A Study of Principal Parameters Effect on SNR of MR Images

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Abstract

The signal-to-noise ratio (SNR) is one of the important measures of the performance of a magnetic resonance imaging (MRI) system. This study presents the six principal scan parameters, which effect on SNR of MR images. Those parameters are TR, TE, FOV, slice thickness, matrix size, and NEX respectively. The objects of this study were to observe the dependence of SNR on those scanning parameters and to compare a background-noise method, which estimate the noise from background pixels, with the subtraction method which estimates the noise from the subtraction of two sequentially acquired image. The General Electric Signa 1.5T MRI system and GE 4b-265826 G6 spherical phantom were used for the evaluation of SNR. The Scanning sequence and the scanning parameters were selected by the suggestion of AAPM report no28 an no34. The results obtained over approximately 3,915 minutes of total scan time present clearly the changing rate of the phantom SNR with respect to the increasing or decreasing of each scanning parameter values. The phantom SNR scales directly with FOV, slice thickness and matrix size while the SNR is nonlinear proportional to TR, TE and NEX. Finally, the result shows that the SNR from subtraction method is slightly greater than the SNR from background-noise method.

Keywords : signal-to-noise ratio, SNR, quality control, magnetic resonance imaging, MRI

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Parameterization of Pb X-Ray Contamination in Simultaneous Tl-201 and Tc-99m Dual-Isotope Imaging

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Abstract In simultaneous Tl-201 and Tc-99m dual isotope imaging, Pb X-rays are a significant source of contamination in the Tl image. In order to characterize this contamination, we simulated images of line sources in the Tc and Tl photopeak windows using an experimentally verified Monte Carlo program. The line sources were placed at various distances from the collimator face and emitted photons with energies from 88 to 140.5 keV. The Pb X-ray contamination line source response function in the Tl window was fitted well by a Gaussian plus an exponential function. The width of these two functions changed linearly with distance. Parameterization of the Pb X-ray response was done by simultaneously fitting the Pb X-ray response functions at various distances with fitting functions that were determined empirically to model the distance dependence of the Gaussian and exponential components of the Pb X-ray response. The parameterized model of Pb X-ray contamination is useful in developing methods to model Pb X-ray contamination in Tl-201 data by Tc-99m. This Pb X-ray contamination model can be used in iterative reconstruction-based cross-talk compensation for simultaneous Tc/Tl dual isotope imaging.

Index Terms : Monte Carlo N-Particle (MCNP), Monte Carlo simulation, Pb X-ray contamination, simultaneous dual-isotope imaging, Tc-99m, Tl-201.

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A novel molecular method for HIV-1 proviral DNA detection: non-radioactively-reversed probe hybridization and nested PCR

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Abstract

A novel molecular method for HIV-1 proviral DNA detection comprising two main techniques: nested PCR, amplifying a target sequence of the ENV-gene of HIV-1, and nonradioactively-reversed probe hybridization for the detection of the amplified target sequence. The dual amplification of inserted HIV-1 proviral DNA in each DNA sample to be tested was performed by nested PCR in two steps: firstly with two outer primers covering the target sequence of the ENV-gene of HIV-1; secondly with two 5'-biotinylated primers specific to the target sequence. The biotinylated PCR product could be visualized as a single band of 141bps in length on agarose gel stained with ethidium bromide. For the confirmation of the primary result, a method of reversed probe hybridization, using a nylon membrane immobilized with the oligonucleotide probe specific to the target sequence, was established. The oligonucleotide probe was given a homopolymer tail with terminal deoxyribonucleotidyl-transferase; the tail was spotted onto a nylon membrane and bound covalently by UV irradiation. Owing to its length, the tail bound to the nylon, leaving the oligonucleotide probe free to hybridize. Hybridization of the amplified target sequence to the immobilized probe was accomplished by a simple colorimetric reaction involving the enzymatic oxidation of a colorless chromogen that yielded a purple color wherever hybridization occurred.

The Southeast Asian journal of tropical medicine and public health. 2002; 33(1) : 72-79
Molecular serotyping of dengue viruses in field-caught Aedes mosquitos by in-house RNA extraction/RT-PCR reagent kits


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Abstract

We developed in-house RNA extraction and RT-PCR reagent kits for the molecular serotyping of dengue viruses in field-caught Aedes mosquitos. Mosquitos that showed positive results by ELISA or IFA were selected for the identification of dengue viruses in order to predict the distribution of the four dengue serotypes. Total RNA was extracted from one whole mosquito as well as from one dissected mosquito by our in-house RNA extraction reagents using the modified method of guanidinium thiocyanate denaturation and isopropanol precipitation. The extracted RNA was amplified by our in-house RT-PCR reagents specific for each dengue serotype under optimized conditions. Dengue viral RNA extracted from a single mosquito as well as from the head and thorax of one dissected mosquito could be detected successfully; it could not be found in the abdomen, however. These results indicated that most of the dengue viruses were located in the head and thorax rather than in the abdomen. The results of dengue serotyping showed a pure specific PCR product for each dengue serotype at 490, 230, 320 and 398 bp for DEN-1, DEN-2, DEN-3, and DEN-4 respectively. In addition, the detection sensitivity was very high: an amount of RNA template equivalent to approximately 1/80 of a single mosquito could be detected by agarose gel electrophoresis and ethidium bromide staining. The coupling of RT-PCR-based surveillance of dengue viral infection with disease mapping data (Geographical Information System, GIS) could serve as an alternative epidemiological means of providing an early warning of dengue fever/dengue hemorrhagic fever epidemics.

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Modified antimicrobial disc susceptibility testing for nutritionally-variant streptococci.

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Abstract

Streptococci that were dependent for their growth upon staphylococci were isolated from a patient with sub-acute bacterial endocarditis and subsequently identified as nutritionally-variant streptococci (NVS). Failure of the isolate to grow on agar media supplemented with pyridoxal hydrochloride or L-cysteine, the known supporting growth factors for NVS, made conventional antimicrobial disc diffusion assay impossible. We modified the assay by co-inoculating Staphylococcus aureus resistant to the drugs being tested as a helper to support the growth of the NVS. Streaking S. aureus closely to the antibiotic discs that were placed above NVS resulted in the growth of satellite colonies of NVS that orbited the S. aureus and that produced a pattern of interrupted zones of growth inhibition. Using an alternative method--adding staphylococcal secreting factor(s) to a 10% staphylococcal cell-free culture supernatant and adding this to an antibiotic susceptibility testing medium,--we found that the NVS formed colonies that formed clear zones of growth inhibition around the disc. When the sizes of the growth inhibition zones produced by both these methods were compared with those recommended by the NCCLS, the NVS were found to be susceptible to penicillin, vancomycin, erythromycin, chloramphenicol, cefoperazone, cefamandole and ofloxacin and resistant to co-trimoxazole, gentamicin and tetracycline. Based on these findings, vancomycin was selected for treatment and the patient was cured of endocarditis. The correlation between the in vitro drug susceptibility testing and the in vivo clinical response indicated that the modified antibiotic susceptibility test is an appropriate method for establishing antibiotic regimens.

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Membrane heme as a host factor in reducing effectiveness of dihydroartemisinin

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Abstract:
Plasmodium falciparum infecting alpha-thalassemic erythrocytes are resistant to artemisinin and its derivatives. Binding of the drug to hemoglobin H resulting in drug inactivation was previously demonstrated. We now show that an additional host factor, membrane heme, significantly accounted for decreased antimalarial activity of artemisinin. The antimalarial activity of dihydroartemisinin in the presence of normal and thalassemic erythrocyte membranes showed a correlation with the heme content of the membrane ($r(2) = 0.466, P < 0.01$). The correlation was more clearly seen when the drug effectiveness was correlated with the heme content of alpha-thalassemic membrane ($r(2) = 0.636, P < 0.01$). However, the drug effectiveness showed no correlation to ferrozine-reactive (free or non-heme) iron content ($r(2) = 0.0001, P > 0.05$). alpha-Thalassemic erythrocytes contained higher amounts of membrane heme ($11.04 +/− 8.96$ nmol/mg membrane protein) than those from normal and beta-thalassemia/HbE erythrocytes ($2.68 +/− 1.28$ and $3.98 +/− 3.98$ nmol/mg membrane protein, respectively, $P < 0.01$). Loss of drug effectiveness was also correlated with increment of heme content in membrane prepared from normal erythrocytes treated with phenylhydrazine. It is concluded that heme in both normal and thalassemic erythrocyte membranes is an important factor in drug inactivation.

Keywords: artemisinin; heme; thalassemia; malaria

BIOCHEMICAL PHARMACOLOGY. 2002; 64(1): 91-98
Manganese superoxide dismutase deficiency enhances cell turnover via tumor promoter-induced alterations in AP-1 and p53-mediated pathways in a skin cancer model

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Abstract:

Previous studies in our laboratories demonstrated that overexpression of manganese superoxide dismutase (MnSOD) suppressed both the incidence and multiplicity of papillomas in a DMBA/TPA multi-stage skin carcinogenesis model. The activity of activator protein-1 (AP-1), which is associated with tumor promotion, was reduced in MnSOD transgenic mice overexpressing MnSOD in the skin, suggesting that MnSOD may reduce tumor incidence by suppressing AP-1 activation. In the present study, we report that reduction of MnSOD by heterozygous knockout of the MnSOD gene (Sod2 -/+ , MnSOD KO) increased the levels of oxidative damage proteins and the activity of AP-1 following TPA treatment. RNA levels of ornithine decarboxylase (ODC) were also increased, suggesting an increase in cell proliferation in the KO mice. Histological examination confirmed that the number of proliferating cells in DMBA/TPA-treated mouse skin were higher in the KO mice. Interestingly, histological examination also demonstrated greater numbers of apoptotic cells in the KO mice after DMBA/TPA treatment. Evidence of apoptosis, including DNA fragmentation, cytochrome e release from mitochondria, and caspase 3 activation were also observed by biochemical assays of the skin tissues. Apoptosis was associated with an increase in nuclear levels of p53 as determined by Western analysis. Quantitative immuno-gold ultrastructural analysis confirmed that p53 immunoreactive protein levels were increased to a greater level in the nuclei of epidermal cells from MnSOD KO mice compared to epidermal nuclei from wild type mice similarly treated. Moreover, p53 levels further increased in the mitochondria of DMBA/TPA treated mice, and this increase was much greater in the MnSOD KO than in the wild type mice, suggesting a link between MnSOD deficiency and mitochondrial-mediated apoptosis. Pathological examination reveals no difference in the incidence and frequency of papillomas comparing the KO mice and their wild type littermates. Taken together, these results suggest that: (1) MnSOD deficiency enhanced TPA-induced oxidative stress and AP-1 and p53 levels, consistent with the increase in both proliferation and apoptosis events in the MnSOD KO mice, and (2) increased apoptosis may negate increased proliferation in the MnSOD deficient mice during an early stage of tumor development.

Keywords: MnSOD; apoptosis; AP-1; p53; skin cancer

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In vitro effect of artesunate against Acanthamoeba spp.

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Abstract

The in vitro effects of artesunate, the antimalarial agent, and metronidazole against Acanthamoeba spp were studied. Acanthamoeba Group II and Acanthamoeba polyphaga-like were isolated from natural water courses in Buri Ram Province, northeastern Thailand. The trophozoites were axenically cultured in PPyG medium and treated with artesunate in a concentration of 5-700 microg/ml. Artesunate showed its ability to inhibit the growth of acanthamoeba trophozoites: 54% at 50 mg/ml (after six days of exposure) and 93.2% at 100 microg/ml (after two days). The 500-700 microg/ml concentration caused inhibition on the first day of more than 93.2%; excystation did not occur in drug-treated medium. The present study shows that artesunate is amebastatic rather than amebicidal in an axenic culture of trophozoites at the highest concentration of 100 microg/ml. Metronidazole, in concentrations of 5-1,000 microg/ml, had no effects on either trophozoites or cysts.

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Factors affecting the hatching of human pinworm ova.

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Abstract

Parasite life-history traits reflect past environmental and host selective pressure that act to produce strategies that maximize successful transmission. Pooled human pinworm eggs were pretreated with 0.9% NaCl, acid digestive enzyme, and alkaline solutions (pH 9.0) and then incubated in 0.9% NaCl at room temperature and 37 degrees C both with and without 5% CO2. Eggs pretreated with both acid and base had the same hatching pattern, which was markedly different to that of the untreated eggs. At room temperature (RT), hatching of the pretreated eggs occurred on the first day and reached its peak rate (>90%) on day 3; at 37 degrees C hatching occurred on the second day and was more than 80% by day 5. Hatching of the untreated eggs was evident on day 2 at RT and between days 3-5 at 37 degrees C although in smaller numbers (<20%). The CO2 did not affect the hatching of larvae. The larvae could survive after hatching in 0.9% NaCl for 2 and 4 days at 37 degrees C and 25 degrees C, respectively. The present investigation gives a different information that human pinworm ova can hatch into larvae with or without exposure to acid digestive enzyme or alkaline solutions.

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Development of an amperometric immunosensor for the determination of methamphetamine in urine

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Abstract

An amperometric immunosensor in the competitive format was developed for the detection of methamphetamine in urine. The electrodes consisted of carbon paste and Ag/AgCl screen printed on heat sealing film, respectively, and of monoclonal anti-methamphetamine antibody as the biorecognition element. Optimum amounts of methamphetamine-N-bovine serum albumin conjugate, monoclonal antibody and alkaline phosphatase-goat anti-mouse immunoglobulin G were 20, 10 ng and 1:10,000 dilution in 10 \(\mu\)l each, respectively. Methamphetamine was detected by the conversion of p-aminophenyl phosphate to electroactive p-aminophenol in the range of 200 ng/ml (lower detection limit) to 1,500 ng/ml methamphetamine in a nearly linear dose response curve. Within amphetamine concentrations of 0-1,500 ng/ml cross-reaction with methamphetamine was not observed. Working with urine samples spiked with methamphetamine, the accuracy and precision of the assay were 91.5-104.4\% and 15.8-24.4\%, respectively. This is a proof of concept in the clinical perspective for an amperometric immunosensor whose electrodes are amenable to future mass production.

Biocatalysis and Biotransformation. 2002; 20(6) : 397-403
Comparison of the nutrient content of fresh fruit juices vs commercial fruit juices

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Abstract

Objective: To compare the types and quantities of carbohydrate, electrolytes, pH and osmolarity of fresh fruit juices and commercial fruit juices.

Material and Method: Forty kinds of fresh fruits available in Thai markets were analyzed for types and quantities of carbohydrate, electrolyte, pH and osmolarity and compared with previously obtained data for commercial fruit juices.

Results: Most fresh fruit juices did not contain sucrose, whereas, commercial fruit juices mostly have sucrose in the range of 3-112 g/L. Although both fruit juices were acidic (pH varied from 3.6-6.7 and 3.2-5.8 of fresh juice and commercial juice), fresh fruit juices had a more neutral pH than commercial fruit juices. Apple, guava, orange, pear, and pineapple juices from commercial fruit juices had a high osmolarity compared with fresh fruit juices. All types of fresh fruit juices contained less sodium than commercial ones, whereas, most fresh fruit juices contained more potassium, phosphorus, and magnesium than commercial fluids.

Conclusion: The nutrient content of fresh fruit juices and commercial fruit juices from the same kinds of fruits are not the same, possibly due to the manufacturing process. Therefore, physicians should know the composition of fruit juices in order to advise patients properly.

Keywords: Commercial Fruit Juices; Fresh Fruit Juices; Fructose; Glucose; Osmolarity; pH; Sorbitol; Sucrose

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Combination of MCNP and SimSET for Monte Carlo Simulation of SPECT With Medium- and High-Energy Photons


Abstract

Monte Carlo (MC) simulation has become an important tool for characterizing and evaluating imaging systems and reconstruction algorithms. In this work, we combined two MC codes—Monte Carlo N-particle transport code system (MCNP) and simulation system for emission tomography (SimSET)—using the advantages of each to produce a simulation tool that is efficient enough to generate single photon emission computed tomography (SPECT) data. The new SimSET-MCNP method allows the use of voxelized three-dimensional (3-D) phantoms and models photon propagation inside collimator-detector systems. This combination provides a tool for evaluating compensation methods applied to imaging of agents where medium- and high-energy photons are important. To validate the new tool, we compared simulated projections of a sphere containing I-123 water solution embedded in a cylindrical water-filled phantom with experimentally measured projections and simulations using SimSET and MCNP alone. Using these data, we compared profiles through the projection data, energy spectra, and relative number of photons in four projection views. The agreement with experiment was good, with disagreements of the order of a few percent. In addition, for the MC simulations, we classified detected photons based on whether they scattered in the phantom, whether they passed through the collimator holes, penetrated the septa, or scattered in the collimator, and whether they resulted from 159-keV or high-energy photons. For all these classes of photons, there was excellent agreement between SimSET-MCNP and MCNP. Finally, we evaluated the new combination in terms of simulation time and found it significantly more efficient than MCNP alone. We conclude that the new simulation tool works and allows the generation of SPECT data using voxelized phantoms for cases when medium- and high-energy photons are important.

Index Terms: Collimator scatter, Monte Carlo (MC) simulation, septal penetration, single photon emission computed tomography (SPECT).

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Analysis of Breast Cancer Susceptibility Genes \textit{BRCA1} and \textit{BRCA2} in Thai Familial and Isolated Early-onset Breast and Ovarian Cancer

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Abstract

Here we report the study on \textit{BRCA1} and \textit{BRCA2} mutations in 12 Thai breast and/or ovarian cancer families and 6 early-onset breast or breast/ovarian cancer cases without a family history of cancer. Five distinct rare alterations were identified in each gene: four introducing premature stop codons, one in-frame deletion, two missense changes, two intronic alterations and one silent rare variant. The \textit{BRCA1} or \textit{BRCA2} truncating mutations were detected in four of seven patients with familial or personal history of breast and ovarian cancer, in one of four isolated early onset breast cancer cases and in none of seven breast cancer site specific families. The \textit{BRCA1} and \textit{BRCA2} mutation yield in Thai patients is consistent with that reported from Europe and North America in similar groups of patients, being particularly high in individuals with personal or family history of breast and ovarian cancer. The \textit{BRCA1} and \textit{BRCA2} alterations found in this series are different from those identified in other Asian studies, and all but two have never been reported before. We report at least three novel deleterious mutations, the \textit{BRCA1} 3300delA, \textit{BRCA1} 744ins20 and \textit{BRCA2} 6382delT. One in-frame deletion was also found, the \textit{BRCA2} 5527del9, which segregated within family members of breast-only cancer patients and was thought to be a cancer-related mutation. \textit{BRCA1} 3300delA and Asp67Glu alterations were detected each in at least two families and thus could represent founder mutations in Thais.

Key Words : breast, cancer, \textit{BRCA1}, \textit{BRCA2}, mutation, Thailand

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