hospital. Patient information like age, gender, term of birth (premature or term infants), cause of hydrocephalus, and postoperative complications (malfunction - obstruction, infection - ventriculitis, seizures), were monitored for one month.

The results obtained are presented in tables and figures. Informed consent of parents was obtained for all infants included in the study.

Results

During the period between January 2019 and May 2022 we followed-up 23 operated infants with VP placement; (11) boys and (12) girls.

Table 1. Total number and gender of operated patients

gender	number	percent (%)
boys	11	47.8
girls	12	52.2
total	23	100

Of a total of 23 operated infants, 14 (60.8%) were preterm (median birth weight 2120 g; mean gestational age 33.1 weeks), 9 (39,1%) were term infants (mean birth weight 3600 g; mean gestational age 38.4 weeks).

Table 2. Term of birth and gestational age

Birth date	number	mean gestational age (week)	mean birth weight (gr.)
preterm	14	33.1 (28-36)	2120
term	9	38.4 (38-40)	3600

The average age was 30 to 43 days. The mean age of operated patients was 33.5 days.

Table 3. Mean age of operated patients

age	days	mean age in days
male	30-39	34.2
female	33-43	31.9

Etiologically, there were several conditions leading to hydrocephalus: congenital hydrocephalus, prematurity, spina bifida, systemic infection and intraventricular hemorrhage.

Table 4. Etiology of hydrocephalus

indication	number	percent (%)
congenital hydrocephalus	5	21.7
prematurity	6	26.08
spina bifida	2	8.7
systemic infection	4	17.3
intraventricular hemorrhage	6	26.08
total	**23**	**100**

Ventriculoperitoneal shunt was placed in all 23 infants with a mean age of 33.5 (30-43) days. Postoperative complications involving ventriculitis and seizures occurred between 10-30 days. Ventriculitis was manifested in 3 preterm (13%) infants, 2 of them (8.6%) died, and seizures occurred in 5 term infants (21.7%), of which 2 (8.6%) died. Seizures were evident in early follow-up in the first 48 hours postoperatively. Nineteen infants (82.6%) were discharged and transferred to the neonatology department.

Table 5. Shunt-associated postoperative complications

Shunt-associated postoperative complications	term of birth - number	number of mortality
ventriculitis	3 preterm	2
seizures	5 term	2

Discussion

Hydrocephalus is a condition of the disturbance of cerebrospinal fluid flow or absorption, followed by increase of fluid volume in the central nervous system. In the diagnosis of hydrocephalus, history and physical examination are very important.

The presence of meningomyelocele, head circumference at birth, growth head according to the age, tight fontanel and separated sutures are clinical signs for establishing the diagnosis. However, "the gold standard" for diagnosis of hydrocephalus is the use of screening diagnostic methods (transfontanellar ultrasound, computed tomography (CT) and magnetic resonance imaging (MRI) [10, 11]. Transfontanellar ultrasound is preferred particularly in prenatal period and premature infants. Various surgical treatments [12,13,14] have been suggested for treatment of hydrocephalus (endoscopic third ventriculostomy, ventriculosubgaleal shunts and VP shunt placement).

Although a few studies [15,16] show male gender predilection, we did not confirm that in our study; there were almost the same number and percentage of male and female operated infants.

According to term of birth and gestational age, most of the operated infants were preterm 14 (60.8%; mean gestational age 33.1 weeks), *vs* 9 (39.1%; mean gestational age 38.4 weeks) term infants.

Several studies [17, 18, 19, 20] have confirmed the most common etiology that causes hydrocephalus – prematurity, below 30 weeks gestational age, followed by systemic infectious and congenital hydrocephalus. In our study, the most common etiology for hydrocephalus were prematurity and intraventricular hemorrhage (26.08%), followed by congenital hydrocephalus (21.7%), systemic infection (17.3%) and spina bifida (8.7%).

Infants treated with ventriculoperitoneal shunt placement are at risk of shunt dysfunction and shunt infection. Shunt malfunction appears to be more dangerous, with more acute and rapid clinical deterioration of reduction in brain compliance. Additionally, temporary increase of intracranial pressure has been correlated with progressive psychological deterioration and worsening of general condition [21].

In a multicentre clinical study (Woo Py *et al*.) have shown a significant relation between etiology of hydrocephalus and shunt-associated postoperative complications [22].

In our study we also confirmed relation between etiology of hydrocephalus and postoperative complications. Ventriculitis occurred in 3 preterm (13%) infants, and newly developed seizures occurred in 5 term infants (21.7%). Immediately after verification of postoperative complications, adequate medical treatment was started; intravenous application of antibiotics and medical drugs for seizures. Electroencephalogram (EEG) changes were seen including focal specific paroxysmal discharges as a result of cortical injury in the process of shunt placement [23].

Prognosis and intellectual outcomes of operated infants mostly depend on preoperative general condition and efficacy of surgical treatment. The poorest outcomes are associated with congenital malformations responsible for a low survival rate and poor mental developmental despite adequate treatment. Better results are observed in intraventricular hemorrhage, epilepsy and hypothalamus-hypophyseal dysfunction [24].

According to several clinical studies [25, 26] the survival rate of operated infants with hydrocephalus is around 90%; half of the untreated cases have been reported to die in the first three years. The mortality rate in our study was 17.3% *vs* 38.7% in a retrospective single-center study conducted by Matthias *et al*. [27]. Our clinical outcomes are much favorable than those presented by others, however, we have had a small number of patients. Larger studies are needed as well as investigation of postoperative follow-up conditions and clinical outcomes after ventriculoperitoneal shunt placement.

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