International Platform of Registered Systematic Review and Meta-analysis Protocols

INPLASY

Improving Predictive Efficiency and Literature Quality Assessment for Lung Cancer Complications Post-Proton Therapy Through Large Language Models and Meta-Analysis

INPLASY202480103
doi: 10.37766/inplasy2024.8.0103
Received: 22 August 2024
Published: 22 August 2024

Wu, JJ.

Corresponding author:
Wu Jyun-Jie

f112152118@nkust.edu.tw

Author Affiliation:
Medical Physics and Informatics Laboratory of Electronics Engineering, National Kaohsiung University of Science and Technology.

ADMINISTRATIVE INFORMATION

Support - This study was supported financially, in part, by grant from the National Science and Technology Council (NSTC) of the Executive Yuan of the Republic of China, (113-2221-E-992-011-MY2).

Review Stage at time of this submission - Completed but not published.

Conflicts of interest - None declared.

INPLASY registration number: INPLASY202480103

Amendments - This protocol was registered with the International Platform of Registered Systematic Review and Meta-Analysis Protocols (INPLASY) on 22 August 2024 and was last updated on 22 August 2024.

INTRODUCTION

Review question / Objective Population (P): Patients with lung cancer. Intervention (I): Use of any form of proton therapy techniques. Comparison (C): Utilization of any machine learning model to predict complications following proton therapy. Outcome (O): Main complications include radiation pneumonitis and radiation esophagitis, among others.

Rationale This research is divided into two main parts: Firstly, it explores the prediction models for complications following proton therapy for lung cancer and compares the applicability of different models. Secondly, it utilizes large language models to enhance the accuracy and efficiency of literature quality assessment. In the first part, we conduct an in-depth analysis of the various complications that can arise after proton therapy for lung cancer, such as radiation esophagitis and radiation pneumonitis, and compare multiple prediction models to determine the most suitable one for specific complications. Additionally, we perform subgroup analyses for different complications to identify the most effective model selection. In the second part, we use large language models like ChatGPT4, Llama2-13B, and Llama3-8B for a preliminary assessment of literature quality, followed by a more thorough analysis using tools like PROBAST.

Condition being studied This study is dedicated to developing and evaluating advanced predictive models to enhance the accuracy of predicting complications after proton therapy for lung cancer. Proton therapy is a sophisticated radiation therapy technique that focuses the radiation dose precisely on the tumor target, significantly reducing damage to surrounding healthy tissues . It has been clinically proven to be highly effective for lung cancer patients. However, despite these advantages, post-treatment complications such as radiation esophagitis and radiation pneumonitis can still severely impact the quality of life of patients. Due to the relatively small sample size of lung cancer patients receiving proton therapy, statistical significance is often not apparent. Therefore, using meta-analysis methods to quantitatively assess the overall effects of all studies can enhance the credibility of the research.

METHODS

Search strategy We used PubMed's Medical Subject Headings (MeSH) as search keywords and conducted literature searches across databases including Web of Science, PubMed, and Scopus. The search cutoff date was set to April 1, 2024.

Participant or population Covers all lung cancer patients and includes all types.

Intervention Refers to patients receiving proton therapy.

Comparator Covers comparisons with various machine learning techniques.

Study designs to be included Includes all types of study designs.

Eligibility criteria
Inclusion Criteria:
1. Studies must detail machine learning models that predict complications following proton therapy for lung cancer.
2. Studies must include any patient undergoing proton therapy for lung cancer.
3. All proton therapy techniques and comparative analyses with other treatment modalities are considered.
4. Studies must report post-treatment complications.
Exclusion Criteria:
1. Meta-analyses and systematic reviews.
2. Studies lacking complete model construction or model outcome evaluation.
3. Studies with unclear methodologies or incomplete data reporting.
4. Literature in languages other than English.
5. Studies with inaccessible full texts.

Information sources Web of Science, PubMed, and Scopus. The search cutoff date was April 1, 2024.

Main outcome(s) Area Under the Curve(AUC).

Quality assessment / Risk of bias analysis PROBAST Tool.

Strategy of data synthesis This study primarily employed several statistical analysis methods, all performed using Python (version 3.11.5). The effectiveness of the predictive models was quantified using the Area Under the Curve (AUC), which evaluates their predictive capability. To assess the heterogeneity among the studies, we utilized degrees of freedom (DF), Cochran's Q test, and the I^2 statistic. An I^2 value exceeding 50% indicated significant heterogeneity. In cases of significant heterogeneity, we adopted a random-effects model. This approach was chosen because, despite varying degrees of statistical heterogeneity, there are inherent differences in treatment methods and types of complications across studies. The overall effect size was represented with a 95% confidence interval (CI), using a p-value of 0.05 to denote statistical significance. Additionally, we presented the results visually through forest plots to illustrate the range and impact of the findings.

Subgroup analysis To identify the sources of heterogeneity, we conducted subgroup analyses by evaluating different complications to investigate potential sources of heterogeneity and compare the performance of different subgroups.

Sensitivity analysis Sensitivity analysis was conducted by removing one article each time in subgroup analysisSensitivity analysis was conducted by removing one article each time.

Language restriction Studies publish in English language.

Country(ies) involved Republic of China (Taiwan).

Keywords Lung Cancer, Proton therapy, Large Language Model, ChatGPT, Meta-analysis, PROBAST.

Contributions of each author
Author 1 - WU Jyun-Jie.
Email: f112152118@nkust.edu.tw