



For immediate release

HKSH's Exemplary Research Efforts in Theranostics World's First Use of Dual-tracer (^{11}C -Acetate and ^{18}F -FDG) PET/CT in ^{90}Y Selective Internal Radiation Therapy (SIRT) for Late-stage Liver Cancer

(3 December 2018 - Hong Kong) Hong Kong Sanatorium & Hospital (HKSH) has been committed to promoting medical research to optimise clinical applications for the benefit of patients. Recently, Department of Nuclear Medicine and PET and Comprehensive Oncology Centre of Hong Kong Sanatorium & Hospital joined efforts to have achieved fruitful results in the Selective Internal Radiation Therapy (SIRT) using Yttrium-90 (^{90}Y) isotopes for Late-Stage Liver Cancer treatment. The research paper was recently published in the November issue of the European Journal of Nuclear Medicine and Molecular Imaging¹.

This study highlights the essence of “Theranostics”, where the diagnostic parameters of PET/CT serve as a guide for treatment planning as well as post-treatment validation, towards higher precision in personalised medicine. Study results showed that most patients could have ^{90}Y injected activity reduced by as much as 50% or more, while achieving the same target tumour dose with minimised damage to the surrounding liver tissue.

Liver cancer is the third cancer killer in Hong Kong. In 2016, there were more than 1,800 new cases and more than 1,500 people died from the disease². At present, surgical resection of the lesion is the first line of treatment for primary liver cancer, but nearly 80% of liver cancer patients are inoperable for the size of the tumour is too large, or the tumour is invading the organ's central and portal veins. For patients with inoperable liver cancer, ^{90}Y selective internal radiation therapy (SIRT) is one of the treatment options.

^{90}Y selective internal radiation therapy (SIRT) is the use of ^{90}Y microspheres delivered through a micro arterial catheter through blood streams to the liver tumour. The microspheres accumulate and release radiation to destroy the tumour cells. **Dr. Thomas LEUNG, Honorary Consultant in Medical Oncology of Hong Kong Sanatorium & Hospital** explained, “ ^{90}Y selective internal radiation therapy can deliver a higher dose than external beam radiation therapy, thus achieving more effective destruction of local tumour cells.” Therefore, only patients meeting strict selection criteria would be considered for this treatment option, and improving accuracy to reduce side effects has become one of the major clinical research objectives.

Conventionally, to be eligible for ^{90}Y selective internal radiation therapy (SIRT), patients must have acceptably good liver functions, with lung shunting and tumour to normal tissue ratio (T/N ratio) from $^{99\text{m}}\text{Tc}$ -MAA scan to be assessed. Patients with lung shunting exceeding 15% are not suitable for the treatment as there will be severe lung damage.

¹ European Journal of Nuclear Medicine and Molecular Imaging:

<http://ejnmmgateway.net/ArchiveArticles.aspx?JournalID=259&CategoryID=2262&CategoryTitle=Volume%2045%20Number%2012,%20Nov%202018>

² Hong Kong Cancer Registry: <http://www3.ha.org.hk/cancereg/topten.html>



It has also been a common protocol to calculate the ^{90}Y injected activity based on the entire radiation area (including tumours) of the liver, and set an overall radiation dose of 120 Gy. The dose for the tumour and normal liver tissues are not calculated separately, and the effects of tumour size and degree of malignancy in the dose-response relationship are not considered. It is possible that for tumours of larger size or higher malignancy, there would be insufficient dose absorption. For tumours of smaller size or lesser malignancy, there may be unnecessary side effects due to excessive dose.

Personalised cancer treatment is the megatrend in medicine. In order to further enhance the personalisation and treatment accuracy of ^{90}Y selective internal radiation therapy (SIRT), Department of Nuclear Medicine and PET and Comprehensive Oncology Centre of Hong Kong Sanatorium & Hospital joined efforts to have conducted a 3-year clinical study in 2014. A total of 62 patients with inoperable liver cancer having received ^{90}Y selective internal radiation therapy (SIRT) were analysed. These patients were the first to receive dual-tracer (^{11}C -Acetate and ^{18}F -FDG) PET/CT to assess the tumour size and tumour malignancy, and also to receive PET scan on the second day and two months after the treatment, to ascertain and evaluate the effectiveness of the treatment.

Dr. Garrett HO, Head of Department of Nuclear Medicine and PET, Hong Kong Sanatorium & Hospital, pointed out: “The study is the world’s first use of diagnostic dual-tracer (^{11}C -Acetate and ^{18}F -FDG) PET/CT to have direct impact and guidance on the delivery of ^{90}Y selective internal radiation therapy (SIRT). This has opened up a new model of cancer treatment in the approach of “Theranostics”, which unites diagnostic and therapeutic applications for diagnosis, drug delivery and treatment response monitoring. Theranostics is certainly a major advancement in nuclear medicine.” Study results showed that the dual-tracer (^{11}C Acetate and ^{18}F -FDG) PET/CT can effectively distinguish the tumour malignancy and dose-response relationships of different malignant tumours to ^{90}Y . Tumours with higher uptake of ^{11}C Acetate are less malignant, and have better response to ^{90}Y . The tumour control / response rate in this study is about 72.4%. Tumours with higher uptake of ^{18}F -FDG are more malignant, and the tumour control / response rate in this study is about 25%.

Dr. William CHEUNG, Specialist in Nuclear Medicine, Hong Kong Sanatorium & Hospital, one of the key investigators of the study, explained: “The clinical data obtained from this study enable us to derive a new formula to calculate a more personalised ^{90}Y injected activity. Tumours of lesser malignancy can be prescribed lower target tumour dose and ^{90}Y injected activity. A majority of the patients in the study have ^{90}Y injected activity reduced by more than half to reach the target tumour dose, minimising the damage to the surrounding liver tissues. For the highly malignant tumours, this formula is also important to increase the accuracy of ^{90}Y injected activity for better therapeutic effect while limiting the impact on normal liver tissue.”

Dr. HO further pointed out: “We have applied Theranostics to the treatment of late-stage liver cancer using ^{90}Y selective internal radiation therapy (SIRT) with good results. It is a big step forward for local advanced medical research, thus achieving more personalised cancer treatment.” From 2003 to now, Hong Kong Sanatorium & Hospital has published more than a dozen papers in the top three international medical imaging journals on the topics of dual-tracer (^{11}C -Acetate and



^{18}F -FDG) PET/CT for liver cancer diagnosis, differentiation (tumour malignancy), and guidance for treatment. The research papers and findings have been cited hundreds of times and clinically confirmed by major medical institutions around the world.

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Case Sharing

Mr. Lee, aged 60, retired, is a hepatitis B carrier with regular check-up in a public hospital. In late 2017, his blood test results showed that there had been a surge in tumour markers level. Subsequent imaging tests confirmed that he was diagnosed with stage 3B liver cancer, with tumours found in both liver lobes.

As Mr. Lee had multiple tumours, with a big one of up to 13cm, a liver surgeon at Hong Kong Sanatorium & Hospital advised that it was inoperable as the tumours were huge in size and close to the veins. Mr. Lee was then referred to Comprehensive Oncology Centre for further medical opinions.

Mr. Lee received one treatment session of ^{90}Y selective internal radiation therapy (SIRT) in March 2018. At the two-month check-up, the tumour size was reduced, and the percentage of the normal liver tissue rose from 35% to 48%. Mr. Lee had then become eligible for surgery, and the removal of tumours were successfully performed in mid-June.

Mr. Lee has recovered with normal liver functions and low level of tumour markers. He is prescribed with daily dose of antiviral drugs, and no follow-up chemotherapy /radiotherapy.

Hong Kong Sanatorium & Hospital

Hong Kong Sanatorium & Hospital is one of the leading private hospitals in Hong Kong. With the motto “Quality in Service . Excellence in Care”, the Hospital is committed to serving the public as well as promoting medical education and researches.

Department of Nuclear Medicine & Positron Emission Tomography

The Department of Nuclear Medicine & Positron Emission Tomography aims at providing the most comprehensive and highest quality Positron Emission Tomography/Computerized Tomography(PET/CT), Positron Emission Tomography/Magnetic Resonance Imaging(PET/MRI), Nuclear medicine, Radionuclide therapy and Radiopharmaceutical dispensing services to the community.

In addition to diagnostic services, our department is the only centre in Hong Kong that incorporates a unique facility to provide a full spectrum of Radionuclide Therapy services for treatment of cancer and metabolic diseases. Scope of treatment services include Iodine-131 for thyrotoxicosis, Iodine-131 for thyroid cancer ablation, Iodine-131 MIBG for neuroendocrine tumor, Lutetium-177 Dotatate for neuroendocrine tumor, Strontium-89 Chloride for bone metastases palliation, Radium-223 Dichloride for bone metastases of prostate cancer, Yttrium-90 Microspheres for liver cancer, and Yttrium-90 Zevalin radioimmunotherapy for non-Hodgkin's lymphoma.

Inaugurated in 1999, we are well known to be the first and always the leading clinical PET centre in China and Asia. Back then it comprised a CTI RDS III medical cyclotron; a radiopharmacy laboratory and a Siemens ECAT Exact BGO dedicated PET scanner for PET scanning service. Most of the PET scans were related to the oncology cases, and there were also some neurological applications including autism and Parkinson cases. We were the only non-FDG production centre in Hong Kong, providing non-FDG scans for patients in need. Those tracers are widely used in



targeting certain specific types of cancer and neurologic diseases. As the carbon-11 and nitrogen-13 labelled non-FDG radiotracers are too short-lived for delivery, patients of other local PET/CT centres are referred to our Hospital for better imaging.

Tel: 2835 8989
Email: petnm@hksh-hospital.com

Comprehensive Oncology Centre

Comprehensive Oncology Centre comprises a professional team of specialists and nurses, endeavouring to provide quality clinical diagnosis, chemotherapy, radiotherapy and patient counselling service, and to promote research, education and training. With combined efforts of wide-ranging specialties including cancer genetics, pathology, dietetics, clinical health psychology, etc., the Centre offers comprehensive and multi-disciplinary cancer management.

Tel: 2835 8877
Email: oncology@hksh-hospital.com

Photo:

1. The study established a new formula to calculate a more personalised ^{90}Y injected activity. **Dr. Garrett HO**, first author of the study, Head of Department of Nuclear Medicine and PET of Hong Kong Sanatorium & Hospital (second from right), **Dr. Thomas LEUNG**, Honorary Consultant in Medical Oncology of Hong Kong Sanatorium & Hospital (second from left), **Dr. William CHEUNG**, Specialist in Nuclear Medicine of Hong Kong Sanatorium & Hospital (first from right) and **Mr. Lee**, a patient who recovered from late-stage liver cancer, after ^{90}Y selective internal radiation therapy (first from left).



For media enquiries, please contact:
Ms. Carol KWOK Tel: 3156 8078
Ms. Tracy CHUNG Tel: 3156 8079
Email: media@cad.hksh.com