

Overexposed Accidents due to Erroneous Input to Treatment Planning System in Japan

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ABSTRACT

Accidental overexposures by radiotherapy have gathered attention recently in Japan. The widely publicized accidents have occurred at the government official benefit society hospital and at the hospital affiliated to a medical school. The accident at the government official benefit society hospital occurred when one of two existing accelerators was renewed. A radiotherapy planning system was also introduced at that time. Then treatment planning for the old and the new linear accelerator was performed using the system. There were variations in wedge factors for the 30 degrees wedge filter between the old and the new linear accelerator. That is, the difference in the structure of the wedge filter (30 degrees) resulted in variations of the wedge factors between both accelerators. In order to keep strength, a lead board was backed to the lead wedge filter for the new linear accelerator, whereas the wedge filter for the old one was made of the iron. The X-ray attenuation of the iron wedge filter is smaller than that of the lead wedge filter. The basic beam data of the old linear accelerator, however, wasn't delivered properly between the user and the maker. Then, the accident took place because the same wedge factor was used for the old and the new linear accelerator. On the other hand, the accident which occurred at the university hospital was brought about by the input mistake in initialization of the computer system when a linear accelerator was introduced. The input mistake was found when the software of the system was updated. If the dose had been measured and confirmed adequately, the accidents could have been prevented in both cases.

Keywords: Overexposed accident, wedge filter, treatment planning

1. INTRODUCTION

In the radiological medical treatment in Japan, the manpower for securing quality control, especially, in radiotherapy, runs remarkably short as compared with the West. In such a situation, the latest highly precise advanced radiotherapy technology, etc., is not fully utilizable. So, there was anxiety about the occurrence of a medical accident relevant to radiotherapy. Under such circumstances, the overexposed accident in a certain hospital in Tokyo was reported all over the country through the mass media in April, 2001. The most anxious fears became reality in radiotherapy. Therefore, a certain conference was newly launched in Japan on June 9, 2001. This conference considers physical / technical quality control (QA/QC) of the radiological medical treatment in Japan from a broad position, and if necessary, it releases an investigation report, advice, etc. This overexposed accident was the initial subject for discussion after this conference's inauguration. The conference analyzed the cause of the accident, talked about the effective preventive measures against recurrence, and released the result as an investigation report. Moreover, advice for accident prevention was also issued. Nevertheless, an overexposed accident which occurred in the attached hospital of a certain university medical department in Japan was reported in July, this year. These two accidents which occurred in Japan are reported.

2. MEDICAL ACCIDENTS

2.1. Case 1

One of two linear accelerators was updated in a certain hospital in Tokyo in July, 1998. At this time, one set of treatment planning system was also introduced simultaneously, and the treatment planning for two linear accelerators was performed by this one set. By the way, since updating was behind schedule, the manufacturer took over the input of the data to the treatment planning system. In addition, verification of the treatment planning system by the presence of

staffs of the manufacturer and staffs of the hospital was not performed. The radiological technologist on the spot had noticed on December 18, 2000 that the dose for the old linear accelerators calculated by the treatment planning system was superfluous. As a result of verification by manual calculation, a problem was in the wedge factor of 30 degrees the wedge filter, and the dose was calculated as 1.35 times of a proper dose. When the data file was investigated, and the data of treatment planning system was checked, it became clear that the wedge factor data for a new linear accelerator was applied to the old linear accelerator. Consequently, when the 30 degrees wedge filter of the old linear accelerator was used, the wedge factor increased to 1.35 times the proper value. Twenty-three patients were irradiated by the old linear accelerator using the 30 degrees wedge filter. In view of progress, medical treatment, treatment period, etc., eight cases caused about generating of radiation damage. In this accident, a committee to investigate the accident was immediately established in the hospital, and the accident was reported to the proper authorities.

2.2 Case 2

Higher doses than the planned irradiation dose have been applied to 12 cancer patients who were undergoing radiotherapy from June, 2000 to July, 2002 in the hospital of a certain university. When a linear accelerator was introduced as a radiation therapy system, there was an input mistake in the initial setting of the computer system for dose calculation. Therefore, a dose from 1.2 times to 1.45 times of the proper dose was irradiated to patients. When the software of the system was updated this year, it turned out that there was an error in the data of a wedge filter for the first time. One of the 12 patients has an advanced disease because of side effects, and side effects may arise in four other patients later on. Since four other patients did not receive much of a dose, the possibility that side effects will occur is low. Three other patients passed away because of the malignant tumor.

3 . SUMMARY

The direct cause of the accident was that the data of the same wedge factor of a new linear accelerator was applied to the old linear accelerator, without inputting the right information into the treatment planning system. It cannot be denied that a shortage of staff engaged in radiotherapy and lack of a quality control section was the remote cause of the accident. The next lesson was obtained from these accidents. An acceptance test sufficient at the time of installation should also be performed, not only regarding the radiation therapy system but the peripheral device, or the system, and the result must be saved in the record clearly. As a short-term measure of accident prevention, the user should reconfirm the value inputted into the treatment planning system together with the dose evaluation parameter used daily. If required, a dose must be measured by the suitable dosimeter and the dose must be checked. As a long-term measure for recurrence prevention, a doctor, a radiological technologist, and a medical physicist need to become skilled further in the business of radiotherapy at large and treatment planning system, commands, algorithms, etc. The shortage of staff in a radiotherapy section should be solved and we should try hard to attain the level of the West. In particular, two radiological technologists per linear accelerator should take charge of radiotherapy. In recent days, the importance of quality control has increased suddenly in the radiotherapy area. In order to perform quality control independently of a medical-examination section, a section mainly consisting of medical physicists, radiological technologists etc. is required. Although it is difficult to realize immediately in Japan today, it is necessary to implement the established policy for each academic society.