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Original article

Awareness and knowledge of MRI safety among radiological students, interns, fresh graduates and trainees

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Abstract: *Background* — Magnetic resonance imaging (MRI) is a safe imaging technique that provides superior soft tissue contrast compared to other radiological imaging modalities. The main objective of this study was to measure awareness and knowledge of radiology students, interns, new graduates, and trainees regarding the safety of MRI.
Material and Methods— To measure awareness and knowledge of the safety of MRI use, data was collected using a questionnaire from 166 subjects (age: 20-60 years) from August to September 2020 at Najran University and all hospitals and dispensaries in Najran region.
Results — A total of 166 participants (45.2% male and 54.8% female) were included in the study. The participants were students (44%) from multiple levels (level 3-9), interns (17%), new graduates (19%), and trainees (20%). Our results showed that MRI is a safe method of evaluation and is superior to other tests in terms of safety and accuracy. Pregnant women can do the MRI scan after the end of the first 3 months.
Conclusion — The MRI scan is safe but it has some risks that must be considered. There are different levels of knowledge and awareness regarding the safety of MRI use among the students, interns, fresh graduates, and trainees from all hospitals.

Keywords: Magnetic resonance imaging, radiology, awareness, knowledge.

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Introduction

Magnetic resonance imaging (MRI) is a non-invasive imaging technology that produces three-dimensional detailed anatomical images [1, 2]. It is frequently prescribed to aid in diagnosing a large number of potential problems [3] or abnormalities [4, 5] in the body and for monitoring treatments [6-8]. MRI scanners employ strong magnetic fields, magnetic field gradients, and radio waves to generate images of the body [1]. This imaging modality is based on sophisticated technology that detects the change in the direction of the rotational axis of protons in the water content of living tissues [9]. MRI does not scintillate the damaging ionizing radiation that is found in X-ray and CT imaging as such, MRI is often described as a safe method of imaging [10-13]. However, recent developments in MRI have led to magnetic resonance (MR) systems with stronger static magnetic fields, faster and stronger gradient magnetic fields, and more powerful radiofrequency transmission coils [14, 15].

These rapid developments have led to potential challenges to safety due to either high local specific absorption rate or large cumulative energy doses delivered during long exam times [16, 17]. Failure to follow safety instructions and use of incorrect or outdated information on the safety aspects of biomedical devices implanted in patients have been reported as causes of MRI-related injuries [16, 18]. Therefore, it is necessary to ensure MR knowledge of providers is current to reduce patient risk. In addition to ensuring contemporaneous knowledge, comprehensive examination of the patient prior to MRI that includes assessment of individual risks and patient supervision during the procedure are necessary to further reduce risk.

The aim of our study was to determine awareness of MRI safety among students, interns, recent graduates and trainees at hospitals. It was hypothesized that there was a lack of knowledge and awareness of best practice to promote safe use of MRI among the students, recent graduates, and trainees in Najran region.

Material and Methods

A total of 166 participants (45.2% male and 54.8% female, age: 20-60 years) were included the study in the period between August to September 2020 at Najran University and all hospitals and dispensaries at Najran region (KSA). The participants were students (44%) from multiple levels (level 3-9), interns (17%), recent graduates (19%), and trainees (20%). They provided informed consent for participation in the study in accordance with the ethical guidelines of the Helsinki Declaration pertaining to the use of human participants in medical research. This study was approved by the Medical Ethics Committee of Najran University.

Prior to commencing the study, an awareness publication was prepared: it included an overview of MRI safety and contraindications for MRI. In order to measure the awareness of MRI safety, participants completed a questionnaire. The questionnaire was comprised of two sections. The first section aimed at measuring knowledge of MRI procedure and comparison with other imaging techniques. The second section was measuring knowledge of MRI use safety.

Data analyses

The frequency and percentage of qualitative data was used to evaluate the awareness and knowledge of included participants compared with other data. Descriptive statistical analyses were performed using Microsoft Excel.

Results

Questionnaire response

As it is shown in *Table* 1, 135 participants (72% of male and 92% of female) responded to the first question correctly. Females had sufficient information about the medical imaging technique that uses magnets and frequency waves as an MRI device than males.

Regarding the first question, we can see a few correct answers at the first levels with a gradual increase in the levels 6 to 9; 22 fresh graduates and 27 trainees and hospital interns answered to the MRI correctly.

For the second question, we obtained 166 answers. Of those, 139 answers were correct. We obtained 27 incorrect answers by choosing CT scans, ultrasound, X-rays, and nuclear medicine.

For the third question, we obtained 166 answers, among which there were different number of *yes* and *no* answers, and to some extent about if they have knowledge about MRI devices and if they think the MRI is safe.

For the fourth question, we obtained 166 answers, and through them, we obtained different number of *yes* and *no* answers about whether they underwent an MRI scan, and before undergoing the scan, did they fill out the consent form themselves. As it is shown in *Table* 2 and *Table* 3, the most answers for each gender were *no*.

For the fifth question, 38% of females were anxious and had fear about the shape of the device. While, 56% of men were anxious about the device sound.

For the sixth question, 49% of males reported that they were familiar with the warning signs of MRI (compared with 32% in females).

In *Table* 3 and *Table* 4, the distribution of the answers to question 7 and 8 are shown.

For the ninth question, 69% of females and 58% of males reported that pregnant women should avoid all kinds of medical imaging.

For the tenth question, 56% of females and 46% of males reported that pregnant employees should not work at the MRI department.

Discussion

This research focused on the knowledge of safety of MRI imaging for students, interns, recent graduates and trainees in Najran region. We found that the MRI scan was safe but it had some risks that should be taken into consideration at the MRI department. This finding broadly supports the previous studies in this area [19,20].

Regarding MRI technique, it was found that females had more knowledge than males. Considering the second question, we noticed that in choosing the correct answer, there was an different percentage between females and males. It was shown that females had more correct answers in comparison with males. This finding indicated that females were more knowledgeable and aware about the risks of metal exposure during the scan.

Table 1. Research project's questionnaire

Items	*Questions*	*Answers*
1	Which medical imaging technology uses a magnetic field and frequency waves to create detailed images of organs and tissues?	MRI, CT, X-ray Correct answer: MRI
2	Which of the following medical imaging modalities can be considered as a metal contraindication?	MRI, CT, X-ray, ultrasound and nuclear medicine Correct answer: MRI
3	Do you think that you have adequate knowledge about MRI devices and do you think it is safe?	Yes, No and to some extent
4	Have you undergone a magnetic resonance imaging scan before, and if you did, did you fill out the consent form by themselves and accurately, and do you undergo a scan by metal detector?	Yes, No
5	What do you think is the cause of most fear and anxiety for a patient in the MRI room?	The shape of the device, the duration of the examination, the sound of the device, preparation for the examination and the contrast agent
6	Do you recognize the meaning of MRI safety signs?	Yes, I don't have any idea, Some of them
7	What side effects can be expected from an MRI scan?	Dizziness and nausea, Burns, Headache, Asthma, Claustrophobia, No side effects, Peripheral nervous stimulation
8	What do you think is not allowed to enter the MRI room?	Phone, Coins and Keys, Credit cards, Pacemaker, Orthodontics, Artificial part, Wheel chair, Oxygen cylinder, Eye lenses and mascara, Tattoo
9	Pregnant women should avoid all types of medical imaging?	Yes, No
10	Do you think that a pregnant employee should not work in the MRI department and if her work, do you think that there is harm to the fetus during an MRI scan?	Yes-No I don't think so-I'm not sure

Table 2. The frequency of answers to question between male and female participants

Gender	*Yes*	*No*
Female	29	63
Male	33	38

Table 3. The frequency between the current status about whether they fill out the consent form themselves accurately and are they checked by a metal detector before scan.

	Male	*Female*
Tatto	0%	0%
Eye lenses and mascara	0%	0%
Phone	15%	29%
Coins and keys	29%	20%
Accessories such as (watch, ring)	18%	13%
Credit cards	2%	9%
Pacemaker	4%	15%
Orthodontics	7%	5%
Artificial part	16%	0%
Wheel chair	2%	5%
Oxygen cylinder	7%	4%

Table 4. The percentage of female and male about 'what do you think is not allowed to enter the MRI room

Participants	*Yes*	*No*
Najran hospital'trainees	4	19
Fresh graduates	10	17
Interns	8	19
Radiology student level -9	6	14
Radiology student level -8	0	11
Radiology student level -7	9	13
Radiology student level -6	6	9
Radiology student level -5	7	10
Radiology student level -4	5	8
Radiology student level -3	7	4

In the second part of this question, we compared the student from level 3 to level 9, interns, fresh graduates, and trainees. We observed that all levels had less awareness and knowledge regarding the risk of exposing metal during MRI. This finding is consistent with that of Yurt et al., who also found that the awareness of the health risks was associated with ionizing radiation [21]. Fresh graduates, interns, and trainees had sufficient awareness and knowledge about the risk of exposing metal during MRI due to the strength of magnet that may attract metal to it. This finding is contrary to a previous study which has suggested that there is limited knowledge of radiation protection among the intern population in Ireland [22].

Evaluation of participants about the knowledge of magnetic resonance imaging devices showed that most of females and males responses indicated they had adequate knowledge about MRI devices.

We found that there were more people who did not undergo an MRI scan and therefore did not have adequate knowledge of MRI machines. We also found that students, trainees, and recent graduates did not undergo an MRI scan but had sufficient knowledge of MRI machines due to the nature of their work at hospitals. Our results revealed that most of the participants did not fill out the consent form accurately and did not undergo a metal detector scan before starting the examination. Indeed, there was a lack of knowledge and standard protocol about patient care and staff in MRI department. General knowledge about radiation protection, health risks and, patient care was insufficient among health professionals [21, 23, 24].

According to our findings, females have more fear and anxiety from the shape of the device, ignoring the sound of the device and the duration of the examination. These results indicated that males have more fear and anxiety from the sound of the device than the shape of the device, the duration of the examination, preparation for the examination, and also the injection of the dye. We also observed that the most common cause of fear and anxiety in MRI room for students of level 3 was a contrast agent. This could be due to the side effects of contrast injection. On the other hand, the students of level 4, level 5, and fresh graduates had fear and anxiety from the shape of the device (due to its big size). Students of level 6 had fear and anxiety from the duration of the scan because some examinations lasted more than 30 minutes. Regarding the students of level 7, level 8, interns, and trainees, the common cause of fear and anxiety was the sound of the device because of the noise causedby the gradients. A previous study reported that up to 30% of patients experienced high levels of anxiety during the examination [25]. MRI scanning procedure, MRI unit, unfamiliarity with the surroundings, and noise were suggested as reasons for these problems [25, 26].

The results of this study revealed that males and females were not aware about the side effects of MRI and they thought it was very safe. In the second part of the question, we compared the level of students from level 3 to level 9, interns, fresh graduates, and trainees. We observed that the answers of each stage differed from the other. Most of the interns chose the *headache* responding to this question because they knew the side effects of MRI and were working at the related department.

In comparison among the level of students from level 3 to level-9, interns, fresh graduates, and trainees, and found that their answers were different. Most answers of the levels 3 to 5 were *orthodontics*. MRI is an important tool in the diagnosis of many head and neck lesions and previous studies suggested that orthodontic appliances lead to image distortion on MRI scans of the head and neck [27, 28]. Each student from levels 7 to 9 and fresh graduates chose the *coins and keys* option. The interns and trainees added phones because it contained electrical charges that MRI devices may attract next to coins and keys. Finally, the students from level 8, chose the *accessories* option.

Our findings showed that for the levels 3 to 6, the most answers were *yes* because of their belief that all medical imaging examinations were harmful to the pregnant women. Therefore, it is important to educate them about the safe scan strategies such as ultrasound and MRI for pregnant women.

It is encouraging to compare this figure with that findings of Alorainy et al, who found that the exposure of the pregnant healthcare workers was risky to the fetus [29].

The level of students from level 3 to level-9, interns, fresh graduates and, trainees believed that the MRI scan was not safe. This result indicated a lack of knowledge that the MRI device was safe for a pregnant woman after the end of the first three months. For the students of levels 7-8-9, interns, trainees, and fresh graduates the most common answer was "*No, I don't think so*". This indicated that they knew and were aware of the safety of the MRI scan. MRI scans have some risk for pregnant women in the first trimester, so it is important to take precautions of them before doing the scan. According to the Safety Committee of the Society for Magnetic Resonance Imaging issued regulatory

documents [30, 31], MR imaging may be used in pregnant women if other non-ionizing forms of diagnostic imaging are inadequate or if the examination provides important information that would otherwise require exposure to ionizing radiation. It is recommended that pregnant patients should be informed that, to date, there has been no indication that the use of clinical MR imaging during pregnancy has produced deleterious effects. However, as noted by FDA, the safety of MR imaging during pregnancy has not been provided'. Moreover, the International Commission on Non-Ionizing Radiation Protection declared that there was insufficient knowledge to establish unequivocal guidance for the use of MRI procedures on pregnant patients.

Limitations

The outbreak of the new coronavirus pandemic 2019 did not allow us accessing other research sources inside the University, and it should be considered as the main limitation of this study.

In the future, we aspire to create educational programs and courses that would involve the entire community on the safety of MRI in order to enhance their knowledge and awareness of the correct procedures.

Conclusion

Our results revealed that the MRI scan is safe but it has some risks that must be considered. There are different levels of knowledge and awareness about the safety of MRI among the students, interns, trainees and fresh graduates. Therefore, all of them should follow and learn the necessary instructions and knowledge in this field.

Ethical approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Declaration of Helsinki and its later amendments or comparable ethical standards.

Conflict of Interest

The author declares that there is no conflict of interest.

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