

RESEARCH ARTICLE

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Prediction of Cranial Radiotherapy Treatment in Pediatric Acute Lymphoblastic Leukemia Patients Using Machine Learning: A Case Study at MAHAK Hospital

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Abstract

Background: Acute Lymphoblastic Leukemia (ALL) is the most common blood disease in children and is responsible for the most deaths amongst children. Due to major improvements in the treatment protocols in the 50-years period, the survivability of this disease has witnessed dramatic rise until this date which is about 90 percent. There are many investigations tending to indicate the efficiency of cranial radiotherapy found out that without that, outcome of the patients did not change and even it improved at some cases. **Methods:** the main aim of this study is predicting cranial radiotherapy treatment in pediatric acute lymphoblastic leukemia patients using machine learning. Scope of this paper is intertwined with predicting the necessity of one of the treatment modalities that has been used for many years for this group of patients named Cranial Radiotherapy (CRT). For this purpose, a case study is considered at Mahak charity hospital. In this paper, our focus is on ALL patients aged 0 to 17 treated at Mahak hospital, one of the best centers for treatment of childhood malignancies in Iran. Dataset analyzed in this study is gathered by the research team from patient's paper-based files. Our dataset consists of 241 observations on patients with 31 attributes after the data cleaning process. Our designed machine learning model for predicting cranial radiotherapy treatment in pediatric acute lymphoblastic leukemia patients is a stacked ensemble classifier of independently strong models with a meta-learner to tune the weights and parameters of the base classifiers. **Results:** The stacked ensemble classifier show highly reasonable performance with AUC of 87.52%. Moreover, the attributes are ranked based on their predictive power and the most important variable for CRT necessity prediction is the disease relapse. **Conclusion:** In order to conclude, derived from previous studies regarding CRT it is not only cost-effective but also more healthy to eradicate the use of CRT for the treatment of childhood ALL. Furthermore, it is valuable to increase the clinical databases by creating more synthetic health databases not only for research purposes but also for physicians to keep track of their patient's status.

Keywords: Acute Lymphoblastic Leukemia (ALL)- childhood blood cancer- cranial radiotherapy- Prediction-MAHAK

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Introduction

Note!!!

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The term "leukemia" covers a wide spectrum of blood disorders (Ahmed Abd El-Nasser et al., 2014 in the reference list???). Leukemia is classified into acute leukemia that advances quickly and chronic leukemia that progresses slowly and has got several obscure complications (Subrajeet Mohapatra et al., 2010 in the reference list???). In chronic leukemia, young blood cells are present, but only the mature ones produce functional cells. Whereas, acute leukemia occurs when white blood

cells are produced out of control massively that the process causes unformed, partially developed cells to be released into the bloodstream (Hassan Rohayanti et al., 2012 in the reference list???; Jyoti Rawat et al., 2015 in the reference list???). Acute leukemia is classified into two major classes based on a French–American–British (FAB) model, which is the most well-known classification model of leukemia: Acute Myeloid leukemia (AML) and Acute Lymphoblastic Leukemia (ALL) (Jakkrich Laosai and Chamnongthai, 2014???; Van-Nhan Tran et al., 2016???; Alsalem et al., 2018). Then ALL is subdivided into T-cell lymphoblastic leukemia (T-ALL) and B-cell lymphoblastic leukemia (B-ALL).

Cancer is the second most common cause of death in pediatrics and leukemia is the leading cause of death in pediatrics (Siegel et al., 2019). Due to vital improvements

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