

## An evaluation of safety policies in Magnetic Resonance Imaging departments

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### Abstract

This study was done to evaluate the application of MRI procedure safety in Sudan as well as to compare the national safety form with the international one. The study was conducted at Khartoum Advancing Diagnostic Center, Elrabat University Hospital and National Cancer Institute (NCI), in the period from January 2011 to June 2011. The sample of the study was 50 patients from both gender and with different ages and examinations. All patients were asked to fill and answer the international ideal safety form before their examination, this to ensure the application of the safety procedures. The national MRI forms were compared with the national one; so as to be able to evaluate what was applied in MRI departments in Sudan. The data was analyzed by using statistical package for Social Studies (SPSS). The results being as follows: 32% had prior surgery, 6% had eye involving metallic object, 20% were injured by foreign body, 20% were suspected to be pregnant, 14% had infusion pump, 4% had implanted drug infusion devise, 2% had prosthesis, 8% had prosthesis limb, 14% had external and internal metallic objects as well as 36% of the sample with hearing aid and were examined by MRI. 6% had cardiac pacemaker, 6% had cochlear implant and implanted hearing aid, 2% had metallic fragments and foreign body and were not examined by MRI. The study concluded that this application was not recommended by the international safety procedures guide lines.

**Key Words:** MRI, Pacemaker, Safety.

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### INTRODUCTION

Magnetic resonance imaging (MRI) is a priceless diagnostic tool used for many diseases and conditions [1–3]. MRI is based on the structure and abundance of water in the different human tissues. It represents the absorption and emission of electromagnetic energy by atomic nuclei in a magnetic field after excitation by a radiofrequency pulse [4–6]. It is an advantageous diagnostic procedure in that it is not at all invasive because there is no exposure to ionizing radiation or potentially nephrotoxic iodinated contrast agents [7]. Three-dimensional visualization of anatomic structures and its superiority in soft tissue contrast are additional advantages [8]. Thus MRI is now considered the gold standard for imaging the brain, spinal cord, musculoskeletal system, head and neck, and complex congenital heart malformations [6]. It also appears to be appropriate for estimating myocardial structure, wall motion, perfusion, and viability. As a result, an important increase in the number of MRI scans performed annually has been observed [9–11]. However, the number of MRI scans in patients with cardiovascular implantable electronic devices mostly pacemakers and cardioverter defibrillators has simultaneously increased [7]. Today millions of patients have implanted cardiac devices. Nevertheless, for many years MRI was not allowed for these patients because of the potential interference of MRI machines with their devices, putting the devices or even their own safety in danger [12]. At least 200,000 patients with cardiac devices are estimated to have been denied an MRI scan in 2004 [13]. According to the American College of Cardiology

Foundation/American Heart Association “ACCF/AHA 2007 Clinical Competence Statement on Vascular Imaging With Computed Tomography and Magnetic Resonance,” metallic implants such as mechanical heart valves, coronary stents, and sternal sutures are compatible with MRI because they are not ferromagnetic, although there will be local image artifacts. In contrast, pacemakers and implanted cardioverter defibrillators are considered a contraindication to MRI [14], although several case series of patients with pacemakers have shown that these patients can successfully undergo MRI at 1.5 T [15–17]. Patients who already have either a pacemaker or implantable cardioverter defibrillator often need an MRI scan. After implantation of the device, each patient is estimated to have a 50% to 75% possibility of requiring an MRI scan some time in his or her life [18, 19].

Three types of electromagnetic fields are used for the generation of an MRI: a constant static magnetic field, a rapidly changing magnetic gradient field, and a strong radiofrequency field [12]. The most commonly used static magnetic field strength for clinical MRI scanning is 1.5 to 3 T [20]. Higher static magnetic fields lead to greater forces on ferromagnetic materials. Gradient magnetic fields constitute spatial variations in magnetic field strength indicating the localization of the signals in the body. Electrical currents in electrically conductive devices and excitation of peripheral nerves can be induced by these changing magnetic fields [20]. The purpose of the study is to evaluate the MRI procedure safety in MRI centers in Sudan.

### MATERIALS AND METHODS

#### Patients

The sample of the study was 50 MRI patients with different gender and ages and examinations. The study was done at Khartoum Advancing Diagnostic Center, Elrabat University Hospital and National Cancer Institute (NCI) , from the period of

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**Table (1) shows MRI contra-indications which have been questioned by MRI technologists**

Items	Yes	No
prior surgery or an operation	16	34
injury to the eye involving a metallic object	3	47
patient ever been injured by a metallic object or foreign body	10	40
pregnant or suspect that are pregnant	10	40
Cardiac pacemaker	3	47

January 2011 to June 2011.

**Materials**

**Machines used**

The power of machine is 0.2 tesla in NCI and 1.5 tesla in both of Al rebat hospital and KADC. The coils were used is head coil, knee coil, array coil and volume coil

**MRI International Form**

The international form that including the variables mentioned in appendix (A:1)was used.

**Method of safety procedures' Evaluation**

In the MRI centers under study, all patients before examination were asked to fill and answer the international ideal safety form before their examination, this to ensure the procedure safety. The national MRI forms were compared with the national one; so as to be able to evaluate what was applied in MRI departments in Sudan.

**Data Analysis Method**

The data was analyzed by using statistical package for Social Studies (SPSS)

**Ethical Issue**

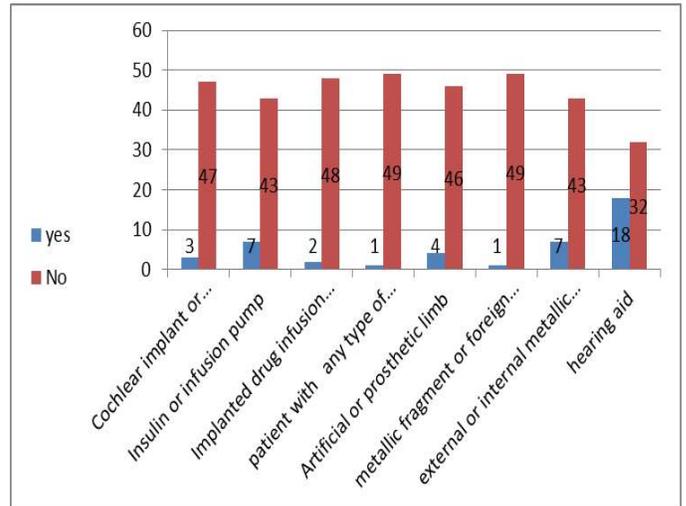
Permission of Diagnostic Radiology Department has been granted.

**RESULTS**

This study was done to evaluate the MRI procedure safety in MRI centers of Khartoum Advancing Diagnostic Center, El rebat University Hospital and National Cancer Institute (NCI) and it compared the national form with the international one. The results being as follows:

**DISCUSSION**

Most MR systems in use today operate at fields ranging from 0.2 to 3Tesla. According to the latest guidelines from the U.S. Food and Drug Administration, clinical MR systems using static magnetic fields up to 8.0Tesla is considered a “non-significant risk” for adult patients. Knowledge of the MRI safety



**Figure (2) reveals MRI contra-indications as demonstrated by MRI technologists.**

is very necessary in the MRI centers. The main objective of this study was to evaluate the MRI procedure safety in MRI centers. The researcher used international questionnaire which was compared with the national questionnaire and found that they similar in contents except that the national form involved question about the general sensitivity.

The results showed that that 32% of the sample were examined by MRI and they had prior surgery, 6% had eye involving metallic object,20% were injured by foreign body ,20% were suspected to be pregnant and were examined by MRI , this was presented in table (1).

About 6% had cardiac pacemaker, 6% had cochlear implant and implanted hearing aid and were not examined by MRI. Although the infusion pump and devises were refused for any MRI examination ; 14% had infusion pump,4% had implanted drug infusion devise,2% had prosthesis, 8% had prosthesis limb ;all were examined by MRI, which was not consigned with the safety procedures guide lines, this was presented in tables ( 1).

About 2% had metallic fragments and foreign body and were not examined, 14 % had external and internal metallic objects as well as 36% of the sample with hearing aid, were examined by MRI ,this was not consigned with safety procedures .this were presented in tables( 1).

The international Form should be applied as it was recommended, but regarding the results; it showed that some items were ignored and the patients were examined using MRI although this was not consigned with the ideal one.

**CONCLUSION**

The main objective of the study is to evaluate the application of the MRI procedure safety in MRI centers. This gave the knowledge of the MRI safety in all the procedures so as to improve the health services in different diagnostic centers in Sudan. The study used the international form and compared it with the notational one ,it was found that the national was consigned with the international, Usage of prescreening form in MR centers very necessary for concerning MRI safety issues. Identify a safety officer responsible of ensuring that MRI safety protocols applied.

Known the ideal components of MR department and how to deal with those that help to keep department with long life and the human inside it in safe environment.

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