Clinics in Oncology

Perspective
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# Application of Digital Medicine in Clinical Oncology

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## Perspective

Technological advances over the past few decades enable a rapid development and reformation in classic medicine. The combination of digital technologies with medicine promotes the emergence of a new science: the Digital Medicine. Digital Medicine is a science explaining medical phenomena, solving medical problems, and exploring medical mechanisms using modern digital technology, with the purpose of improving the quality of human life [1]. It is an interdisciplinary study characterized by precision, predictability, individuation and micro-invasion, which can perfectly compensate the shortcomings of classic medicine of being highly personal, unpredictable and often imprecise. Diagnosis and treatment of tumor has long been a critical issue because of its complexity and metastasis. Early diagnosis and accurate treatment of the tumor is essential for its prognosis. That's why the application of digital medicine in clinical oncology makes sense for the rapidness and accuracy of digital technologies.

Digital technologies have great and active influences on medicine both in diagnostics and treatment. A series of digital technologies have already applied in medicine, including orthopedics, plastic surgery, maxillofacial surgery, dentistry and urology, to improve the accuracy of surgical procedures such as the modern digital scanning, artificial intelligence, big data analytics, human-computer interfaces, robotics and 3D visualization technologies. Applications of these digital technologies have all helped to not only increase our understanding of the physiology of the human body and enabled early detection of medical conditions but also have contributed to increasingly more targeted and personalized interventions [2]. Here, 3D visualization technologies includes the 3D navigation, 3D reconstruction and 3D printing are taken out to explain how the digital technologies take effect in clinical oncology.

## Three-dimensional Reconstruction in Clinical Oncology

Medical 3D reconstruction refers to iterative algorithms used to reconstruct 2D and 3D images in certain imaging techniques. To accomplish the 3D reconstruction of the tumor, a high-precision thin-sectional Computed Tomography (CT) scan of the tumor should be performed first. Subsequently, the patient's CT data would be imported into a computer to be processed. Data of the tumor and its surrounding tissue and organs would be semi-automatically segmented, and finally the 3D reconstruction is performed.

Take one of my patients with a giant tumor on the left thoracic cavity for example. In this case, the tumor has invaded the left side of the chest wall. Firstly, the CT scan was performed with a scanning resolution of 512 × 5112, pixel size of 0.684 × 0.684, and layer spacing distance of 0.7 mm. Secondly, the patient's CT data were imported into Amira commercial software. Data on pulmonary vessels, ribs, cartilage, sternum, lung, and the giant tumor were semi-automatically segmented, and then 3D reconstruction was performed [3]. According to the 3D reconstruction of CT images, we knew the tumor size and defined the area and spatial shape of the chest wall that was intended to be removed.

Through the 3D reconstruction technology, not only the tumor, but also the relationship between the tumor and its surrounding organs can be directly presented in a three-dimensional way, which enables experts to observe the tumor obviously and clearly to decide whether the tumor is benign or malignant. In this way, the level of diagnostics of the tumor is improved.

## Three-dimensional Printing in Clinical Oncology

As a branch of digital medicine, medical 3D printing, taking CT or MRI images as a template, builds accurate real size and structure of medical models, medical devices and implants [4]. Based on the 3D reconstructed model, 3D printing would be performed for the tumor and its surrounding organ tissue.

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Take the same case above for example, after 3D reconstruction of the tumor, we use the print medium-sized 3D printer (model: UN-3D-S2) provided by Uniroyal Technology Co., Ltd (Qingdao, China). Fused deposition molding was applied with a printing thickness of 0.1 mm and a maximum printing size of 400mm × 200mm. Printing material was an acrylonitrile butadiene styrene resin plastic thread, and the support material was reprap/mendal dissolvable plastic thread. We successfully reconstructed the 3D model of the giant tumor and its adjacent structures including pulmonary vessels, lung, bronchus, ribs, sternum, costal cartilage, and the chest wall. The 3D shape of the titanium plate was determined, and surgical program was clearly designed before the operation.

From above, application of 3D printing in clinical oncology makes it convenient for experts to make accurate diagnosis, to determine the condition of the tumor and to make appropriate operation program, which is of great sense for the later operation procedure of the patient.

## Application of Digital Medicine in Radiation Oncology

Data from the World Health Statistics show that malignant tumors are the second leading cause of death next to cardiovascular diseases. Four strategies including surgery, chemotherapy, radiotherapy and biotherapy are commonly used to treat malignancies. The adoption of digital medicine has already made radiotherapy the forerunner of personalized clinical oncology and helped it to develop individualized treatments based on anatomical information combined with clinical parameters [5]. The leading technique of 3D-conformal treatment, including the Intensity-Modulated Radiation Therapy (IMRT) techniques with image guidance, is also adopted in radiotherapy to improve accuracy of treatment.

In China, a current research program named "three-dimensional Visible Treatment Planning System (3DV + TPS), the Design of Integrated Solution, is carried out by the Third Military Medical University (TMMU) together with Yorktal Digital Medical Imaging Technology, Co. Ltd. in Shenzhen. The project is an integration that involves enterprise manufacturing, teaching, research, medical treatment, and detection, and that will generate products able to benefit clinical practice in many aspects, showing typical demonstration effects [6]. By adopting this technology, it can achieve the rapid and precise determination of regions and interest, the automatic and dynamic calculation of three-dimensional radiation doses, the three-dimensional visualization of the regions of interest and its fusion and registration with the digital phantom and etc.,

Precise radiotherapy is an important means to realize precise treatment of cancer. Therefore, it is of vital importance for hospitals to apply digital medicine, the integrative, precise and individualized medical techniques, into the clinical oncology to improve the treatment of tumors.

Digital Medicine will definitely become an important vehicle to realize personalized and precise medical diagnosis and treatment. It is of great practical significance to implement the digital medicine into clinical oncology for its accuracy and rapidness, which can perfectly deals with the complexity and metastasis of the tumor. Besides the quick diagnosis and accurate treatment, application of digital medicine can guarantee a safer and less-invasive operation in cutting off the tumor. Moreover, it also helps for surgical rehearsal by improving the surgical resection efficacy and reducing complications. With its continuously development, digital medicine will certainly reform clinical oncology in many aspects with wide applications in a variety of clinical settings, thus improving patients' prognosis.

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