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Long-Term Neurodevelopmental Outcomes of Very Low Birth Weight Infants

Çok Düşük Doğum Ağırlıklı Bebeklerin Uzun Dönem Nörogelişimsel Sonuçları

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Abstract

Objective: The aim of this study was to examine the long-term neurodevelopmental outcomes of very low birth weight (VLBW) infants and identify factors influencing these outcomes.

Methods: A cohort consists of 66 VLBW infants, aged 2 years and older (2-10 years). They were evaluated through neurological examinations, neurodevelopmental screening [using the Denver developmental screening test-II (DDST) and the Wechsler intelligence scale for children-revised (WISC-R)], and cranial magnetic resonance imaging (MRI).

Results: Cerebral palsy was diagnosed in 13.6% of cases. Meanwhile, 29.6% had significant neurological sequelae such as sensorineural hearing loss, hydrocephalus, and epilepsy. The other health problems, including attention-deficit hyperactivity disorder, strabismus, and refractive errors (myopia, hypermetropia), were observed in 34.8% of the subjects. Developmental delay affected 73.7% of children assessed with DDST; although, all nine children evaluated with WISC-R had normal cognitive function. Cranial MRI abnormalities were observed in 28.8% of cases. Risk factors, such as polyhydramnios, placenta previa, placental abruption, chorioamnionitis, passive smoking, assisted reproductive technologies, and severe neonatal complications [intraventricular hemorrhage (IVH), periventricular leukomalacia (PVL), and retinopathy of prematurity (ROP)], were linked to poorer outcomes. PVL, IVH, and ROP increased poor prognosis odds by factors of 33, 10, and 5.8, respectively.

Conclusion: Although the incidence of major neurological disorders, such as cerebral palsy, has decreased with advances in neonatal intensive care, minor neurodevelopmental issues continue to affect the quality of life in VLBW infants. Prevention strategies should focus on addressing both major and minor neurodevelopmental challenges, with an emphasis on reintegrating VLBW individuals into society as healthier members.

Keywords: Very low birth weight infants, long-term neurodevelopmental outcomes, cerebral palsy, cranial magnetic resonance imaging, developmental screening tests

Öz

Amaç: Bu çalışmada çok düşük doğum ağırlıklı (ÇDDA) bebeklerin uzun dönemdeki nörogelişimsel sorunları ve bu sorunları etkileyen faktörlerin araştırılması amaçlanmaktadır.

Yöntem: Yaşları 2 yaş ve üzeri olan 66 ÇDDA olguya nörolojik muayene, nörogelişimsel tarama testleri [Denver gelişimsel tarama testi-II (DGTT), Wechsler çocuklar için zeka ölçeği-revize (WISC-R)], kraniyal manyetik rezonans görüntüleme (MRG) uygulandı.

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Öz

Bulgular: Olguların %13,6'sında serebral palsi tespit edilirken, %29,6'sında sensörinöral işitme kaybı, hidrosefali ve epilepsi gibi majör nörolojik sekeller saptandı. Olguların %34,8'inde dikkat eksikliği hiperaktivite bozukluğu, şaşılık, miyopi, hipermetropi gibi minör nörolojik problemler tespit edildi. DGTT ile değerlendirilen vakaların %73,7'sinde gelişimsel gecikme gözlenirken, WISC-R testi ile değerlendirilen 9 olgunun tamamı normal zeka gösterdi. Kraniyal MRG ile hastaların %28,8'inde anormallikler saptandı. Polihidramnios, plasenta previa, plasenta dekolmanı, koryoamniyonit, pasif sigara içimi, yardımcı üreme teknikleri ve bazı neonatal durumlar [intraventriküler kanama (IVK), periventriküler lökomalazi (PVL) ve prematüre retinopatisi (ROP)] gibi risk faktörleri, daha kötü nörolojik prognozla ilişkilendirilmiştir. PVL, IVK ve ROP'un kötü nörolojik prognozu sırasıyla 33, 10 ve 5,8 kat arttırdığı görülmüştür.

Sonuç: Yenidoğan yoğun bakım üniteleri bakımındaki gelişmelerle birlikte serebral palsi gibi majör nörolojik bozukluklar azalmış olsa da, minör nörolojik sorunlar hala yaşam kalitesini etkilemektedir. Önleme stratejileri ve programları ile majör ve minör nörogelişimsel problemlerin ele alınması, ÇDDA'lı bebeklerin sağlıklı bireyler olarak topluma yeniden kazandırılması hedeflenmelidir.

Anahtar Kelimeler: Çok düşük doğum ağırlıklı bebekler, uzun dönem nörogelişimsel prognoz, serebral palsi, kraniyal manyetik rezonans görüntüleme, gelişimsel tarama testi

Introduction

Preterm birth is defined as delivery before 37 completed weeks of gestation. However, this study specifically focuses on a high-risk subgroup-infants born before 32 weeks of gestation with a birth weight of less than 1,500 grams, commonly referred to as very low birth weight (VLBW) infants. These infants are at increased risk for neonatal morbidity and long-term neurodevelopmental impairments. Advances in neonatal intensive care have significantly improved the survival rates of VLBW infants. However, these gains have also been accompanied by increased rates of neurodevelopmental challenges[1-3]. The rise in major morbidities such as cerebral palsy (CP), epilepsy, mental retardation, vision and hearing problems and some minor morbidities (learning disabilities, speech delay, communication difficulties, attention deficit hyperactivity coordination and balance disorders, behavioral problems, myopia, strabismus and mild hearing loss) is remarkable and has long-term implications for the quality of life of these infants[2,4,5]. CP is a major neurological condition defined as a group of permanent disorders of movement and posture resulting from static damage to the developing brain. Although CP is not progressive, its clinical manifestations can develop with age and lead to varying degrees of motor limitations[6]. Prematurity is one of the most important risk factors for CP. VLBW preterm infants born before 32 weeks of gestation and weighing less than 1500 grams have a significantly increased risk for CP[1,7]. Motor disorders in CP are frequently accompanied by sensory, perceptual, cognitive, communication, and behavioral disorders, epilepsy, and musculoskeletal problems. These represent a major public health concern. Although many neurological early diagnosic methods have been proposed, there is no standard method accepted internationally. Diagnosis in CP is usually made at the age of two with a detailed history, determination of clinical risk factors, complete neurological examination, developmental tests and supportive brain magnetic resonance imaging (MRI). Diagnosing CP as early and correctly as possible is important for the premature infant to be integrated into society as a useful individual. In addition, early initiation of special education, physiotherapy and other treatment methods, prevention of possible accompanying complications or reduction of their effects and early psychological support to the parent are necessary, and a multidisciplinary approach should be adopted in treatment[7,8]. There are many prenatal and neonatal risk factors that negatively affect neurodevelopmental prognosis in the development of CP[1,3,7,8]. As a result of upper motor neuron damage in the cortex caused by antenatal and prenatal risk factors, motor control is impaired and leading to spasticity. This occurs due to a reduction in signals to the reticulospinal and corticospinal tracts, which affects on the motor units[9]. The risk of brain damage (white matter damage, intraventricular hemorrhage (IVH), and cortical and deep gray matter damage) increases with decreasing gestational age and birth weight. Therefore, optimizing prenatal neonatal and newborn care, identifying risk factors in advance and taking precautions are crucial to ensure optimal neuromotor development[3,8]. Comprehensive monitoring starting from the prenatal period, continuous surveillance during the neonatal intensive care unit (NICU) stay, systematic identification of risk factors, and the implementation of targeted preventive strategies are fundamental for the accurate diagnosis of CP and the anticipation of associated complications. Detailed neurological evaluations, developmental assessments, and MRI, recognized as the gold standard for identifying neuroanatomical abnormalities, are indispensable components of this approach[10]. Thus, neurodevelopmental sequelae will be minimized with early diagnosis and appropriate treatment approaches.

In this study, we aimed to investigate both major and minor issues, particularly CP, in premature infants born with VLBW (≤1500 g) and ≤32 weeks gestational age, who were treated in the NICU of Aydın Adnan Menderes University Faculty of Medicine between January 2000 and December 2010. At age 2 and older, these infants underwent neurological examinations, developmental assessments, and cranial MRI. We also investigated the prenatal and neonatal risk factors that influence long-term neurodevelopmental outcomes and identified the most significant risk factors associated with adverse outcomes.

Materials and Methods

These patients were part of a cohort of 169 preterm infants (≤32 weeks gestation) with (VLBW, birth weight ≤1500 g) who were hospitalized and followed up in the NICU of the Department of Pediatry at Aydın Adnan Menderes University between January 2000 and December 2010. This retrospective and cross-sectional study included 66 patients aged 2 years and older, who underwent neurological examination, developmental assesments, and cranial MRI, and whose families provided written consent.

Neurological examinations were performed by pediatric neurologists at our center. Perinatal risk factors, including unmonitored pregnancy, maternal smoking during pregnancy, passive smoking, premature rupture of membranes, maternal urinary tract infection, oligohydramnios, polyhydramnios, preeclampsia, placenta previa, abruptio placenta were obtained from medical records. Neonatal risk factors, including mechanical ventilatory support, respiratory distress syndrome, bronchopulmonary dysplasia, retinopathy of prematurity (ROP), apnea, sepsis, IVH, periventricular leukomalacia (PVL), were also collected from the files. CP and accompanying major and minor sequelae were determined. Major neurodevelopmental sequelae were recorded as CP, epilepsy, hydrocephalus and hearing loss[1]. Minor neurodevelopmental sequelae included attention deficit hyperactivity disorder (ADHD), strabismus, refractive errors (myopia/hypermetropia)[5]. The patients diagnosed with functional motor disorders were classified into 5 levels using the gross motor function classification system (GMFCS)[11]. Level 1 was classified as the least dependency in motor functions, while level 5 was classified as the most dependency. The Denver developmental screening test-II (DDST) was administered to children aged six and under, and children at risk who were apparently normal and had age- appropriate skills were assessed in four areas: gross and fine motor, cognitive, personal, and language. In the DDST, if there were no delays or delays in a category and at most one warning, that section was interpreted as "normal" in itself. Two or more delays in a category were interpreted as "abnormal" cases[12]. For verbal and performance assessments in children over 6 years of age, the Wechsler intelligence scale for children-revised (WISC-R) was used[13]. Cranial MRI scans were performed on all participants included in the study. Cranial MRI findings were classified into 6 categories: structural disorders of the central nervous system, white matter lesions, cortical/subcortical lesions, basal ganglia/thalamus lesions, other anomalies (asymmetric ventricle, cystic lesion, hydrocephalus) and normal findings[14]. Ethics committee approval for our study was received from Adnan Menderes University Faculty of Medicine Non-invasive Clinical Research Ethics Committee (approval no: 2012/36, date: 26.03.2012). The study was part of a pediatric specialty thesis.

Statistical Analysis

The Statistical Package for the Social Sciences (SPSS) 21 was used in the analysis of data. Pearson chi-square, Linear-by-Linear Association, and Fisher's exact tests were used to compare categorical data. The odds ratio was used to determine the most important risk factor among significant categorical risk factors. Quantitative data were expressed as mean ± standard deviation values, while categorical data were expressed as n (number) and percentages (%). Data were examined at a 95% confidence level and p-values less than 0.05 were considered significant.

Results

A total of 66 cases between 2-10 years of age, 34 (51.5%) of whom were girls, were included in the study. The mean gestational age was 29.5±1.77 (25-31.6) weeks and mean birth weight was 1255±254.2 g. The general characteristics of the cases are summarized in Table 1, while their distribution based on birth weight and gestational age is detailed in Table 2.

Neurological Examination Results

Neurological examination findings were normal in 49 patients (74.2%), while 17 patients (25.8%) exhibited abnormal findings. Among these, nine patients (13.5%) were diagnosed with CP. Six of these patients were already under follow-up in our pediatric neurology clinic with a confirmed diagnosis of CP, while three additional patients were newly diagnosed

with CP as a result of this study and were subsequently referred to physical therapy and special education treatment programs for follow-up. According to the GMFCS of the cases with CP; one was stage 5, one was stage 4, and 7 were stage 2. As a major neurological sequela, 1.5% of the cases had bilateral sensorineural hearing loss, and 1.5% required a shunt for hydrocephalus. Antiepileptic treatment was ongoing in 9.1% of the cases due to epilepsy. Regarding minor neurological findings, 12.1% had strabismus, and 10.6% were using corrective glasses for refractive errors. Additionally, 12.1% were under child psychiatry follow-up for ADHD. The detailed data on major and minor neurological sequelae are presented in Table 3. The relationship between the prenatal risk factor polyhydramnios and neurological examination abnormalities was found to be statistically significant (p=0.015). Additionally, significant associations were observed between neonatal risk factors, including IVH, PVL and ROP, and neurological examination abnormalities (p=0.001, <0.001, 0.008, respectively). The ORs for these factors were 10, 33 and 5, respectively.

Table 1. General characteristics of the study group

Number of cases	66
Birth weight (gr)	1255.3±254.2
Gestational age (weeks)	29.52±1.77
Gender (M/F)	32/34
1st min Apgar ≤6	14 (21.2%)
5th min Apgar ≤6	4 (6.1%)
Normal spontaneous vaginal delivery	16 (24.2%)
Caesarean section	50 (75.8%)
Singleton pregnancy	47 (71.2%)
Twin pregnancy	16 (24.2%)
Triplet pregnancy	3 (4.5%)

Table 2. Distribution of cases by birth weight and gestational age (n=66)

Gestational age (weeks)	**n**	**%**
25-27	11	16.6
28-30	36	54.4
31-32	19	29.0
Birth weight (g)	**n**	**%**
700-750	2	3.0
751-1000	9	13.7
1001-1250	22	33.7
1251-1500	35	49.6

Developmental Test Results

Of the 66 cases, 57 (86.4%) were in their first six years of age and underwent the DDST. Of these, 24 (36.4%) were found to be normal for their age, while 42 (63.6%) showed abnormalities. WISC-R was administered to 9 (13.6%) cases over the age of six, and the mental functioning levels and general functionality of all these cases were found to be normal or above average (Table 4). A statistically significant relationship was observed between prenatal risk factors, including passive smoking, assisted reproductive technology,

Table 3. Associated minor/major neurological sequelae

Number of cases	**n**	**%**
*ADHD	8	12.1
*Strabismus	8	12.1
*Myopia	5	7.6
**Hypermetropia	2	3
**Deafness (bilateral sensorineural hearing loss)	1	1.5
**Hydrocephalus	3	4.6
**Epilepsy	6	9.1
**Cerebral Palsy	9	13.6

*: Minor sequelaes, **: Major sequelaes
ADHD: Attention deficit hyperactivity disorder

Table 4. Developmental screening test results

		Normal n (%)	**Abnormal n (%)**
	Language	24 (42.1)	33 (57.9)
Denver DST (n=57)	Fine motor	35 (61.4)	2 (38.6)
	Gross motor	31 (54.4)	26 (45.6)
	Personal-social	30 (52.6)	27 (47.4)
WISC-R (n=9)		9 (100)	0 (0)
TOTAL		24 (36.4)	42 (63.6)

DST: Developmental screening test, WISC-R: Wechsler intelligence scale for children-revised

polyhydramnios, maternal urinary tract infections, chorioamnionitis, placenta previa, and abruptio placenta, and abnormal findings in developmental tests (p=0.047, 0.021, 0.046, 0.042, 0.047, 0.023). Similarly, the relationship between neonatal risk factors, such as IVH and PVL, an d abnormalities in developmental tests was statistically significant (p=0.049, 0.043).

MRI Results

MRI findings were normal in 47 cases (71.2%). PVL was detected in 12 cases (18.2%). The distribution of cranial MRI findings is shown in Table 5. The relationship between the prenatal risk factor of polyhydramnios and MRI abnormalities was found to be statistically significant (p=0.006; OR=10.39).

Table 5. Cranial MRI findings of the cases

Number of cases	**n**	**%**
Normal	47	71.2
PVL	12	18.2
Cortical/subcortical lesion	1	1.5
Basal ganglia/thalamus lesion	1	1.5
Other abnormalities		
-Asymmetric ventricle	1	1.5
-Cystic lesion	1	1.5
-Hydrocephalus	3	4.6
TOTAL	66	100

MRI: Magnetic resonance imaging, PVL: Periventricular leukomalacia

Additionally, the relationship between neonatal risk factors, including gender, IVH, PVL, and ROP, and MRI abnormalities was also statistically significant (p=0.001, 0.001, <0.001, 0.002; OR=6.1, 9.4, 13.2, 3.8, respectively). The prenatal and neonatal risk factors associated with adverse neurodevelopmental outcomes are summarized in Table 6.

Discussion

CP is a condition that significantly impacts motor development, cognitive abilities, and overall quality of life, particularly in premature infants. The risk of CP in VLBW infants is 50-70 times higher than in term infants. However, with technological advancements in NICUs, the global the rate of CP and neurological pathologies was between 8-37%[1-3,8,15]. Improved survival rates and better care in NICUs have contributed to a decline in CP prevalence; however, minor sequelae in these infants may be overlooked in clinical practice. In response, our study emphasized the importance of closely monitoring minor neurological abnormalities, which, despite their subtlety, can significantly impact long-term outcomes. The frequency of CP and other neurodevelopmental morbidities varies across studies, with global and national differences observed in VLBW populations. Erdem et al.[16] reported a neurological abnormality rate of 24.2% in 62 VLBW infants, with 14.5% developing CP. Similarly, Valcamonico et al.[17] observed a CP prevalence of 20.6% among severe cases and 18.7% among mild cases in their cohort. Aslan and Çalkavur[1] detected

Table 6.Prenatal and neonatal risk factors with negative effects on neurodevelopment

p		**Neurological examination**		**Developmental test**		**Cranial MRI**	
		Odss ratio (95% CI)	**p**	**Odss ratio (95% CI)**	**p**	**Odss Ratio (95% CI)**	
	Polyhydramnios	ns	-	0,046	7,19 (0,859-60,1381)	ns	-
	Passive smoking	ns	-	0,047	3 (0,994-9,051)	ns	-
	ART	ns	-	ns	-	ns	-
	Maternal UTI	ns	-	ns	-	ns	-
Prenatal	Chorioamnionitis	ns	-	ns	-	ns	-
	Placenta previa	ns	-	ns	-	0.006	10.39 (1.869-57.714)
	Placental abruption	ns	-	ns	-	ns	-
Neonatal	Male gender	ns	-	ns	-	<0.001	6.133 (2.111-17.824)
	IVH	0.001	10 (2.472-40.447)	ns	-	0.001	9.462 (2.224-40.252)
	PVL	<0.001	33.571 (6.052-186.228)	ns		<0.001	13.2 (3.017-57.759)
	ROP	0.008	5.766 (1.707-19.469)	ns	-	0.002	3.8 (1.195-12.087)

ns: not significant, ART: Assisted reproductive technology, UTI: Urinary tract ınfection, MRI: Magnetic resonance imaging, CI: confidence interval, IVH: Intraventricular hemorrhage, PVL: Periventricular leukomalacia, ROP: Retinopathy of prematurity

neurological examination pathologies as CP in 8% of 107 premature babies. In studies conducted in our country on preterms at 34 weeks and below, the prevalence of CP was found to be 8.5% and 11.1%, respectively[2,8]. Evensen et al.[18] evaluated infants with VLBW at the age of 5 years and found the rate of CP and neurological pathologies was between 8-37%. In a study conducted in Australia between 1980-2017, in which data were collected from 6 different centres, CP was found to be 7.1%, minor neurological sequelae 1.6% and severe neurological sequelae 16.9%[7]. In our study, CP was identified in 13.5% of VLBW infants, major neurological sequelae in 25.8%, and minor abnormalities in 34.8%. These findings are consistent with the results reported in previous studies[2,7,8,16]. These results highlight the need for structured follow-up programs to track both major and minor neurodevelopmental outcomes in VLBW infants, ensuring comprehensive care and timely interventions to mitigate long-term complications.

CP risk is significantly higher in VLBW infants (<1500 g, <32 weeks), with risk increasing as gestational age and birth weight decrease, consistent with Aslan and Çalkavur[1], Bulbul et al.,[2] and Göçer et al.[8] findings. In our study of high -risk infants treated in NICUs, birth weight showed no significant impact on neurological examinations, developmental test outcomes, or cranial MRI findings. These results are consistent with those of Thompson et al.,[19] who reported similar findings in a comparable cohort, highlighting the challenges of establishing clear associations in smaller sample sizes. These discrepancies underline the importance of larger, more homogeneous cohorts to better define the relationship between prematurity and neurodevelopmental outcomes.

Several prenatal and neonatal risk factors, including passive smoking (p=0.047), placenta previa (p=0.047), abruptio placenta (p=0.023), polyhydramnios (p=0.046), male gender (p=0.001), IVH (p=0.001), PVL (p≤0.001) and ROP (p=0.002), were identified as significant contributors to adverse neurodevelopmental outcomes in our study, in line with previous literature[1,3,8]. Moreover, the risk of brain injury, including white matter damage and IVH, increases with lower gestational age and birth weight. Early identification and optimization of prenatal and neonatal care are essential for improving neuromotor development.

There are studies in the literature showing that all risk factors in the antenatal and neonatal periods may cause spasticity, mostly spastic diplegia. In the study conducted by Ahlin et al.,[20] it was shown that all factors in the antenatal, perinatal and postnatal periods increase the risk of spastic diplegia and quadriplegia. In the study conducted by Himmelmann et al.,[21] it was determined that perinatal or postnatal etiologies played a role in 80% of the patients with dyskinetic CP. In our study, 7 of all cases diagnosed with CP were diplegic and 2 were tetraplegic. Similar to the literature, spastic diparesis was found more.

Studies on premature infants with CP have consistently shown a higher prevalence of male predominance. Metz et al.[22] reported a male-to-female ratio of 1.72 in 384 cases and Ekici et al.[23] found a ratio of 1.5 in a Turkish population. The increased vulnerability of males to CP and other neurodevelopmental disorders has been attributed to differences in brain organization, genetic predispositions, and the neuroprotective effects of female sex hormones. Importantly, our findings revealed that the association between male sex and MRI abnormalities was six times higher compared to females, further emphasizing the role of gender in the neurodevelopmental prognosis of this population.

The importance of developmental tests has long been recognized, with screening highlighting the risk of neurological and developmental delays in VLBW infants, even in the absence of major morbidities. Studies have consistently shown significant delays across all areas of the DDST in this population compared to term infants. Göçer et al.[8] reported abnormal DDST results in 27.4 % of 117 high-risk preterm infants, while Bulbul et al.[2] identified delays in personal-social (4.2%), fine motor (6.3%), language (5.2%), and gross motor (9.4%) skills in preterm infants assessed at a corrected age of 12-18 months. In our study, 63.6% of patients evaluated with the DDST exhibited abnormal findings, with delays in gross motor skills (45.6%), fine motor skills (38.6%), language (57.9%), and personal-social (47.4%) areas. Prenatal and neonatal risk factors have been shown to negatively impact long-term WISC-R scores. Kucur et al.[24] found that PVL reduced WISC-R scores in their study of 11-12 year old late/early preterm children. However, in our study, all 9 cases tested with WISC-R had normal or above-average verbal and performance scores. This discrepancy may be due to the small sample size and suggests that the NICU care at our institution was well-developed during that period. Developmental tests are essential for tracking neurodevelopmental prognosis, premature with CP, where motor impairments frequently coexist with sensory, cognitive, and behavioral disorders, epilepsy, and musculoskeletal

issues. Although CP diagnosis often occurs around two years of age using clinical risk assessment, neurological examination, developmental tests, and MRI findings, there is no universally accepted early diagnostic standard. To bridge this gap, comprehensive developmental evaluations are essential to detect cognitive and behavioral disorders that may not be evident through neurological examination alone[10]. Our study utilized DDST and WISC-R developmental tests. This methodology underscores the critical role of comprehensive developmental evaluations in the long-term monitoring of premature infants, providing valuable contributions to the literature on neurodevelopmental care.

Cranial MRI is a crucial tool for assessing the neurodevelopmental prognosis of premature infants with VLBW. MRI plays a key role in identifying neonatal factors, such as IVH and PVL, which contribute to white and grey matter damage and are involved in the etiology of CP. It also helps detect major and minor morbidities observed in infants with VLBW by the age of 2 and beyond[15,17]. Several studies in the literature have highlighted the significance of MRI in detecting abnormalities in VLBW infants. Erdem et al.[16] identified radiological abnormalities in 40% of CP cases, including 6.5% with PVL. Woodward et al.[25] reported 17% moderate and 4% severe white matter abnormalities in premature infants, while Boswinkel et al.[26] found white matter abnormalities in 23.5% and cerebellar hemorrhage in 12.6% of cases[25,26]. Aslan and Çalkavur[1] observed cranial MRI abnormalities in 29% of infants under 34 weeks. Katušić et al.[27] found abnormal MRI in LBW infants and noted a correlation with motor performance deficits. Martini et al.[28] found significant associations between developmental delays and abnormal cranial MRI findings, particularly with white matter lesions, which were linked to poorer motor and cognitive outcomes. In our study, 28.8% of cranial MRI findings were abnormal, with PVL identified in 18.2% of the cases. Our research underscores the crucial role of MRI in assessing the neurodevelopmental prognosis of preterm infants, making a significant contribution to the literature.

Study Limitations

The limitations of our study include the small sample size, with only nine cases out of 169 participants being over the age of six.

Conclusion

Our study emphasizes the critical role of comprehensive developmental evaluations, such as the DDST and WISC-R, in the long-term monitoring of premature infants, highlighting the importance of early interventions for improving neuromotor outcomes. Moreover, it underscores the value of MRI as an indispensable tool for assessing the neurodevelopmental prognosis of preterm infants, contributing significantly to the existing literature on neurodevelopmental care. The findings also stress the importance of minimizing predictable and preventable prenatal and neonatal risks associated with CP and its sequelae. Through neurological examination, developmental testing, and cranial MRI in VLBW infants, particularly at two years of age and beyond, we highlight the ongoing need for continued surveillance in monitoring CP and its often-overlooked minor sequelae. This calls for more frequent follow-up assessments to improve early detection and outcomes. Finally, our study advocates for more comprehensive, nationally representative research to better understand and address the risks associated with CP, underscoring the need for targeted public health strategies to support this issue at risky population.

Ethics

Ethics Committee Approval: Ethics committee approval for our study was received from Adnan Menderes University Faculty of Medicine Non-invasive Clinical Research Ethics Committee (approval no: 2012/36, date: 26.03.2012).

Informed Consent: This retrospective and cross-sectional study included 66 patients aged 2 years and older, who underwent neurological examination, developmental assesments, and cranial MRI, and whose families provided written consent.

Footnotes

Authorship Contributions

Surgical and Medical Practices: S.O., A.T., Concept: S.O., A.T., Design: S.O., A.T., Data Collection or Processing: S.O., A.T., Analysis or Interpretation: S.O., A.T., Literature Search: S.O., A.T., Writing: S.O., A.T.

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