Effect of attenuation correction on lesion detection using a hybrid PET system

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Abstract

Objective: The purpose of this study was to investigate the effect of attenuation correction (AC) on lesion detection for a hybrid PET system. Material and Method: Experimental list-mode data were acquired from hot spheres inside a uniform cylindrical phantom with an elliptical cross-section using a Siemens E.CAM+ dual-camera hybrid PET system. Spheres with inner diameters of 0.8- and 1-cm and the cylindrical phantom were filled with F-18 to simulate lesions with lesion-to-background (L/B) ratios of 14:1 and 8:1, respectively, found in clinical PET studies. The list-mode data of each sphere size were regrouped into sinograms with peak-to-peak energy window settings at 30\% and 20\% for the 0.8- and 1-cm diameter lesion, respectively. They were then rebinned using the single slice rebinning method. Attenuation correction was applied assuming uniform attenuation. The sinograms with and without AC were reconstructed using 5 iterations of OS-EM algorithm with 8 angles/subset and postfiltered with a Butterworth filter with n = 5 and fc = 0.52 cycles/cm. Human observer performance study and localization receiver operating characteristic (LROC) analysis were used to evaluate the reconstructed images for maximum lesion detection. Average areas under the LROC curves (A\textsubscript{LROC}) across 8 observers obtained with and without AC were determined. The null hypothesis that there was no difference between with AC and without AC was tested using a two-tailed t-test with 95\% confidence interval. Results: The results indicated that for the 0.8-cm lesion with 14:1 L/B ratio, the A\textsubscript{LROC} decreases from 0.66 to 0.62 when AC is applied as compared to without AC and from 0.69 to 0.63 for the 1.0-cm lesion with 8:1 L/ B ratio, but no statistical significant difference (p > 0.05). Conclusion: The authors conclude that for a phantom with hot lesions embedded in a uniform background, AC decreases lesion detectability compared to without AC using a hybrid PET system for small lesion sizes.

Keywords: Attenuation correction; Hybrid PET; LROC study

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Different roles of Sp family members in HIV-1 Tat-mediated manganese superoxide dismutase suppression in hepatocellular carcinoma cells

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Abstract

The expression of manganese Superoxide dismutase (MnSOD) is regulated by agents associated with cancer development. It has been shown that infection with the human immunodeficiency virus type 1 (HIV-1) is associated with the development of liver cancer and that the transactivating transcriptional factor (Tat) of human HIV-1 reduces the expression of MnSOD in several cell types. However, the role of Tat in the expression of MnSOD in hepatocellular carcinoma is unknown. Furthermore, the precise mechanisms whereby Tat suppresses MnSOD expression in hepatocellular carcinoma cells remain unclear. In this report, we build on our original observations that Tat changes the distribution of Sp family members on the MnSOD promoter, which accounts for Tat-dependent changes in basal expression. In hepatic cells, Tat expression upregulates Sp1/Sp3, which play different roles in regulating MnSOD transcription. While overexpression of Sp1 stimulates, overexpression of Sp3 represses transcriptional activity. The transcription repression effect of Sp3 is not due to Sp3 competing for the binding site with Sp1 because only the full-length Sp3 but not the truncated Sp3 suppresses MnSOD promoter activity. These findings suggest a novel mechanism by which Tat modulates the repression of the MnSOD gene and establish a link between HIV infection and liver cancer.

Current infection rate of Giardia lamblia in two provinces of Thailand.

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Abstract
The aim of this study was to survey for the current rate of Giardia lamblia infection in three different districts in two provinces of Thailand, Surin and Samut Sakhon, in March 2002, October 2003, and March 2004. Two districts are rural areas and another is sub-urban. Volunteers of any age from Surin Province and children aged between 5 to 7 years old from three secondary schools in Samut Sakhon were enrolled for the stool examination. The method used was stool examination by both simple smear and normal saline concentration technique on fresh collected feces. All samples were tested in duplicate. Out of 3,358 healthy individuals from rural Surin Province, 75 cases (2.2%) were found positive for G. lamblia, 30 of which were below 10 years of age. By comparison, 656 individuals from sub-urban Samut Sakhon Province volunteered and 43 (6.5%) were positive for G. lamblia. Other intestinal parasites, both helminth and protozoa, were also identified from these two groups: hookworm, Enterobius vermicularis, Strongyloides stercoralis, Trichuris trichiura, Taenia species, Entamoeba histolytica, Entamoeba coli, Endolimax nana, and Blastocystis hominis. From this study, the data showed that parasitic infection acquired via fecal-oral route is still a significant problem for these two provinces of Thailand.
Construction of Molecularly Imprinted Polymers for Cholesterol by Semi-covalent Imprinting Approach and Nitroxide Mediated Radical Polymerization

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Abstract

Molecularly imprinted polymers (MIPs) for cholesterol were successfully constructed using a combination of semi-covalent imprinting approach and nitroxide mediated radical polymerization. Cholesteryl (4-vinyl) phenyl carbonate was firstly synthesized and applied as a template-monomer adduct. Nitroxide initiator, 3-(4-buty1phenol)-1, l'-dimethyl-3 -(2,2',6,6'-tetramethylpiperidinooxy) propyl cyanide, was synthesized and added to the reaction mixture to assist polymerization of the functional monomer (divinylbenzene; DVB) in the vicinity of the template molecule. Subsequent to polymerization, the cholesterol molecule was hydrolyzed from the polymer matrix by refluxing in 1M NaOH and then neutralized with HCl. Binding capability of the MIP-H (hydrolyzed form) to cholesterol was assessed by radioligand binding analysis. Our results revealed that uptake of cholesterol into the binding cavity of the MIP-H was estimated to be up to 6 and 3 times higher than those of the unhydrolyzed form (MIP-UH) and control polymer (NIP-H), respectively. All these findings have opened up a potential approach for a specific ligand recognition of biological macromolecules, which could constitute another promising trend of sensor development.

Keywords: Molecular imprinting technique, molecularly imprinted polymer, cholesterol, nitroxidemediated radical polymerization

Original article

Construction of chimeric antibody binding green fluorescent protein for clinical application

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ABSTRACT

A chimeric antibody-binding green fluorescent protein (ZZGFPuv) was successfully constructed and applied as a powerful tool for immunological diagnosis. A gene encoding two repetitive sequences of Z-domain, derivative of IgG-binding B domain of staphylococcal protein A, was fused in-frame to the N-terminus of gfpuv gene. The chimeric gene was subsequently transformed and expressed in various strains of E. coli. Expression of chimeric protein in E. coli strain HB101 resulted in a protein translocation from cytoplasm to periplasmic space and cultivation medium. The chimeric ZZGFPuv could be purified using either IgG Sepharose column or immobilized metal (Cu2+) affinity chromatography. The purified protein migrated in non-denaturing SDS-PAGE as two major bands. A fluorescent band was located at 36 kDa while another band at 48 kDa exhibited non-fluorescence. The fluorescent band was isolated and assessed for IgG-binding via fluorescent emission. The lowest amount of IgG that could be detected by dot immunobinding assay was approximately 630 ng. Indirect immunofluorescent assay for a serological detection of leptospirosis was performed by using the chimeric ZZGFPuv as IgG detector. A strong fluorescent intensity as comparable to that of the fluorescein isothiocyanate (FITC) conjugated system was significantly detected. All these findings support a high feasibility to apply the chimeric Abinding GFP for clinical applications in the future.

Keywords: Fc binding, Z-domain, green fluorescent protein

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Comparison of physiological, cytopathogenic and immunological properties between two environmental isolates of Acanthamoeba spp.

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Abstract
The aim of this study was to determine whether pathogenic and less-pathogenic isolates of environmental Acanthamoeba exhibit differences in adhesion to human erythrocytes. Based on physiological properties of temperature, tolerance, and rapid growth, Acanthamoeba were divided into pathogenic and less-pathogenic isolates. Acanthamoeba were tested for their ability to produce cytopathic effects (CPE) using two human cell lines, HEp-2 and KB cells. Both ameba isolates caused CPE to both cell lines with the same pattern without significant difference. Human erythrocytes from 20 healthy volunteers were used to study the erythrocyte reactivity of Acanthamoeba by co-incubation with trophozoites. The pathogenic Acanthamoeba exhibited significantly higher erythrocyte adhesion as compared to the less-pathogens (p<0.05). Erythrocyte activity occurred in the presence of plasma in all blood samples, suggesting the role of plasmatic components and contact-dependent mechanisms to produce host cell cytotoxicity. The present results showed correlation between the physiological properties and erythrocyte reactivity of Acanthamoeba.

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Co-expression of zinc binding motif and GFP as a cellular indicator of metal ions mobility

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Abstract

A significant role of zinc-binding motifs on metal mobility in *Escherichia coli* was explored using a chimeric metal-binding green fluorescent protein (GFP) as an intracellular zinc indicator. Investigation was initiated by co-transformation and co-expression of two chimeric genes encoding the chimeric GFP carrying hexahistidine (His6GFP) and the zinc-binding motif fused to outer membrane protein A (OmpA) in *E. coli* strain TG1. The presence of these two genes was confirmed by restriction endonucleases analysis. Co-expression of the two recombinant proteins exhibited cellular fluorescence activity and enhanced metal-binding capability of the engineered cells. Incorporation of the zinc-binding motif onto the membrane resulted in 60-fold more binding capability to zinc ions than those of the control cells. The high affinity to metal ions of the bacterial surface influenced influx of metal ions to the cells. This may affect the essential ions for triggering important cell metabolism. A declining of fluorescent intensity of GFP has been detected on the cell expressed of zinc binding motif. Meanwhile, balancing of metal homeostasis due to the presence of cytoplasmic chimeric His6GFP enhanced the fluorescent emission. These findings provide the first evidence of real-time monitoring of intracellular mobility of zinc by autofluorescent proteins.

Keywords: chimeric green fluorescent protein, zinc ions, co-transformation, co-expression, metal mobility

Characterization of deltamethrin resistance in field populations of Aedes aegypti in Thailand

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Abstract

Five field collections of adult Aedes aegypti mosquitoes from different areas in Bangkok and Pathum Thani provinces were subjected to susceptibility tests against deltamethrin. Low levels of resistance were detected among all populations tested (RR50 = 8-17.2) compared to the susceptible strain, Bora (French Polynesia). Among the five populations tested, the BKH (Bang Khen, Bangkok) and PSC (Phasicharoen, Bangkok) populations showed a higher level of deltamethrin resistance than the other three populations (RR50 of BKH= 17.2, and of PSC= 13.6) and cross-resistance to DDT was observed in these strains. Biochemical analysis showed a significant elevation of mixed function oxidases enzyme activity in all populations. There was an elevation of non-specific esterases in all populations except BKL, and there was no consistent association of glutathione S-transferases with deltamethrin and DDT resistance, although not all populations were bioassayed for DDT. The partial cDNA sequence of the para-type voltage-dependent sodium channel (IIS4-IIS6) was determined for BKH and PSC populations. Common amino acid substitution, leucine to phenylalanine in the IIS6 region, found for insects including Anopheles gambiae was not found in either the BKH or the PSC populations. However, two other amino acid substitutions (proline substituted with serine at position 64 in the PSC population and leucine with phenylalanine at position 69 in the BKH population) were found in the IIS5-IIS6 inter-segment region sequenced. The role these substitutions play in target site resistance is uncertain at this time.

Antibodies from Patients with Melioidosis Recognize *Burkholderia mallei* but Not *Burkholderia thailandensis* Antigens in the Indirect Hemagglutination Assay

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Abstract

The indirect hemagglutination assay routinely used to detect antibodies to *Burkholderia pseudomallei* was modified to detect cross-reactivity of antibodies to *B. pseudomallei*, *B. mallei*, and *B. thailandensis* antigens. We demonstrate a lack of cross-reactivity between *B. pseudomallei* and *B. thailandensis* but marked cross-reactivity between *B. pseudomallei* and *B. mallei*.

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Analysis of SERF in Thai blood donors

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Abstract

The Cromer blood group system consists of nine high-prevalence and three low-prevalence antigens carried on decay-accelerating factor (DAF). We recently described one of these Cromer high-prevalence antigens, SERF, the absence of which was found in a Thai woman. The lack of SERF antigen in this proband was associated with a substitution of nucleotide 647C>T in exon 5 of DAF, which is predicted to be a change of proline to leucine at amino acid position 182 in short consensus repeat (SCR) 3 of DAF. This study reports on PCR-RFLP analysis of the SERF allele with BstNI restriction endonuclease on more than one thousand Thai blood donor samples. One new donor homozygous (647T) and 21 donors heterozygous (647C/T) for the SERF allele were found. Among this cohort of random Thai blood donors, the SERF allele frequency was 1.1 percent. Thus, like other alleles in the Cromer blood group system, SERF is found in a certain ethnic group.

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Practical guidelines for radiographers to improve computed radiography image quality

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Abstract

Computed Radiography (CR) has become a major digital imaging modality in a modern radiological department. CR system changes workflow from the conventional way of using film/screen by employing photostimulable phosphor plate technology. This results in the changing perspectives of technical, artefacts and quality control issues in radiology departments. Guidelines for better image quality in digital medical enterprise include professional guidelines for users and the quality control programme specifically designed to serve the best quality of clinical images. Radiographers who understand technological shift of the CR from conventional method can employ optimization of CR images. Proper anatomic collimation and exposure techniques for each radiographic projection are crucial steps in producing quality digital images. Matching image processing with specific anatomy is also important factor that radiographers should realise. Successful shift from conventional to fully digitised radiology department requires skilful radiographers who utilise the technology and a successful quality control program from teamwork in the department.