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Multi-modality imaging in the patients with myocardial infarction after coronary artery bypass graft and autologous bone marrow stem cell transplantation

Objective: To evaluate the value of multi-modality imaging (PET/CT+CAG+CMRI) in post myocardial infarct (MI) patients followed coronary artery bypass graft (CABG) and autologous bone marrow stem cell (BMSC) therapy.

Methods: A total of 43 patients with MI (27 males, 16 females, age range: 47–72 years) were prospectively enrolled in the year 2012 between January and December. All patients underwent CABG+BMSC transplantation and were divided into 3 groups according to the time interval between two treatments (group 1: 0–3 d, group 2: 4–14 d, group 3: 15–30 d). All patients were scanned with CMRI, PET/CT (18F-FDG), and CAG at different time-points pre-/post-treatment. The quantitative parameters included vascular stenosis degree (VSD), LVEF, percentage size of infarction (PSI), the number of segments in mismatched myocardial perfusion/metabolic and the K value for radioactive distribution grading. One-way analysis of variance and the least significant difference t test were used to compare parameters before and after treatment in the same group and among three different groups.

Results: Regarding PET/CT diagnostic efficacy of abnormal myocardial segments, the sensitivity, specificity, positive predictive value and negative predictive value were 95.4% (540/566), 87.3% (144/165), 96.3% (540/561) and 84.7% (144/170), respectively. After CABG and BMSC transplantation treatments for 12 months, VSD decreased significantly ((69.1±9.5)%: F=12.854, P<0.05), comparing with the baseline ((74.8±7.9)%: t=3.074, P<0.05). Comparing to the baseline, LVEF in 3 groups increased slightly (F values: 0.906, 0.298, 0.059, all P>0.05). PSI of patients in group 2 decreased greatly after 12 months treatment ((35.70±12.59)%: F=3.792, t values: -2.916-4.059, all P<0.05). K values for radioactive distribution grade decreased obviously after 1 month and 12 months treatment comparing to the baseline (11.79±1.87, 12.39±2.35, 14.05±2.15; F=4.212, t values: -4.619, -0.989, all P<0.05). Number of myocardial perfusion/metabolic abnormal segments in group 2 after 1 month treatment was lower comparing to the baseline and 24 months treatment (10.17±0.66, 12.92±0.99, 14.17±1.21; F=3.543, t values: -2.146, -2.898, all P<0.05).

Conclusions: Multi-modality imaging may be used for accurately detecting abnormal myocardium and predicting prognosis. CABG+BMSC therapy during day 4–14 post-MI may temporarily improve perfusion and metabolism in viable myocardium, but the long term prognosis seemed not be improved.

Predictive value for adverse cardiac events of left ventricular diastolic function measured by gated myocardial perfusion imaging
Zhang Juan, Yao Zhiming, Guo Yue, Yu Zhiguo, Li Wenchan, Xue Qianqian, Gao Xuan

Objective: To study the predictive value for adverse cardiac events (ACE) of left ventricular diastolic function measured by G-MPI.

Methods: Patients assessed by 2 days rest-stressed G-MPI during March 2012 to May 2013 in Beijing Hospital were collected and observed for the cumulative survival rate without ACE after G-MPI. ACE included cardiac death, non-fatal MI and late revascularization (60 d after the examination). Using quantitative gated SPECT (QGS) to get the LVEF and left ventricular peak filling rate (PFR). Using 17 segments, 5-point scoring system to get the summed stress score (SSS). Cox regression analysis was used to identify the independent predictors for ACE, and Kaplan-Meier method was used to investigate the cumulative survival rate without ACE. χ² test was also used.

Results: A total of 11 patients who underwent early revascularization (within 60 d after G-MPI) were excluded and 139 patients (76 males, 63 females; average age 68.73 years) were assigned to different groups for outcome analysis, and 9 (6.5%, 9/139) patients had ACE in the whole group. Cox regression analysis showed that SSS, LVEF, PFR were the independent predictors for ACE (all P<0.05). Patients with PFR≥2.1 EDV/s had a higher incidence of ACE than those with PFR≥2.1 EDV/s (14.3% (7/49) vs 2.2% (2/90), χ²=7.63, P<0.05). Kaplan-Meier survival analysis showed that the cumulative survival rate without ACE was lower in patients with PFR<2.1 EDV/s than that in patients with PFR≥2.1 EDV/s (67.7% vs 95.0%), and lower in patients with LVEF<50% than that in patients with LVEF≥50% (32.0% vs 90.8%), and also lower in patients with SSS≥8 than those with SSS<8 (62.0% vs 94.7%; χ² values: 11.92, 11.27, 10.40, all P<0.01). Combining PFR with SSS and LVEF respectively, Kaplan-Meier survival
analysis showed that the cumulative survival rate without ACE in patients with LVEF≥50% was higher than that in patients with LVEF<50% when PFR<2.1 EDV/s (76.7% vs 30.8%), and also higher in patients with SSS<8 than that in patients with SSS≥8 when PFR≥2.1 EDV/s (100% vs 72.2%; χ² values: 7.14, 13.09, both P<0.01). Conclusion: PFR of left ventricular diastolic function measured by G-MPI is one of the independent predictors for ACE, and it could effectively improve the predictive value for ACE if combined with LVEF and SSS.

Diagnostic value of glomerular filtration rate, microalbuminuria, β2-microglobulin and cystatin C for renal function in patients with diabetic nephropathy
Feng Xuefeng, Li Aimei, Xu Shoulin, Jia Peng, Shen Shanmei

Objective: To investigate the clinical value of GFR, microalbuminuria (mAlb), serum β2-microglobulin (MG) and cystatin C (CysC) for the evaluation of renal function in patients with DN. Methods: A total of 150 patients with type 2 DM diagnosed by WHO standard (1999) from December 2012 to December 2015 were retrospectively analyzed. Thirty-three kidney transplantation donors during the same time were chosen as the control group. The urine mAlb, Cr, albumin/Cr ratio (ACR) and Scr, serum β2-MG, CysC, urea, uric acid (UA), fasting blood glucose (FBG), hemoglobin A1c (HbA1c) and C-reactive protein (CRP) were measured. 99mTc-DTPA renal dynamic imaging was performed. The Gates method was used to calculate GFR, and the modification of diet in renal disease (MDRD) method was used to calculate the estimated GFR (eGFR). The relative equation between GFR and eGFR was studied. The clinical stages of renal function in type 2 DM patients were evaluated by Mogenesen standard method. Two-sample t test was used for data analysis. ROC curve analysis was performed to study the diagnostic value of GFR in DN. Results: The patients were divided into merely type 2 DM group, early stage DN (I, II, III), and clinical DN(IV) groups by Mogenesen standard method. GFR and eGFR in the DN I stage were higher than those of the merely type 2 DM group (t values: -7.502, -3.629, both P<0.01), and GFR and eGFR decreased with the increased stage of DN. However, serum UA, CRP, FBG and HbA1c, Scr, urea, β2-MG, CysC, mAlb and ACR increased when the stage of DN was higher. GFR and eGFR showed a linear correlation, with the regression equation of y=0.957x+6.823. AUC of ROC in patients with DN I was 0.989. With the cutoff value of 125.09 ml/min, the sensitivity and specificity were 96.2% (25/26) and 98.4% (122/124) respectively in diagnosis of DN I. Between high UA and normal UA groups, FBG and HbA1c were not significantly different (t values: -1.010, -1.034, both P>0.05), but the renal function indicators were different (t values: -5.090-2.209, all P<0.01). Compared with the normal CRP group, the FBG, HbA1c and renal function indicators were statistically different in high CRP group (t values: -6.114-7.386, all P<0.01). Conclusions: GFR and eGFR show a linear relationship in type 2 DM. GFR is a sensitive, specific diagnostic index in DN period. β2-MG, CysC, mAlb and ACR are conducive to the early diagnosis of DN. High UA is an independent risk factor for the onset of DN, and high CRP is an inflammatory damage factor in DN.

Application of amide proton transfer imaging in differentiating glioma from treatment effect

Objective: To explore the application of amide proton transfer (APT) imaging in differentiating glioma from treatment effect and to evaluate the diagnostic efficiency of the quantitative APT-related parameters. Methods: A total of 23 patients (15 males, 8 females, age: 13-80 years) with 27 lesions who had undergone APT imaging in Tongji Hospital(Wuhan, China) from October 2014 to June 2015 were enrolled in this prospective study. The scan protocols were MRI normal plain scanning, diffusion WI, contrast-enhancement T1WI and APT imaging. Both the magnetization transfer ratio (MTR) and the relative MTR (rMTR) of lesions were manually measured by drawing ROI in the functional post-processing workstation. The results were compared with those of pathologic examinations and radiographic follow-up (>3 months). Mann-Whitney u test was used to analyze the data. Results: Compared with contralateral white matter, the primary gliomas (n=12) and recurrent gliomas (n=8) manifested hyper-intensity, while the treatment induced injuries (n=7) showed iso- or hypo-intensity. The difference of MTR between tumors and treatment effects was significant (102.78(101.93, 103.84) vs 100.17(99.94, 100.63); z=-3.76, P<0.01), so was the difference of rMTR between tumors and treatment effects (3.92%(2.69%, 4.67%) vs 0.47%(-0.79%, 1.11%); z=-3.43, P<0.01). Both those two quantitative parameters exhibited excellent diagnostic performance with the AUC of 0.986 and 0.943. The specificity, sensitivity and accuracy of MTR were 100%(20/20), 6/7 and 96.3%(26/27) in the threshold of 100.68, while those of rMTR were 95.0%(19/20), 6/7 and 92.6%(25/27) in the threshold of 1.66%. Conclusions: Combined with the routine MRI images, APT imaging can provide excellent qualitative and quantitative information in differentiating glioma from treatment effect. Both MTR and rMTR are helpful for the differentiation with high sensitivity and specificity and can be used as non-invasive imaging biomarkers in evaluating
Comparison of different chemiluminescence immunoassay analyzers for determination of serum thyroid stimulating hormone in patients with suspicious subclinical hypothyroidism

Wang Tingting, Shao Fengling, Lu Hankuai

Objective: To evaluate the differences of serum TSH of suspicious subclinical hypothyroidism determined by four automatic biochemical analyzers and the impact on clinical diagnosis and treatment. Methods: Taking results of Roche Cobas e601 laboratory test as a reference, 103 serum samples with TSH 2.50-10.00 mU/L (90 with TSH ≥ 4.27 mU/L) and normal FT3, FT4 were selected. Four different automatic biochemical analyzers (Cobas e601, Immulite2000, Centaur XP, I2000) were used to measure TSH of the serum samples at the same time. Wilcoxon signed rank test, Spearman correlation analysis were used for data analysis. Results: TSH (M(P25, P75)) measured by 4 methods were 5.20(4.73, 6.40), 2.95(2.59, 3.48), 3.30(2.94, 4.15) and 4.10(3.43, 4.75) mU/L, which varied significantly from one assay to another (z values: -8.78, -8.41, -7.64, -8.09, -8.50, all P < 0.05). The correlations between methods were of great differences (r, ranged from 0.45 to 0.92). Significant differences existed in each other for subclinical hypothyroidism diagnosis based on TSH cutoff respectively. Conclusions: Results from different automatic immunoassay analyzers in patients with TSH of 2.50-10.00 mU/L varied widely, hence, it is indeterminate to diagnose subclinical hypothyroidism only relies on a single serum TSH test.

Imaging atherosclerosis model rabbits with ⁹⁹mTc-scfV-VCAM-1 single chain antibody fragment against vascular cell adhesion molecule-1

Liu Chunbao, Zhang Xiao, Song Yiling, Zhang Fengchen, Zhang Yingying, Wang Yichun, Lan Xiaoli, Zhang Yongxue

Objective: To investigate the imaging performance and feasibility of ⁹⁹mTc labeled scFv against VCAM-1(⁹⁹mTc-scFv-VCAM-1) on atherosclerosis model rabbits. Methods: HYNIC was used as a chelator for ⁹⁹mTc labeling. The labeling efficiency and radiochemical purity of ⁹⁹mTc-scFv-VCAM-1 were measured by instant thin layer chromatography after PD-10 purification. New Zealand white rabbits were employed for establishing atherosclerotic animal models by endothelia immunity injury and high fat diet, and plaques at aorta lesions were examined by HE staining. Model rabbits were sacrificed after administration of ⁹⁹mTc-scFv-VCAM-1 at 1 or 2 h respectively, and tissue samples were measured with gamma counter and weighted to obtain in vivo biodistribution data. Planar imaging was performed 1 and 2 h after the injection of ⁹⁹mTc-scFv-VCAM-1 to investigate radioactivity of abdominal aorta. After imaging study, atherosclerosis plaque and VCAM-1 expression at aortas were confirmed by the immunohistochemistry (IHC) study. Two-sample t-test was used to analyze data. Results: ⁹⁹mTc-scFv-VCAM-1 was successfully synthesized. Its labeling efficiency was 75%-83%, radiochemistry purity was (98.54 ± 1.03)% and specific activity was 216 MBq/nmol. Atherosclerosis plaque was confirmed at the aortas of experimental rabbits by HE staining, while no plaque was observed in controls. Biodistribution data indicated that the tracer was cleared mainly through the kidneys. Planar imaging showed that the tracer uptake in abdominal aorta of model rabbits was higher than that of control rabbits, the T/B ratios at 2 h of the model group and control group were statistically different (3.68 ± 0.73 vs. 7.42 ± 0.39; t = 2.950, P < 0.05; n = 5). Atherosclerosis plaque and high level of VCAM-1 expression were observed at aortas of model rabbits by IHC study. Conclusions: It is feasible and effective to detect vulnerable plaques using ⁹⁹mTc-scFv-VCAM-1. It may provide a promising way for early diagnosis and accurate evaluation of atherosclerosis.

Relationship between the peripheral dose and radioactive counts of ¹²⁵I seeds detected by SPECT/CT


Objective: To explore the relationship between the peripheral dose and radioactive counts of ¹²⁵I seeds detected by SPECT/CT. Methods: Six ¹²⁵I seeds (1.48 × 10⁷ Bq, 1.85 × 10⁷ Bq, 2.22 × 10⁷ Bq, 2.59 × 10⁷ Bq, 2.96 × 10⁷ Bq, 3.33 × 10⁷ Bq) were put into the solid water phantoms respectively. SPECT/CT was applied to scan the seeds. The radioactive counts (x) at the distance of 1-15 mm from the center of seeds were recorded respectively, while the corresponding doses (y, cGy) were calculated. SPSS 18.0 was used to analyze the relationship between the radioactive counts and peripheral dose. Results: There was an exponential relationship between the peripheral dose of ¹²⁵I seeds and the radioactive counts. The formula was as follow: \( y = 507.849 \times x^{1.004} \). Conclusions: SPECT/CT can visualize the peripheral dose of ¹²⁵I seed, which may provide a method for dosimetric verification after brachytherapy.

Progression in photoacoustic imaging for cancer diagnosis and therapy

Zhang Jun, Peng Qiaoli, Zhang Xiaoming, Liu Gang

Abstract: Photoacoustic imaging (PAI) is an emerging new biomedical imaging technique integrated with the high spatial resolution of ultrasonic imaging and high contrast of optical imaging for real-time molecular imaging. PAI is well-suited
for in vivo cellular/molecular signatures imaging in cancer diagnosis, therapy management and treatment response, with a promising potential in clinical and translational medicine. This review summarizes the current state of PAI application research on cancer theranostics, and gives insights on future translational medicine research.

Recent advances in radiotracers for apoptosis imaging

Zhang Xiaojun, Zhang Jinming

Abstract: Apoptosis plays a crucial role in various physiology and pathologic processes of organisms. The non-invasive imaging of apoptosis may have potentially important diagnostic and prognostic predictive values on apoptosis-associated diseases, such as neurodegenerative diseases and neoplasms. Molecular imaging of nuclear medicine provides a useful tool to investigate these features in vivo by using suitable radiopharmaceuticals. This review summarizes the recent advances in imaging agents targeting the apoptosis process.