The Modified Method of Splenic Irradiation

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Splenic irradiation in chronic myelogenous leukemia is reserved for patients who have painful splenomegaly despite chemotherapy and/or inoperable splenomegaly because of huge size. The role of splenic irradiation is diminution of painful splenomegaly and indirect effect of splenic irradiation on unirradiated hematopoietic and lymphoreticular tissue such as reduction of leukocyte count and increase of hemoglobin level. We report on a useful clinical method for splenic irradiation in chronic myelogenous leukemia. We have used sonography as the tool of simulation. The portal size using modified method is smaller than the field size of conventional simulation, and so this method suggests that useful to irradiation of huge splenomegaly, effective shielding of critical organ and the downfall of complication during irradiation of spleen.

Key Words: Splenic irradiation, Chronic myelogenous leukemia, Sonography

INTRODUCTION

Chronic myelogenous leukemia has been regarded as one of a group of myeloproliferative syndromes that include polycythemia vera, agnogenic myeloid metaplasia, essential thrombocytosis, and erythroleukemia[1].

Despite its name this is a rapidly progressive malignancy with a median survival in untreated cases of only 19 months[2]. It is characterized by the proliferation of primitive granulocytes in the bone marrow and other organs, the spleen in particular.

Splenic irradiation for patients with chronic myelocytic leukemia was first described in 1903 by Senn[3], and prior to the advent of effective chemotherapy, was the accepted initial treatment. At present, splenic irradiation is reserved for patients who are symptomatic despite chemotherapy. The roles of splenic irradiation in chronic myelogenous leukemia have been known as both to relieve painful splenomegaly and to take advantage of an indirect effect of splenic irradiation on unirradiated hematopoietic and lymphoreticular tissue such as reduction of leukocyte count and increase of hemoglobin level.

It is our purpose to investigate the new method of simulation in splenic irradiation of chronic myelogenous leukemia using sonography.

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RATIENTS AND METHODS

Splenic irradiation in chronic myelogenous leukemia patients was referred to the Division of Radiation Therapy, St. Mary's Hospital Catholic University Medical College since July 1987. They all had huge spleen with or without pain during chemotherapy or even after chemotherapy.

The portals of splenic irradiation have been determined by using the sonography. We used with sector and linear type of transducer. The frequency of transducer was 3.5 MHz and 5 MHz. We have got splenic sonography of patients in supine position, and marker pen has traced with transducer along the margin of spleen(Fig. 1).

We don't have traced upper and lateral margin of the spleen. Because the upper margin and lateral margin of the enlarged spleen have obtuse angle, and have been alike to the margin of simulator film using roentgenography. The margin of irradiated portals was defined by 3 methods(Fig. 2).

Firstly, the most convex point of enlarged spleen in vertical view of spleen sonogram was determined as the margin of portals. Secondarily, the hilum point of spleen was decided as that margin. Finally, the point which the thickness of enlarged spleen formed 1:2 ratio in vertical view of spleen sonogram was fixed on the margin of spienic irradiation.

After marking on the abdomen using sonogram, we have simulated by simulator along the previous markings using sonogram. This portal size was smaller than the field size determined according to

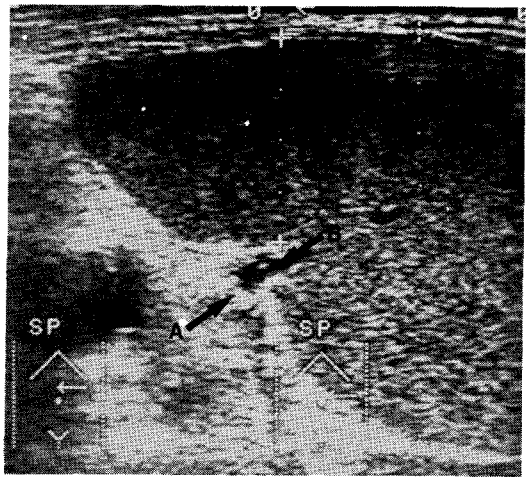

Fig. 1. Spleen sonography with marginal markings. A : the most convex point B : spleen hilum C,D : Thickness of spleen, C : D = 1 : 2.

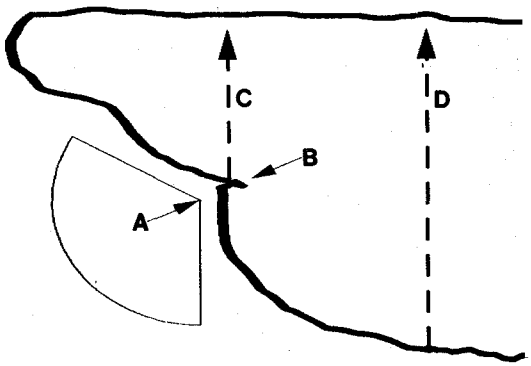

Fig. 2. Schematic diagram of marginal markings. A : the most convex point B : spleen hilum C,D : Thickness of spleen, C : D = 1 : 2

the size of palpated spleen and splenic contour as it appeared on the simulation film (Fig. 3).

Splenic irradiation was given with a 6 MV Linear accelerator, with the source axis distance (SAD) 100 cm. Splenic irradiation was given in daily doses of 25 to 100 cGy (tumor dose) for a total varying from 150 to 800 cGy (average 450 cGy), in attempts to induce initial clinical remission and again when the disease recurred or became resistant to chemotherapy.

The shielding areas were shielded with 5 HVL of pb. All patients were treated AP:PA with the ratio of 1:1. We estimated the size of spleen by sonography

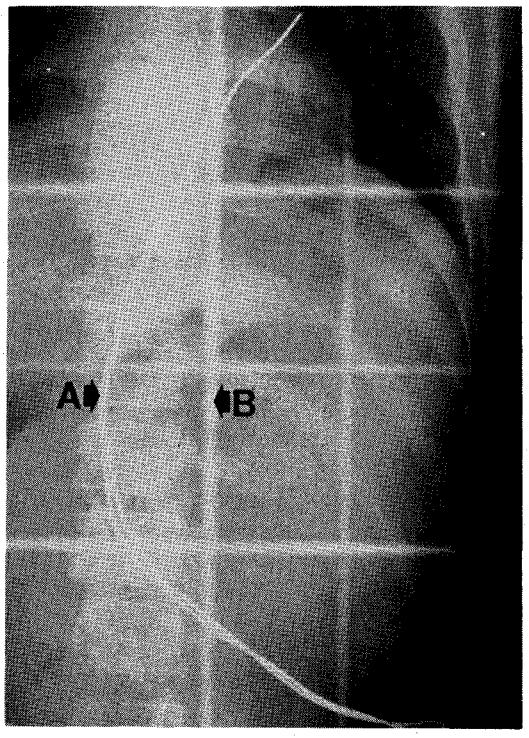

Fig. 3. Simulation film. A : spleen contour. B : treatment fields

every other day to evaluate the response to splenic irrradiation and reduced the field size as splenomegaly regressed response to splenic irradiation.

DISCUSSION

Chronic myelogenous leukemia is the acquired disease of hematopoietic stem cell proliferation and characterized by marked expansion of granulocyte. Chronic myelogenous leukemia is easily diagnosed by splenomegaly, leukocytosis, increased absolute count of basophils and eosinophils, the presence of Philadelphia chromosome and decreased activity of leukocyte alkaline phosphatase.

Treatment consists of chemotherapy, radiotherapy, splenectomy, leukapheresis and bone marrow transplantation. The mean survival is 36 months to 44 months[4~6].

Most of patients are stable until accelerated or blast crisis, if they well treated. But Philadelphia chromosome negative chronic myelocytic leu-

kemia patients characteristically do poorly with therapy and have a mean survival in the range of 14 months to 19 months.

Wilson and Johnson reported in 1971 their experience with splenic irradiation in 20 patients with chronic myelocytic leukemia who had received prior chemotherapy[7]. They noted relief of splenic pain and regression of splenomegaly in about 50% of their patients, but serious hematologic toxicity was seen in 6 patients, 5 of whom died.

At present, splenic irradiation is reserved for patients who are symptomatic despite chemotherapy. There are few data available in literature for critical review of the optimal portal, dose, fraction and duration of radiation treatment of these patients. Wagner et al have reported that "The most frequently applied treatment was to a portal measuring 200 to 300 cm^2 with a total dose of 100 to 1500 cGy delivered in 9 to 15 days"[8].

Mair has suggested the technique of spleen irradiation that the maximum fields was 15×10 cm^2[9] and no attempts was made to include the whole spleen if this could not adequately be encompassed within this maximum size.

The treatment portals should encompass the entire spleen with a 1 cm to 2 cm margin and splenic irradiation in daily fractions of 50 to 100 cGy to a total dose of 1000 cGy is usually adequate. In our practice, most of patients have large hepatosplenomegaly and the average portal size using roentgenogram has been exceeded the maximum field in previous literature. And so we cannot have applied previous method of literature.

This modified method was more effective method for splenic irradiation especially huge splenomegaly and shielding of critical organ including bowel loop because of smaller field than portal field using roentgenogram (simulator).

Careful monitoring of peripheral blood count is essential during splenic irradiation, since even small doses of radiation are capable of causing severe cytopenias when irradiation of spleen in chronic myelogenous leukemia patients. Mair reported that irradiation of spleen should be suspended if the platelet count drops below 80× 10^9/L and the white cell count and platelet count will continue to drop for two weeks after irradiation is completed[9].

Because the portal fields of this modified method were the small field comparing with the portal size using conventional simulation, our method will be promising a few number of interrupted treatment due to drops of hematologic status.

CONCLUSION

We have developed the modified method of simulation for splenic irradiation by using of sonography. The portal size using modified method is smaller than the field size of conventional simulation, and so this method suggests that useful to irradiation of huge splenomegaly and effective shielding of critical organ including kidney and bowel loop and will be promised the descent of side effect during irradiation of spleen.

REFERENCES

1. **George P Canellos:** Chronic leukemia. 'In' Cancer, Principles and Practice of Oncology. 2nd ed. Philadelphia, Lippincott Co, 1985, 1739-1752
2. **Minot JB, Buckman TE, Isaacs R:** Chronic myelogenous leukemia-age, incidence, duration and benefit from irradiation. JAMA 82, 1489
3. **Senn NS:** Case of splenomedullary leukemia successfully treated by the use of the roentgen ray. Med Record 64:282-282, 1903
4. **Haskell CM:** Chronic myelogenous leukemia. 'In' Cancer Treatment, 2nd ed, Philadelphia, WB Saunders Co, 1985, 721-729
5. **Portlock CS, Goffinet DR:** Chronic myelogenous leukemia. 'In' Manual of Clinical Problems in Oncology, 3rd ed, Little, Brown Co, 1981, 212-215
6. **Lichtman MA:** Chronic myelogenous leukemia 'In Hematology and Oncology, Ist ed, New York, Groune and Stratton 1983,, 151-153
7. **Wilson JR, Johnson RE:** Splenic irradiation following chemotherapy in chronic myelogenous leukemia. Radiology 101:657-661, 1971
8. **Wagner H, Mckeough PG, Desforges J, et al:** Splenic irradiation in the treatment of patients with chronic myelogenous leukemia or myelofibrosis with myeloid metaplasia. Cancer 58:1204-1207, 1986
9. **Mair G:** Hematological malignancy in the adult. 'In Radiotherapy in Clinical Practice, Butterworth & Co, Ltd, 1986, 258-279

═ 국문초록 ═

초음파를 이용한 비장의 조준법

가톨릭의대 부속 성모병원 방사선과학교실

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만성 골수성 백혈병 치료에 있어서 비장의 방사선 조사는 화학요법에 반응이 없거나, 비종대가 심하여 비장 절제술을 시행할 수 없는 환자 그리고 통증을 동반한 비종대 환자에서 증상완화를 위하여 사용되고 있다.

가톨릭의대 성모병원 방사선과에서는 만성 골수성 백혈병에 있어 비장의 방사선 조준시 초음파를 이용하여 치료범위를 정하는 새로운 방법을 개발하여 이에 보고 하는 바이다. 이 방법의 장점은 기존의 방사선 조준기를 사용하여 결정하는 방사선치료범위보다 작으며 비장만을 정확하게 포함 할 수 있으므로 효과적인 비장 조사 및 주변 장기의 방사선 보호, 그리고 부작용 등을 감소시킬 수 있다.