

DIAGNOSTIC AND EVOLUTIONARY ASPECTS OF INTRAVENTRICULAR HEMORRHAGE IN PRETERM INFANTS

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ABSTRACT

Objectives. The aim of this study was to assess the risk factors, the grades of severity, and the complications associated with intraventricular hemorrhage.

Methods. The retrospective study, conducted over a period of five years in the Neonatology Clinic Timisoara, included 514 preterm infants with specific sonographic signs of intraventricular hemorrhage (IV).

Results. The incidence varied indirectly proportional to gestational age, being higher among preterm VLBW and ELBW. The main incriminated risk factors were: acidosis, respiratory distress syndrome, hypoxia and hypercarbia. The distribution of cases based on the degree of severity was as follows: grade I, 204 patients (39.68%), grade II, 142 patients (27.62%), grade III, 91 cases (17.70%) and grade IV, 77 cases (15%). Most cases were asymptomatic, being diagnosed based on routine ultrasound. 36% had saltatory evolution, with progressive deterioration of neurologic status, altered muscle tone and respiratory distress. 21% had catastrophic evolution with bulging fontanelle, projectile vomiting, seizures, decerebrate posturing, and apneic spells. Upon follow-up at 6 months, the outcome of the sonographic signs depended on the severity of the bleed, 28.9% cases presented complete resorption, 35% germinal matrix cyst and 25.87% ventriculomegaly.

Conclusions. Transfontanellar ultrasound was the diagnostic method of choice. Most intraventricular bleedings were diagnosed among VLBW and ELBW infants, and were severe forms of disease. Mild and medium forms of disease had good outcome, with partial/ complete resolution of the ultrasonographic signs. Posthemorrhagic obstructive hydrocephalus was the most common complication.

Key words: intraventricular hemorrhage, preterm, ultrasonography

INTRODUCTION

Intraventricular hemorrhage (IVH) represents the most common form of intracranial hemorrhage, particularly in preterm infants, especially those with gestational age < 32 weeks and birth weight < 1500 g (1). Its importance resides in the correlation with neurodevelopmental outcome (2). The incidence of IVH, inversely proportional to gestational age, has gradually declined in the last decades, ranging between 15-25% (2). Risk factors, besides prematurity, include: intrapartum asphyxia (3), maternal chorioamnionitis (4), respiratory distress syndrome (5), pneumothorax (6), neutropenia (7), hypoxemia, hypo/hypercapnia (8), severe acidosis (9), rapid infusions of bicarbonate (10) and ulcero-necrotic enterocolitis (11). Potential compli-

cations, especially in the more severe bleeds, obstructive hydrocephalus (12), periventricular leukomalacia (13), periventricular hemorrhagic infarction (14), cerebral palsy (15), learning disabilities, language and behavior disorders (16), represent causes of neonatal and pediatric morbidity – neurological sequelae. Given these complications, one can establish by means of standardized clinical criteria and specific investigations (cranial ultrasound, electroencephalogram, computed tomography and cerebral magnetic resonance imaging) the long term prognosis. The short term prognosis and the survival rate depends, in the severe bleeds, on the risk factors, the presence of associated vital distress, and on the immaturity of the cerebral circulatory system.

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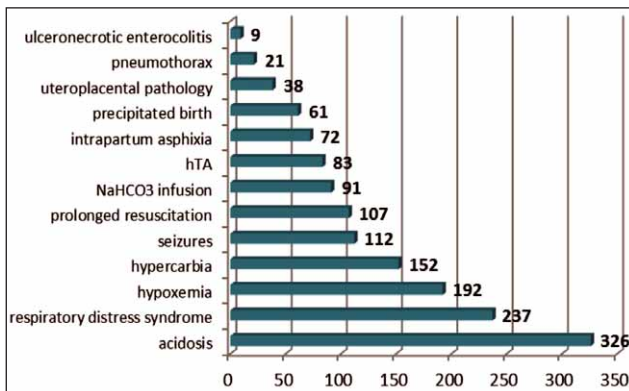
MATERIAL AND METHOD

The 5-year retrospective study (January 2007 – December 2012) was performed in the Puericulture and Neonatology Ward Timisoara on preterm newborns with ultrasonographic signs of intraventricular hemorrhage. Exclusion criteria were: cerebral malformations, metabolic disorders, central nervous system infections and genetic disorders. Serial cranial ultrasonography, as part of a routine screening, was the elective method in establishing the diagnosis, using a 5 MHz sector transducer.

RESULTS

The study included 514 cases out of 3017 preterm infants admitted between 2007-2012, the incidence of the disease being 17.03%. The incidence was inversely related to gestational age, higher among preterm infants with very low and extremely low birth weight (64%, respectively 78%).

14% of cases presented intrapartum risk factors such as: acute hypoxia, complicated labour, precipitate delivery; postnatal factors included: acidosis, hypoxia, hypercarbia and respiratory distress syndrome.



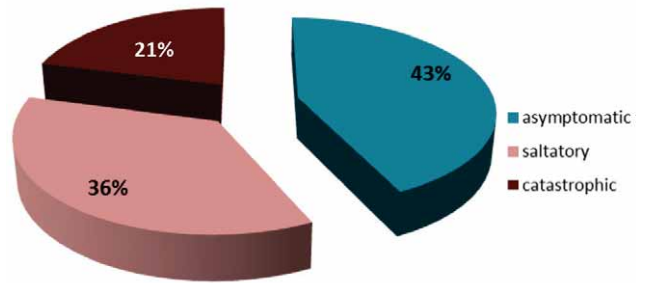
GRAPHIC 1. Risk factors of IVH among the studied lot

Medium gestational age was 29.7 weeks, and medium birth weight was 1100g. 63% of the studied infants were born by vaginal delivery, while 47% were born by cesarean section.

The prevalence of IVH was higher among VLBW (64.21%) and ELBW (78.5%) preterms, as opposed to the rest (25,19%).

The majority of the cases were asymptomatic (43%), being diagnosed by routine cranial ultrasound examinations. The saltatory pattern, present in 36% of cases, was associated with progressive neurologic deterioration, abnormal posture and eye movements, respiratory distress. The rest of 21% had catastrophic clinical findings: bulging anterior fontanelle, dehiscent cranial sutures, projectile

vomiting, fixation of pupils, nistagmus, seizures, decerebrate posture, apneic spells, cardiac rhythm disorders.



GRAPHIC 2. Clinical picture

Cranial ultrasonography was the elective diagnostic investigation, hemorrhagic lesions having as ultrasonographic correspondent increased echogenicity in the periventricular region.

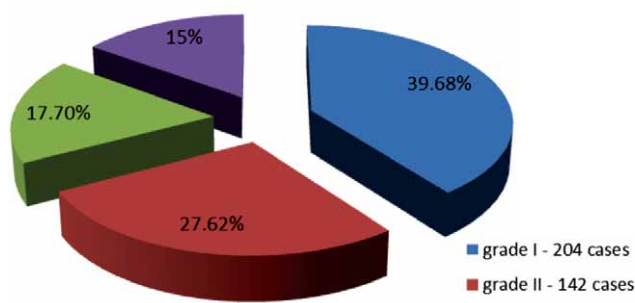


FIGURE 1. Transfontanelar ultrasonography II/III degree IVH (coronal section)



FIGURE 2. Transfontanelar ultrasonography IV degree IVH (posterior coronal section)

Regarding the severity, most cases presented with echographic signs of first and second degree hemorrhage.



GRAPHIC 3. Degrees of severity of IVH

Cases with active posthemorrhagic hydrocephalus, that demanded ventriculo-peritoneal shunt (n = 48), were pro-operatory further investigated by computed tomography or MRI.

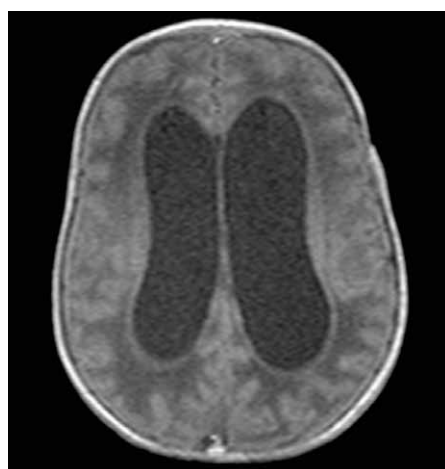


FIGURE 3. Cerebral computed tomography

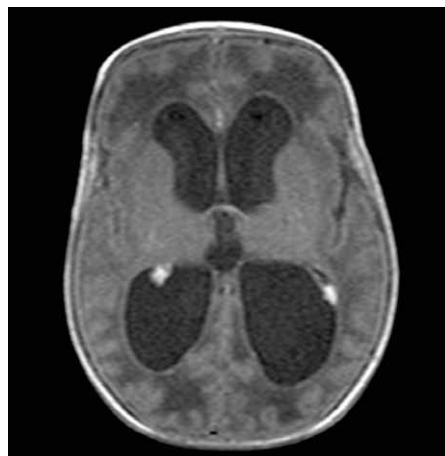


FIGURE 4. Cerebral computed tomography - IV degree IVH

The outcome of IVH, depended on the severity of damage:

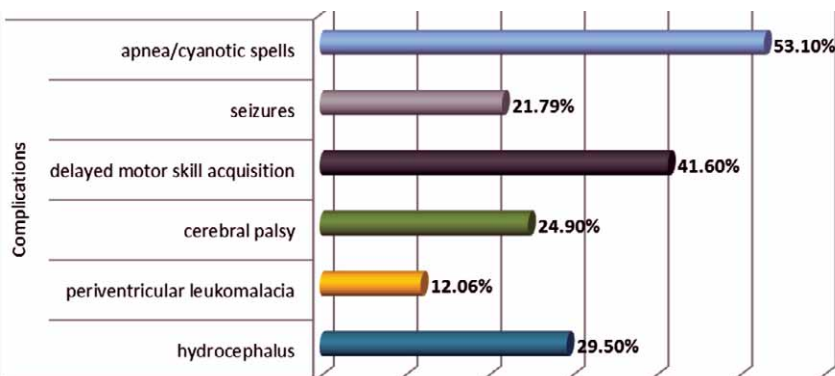
- grade I: complete resorbtion 46,52%, germinal matrix cyst 52,46%, medium ventriculomegaly 1,02%;
- grade II: complete resorbtion 38,11%, germinal matrix cyst 34,59%, mild 14,2%, medium 9,01%, and severe ventriculomegaly 11,3%;
- grade III: medium ventriculomegaly 36,45%, severe ventriculomegaly 26,04%;
- grade IV: multicystic encephalomalacia 18,05%, porencephaly 21,66%, severe ventriculomegaly 58,33%.

DISCUSSIONS

IVH remains a serious problem despite significant medical progress in the last decade, because of increasing survival of extremely low birth weight preterms, and because of the potential complications of this disease. The incidence of IVH was relatively low compared to the literature reviews (15- 25%). Among the risk factors, the most common were acidosis (ph < 7,20), acute respiratory failure (O2Sat < 80%), neonatal seizures, prolonged neonatal resuscitation, and rapid infusion of bicarbonate.

The primary lesion originates in the subependymal germinal matrix. This involutive area is the center of glial and neuronal proliferation between 23- 32 weeks of pregnancy, having a rich blood supply in order to assure the necessary energetic needs (17). The germinal matrix vessels have scarce glial support (18), therefore being highly susceptible to cerebral pressure and flow variations (19).

Preterms have low capacity of cerebral autoregulation, that can be altered by intrapartum asphyxia, hypo/hypercarbia, hypovolemia, rapid volemic infusions, and by the hemodynamic effect of the persistence of the arterial canal (20- 22). Neuro-pathological studies sustain the venous origin of



GRAPHIC 4. Incidence of complications

the intraventricular haemorrhage (23); the venous pressure can be increased by compression of the head during labour (24), respiratory distress, tracheal suctioning (25), high peak inspiratory pressure (26). IVH occurs almost exclusively in the first three days of life (27).

Recent studies have demonstrated a significant correlation between early red blood cells (RBW) transfusions and severe IVH. This may be due to the lack of deformability of the transfused RBC, that can clog the capillary flow, thereby increasing the pressure upstream and leading to capillary rupture (28-30). Repeated early RBC transfusions inhibit the erythropoietin synthesis, critical neuroprotective factor (31-32). Therefore, efforts of reducing the necessity of early RBC transfusions (by delayed cord clamping (33), or cord milking (34), and administration of recombinant erythropoietin (35) may reduce the incidence of IVH severity by up to 50%. 7 percent of the studied preterms received blood transfusions in the first days of life.

Germinal matrix hemorrhage and extension of the hemorrhage into the lateral ventricles without hydrocephalus (first and second degree IVH), although having a high incidence (39,68, respectively 27,62%), were asymptomatic or accompanied by discrete symptomatology with good neurological outcome. This is the reason why all preterm infants < 30 weeks should be screened by cranial ultrasonography at 7-14 days postnatal life and at 36-40 weeks postmenstrual age (36). In the absence of signs of intracranial pressure and of seizures, the first cranial ultrasound was performed between 3-7 days of life among the studied lot.

The prevalence of severe disease was similar to the one from the literature (25% – third degree, and 15% – fourth degree IVH). In almost half of the cases the ultrasonographic lesions had no clinical correspondent. The symptomatology of the cases

with saltatory evolution had subacute onset, in 1-3 days, with hypotonia, nystagmus and posture disorders. The clinical picture of the catastrophic cases included respiratory disorders (apneic spells, increased oxygen demand), seizures, somnolence, decerebrate posture, bulging anterior fontanelle, projectile vomiting, protrusion and mastication movements, fixation of pupils, hypotension and bradycardia, sudden decrease of hemoglobin/hematocrit and glucose metabolism disorders. Cases with marked deterioration of general wellbeing disclosed ultrasonographic changes: the big hyperreflectogenic lesions from inside the lateral ventricles and the cerebral parenchyma were followed by major neuropathological lesions: multicystic encephalomalacia, porencephaly, cerebral atrophy and evolutive hydrocephalus.

CONCLUSIONS

Cranial ultrasonography was the method of choice in establishing the correct diagnosis.

The prevalence of IVH was 17.03%, being highest among VLBW and ELBW preterms, which presented severe forms of disease. Although ultrasonography, a rapid and simple diagnostic method, has certain advantages compared to other types of imaging methods (dynamic evaluation, prompt recognition of complications, lower costs), in current medical practice, cerebral MRI or CT are necessary in cases that need ventriculoperitoneal shunt.

The mild and moderate forms of disease had satisfactory outcome, with complete/partial remission of ultrasonographic signs.

Posthemorrhagic obstructive hydrocephalus was the most common complication, in 29,50% of cases (26,04% of preterms with third degree IVH, and 58,33% of those with fourth degree IVH).

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