Correlation between clinical and ultrasound findings in preterm infants with cystic periventricular leukomalacia


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Cystic periventricular Leukomalacia (CPVL), a hypoxic-ischemic lesion of the neonatal brain, which can now be diagnosed in life thanks to ultrasound brain scanning, is considered to be one of the main causes of cerebral palsy (CP), especially in preterm infants. The purpose of our study was to verify this assumption in a population of 337 of gestational age > 32 weeks. The frequency of CPVL proved to be 5.4% for lesions with a diameter of ≥ 3 mm or 9.3% including those of smaller diameter. The development of CPVL infants was favorable in 29% and adverse in 71% of cases. In the latter cases neuromotor sequelae (CP in 62.5% and motor retardation in 8.5%) were accompanied by various other neuropsychic deficits. Prognosis depends on the site and size of the cysts, being harsher for posterior lesions and those exceeding 1 cm in diameter.

Key-Words: Cystic periventricular leukomalacia (CPVL) — preterm infants — cerebral palsy

Introduction

Periventricular leukomalacia, which has long been known to pathologists as hypoxic-ischaemic lesion of the neonatal brain [3], has gained in importance for the clinician, and in particular in preterm infants, since the use of transfontanelle brain ultrasound (US) in neonatal intensive care units has allowed the diagnosis and the follow-up of the evolution of the lesion [10, 11, 15]. Clinical follow-up studies of these children have shown a high incidence of neurodevelopmental consequences, particularly in subjects with cystic leukomalacia (CPVL), so much so that CPVL may be included among the principal causes of cerebral palsy (CP) in preterm infants [7, 8, 13, 17]. In order to verify these observations, we present our experience of the neurodevelopmental outcome of preterm infants with a diagnosis of cystic periventricular leukomalacia.

Patients and Method

337 neonates with a GA ≤ 32 wks were admitted to the Neonatal Pathology Division of the San Matteo Polyclinic, IRCCS, Pavia, between 1 April 1983 and 30 September 1988. All surviving infants (257 = 76.3%) were examined by serial ultrasonography during the hospital stay. All the examinations were carried out in the cot, using a portable real-time device with a 5

40% financed by Ministry of Education fund.
MHz sector scanner. The evaluation protocol consists of a US examination as early as possible, at the 3rd, 5th, 7th, 10th, 15th, 21st and 30th day, and then every 15 days until discharge [14]. Further US examinations were effected at variable intervals according to the needs of the clinical neurological examination, but in most cases up to age 6 months.

Diagnosis of cystic PVL was made on the basis of the presence of non-echogetic areas at the typical periventricular site, following hypechogeticities present at birth, arising in the post-natal period and with a variable size (from a few millimetres to 1 cm or more). We defined the cysts as single or multiple, uni- or bilateral, affecting the frontal, parietal or occipital zones. No lesions were found in the temporal area.

All the neonates were examined at intervals by a child neuropsychiatrist (EF) throughout the hospital stay. Particular significance was attached to the evaluation between 38 and 42 weeks gestational age (GA). After an initial phase of observation, behavioral parameters, such as the state, visual attention [6], hand-mouth attraction, and contact, were assessed during the examination, as were maturational neurological parameters following Amiel Tison [1,2] with particular attention to spontaneous motility, posture, muscle tone, tendon reflexes, any presence of tremor, clonus, abnormal movement, and the presence or absence of the principal neonatal reflexes.

The child neuropsychiatrist who examined the subjects during their hospital stay followed up every 2 months during the first 2 years of life and then twice yearly or more frequently when it proved clinically necessary. We followed the methodology proposed by Amiel Tison and Grener [1].

The Developmental Quotient (DQ) was evaluated periodically by Bayley’s Scales up to 30 months and the IQ was assessed by the Stanford Binet test; definitions were normal (DQ/IQ ≥ 85), borderline (70-84) or pathological (< 70). Ophthalmological and audiometric examinations were done to elicit any sensory defects. Neurodevelopmental outcome was classified according to Stewart et al. [20] and particular attention was paid to any signs of infantile cerebral palsy, defined on Hagber’s criteria [9], or motor delay defined as sitting position maintained after 9 months and autonomous deambulation achieved after 18 months and by 2 years GA.

**Results**

We identified 24 children with GA ≤ 32 weeks affected by cystic PVL (22 of these were hospitalised from birth, 2 transferred at 1 month). The incidence of this disease in the surviving infants hospitalised from 1-IV-1983 to 30-IX-1988 and with a GA ≤ 32 weeks was 9.3%, or 5.4% considering only lesions ≤ 3 mm, diagnosis of which, using a device with a 5 MHz probe, is reliable [14]. 13 are males and 11 females, GA ranging from 26 to 32 weeks (mean 28.3 weeks) and with birth weight between 900 and 2000 grams (mean 1297.7 grams), all appropriate for GA.

11 subjects had a 5' Apgar Score ≤ 6. All subjects presented respiratory insufficiency of varying degree, and 20 needed assisted ventilation. Other neonatal pathological conditions were also present: acidosis (pH ≤ 7.20) (11 cases), apnea attacks (10 cases), neonatal seizures (4 cases), anemia (2 cases) and severe renal failure (1 case).

As well as cystic PVL brain US showed intraventricular hemorrhage in 17 subjects: 3 patients later presented ventricular dilatation which needed ventricular-peritoneal shunt surgery, 1 patient a serious intraparenchymal hemorrhage and 8 patients signs of cerebral atrophy.

Clinical assessment between 38 and 42 weeks was rated within normal limits in 1 subject and pathological in 23.

The principal clinical pathological signs found were:

- poor behavioral parameters
- poor spontaneous gross and fine movements, mostly of the lower limbs
- fixed, hardly variable, posture, with a dominance of an extensor pattern in the lower limbs
- reduced muscle tone in the trunk, head and lower limbs, with spontaneous stiffening at intervals, particularly of the lower limbs

All the healthy subjects were followed up for a period varying from 1 to 5 years (average 2.4). The outcome for subjects with cystic PVL is shown in Table I.

7 subjects (29%) had a normal motor and intellectual development, while 17 (71%) presented sequelae: motor delay with a moderate or mild intellectual deficit in 2 children (8.5%) and cerebral palsy in 15 (62.5%); of these only 2 patients (1 hemiplegia and 1 diplegia) had a DQ/IQ appropriate for GA, while the other 13 presented a moderate or marked deficit in DQ or IQ. 10 subjects were microcephalic and 3 hydrocephalic, and 3 subjects with infantile cerebral palsy also suffered seizures. Visual disturbances were associated with CPVL in 9 subjects (37.5%): 8 presented strabismus and 1 cortical blindness.

None of the infants we have studied so far has presented hearing deficits. Correlations are presented between the site of the CPVL and neuromotor development in Table II and DQ/IQ in Table III at the age at which the subjects were last observed. The correlation between leukomalacia cyst size and motor outcome