

### Medical Imaging: Concerns and Appropriate Use Criteria

Current era is hallmarked by humongous development in medical imaging which includes both radiation based radiological and nuclear medicine procedures and non-radiation based procedures like ultrasound and magnetic resonance imaging (MRI). Medical imaging has significantly improved the quality of health care by making it safer by providing less invasive methods for diagnosis and treatment. It is imperative that radiologists and nuclear physicians who have imaging-focused education must be trained and have experience to provide patients with the safest, most effective medical imaging with most accurate diagnostic interpretations. Appropriate use of medical imaging remains a cornerstone of high quality medical care. In recent years there has been growing but valid concerns over the deleterious effects of ionizing radiations and morbidity associated with injected contrast and radiopharmaceuticals. Due to these concerns, appropriate use criteria have been published by various professional societies, encompassing that potential benefits should outweighed the risk of imaging procedure that is being performed.

There has been an unprecedented increase in utilization of radiation based radiological and nuclear medicine procedures in United States as compared to rest of the world. According to a report, in 2006, 380 million radiologic procedures and 18 million nuclear medicine procedures were performed in the United States.<sup>1</sup> To highlight the disproportionate use, U.S. people making 4.6% of global population had approximately 50% of all nuclear medicine procedures worldwide.<sup>2</sup> Due to overwhelming use, there has been a sixfold increase (from 0.5 to 3.0 millisieverts, mSv) in annual radiation dose from 1980 to 2006 to an American.<sup>1</sup> On contrary during the past 30 years, the natural background radiation dose to an American (2.4 mSv annual per capita) has remained unchanged.<sup>1</sup> A study published in 2009 illustrated impact of this radiation exposure by stating that 02% of all future cancers cases will likely come from previous CT exposure and resulting in approximately 15,000 deaths annually in United States.<sup>3</sup> Another study published by Smith et al, showed a 13-fold difference between the lowest and highest amounts of radiation exposure for each study protocol, even within the same institutions and accentuates the hazard of underestimating the cumulative risk of developing cancer for an individual patient.<sup>4</sup>

There is also growing concerns over morbidity associated with contrast materials used in radiology and MRI. Fortunately the morbidity or side effects associated with radiopharmaceutical used in nuclear medicine are very uncommon. Side effects of radiographic contrast media range from a mild inconvenience, such as itching (incidence of <3%), life-threatening cardiac arrhythmias (i.e. ventricular tachycardia), overt bronchospasm, laryngeal edema, cardiac failure and loss of consciousness, pulmonary edema, seizures, syncope (Mortality <1 death per 100000 patients).<sup>5</sup> Contrast-induced nephropathy (CIN) is a well-known adverse reaction associated with the use of intravenous or intra-arterial contrast material. It has an incidence of about 3% for outpatients with creatinine clearance >45 ml/24 hr but accounts for 12% of hospital acquired acute renal failure.<sup>6</sup> Nephrogenic systemic fibrosis (NSF) is characterized by scleroderma-like tissue changes in the skin, internal organs, eyes, and blood vessels. Gadolinium-based magnetic resonance imaging (MRI) contrast agents are associated with the incidence of nephrogenic systemic fibrosis.<sup>7</sup> It could occur with all gadolinium agents, but linear, ionically charged structures are at highest risk of deposition of toxic gadolinium causing NSF.<sup>8</sup>

To address these issues, International Atomic Energy Agency (IAEA) has issued policy of justification and optimization for radiation based procedures. Similarly various professional societies have also published appropriate use criteria (AUC) to be practiced by the radiologists, nuclear physicians and referring physicians. These criteria stress upon the imaging facilities to look for justification of requested procedure in the clinical scenario and if benefits does not outweigh the risks, than a safer

procedure or same procedure with modified protocol must be offered. However, if benefits outweigh the risks associated with a specific procedure, than procedure must be done in an optimize protocol to have complete and pertinent clinical information. By adopting a policy of "Right test for Right patient at Right time in a Right manner ensures Right outcome" these real imaging related concerns could be addressed in a successful manner.

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**Maseeh uz Zaman,<sup>1</sup> Nosheen Fatima,<sup>2</sup> Areeba Zaman,<sup>3</sup> Sidra Zaman,<sup>3</sup> Unaiza Zaman<sup>3</sup>**

<sup>1</sup> *Department of Radiology, Aga Khan University Hospital (AKUH), Karachi, Pakistan*

<sup>2</sup> *Department of Radiology, Dr. Soliman Fakeeh Hospital, Jeddah, Saudi Arabia.*

<sup>3</sup> *Dow Medical College / Dow University of Health Sciences, Karachi, Pakistan.*