

Comprehensive Rehabilitation Management of Pediatric Acute Lymphoblastic Leukemia: A Case Report

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Introduction:

Acute Lymphoblastic Leukemia (ALL) is the most common cancer diagnosed in children, characterized by the proliferation of immature lymphocytes in the bone marrow and potentially affecting the central nervous system (CNS). This case report follows the journey of three-year-old Keshvi, who presented with symptoms of bruising and reluctance to walk, leading to the diagnosis of ALL.

Following diagnosis, Keshvi underwent a rigorous chemotherapy regimen consisting of prednisone, dexamethasone, vincristine, daunorubicin, doxorubicin, l-asparaginase, methotrexate, cyclophosphamide, and cytarabine. This treatment, spanning over 2.5 years and divided into induction, CNS preventive therapy, consolidation, and reinduction with maintenance phases, aimed to eradicate leukemic cells and prevent relapse.

Despite the successful management of her leukemia, Keshvi faced various physical challenges, including pain, decreased strength, endurance, and functional mobility. A comprehensive physical therapy assessment revealed multiple impairments, including nociceptive pain, decreased strength and endurance, and limited functional mobility.

This case report outlines Keshvi's physical therapy diagnosis, prognosis, and rehabilitation goals, which were collaboratively determined with her family. The plan of care involved a multidisciplinary approach, including physical therapy interventions aimed at improving Keshvi's strength, endurance, and functional mobility.

Throughout her rehabilitation journey, Keshvi encountered complications such as peripheral neuropathy and avascular necrosis, which were effectively managed with adjustments to her treatment plan and the provision of appropriate orthotic devices.

Ultimately, Keshvi completed her medical intervention and transitioned back to kindergarten, engaging in activities such as riding her bike and playing with her friends. This case report highlights the importance of comprehensive rehabilitation management in optimizing functional outcomes and quality of life for pediatric ALL patients.

Case Description:

Acute Lymphoblastic Leukemia History Three-year-old Keshvi presented to her paediatrician with excessive bruising, accompanied by reports of wanting her parents to carry her rather than having to walk. She had no significant past medical history and was performing all age-appropriate skills until 3 weeks ago. Her white blood cell count was high. Analysis of bone marrow aspirate and cerebrospinal fluid from a lumbar puncture showed an overproduction of blast cells and CNS involvement. Keshvi's disease was diagnosed as ALL, and she was referred to a hospital approximately 60 minutes from her hometown to receive treatment. She was enrolled on a standard risk protocol to receive combination chemotherapy (prednisone, dexamethasone, vincristine, daunorubicin, doxorubicin, l-asparaginase, methotrexate, cyclophosphamide, and cytarabine). Chemotherapy will last approximately 2.5 years and will be administered in four main phases: induction, CNS preventive therapy, consolidation, and re-induction and maintenance therapy. Today, Keshvi's blood counts were mildly low (WBC 4.6 [normal range, 4.9 to 12.9/mm³]; RBC 3.2 [normal range, 3.90 to 5.30/mm³]; Hbg 10.0 [normal range, 11.5 to 14.0]; platelet 98,000 [normal range, 190,000 to 490,000]) (St. Jude Children's Research Hospital normal blood value ranges for a 3-year-old child). Keshvi lives at home with her mother, father, and two older brothers. She enjoys playing with her dolls, riding her bike, and going to the playground. She used to

attend a preschool 2 hours a day, 3 days a week, before her diagnosis. Keshvi's mother works out of the home and her father is an accountant. Keshvi's parents report that their daughter has not attended preschool in 8 weeks. Keshvi was referred to the physical therapy department 3 weeks after her initial diagnosis, with the goal of increased functional mobility. Her parents were very concerned because Keshvi was not walking. Physical Therapy Systems Review Keshvi is bright and was very comfortable talking with the physical therapist when her father was holding her. She appeared fearful of movement. Her muscle tone appears within normal limits to mildly low. Vision, hearing, and sensation appear intact. She doesn't appear to have any pain while her father is holding her. She is mildly pale with a few healing bruises. Her respiratory rate and breathing pattern appear normal at rest. Physical Therapy Tests and Measures Keshvi presented with a full active range of motion (AROM) in her neck, trunk, upper extremities, and lower extremities. Her strength was examined while she was playing with toys and was grossly 4 (0 to 5 scale). Keshvi tracked right/left/up/down. She followed directions when spoken to at a normal voice level. Her sensation was within normal limits (WNL) as measured by light touch, and her muscle tone was WNL. Keshvi had no pain, as measured by the FLACC scale when she was sitting and playing; however, when she was in a standing position, her FLACC pain score was 5, indicating pain in her lower extremities. Keshvi's skin colour was mildly pale and she presented with three large bruised areas, which were healing. Keshvi's skin around her central line was clean and dry. Keshvi presented with decreased endurance, as indicated by her increased work of breathing and increased heart and respiratory rates while she performed functional tasks such as transitioning from sitting to standing and ambulating. Keshvi ambulated independently for 2 feet, slowly with a short step length, and then began to cry. Keshvi stood independently with her hand on a bench and cruised right and left for 3 feet. Keshvi transitioned from sitting on a bench to standing with moderate assistance, and from standing to sitting on the floor by half-kneeling with her hand on her knees and then on the floor, with minimal assistance for balance. She crawled on her hands and knees for a distance of 4 feet independently. She would not attempt to ascend a step.

Physical Therapy Diagnosis

- Nociceptive pain caused by increased blast cell production in the bone marrow and arthralgia from high-dose methotrexate and intrathecal cytarabine
- Decreased strength from inactivity
- Decreased endurance from inactivity
- Decreased functional mobility due to pain, limited strength, and nausea
- Decreased participation in play and nonattendance at school

Physical Therapy Prognosis Keshvi is expected to have a full recovery from her physical therapy diagnoses. After she receives chemotherapy for a few more weeks, she should have no more bone pain from her initial disease. Over the next 3 months, Keshvi will increase her strength and endurance so she can participate in family activities. Goals as Determined with Keshvi and Her Family

- At 1 week, ambulate independently with a rolling walker
- At 4 weeks, ambulate independently without assistance, transition from ring sitting to standing independently, ascend and descend three steps with one hand on a rail
- At 6 weeks, ascend and descend three steps independently, jump up independently with both feet leaving the floor 1 inch

Ongoing goals, including family independently assisting Keshvi with the exercise program

Plan of Care Keshvi will receive physical therapy three times a week for the first 2 weeks. She is scheduled to be an inpatient for a week while she receives chemotherapy. The frequency of her physical therapy will then be decreased to two times a week for 2 weeks, and then once a week. As soon as Keshvi is ambulating independently and performing age-appropriate gross motor skills, she will receive physical therapy services on an as-needed basis only. The plan for physical therapy services with Keshvi will involve educating Keshvi and her family in the following areas: activities to regain function, normal development, resuming activities that are important to Keshvi and her family such as going to the park and riding their bikes together as a family, and future concerns such as the development of peripheral neuropathy or osteonecrosis. The physical therapist may find that Keshvi could benefit from a referral to occupation therapy to assist with fine motor skills or activities of daily living with a focus on age-appropriate developmental skills.

Physical Therapy Patient-related Instruction Activity:

Ankle dorsiflexion passive ROM and family instruction on signs and symptoms of peripheral neuropathy due to vincristine (foot drop, tripping, poor grip strength) - Frequency: Five times a week. Intensity: Mild stretch. Duration: Hold for 30 seconds. Activity: Strengthening exercises-Frequency: Five times a week. Intensity: Fun, functional, strengthening activities such as squatting to pick up a toy off the ground; tossing a ball overhead, from the mid-chest region, and underhand; painting a picture while standing at the kitchen table, squatting to pick up a different colour marker; and doing ankle pumps while listening to music. Duration: Throughout the day, because she will not tolerate long periods of exercise at one time; therefore, three sets of 10 repetitions are recommended. Activity: Ambulation with a walker—Frequency: When she needs to transition from one activity to another. Intensity: Short distances to start and build up. Duration: Throughout the day. Activity: Aerobic exercise, tricycle riding—Frequency: 7 days a week. Intensity: Slow and controlled. Duration: 5 minutes to start and buildup to 10 minutes. She should be wearing a helmet.

Physical Therapy Procedural Intervention

The physical therapist will help Keshvi perform ankle dorsiflexion stretching and review procedures to ensure proper alignment with Keshvi's parents. The therapist will encourage Keshvi to play a game such as basketball that requires her to transition from standing to squatting to pick up the ball, walking over to the basket, and tossing the ball into the basket. This activity will assist Keshvi with her upper and lower extremity strength and ambulation skills. While Keshvi rides a tricycle, the therapist will monitor her heart rate with a pulse oximeter and visually observe her respiratory rate, skin colour, and breathing pattern. During the physical therapy session, the therapist will be able to determine Keshvi's improvements in ROM, strength, endurance, and functional mobility, and then make recommended suggestions to Keshvi and her family on how to modify her home or inpatient exercise program. Episode of Care Three months after Keshvi received the initial diagnosis of ALL, she met all her previously set goals. However, 1 month later, she developed peripheral neuropathy, as indicated by frequent tripping while she was walking and running. The physical therapy examination indicated that Keshvi had weak intrinsic musculature in her feet and hands and decreased active ankle dorsiflexion strength. Keshvi's doctors decreased her dose of vincristine to reduce the effects of peripheral neuropathy, and the physical therapist provided Keshvi with bilateral solid ankle-foot orthoses to help prevent falls and to protect the alignment of her ankle structure. Keshvi continued to perform her ankle dorsiflexion stretching and strengthening exercises as previously recommended. Fourteen months after the diagnosis of ALL, she developed severe pain in her right foot. Keshvi's mother was very concerned because this was the initial symptom of ALL; however, it did not signal a return of leukaemia but was a symptom of avascular necrosis that had developed in her calcaneus. Her physician modified Keshvi's corticosteroid dose and recommended that she use her walker again for a few weeks. After 1 month, Keshvi no longer required the use of the walker to ambulate and was pain-free unless she ambulated for long distances. When Keshvi completed her medical intervention, she no longer needed to use an ankle-foot orthosis. Keshvi has osteopenia due to the effects of chemotherapy with methotrexate and corticosteroids. She is now in kindergarten, riding her bike, and playing with her friends without difficulty. Keshvi still runs slowly and not as smoothly as her friends, but she is hopeful her running will improve.

References:

- [1] St. Jude Children's Research Hospital's normal blood value ranges for a 3-year-old child.
- [2] FLACC scale for pain assessment in pediatric patients.
- [3] Recommendations for physical therapy interventions in pediatric oncology patients.
- [4] Management of chemotherapy-induced peripheral neuropathy in pediatric cancer patients.
- [5] Rehabilitation strategies for avascular necrosis in pediatric leukemia patients.
- [6] Impact of multidisciplinary rehabilitation on functional outcomes and quality of life in pediatric cancer survivors.