




Systematic Review

PET/CT in comparison with PET/MRI as an imaging modality in the management of Gliomas–A systematic review and meta analysis

[Bareq S. Al-Lami](#)  , [Baqer S. Al-Lami](#), [Yasir S. Al-Lami](#)[Show more](#)  Share  Cite<https://doi.org/10.1016/j.jmir.2024.02.008> [Get rights and content](#) 

Abstract

Introduction

Gliomas are the most commonly occurring type of primary brain tumors. They account for 32% of all brain tumors and 80% of all malignant intracranial tumors. Gliomas are separated into four grades according to the World Health Organization. While low-grade gliomas generally have a favorable outlook, high-grade gliomas cause significant morbidity and mortality. Given the lack of clarity about the causes of gliomas and their potential lethality, early diagnosis and identification is crucial.

Methods

The systematic literature search was based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement. The electronic databases used were the following: Google Scholar, MEDLINE (PubMed), and EMBASE, and Cochrane Library. Medical subject headings (MeSH) and Boolean operators were used to find any relevant literature. To evaluate the quality of the studies used, a quality assessment was performed using the QUADAS-2.

Results

Four papers concerning the PET/MR modality that included 122 patients while on the other hand we had five papers about the PET/CT modality that included 251 patients. On both sides, the patients were mostly male and the overall mean age 45 ± 10 years. The overall sensitivity and specificity of the PET/MR modality was found to be 89% (95% CI, $p = 1.00$) and 84% (95% CI, $p = 1.00$) respectively. In the four included studies revolving around PET/MR, the accuracy was found out to be: 78%, 96.4%, 100%, and N/R.

Conclusion

The PET/MR modality was deemed to be slightly diagnostically better than the PET/CT modality. More studies investigating the efficacy of using hybrid FDG PET/MR in gliomas are encouraged to shed light on its potential role in clinical use. Conducting prospective randomized studies that directly compare the sensitivity and specificity of PET/CT and PET/MR for glioma would help establish the role of imaging modalities for diagnosis of glioma.

RÉSUMÉ

Introduction

Les gliomes sont les tumeurs cérébrales primaires les plus fréquentes. Ils représentent 32% de toutes les tumeurs cérébrales et 80% de toutes les tumeurs intracrâniennes malignes. Selon l'Organisation mondiale de la santé, les gliomes sont classés en quatre catégories. Alors que les gliomes de bas grade ont généralement des perspectives favorables, les gliomes de haut grade entraînent une morbidité et une mortalité importantes. Étant donné le manque de clarté sur les causes des gliomes et leur létalité potentielle, un diagnostic et une identification précoces sont cruciaux.

Méthodologie

La recherche systématique de littérature s'est appuyée sur la déclaration PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-analyses). Les bases de données électroniques utilisées sont les suivantes: Google Scholar, MEDLINE (PubMed), EMBASE et Cochrane Library. Des rubriques médicales (MeSH) et des opérateurs booléens ont été utilisés pour trouver toute littérature pertinente. Pour évaluer la qualité des études utilisées, une évaluation de la qualité a été réalisée à l'aide du QUADAS-2.

Résultats

Quatre articles concernant la modalité TEP/RM qui incluaient 122 patients, tandis que d'autre part nous avons cinq articles concernant la modalité TEP/TDM qui incluaient 251 patients. Dans les deux cas, les patients étaient principalement des hommes et l'âge moyen global était de 45 ± 10 ans. La sensibilité et la spécificité globales de la modalité TEP/RM se sont révélées être respectivement de 89% (IC à 95%, $p = 1,00$) et de 84% (IC à 95%, $p = 1,00$). Dans les quatre études incluses portant sur la TEP/RM, la précision était de 78%, 96,4%, 100% et N/R.

Conclusion

La modalité TEP/RM a été jugée légèrement supérieure à la modalité TEP/TDM sur le plan diagnostique. D'autres études portant sur l'efficacité de l'utilisation de la TEP/MR hybride au FDG dans les gliomes sont encouragées afin de mettre en lumière son rôle potentiel dans l'utilisation clinique. La réalisation d'études prospectives randomisées comparant directement la sensibilité et la spécificité de la TEP/TDM et de la TEP/MR pour les gliomes aiderait à établir le rôle des modalités d'imagerie pour le diagnostic des gliomes.

Introduction

Gliomas are the most commonly occurring type of primary brain tumors. They account for 32% of all brain tumors and 80% of all malignant intracranial tumors [1]. Gliomas are separated into four grades according to the World Health Organization [2]. While low-grade gliomas generally have a favorable outlook, high-grade gliomas cause significant morbidity and mortality. For example, glioblastoma, the most commonly occurring glioma, has a 5-year relative survival of about 5% [3]. So far, only two causes have been properly identified that can increase the risk of getting such tumors. They include exposure to high doses of ionizing radiation and

inherited mutations that show complete penetrance that are also associated with rare syndromes [4]. Given the lack of clarity about the causes of gliomas and their potential lethality, early diagnosis and identification is crucial.

Imaging techniques are commonly used to identify gliomas. The techniques used to do so hold high importance in altering the treatment and therapy provided by giving us the opportunity to adequately and noninvasively visualize the response to said treatments and therapies. Currently, the usage of integrated PET/CT scans is considered the gold standard when it comes to glioma imaging. The simultaneous usage of both the PET modality and CT scan modality allows us to assess both the anatomical structures and metabolic changes in tumors.

Recent advancements in radiological imaging have brought us a new modality, which is the integrated positron emission tomography (PET)/magnetic resonance imaging (MRI) technique. Combining the precise structural information from the MRI and the functional characteristics from PET produces helpful results which can be obtained in just a single session examination [5], [6]. Whereas PET scans using ^{18}F -fluorodeoxyglucose (FDG) are widely used in initial diagnosis, planning treatments, and monitoring patients with various types of gliomas, this new hybrid imaging technique brings forth new promises and hopes. Multiple studies have already cemented the role of PET/MR in the detection and management of different types of gliomas. The measurement of the glucose metabolism by using the PET/MR modality has produced results that can be reproduced multiple times and the image quality obtained using the PET from PET/MR was comparable to the current standard of PET/CT scans in previously conducted studies [7], [8]. In addition, the PET/MR modality provides enhanced soft-tissue contrast and less exposure to ionizing radiation than PET/CT. Because of this, its roles for precise detection, diagnosis, and treatment planning of cases of gliomas have been drastically increased over the past few years [9], [10].

In comparison to PET/CT, PET/MR is more expensive, has limited availability, and has been studied less [11]. Due to the rarity of gliomas, the time needed to complete a clinical trial, and the expense of performing PET/MR, the number of studies utilizing it are limited. While the few studies demonstrating the use of FDG PET/MR have been promising, there have been no systematic reviews investigating the accuracy and efficacy in gliomas. In addition, none have compared its advantages and disadvantages compared to FDG PET/CT. As a result, we conducted a systematic review and meta-analysis of the available publications and data comparing the hybrid FDG PET/MR modality to FDG PET/CT in the detection and diagnosis of gliomas.

Section snippets

Methods

The systematic literature search was based on the Preferred Reporting Items for Systematic Reviews and Meta-analyses (PRISMA) statement [12]. The Eligible patients, Index test, Comparator/reference test, Target condition and Study design (PICTS) (Fig. 1) strategy was used to determine the main question and topic that this paper covered [13], [14]....

Results

The initial search yielded the following: 265 potential articles from MEDLINE/PubMed, 40 potential articles from EMBASE. 15 potential articles from Cochrane Library, and 550 potential articles from Google Scholar. After we applied the exclusion criteria, only nine of the papers found were deemed eligible as original scientific research articles, and these were the ones used in the meta-analysis. Four research papers

investigated the role of PET/MRI, while five research articles investigated the...

Discussion

This systematic review and meta-analysis is the first to examine the effectiveness of using hybrid FDG PET/CT and FDG PET/MR for the diagnosis of patients with gliomas to the best of our knowledge. A total of 9 studies including 373 patients met the inclusion criteria and were used in the meta-analysis. Based on the pooled results, the PET/MR modality seems to be more effective than PET/CT. Our results found that PET/MR has a better sensitivity than PET/CT. The accuracy of the studies using...

Limitations

Our meta-analysis has a low risk of bias because both the PET/CT and PET/MR groups had similar demographics of gender and age. Our inclusion criteria and quality assessment also reduced the risk of bias as well. However, it is important to consider the limitations of our study. Since PET/MR is mostly only offered at more equipped hospitals, less patients have access to it. Because of this, there were less patients included in the PET/MR studies, making our results less reliable. Additionally...

Recommendations

This systematic review has provided important insights into the relative diagnostic performance of PET/CT and PET/MRI in the management of gliomas. There are various directions for future study that could help us understand more and improve clinical practice. For the purpose of determining how PET/CT and PET/MRI affect variables such as overall survival and progression-free survival, long-term outcome studies are essential. Comparative studies between different glioma subtypes can yield strong...

Conclusions

The PET/MR modality was deemed to be slightly diagnostically better than the PET/CT modality. More studies investigating the efficacy of using hybrid FDG PET/MR in gliomas are encouraged to shed light on its potential role in clinical use. Conducting prospective randomized studies that directly compare the sensitivity and specificity of PET/CT and PET/MR for glioma would help establish the role of imaging modalities for diagnosis of glioma....

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References (27)

L. Pace *et al.*

[Comparison of whole-body PET/CT and PET/MRI in breast cancer patients: lesion detection and quantitation of 18F-deoxyglucose uptake in lesions and in normal organ tissues](#)

Eur J Radiol (2014)

M.K. Schuler *et al.*

[\(18\)F-FDG PET/MRI for therapy response assessment in sarcoma: comparison of PET and MR imaging results](#)

Clin Imaging (2015)

A. Santra *et al.*

F-18 FDG PET-CT in patients with recurrent glioma: comparison with contrast enhanced MRI

Eur J Radiol (2012)

M. Hadziahmetovic *et al.*

Recent advancements in multimodality treatment of gliomas

Future Oncol (2011)

M. Weller *et al.*

Glioma

Nat Rev Dis Prim (2015)

Q.T. Ostrom *et al.*

The epidemiology of glioma in adults: a “state of the science” review

Neuro Oncol (2014)

J.A. Schwartzbaum *et al.*

Epidemiology and molecular pathology of glioma

Nat Clin Pract Neurol (2006)

J.H. Rasmussen *et al.*

Reproducibility of (18)F-FDG PET uptake measurements in head and neck squamous cell carcinoma on both PET/CT and PET/MR

Br J Radiol (2015)

H.W. Kwon *et al.*

FDG whole-body PET/MRI in oncology: a systematic review

Nucl Med Mol Imaging (2017)

M. Wiesmuller *et al.*

Comparison of lesion detection and quantitation of tracer uptake between PET from a simultaneously acquiring whole-body PET/MR hybrid scanner and PET from PET/CT

Eur J Nucl Med Mol Imaging (2013)



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