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BENCH TO BEDSIDE: TRANSLATIONAL NUCLEAR MEDICINE RESEARCH AND CLINICAL THERANOSTICS IN PUMCH

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Abstract

Peking Union Medical College Hospital (PUMCH) was founded in 1921. In 1958, PUMCH established the first nuclear medicine (NM) department in the country which eventually became the most comprehensive unit of nuclear medicine in China. The department has topped the ranking in "China's Hospital Rankings" for consecutively 7 years and has done great efforts in translational research of nuclear medicine and molecular imaging. By now, over 10 isotopes and 100 radiopharmaceuticals are employed to support routine clinical work and more than 50 research projects as well, involving theranostic and preclinical exploration. These research achievements were highly glorified in the top international conferences and journals. The department not only keeps up with the advanced medical technologies in the world but also indulges in promoting novel technology applications in domestic hospitals. After a 60 years journey, the department of nuclear medicine in PUMCH with her superior capability will continuously lead NM exploration and development in China. The department will begin another new and prosperous journey in the new era.

INTRODUCTION OF PUMCH AND NUCLEAR MEDICINE DEPARTMENT

PUMCH is renowned both at home and abroad for its comprehensive disciplines, high technical capabilities, outstanding specialties, and integrated disciplinary strengths. Undergirded by a commitment to professional ethics and a rigorous academic attitude, each department indulges in providing the best possible medical service and being a hospital and department that is nothing less than the best in China and internationally renowned. Depending on the constant efforts of generations, PUMCH has been leading the advances of modern medical sciences in China, standing Top 1 every year from 2009 to 2022 in the Chinese best hospitals ranking.

PUMCH established the nuclear medicine department in 1958, which was also the first one in the mainland of China. Now, the department is the most comprehensive unit of nuclear medicine in China. It consists of 7 PET and 10 SPECT scanners for imaging diagnosis, 1 ward with 10 beds for nuclide therapy, radioimmunoassay lab, and radiochemistry labs. Each year, more than 30 thousand patients received NM service and 100 thousand samples were tested in our department. More than 10 isotopes and 90 radiopharmaceuticals are employed to support clinical work and nearly 50 research projects as well. As shown in Fig. 1, over 60 members now work and study every day in the department. Our department eventually made the history of nuclear medicine science in the country and takes the leading place in medical care, teaching, and scientific research in nuclear medicine. We have gained nuclear medicine top 1 for consecutively 7 years since NM was recruited in "China's Hospital Rankings" in 2014.

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Figure 1: Faculties and staffs of the PUMCH nuclear medicine department in 2021.

TRANSLATIONAL RESEARCH IN NUCLEAR MEDICINE DEPARTMENT

The UM department also attempts to do great efforts in translational research of nuclear medicine. For example, we attempted to use ^{188}Re, ^{89}Zr, ^{64}Cu, and ^{86}Y labeling novel precursors and endothelial progenitor cells for preclinical theranostic research [1-3], see Fig. 2 to 4. These

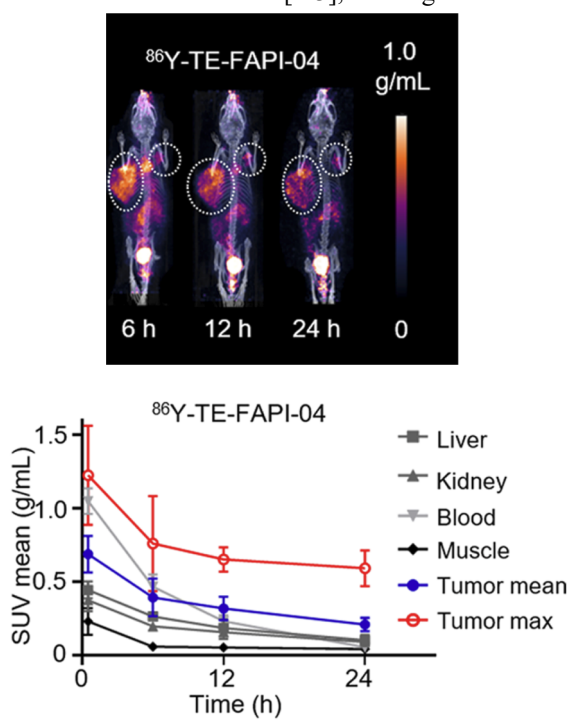

Figure 2: PET/CT MIP images and time activity curve of ^{86}Y-TE-FAPI-04 for late-time-point cancer diagnosis [1].

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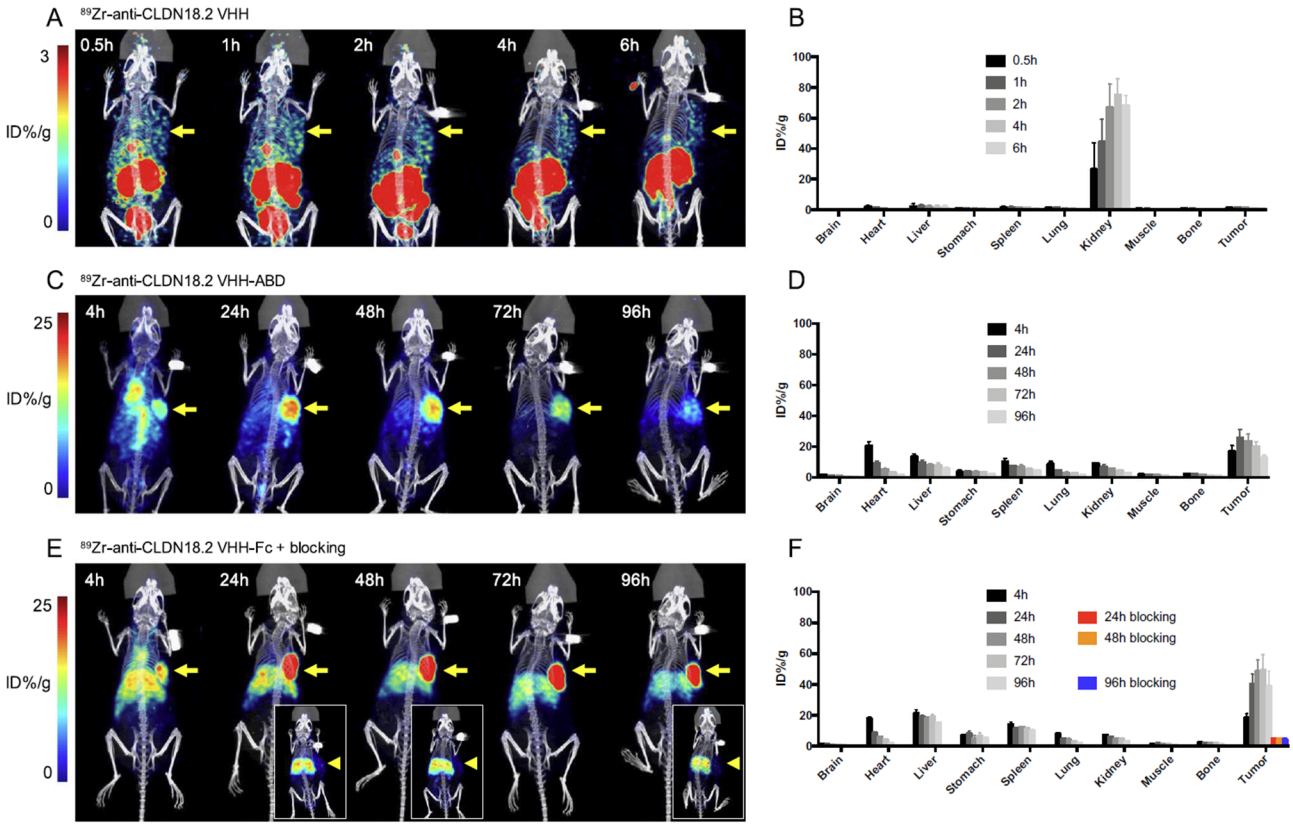

Figure 3: ^{89}Zr- anti-CLDN18.2 for evaluating CLDN18.2 expression in gastric cancer [2].

preclinical research achievements were highly glorified in the top international conferences and journals. However, the advantages of these glories are present only in so far as they have been proven to be valuable approaches to diagnosing and treating diseases. Therefore, translational medicine research must be done with these preclinical results.

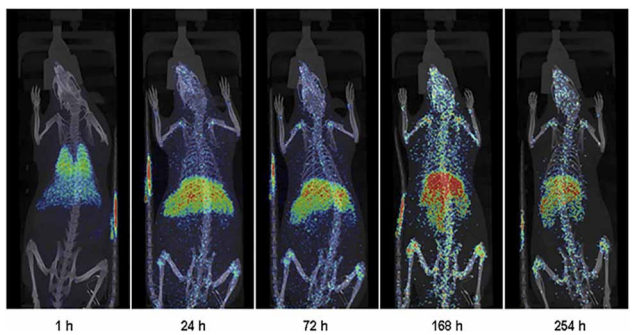

Figure 4: Whole-body microPET/CT MIPs of ^{89}Zr-oxine EPCs in health rats [3].

The conventional translational research in our department is following international advances timely and effective. For example, about 40 years of serial translational research on somatostatin receptors. From technetium to Gallium labeling, from imaging to therapy, from agonist to antagonist, we followed the international steps in this area. Some research was published in the Journal of Nuclear Medicine, and some even as a featured article and cover image [4-5]. These confirm authoritatively the quality and innovation of our research work.

APPLICATION OF TRANSLATIONAL RESEARCH IN CLINIC

In addition to conventional translational research, we indulge in giving hand to clinicians when they meet difficult cases in PUMCH. As the best hospital in China, The PUMCH has always played a leading role in the diagnosis and treatment of complex, severe, and rare diseases. For example, ^{18}F-MFBG illustrates more sensitivity and specificity than ^{123}I-MIBG in diagnosing primary pheochromocytoma and metastasis [6-7]. ^{177}Lu TATE is used for the patient with advanced and cureless GEP NET [8-9], as shown in Fig. 5. The largest sample size cohort study on

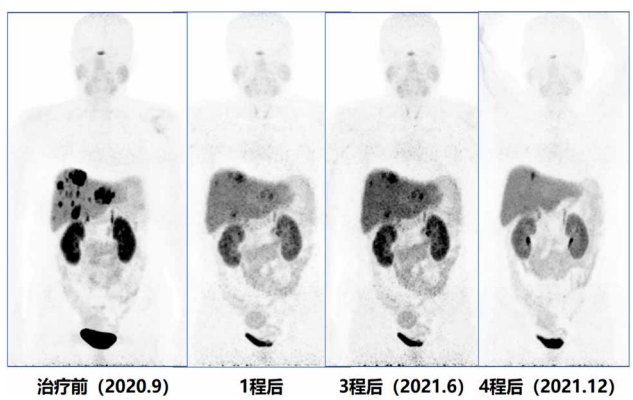

Figure 5: ^{177}Lu TATE for patient with advanced GEP NET within the 4 cycles of treatment. Left to right: before treatment, and after 1 course, and 3 and 4 courses of treatment.

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insulinoma detection and localization with GLP-1 receptor imaging was conducted in our department [10], see Fig. 6. Aldosterone-producing adenoma diagnosis with CXCR4 receptor imaging could help clinicians [11-13]. We also made a lot of effort in establishing and popularizing PYP imaging for ATTR-CM in China, as well as exploring the frontiers in myocardium amyloydosis, such as improving ATTRm diagnosis sensitivity and AL-CM risk assessment [14-15].

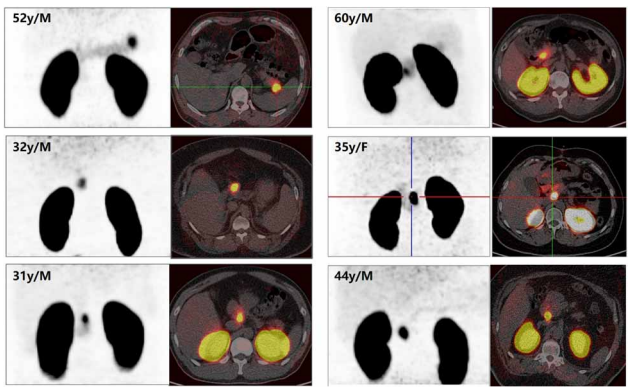

Figure 6: ^{68}Ga-NOTA-Exendin-4 for detecting localized insulinoma.

Now, we set up a translational medicine corporation platform with the clinical departments in PUMCH. We also establish close collaboration with universities, institutions, companies, and the government to support NM translational research in PUMCH, such as nuclide production, radiopharmaceuticals, image data analysis, and quality control. All these platforms lay a foundation for comprehensive clinical resources, and technical advantages result in innovation for translational nuclear medicine in our department. This is the entire research journey of a self-dependent theranostic tracer. In order to deal with the difficulties we meet in renal cell carcinoma treatment, we focus on the CAIX target. Synthesized tracer and labeled. After preclinical research work, including cells and animals, we began the clinical trial. By now, the results are very promising.

CONCLUSION

From bench to bedside, the NM department shows great advantages in translational medicine research and effective outcomes. PUMCH nuclear medicine department will still strive forward to in-depth studies for further exploration and improvement.

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