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Comparative study of [18F]PSMA-1007and [68Ga]PSMA-11 for Prostate Cancer PET Imaging in Thailand

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Background
In Thailand, PET/CT is a new technology of nuclear medicine with high efficacy for cancer diagnosing, measuring response to treatment, and guiding radiation therapy. With the advantages of PET/CT, physicians are able to accurately make treatment planning for each cancer patient toward the improved quality of life and longer survival. National Cyclotron and PET Centre was established at Chulabhorn Hospital following the aspirations of Prof. Dr. HRH Princess Chulabhorn Mahidol to serve as the first national center for the production of radiopharmaceuticals in cancer research and development of new treatment modalities.
Currently, radiolabeled tracers targeting prostate-specific membrane antigen (PSMA) have become the important radiopharmaceuticals for PET-imaging of prostate cancer. The first PSMA-based radioligand in Thailand is [68Ga]PSMA-11 produced by 68Ge/68Ga generator and a manual synthesis module, supplied by Isotope Technologies Garching (ITG). During the period of a generator, about 200 batches of [68Ga]PSMA-11 should be prepared with the product stability of only 4 hours. In addition, the maximum activity is sufficient for only 3 patients at the beginning and lower at the later batches. Whereas, there is limited production capacity given by 68Ga generator. In contrast, [18F]PSMA-1007 from cyclotron has longer half-life and demonstrates higher yield of activity, with outstanding tumor uptake and better diagnostic efficacy when compared to [68Ga]PSMA-11. Hence, it is likely that [18F]PSMA-1007 can possibly be an alternative tracer to replace [68Ga]PSMA-11.
Methodology
The radiosynthesis of [68Ga]PSMA-11 was carried out using ITG manual synthesis module and disposable cassettes. 68GaCl3 from generator in 0.05 M HCl and PSMA-11 precursor in 0.25 M sodium acetate buffer were labeled at 105℃ for 5 minutes, followed by the purification in a C18 cartridge and collection through a 0.22μm sterile filter. Whilst, the radiosynthesis of [18F]PSMA-1007 was done on ORA NEPTIS® Perform, using disposable cassettes. 18F- from cyclotron was trapped on the QMA and eluted by 0.075 M TBAHCO3 to reactor for radiolabeling with PSMA-1007 precursor in DMSO, followed by the purification through a series of PS-H+ and C18ec cartridges. Then, [18F]PSMA-1007 passed through 0.22μm sterile filter to final product vial.
Results and Discussion
The radiosynthesis of [68Ga]PSMA-11 achieved in 15 minutes with radiochemical yield of 74.69% (n=32) and maximum activity of 32.9 mCi. The radiochemical purity (RCP) was > 95% for only 4 hours. Whereas, [18F]PSMA-1007 was achieved in 45 minutes with radiochemical yield of 56.64% (n=10). The obtained activity was sufficient for at least 8 patients and the maximum depended on cyclotron irradiation time. The radiochemical purity was > 95% for 8 hours. Additionally, PET/CT imaging of [18F]PSMA-1007 showed higher uptake in liver and better lymph node pathology. Moreover, the non-urinary background overcame some limitations of [68Ga]PSMA-11.
Conclusion
[18F]PSMA-1007 possesses longer half-life than [68Ga]PSMA-11 with high radiochemical yield and more accurate diagnostics, which can serve to other PET/CT centers. As a result, more patients have more chance to access effective diagnosis and better opportunity towards the improved quality of life and longer survival.

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