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心領神會—核子醫學的心視野與退化性神經疾病研討

Joint Symposium on Nuclear Cardiology and Neurology Taiwan Society of Nuclear Medicine 2024

時　　間：113 年 6 月 22 日(星期六) 08:00~17:00
地　　點：臺北榮民總醫院 第三門診大樓 9 樓 *CiC* 創意谷

08:00-08:20	***報到 Registration***	
08:30-08:40	***開場致詞 Opening Remarks***	彭南靖主任 Nan-Jing Peng
08:40-09:00	***貴賓致詞 Address by VIPs***	高梓木院長 Tsu-Mu Kao 吳彥雯主任 Yen-Wen Wu
	座長：吳彥雯 主任 (Yen-Wen Wu) 胡蓮欣 醫師 (Lien-Hsin Hu)	
09:00-09:45	人工智慧對輔助核醫心臟影像診斷及預後判斷之效應 The Impact of AI-Enhanced Nuclear Cardiology for Accurate Diagnosis and Risk Prediction	Dr. Yuka Otaki (日本)
	座長：彭南靖 主任 (Nan-Jing Peng) 汪姍瑩 主任 (Shan-Ying Wang)	
09:45-10:30	影像位移及校正之臨床落地應用：我們是否已經做好準備? Motion Detection and Correction: Are we Ready for Clinical Implementation? (預錄)	Martin Lyngby Lassen, PhD (丹麥)
10:30-10:45	***Coffee Break***	
	座長：余文鍾 主任 (Wen-Chung Yu)	
10:45-11:15	ATTR 診斷相關核子影像醫學之進展 Advances in Nuclear Imaging for the Diagnosis of ATTR	吳彥雯主任 Yen-Wen Wu
	座長：林彥宏 教授 (Yen-Hung Lin)	
11:15-11:45	從神經內科學的角度探討遺傳型 ATTR Hereditary ATTR: A Neurological Perspective	謝松蒼教授 Sung-Tsang Hsieh

座長：余文鍾 主任 (Wen-Chung Yu)
林彥宏 教授 (Yen-Hung Lin)

11:45-12:15	Panel Discussion	謝松蒼教授 Sung-Tsang Hsieh 鄭媚方主任 Mei-Fang Cheng
12:15-13:30	***Lunch***	

座長：洪光威 副院長 (Guang-Uei Hung)

13:30-14:15	類澱粉蛋白正子掃描圖像量化 Amyloid-PET Image Quantification	Dr. Norman Koglin (德國)

座長：何恭之 主任 (Kung-Chu Ho)

14:15-15:00	神經疾病中不斷發展的 PET 示蹤劑 Evolving PET Tracers in Neurodegenerative Disorders	Prof. Matthias Brendel (德國)
15:00-15:15	***Coffee Break***	

座長：李哲皓 秘書長 (Tse-Hao Lee)
王正忠 副院長 (Cheng-Chung Wang)

15:15-16:00	台灣核子醫學腦影像資料庫：從建置到研究運用 Taiwanese Nuclear Medicine Brain Image Database: From Construction to Research Application	倪于晴博士 Yu-Ching Ni

座長：王昱豐 理事長 (Yuh-Feng Wang)
高梓木 院長 (Tsu-Mu Kao)

16:00-16:45	非侵入性動脈粥狀硬化造影-回顧與展望 International Non-Invasive Atherosclerosis Imaging-Review and Prospect	夏建忠研究員 Chien-Chung Hsia
16:45-	***閉幕 Closing Remarks***	王昱豐 理事長 Yuh-Feng Wang

國家原子能科技研究院
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The impact of AI-enhanced nuclear cardiology for accurate diagnosis and risk prediction

人工智慧對輔助核醫心臟影像診斷及預後判斷之效應

Yuka Otaki

Department of Radiology, Sakakibara Heart Institute, Tokyo, Japan

Currently, cardiologists have the benefits of multiple non-invasive cardiac imaging technologies including Single Photon Emission Computed Tomography (SPECT), Positron Emission Tomography (PET), Computed Tomography (CT), and Magnetic Resonance Imaging (MRI), a significant leap from what was available in previous years. The role of nuclear cardiology has evolved, now prioritizing the precise diagnosis of myocardial ischemia and the effective risk stratification for future cardiovascular events. To meet these objectives, expert readers are now increasingly utilizing software quantification tools alongside visual assessment to refine the diagnosis process. This approach not only enhances the accuracy of diagnoses but also streamlines the workflow within the nuclear cardiology lab. The integration of artificial intelligence (AI) into this process is posed to revolutionize the field further by optimizing imaging processing and significantly improving the precision of both diagnoses and prognoses derived from nuclear cardiology imaging.

In this presentation, the author delves into detailed insights and experience garnered over eight years in a cardiovascular imaging lab in the US. Through this exploration, the presentation aims to underscore the vital role and immense potential of nuclear cardiology in the contemporary era, characterized by the widespread adoption of multimodal imaging strategies.

Motion detection and correction: Are are we ready for clinical implementation?

影像位移及校正之臨床落地應用：我們是否已經做好準備？

Martin Lyngby Lassen
University Hospital Copenhagen Rigshospitalet, Denmark

Nuclear cardiology has advanced rapidly in recent years. One of the driving factors has been the increasing sensitivity, improved spatial resolution, and ingenuity in designing PET/CT, SPECT/(CT), and PET/MRI scanners. Consequential to the improved spatial resolutions (with resolutions of ≈ 1mm in latest generation PET/CT systems), even subtle motion during the acquisitions risks introducing detrimental blurring to the resulting images. For cardiac imaging protocols, motion during the scans can be divided into four distinct types: cardiac contractions, respiratory motion, patient motion, and myocardial creep. Unique motion detection and correction patterns have been devised for perfusion imaging protocols to minimize the impact of motion or even correct the motion. Detection of cardiac contractions is utilized in routine assessments, where it is often monitored using a 3-lead ECG device, while several techniques have been proposed to detect respiratory motion during the scans. The most common are respiratory bellows, infrared systems, and finally, data-driven methods.

Besides perfusion imaging, automated motion correction algorithms are also emerging for dynamic scans, thus facilitating the assessment of myocardial blood flow and flow reserves with motion-limited imaging series.

This presentation seeks to cover the current state-of-the-art in detecting and correcting for motion during cardiac PET and SPECT acquisitions.

Advances in nuclear imaging for the diagnosis of ATTR

ATTR 診斷相關核子影像醫學之進展

Christoph Rischpler
Klinikum Stuttgart, Germany

Cardiac amyloidosis (CA) is an underdetected cause for heart failure which has significantly gained attention in the past years. Systemic amyloidosis is a disorder that leads to extracellular deposition of misfolded proteins affecting organ function. In the vast majority of cases light-chain (AL) or transthyretin (ATTR) amyloid deposits are responsible for CA, leading to systolic and diastolic dysfunction, hypertrophy, arrhythmias, conduction blocks, and heart failure. Cardiac involvement is the most significant prognostic factor in patients with amyloidosis. AL amyloidosis can be treated with different anti-plasma cell regimens. In case of hematological response5 organ responses with improving organ function are possible. In ATTR amyloidosis disease specific therapeutic approaches include transthyretin stabilizers or transthyretin gene silencers.

The diagnosis of amyloidosis is based on Echocardiography, ECG, Laboratory Tests, Cardiac Biomarkers, Catherization, Magnetic Resonance Imaging, and Nuclear Imaging but a reliable diagnosis is provided only by histopathological examination. Nuclear imaging plays an important role in diagnosis and monitoring of illness.

Until recently endomyocardial biopsy has been the “gold standard” for diagnosing all types of cardiac amyloidosis, but non-invasive strategies are emerging. It has been known for few years now that accumulation of bone-seeking radiopharmaceuticals like 99 m Tc-3 , 3-diphosphono-1 , 2-propanodicarboxylic acid (99mTc-DPD) have very high accuracy in diagnosing ATTR amyloidosis.

Positron-emission tomography with computed tomography (PET-CT) has also been explored as a diagnostic tool for cardiac amyloidosis and recent studies have shown the promise of 18F-flutemetamol PET imaging for detecting ATTR cardiac amyloidosis.

In the speech we will address the advances in nuclear imaging as regards to the diagnosis and confirmation of ATTR.

Hereditary ATTR: A neurological perspective

從神經內科學的角度探討遺傳型 ATTR

Sung-Tsang Hsieh
謝松蒼
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臺大醫院 神經部

Hereditary transthyretin (ATTR) amyloidosis is characterized by a slowly progressive peripheral sensorimotor and/or autonomic neuropathy as well as non-neuropathic changes of cardiomyopathy, nephropathy, vitreous opacities, and CNS amyloidosis. Neurological involvement usually starts in the lower extremities with paresthesias and hypesthesias of the feet, followed within a few years by motor neuropathy. In some persons, particularly those with early-onset disease, autonomic neuropathy is the first manifestation of the condition; findings can include: orthostatic hypotension, constipation alternating with diarrhea, attacks of nausea and vomiting, delayed gastric emptying, sexual impotence, anhidrosis, and urinary retention or incontinence. Cardiac amyloidosis is mainly characterized by progressive cardiomyopathy. Individuals with leptomeningeal amyloidosis may have the following CNS findings: dementia, psychosis, visual impairment, headache, seizures, motor paresis, ataxia, myelopathy, hydrocephalus, or intracranial hemorrhage.

Disease onset typically occurs in adult life, with age and presenting symptoms largely depending on genotype. Initial signs usually include pain, temperature sensation loss, numbness or tingling in lower limbs extremities. Motor neuropathy progressively ensues causing walking instability, inability to walk unassisted and ultimately need for a wheelchair. Autonomic symptoms, including bowel abnormalities, early satiety, orthostatic hypotension and erectile dysfunction may appear in the initial stages of the disease, particularly in patients with an early onset phenotype. Heart involvement, with signs of infiltrative cardiomyopathy leading to heart failure, develops in the majority of patients. Most patients are therefore classified as mixed phenotype (both neurological and cardiac). With respect to drug prescription, impairment due to polyneuropathy is scored with the familial amyloidotic polyneuropathy (FAP) staging system which has three stages : stage 1 is defined by unassisted walking; stage 2 is defined by need for assisted walking and stage 3 is defined by wheelchair-bound or bedridden patient.

Amyloid-PET image quantification

類澱粉蛋白正子掃描圖像量化

Norman Koglin

Head, Scientific Operations (Clinical R&D) at Life Molecular Imaging, Germany

Background : Amyloid positron emission tomography (PET) with [18F]florbetaben is an established tool for detecting Aβ deposition in the brain in vivo and has been approved for routine clinical use since 2014 as Neuraceq® based on visual assessment (VA) of PET scans. Quantitative measures are however commonly used in the research context, with many of the available PET software packages capable of calculating amyloid burden both on a regional and a composite level, allowing continuous measurement of amyloid burden in addition to the approved dichotomous VA.

Methods : This study aimed to provide scientific evidence of the robustness and additional value of florbetaben PET quantification, with a focus on Centiloid-based analysis. The diagnostic performance (i.e., sensitivity and specificity) of quantification against the histopathological confirmation of Aβ load was estimated and compared to the effectiveness of the approved VA method. Additionally, the concordance between visual and quantitative evaluation of florbetaben PET scans was assessed. The reliability and comparability of the different analytical pipelines was further tested. Florbetaben PET images analyzed in this retrospective analysis had been acquired in previous clinical trials. The study population consisted of 589 subjects with at least one available florbetaben PET scan. Florbetaben PET scans were quantified with 15 analytical pipelines using nine software packages that used several metrics to estimate Aβ load (SUVR, Centiloid, amyloid load and amyloid index). Six analytical methods reported Centiloid.

Results : The mean sensitivity, specificity, and accuracy were 96.1 ± 1.6%, 96.9 ± 1.0%, and 96.4 ± 1.1%, respectively, for all quantitative methods tested when compared to histopathology, where available. The mean percentage of agreement between binary quantitative assessment across all 15 methods and visual majority assessment was 92.4 ± 1.5%. Assessments of reliability, correlation analyses, and comparisons across software packages showed excellent performance and consistent results between analytical methods.

Conclusion : This study demonstrated that quantitative methods using both CE marked software and other widely available processing tools provided comparable results to visual assessments of FBB PET scans. Software quantification methods, such as centiloid analysis, can complement visual assessment of FBB PET images and could be used in the future for identification of early amyloid deposition, monitoring disease progression and treatment effectiveness. Based on this study, quantification of [18F]florbetaben PET as an adjunct to visual assessment was recently approved by the European Medicines Agency (EMA) in the EU for Neuraceq®.

Evolving PET tracers in neurological disorders

神經疾病中不斷發展的 PET 示蹤劑

Matthias Brendel

Professorship for Translational Molecular Imaging, Germany

This lecture will provide an overview of the current use of new PET tracers in preclinical and clinical research and the latest understanding of biomarkers in neurological disorders. Three topics will be presented in more detail: (i) Advances in Tau PET research for AD and movement disorder patients, (ii) A new approach for ATN assessment, (iii) Cell sorting after radiotracer injection to decipher the PET signal source.

Advances in Tau-PET research for AD and movement disorder patients: Tau-PET emerged as a valuable biomarker for the differentiation of the 4-repeat (4R) tauopathy progressive supranuclear palsy (PSP) from healthy and disease controls. Furthermore, we applied a novel approach of cell sorting after radiotracer injection and observed higher tracer uptake in single neurons compared to astrocytes of PS19 mice. Regional [18F]PI-2620 tau-PET signals in vivo correlated strongly with abundance of fibrillary tau in subsequent autopsy samples of PSP patients and disease controls. In an additional autopsy sample of deceased patients with PSP, tau-positive neurons with high AT8 density but not tau-positive astrocytes were the driver of [18F]PI-2620 autoradiography signals. In summary, neuronal tau constitutes the dominant signal source of tau-PET signal increases in 4R-tauopathies, yielding the capacity to translate to an in vivo signal.

ATN assessment using kinetic modelling of a single Tau-PET session : Patients with neurodegenerative

diseases are classified molecularly using the A/T/N classification system. Apart from fluid biomarkers and structural MRI, the A/T/N system utilizes characteristic features from Amyloid-PET (A), Tau-PET (T), and FDG-PET (N), requiring multiple imaging sessions. Thus, we evaluated the value of dynamic tau-PET with [18F]PI-2620 to assess A/T/N in individual patients during a single imaging session. Perfusion [18F] PI-2620 images (R1) were validated as a surrogate marker for neuronal injury, exhibiting strong quantitative and visual correlations with early-phase Amyloid-PET and FDG-PET, as well as with volumetric MRI and CSF total tau levels. Our results suggest that [18F]PI-2620 imaging has the potential to facilitate the assessment of PET-based A/T/N during a single dynamic PET session.

Cell sorting after radiotracer injection deciphers the PET signal source: Various cellular sources hamper interpretation of positron-emission-tomography(PET) biomarkers in the tumor microenvironment (TME). Combining cellular tracer uptake measures with 3D-histology facilitates precise allocation of PET signals and serves to validate emerging novel TAM-specific radioligands.

Taiwanese nuclear medicine brain image database: From construction to research application

台灣核子醫學腦影像資料庫：從建置到研究運用

Yu-Ching Ni
倪于晴
National Atomic Research Institute, Department of Radiation Protection , Taoyuan, Taiwan, ROC
國家原子能科技研究院 輻射防護研究所

Through collaboration between the National Atomic Research Institute's Radiation Imaging Group and the domestic medical community, a nuclear medicine cerebral blood flow imaging database specifically designed for the Taiwanese population has been established. This presentation will introduce the progress of the database construction, the composition of the dataset, and its scale. Additionally, it will share the results of dementia differentiation research conducted using this database, with the hope of enhancing the diagnostic capabilities for dementia and the application value in related research fields in the future.

International non-invasive atherosclerosis imaging-review and prospect

非侵入性動脈粥狀硬化造影的研發現況與應用

Chien-Chung Hsia

夏建忠

National Atomic Research Institute, Department of Isotope Applications, Taoyuan, Taiwan, ROC

國家原子能科技研究院 同位素應用研究所

Chronic inflammation of arteries due to hyperlipidemia leads to thickening and loss of elasticity of the arterial wall connective tissue, resulting in atherosclerotic lesions. In the mechanism of vascular inflammation, macrophages play a key role. There are now many radiopharmaceuticals in imaging atherosclerosis. Among them, the chemokine C-X-C receptor type 4 (CXCR4) plays an extremely important role in inflammation and tumor biology. A new small molecule antagonizing CXCR4 was designed through computer simulation technology. The chemical structure of the agent APD was verified by radioisotope labeling and effectiveness in the ApoE-/- mouse model. The results represent that 68Ga-APD can be rapidly excreted through the kidneys and can be found in the atherosclerotic lesions of ApoE-/- mice/ The background ratio (TBR) is >10 (0.5~1.5 hours after drug injection), and the sensitivity and specificity are better than existing related drugs in the world. This imaging technology platform has been successfully used in clinical medicine and healthy food efficacy Through verification, the research and development cycle of new cardiovascular-related drugs and healthy foods will be further shortened in the future, and research and development costs and failure risks will be significantly reduced.