

CLINICAL SPECTRUM AND PROGNOSIS OF NEONATAL BRACHIAL PLEXUS PALSY CASES IN A TERTIARY CARE CENTER

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Abstract

Background: Neonatal Brachial Plexus palsy (NBPP) is a common cause of birth trauma. The incidence varies worldwide owing to differences in obstetric care and management standards. NBPP can present with varying degrees of weakness and sensory loss. The management of NBPP still requires further improvement. However, the critical time for surgical intervention remains controversial. This study examined the clinical spectrum and outcomes of Neonatal Brachial Plexus Palsy cases managed in a tertiary care centre in Madurai. **Material and Methods:** This prospective observational study included 75 patients with neonatal brachial plexus palsy registered at the District Early Intervention Centre at the Institute of Child Health and Research Centre, Government Rajaji Hospital (GRH), and Madurai Medical College, Madurai, for one year. The required information was obtained, babies were assessed clinically, and the type of Brachial Plexus Palsy was graded. **Results:** Of 75 patients, 44% presented with shoulder dystocia, 29.3% had instrumental deliveries, and primiparity had the highest incidence (78.7%). The mean birth weight was 3.21±0.39 kg. Grade 1 BPP was observed in 25.3% of babies, grade 2a in 60%, grade 2b in 10.7%, and grade 3 in 4% of babies. The recovery rate with conservative management was 94.5% at 3.5 months. There was a significant difference in birth weight, Naraka's Grading, MRI findings, shoulder dystocia and birth asphyxia between recovery ($p < 0.05$). **Conclusion:** Shoulder dystocia, birth weight > 3.5 kg, instrumental delivery, and primiparity were significant risk factors for NBPP. Effective conservative management with physiotherapy and range-of-motion exercises provides excellent results with good functional recovery.

INTRODUCTION

Obstetric Brachial Plexus Palsy (OBPP) remains one of the most commonly encountered birth injuries. The incidence of OBPP varies in different parts of the world due to differences in social standards, with more institutional deliveries and improved obstetric care and management. The incidence in Western countries is approximately 0.3 to 3 per 1000 live births. In India, the incidence was as high as 8–10 per 1000 live births two decades ago. However, the latest trends show a decline in incidence of approximately 0.4 to 2.5 per 1000 live births. Although widely known as obstetric brachial plexus palsy, birth-related brachial plexus palsy replaces the term because of its negative implications. Birth-related Brachial Plexus palsy (BRBPP) refers to an injury to a portion or all of the brachial plexus and can present with variable degrees of weakness and sensory loss.

Erb's palsy refers to upper plexus involvement (C5, C6), and Klumpke's paralysis refers to lower plexus involvement (C8, T1). Various natal factors, such as prolonged labour, shoulder dystocia, increased weight gain during pregnancy, and foetal factors, such as macrosomia, have been attributed to the risk factors for BRBPP. Managing Brachial Plexus Palsy remains challenging, even with technical and surgical advancements. Conservative management alone provides approximately a 60%–90% recovery rate. The optimal timing of surgical intervention in cases of recovery failure with conservative management remains controversial.

Hence, knowledge of the statistics of the incidence, risk factors, and outcomes of BRBPP with different treatment modalities available in local settings is essential. This study attempts to discover all the above statistics in our geographic area. This helps us understand the role of early-initiated physiotherapy, the need for strict follow-up and assessment, and the

critical time for surgical intervention in birth-related brachial plexus palsy.

Aim

This study examined the clinical spectrum and outcomes of Neonatal Brachial Plexus Palsy cases managed in a tertiary care centre in Madurai.

MATERIALS AND METHODS

For one year, this prospective observational study was conducted on 75 patients with neonatal brachial plexus palsy registered at the District Early Intervention Centre at the Institute of Child Health and Research Centre, Government Rajaji Hospital (GRH), and Madurai Medical College. The institutional ethics committee approved the study before initiation, and informed consent was obtained from all patients.

Inclusion Criteria

Neonatal Brachial Plexus Palsy cases registered in the District Early Intervention Center were included.

Exclusion Criteria

Patients with chromosomal disorders or multiple congenital anomalies were excluded.

The required information was obtained, babies were assessed clinically, and the type of Brachial Plexus Palsy was graded. Treatment was initiated with physiotherapy and range of motion exercises. They were followed up weekly for three months, and recovery was assessed. Infants who showed no clinical recovery in 8 to 10 weeks of physiotherapy underwent nerve conductance studies, and treatment was planned accordingly.

Statistical Analysis

The data were analysed using Microsoft Excel Software and then improved using SPSS Software. The descriptive characteristics of the sample were analysed using descriptive analysis, including the distribution and the Mean Chi-square test. Fischer's exact test was used to test the statistical significance of all categorical variables. Statistical significance was set at 0.05.

RESULTS

Among the study participants, 35 children were less than 7 days old, 38 children were 7 days to 1 month, and two children were more than one month old. Twenty-nine were male, and 46 were female. Twenty-four were born, and 51 were born. Regarding the time of diagnosis, 45 participants were diagnosed at birth, 15 were diagnosed within 7 days, and 15 were diagnosed from 7 days to 1 month.

The mean age of the mothers of study participants was 24.51 ± 3.46 years. Twelve mothers were aged between 18 and 20 years. Thirty-two mothers were aged between 21 and 25 years old. Twenty-eight mothers were 26–30 years old, and three were 31–32. Fifty-nine were primiparous, and 16 were multiparous. Fifty-six mothers had no comorbidities,

gestational diabetes mellitus was observed in 13, and six mothers had hypothyroidism.

Among the mothers of the study participants, 53 had normal vaginal delivery, 13 had AVD outlet forceps, and 9 had AVD vacuum. Sixty-four were delivered by vertex presentation, and 11 by breech presentation. Thirty-three patients had shoulder dystocia, and 42 did not. [Table 1]

The mean birth weight of the participants was 3.21 ± 0.39 kg. 28 children had a birth weight of 2.5-3 kg, 33 had a birth weight of 3.1-3.5 kg, and 14 had a birth weight of > 3.5 kg. Twenty participants had resuscitation at birth, and 55 did not have resuscitation at birth. Twenty-eight participants had NICU admission, and 47 did not have NICU admission. Thirty-four participants had their left arm affected, and 41 had their right arm affected. Nineteen had Naraka's Grading of 1, 45 had Naraka's Grading of 2a, 8 had Naraka's Grading of 2b, and 3 had Naraka's Grading of 3. None of the participants had a Naraka grading of 4. 1 had a humerus fracture, and 74 had no associated injuries. Thirty-one patients had normal MRI findings, four had preganglionic involvement, 28 had postganglionic involvement, and 12 did not undergo MRI. Four patients had NCS with signs of denervation, and 71 did not. Eighteen participants recovered within ten weeks, 51 from 10 to 14 weeks, four did not recover, and two were lost to follow-up. Four patients were referred for surgery. [Table 2]

At birth weights of 2.5 3 kg, eight participants recovered within 10 weeks, 17 participants recovered from 10 to 14 weeks, one had no recovery, and two were lost to follow-up. In participants with birth weights of 3.1 to 3.5 kg, 9 recovered 75 within 10 weeks, and 24 recovered from 10 to 14 weeks. In participants with a birth weight of more than 3.5 kg, one participant recovered within 10 weeks, 10 participants recovered from 10 to 14 weeks, and three participants had no recovery. This difference was statistically significant according to Fisher's exact test ($p < 0.05$).

According to Naraka's grading of 1, 12 participants recovered in < 10 weeks, six from 10 to 14 weeks, and 1 participant was lost to follow-up. In participants with Naraka's Grading of 2a, six participants recovered in < 10 weeks, 38 participants recovered from 10 to 14 weeks, and one participant was lost to follow-up. Seven participants with Naraka's grading of 2b recovered from 10 to 14 weeks, and one had no recovery. None of the three participants with Naraka's Grading of 3, all the 3 participants had recovered. This difference was statistically significant according to Fisher's exact test ($p < 0.05$).

In normal MRI findings, seven participants recovered within 10 weeks, 23 participants recovered from 10 to 14 weeks, and one was lost to follow-up. In study participants with preganglionic MRI findings, all 4 participants had no recovery. Of

the study participants, 79 had postganglionic MRI findings, three recovered within 10 weeks, 24 recovered from 10 to 14 weeks, and one was lost to follow-up. In the study, eight participants who had not undergone MRI recovered within 10 weeks, and four recovered from 10 to 14 weeks. This difference was statistically significant according to Fisher's exact test ($p < 0.05$).

In the normal vaginal delivery group, 11 participants recovered within 10 weeks, 36 participants recovered from 10 to 14 weeks, 4 participants had no recovery, and two were lost to follow-up. In this study, 81 participants with AVD by vacuum, 2 participants recovered within 10 weeks, and 7 participants recovered from 10 to 14 weeks. In a study of participants with AVD outlets, five recovered within 10 weeks, and eight recovered from 10 to 14 weeks. This difference was not statistically significant according to Fischer's exact test.

In shoulder dystocia, 3 participants recovered in < 10 weeks, 26 from 10 to 14 weeks, and four without recovery. Of the study participants with no shoulder dystocia, 15 recovered within 10 weeks, 25 recovered from 10 to 14 weeks, and two were lost to

83 follow-ups. This difference was statistically significant according to Fisher's exact test ($p < 0.05$).

In the study, participants had birth asphyxia, 16 participants recovered from 10 to 14 weeks, 3 participants had no recovery, and 1 participant was lost to follow-up. In the study of participants with no birth asphyxia, 18 participants recovered within 10 weeks, 35 participants recovered from 10 to 14 weeks, one participant had no recovery, and one participant was lost to follow-up. This difference was statistically significant according to Fisher's exact test ($p < 0.05$). [Table 3]

For normal vaginal delivery, 13 had grade 1, 33 had grade 2a, 4 had grade 2b, and 3 had grade 3. Of the study participants who had an AVD vacuum, two had a grade of 1, four had a grade of 2a, and three had a grade of 2b. In the study, participants had 87 AVD outlets: 4 had a grade of 1, 8 had a grade of 2a, and 1 had a grade of 2b. This difference was not statistically significant according to Fischer's exact test. In need of surgery, Naraka's grading of 2b, 89, and 1 required surgery. In participants with a Naraka grading of 3, 3 participants required surgery. This difference was statistically significant according to Fisher's exact test ($p < 0.05$). [Table 4]

Table 1: Demographic data of the study

		Frequency (%)
Age (years)	< 7 days	35(46.7%)
	7 days to 1 month	38(50.7%)
	> 1 month	2(2.7%)
Gender	Male	29(38.7%)
	Female	46(61.3%)
Inborn/outborn	Inborn	24(32%)
	Out born	51(68%)
Time of diagnosis	Birth	45(60%)
	Less than 7 days	15(20%)
	7 days to 1 month	15(20%)
Age of the mother	18-20	12(16%)
	21-25	32(42.7%)
	26-30	28(37.3%)
	31-32	3(4%)
Parity	Primi parous	59(78.7%)
	Multi parous	16(21.3%)
Maternal comorbidities	No	56(74.7%)
	GDM	13(17.3%)
	Hypothyroid	6(8%)
Mode of delivery	Normal vaginal delivery	53(70.7%)
	AVD outlet	13(17.3%)
	AVD vacuum	9(12%)
Presentation	Vertex	64(85.3%)
	Breech	11(14.7%)
Shoulder dystocia	Yes	33(44%)
	No	42(56%)

Table 2: Various findings of the study

		Frequency (%)
Birth weight	2.5 to 3	28(37.3%)
	3.1 to 3.5	33(44%)
	> 3.5	14(18.7%)
Resuscitation	Yes	20(26.7%)
	No	55(73.3%)
NICU admission	Yes	28(37.3%)
	No	47(62.7%)
Arm affected	Left	34(45.3%)
	Right	41(54.7%)
Naraka's Grading	1	19(25.3%)

	2a	45(60%)
	2b	8(10.7%)
	3	3(4%)
Associated injuries	Humerus fracture	1(1.3%)
	Nil	74(98.7%)
MRI findings	Normal	31(41.3%)
	Preganglionic	4(5.3%)
	Postganglionic	28(37.3%)
	Not done	12(16%)
NCS	Yes, with signs of denervation	4(5.3%)
	No	71(94.7%)
Time for recovery	< 10 weeks	18(24%)
	10 to 14 weeks	51(68%)
	No recovery	4(5.3%)
	Lost to follow up	2(2.7%)
Need for surgery	Yes	4(5.3%)
	No	71(94.7%)

Table 3: Association of birth weight, Naraka's Grading, MRI findings, mode of delivery, shoulder dystocia and birth asphyxia between recovery

		Recovery				P-value
		<10 weeks	10-14 weeks	No recovery	Lost follow up	
Birth weight	2.5-3	8(28.6%)	17(60.7%)	1(3.6%)	2(7.1%)	0.036*
	3.1-3.5	9(27.3%)	24(72.7%)	0	0	
	>3.5	1(7.1%)	10(71.4%)	3(21.4%)	0	
Naraka's Grading	1	12(63.1%)	6(31.5%)	0	1(5.2%)	< 0.001*
	2a	6(13.3%)	38(84.4%)	0	1(2.2%)	
	2b	0	7(87.5%)	1(12.5%)	0	
	3	0	0	3(100%)	0	
MRI finding	Normal	7(22.6%)	23(74.2%)	0	1(3.2%)	< 0.001*
	Preganglionic	0	0	4(100%)	0	
	Postganglionic	3(10.7%)	24(85.7%)	0	1(3.6%)	
	Not done	8(66.7%)	4(33.3%)	0	0	
Mode of delivery	Normal vaginal delivery	11(20.8%)	36(67.9%)	4(7.5%)	2(3.8%)	0.829
	AVD vacuum	2(22.2%)	7(77.8%)	0	0	
	AVD outlet	5 (38.5%)	8(61.5%)	0	0	
Shoulder dystocia	Yes	3(9.1%)	26(78.8%)	4	0	0.002*
	No	15(35.7%)	25(59.5%)	0	2(4.8%)	
Birth asphyxia	Yes	0	16(80%)	3(15%)	1(5%)	0.001*
	No	18(32.7%)	35(63.6%)	1(1.8%)	1(1.8%)	

Table 4: Association of mode of delivery and need for surgery between Naraka's Grading

		Naraka's Grading				P-value
		1	2a	2b	3	
Mode of delivery	Normal vaginal delivery	13(24.5%)	33(62.3%)	4(7.5%)	3(5.7%)	0.588
	AVD vacuum	2(22.2%)	4(44.4%)	3(33.3%)	0	
	AVD outlet	4(30.8%)	8(61.5%)	1(7.7%)	0	
Need for surgery	Yes	0	0	1(12.5%)	3(100%)	< 0.001*
	No	19(100%)	45(100%)	7(87.5%)	0	

DISCUSSION

In this study conducted at our tertiary care centre, the incidence of Neonatal Brachial Plexus Palsy in newborn babies was 1.8 per 1000 live births. Out of the total 75 cases, 32% were born babies, and 68% were outborn babies referred from hospitals both government and private hospitals in and around our centre. The incidence was higher in female infants (61.3%) than in male infants (38.7%). Regarding the maternal risk factors, the mean age of the mother in our study group was 24.5 ± 3.46 , and their mean weight gain during pregnancy was 10.98 ± 1.04 . Primiparity was associated with the highest incidence of 78.7%, and incidence in multigravida was 21.3% which agrees with a study by Tandon and Tandon where NBPP occurred more likely in

primiparous women, especially in those with shoulder dystocia.^[1]

Maternal comorbidities in the form of gestational diabetes were found in 17.3% and hypothyroidism in 8% of cases. Instrumental delivery was 29.3%, with 17.3% being outlet forceps and 12% being vacuum deliveries, which affected the occurrence of NBPP. Regarding foetal risk factors, only 11 babies (14.7%) presented with a breech presentation. Nearly 33 infants (44%) had shoulder dystocia, which is a significant risk factor. This is comparable to studies by Mollberg et al., who found SD in 30%, and Donnelly et al., who found SD associated with 51% of NBPP.^[2,3] High birth weights have been reported as a significant etiological factor for NBPP.^[4,5,6]

Our study reported a mean birth weight of 3.21 ± 0.39 , with 44% of study participants having a BW

between 3.1 to 3.5 kg and only 14% weighing more than 3.5 kg. Twenty (26.7) infants required resuscitation. When these newborns were graded according to the type of injury, 60% had Naraka's grading of 2a, 25.3% had a grading of 1, 2b in 10.7%, and 4% had a grade of 3. A significant association was found between the injury grade and recovery time. The type of nerve injury and whether MRI studies found preganglionic or postganglionic injury also had statistical significance with recovery duration. There was also a significant association between shoulder dystocia and the recovery time.

The need for surgical intervention was found to be associated with more severe injuries, such as grade 3. Of the 75 infants, two were lost to follow-up. Among the remaining 73 newborns who were followed up, the recovery rate was 94.5% within 3.5 months of physiotherapy in our study. This contrasts with a study by Hoeksma et al., where 66% of children recovered in 6 months, and Noetzel et al., where only 66% of infants achieved complete recovery by 4.5 months.^[7,8] In a study by Jackson et al., recovery was reported in 68% of grade 1 and grade 2 injuries, while grade 3 and 4 did not recover. In our study, among the 75 infants, excluding the two infants who lost follow-up, the recovery rate was around 100% in grade 1, 98% in grade 2, and no recovery in grade 3 injuries with physiotherapy. All three infants with grade 3 injury and one infant with grade 2b injury, who showed no signs of recovery with physiotherapy, were subjected to NCS, which revealed signs of denervation. They required surgical exploration and were referred to a higher centre for further management.

CONCLUSION

This study concludes that shoulder dystocia, more than 3.5 kg birth weight, Instrumental deliveries, and primiparity are significant risk factors for Neonatal Brachial Plexus Palsy. Effective Conservative management with physiotherapy and range-of-motion exercises provides excellent results with good functional recovery. With conservative management alone, the recovery rate was higher in

grade 1 and 2 brachial plexus palsies. Infants with Grade 3 brachial plexus palsy injuries require strict follow-up once every two weeks while they are treated conservatively. The decision regarding the need for surgical intervention is made when there are no signs of recovery, even after three months of physiotherapy, with good compliance. The early referral of such infants to specialised centres using a multidisciplinary approach is strongly indicated.

Limitations

The uniconcentric study included one geographic area; hence, the results could not be applied to a wider population. Since the study was conducted among infants registered in the DEIC, where all inborn babies and only referred outborn babies were registered, the true burden of NBPP among outborn babies is unknown.

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