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Nuclear Medicine Quality Assurance and Quality Control in Korea

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INTRODUCTION

Joint committee accreditation hospitals' manual suggests that the instrument calibration procedures sufficient to affirm proper performance shall be conducted each day instrument is used, and the results are recorded. All interpretation of radioisotope imaging procedure is based on the assumption that the sufficient to performance of the system is reliable and accurate. To provide evidence of reliability and accuracies of the system, a standardized program of quality assurance (QA) and quality control (QC) is essential.

In Korea, the first dot scanner (Trace Lab) and gamma camera (NC, Pho/Gamma) were installed at Seoul National University Hospital in 1960 and 1969, respectively. Since then, the number of gamma cameras has been slowly increased in 1970's and rapidly increased in 1980's and 1990's. There are currently 186 gamma camera installed over 96 hospitals. There are recently 3 PET cameras installed over 3 hospitals and a few more PET cameras will be soon installed. In this paper, the current status of gamma and PET cameras in Korea and their quality assurance (Q.A) and quality control (Q.C) programs will be reviewed.

QUALITY ASSURANCE AND QUALITY CONTROL IN KOREA

1. The status of Gamma Camera and PET

Gamma camera and PET have been installed through over 10 local agencies of their manufacturers. There are no domestic manufacturers for gamma camera or PET. The market shares are Siemens (36%), ADAC (15%), GE (12%), and Picker (10%) of total gamma cameras(1). The mean age of the gamma camera is 7 years old. 113 out of 186 gamma camera have SPECT capabilities. 161 of them are connected to the digital computers. There are currently three PETs installed in Korea. GE Advance PET at Samsung medical center and Korea cancer center hospital, and Siemens Exact PET at Seoul national university were installed. New PET systems are planned to be soon installed at Yonsei university medical center and Asan medical center.

2. Quality Assurance (Q.A)

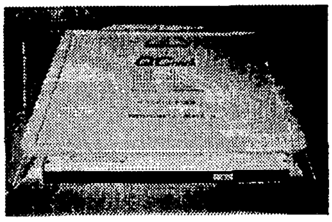
QA in nuclear medicine needs to put all efforts to be free from all errors and artifacts. This will need to cover all aspects of clinical practice including the preparation and dis pensing of radiopharmaceuticals, the protection of patients, staff and the general public a gainst radiation hazards and accidents by the faulty equipment, the scheduling of patients, the setting-up, use and maintenance of electronic instruments, the methodology of the ac tual procedures, the analysis and interpretation of data, the reporting of results, and the k eeping all records. Successful Q.A requires integrated programs. These will include clinic al conference, administrative meeting, follow-up studies, technologists' staff meeting, lectur es, research meeting, SPECT and PET meeting, radiation safety committee, validation of nuclear medicine results, phantom Q.A. program, and procedure review meeting(2).

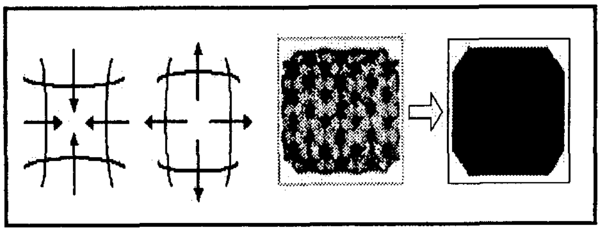
3. Acceptance Test

Acceptance test is very important to evaluate the performance of the cameras right afte r installation to make sure that the cameras will be functioning according to the specifica tions. The regulatory guide of the medical instruments was established in 1992 in Korea. The acceptance tests have been carrying out by local engineers according to the NEMA protocols. Acceptance tests include intrinsic spatial resolution, intrinsic spatial linearity, i ntrinsic energy resolution, intrinsic flood field uniformity, intrinsic count rate performance, multiple window spatial registration, system spatial resolution, system sensitivity, angular variation of flood uniformity and sensitivity, system spatial resolution with/without scatte r, and system count rate performance with scatter.

4. Quality Control (QC)

An important question will be why we need QC ? The objectives of QC in nuclear m edicine are monitoring, maintaining, and characterizing a high standard of performance of nuclear imaging studies. System performance, image quality, and quantitation are regulat ed by these measurements which range from daily checks of system uniformity and integ rity to periodic checks of both the accuracy and precision of nuclear medicine instrument s and their corrections. Radioiotope scanning QCs are well described and guided by IAE A(International Atomic Energy Agency) TECDOC-602 (3), NEMA(National Electrical Man ufacturers Association) scintillation camera (4), and NEMA PET (5). The types of tests a re acceptance testing and recalibration for preventive maintenance as a benchmark. Routin e tests include flood field uniformity (Figure 1), spatial resolution, and spatial linearity (Figure 2). These tests generally perform by nuclear medicine technologist and weekly te sting is recommended. Resolution and linearity testing may be performed simultaneously with the aid of a flood source and either a parallel-line-equal-space, bar, orthogonal hole or resolution-quadrant phantom (6-7). This may be performed extrinsically or intrinsicall y using a point source or sheet source. At least monthly there should be a full system t est using a phantom which can evaluate system uniformity and resolution simultaneously.





Fgure 1. A set-up for uniformity QC with Co-57 Flood source

Figure 2. Pincushion and Barrel effects, and wi thout linearity correction and with linearity correction

Resolution phantoms should have a variety of sizes of cold lesions. Data acquisition with clinical parameters will allow the user to optimally evaluate parameter selection to provi de the most information. Types of instruments to be tested by standardized QC program include dose calibrators, area survey meter, gamma camera, SPECT, and PET.

A current QC program was established in 1994 for the purpose of certification of QC and preventative maintenance, since the national QC program for nuclear medicine equip ments was initiated in 1984. The survey has shown that the uniformity is performed dail y in 20%, weekly in 30%, and monthly or occasionally in 50% using a point source or flood field uniformity phantom. The results are usually evaluated visually or relatively by comparing the result image with reference image. QC phantoms available at 96 hospital s include flood-field phantom, Co-57 disk phantom, quadrant bar phantom, NEMA spatial resolution phantom, SPECT and PET phantoms. However, only 12 out of 96 hospitals h ave Co-57 sheet source. This results in rarely doing daily uniformity QC in many hospit als.

CONCLUSION

In Korea, the importance of standardized QA and QC program is well understood. The national organization has been putting all their effort to establish the national QC proga m. There are currently a number of on-going projects to develop clinically acceptable sta ndard QC protocols, although there have been major difficulties in practicing nuclear me dicine QC mainly due to lack of nuclear medicine physicists, well-trained engineers, educ ated technologists, and educational programs.

In the symposium, more detailed measurements and objectives of nuclear medicine QA and QC program will be discussed. These may provide a guideline to nuclear medicine imaging to optimize and maintain their instruments for clinical and research applications.

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