Computer Applications in Radiotherapy in Bosnia and Herzegovina

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SUMMARY
Background: Radiotherapy is one of the earliest fields in Medicine in which computers have made an inroad. The main uses of computers, which include treatment planning, dose calculations, localization of tumors, verification of patient setups and radiation beam data acquisition, are highlighted in this paper. It is believed that a modern Radiotherapy department cannot function optimally without some form of computing facilities. Aim: To discuss the use of computers in the radiotherapy department of Institute of Oncology in Sarajevo Bosnia and Herzegovina. Methods and Materials: In 1999, a first linear accelerator was installed in our department for external radiotherapy, supported with CMS and Precise Plan planning systems. In the department for Brachytherapy we installed GamaMed plus High Dose Brachytherapy machine with Ir 192 radioactive sources, and ABACUS planning system. The patients were treated with 1D, 2D and 3D planning systems. Results: There were around 2300 patients treated in our department for external radiotherapy and 250 patients yearly treated in our department for brachytherapy. Of these 1500 with 1D were irradiated, 500 with 2D and 250 with 3D planning treatments, with constant tendency of increase in 3D planning for about 20% yearly. Conclusion: New equipment supported with new sophisticated planning systems enabled us to treat more patients in a more accurate way in less time. We are now approaching European standards in this field of medicine.

Key words: Radiotherapy, computers, cancer

INTRODUCTION
Human – computer interaction is a discipline concerned with the design, evaluation and implementation of interactive computing systems for human use and with the study of major phenomena surrounding them (1). Radiotherapy is one of the earliest fields in Medicine in which computers have made an inroad (2).

The history of the use of computers in radiotherapy is not very long. The early computers were home made special purpose analog systems designed to relieve the tedium of calculation and improve accuracy. The first hospital who applied automatic computing machinery was Memorial Hospital New York in order to digitize isodose charts. This was a work of K.S. Tsien. Later in the same hospital, it was applied to the brachytherapy. Clarkson developed method which led to the production of depth dose tables (3).

All this historical work was done mostly on central computers. It was not the best solution for clinical work due to sharing time on central computer, and graphics input was not possible.

In 1965 started development of small computers designed and configured for radiotherapy. These PC’s were able to handle graphic input, were dedicated to treatment planning and were low cost. This paved the way for the modern treatment planning computers.

A pioneering radiotherapy technique that allows doctors to blast tumors with high levels of radiation without harming the healthy tissue has been invented by cancer researchers (4).

Today we have a system of three-dimensional energy beams to match the exact shape of the tumor, allowing us to target high doses of radiation with high accuracy.

2. MATERIALS AND METHODS
Constant developing of computer technology led to increase of its use in the field of radiation oncology in the process of radiotherapy.

The goal of radiotherapy cancer treatment is to cure or locally control the disease while minimizing complications in normal tissues (5).

The process of treatment planning is an instrument in accomplishing that goal. The entire treatment planning process involves many steps, beginning from beam data acquisition and their entry into computerized treatment planning system (TPS), through patient data acquisition to treatment plan generation and final transfer data to the treatment machines (6).

PICTURE 1. Cabinet for physicists in Institute for oncology Sarajevo
errors in the administration of radiotherapy continue to occur and lead to harm or death to patients; although small in proportion each year, they are preventable.” Radiotherapy is now calculated using ‘increasingly complicated’ computer operating systems and software. These allow treatments to be highly accurate.

Computers enable precise localization of tumors, healthy tissues and so called organs at risk (OAR) which need to be protected. They are most important in dose calculation. Also, they play great role in all other steps of treatment planning (7).

TPS is consisted of computer software and at least one computer. Hardware includes a central processing unit, graphical display, and input devices for entering patients and treatment machines data, output devices for hardcopy printouts of patients’ treatments and records and network communications devices. CT and MR scanners are usually used for acquisition of patients’ anatomy and tumor localization data. These data are sent through network to TPS.

If necessary, field design is performed and finally dose distribution within patient is calculated, optimized and evaluated by medical physicist and finally approved by radiation oncologist.

Before 1970’s, dose calculation was mainly performed manually by manipulation of isodose charts. Later, computerized TPS became standard. Complexity and sophistication of calculation algorithms have significantly increased and they evolved from simple 2D models to 3D Monte Carlo techniques, while higher computing speed led to increased calculation speed.

In external beam radiotherapy, modern 3D TPS generates beam shapes and dose distributions. In brachytherapy it calculates optimal source position and treatment times, both with the intent to maximize tumor control and provide the best possible health tissue protection.

3. RESULTS
Radiation oncologists, medical physicists and radiation technologists are included in the process of developing plans for radiotherapy treatments. In-
Institute of Oncology in Sarajevo is the only institution in Bosnia and Herzegovina equipped to provide radiotherapy in the whole country for now. We treated in the department for external radiotherapy around 2300 patients with different malignant tumors in 2007, which is about 40% of patients we are expecting each year.

In the department for brachytherapy we treated 250 patients, gynecological tumors 233 and 17 colon cancers.

During this year we performed 247 3D plans based on CT scans and about 500 2D plans. We created 5448 individual shields for our patients due to lack of MLC.

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4. CONCLUSION

- High-speed computers are essential for any modern department for radiotherapy
- Radiotherapy planning computers allow physicians, physicists, dosimetrists, and technologists to optimize the delivery of radiation therapy in treating cancer and related diseases
- High-speed computer calculations permit quick, individualized patient treatment plans that maximize radiation doses to tumors and minimize those to healthy tissue, making local control and eradication of disease more effective than in previous years.
- This way, we are able to give the best possible radiotherapy treatments to very large number of patients.
- Institute of Oncology in Sarajevo Bosnia and Herzegovina have modern radiotherapy equipment and fully educated physicians, physicists and technologists to provide good radiotherapy treatments.

REFERENCES

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