

IMPROVING THE ACCURACY OF INFECTION IMAGING

Melinda C Rosenzweig, Marina L Dunne. Royal Perth Hospital, Australia

Imaging using labelled white blood cells (Tc-99 m or In-111) or Gallium-67 is commonly performed to localise infection in patients with septic symptoms. However the image quality is often not good enough for accurate localisation of the tracer accumulation.

This problem can be overcome by dual imaging. This method helps improve localisation by simultaneously taking images of the white blood cell/gallium uptake and the relevant anatomy. At Royal Perth Hospital dual imaging is performed in two ways. Indium-111 labelled white blood cells may be imaged simultaneously with a Tc-99 m MDP bone scan, which takes advantage of the different gamma energies of In-111 and Tc-99 m. Gallium and WBC SPECT images may also be coregistered with a CT scan performed immediately after on our SPECT/CT GE Hawkeye Infinia Gamma Camera.

The cases presented illustrated that simultaneous infection and anatomical imaging is simple to perform and adds a significant degree of confidence in localising the site of sepsis. This is particularly useful in distinguishing bone from soft tissue infection.

AN IMPROVED 99mTc-APROTININ KIT FORMULATION: QUALITY CONTROL ANALYSIS OF COLD KIT SHELF LIFE AND RADIOTRACER STABILITY

Douglas R Smyth, Chris Tsopelas. Royal Adelaide Hospital Radiopharmacy, Nuclear Medicine Department, Australia

Aprotinin is a small protein that inhibits serine proteases and has been shown to bind to amyloid fibrils of varying chemical composition in-vitro. 99mTc-aprotinin has demonstrated potential for imaging cardiac and pleuropulmonary AL amyloidosis and other forms of amyloidosis present as deposits in joints, the tongue or intestines and other sites excluding the kidneys and liver. Radiolabelling of aprotinin was previously achieved by addition of 99mTc-pertechnetate to an alkaline mixture of Trasylol (aprotinin injection) and stannous chloride, followed by a necessary filtration step after 20–30 min. We have developed a modified cold kit formulation, utilising pharmaceutical starting materials, that provides a more convenient and efficient radiolabelling procedure where filtration is not required prior to injection. The shelf life of the cold kits was validated after storage in a freezer. The reducing agent used was stannous-pyrophosphate (PYP) and the alkaline buffer was a phosphate-glycine mixture (pH 10.5). Quality control testing of the cold kits was performed after 0, 1, 2, 3 and 6 months storage by assessing the percentage RCP of 99mTc-aprotinin by ITLC-SG. Radiotracer stability was examined in the same way 25, 85 and 265 min post reconstitution (pr) via a three strip system employing acetone, saline and ammonia:ethanol:water mixture (1 : 2 : 5). A rapid quality control cartridge method was also investigated. Radiolabelling of the cold kits yielded RCP > 95% at 25 mins pr and all other time points, from a formulation that avoided a filtration step. The impurities were quantified as 99mTcO₂ (< 4%), 99mTc-pertechnetate (< 0.5%) and 99mTc-PYP (< 0.7%) by paper methods. The improved 99mTc-aprotinin kit formulation has greater convenience and efficiency in the clinical setting.

COMPARISON OF SINGLE PHOTON EMISSION TOMOGRAPHY TO MULTI-SLICE HELICAL COMPUTED TOMOGRAPHY IN THE DIAGNOSIS OF PULMONARY EMBOLISM IN PATIENTS WITH INDETERMINATE VENTILATION PERFUSION SCINTIGRAPHY

Vito Rubino, Steven Unger, Leighton Barnden, Richard Ruffin. The Queen Elizabeth Hospital, Australia

Introduction: Single Photon Emission Computed Tomography (SPECT) offers improved anatomical resolution over planar Ventilation-Perfusion (VQ) scintigraphy. Despite the widespread acceptance of Multi-slice Computed Tomography Pulmonary Angiography (CTPA) in the diagnosis of Pulmonary Embolism (PE), few studies have directly compared the diagnostic performance of SPECT and CTPA.

We hypothesise SPECT may surpass planar VQ and be at least comparable to CTPA in PE diagnosis in patients with indeterminate (intermediate probability) planar VQ scans.

Methods: 268 patients underwent VQ scans between February and December 2004. From this pool, 11 patients with an indeterminate VQ scan who fulfilled the entry criteria (7 males, 4 females, age range 32–89) underwent SPECT. Images were assessed retrospectively by 2 experienced observers using revised PLOPED criteria. CTPA was performed within 48 h. The diagnosis at 3–6 month clinical follow up determined the presence or absence of PE.

Results: Follow up data was available for 9 patients. The prevalence of PE was 1/9 (11%). SPECT correctly led to a reclassification of scans from intermediate probability to low-normal probability in 7/9 (77%) and to high probability in 1/9 (11%). The 1/9 patients who could not be re-classified, did not have PE at follow-up. SPECT increased subsegmental defect detection (18) compared to planar images (11), but not segmental defects (6 SPECT, 7 planar). Overall sensitivity, specificity and negative predictive value of SPECT was 50%, 100% and 85%, respectively. CTPA was positive in the 1 patient with PE and negative in all other subjects.

Conclusion: SPECT appears to improve subsegmental defect detection, scan probability assignment and the specificity of V/Q scintigraphy. Patients with indeterminate VQ scans may benefit from SPECT. The small cohort does not allow validation of the comparative accuracy of CTPA and SPECT.

ARTIFICIAL NEURAL NETWORKS ASSISTED SCREENING FOR OSTEOPOROSIS IN POSTMENOPAUSAL WOMENYuh-Feng Wang¹, Jainn-Shiun Chiu¹, Yu-Chuan Li². ¹Department of Nuclear Medicine, Buddhist Dalin Tzu Chi General Hospital, Chiayi County, ²Graduate Institute of Medical Informatics, Taipei Medical University, Taipei City, Taiwan

Purpose: Osteoporosis is an essential index of health and economics in every country. Recognizing asymptomatic people with high risks of osteoporosis remains a difficult challenge. In this research, we developed internally validated artificial neural networks (ANNs) to notify the osteoporotic cases in postmenopausal women.

Methods: 942 postmenopausal women, average 62.67 ± 9.97 years old, were involved. Subjects randomly divided into 2 groups: the training set ($n = 707$) and the validation set ($n = 235$). The Predictors include age, body height, weight, mass index, smoking, alcohol, coffee, and steroid consumptions. The output variable was dichotomous, either nonosteoporosis (T-score more than -2.5, $n = 728$) or osteoporosis (T-score equal to or less than -2.5, $n = 214$), decided using dual-energy X-ray absorptiometry (DEXA). Three mathematical models of ANN, namely probabilistic neural network (PNN), radial basis function (RBF), and multilayer perceptron (MLP), were tested and the results were evaluated using the receiver-operating characteristics (ROC) curve analysis. The best simultaneous sensitivity and specificity were calculated and the discriminant power of each model was also represented by the area under the ROC curve (AUC).

Results: Both PNN and RBF models have higher sensitivity (77.4% vs• 83.0%) and specificity (75.3% vs• 70.9%) than that of MLP (75.5% and 57.1%). The AUCs were also superior in the PNN (0.826) and RBF (0.837) than the MLP (0.711). Pairwise comparison of AUCs showed that the RBF and PNN models significantly outperformed the MLP model ($P = 0.001$ and $p = 0.002$, respectively). However, the RBF and PNN models ($P = 0.550$) performed similarly well.

Conclusion: ANNs can be an assessment for bone mineral condition in postmenopausal women or a screening tool to stratify the high risk subjects into osteoporotic group.