Evaluation of Angiography Device Performance Using NEMA Standard XR-21 Phantom

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Abstract : This study aimed to evaluate standard plan about image quality and dose as the necessity of well performance and the security administration of angiography device. This examination has been carried out in 21 hospitals which are mostly located in nationwide. The angiography device consists of 37 which is nearly using NEMA (National Electrical Manufacturers Association) standard XR-21 phantom. We established 6 standards, which are : Image-field geometry, Spatial resolution, Lower contrast iodine detectability, Visuality moving target, Phantom entrance dose and Image distortion. These results indicated that among 37 angiography devices, there were 18 II type devices and 19 FD type devices, occupying 50% share. In conclusion, after conducting overall test, we established that FD type devices are superior to II type devices. However, concerning dose measurement, we conclude that differences between them are marginal.

Keywords : Angiography, NEMA standard XR-21 phantom, FD type devices

1. Introduction

As angiography devices used for intervention radiological procedures nowadays cause patients and radiological workers to suffer from exposure to radiation the most, it becomes more important to inspect their performance and to manage their safety. In Korea, a regulation on safety of the radiological diagnosis devices has been enacted in 1995, and since then, it has been amended until today [1]. However, unlike general diagnosis radiological devices and speciality medical devices such as CT (Computed Tomography), MRI (Magnetic Resonance Imaging) and mammography, the existing widely approved performance assessment standards for angiography devices are not sufficient. In addition, if using with inappropriate maintenance or in spite of their lowered performance, it can cause serious side-effects as it may increase the chance of exposure of operators and patients to radiation or provide incorrect image information, which may lead to an insufficient treatment. The purpose of this study is to establish adequate inspection standards and inspection methods in order to decrease patients' and operators' exposure to radiation during angiography operation and to prevent treatment errors due to wrong image information provided by low performing angiography. In this study, instead of ACR (The American College of Radiology) phantom which was often used in the previous studies, NEMA (National Electrical Manufacturers Association) phantom was used because, in a low contrast resolution measurement, NEMA phantom is measured by iodine while ACR phantom consists of holes and it is possible to check movement of the moving target as NEMA phantom includes a rotating spoke device unlike ACR phantom. Above all, in August 2000, SCAI (The Society for Cardiovascular Angiography and Interventions) reported that NEMA phantom had a proper image for a
medical examination and was appropriate to accurately measure the amount of energy, quality and incidence dose of an image that a patient receives during acquisition of images based on the cardiac angiography measurement standards [2-6].

2. Experiment Materials and Methods

2.1 Experiment equipment

We inspected 37 units of devices at 21 hospitals across the country. Inspection items of equipment status were the total number of installed equipment, manufacturers, installed years and equipment models.

We established 6 standards, which are: Image-field geometry, Spatial resolution, Lower contrast iodine detectability, Visual moving target, Phantom entrance dose and Image distortion (Figure 1).

We set the composition order of NEMA phantom as shown in Figure 2 according to recommendation of SCAI, resolving power chart and iodine belong between slice 1 and slice 2. And the spatial resolution plate was kept at 45° towards a vertical shaft of positive pole and negative pole of X-ray tubes.

2.2 Experiment methods

2.2.1 Image-field geometry (Beam alignment test)

To measure beam alignment, the distance between source and an image of an angiography device was set as 100 cm, and images were sorted into 3 groups according to the results as shown in Figure 3. Figure 4 indicates the alignment imaging by NEMA phantom.

2.2.2 Spatial resolution and Low-contrast iodine detectability

Spatial resolution measurement was conducted by the method that 3 observers measured the value of lp/mm of resolution pattern of 0.1 mmPb located in the center of

![Figure 3. Series of beam alignment.](image1)

![Figure 4. Beam alignment image.](image2)

![Figure 5. Spatial resolution and Low-contrast iodine detectability.](image3)