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MİDE KANSERLİ HASTALARDA RADYOTERAPİ SIRASINDA DALAK DOZİMETRİSİ VE DOZ/HACİM ORANI

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ÖZET

Dalak, doğuştan ve edinsel bağışıklık sistemi açısından önemli bir role sahiptir. Dalak, genellikle konturları olmayan ve abdominal radyoterapi vakalarında ihmal edilebilme ihtimali olan bir organdır. Bu nedenle dalak dozimetrisi nadiren çalışılmıştır. Bu çalışmada mide kanserli hastalarda dalak radyasyon dozunu ve dalak hacmi kaybı ile ilişkisini araştırmayı amaçladık. Veriler, kanserin evreleri, tedavi planı, dalak şekillendirme ve dozimetri, 3 boyutlu bilgisayarlı tomografi (3D CT) gibi klinik ve demografik faktörlerden oluşmaktadır. Tedavi öncesi ve tedavi sonrası fazdaki dalak hacimleri karşılaştırılmıştır. Medyan V20 değeri 65.5 (0.0-100.0) idi. Radyoterapi öncesi ve sonrası medyan dalak hacimleri sırasıyla 185.1 (71.4-488.0) cm^3 ve 138.2 (59.0- 429.0) cm^3 olarak ölçüldü. Bu hacim kaybının istatistiksel olarak anlamlı olduğu bulundu (p = 0,001). Üst karın malignitesi, özellikle mide kanseri olan hastaları, hipospleniye bağlı olabilecek enfeksiyonlardan korumak için RT sırasında dikkatli bir şekilde taranmalıdır. Ayrıca, üst abdominal malignitesi olan hastalarda RT'nin dalak hacmi ve dalak fonksiyonu üzerindeki etkilerini netleştirmek için ileriye dönük ve daha geniş örneklemli çalışmalara ihtiyaç vardır.

Anahtar Kelimeler: Abdominal radyoterapi, Mide, Kanser, Dalak

SPLEEN DOSIMETRY AND DOSE / VOLUME RATIO IN GASTRIC CANCER PATIENTS RECEIVING RADIOTHERAPY

ABSTRACT

Spleen has a significant role in terms of congenital and acquired immune systems. The spleen is an organ that is generally not contoured and may be neglected during abdominal radiotherapy cases. Thus spleen dosimetry has rarely been studied. In the present study, we aimed to research splenic radiation dose and the association with loss of splenic volume in patients with gastric cancer. The data consisted of demographical factors and clinical factors such as stages of cancer, treatment plan, spleen contouring and dosimetry, and 3 dimensions computerized tomography (3D CT). The volumes of the spleen in the pretreatment phase and post-treatment phase were compared. Median V20 value was 65.5 (0.0-100.0). The median pre and post-radiotherapy spleen volumes were measured to be 185.1 (71.4-488.0) cm3 and 138.2 (59.0-429.0) cm3 respectively. This loss of volume was found to be statistically significant (p = 0.001). Patients with upper abdominal malignancies specifically gastric cancer

can be screened carefully during RT for protecting patients from infections that can be due to hyposplenism. Further, prospective and larger sampled studies are needed to clarify the effects of RT on spleen volume and splenic function in patients who have upper abdominal malignancies.
Keywords: Abdominal radiotherapy, gastric, cancer, spleen, volume

INTRODUCTION

Chemotherapy and radiotherapy (RT) have been considered to be standard treatment options for localized esophagus and gastric cancers. These treatment options can be supported by surgical methods or they can be used alone (1-5) RT may be tended to bring side effects; however, three dimensions and intensity-modulated RT lead to affect the target organ and thus the side effects may be minimized (6-9). In the treatment plan, the RT dose should be balanced according to each organ such as the lung, liver, spinal cord, intestinal system, and kidneys. However, there has been limited data about the radiation dose and spleen volume. Spleen has a significant role in terms of congenital and acquired immune systems (10). The spleen targets the antigens, produces antibodies, and also has a special place for iron metabolism which is promoted by macrophages (11, 12). There are numerous complications in patients with gastric and esophageal cancers who have been treated with curative surgical approaches. Hyposplenism and splenectomy are commonly known risk factors for infections as well as sepsis (13-15).

Because there has been limited data about the calculation of radiation dose for the spleen in patients with upper abdominal malignancies who were treated by RT, there is no standardized guideline for pneumococcus vaccine for such patients. Furthermore, there is limited data that investigated the effects of chemotherapy and RT on spleen volume in patients who are diagnosed with upper abdominal malignancies (16-18). In the present study, we aimed to research splenic radiation dose and splenic volume before and after treatment in patients with gastric cancer.

METHODS

The present study was conducted at Trakya University, Department of Radiation Oncology. The records of patients who have been treated with RT between the dates of January 2010- March 2012 were investigated retrospectively. The data consisted of demographical factors such as age and gender and clinical factors such as stages of cancer, treatment plan, spleen contouring and dosimetry, 3 dimensions computerized tomography (3D CT) volumes of the spleen in the pre-treatment phase and post-treatment phase, the existence of chemotherapy. 26 patients with gastric cancer were investigated retrospectively.

Spleen Contouring and Dosimetry

All patients were in a supine position and motionless during the simulation. Toshiba Asteion S4 simulator was used to obtain non-contrasted axial CT slices of 5 mm thickness throughout the thorax and abdomen. No oral or IV contrast was used. After the isocenter was detected the CT images were transferred to Elekta XIO 4.6 Socal or Varian Eclipse 6.5 planning/contouring computers for treatment planning (Figure 1). The final treatment plan was used for all the patients and spleen contouring was applied on every axial slice by a physician (NK). Following the completion of spleen contouring, a splenic dose/volume histogram was made and the dose-volume data of the spleen was obtained (Figure 1). Splenic volume data (Pre-RT splenic volume) and dosimetric information namely minimum (Dmin), maximum (Dmax), and average/median splenic doses and volumes receiving dosages 10 (V10), 20 (V20), 25 (V25), and 30 Gy (V30) and higher than, were calculated.

In patients with follow-up CT scans; the most recent follow-up scan was transferred to the planning unit and the spleen was recontoured obtaining the information on the post-RT volume (Post-RT spleen volume) (Figure 2). The median duration was 9 months between pre-RT and post-RT (minimum 3 months and maximum 22 months). All volumetric parameters were formulated as cm3. Gy was used for spleen doses units and % for V10-30 units. The volume ratio was calculated with the "Post-RT volume/Pre-RT volume" equation.

Statistical Method

All obtained data were analyzed by Statistical Package for the Social Sciences-PC version 20 (License Number:10240642). A confidence interval (CI) of 95% and a 2-tailed P value less than 0.05 were accepted to be statistically significant for all analyses. All numerical variables were tested by the Shapiro-Wilk test for normality of distribution The numerical data were expressed as mean ± standard deviation or median and minimum -maximum. Pre-RT and post-RT splenic volume changes were assessed with Wilcoxon Test.

RESULTS

Twenty-six patients were included in to present study. The median age of patients was 63 (33-81). 65% percent of patients were at the III or IV stages of cancer. Postoperative adjuvant or curative RT was administrated to 20 patients (%77) and the total dose varies between 42-50 Gy. The main demographical and clinical characteristics were presented in Table 1.

The minimum median splenic dose was 1.9 Gy (0.5 Gy - 45.0 Gy). The maximum median splenic dose was 48.1 Gy (11.9 Gy - 50.4 Gy). The median splenic dose was 26.4 Gy (4.6 Gy-47.8 Gy. The dosimetry data of patients were shown in Table 2.

The splenic median volume of patients was 185.1 cm3 (71.4 cm3-488.0 cm3) in the pre-RT phase and 178.6 cm3 (59 cm3-429 cm3) in the post-RT phase. There was a significant reduction in splenic volume before and after RT (p=0.001) (Table 2, Figure 3).

DISCUSSION

In this study, we aimed to investigate splenic dose-volume data of patients with gastric cancer who were treated with RT. Also, we documented the clinical characteristics of the patients mentioned above.

The response of the spleen to radiation has a similar response to lymph nodes. The structure of the white pulp of the spleen is similar to lymphatic nodes and the red pulp contains all of the elements of blood. Lymphopoiesis is commonly developed into the white pulp of the spleen. In abnormal conditions, granulopoiesis is created in the red pulp of the spleen. Thus, lymphopoiesis and granulopoiesis may be disturbed after radiation exposure to the spleen. In high doses of RT such as 40 Gy and above, the outcome of RT may be like a splenectomy (19). It has been reported that RT reduced the leukemic cells as well as some subgroups of T cells. Although there is not a systematic study that investigated the association between RT and splenic functions, it can be said that there would be suppression of the immune system after splenic radiation exposure. Thus, screening the splenic functions in patients who have malignancies is quite important because of possible infections. Furthermore, patients with gastric cancer who received RT can be considered to be given more attention in terms of infections. Because, during RT to upper abdominal malignancies, the functions and structure of the spleen can be disturbed (20).

Although the problem mentioned above is challenging, there have been limited numbers of studies that investigated splenic volume during RT. A study that researched the splenic volumes in patients who had ovarian cancers and who had received 2000 rad RT was reported to have splenic atrophy (21). Dailey et al. reported reduced splenic volume after treatment in patients with Hodgkin Lymphoma who had received RT. In this study, authors also reported that there have been not any significant volumetric changes in the spleen after chemotherapy

(19). Regarding the radiation dose interval, it has been reported that spleen functions could be affected with a 2-40 Gy dose range (22-24)

In the present study, patients with gastric cancer were included. There has been only one study that investigated the spleen volume changes in gastric cancer patients who received RT. Trip et al. reported an average of 37% splenic volume reduction in patients with gastric cancer after RT (25). In the present study, splenic volume was found to be reduced after RT in all patients group. It can be said that our result is in line with Trip et al.'s study (25).

Our study has some limitations. Firstly, the retrospective design of the study can be considered a limitation. Although the volume changes of the spleen were measured, we could not demonstrate changes in the spleen functions. The majority of patients were receiving chemotherapy and this issue can be a confounding factor. The small sample size of the group can be considered to be inadequate for making a general conclusion.

In conclusion, patients with upper abdominal malignancies specifically gastric cancer can be screened carefully during RT for protecting patients from infections that can be due to hyposplenism. Further, prospective and larger sampled studies are needed to clarify the effects of RT on spleen volume and splenic function in patients who have gastric cancer.

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Table 1. Demographical and Clinical Characteristics of Patients

	Gastric Cancer (n=26)
Age(years)	
Median (min-max)	63 (33-78)
Gender (%)	
Male	19 (73%)
Female	7 (37%)
Stage, n (%)	
I-II	9 (35%)
III	11 (42%)
IV	6 (23%)
Treatment, n (%)	
Postop adjuvant + curative	20 (77%)
Palliative	6 (23%)
Chemotherapy, n (%)	
Yes	21 (81%)
No	5 (19%)

Table 2. The dosimetry data of patients

	Value (Range)
Splenic volume rate (cm^3) (Post-RT/Pre-RT)	0.69 (0.38-1.21)
Minimum splenic dose (Gy)	1.9 (0.5-45.0)
Maximum splenic dose	48.1 (11.9-50.4)
Median splenic dose	26.4 (4.6-47.8)
V10 (%)	90.8 (1.8-100.0)
V20 (%)	65.5 (0.0-100.0)
V25 (%)	53.0 (0.0-100.0)
V30 (%)	44.0 (0.0-100.0)

Table 3. Comparison of splenic volume before and after treatment

Gastric Cancer (n=26)		**p***
Pre-RT splenic volume	**Post-RT splenic volume**	
185.1 (71.4-488.0)	138.2 (59.0-429.0)	**0.001**

*Mann-Whitney U test.

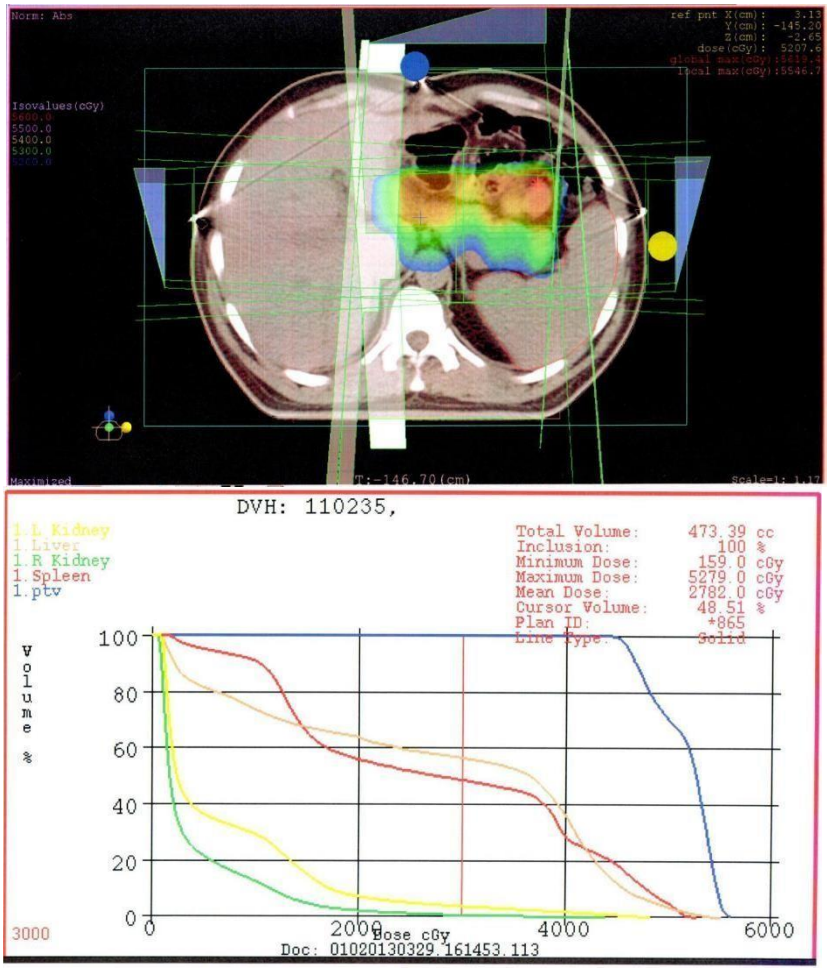

Figure 1: Demonstration of radiotherapy fields and dose color wash, and the comparison of splenic volumes between pre-radiotherapy and post-radiotherapy

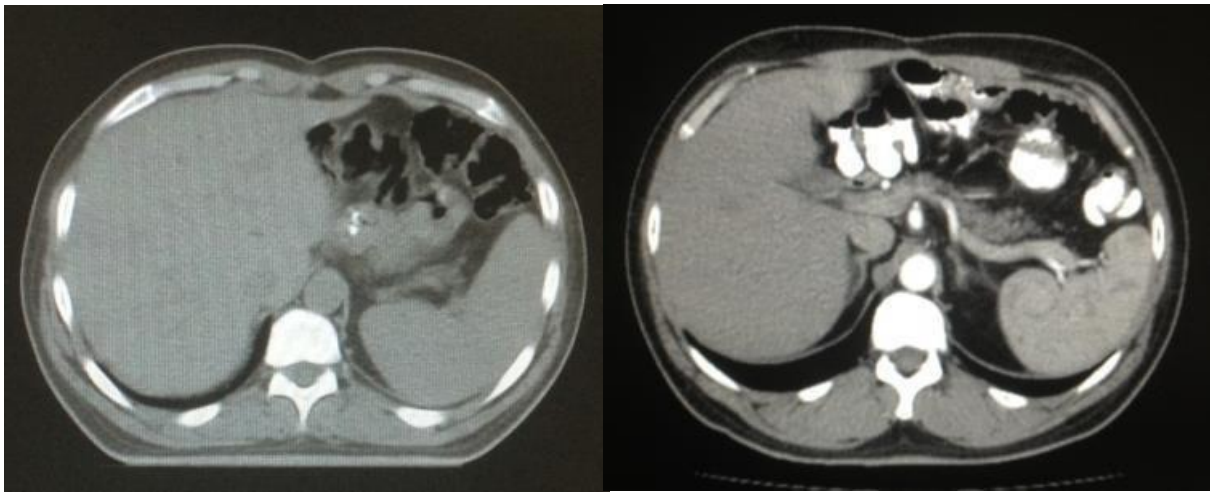

Figure 2. The volume change of the spleen before and after treatment was demonstrated.

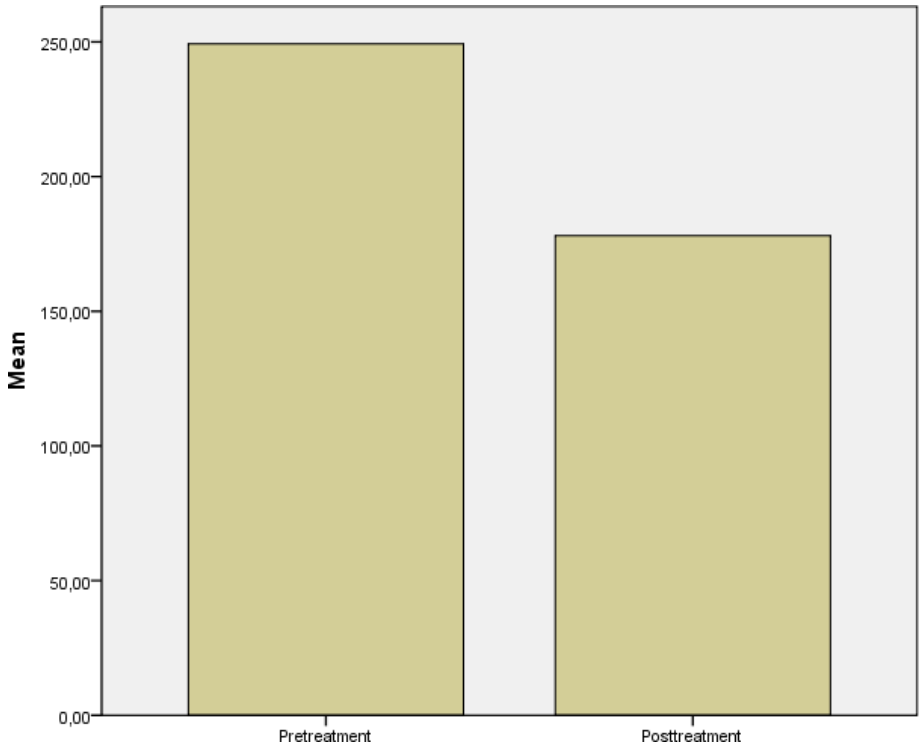

Figure 3. Demonstration of volume change of spleen before and after R