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Risk Factors and Outcomes of Neonatal Radial Nerve Palsy

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Introduction

Traumatic peripheral nerve palsies are exceedingly rare injuries affecting the newborn patient.¹ Neonatal radial nerve palsies in particular are scarcely represented in the literature, with only a few case series reporting on the topic.²⁻⁷ Frequently associated with difficult labor and delivery, it has been suggested that prolonged, continuous pressure placed on the radial nerve as it courses down the humerus causes a neuropraxia that is often self-resolving.⁶ Given similarities in presentation to brachial plexus birth injury (BPBI), radial nerve palsies can often be misdiagnosed leading to undue distress to patients' families.⁸ It is therefore imperative to differentiate these two injuries as the treatment and outcomes differ drastically. Although multiple case reports on neonatal radial nerve palsy note spontaneous resolution of symptoms, no study has objectively reported on the injury's presentation and natural history. This series describes the presentation and relevant risk factors associated with neonatal radial nerve palsy while also quantifying the progression of this condition with a validated measure of active motor function.

Methods

Following institutional review board (IRB) approval, a billing query using ICD-9 and 10 codes was conducted for all patients seen for radial nerve palsy from 2007-2022. All patients presenting with signs and symptoms of isolated radial nerve palsy at less than 12 months of age were included. Patients with other common birth injuries including brachial plexus birth injury, clavicle fracture with pseudoparalysis, or humeral shaft fracture with pseudoparalysis were excluded. After identification, clinic and occupational therapy visit notes were reviewed to abstract demographic data, gestational/birth history, presenting symptoms, physical exam findings, and treatments. Serial Active Movement Scale

(AMS) scores, a validated scoring system ranging from 0-7 to assess motor function in infants, were routinely captured at each visit to track injury progression over time (Table 1).⁹ Descriptive statistics were used to report demographics, risk factors, symptoms, and treatments while paired student t-tests were used to compare AMS scores at presentation and at final follow up.

Results

Twenty-eight total patients with neonatal radial nerve palsy were included. The male to female ratio was 1:1 with an average age at presentation of 18.1 days (range 6 - 53 days). Prolonged labor was recorded for 16 mothers (57.1%) including 12 that underwent Cesarean section and 1 that required an instrumented delivery. Two additional vaginal deliveries were complicated by shoulder dystocia. Fifteen patients (54%) had skin markings overlying the radial nerve, including posterolateral arm ecchymosis or fat necrosis (Figure 1b).

Twenty-four patients had complete wrist and finger drop (Figure 1a), while the remaining four had weakness of wrist and finger extension. Mean initial AMS scores for wrist, finger, and thumb extension were 2.1/7, 1.6/7, and 1.5/7 respectively. Wrist and finger progressive extension splints were used in 22 patients for an average of 7.68 weeks (range = 3-26 weeks). The remaining patients were treated with stretching (n = 1) or monitoring (n = 5). Statistically significant improvements in AMS scores were noted between initial and final evaluations with final mean wrist, finger, and thumb extension scores of 6.7/7, 6.8/7 and 6.8/7 respectively (p < 0.001) (Table 2). Of the 26 patients with resolution and normalization of AMS scores at final follow up (2 patients lost to follow-up), 18 (69.2%) had resolution by 4 months and 26 (100%) had resolution by 9 months. The average time to resolution for our entire cohort was 11.8 weeks.

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Table 1. Active Movement Scale (AMS) Scores

Score	Observed Movement
Gravity Eliminated	
0	No response
1	Twitch, without movement
2	< Half range
3	> Half range
4	Full movement
Antigravity	
5	< Half range
6	> Half range
7	Full range

Discussion

Developed for the purpose of evaluating active motor function in patients with brachial plexus birth injury, the Active Movement Scale has been validated and adopted in clinical practice at several institutions.⁹ With nearly all patients returning for multiple follow up visits, we were able to see a gradual progression toward resolution in the entire cohort. Compared to AMS scores at initial presentation, statistically significant improvements in radial nerve function were seen across the entire cohort.

Difficult labor and prolonged pressure to the lower humerus remains the most likely etiology for radial nerve palsy. As the fetus descends the birth canal, the maternal pelvic brim exerts pressure on the radial nerve as it courses down the spiral groove and along the posterolateral humerus. In instances of prolonged delivery this pressure is accentuated leading to neuropraxia. Consistent with existing literature, risk factors that predisposed these patients to long periods of radial nerve compression were common in the cohort. This study also identified 15 patients that presented with distinct skin markings at the posterolateral upper arm, such as ecchymosis and subcutaneous nodularity which likely represents fat necrosis. A previous series of 25 patients reported skin markings in up to 70% of newborns presenting with signs and symptoms of radial nerve palsy, suggesting that careful examination of the extremity can be helpful in determining the diagnosis.²

This study is not without limitations. Since no specific ICD code for neonatal radial nerve palsy exists, it is possible cases could have been miscoded as another type of nerve injury. To mitigate this, broad ICD codes were used in the search query and charts were reviewed by hand to determine eligibility. Additionally, AMS scores were recorded at follow-up visits only meaning overall time to resolution may be overstated. Finally, given the



Figure 1. Typical neonatal radial nerve palsy presentation. (A) Wrist and finger drop but preserved elbow flexion. (B) Ecchymosis and fat necrosis of the posterolateral arm consistent with pressure from prolonged labor.

Table 2. AMS scores and time to resolution for 26 patients with AMS scores at final follow up.

ID	Gender	Time to Presentation (days)	Initial Wrist extension	Final Wrist Extension	Initial Thumb Extension	Final Thumb Extension	Initial Finger Extension	Final Finger Extension	Treatment	Time to Resolution/ Discharge (weeks from presentation)
1	F	6	2	7	0	7	0	7	wrist splint + stretching	16
2	F	7	0	7	0	7	0	7	Stretching	7
3	M	7	2	7	2	7	2	7	wrist splint + stretching	7
4	F	10	0	NA	0	NA	0	NA	wrist splint + stretching	6
5	F	10	0	7	0	7	0	7	wrist splint + stretching	24
6	F	11	2	7	0	7	0	7	wrist splint + stretching	10
7	M	12	0	6	0	7	0	7	wrist splint + stretching	26
8	M	13	0	6	0	6	0	6	wrist splint + stretching	6
9	M	11	1	7	0	7	0	7	wrist splint + stretching	7
10	F	19	2	7	0	7	0	7	wrist splint + stretching	6
11	F	16	7	NA	7	NA	7	NA	none (already resolved)	0
12	M	16	2	7	0	7	0	7	wrist splint + stretching	18
13	M	19	3	7	6	6	3	6	wrist splint + stretching	8
14	F	19	2	7	0	7	0	7	wrist splint + stretching	4
15	F	19	0	7	0	7	0	7	wrist splint + stretching	16
16	F	22	3	7	3	7	3	7	wrist splint + stretching	27
17	M	22	7	NA	7	NA	7	NA	none (already resolved)	0
18	M	25	0	7	0	7	0	7	wrist splint + stretching	24
19	F	32	2	7	0	7	0	7	wrist splint + stretching	24
20	M	11	0	6	0	6	0	6	observation	4
21	M	14	2	6	0	6	2	6	wrist splint + stretching	5
22	F	38	2	6	2	6	2	6	wrist splint + stretching	6
23	F	53	7	NA	7	NA	7	NA	none (already resolved)	0
24	M	26	6	6	3	7	5	7	observation	12
25	M	9	0	7	0	7		7	wrist splint + stretching	35
26	M	20	0	7	0	7	0	7	wrist splint + stretching	8
Averages		17.88	2.08	6.72	1.48	6.77	1.58	6.77		11.77
p-values			<0.001		<0.001		<0.001			

relatively small sample size of this study, it was impossible to perform comparative analyses correlating risk factors to presentation severity and time to resolution. Therefore, large multi-center studies should be considered to better quantify the risk factors of this injury.

Conclusion

Radial nerve palsy is a rare injury in the newborn population. Most of the reported cohort had a history of prolonged labor and physical exam findings consistent with radial nerve compression, supporting the theory that

prolonged compression the radial nerve is responsible for this condition. Nearly universal resolution has previously been reported; however, this is the first study to document the timing and completeness of neurologic recovery with a validated tool for motor function. While this presentation can be distressing to parents and caregivers, a careful history and physical exam can help exclude injuries with worse outcomes. Complete resolution of neonatal radial nerve palsy can be expected within months.

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