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Predictive Factors for Inpatient Falls among Children with Cerebral Palsy[1,2,3]

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Objective: Inpatient falls are of significant concern. The aim of this prospective study was to determine the predictors of inpatient falls among children with cerebral palsy in a rehabilitation hospital.
Design and Methods: A total of 93 patients with cerebral palsy were assessed based on history, physical findings, the Selective Motor Control Test, the Gross Motor Functional Classification System, the Berg Balance Scale and the Manual Ability Classification System. Previous history of falls/frequent falls, and any falls which occurred during hospitalization, were recorded.
Results: Of all 93 patients, 25 (27%) fell and 68 (73%) did not fall. The mean age of the fallers (6.3 ± 2.0 years) was lower than that of the non-fallers (8.1 ± 3.9 years). Behavioral problems according to the mother's statement (OR 26.454), not being able to maintain a long sitting position (OR 10.807), ability to balance on knees without support (OR 9.810), a history of frequent falls (OR 4.893) and a negative Thomas test (OR 4.192 fold) were found to increase the risk of inpatient falls.
Conclusions: In these children with cerebral palsy, behavioral problems according to the mother's statement, a history of frequent falls, not being able to maintain a long sitting position, a negative Thomas test, and able to balance on knees without support were associated with the risk of inpatient falls. Children with cerebral palsy may experience inpatient falls. Further studies are required in order to develop prevention programs.
Practice Implications: For patients diagnosed with cerebral palsy, these results may help identify possible inpatient fallers on hospital admission.

FALLING IS ONE of the causes of morbidity and mortality in the pediatric population (Chadwick & Salerno, 1993; Pitone & Attia, 2006). Moreover, falls have the first place among the adverse events in pediatric hospitals (Ornelas-Aguirre, Arriaga-Dávila, Domínguez-Serrano, Guzmán-Bihouet, & Navarrete-Navarro, 2013). Cranial trauma is reported to be the most frequent injury of children who have fallen (Güzel, Karasalihoğlu, & Küçükuğurluoğlu, 2007; Işık, Gökyar, Yıldız, Bostancı, & Ozdemir, 2011). In a multicenter observational study, the pediatric inpatient fall prevalence was 0.84 per 1000 patient days and in 48% these falls were classified as preventable (Jamerson et al., 2014). In another study, fall rates of inpatient children were reported to range from 2.5–3.0% per 1000 patient days (Hill-Rodriguez et al., 2010). Even though developmental falls are a natural part of a child's development, falls which result in injury should be considered in the prevention of falls (Graf, 2011).

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Fall prevention strategies are important and are useful to apply in the aim to prevent inpatient falls in pediatric hospitals (Tung, Liu, Yang, Syu, & Wu, 2009).

Cerebral palsy (CP) is a group of disorders related to the development of movement and posture resulting in activity limitations, which are the result of non-progressive disturbances that occur in the developing fetal or infant brain (Rosenbaum et al., 2007). In a study on 25 adults (aged 30–65 years) with CP, Morgan and McGinley (2013) found a relation between the history of falls and the performance of various functional mobility and balance tests. In their study, history of falls was present in all the Gross Motor Function Classification System (GMFCS) levels, and fall history was not related to reported gait decline. Fall risk indicators, like the Berg Balance Scale and FROP-Community (Fall Risk for Older People assessment tool), were related to GMFCS levels. In their population, the history of fall rates was 68%; this emphasizes the need to identify fall risk factors with prospective fall data in adults with CP. In another study among adults with CP, the same authors reported that 33 of the 34 included patients experienced a fall in the previous year. Falls also have an impact on an individual's psychological status presenting as feelings of fear, embarrassment, powerlessness, and isolation (Morgan, McDonald, & McGinley, 2015). In a study among children with CP, the authors tested fall risk before and after postural balance training; although the scores improved after training, the authors did not investigate 'real' falls (El-Shamy & Abd El Kafy, 2014).

Few data are available on pediatric inpatient falls; moreover, the consequences of falls may be serious and some of these falls are preventable (Sherrod & Good, 2006). In addition, reports on the determined risk factors are inconsistent (Graf, 2005; Razmus, Wilson, Smith, & Newman, 2006; Schaffer et al., 2012). Studies on pediatric inpatient falls have shown that impaired gait, impaired mental status, episodes of disorientation (Razmus et al., 2006), and developmental delay or intellectual disability (Schaffer et al., 2012) are present to a certain extent among fallers. Graf (2005) reported that male gender, long length of hospital stay (>5 days), having more than one diagnosis, communication defects, confusion, retardation of growth, muscle weakness, requirement for physical and occupational therapy, impaired gait, impaired balance, requirement for ambulation aid, anticonvulsant use, neurological diagnosis, epilepsy and orthopedic diagnosis all *increase* the probability of falling, while factors such as diseases related to general surgery, infection, intravenous treatment and having parents nearby *decrease* the probability of pediatric inpatient fall risk. Hyperactivity and general weakness have also been identified as inpatient fall risk factors among hospitalized children (Cho, Song, & Cha, 2013). Finally, in a large children's hospital, lower nurse staffing levels during shifts were found to be associated with inpatient falls (Hagan & Jones, 2015).

Children with CP have most of the characteristics associated with falls among children. However, to our knowledge, no study has prospectively evaluated the risk of inpatient falls among children with CP. We ssume that, based on the literature and the characteristics of CP (motor, sensory and cognitive disruptions, communication-behavioral problems, seizures, and secondary muscle and skeletal problems) children with CP may be at risk of inpatient falls. Moreover, few data are available on predicting inpatient falls among this specific pediatric population.

Therefore, this study investigates in-hospital falls among children with CP to explore the following questions: i) which individuals with CP are at increased risk of falling, and ii) what are the predictors of inpatient falls among children with CP.

Methods

This prospective cohort study was performed with the approval of the Institutional Review Board of Ankara Physical Medicine and Rehabilitation Education and Research Hospital. Informed consent for participation in the study was obtained from the parents of each patient.

Subjects

Included were consecutive (i.e. all patients meeting the inclusion criteria on admission) patients (aged 3–18 years) who fulfilled the definition of CP (Rosenbaum et al., 2007). In addition, all were hospitalized for rehabilitation in our 44-bed (supervised by 7 staff), public, tertiary referral center between February 2011 and January 2012. Exclusion criteria were the presence of any acute systemic disorder that would affect the patient's general health status causing severe malaise, co-existing neurological disease, amputation, or any orthopedic problem not related to CP that would increase the risk of fall.

All participating children were in the rehabilitation center due to motor disruptions, and muscle and skeletal problems. For these conditions they received a conventional rehabilitation program for 5 ± 2 weeks, 5 days/week. The program consisted of a range of motion exercises, progressive resistive exercises, balance/coordination/posture exercises, ambulation training, orthotic and ambulation aid training, stretching, and application of heat if required. A fall prevention program, which is routinely applied in our hospital, was applied to all patients. All hospitalized children are considered to be at high risk. The prevention program includes the training of each caregiver with regard to orientation in the hospital. The parents were informed about continuous observation of the child, the use of a wheelchair, and were also supplied with protective bed rails. Regular checks of various environmental factors (e.g. wet floors, safety of the corridors, etc.) were performed by the hospital staff.

Procedure

A total of 93 children who met the study criteria were assessed by one of the investigators (S.A.) at the beginning of the hospital stay (within 1 ± 2 weeks of admission). The assessment took about 1 h for each patient. Interviews were conducted with the parents to determine demographics, presence of problems accompanying CP (verbal/visual/hearing problems, intellectual disability, seizure, and behavioral problems) (Rosenbaum et al., 2007), presence of history of falls (i.e. any falls in the previous year), history of frequent falls (i.e. ≥2 per month), and limitation of cooperation. The type of CP [spastic (unilateral or bilateral),