RADIOLOGICAL INCIDENTS IN RADIOTHERAPY

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INTRODUCTION

Radiotherapy has been an essential component of the treatment of cancer for many years, with approximately half of all cancer patients requiring radiotherapy at some time of illness. Radiotherapy is a highly complex process, involving many steps and many individuals in the planning and delivery of the treatment. Such complexity leads to a multiple of opportunities for errors to occur. Though major incidents are infrequent, the consequences can be extremely serious, as evident from the few, but disturbing high-profile incidents that have been reported recently [1, 2]. Therefore quality assurance and safety problems are at present time main issues of many radiation oncology institutes, regulatory bodies or national and international organizations.

In many countries a reporting system of radiological incidents to national regulatory body exists and providers of radiotherapy treatment are obliged to report all major and/or in some countries all incidents occurring in institution. State Office for Nuclear Safety (SONS) is providing a systematic guidance for radiotherapy departments from 1997 by requiring inclusion of radiation safety problems into Quality assurance manual, which is the basic document for obtaining a license of SONS for handling with sources of ionizing radiation. For that purpose SONS also issued the recommendation "Introduction of QA system for important sources in radiotherapy-Radiological incidents" [3, 4] in which the radiological incidents are defined and the basic guidance for their classification (category A, B, C, D), investigation and reporting are given.

At regular periods the SONS in co-operation with radiotherapy centers is making a survey of all radiological incidents occurring in institutions and it is presenting obtained information in synoptic communication (2003 Motolske dny, 2005 Novy Jicin). This presentation is another summary report of radiological incidents that occurred in our radiotherapy institutions during last 3 years. Emphasis is given not only to survey and statistics, but also to analysis of reasons of the radiological incidents and to their detection and prevention.

MATERIAL AND METHODS

At present time there are 40 licensed radiotherapy institutions in our country. A questionnaire of SONS concerning of radiological incidents was sent to 25 institutions at the beginning of this year. The rest of institutions were intentionally not requested to contribute to the inquiry because they are providing only palliative or analgesic treatments or they are using only single old Co-60 sources and they are treating low number of patients. The protocols or reports of radiological incidents have been received from 21 institutions, 4 institutions reported that they had no incident during last three years. Totally 160 reports were received and all of them were suitable for detailed analysis. Number of records from individual institutions varied from 2 to 24 (with a median 4). Only 4 institutions reported that they are also recording potential incidents (near miss), the category that was introduced in the SONS recommendation [4] as the category D and therefore only few reports were received. Data from all records were transferred into simple database and evaluated from different aspects like: what was the reason for incident, who was responsible for incident, in which stage of radiotherapy process incident occurred etc. Relations between incident category and above mentioned aspects were investigated. Protocols from the most serious category of incidents (category A) reported to SONS and investigated by SONS were also used for analysis.

RESULTS

Table 1 gives overview of main causes of radiological incidents recorded at radiotherapy institutions during last three years. Total number of recorded incidents was 160, but only 5 of them were in category D. Normally, number of near miss or potential radiotherapy errors, which were detected and corrected for before treatment delivery, must be much larger than number of incident in all three categories.

Table 1: Survey of main causes from recorded radiotherapy errors leading to radiological incidents and their classification. Total No of records 160.

Type of error	cat. A	cat. B	cat. C	cat. D	Total	Percent
Wrong patient/ wrong plan			38		38	23,8
Equipment errors			23		23	14,4
Wrong accessories/shielding			17		17	10,6
Patient alignment issue		2	10	1	13	8,1
Wrong number of fractions			11		11	6,9
Wrong energy, table or unit position	1		10	1	11	6,9
Scheduling			10		10	6,3
Wrong time, MU, dose, activity		3	3		6	3,8
Marking or simulator issue		2	3	3	8	5,0
Right/left error	4		1		5	3,1
Movement of patient during treatment			5		5	3,1
Communication			4		4	2,5

Fig. 1 gives the distribution of personnel responsible for radiological incidents. The majority of radiological incidents took place during patient's treatment and therefore mostly radiological technologists were responsible for them. Fig. 2 gives distribution of all radiological incidents according to categories and patient pathway surveyed in this study.

Fig. 1: Distribution of persons responsible for radiological incident.

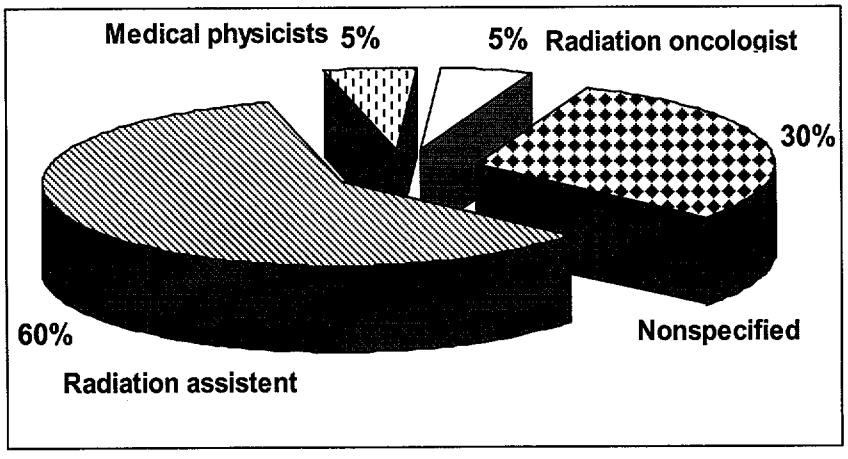
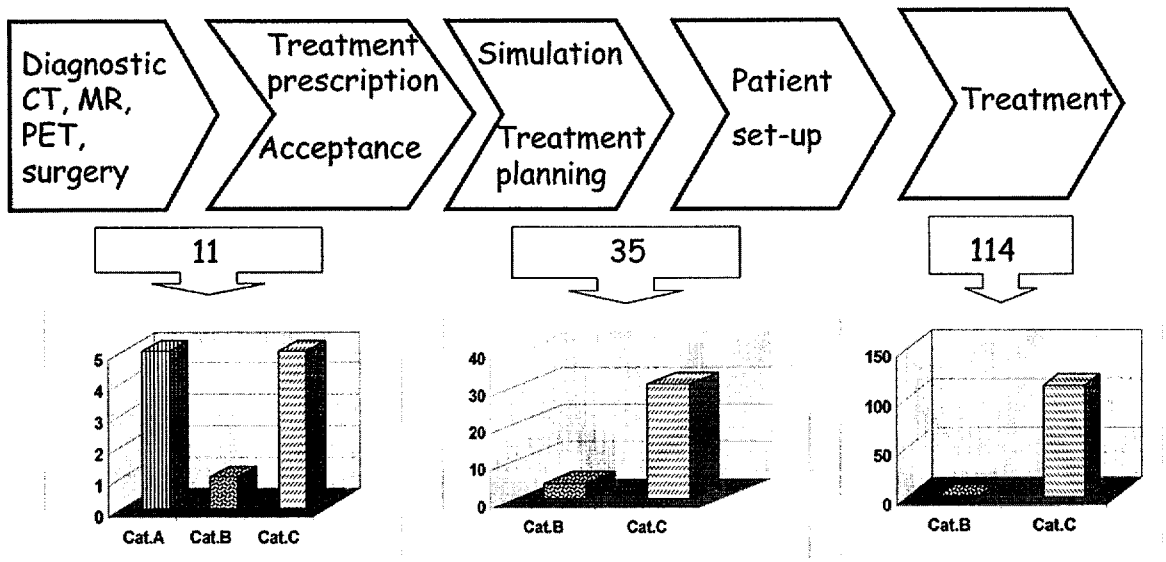


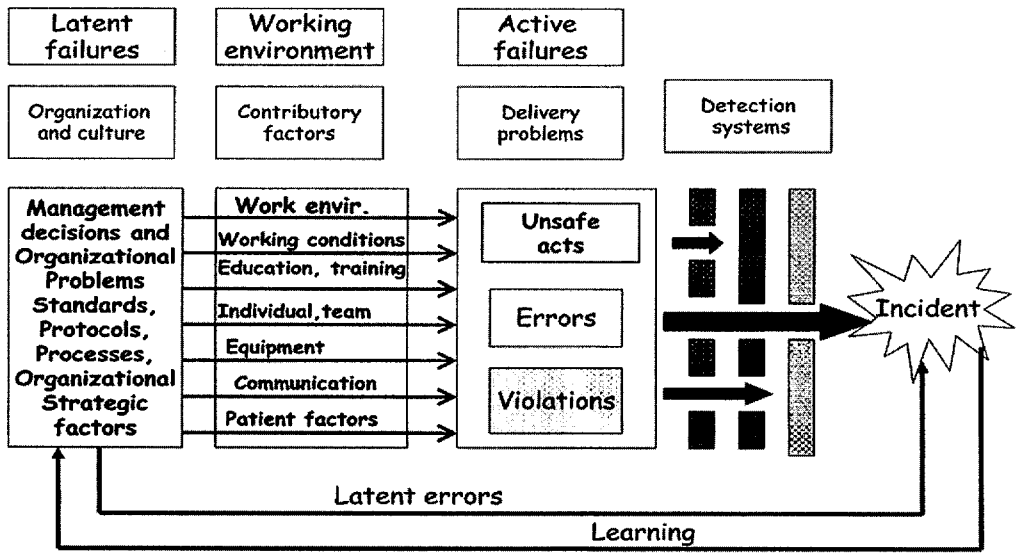
Fig. 2: Distribution of radiological incidents according to category and patient pathway



DISCUSSION

Detailed analysis of radiological incidents using data from different databases (RADEV of IAEA, ROSSIS of radiological technologists, Dublin, US NCR, etc.) proved that majority of incident is caused by human errors (generally 85-90%). Data from our series also show that only 14.4% of incidents occurred due to failure of treatment unit or verify and record computers. Main attention during our analysis was devoted to human failures, which were reasons of most radiological incidents. When analyzing incident we can distinguish three key steps. First, one has to consider the chain of events leading up to the incident, the narrative of events and problems. Second, one examines this narrative to identify specific errors and problems that occurred during the process. Third, one looks for the causes of these errors that, in the terms of the framework, are referred to as contributory factors. A model that provides the basis for a practical approach to incident analysis is very helpful. Fig. 3 gives a model used in this work that is based on Reason's organizational accident model [5, 6].

Fig. 3: Model of radiological incidents



With the help of proposed model we can detect, that most of the reported radiological incidents were caused by the lack of organizational structure, i.e. by the lack of proper standards, protocols, check lists, etc. Working environment only contributed to escalation of the incidents. Looking at Fg.2 it is alarming that human mistakes which occurred at the beginning of radiotherapy process, which means during commissioning of therapy unit or reception of patients, remained undetected during the whole or main part of radiotherapy process. Therefore a new detection systems or barriers must be introduced to avoid such transmission. Introduction of check lists, protocol for site to be treated, independent checks of clinical data, comparison of diagnostic and simulator images, checks of patient's documentation during the set-up, not only of prescribed dose, regular overview of patient's charts, etc. could help to avoid radiotherapy errors.

The majority of radiological incidents were caused by radiological technologists during treatment procedure (see Fig.1). But these errors were in most cases correctable, because they were link to mainly one or few fractions or one treatment's field. Contrary to that a wrong decision of radiological oncologist during patient's reception or an error made by medical physicist during commissioning and planning procedure lead to adverse events in which patients are unintentionally harmed by treatments. Therefore it is necessary that each radiotherapy institution should have protocols within its QA system that define what data are to be checked by planners and prescribers along the radiotherapy pathway and how the results of these checks are to be recorded.

The most common radiological incidents in our series were wrong patient or the use of wrong treatment plan. These errors are typical human errors arising from inattention, bad communication with patients, rush in treatment room, etc. To avoid these errors one can improve identification of the patient by using a photograph on the screen in treatment room, identification belt or card with bar code, direct communication with a patient, biometric data identification etc. To avoid wrong choice of treatment field a verification system must be used on all machines.

CONCLUSION

Analyses of incidents in radiotherapy have led to a much broader understanding of incident causation. Information about the error should be shared as early as possible during or after investigation by all radiotherapy centers. Learning from incidents, errors and near misses should be a part of improvement of the QA system in institutions. Generally, it is recommended that all radiotherapy facilities should participate in the reporting, analyzing and learning system to facilitate the dissemination of knowledge throughout the whole country to prevent errors in radiotherapy.

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