ABSTRACT

**Purpose:** To explore the pattern of practice of palliative splenic irradiation (PSI) at the National Cancer Institute (NCI), Cairo University.

**Patients and Methods:** The medical records of patients referred for PSI during the time period from 1990 to 2005 were retrospectively reviewed. We compared the three most common planning techniques (two parallel opposing, single direct field, anterior and lateral fields).

**Results:** Eighteen patients who received PSI were identified. Thirteen patients were diagnosed as CML and 5 as CLL. The mean age of the patients was 44 (±16) years and the majority were men (60%). Spleen enlargement was documented in all cases. The single direct anterior field was the most commonly used technique. The dose per fraction ranged from 25cGy to 100cGy. The total dose ranged from 125cGy to 1200cGy and the median was 200cGy (mean 327cGy). There was no significant difference between CML and CLL patients regarding the dose level. Three out of 5 CLL patients and only one out of 13 CML patients received re-irradiation. All patients showed subjective improvement regarding pain and swelling. There was a significant increase in the hemoglobin level and a significant decrease in the WBC count. The single direct field shows variations in the dose from 56 to 102%; however, it is the simplest and the best regarding the dose to the surrounding normal tissues especially the kidney and the liver.

**Conclusion:** PSI has a significant palliative benefit. Although the most widely accepted technique is the 2 parallel opposing anterior-posterior fields, single anterior field is also considered as a suitable option. Higher doses are needed for CLL patients compared to CML patients.

**Key Words:** CML – Palliative radiotherapy – Splenic irradiation.

INTRODUCTION

Splenic radiation is occasionally given for patients with splenomegaly due to leukemia and myeloproliferative diseases resistant to standard chemotherapy or biologic therapy. The underlying biologic mechanisms to explain the response of splenomegaly to radiation is poorly understood. Possible underlying mechanisms include direct radiation-induced cell death, immune modulation, or cytokine induction [1]. Splenic radiation for the palliation of painful splenomegaly due to chronic lymphocytic leukemia and prolymphocytic leukemia is effective in >50% of patients [2]. Splenomegaly due to hairy cell leukemia or chronic myeloproliferative syndromes also respond to this regimen. Radiation appears less effective in the treatment of splenomegaly-related anemia or thrombocytopenia [2,3].

There is little consensus on the indications the techniques and dose schedules for palliative splenic radiotherapy in published studies. Jyothirmayi and Coltart [4], in an audit of the indications and techniques of palliative splenic radiotherapy in UK, showed that the anterior-posterior parallel opposed fields technique is the most commonly used (54%), followed by the single direct anterior field technique (used by 32% of radiotherapists), others (2%) used the oblique anterior and posterior fields technique. They also showed a great diversity in the dose fractionation scheme with the dose per fraction ranging from 20 to 200cGy.

Palliative splenic irradiation has been practiced at the National Cancer Institute (NCI), Cairo University, for a long time. The aim of this work is to explore the pattern of practice
and the effect of splenic irradiation at NCI, Cairo University and to compare the different techniques used for it.

PATIENTS AND METHODS

The medical records of patients referred to the department of Radiation Oncology NCI, Cairo University, for palliative splenic irradiation during the time period from 1990 to 2005 were reviewed. A total of 18 patients who received palliative spleen irradiation were identified. The medical records of these patients were precisely reviewed and the data were collected. Clinical presentation data including the diagnosis, presenting symptoms, the size of the spleen and the differential blood count before starting radiotherapy were reviewed. Radiotherapy treatment details regarding the number of fields used, beam arrangement, energy used, dose per fraction, total dose and overall treatment time were also documented. The response to radiotherapy including the improvement of pain, decrease in the splenic size, changes in the differential blood count and the need of re-irradiation were assessed as well.

To find the best field arrangement, the three most commonly recognized techniques (direct single anterior field, two parallel opposing anterior-posterior fields and two anterior and lateral fields) were compared. Using our planning system (Precise plan), we evaluated the three different techniques. We compared these techniques regarding the dose homogeneity within the target and the dose to the surrounding critical structures like the kidney and the liver.

Statistical analysis:

The statistical analysis was performed using the SPSS version 9 software. Patients’ characteristics and measured data were presented as proportion (frequency) for categorical variables and mean ± SD for qualitative variables; median and range were added for data with small sample size. After verification of the normal distribution of the data, the paired sample t test was used to compare quantitative variables. The Chi square and Fisher’s Exact tests were used to compare categorical variables.

RESULTS

Eighteen patients who received palliative radiotherapy to the spleen were identified from the NCI records during the time period from 1990 to 2005.

The mean age of the patients was 44 (±16) years and the majority were men (60%). Thirteen patients had CML while 5 patients had CLL.

The main presenting symptoms were swelling, discomfort and indigestion in 11 patients. Pain was the presenting symptom in 5 patients, 2 patients presented by symptoms of hypersplenism (fatigue).

All patients had spleen enlargement; they differed in the way how this enlargement was documented in their medical records. In 5 patients, it was documented by the number of centimeters below the costal margin and this ranged from 15 to 35cm. In 5 other patients, it was documented by the number of cm across the midline and this ranged from 4 to 8cm. In 3 patients, it was reported as “just reaching the right iliac fossa”, while in 2 patients the two dimensional measurement of the subcostal part of the spleen was written (15 X 15cm & 28 X 15cm).

The mean hemoglobin value for the referred patients before treatment was 8.7 (±2.8) g/dl and the mean WBC was 88.4 (±68.7) x 10^3/µl. The mean platelet count was 309.4 (±294) x 10^3/µl. In CML patients, the mean hemoglobin value for patients before treatment was 8.0 (±2.2) g/dl and the mean WBC was 80.4 (±71) x 10^3/µl. The mean platelet count was 379 (±288) x 10^3/µl. In CLL patients, the mean hemoglobin value for the referred patients before treatment was 10.2 (±3.2) g/dL and the mean WBC was 52.5 (±57) x 10^3/µl. The mean platelet count was 110 (±50) x 10^3/µl.

Radiotherapy technique:

Different radiotherapy techniques were used in palliative splenic irradiation:

1- The single direct anterior field technique was used in 7 patients. The dose was calculated as a given dose in 6 patients, while it was calculated at 3cm depth in one patient.

2- The anterior, posterior and lateral fields (3 fields) technique was used in 5 patients.

3- The anterior and posterior fields (2 parallel opposing fields) technique was used in 3 patients.
4- The anterior and lateral fields (2 wedged fields) technique are used in 3 patients.

The dose per fraction ranged from 25 to 100cGy, but the majority of the patients (14 patients, 78%) received 50cGy per fraction. Although the total dose received by the patients was 150cGy in 7 patients, it ranged from 125 to 1200cGy (mean dose was 327±279cGy; median 200cGy). The number of treatment fractions ranged from 3 to 12 fractions. There was no significant difference between CML and CLL patients regarding the total dose received or the dose per fraction. In CML patients, the mean dose per fraction was 57 (±21) cGy and the mean total dose was 319 (±303) cGy. All CLL patients received 50cGy per fraction and the mean total dose was 350 (±231) cGy (p=0.841).

Re-irradiation:

Four patients received re-irradiation to the spleen, the dose per fraction ranged from 50 to 100cGy and the total dose received in the re-irradiation setting ranged from 100 to 1350cGy, with the maximum total dose received of 1500cGy (one patient). Three out of the 5 CLL patients received re-irradiation, while only one of the 13 CML patients received re-irradiation; this difference was statistically significant by Fisher’s Exact Test (p=0.044). The CML patient who received reirradiation had an initial dose of 150cGy and 100cGy reirradiation (total 250cGy).

Response to treatment:

All patients showed subjective improvement regarding the pain and the swelling. The hemoglobin level showed a significant increase after radiotherapy from 8.7 (±2.8) g/dl to 9.9 (±2.3) g/dl (p=0.007). The WBC count showed a significant decrease from 88 (±68) x 10³/µl to 44 (±52) x 10³/µl (p=0.019). There was no significant change in the platelet count.

Comparison of different fields arrangements:

Regarding spleen coverage with homogenous dose distribution, as shown in Table (1), the 2 field arrangements (either anterior-posterior or anterior and lateral) achieved reasonable coverage of the spleen with homogenous dose distribution. This was clear when compared with single direct field using 6 MV energy which showed variation in the dose from 56% to 103%. On the other hand, the single direct anterior field technique was the best regarding the dose to the surrounding normal tissues, especially the kidney. For example, the volume of the kidney receiving 90% of the given dose (18Gy in case of giving 20Gy total dose) was 0% in case of single anterior field as compared to 93% in 2 parallel opposing fields and 43% with two wedged fields. Regarding the dose to the liver, the 2 wedged fields resulted in a mean liver dose of 35% of the given dose while the dose to the liver was negligible for the single anterior field and the 2 parallel opposing fields (5% and 6%, respectively).

<table>
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<th>Table (1): Dose distribution in different organs using different techniques.</th>
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<td>Single anterior</td>
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<td>Mean (±SD)</td>
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<td>Liver mean dose</td>
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<td>Left kidney V90% (18Gy)</td>
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DISCUSSION

Splenic irradiation has been used as a treatment for hematological disorders since 1903 [5]. Its usage has declined with the advent of effective chemotherapy and is currently limited to palliation of symptoms in patients who are refractory to, or unsuitable for, chemotherapy [6].

Splenomegaly is usually associated with chronic lymphoid and myeloid malignancies. In this study, more patients with CML were referred for PSI compared to lymphoid malignancies. The main aim of splenic irradiation is palliation of symptoms mainly swelling, discomfort and pain.

There is an enormous disagreement concerning the dose for palliative splenic irradiation. In CLL patients, most studies used single doses between 0.5 and 1Gy given daily or 1-3 times a week until remission or significant reduction of splenic size. The median cumulative dose
The disagreement also exists regarding the best technique or field arrangement for palliative splenic irradiation. Weinmann et al. [1], in their review article, described the technique of irradiation as anterior-posterior portals encompassing the whole spleen. They recommended primary CT-planning as it is beneficial for patients who may need re-irradiation or in case of primarily impaired renal function. Also, they pointed to the importance of considering the dose received by the kidney. Jyothirmayi and Coltart [4], in an audit of the indications and techniques of palliative splenic radiotherapy in the UK, showed that anterior-posterior parallel opposed fields is the most commonly used technique (used by 54% of clinicians) followed by single direct anterior field (32%), whereas 12% used both techniques interchangeably and only 2% used oblique anterior and posterior fields. In the present study, there were more trends to use a single direct anterior field as was seen in 7 out of the 18 patients followed by 3 fields’ technique anterior, posterior and lateral fields. Three patients only were irradiated using anterior-posterior fields. The use of the single direct anterior field can be supported by many facts. First, it is a very simple technique. Second, in the absence of any evidence to support the use of a certain dose per fraction, the dose inhomogeneity could not be considered a limiting factor. In other words, if we irradiated the spleen by 100cGy given dose anteriorly this means that part of the spleen will receive 100cGy per fraction and the rest will receive a lesser dose down to 50cGy per fraction and both are accepted. Lastly, it markedly decreases the dose to the kidney compared to the parallel opposing fields and, unlike lateral fields, it eliminates any dose delivered to the liver and the small bowel.

In conclusion, there appears to be a significant palliative benefit to a short course of low-dose radiation therapy for patients with splenic enlargement related to leukemia and lymphomas. Different techniques can be used, although the most widely accepted technique is the 2 parallel opposing anterior-posterior fields; the single direct field is also considered suitable option. In view of the wide variations in the dose regimen prescribed, no standardized recommendation could be given for any specific dose regimen, but higher doses are needed for CLL patients compared to CML patients.
REFERENCES


