UNIVERSITY OF MEDICINE, PHARMACY, SCIENCE AND TECHNOLOGY OF TÂRGU MUREȘ

DOCTORAL SCHOOL IN MEDICINE AND PHARMACY

UNIVERSITATEA DE MEDICINĂ,
FARMACIE, ȘTIINȚE ȘI TEHNOLOGIE
„GEORGE EMIL PALADE"
DIN TÂRGU MUREȘ

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DOCTORAL THESIS

SUMMARY

RADIOIMAGING AND ANATOMOPATHOLOGICAL CONFRONTATIONS REGARDING THE EVALUATION AND CHARACTERIZATION OF RENAL EXPANSIVE PROCESSES

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Introduction

Worldwide, renal cell carcinoma (RCC) is the sixth most commonly diagnosed cancer in men and the 10th in women, accounting for 5% and 3% of all cancer diagnoses, respectively. The detection and imaging characterization of renal expansive processes is a challenging diagnosis, as it is not always possible to differentiate between malignant and benign tumor masses. The renal biopsy can be a reliable alternative, providing information about the histology of a renal mass, but regarding the precise determination of the tumor grade it is controversial due to the heterogeneity of RCC. Recently, new imaging modalities have been developed, aiming to solve the present difficulties, thus overcoming the subjective nature of the interpretation of images. Thus, imaging methods do not involve any automation of diagnostic processes, but provide additional data to existing ones. One of the new imaging perspectives is radiomics, an imaging modality that quantitatively approaches medical imaging.

The purpose of the doctoral thesis

The aim of this doctoral thesis is to create a positive impact, a preliminary step, both in the development of the therapeutic decision serving as an adjunct in making clinical decisions for proper management and for the survival of patients with renal cell carcinoma by increasing efficiency in the staging and grading of the preoperative tumor using a noninvasive method.

The general part of the doctoral thesis includes 6 chapters. The first chapter describes epidemiology, etiology and risk factors for renal expansive processes. The second chapter develops on how the histopathological diagnosis divided into two categories, namely cystic renal expansive processes and solid renal expansive processes. Chapter three contains information on diagnostic imaging and characterization, while Chapter 4 contains information on kidney puncture-biopsy. Chapter 5 focuses on the prognostic factors and Chapter 6 on the main treatment modalities.

The motivation of this research is presented in the second part of the thesis, namely in the "Personal contribution" part. To achieve the purpose of the research, three articles were written.

Study 1 evaluated the usefulness of quantitative MDCT parameters, using both a 2D ROI and a 3D ROI (representative of the entire tumor volume), to differentiate the main subtypes of RCC, as well as to differentiate RCC from benign oncocytoma.

Study 2 aimed to assess whether radiomic features extracted from a four-phase MDCT study may be useful to preoperatively differentiate the WHO/ISUP nuclear degrees of ccCCR.

The third article was a systematic review of the current literature on the clinical value and applications of 3D virtual reconstructions (VR) for renal tumors, thus having a threefold purpose: firstly, a systematic analysis of the accuracy of 3D VR in delimiting renal anatomy and renal tumors, secondly, the systematic analysis of the clinical value and utility of 3D VR in pre-surgical planning and simulation of renal

procedures, and thirdly, the systematic review of the utility of 3D VR models in patient medical education and doctor-patient communication.

Results and conclusions

These studies focuse mainly on new methods of imaging analysis in the field of artificial intelligence and on the clinical value and applications of 3D virtual reconstructions in the diagnosis and management of renal expansive processes.

The results of our research are promising but they must be seen as preliminary and as having important practical implications. Thus, medical images can become a valuable source of information, and radiomic characteristics can be used as a noninvasive method for characterizing and classifying lesions. However, as a further prospective, multicenter studies on larger patient groups are needed in the future to validate the performance of our results.

The originality of the thesis

This doctoral thesis was developed based on three different articles (two studies and a critical review of the current medical literature) focused on the role of imaging in the analysis and characterization of renal expansive processes using MDCT, as well as the clinical value and utility of 3D renal models in individual patient management, making significant contributions to existing data in the literature.

Quantitative MDCT parameters may be a preliminary step in the development of a multiparametric decision model that can serve as an adjunct in clinical decision making for appropriate management for each patient. Study 2 is the first in Romania and the first study published in literature (so far to the best of our knowledge) which evaluate the usefulness of textural analysis parameters extracted from a four-phase MDCT study in order to develop a prediction model to preoperatively identify the WHO / ISUP nuclear grade.

Integration of a 3D virtual reconstruction model into the decision-making therapeutic plan and real-time operating technique can help urologists transfer the simulation of the technique into a successful surgical performance, improving patient outcomes and possibly reducing complications.