

Radiotherapy Interruption in Cancer Patients: Rates and Causes at Ahvaz Golestan Hospital

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Introduction: Radiotherapy is one of the most common cancer treatment modalities. The goal of this study was to establish the rates and causes of radiotherapy interruptions in cancer patients at Ahvaz Golestan Hospital.

Methods: In this retrospective study, the data were collected during period from 2012 to 2013, from cancer patients who received radiation therapy at Golestan Hospital. Demographic characteristics and radiotherapy interruption frequency and reasons were reviewed and analyzed.

Results: Among 1476 cases, 70.7% of patients had no radiotherapy interruption. The most common cause of treatment interruption was equipment damages and/or maintenance in 29.5% of patients. There were statistically significant relations between radiotherapy interruption with site of cancer ($P=0.014$) and living place of patients ($P=0.006$), respectively.

Conclusion: Generally, treatment interruption at our center was not much higher than other centers; however, the most common cause of treatment interruption was equipment damages and/or maintenance, which was higher than most centers.

Introduction

Cancer is one of the most common causes of death all over the world which is spreading fast. Different types of treatment modalities are used in different types of cancers; such as surgery, chemotherapy, and radiotherapy [1]. Radiotherapy is based on exposing malignant cells to ionizing radiation, which can lead to death of these cells [2]. The ideal goal of radiotherapy is the delivery of more doses to tumor cells and less doses to the surrounding normal tissues to produce a high probability of tumor control whilst causing minimal normal tissue complications [3].

A conventional course of radiotherapy is scheduled for five days per week over several weeks; however, interruptions in this course may occur and unplanned gaps are a common occurrence. These gaps and interruptions in treatment regime may lead to the repopulation of tumor clonogens [4]. In particular for the head and neck cancers for which the evidence is the strongest for accelerated repopulation of clonogenic tumor cells, it is estimated that each one and seven days interruptions in treatment course result in 0.68-1.4% and 14-20% reduction in the local control rate, respectively [5-6-7].

Completion of radiotherapy schedule has special importance for increasing tumor control probability and reducing the probability of tumor progression and/ or recurrence [8-9-10]. Thus, one of the main goals in radiation therapy is the delivery of the total dose without any interruptions or prolongation of the overall treatment time [5-9-11].

Based on above discussion, the interruption in treatment schedule has a negative effect on disease control, therefore this research was planned to investigate a comprehensive study on reasons of radiotherapy interruption at Golestan Hospital which is the major center of radiotherapy and oncology in southwest of Iran.

Materials and Methods

Cancer patients treated at the Ahvaz Golestan Hospital during March 2012 to March 2013 were included in this retrospective analytical-descriptive study which was done at 2015. All patients treated with Varian Clinac 2100C or Siemens Primus linear accelerators. Patients were included whether their radiation treatment was curative or palliative. Patients treated with no treatment gap were excluded from the study. Interruptions in treatment were considered as the number of calendar days over which it would have been possible to have treatment (i.e., weekdays). Weekends were not regarded as missed appointments. The required information in the questionnaire included age, gender, site of cancer (head and neck v/s other types), intent of treatment (curative v/s palliative), interruption period, causes of interruption, patients' address and phone numbers.

The Statistical Package for the Social Sciences (SPSS) version 15 was used to analyze the obtained data. The descriptive statistics were average and standard deviation in quantitative variables, and frequency and percent in qualitative variables. In order to found any relation between different variables, the Fischer, independent T, Chi score and regression logistic tests were applied. P-values of < 0.05 were considered significant.

Results

Among 1476 patients of this study, 861 were female (58.3%) and 615 were male (41.7%). About 32.7% of male patients (201 from 615 patients) and 26.8% of female patients (231 from 615 patients) had interruption in their radiotherapy course (Table 1). There was no significant correlation between patients' gender and interruption probability (P-value: 0.055, OR: 1.254).

Variable	Number	Percent
Sex		
Male	615	41.7%
Female	861	58.3%
Site of Cancer		
Head and Neck	376	25.5%
Other Sites	1100	74.5%
Living Place		
Ahvaz City	568	38.5%
Khuzestan Province but not in Ahvaz city	738	50%
Out of Khuzestan Province	170	11.5%
Intent of Treatment		
Curative	1302	88.2%
Palliative	174	11.7%
Radiotherapy Interruption		
No Interruption	1044	70.7%
Interruption	432	29.3%

Table 1: Patient Characteristics and Study Variables.

The patients' ages were in the range of 1 to 96 years old with the average age of 51.72 years with 18.004 standard deviation. In 1044 patients without interruption and 432 interrupted patients, average ages were 51.87 and 51.22 years old, respectively. There was no significant relation between patients' ages and interruption probability (P-value: 0.535).

Based on the cancer site, the patients were divided in two categories; 376 patients (25.5%) had head and neck cancer and the remaindered 1100 patients (74.5%) had cancers of other sites. More than 35.1% of 376 patients with head and neck cancer (132 patients) and 27.3% of 1100 patients with other sites of cancer (300 patients) had interruption in their treatment courses. The probability of treatment interruption in head and neck cancers was significantly higher than other cancers (P-value: 0.014, OR: 1.377).

Also, the patients were categorized for their living place as follows: 568 patients (38.5%) were in Ahvaz city, 738 patients (50%) in Khuzestan province but not in Ahvaz city, and the remaindered 170 patients (11.5%) out of Khuzestan province. About 30.3% of 568 Ahvazi patients (172 patients), 26.5% of 738 non-Ahvazi patients from Khuzestan province (196 patients), and 37.9% of 170 patients from out of Khuzestan province (64 patients) had interruption in their treatment courses. There were no statistically significant differences in interruption probability among Ahvazi and non-Ahvazi patients from Khuzestan province (P-value: 0.134). However; the probability of treatment interruption in patients from out of Khuzestan province was significantly higher than Ahvazi (P-value: 0.093, OR: 1.362) and non-Ahvazi patients from Khuzestan province (P-value: 0.006, OR: 1.642).

Moreover, based on the intent of treatment, the patients were divided into two groups; 1302 patients had curative treatment (88.2%) and 174 patients had palliative treatment (11.7%).

There was no any interruption in 70.7% of patients (1044 people) in the treatment course (Table 1 and 2).

Interruption Cause	Number	Percent
Equipment damages and/or maintenance	127	29.5
Side effects	73	16.7
Public holidays	35	8.1
Patient death	23	5.3
Distance	20	4.7
Treatment cost	8	1.9
Other causes	34	7.9
Unspecified causes	112	25.8
Total	432	100.0

Table 2: Causes of Radiotherapy Interruption.

On the other hand, the treatment interruption was found in 29.3% of patients (432 people), 13.2% of patients (195 people) with 1 to 3 days interruption period, 11.2% of patients (165 people) with 4 to 30 days interruption period, and 4.9% of patients (72 people) with more than 30 days interruption period (Table 3).

Interruption Period	Number	Percent
Non	1044	70.7
1-3 days	195	13.2
4-30 days	165	11.2
>30 days	72	4.9

Total	1476	100.0
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Table 3: Periods of Radiotherapy Interruption.

The most common cause of interruption in the treatment course was equipment damages and/or maintenance with 29.5% (127 patients) of all causes. Other causes of treatment interruption were treatment side effects and general conditions (16.7%), public holidays (8.1%), patients' death (5.3%), trip difficulties (4.7%), treatment cost (1.9%), and miscellaneous causes (shifting to another center and personal problems or tendencies in 7.9%). In 112 patients (25.8%) no clear reason was found and the patients were not accessible for more investigation (Table 2).

Discussion

More than 35.1% of patients with head and neck cancer and 27.3% of patients with other sites of cancer had interruption in their treatment courses, which this difference was statistically significant (P-value: 0.014, OR: 1.377). This is in contrast with a Spanish study by Garau et al in 2008 in which only 23.4% of patients finished their radiotherapy in the planned overall treatment time (OTT) but 48.9% of head and neck cancer patients finished their treatment in the planned OTT. One of the main reasons for this difference is that for the head and neck cancers, the patients receive more doses of radiation due to curative and radical intent of treatment in these patients, hence showing more severe and debilitating treatment side effects. Also in general, these patients have low socioeconomic status with less social and family support leading to increasing rates of interruption. The Royal College of Radiographers [12-13] recommends that proactive support from a multidisciplinary team of healthcare professionals and counselors be available to patients to reduce treatments missed from acute toxicities. Unfortunately we don't have this team at our center.

About 30.3% of Ahvazi patients, 26.5% of non-Ahvazi patients from Khuzestan province, and 37.9% of patients from out of Khuzestan province had interruption in their treatment courses. The probability of treatment interruption in patients from out of Khuzestan province was significantly higher than Ahvazi (P-value: 0.093, OR: 1.362) and non-Ahvazi patients from Khuzestan province (P-value: 0.006, OR: 1.642). This difference is most likely due to the distance of living place to the radiotherapy center.

The treatment interruption was found in 29.3% of patients, 13.2% of patients with 1 to 3 days gap, 11.2% of patients with 4 to 30 days gap, and 4.9% of patients with more than 30 days gap. This rate was equal or lower than other centers. A study by Barton et al in 1990 showed that 589 out of 1012 (58%) patients with laryngeal cancer had radiotherapy interruption at Princess Margaret Hospital of Toronto during 22 years period from 1960 to 1982 [14]. A national audit of radiotherapy in head and neck cancer in the United Kingdom by James et al in 2000 showed that 1467 out of 2553 (55%) patients had one or more treatment interruptions [15]. Another audit of the effectiveness of national radiotherapy practice in head and neck cancer in the United Kingdom by James et al in 2005 showed that 397 out of 631 (63%) patients had one or more treatment interruptions [16]. A study by Gidding et al in 2009 [4] showed that 74% of 471 patients with head and neck cancer had radiotherapy interruption at the Vancouver Cancer Centre of the BC Cancer Agency during 3 years period from 2006 to 2008. Treatment breaks of greater than three days were present in 11% of radiotherapy courses. A Spanish study by Garau et al in 2008 [12] showed that 76.6% of 478 cancer patients with all primary sites treated with curative intent had radiotherapy interruption and 17.9% of the interruptions were greater than 5 days and 5.6% greater than 10 days.

There are some differences in the causes of interruption in Ahvaz and those reported in other centers. Public holidays are one of the most common causes of treatment gaps; however in Ahvaz holidays accounted for 8.1% of treatment interruptions, whereas in the United Kingdom they were responsible for 39%, in the Spanish study 45%, and in Vancouver for 69% of treatment



interruptions. This is because of efforts aimed at working our staff and machines in the most public holidays in Ahvaz.

Machine breakdown and maintenance account for 44% of treatment interruptions in the United Kingdom, 45% in Spain, and 2% in Vancouver. About 29.4% of gaps were due to this reason in Ahvaz. This is because of efforts aimed at treating patients with another machine, despite of high rate of machine break down at our center.

The second most common cause of interruption in Ahvaz was treatment side effect (16.7%) which was higher than other centers and equal to older studies like the study of Barton et al in which radiation side effects was responsible for 16% of all treatment breaks. This rate was 2% in Spain, 10% in Vancouver, and 8% in the United Kingdom. This is because of lack of a multidisciplinary team to support patients to reduce treatments missed from acute toxicities.

In conclusions, unplanned radiotherapy interruption is a major problem in normal clinical practice. Generally, treatment interruption at our center was not much higher than other centers; however, the most common cause of treatment interruption was equipment damages and/or maintenance, which was higher than most centers. This important issue requires special attention of authorities. Most interruptions are short and can be planned by treating patients on weekends and holidays to maintain the OTT.

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Authors' contributions

S.R have conceived the manuscript and revised it. N.H. , M.B. , S.A , M.H. , H.S. and S.T. . provided clinical data, pathological diagnoses, and information. also wrote the manuscript and performed the technical tests.

Compliance with ethical guidelines

Conflict of interest

Authors declare that they have no conflict of interest.

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Human and animal rights and informed consent

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References

References

1. Paul Symonds R., Foweraker Karen. Principles of chemotherapy and radiotherapy. *Current Obstetrics & Gynaecology*. 2006; 16(2)[DOI](#)
2. Sridhar T., Symonds R. Paul. Principles of chemotherapy and radiotherapy. *Obstetrics, Gynaecology & Reproductive Medicine*. 2009; 19(3)[DOI](#)
3. Sinclair Judith A, Oates Jason P, Dale Roger G. BED-time charts and their application to the problems of interruptions in external beam radiotherapy treatments. *International Journal of Radiation Oncology*Biological*Physics*. 1999; 44(2)[DOI](#)
4. Giddings Alison. Treatment Interruptions in Radiation Therapy for Head-and-Neck Cancer: Rates and Causes. *Journal of Medical Imaging and Radiation Sciences*. 2010; 41(4)[DOI](#)
5. Bese Nuran Senel, Hendry Jolyon, Jeremic Branislav. Effects of Prolongation of Overall Treatment Time Due To Unplanned Interruptions During Radiotherapy of Different Tumor Sites and Practical Methods for Compensation. *International Journal of Radiation Oncology*Biological*Physics*. 2007; 68(3)[DOI](#)
6. Withers HR, Maciejewski B, Taylor JM, Hliniak A. Accelerated Repopulation in Head and Neck Cancer. *Front Radiat Ther Oncol*. 1988; 22:105-110. [DOI](#)
7. Bentzen Søren M., Thames Howard D.. Clinical evidence for tumor clonogen regeneration: interpretations of the data. *Radiotherapy and Oncology*. 1991; 22(3)[DOI](#)
8. Fesinmeyer Megan Dann, Mehta Vivek, Blough David, Tock Lauri, Ramsey Scott D.. Effect of Radiotherapy Interruptions on Survival in Medicare Enrollees With Local and Regional Head-and-Neck Cancer. *International Journal of Radiation Oncology*Biological*Physics*. 2010; 78(3)[DOI](#)
9. H. HENDRY R. I. MACKAY S. A. ROBERT J.. Outstanding issues in radiation dose-fractionation studies. *International Journal of Radiation Biology*. 1998; 73(4)[DOI](#)
10. Yaes RJ. Some common causes of treatment prolongation. *Int J Radiat Oncol Biol Phys*. 1995; 31:686-687.
11. Lindberg Robert D., Jones Kristie, Garner Hershel H., Jose Baby, Spanos William J., Bhatnagar Divya. Evaluation of unplanned interruptions in radiotherapy treatment schedules. *International Journal of Radiation Oncology*Biological*Physics*. 1988; 14(4)[DOI](#)
12. Macià i Garau Miquel, Solé Monné Josep, Cambra Serés María José, Monfà Binefa Carlota, Peraire Llopis Maribel. Compliance to the prescribed overall treatment time (OTT) of curative radiotherapy in normal clinical practice and impact on treatment duration of counteracting short interruptions by treating patients on Saturdays. *Clinical and Translational Oncology*. 2009; 11(5)[DOI](#)
13. Board of Faculty of Clinical Oncology. *The Royal College of Radiographers (2008). The timely delivery of radical radiotherapy: standards and guidelines for the management of unscheduled treatment interruptions, third edition*. [http:// www.rcr.ac.uk](http://www.rcr.ac.uk).
14. Barton M.B., Keane T.J., Gadalla T., Maki E.. The effect of treatment time and treatment interruption on tumour control following radical radiotherapy of laryngeal cancer. *Radiotherapy and Oncology*. 1992; 23(3)[DOI](#)
15. James N.D, Robertson G, Squire C.J, Forbes H, Jones K, Cottier B. A National Audit of Radiotherapy in Head and Neck Cancer. *Clinical Oncology*. 2003; 15(2)[DOI](#)
16. James N.D., Williams M.V., Summers E.T., Jones K., Cottier B.. The Management of Interruptions to Radiotherapy in Head and Neck Cancer: An Audit of the Effectiveness of National Guidelines. *Clinical Oncology*. 2008; 20(8)[DOI](#)