Comparative study on the diagnostic value of ^{18}F-FDG PET/CT imaging and integrated PET/MR imaging in pediatric tumors

Xuemei Sun[1] **MD,**
Jiahe Gu[2] **MD**

1. Pediatric Department, Taizhou People's Hospital, Taizhou, China
2. Radiologic Department, Taizhou People's Hospital, Taizhou, China

Keywords: Pediatric tumors
- ^{18}F-FDG PET/CT imaging
- Integrated PET/MR imaging
- Diagnostic value

Corresponding author:
Jiahe Gu MD,
Radiologic department, Taizhou People's Hospital, Taizhou, China
Sanwang1985@163.com

Received:
12 October 2024
Accepted revised:
1 August 2025

Abstract

Objective: To analyze and compare the diagnostic value of fluorine-18-fluorodeoxyglucose (^{18}F-FDG) positron emission tomography/computed tomography (PET/CT) imaging and integrated PET/magnetic resonance imaging (MR) in pediatric tumors. **Subjects and Methods:** A retrospective analysis was conducted on the clinical data of 61 pediatric patients with malignant tumors admitted to our hospital from September 2022 to December 2023. All patients underwent pathological examinations as well as ^{18}F-FDG PET/CT and integrated PET/MR imaging. The pathological diagnosis results were used as the gold standard. Pearson correlation analysis, Bland-Altman analysis, and t-tests were used to compare the maximum standardized uptake value (SUVmax), signal-to-noise ratio (SNR), and target-to-background ratio (T/B) between the two methods. Chi-square tests were employed to compare the diagnostic efficacy differences of each index. **Results:** Among the 61 pediatric malignant tumor patients, a total of 417 lesions were detected, of which 363 lesions showed high uptake on both PET/MR and PET/CT. Among the remaining 54 PET-negative lesions, 9 were CT-positive but MR-negative, including 6 in the lungs and 3 in the vertebrae, while 12 lesions were MR-positive but CT-negative, including 5 in the liver, 4 in the brain, and 3 in the breasts. No statistically significant difference was found in the PET positivity rate or diagnostic results between the two devices ($P<0.05$). Bland-Altman analysis showed that the background uptake of PET/MR images was lower than that of PET/CT, and the SNR was higher ($P<0.05$); the SUVmax of the lesions on PET/MR was higher than that on PET/CT ($P<0.05$); the T/B value of PET/MR images was higher than that of PET/CT ($P<0.05$). In terms of correlation, the SUVmax, SNR, and T/B values between PET/MR and PET/CT were positively correlated ($r=0.919, 0.507, 0.698$, $P<0.05$). **Conclusions:** In the diagnosis of pediatric malignant tumors, PET/MR and PET/CT have relatively consistent lesion detection rates. PET/MR images have a higher SNR and better resolution, making them more advantageous than PET/CT for evaluating lesions in the liver, brain, and other soft tissue organs, thus warranting clinical application.

Hell J Nucl Med 2025; 28(2):131-136 *Epub ahead of print: 4 August 2025* *Published online: 30 August 2025*

Introduction

In recent years, the incidence of pediatric tumors has been gradually rising, making it one of the leading diseases threatening children's health worldwide [1]. Early and accurate diagnosis is crucial for improving the survival rate and quality of life for pediatric tumor patients. Imaging examinations play a key role in the early detection, staging, and treatment evaluation of tumors [2]. Selecting an efficient and accurate imaging tool has become an important topic in clinical medicine. Currently, positron emission tomography/computed tomography (PET/CT) is widely used as a conventional imaging tool for tumor detection and staging [3]. Positron emission tomography/CT captures the metabolic activity of tumor cells in the body using the tracer fluorine-18-fluorodeoxyglucose (^{18}F-FDG) combined with anatomical information from CT, thus providing functional and anatomical images of tumor lesions [4]. However, PET/CT has certain limitations in soft tissue resolution, especially when detecting lesions in complex organs such as the liver and brain, where magnetic resonance imaging (MRI) often provides clearer images [5].

Integrated PET/MR, a rapidly developing imaging technology in recent years, combines PET's functional imaging with MRI's high-resolution anatomical imaging of soft tissues [6], offering the potential to provide more detailed and accurate information for the diagnosis of pediatric tumors. Compared to PET/CT, PET/MR can further improve tumor imaging quality, particularly in displaying lesions in the liver, brain, and other soft tissue organs. It also reduces radiation exposure, which is especially important for growing pediatric pati-

ents [7]. Therefore, PET/MR technology is considered an important development direction in future tumor diagnosis. Although PET/MR has advantages in imaging quality, its application is still in the early stages, and the costs are high, limiting its widespread adoption. Thus, comparing the diagnostic value of PET/MR and PET/CT in pediatric tumors has become a highly relevant research topic. For these reasons, this study aims to retrospectively analyze the imaging data of 61 pediatric patients with malignant tumors treated at our hospital, to explore the differences and advantages of ^{18}F-FDG PET/CT imaging and integrated PET/MR imaging in the diagnosis of pediatric tumors, and provide valuable references for clinical decision-making.

Subjects and Methods

Basic information

A retrospective analysis was conducted on the clinical data of 61 pediatric patients with malignant tumors who were admitted to our hospital between September 2022 and December 2023. These patients had clinical indications for staging or re-staging using PET/CT. Among the 61 patients, 24 were male and 37 were female; their ages ranged from 0 to 12 years, with an average age of (4.79±3.26) years. All patients underwent pathological examinations, as well as ^{18}F-FDG PET/CT imaging and integrated PET/MR imaging. The pathological results of the primary lesions were confirmed through postoperative pathology or biopsy pathology, while the diagnosis of metastatic lesions was based on a comprehensive clinical assessment.

Examination methods

^{18}F-FDG PET/CT imaging

Before undergoing ^{18}F-FDG PET/CT imaging, all patients were required to fast for at least 6 hours. At the time of ^{18}F-FDG injection, the blood glucose level of the patients had to be controlled below 7.8mmol/L. Each patient received an injection of ^{18}F-FDG at a dose of 3.7MBq/kg based on their weight, and whole-body scanning commenced 40 minutes after injection. During the scan, patients were positioned supine for static imaging. For younger patients or those unable to cooperate, sedation or hypnosis was induced 30 minutes prior to the examination using a 10% chloral hydrate solution administered orally or by enema. Additionally, all patients and their legal guardians signed informed consent forms before the examination.

The ^{18}F-FDG PET/CT imaging was performed using the Discovery 710 PET/CT system manufactured by GE, USA. For the CT portion, the tube voltage was set at 120kV, and the tube current was 120mA. The slice thickness and interval were both 3.75mm, with a pitch of 0.984mm, and the reconstructed slice thickness was 1.25mm. Positron emission tomography scanning was performed in 3D mode, with each bed position scanned for 3 minutes. Image reconstruction of the PET images employed the ordered subset expectation maximization (OSEM) algorithm, using time-of-flight (TOF) and point spread function (PSF) correction to improve image quality and accuracy.

Integrated PET/MR imaging

Immediately following the PET/CT scan, integrated PET/MR imaging was conducted using a SIGNA PET/MR (3.0 T) system manufactured by GE, USA, for whole-body imaging, with the patient remaining in a supine position. The MR sequences used in PET/MR scanning included axial LA-VA-Flex T1-weighted imaging, fat suppression (FS) PROPELLER T2-weighted imaging, and diffusion-weighted imaging (DWI) with a b-value of 800s/mm^2. The slice thickness was set at 6.0 mm, and the interslice gap was 1.0mm, with a field of view (FOV) of 34.0mm; for coronal scanning, the slice thickness was 5.5mm, with an interslice gap of 1.0mm, and the field of view was 42.0mm. The total examination time was approximately 40 minutes. Respiratory gating technology was employed during data acquisition to reduce respiratory motion artifacts. Positron emission tomography images were acquired in 3D mode, with both respiratory-gated data (about 3 minutes) and non-gated data (6 minutes) collected. The image reconstruction method used was also OSEM, with TOF and PSF correction to ensure consistency in image quality with PET/CT.

Image processing

Image processing was completed using GE's AW Server 2.0 workstation. High FDG uptake lesions detected in PET/MR and PET/CT imaging were marked, and their morphological information from MRI and CT scans was compared and analyzed. Additionally, lesions that did not show significant ^{18}F-FDG uptake on PET imaging but were highly suspected of being malignant based on MRI or CT were recorded and analyzed. All PET/MR lesions were compared with the corresponding PET/CT clinical reports to assess differences and complementarity between the two modalities. The size, location, and extent of the tumors were determined by combining the morphological characteristics of the tumors with the ^{18}F-FDG metabolic data. In both PET/MR and PET/CT images, regions of interest (ROI) were delineated, and the maximum standardized uptake value (SUVmax) for each ROI was measured. Additionally, the average liver background SUV and standard deviation were measured in the same planes and positions to ensure comparability of liver SUV values. Using these measurements, the target-to-background ratio (T/B) and the signal-to-noise ratio (SNR) of the PET images were calculated.

Result evaluation

Two experienced clinicians independently assessed the image quality using a double-blind method. The image quality grading standard was divided into four levels: Grade 1 indicated the image was not diagnostic; Grade 2 indicated poor image quality; Grade 3 indicated moderate quality; and Grade 4 indicated excellent quality. The characteristics of malignant tumors mainly included large tumor volume, lobulated or spiculated margins, punctate or "sand-like" calcifications, as well as signs of tumor invasion into surrounding tissues or distant metastasis, all of which were accompanied by significantly increased ^{18}F-FDG metabolism. Based on the above imaging

features, PET/CT and PET/MR images were analyzed for diagnosis.

Statistical analysis

GraphPad Prism 8 software was used for plotting, and SPSS 22.0 software was used for data processing. Pearson correlation analysis was applied to compare the consistency of the SUV values between the two imaging modalities. Bland-Altman analysis and t-tests were conducted to compare SUV and T/B values between the two. The chi-square test was used to compare the differences in imaging results between the two modalities. A P-value of <0.05 was considered statistically significant.

Results

Pathology and follow-up results

The main tumor types in the 61 pediatric patients in this study included: 35 cases of neuroblastoma, accounting for the largest proportion; followed by 7 cases of nephroblastoma, 6 cases of rhabdomyosarcoma, 5 cases of pancreatoblastoma, 2 cases of adrenocortical carcinoma, and 6 cases of lymphoma. Among all diagnosed patients, a total of 417 lesions were detected, of which 351 were malignant (including primary lesions, tumor recurrence, and metastases), and 66 lesions were benign.

Comparison of imaging findings

Comparing the PET images from both methods, it was evident that PET images from PET/MR showed clearer lesions, with more pronounced uptake and better contrast. Bland-Altman analysis showed that PET/MR images had lower background uptake and higher SNR compared to PET/CT (P< 0.05); the SUVmax of lesions shown by PET/MR was higher than that of PET/CT (P<0.05); the T/B value of PET/MR images was higher than that of PET/CT (P<0.05), as shown in Table 1 and Figure 1. Regarding Pearson correlation, SUVmax, SNR, and T/B values between PET/MR and PET/CT were positively correlated (r=0.919, 0.507, 0.698, P<0.05), as shown in Figure 2.

During the study, 8 patients were unable to complete the PET/MR examination, with 6 of them becoming emotionally unstable due to prolonged fasting and scanning time, and the remaining 2 cases ending prematurely due to tumor-induced pain. Nevertheless, these patients successfully completed the PET/CT examination, and the aforementioned issues did not affect the final diagnostic results. In terms of subjective image quality scoring, approximately 98.4% of CT images met diagnostic standards, with artifacts mainly arising from respiratory motion, physiological artifacts from the intestines and bladder, etc.; about 95.1% of PET/MR images met diagnostic standards, with artifacts in MR images mainly caused by respiratory motion, vascular pulsation, and metal implants.

Comparison of PET/CT and PET/MR diagnostic results

In this study, a total of 417 lesions were detected among the 61 pediatric patients with malignant tumors. Positron emission tomography/MR and PET/CT both detected 363 lesions with high ^{18}F-FDG uptake. There were 54 lesions that did not show significant ^{18}F-FDG uptake on PET imaging (i.e., PET-negative). Among these PET-negative lesions, 9 were positive on CT imaging but did not show abnormalities on MR imaging; these included 6 lung lesions and 3 vertebral lesions. Conversely, 12 lesions were positive on MR imaging but undetected by CT imaging, including 5 liver lesions, 4 brain lesions, and 3 breast lesions.

In addition, new metastatic lesions were detected in 5 patients due to the advantages of PET/MR imaging and its high soft tissue resolution, resulting in changes in tumor staging. In 3 post-operative pancreatoblastoma patients, lesions originally suspected to be liver metastases were reclassified as benign lesions during PET/MR examination, avoiding incorrect treatment plans. The tumor T staging of 2 pelvic rhab-

Table 1. *Comparison of Lesion SUVmax, SNR, and T/B Values ($\bar{x} \pm s$).*

Parameter	Value	Bland-Altman		t	P
		Mean Difference	95% CI		
CT-Lesion SUVmax	4.53±2.29	1.59	-0.83~4.02	3.283	0.001
MR-Lesion SUVmax	6.12±3.01				
CT-SNR	6.74±1.70	1.95	-2.79~6.64	4.686	＜0.001
MR-SNR	8.69±2.77				
CT-T/B	4.25±2.53	3.07	-6.71~12.89	3.479	＜0.001
MR-T/B	7.32±6.41				

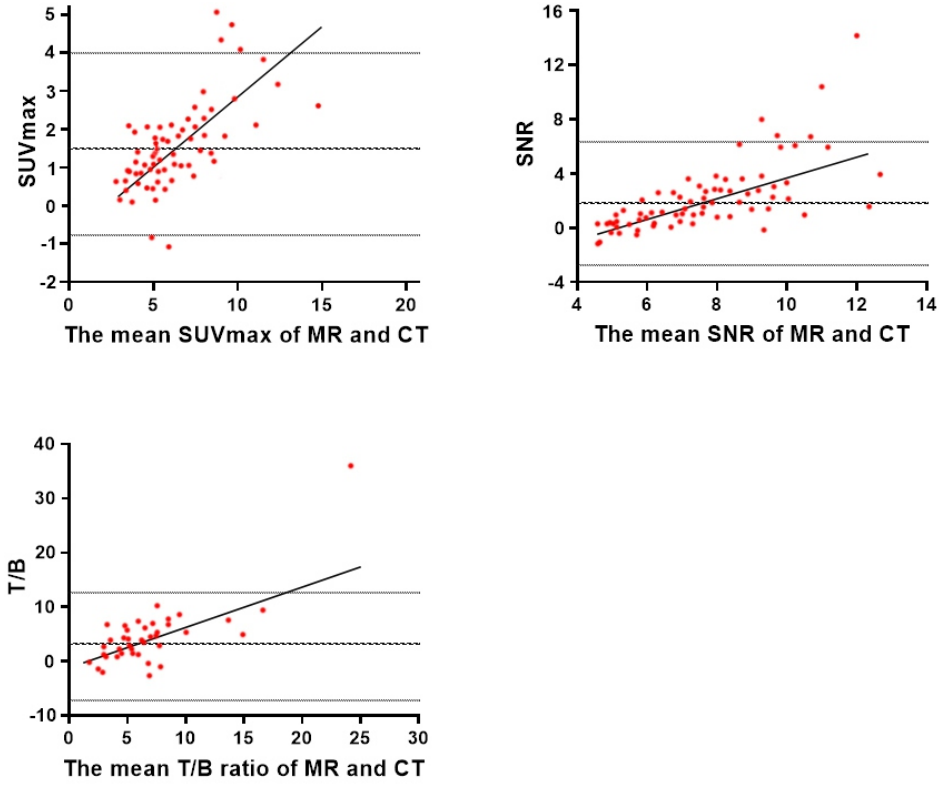

Figure 1. Bland-Altman plots comparing lesion SUVmax, SNR, and T/B values.

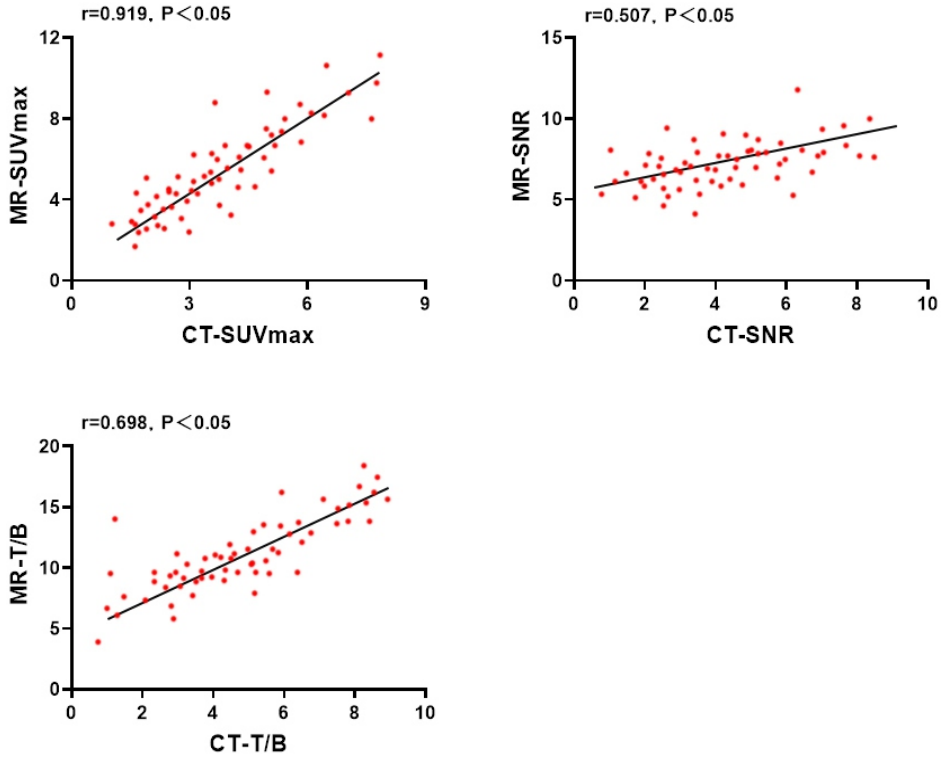

Figure 2. Correlation between lesion SUVmax, SNR, and T/B values in PET/MR and PET/CT.

domyosarcoma patients was adjusted after PET/MR imaging, demonstrating the advantages of PET/MR in pelvic soft tissue tumors. Moreover, in one case of lymphoma with pulmonary and systemic lymph node infiltration, PET/CT was found to be superior to PET/MR in T and N staging. It is worth noting that 8 patients who were initially scheduled for PET/MRI examinations were excluded from the analysis because they were unable to complete the procedure. Among these, 6 patients became emotionally unstable due to the prolonged scanning time, while 2 patients discontinued the exam prematurely due to tumor-related pain. The extended duration of the scan was particularly challenging, as prolonged immobilization is difficult for children, and sedation is not always a viable solution. In addition, claustrophobia, which can be exacerbated by the enclosed MRI environment, may further complicate the procedure in pediatric patients. These patients' results were not included in the final diagnostic comparison.

No significant difference was observed in the diagnostic results between the two devices across the 61 patients ($P > 0.05$).

Discussion

The diagnosis of pediatric malignant tumors often requires multiple imaging examinations, including X-ray, ultrasound, MRI, CT, and PET, which have been proven to have high sensitivity and specificity over the past few decades. These examinations play a crucial role in the detection, localization, and staging of tumors [8, 9]. However, for pediatric patients with malignant tumors, undergoing multiple imaging examinations can be time-consuming and may easily lead to issues like repeated sedation, causing unnecessary stress and risks to the child [10]. Therefore, optimizing the imaging examination process, reducing unnecessary examinations, and improving diagnostic accuracy and efficiency have become urgent issues for clinicians to address.

Among the existing imaging techniques, ^{18}F-FDG PET/CT is widely used in the staging, restaging, and therapeutic monitoring of pediatric malignant tumors due to its high sensitivity and specificity [11]. This technology allows for the detection of tumor lesions throughout the body via whole-body scanning, with a notable advantage in localizing recurrent and metastatic lesions [12]. However, conventional CT and MRI have their respective advantages and limitations in detecting tumor lesions in different regions [13]. For example, CT performs well in imaging bony structures, while MRI has a distinct advantage in soft tissue contrast. The results of this study demonstrate that the clinical application of whole-body integrated PET/MR is feasible, and it shows high consistency with PET/CT in lesion detection, with 96.1% of lesions accurately localized by either of these imaging modalities. In certain specific cases, lesions that were unclear on CT could be definitively diagnosed by MRI, and vice versa, suggesting that PET/MR and PET/CT have a degree of complementarity in imaging specific anatomical regions. Particularly in the imaging of soft tissue tumors, MRI's contrast advantage makes it superior to CT in detecting lesions in areas such as the liver, brain, and breast. In this study, of the 54 PET-negative lesions, 12 were confirmed as positive by MRI but were negative on CT, including 5 in the liver, 4 in the brain, and 3 in the breast. In this context, other studies have also supported the clinical value of PET/MR. Drzezga et al. (2012) [14] analyzed 32 patients with various tumors, confirming the feasibility of whole-body imaging with PET/MR and noting that the quality of PET images was similar to that of PET/CT. Furthermore, Saade-Lemus et al. (2020) [15] further revealed the advantages of PET/MR in anatomical localization, particularly in soft tissue-rich regions such as the head and neck, upper abdomen, and pelvis, where its contrast is significantly superior to that of PET/CT, increasing the accuracy of anatomical localization. Although PET/MR shows clear advantages in certain anatomical regions, PET/CT remains irreplaceable in the detection of lesions in areas such as the skeleton and lungs. In this study, of the 54 PET-negative lesions, 9 were confirmed as positive by CT but were negative on MRI, including 6 in the lungs and 3 in the vertebral bodies. Therefore, PET/MR and PET/CT can complement each other in tumor lesion imaging. The combination of both imaging techniques can provide more comprehensive diagnostic information, effectively improving diagnostic accuracy and avoiding misdiagnosis or missed diagnoses due to reliance on a single imaging modality.

Radiation dose management is crucial for pediatric patients. Compared with adults, children are more sensitive to ionizing radiation [16], so reducing radiation doses as much as possible while ensuring image quality is an important consideration in imaging examinations. Although ^{18}F-FDG PET/CT can provide precise diagnostic information for the staging and restaging of pediatric malignant tumors, the ionizing radiation risk it presents cannot be ignored [17]. In recent years, low-dose ^{18}F-FDG PET/CT technology has gained widespread attention, effectively reducing radiation exposure by lowering the activity of radiotracers and using low-dose CT scanning [18, 19]. However, PET/MR technology itself does not involve ionizing radiation, making it significantly advantageous compared to CT [20, 21], especially since its longer acquisition time allows for further reduction in the injected dose. Eldib et al. (2015) [22] demonstrated that by increasing the PET/MR acquisition time (which is required for MR imaging) from 8 minutes to 24 minutes, the ^{18}F-FDG dose could be reduced by up to 75%. Unlike the low-dose strategy of PET/CT, PET/MR relies on its longer MR scanning time. Thus, by matching the PET acquisition time with the MR imaging time, it is possible to maintain high-quality images while reducing the dose of radiotracers.

Conclusion and limitations

This study compared the application effects of ^{18}F-FDG PET/CT and PET/MR in the diagnosis of pediatric malignant tumors. The results indicate that PET/MR and PET/CT exhibit high consistency in the detection of most lesions, with both technologies showing certain complementarity in specific anatomical regions. Therefore, combining the two techniques allows for more comprehensive lesion localization, which helps improve diagnostic accuracy in complex cases while reducing the harm caused by ionizing radiation to children. It should be noted that, despite many valuable conclu-

sions drawn from this study, there are still some limitations that need to be addressed and explored in future research: 1) Limited sample size: The sample size of this study is relatively small, covering only a limited number of pediatric patients with malignant tumors, which may limit the generalizability of the study results; 2) Insufficient lesion classification: This study did not conduct detailed classification and subgroup analysis of different types of tumor lesions, while different types of tumors may exhibit significant differences in imaging characteristics and lesion growth patterns; 3) Technical Challenges and Feasibility for Pediatric Populations: While PET/MR offers clear advantages, particularly in soft tissue resolution, its widespread clinical use, especially in pediatric populations, is hindered by certain challenges. The extended scan duration required for PET/MR makes it difficult for younger patients to remain still, often necessitating sedation. However, sedation is not always a viable solution due to medical risks and individual patient factors. Additionally, the enclosed nature of the PET/MR scanner increases the likelihood of claustrophobia, further complicating its use in children. These factors highlight the need for further technical advancements, as well as patient-centered strategies, to improve the feasibility and accessibility of PET/MR imaging in clinical practice; 4) Lack of long-term prognosis data: This study primarily focused on the accuracy of diagnosis and the optimization of examination processes but lacked an analysis of the impact of imaging examinations on patients' long-term prognosis. In summary, this study made some progress in the selection and optimization of imaging technologies for the diagnosis of pediatric malignant tumors. However, limitations remain in terms of sample size, lesion classification, cost-benefit analysis, and the lack of long-term prognosis data, which need to be further improved and refined in future research.

Bibliography

1. Kattner P, Strobel H, Khoshnevis N et al. Compare and contrast: pediatric cancer versus adult malignancies. *Cancer Metastasis Rev* 2019; 38(4): 673-82.
2. Llanos D, de la Pedraja Í, Campos L et al. Imaging palpable tumors in pediatrics. *Radiologia (Engl Ed)* 2022; 64(6): 552-65.
3. Kroeze E, Padilla LA, Burkhardt B et al. ^{18}F-FDG-PET/CT imaging in diagnostic workup of pediatric precursor B-cell lymphoblastic lymphoma. *Pediatr Blood Cancer* 2023; 70(11): e30642.
4. Agrawal A, Shah S, Gnanasegaran G et al. PET/CT Normal Variants and Pitfalls in Pediatric Disorders. *Semin Nucl Med* 2021; 51(6): 572-83.
5. States LJ, Reid JR. Whole-Body PET/MRI Applications in Pediatric Oncology. *Am J Roentgenol* 2020; 215(3): 713-25.
6. Pedersen C, Aboian M, McConathy JE et al. PET/MRI in Pediatric Neuroimaging: Primer for Clinical Practice. *Am J Neuroradiol* 2022; 43(7): 938-43.
7. Giraudo C, Carraro S, Zucchetta P, Cecchin D. Pediatric Imaging Using PET/MR Imaging. *Magn Reson Imaging Clin N Am* 2023; 31(4): 625-36.
8. Handa A, Nozaki T, Makidono A et al. Pediatric oncologic emergencies: Clinical and imaging review for pediatricians. *Pediatr Int* 2019; 61(2): 122-39.
9. Boterberg T, Dunlea C, Harrabi S et al. Contemporary paediatric radiation oncology. *Arch Dis Child* 2023; 108(5): 332-7.
10. Tydings C, Kim A. Technology and precision therapy delivery in childhood cancer. *Curr Opin Pediatr* 2020; 32(1): 1-6.
11. Chen W, Liu L, Li Y et al. Evaluation of pediatric malignancies using total-body PET/CT with half-dose ^{18}F-FDG. *Eur J Nucl Med Mol Imaging* 2022; 49(12): 4145-55.
12. Geitenbeek RTJ, Martin E, Graven LH et al. Diagnostic value of ^{18}F-FDG PET-CT in detecting malignant peripheral nerve sheath tumors among adult and pediatric neurofibromatosis type 1 patients. *J Neurooncol* 2022; 156(3): 559-67.
13. Voss SD. Staging and following common pediatric malignancies: MRI versus CT versus functional imaging. *Pediatr Radiol* 2018; 48(9): 1324-36.
14. Drzezga A, Souvatzoglou M, Eiber M et al. First clinical experience with integrated whole-body PET/MR: comparison to PET/CT in patients with oncologic diagnoses. *J Nucl Med* 2012; 53(6): 845-55.
15. Saade-Lemus S, Teixeira SR, Vossough A et al. Emerging Roles of PET/MR in the Pediatric Hospital. *PET Clin* 2020; 15(3): 253-69.
16. Kutanzi KR, Lumen A, Koturbash I, Miousse IR. Pediatric Exposures to Ionizing Radiation: Carcinogenic Considerations. *Int J Environ Res Public Health* 2016; 13(11): 1057.
17. Voss SD. Functional and anatomical imaging in pediatric oncology: which is best for which tumors. *Pediatr Radiol* 2019; 49(11): 1534-44.
18. Zhao YM, Li YH, Chen T et al. Image quality and lesion detectability in low-dose pediatric ^{18}F-FDG scans using total-body PET/CT. *Eur J Nucl Med Mol Imaging* 2021; 48(11): 3378-85.
19. Yu S, Qian Z, Liu H et al. Optimized low-dose positron emission tomography/computed tomography schemes in pediatric tumor patients: a randomized clinical trial. *Transl Pediatr* 2022; 11(9): 1510-20.
20. Saade-Lemus S, Nevo E, Soliman I et al. Clinical pediatric positron emission tomography/magnetic resonance program: a guide to successful implementation. *Pediatr Radiol* 2020; 50(5): 607-17.
21. Connor K, Aldridge MD, Gallegos C. Understanding the Experience of Mothers of Medically Complex Children through Photojournaling. *J Mod Nurs Pract Res* 2022; 2(2): 5.
22. Eldib M, Bini J, Lairez O et al. Feasibility of ^{18}F-Fluorodeoxyglucose radiotracer dose reduction in simultaneous carotid PET/MR imaging. *Am J Nucl Med Mol Imaging* 2015; 5(4): 401-7.