Critical Reviews in Oncology/Hematology 105 (2016) 145–155

Contents lists available at ScienceDirect

Critical Reviews in Oncology/Hematology

journal homepage: www.elsevier.com/locate/critrevonc

Review of hematological indices of cancer patients receiving combined chemotherapy & radiotherapy or receiving radiotherapy alone

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Contents

ARTICLE INFO

Article history:
Received 3 February 2016
Received in revised form 9 May 2016
Accepted 1 June 2016

Keywords:
Chemotherapy
Radiotherapy
Hematology
Anemia
Immunity

ABSTRACT

We observed the outcomes of chemotherapy with radiotherapy (CR) or radiotherapy (RT) alone for cancer patients of larynx, breast, blood and brain origins through complete blood count (CBC). Following were more depressed in CR patients: mean corpuscular hemoglobin-MCH & lymphocytes-LYM, hematocrit, mean corpuscular hemoglobin concentration-MCHC, hemoglobin-HB and red blood cells-RBC. In RT patients, following were more depressed: LYM, MCH and MCHC. Overall, in all cancer patients, the lymphocytes were depressed 52%. There existed a significant difference between white blood cells and RBC in both CR and RT patients. A significant moderate negative correlation is found in HB with the dose range 30–78 (Gray) given to the CR cancer patients. More number of CBC parameters affected in patients treated with CR and RT; but in less percentage as compared to patients who treated with RT alone. The cancer patients suffered from anemia along with immune modulations from the treatments.

1. Introduction

The current prospective cross-sectional review study focused the impacts on the hematological indices from complete blood count (CBC) test, in four different types of cancer (larynx, breast,

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http://dx.doi.org/10.1016/j.critrevonc.2016.06.001
1040-8428/

blood and brain) patients. There were two groups of cancer patients: one group of cancer patients treated with radiotherapy along with chemotherapeutic drugs and other group of patients treated with radiotherapy alone. The comparisons made to point out the impacts of radiotherapy treatment with or without a chemotherapy treatment. The hematopoietic system comprises a major blood forming system, that is, bone-marrow. This system's functional cell transit oxygen in blood, shelter immune system from different bacteria, viruses, etc. and ensures blood coagulation holding intact blood vessels (Smirnova, 2010; Shahid et al., 2015). The regular pluripotent hematopoietic stem cells (HSC) preserve the production of an accepted number of differentiated hematopoietic cells in the normal microenvironment of bone-marrow. Mature blood cells use to have a limited life span and must be replaced by a continuous self-renewing proliferation and differentiation processes. Several intermediate or immature blood cells produce during differentiation in multistage phases (Wognum et al., 2003). Immune alteration and anemia have been reported in cancer patients who receive chemotherapy or radiotherapy or chemotherapy and radiotherapy both, has long been in debate. Anemia is prevalent in patients with breast cancer as reported by Aapro et al. (2011). Immune suppression has been correlated with the growth of the tumor via. activation of blocking antibodies, suppressed macrophages and suppressed T-cells, etc. (Finke et al., 1993). We presented a detailed discussion with special emphasis on immune alterations and anemia in cancer patients. Side-effects from both radiotherapy and chemotherapy treatments are evident on bone-marrow which is a major site for major pluripotent HSC (hematopoiesis) (Wognum et al., 2003). Chemotherapy is known to induce both sustained and transient anemic conditions in cancer patients (Mercadante et al., 2000). For example, lower levels of hemoglobin levels have been identified in head and neck cancer patients along with prolonged myelosuppression (Mercadante et al., 2000). Besides, other common side effects (e.g., nausea, loss of balance, trembling, appetite loss, constipation, hair loss, fatigue, muscle pain, nerve damage pain etc.), a chemotherapy course damages the dividing cells. Chemotherapeutic drugs' side-effects on the blood cells are evident in the form of reduced (red blood cells) RBCs and (Platelets) PLTs (Cancer Research UK, 2015; American Society of Clinical Oncology, 2015; Mackall et al., 1994). The depletion observed in T-cells are related to the immunodeficiency and then opportunistic infections have frequently been reported in cancer patients undergoing intensive chemotherapy (Mackall et al., 1994). Chemotherapy is a frequent recognized source of chronic anemia by iron deficiency (hemolytic), which can increase the risk of death or impairs the quality of life-QOL (Deger et al., 2013; Ait-Oudhia et al., 2011; Auerbach et al., 2004; Harrison and Blackwell, 2004).

Although, radiotherapeutic techniques are considered effective in killing cancerous cells, but, local recurrences may be generated through it, which may further pose a risk in longer survival for patients. The probability of the local tumor pre or post-surgical can be influenced by several factors such as a dose/fraction, treatment time, radiation doses etc. (Harrison et al., 2002a). A progress through magnetic resonance imaging (MRI), computed tomography (CT) and positron emission tomography (PET) along with molecular imaging techniques, have led the creation of more advanced techniques such as intensity modulated radiotherapy (IMRT), three-dimensional conformal radiation therapy (3D-CRT), intensity modulated proton therapy (IMPT), conformal radiation therapy (CRT) and proton beam facility (American Cancer Society, 2014; Zelefsky et al., 2006; Kamensek and Sersa 2008). Radiotherapy treatment includes the scheduling and staging of the radiation doses per fraction depends on the type of cancer (West and Barnett, 2011; Shahid, 2015). Around the world, around 50% cancer patients are being treated with different radiotherapy procedures in combination with chemotherapeutic drugs or alone before or after surgery. Undoubtedly, with the aid of medical ionizing radiations (IRs) e.g., X-rays or gamma rays; improvements in the average survival rates of the cancer patients have been achieved. Further, the side effects or the damage caused by IRs has also been reported in terms of affected oxygen levels followed by a chronic or intermittent hypoxia across the tumors due to cell radiosensitivity (Begg et al., 2011; Kamensek and Sersa 2008; American Cancer Society, 2014; West and Barnett, 2011; Niu et al., 2010; Yoon et al., 2010). Such variations have been reported based on different proximal radiation dose range or an individual patient's overall condition (Cintra et al., 2013). Especially those tumors, which were reported as unsuitable for the surgery, the local radiation treatment was promising. Around 50% of the cancer patients who receive radiotherapy, among them 40% were cured by it as compared to 49% survival through surgery and 11% by chemotherapy as mentioned by West and Barnett (2011). Radiation carcinogenesis is a known process to induce secondary malignancy along with radiotoxicity (Obedian et al., 2000; Zelefsky et al., 2006). During radiotherapy treatment, even the out-of-field organs receive low doses of radiation and it is well known that even low radiation doses receive persistently, they can be harmful to induce another tumor; therefore, proper management is always recommended (Aziz et al., 2011; Shahid, 2015; Zelefsky et al., 2006). The radiation-induced cancer risk arises even from the modern machines, because of edge-radiation fields or secondary scattered low-dose radiations (Murray et al., 2013) received by other tissues of different organs (Evans et al., 2006; Brachman et al., 1991; Murray et al., 2013; Sungkoo et al., 2011; Schneider et al., 2006; Linet et al., 2012; Rheingold et al., 2003; Suit et al., 2007; Sountoulides et al., 2010; Schneider 2011). Acute and protracted reactions, both are evident from the radiotherapy treatment. Acute effects occur in rapidly proliferating tissues as a result of cell death, and following are reported: diarrhea, cystitis, erythema, dermatitis, desquamation and hair loss, etc. The late effects can impact QOL and further a life-threatening condition could be prevailed. Other late effects include: infertility, hormone deficiencies and secondary malignancies, fibrocytes to growth factors, chemokines and cytokines release after irradiation. As per hematopoietic system, the radiotoxicity reported in the form of the decreased total white blood cells (WBCs) and PLTs in the form of leukopenia and thrombocytopenia respectively, have been reported (West and Barnett 2011; Scott 2002; Leyland-Jones et al., 2005; Crawford et al., 2002). It was mentioned by Kamensek and Sersa (2008), that in order to enhance the efficacy of radiation therapy and to minimize side effects the entire cancer treatment, it should be with either in combination with chemotherapy or gene therapy.

2. Patients and methods

2.1. Blood sampling and information collection

Blood samples (1-ml) were collected by informed consents from four different types (larynx, breast, blood and brain) of cancer patients (n = 60). There were two groups of cancer patients; one group included those cancer patients who were treated with both chemotherapy and radiotherapy (CR) and the second group of those cancer patients who were treated only with the radiotherapy (RT). Information regarding age, sex, relevant clinical information, chemotherapy and radiotherapy staging, dietary habits and occupation were also gathered.

2.2. Chemotherapy drugs and radiotherapy modalities

Following chemotherapeutic drugs had been considered for the treatment of cancer patients in this study: Doxorusicin