Clinical Exercise Interventions in Pediatric Oncology: Can they Reduce Late Toxicities?

Baker S and Patel S*

Division of Radiation Oncology, University of Alberta and Department of Radiation Oncology, Cross Cancer Institute, Edmonton, Canada

Keywords: Physical therapy; Irradiation; Pediatric; Adult; Adverse effects

Advances in the treatment of pediatric malignancies have resulted in combined survival rates for all sites in excess of 80% [1]. With improved cancer outcomes and a growing population of pediatric cancer survivors, efforts to reduce long term treatment toxicities are becoming increasingly important. Radiation therapy (RT), although a key component in many treatment protocols, has significant long term side effects which can impact quality of life. Exercise, yoga and other physical therapies are potential strategies to mitigate late RT side effects and improve functional outcomes.

Late RT sequelae result from microvascular damage and tissue fibrosis to organs within the RT field. Side effect profile is determined by the anatomic region of treatment, the severity dependent on RT dose, fractionation, and any additional effects from chemotherapy or surgery. Increasingly conformal delivery techniques such as proton RT and intensity modulated RT reduce the dose to normal tissue. Bones within a RT field can exhibit impaired growth and risk of osteopenia. Lung and cardiac tissue may fibrose and cause restrictive pulmonary or cardiovascular disease. Hearing loss and endocrinopathies can follow cranial RT. The neurocognitive consequences of pediatric cranial RT include significant reduction in IQ scores, impairments in memory and attention, and higher rates of behavioral and psychiatric disorders [2,3]. Adults who received RT as a child are less likely to obtain a college education and be employed than the general population [4].

There is increasing evidence suggesting exercise can alter the natural history of RT side effects in pediatric patients. In keeping with its neurocognitive effects, postmortem analysis shows an almost complete loss of hippocampal neurogenesis in patients following treatment for central nervous system tumours [5]. Studies in a murine model show that mice irradiated early in life show a restoration of neurogenesis through voluntary exercise [6] and that a daily running regime can offset RT-induced spatial memory decline [7]. Studies are underway in humans to investigate the neuro-protective effects of exercise in children following cranial RT [8].

Known physiologic effects of exercise in the general population, including increased tissue capillary formation and improved cardiovascular performance, may particularly benefit patients who have undergone RT and risk adverse effects from microvascular fibrosis. Several recent trials of short-term exercise interventions in pediatric oncology patients have reported improvements in motor function, functional mobility, and health-related quality of life [9]. In a population where emotional and attentional deficits may exist as side effects of treatment, the relaxation and meditation techniques provided through yoga may provide additional benefits. Recent reviews of yoga in adult oncology patients have suggested improvements in mood, fatigue, and sleep [10].

Several small randomized controlled trials have investigated the effects of exercise programs in pediatric oncology patients. A cross-over randomized trial of 30 pediatric oncology inpatients investigated health-related quality of life measures in patients who underwent a tri-weekly, 30 min physical activity program during their hospital admission and found improvements in physical functioning, self-esteem, mental health, and behavior [11]. Similarly, a 12 week, bi-weekly yoga intervention in outpatients found significant improvements in health-related quality of life and functional mobility [12].

The benefits of exercise in the adult population of cancer patients have been better studied and consensus guidelines exist [13]. Several challenges exist to developing evidence-based pediatric exercise recommendations, however. There is still a relative paucity of data in the pediatric group. Many studies have a cohort design where the confounding factors of increased social interaction implicit with an exercise intervention make definitive attribution of beneficial effects to exercise difficult. Further, response bias in voluntary programs may inflate estimates of feasibility and attendance rates. It is uncertain which activities may be most appropriate and beneficial for particular patient groups; interventions have varied from play-based activities such as soccer, tennis, dance, and karate [11], to strength and coordination training [9], to yoga [12]. Program duration and timing with respect to RT are highly variable. The majority of studies have been conducted in patients with the most common childhood malignancy, acute lymphoblastic leukemia [14], and whether their findings are applicable to other cancers is uncertain.

Radiotherapy is an integral component of many treatment protocols for pediatric malignancies. Late radiotherapy toxicities including growth impairment and neurocognitive deficits can negatively impact survivors’ subsequent health and quality of life. Exercise and physical therapies may be a viable and effective strategy to mitigate late radiotherapy side effects. Further study will likely reveal exercise and physical therapies to be safe, cost-effective, and highly effective strategies to ameliorate late RT toxicities in this patient group.

References


*Corresponding author: Samir Patel MD, Department of Radiation Oncology, University of Alberta, 11560 University Avenue, Edmonton, Canada, T6G 1Z2, Tel: 1-888-342-2471; Fax: 780-342-2063; E-mail: samir.patel2@albertahealthservices.ca

Received September 02, 2015; Accepted September 14, 2015; Published September 21, 2015


Copyright: © 2015 Baker S, et al. This is an open-access article distributed under the terms of the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.


