Chapter 2
Role of Radiomics in the Diagnosis of Cancer

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ABSTRACT

Radiomics has become a game changer in the field of cancer imaging. Because ordinary medical images can be transformed into measurable mineable information, they thus provide both diagnostic accuracy and precision to treatment planning. Radiomics automatically identifies hundreds to thousands of quantitative features that include tumor shape, texture, intensity, and spatial relationships. AI, especially machine learning and deep learning algorithms, allows automated feature selection, pattern recognition, and predictive modeling that have reliably shown better performance when compared to conventional diagnostics methods. Lung, breast, brain, liver, and pancreatic cancer case studies show remarkable diagnostic performance, with area under the curve values that commonly range above 0.90. Multi-modality radiomics methods have been proven better than single-modality methods. The clinical advantages relate to precision oncology enables, minimized invasive biopsy, reducing the cost of utilizing. However, there are issues such as variability and non-standardization in imaging protocol.

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1. INTRODUCTION

Cancer is one of the significant causes of mortality and a challenging issue to life expectancy increments in all global countries. Estimates by the WHO in 2019 show that around the world cancer is now the leading or the second leading cause of death before the age of 70 years in 112 of 183 countries and in the remaining 23 countries cancer is the third or the fourth leading cause of death before the age of 70 years. Even though oncology has experienced an impressive array of innovations in the field, the increase in the burden of cancer is caused by such factors as aging populations, environmental exposure, and lifestyle. One of the major factors that can determine the prognosis of the cancer is the stage of the disease where it is identified. The timely and correct diagnosis can ensure a better outcome of the treatment, survival, and fewer costs in the healthcare industry (Osei-Afriyie et al., 2021; Gillies & Schabath, 2020).

Medical imaging plays a crucial role in detecting cancer, determining its stage, designing treatment approach and assessment of response. Conventionally the assessment of the radiological information was performed after a site- based assessment and subjective assessment of the information such as size, shape and contrast enhancement of a tumor., it has the limitation of lacking quantitative depth required for characterization of intra-tumoral heterogeneity. This gap between the visual interpretation and biological complexity is the main reason why radiomics has its justification (Gillies et al., 2016).

Radiomics helps to fill this gap by turning images into mathematically rich datasets which can be used to further characterize tumor heterogeneity than is visible to the human eye. Radiomics is a system that derives a very large number of quantitative characteristics of a standard medical image (such as CT, MRI or PET), using sophisticated algorithms, and statistical methods (Aerts et al., 2014).

By synthesizing insights from previous studies it can be seen that radiomics is not just a technological advancement, but rather a clinically necessary evolution towards precision oncology because Radiomics offers a useful, non-invasive approach to employ high dimensional mineable information in order to describe tumors with a greater level of detail by transforming imaging data. Radiomics can help in the prevention of advanced cancers, the stratification of risk of heavy-hitters and may also have the capability of replacing the molecular/histopathological data in cancer diagnostics. It is also potentially useful to distinguish between malignant lesions and benign lesions, not to mention gauging the agility of the tumor, and even forecasting treatment response (Parmar et al., 2015).

This chapter gives an idea of how radiomics has developed as a cancer detection tool,, the major principals involved in the context of using radiomics to detect cancer, the various current applications of radiomics to the different type of cancer