



Editorial

Do Magnetic Resonance Imaging Technologists in Canada Always Ask Patients to Change Before Examinations?

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Introduction

Silver and copper microfiber-embedded textiles are used to control odor through antibacterial properties, and their use has become increasingly common [1]. When silver or copper come into contact with body fluids, they release metallic ions that kill microbes and bacteria [1]. An increased number of clothing items are incorporating metallic microfibers into clothing material ranging from athletic apparel to socks and orthotics [2]. In Canada, these products are sold under various brands—including, but not limited to—Reebok, Adidas, Knixwear, Mark's Work Warehouse, Lululemon, Tommy Copper, Pere-tex, and Microban [2–6].

Many patients intentionally wear metal-free clothing to their magnetic resonance imaging (MRI) appointment so that they would not have to change into hospital-provided attire. However, the invisible metallic microfibers are conductive materials. When they present in the magnet during the scan acquisition, the material can heat up, resulting in burn injuries to patients undergoing the procedure [2]. In 2013, Pietryga et al reported a case where a patient underwent an MR scan wearing an undershirt containing silver microfibers and sustained cutaneous burns. The burns were caused by heating in the silver microfibers because of electromagnetic induction of the radiofrequency (RF) electromagnetic pulses [2]. When the changing magnetic flux lines intercept an electrically conductive loop (a.k.a. loop formed by silver microfibers), eddy currents are induced in the loop [7]. The induced current generates heat due to ohmic heating. The worst

electromagnetic induction heating occurs when the conductive loop is in a resonant condition (oscillating frequency is $1/\sqrt{LC}$, where L is inductance and C is capacitance of the conductive loop) [7].

Another possible heating mechanism to explain why metallic microfibers can heat up during MR scan is due to the antenna effect [7]. Conductive material like metallic microfibers can act as an antenna, which captures the electromagnetic waves to extract power from them. Resonance is achieved when the length of the antenna is approximately half of the RF wavelength [7]. Resonant antenna induces additional electric fields in the conductive material and produces energy as heat [7]. The energy produced is usually confined to the tip of the conductive material. Dempsey et al [7] have demonstrated significant temperature rise due to resonant circuit and antenna effect. Therefore, when metallic microfibers form loops that meet the resonant circuit criteria or when the microfibers have a length that is equivalent to half of the RF wavelength burn injuries can happen.

Many MRI facilities in the United States allow patients to wear their own loose-fitting clothing during MR examinations [2]. We investigated current practices among MR technologists in Canada to get an idea of current practices and the level of awareness MRI technologists have regarding clothing material-related burns. In this communication, we report results from a survey exploring other factors that may influence technologist practices, such as work experience and institutional policy, and make recommendations where appropriate.

Methods

An anonymous survey of ten questions (see [Appendix](#)) was created using Survey Monkey by members of the University Health Network MRI team and sent out to MRI

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technologists currently practicing in Canada. The study was approved by University Health Network research ethics board. Implied consent was obtained from all participants. A brief explanation on the purpose of the study and rights of the participants were stated in the first page of the survey. Participants were given the option to choose not to participate in the survey, or to opt of answering any questions which they considered inappropriate. The survey link was initially advertised on the Canadian Association of Medical Radiation Technologists (CAMRT) Twitter and Facebook accounts, and then sent out by the CAMRT to all members registered as MRI technologists through a mass e-mailing.

A total of 246 responses were received. All data were exported from Survey Monkey and stored in a password-protected Excel file. Among the 246 survey responses collected, 35 were incomplete. These incomplete survey responses had more than one question left unanswered and were therefore excluded from the data analysis.

Results

Current Practices

Results demonstrated that when patients arrived for an MR scan wearing a plain T-shirt and stretch pants, 56% of technologists would ask them to change into hospital attire (regardless of what the patient was wearing). Twenty-five percent would ask patients to get changed based on the type of examination to be performed. Since there was no metal on the patient, 17% of technologists would not ask them to get changed. At last, 2% would only ask patients to get changed if their examination was planned for a stronger magnet (see Figure 1).

Technologist Awareness of Clothing-Related Burn Injuries

Results showed that 78% of technologists had heard of, or had encountered material-related burns, while 22% of technologists were not aware of such incidences. Among the 78% of technologists who had heard of, or encountered burn incidence, 26% were able to explain that the burn was caused by metallic fibers inside the magnet where the changing RF and/or magnetic fields induces a current within the fibers, and as a result, generates heat. Thirty-eight percent of

technologists knew that metallic fibers on clothing can cause burns when inside the magnet but failed to explain the physics-related rationale. Nine percent of technologists explained why burns can happen inside the magnet but failed to mention that clothing-related burns are caused by metallic fibers. Twenty-seven percent of technologists were not able to identify the source for the burn or explain the rationale.

Discussion

Factors such as years of working MRI experience, site policy, and burn awareness were analyzed for statistical significance using Pearson's chi-square test to determine if there was any relationship between each factor and technologists' practices.

There was no significant relationship between years of working experience and the technologist's practice (chi-square 9.01, $P = 0.342$), as summarized in Table 1. Nevertheless, one interesting fact to note from observed data is that people who had worked more than 20 years were less likely to ask patients to get changed (based on the types of examinations performed); whereas people who had worked between 6 and 10 years were more likely to ask their patients to get changed.

Table 2 represents the relationship between the existence of a site policy and technologists' practices. At sites where there is a policy on changing patients, technologists were more likely to always ask their patients to change, while at sites where there is no policy (or technologists are not aware of the policy), technologists did not ask patients to change as often.

Table 3 illustrates the relationship between technologists' awareness regarding clothing burn incidence and their own practices. Most observed data show that there was no relationship; however, the observed value in the cell "not aware and no change required" was much higher, showing that technologists who were not aware of burn incidence were more likely to not ask patients to get changed. The discrepancies between high awareness and low compliance could be due to a few factors; for example, patient's mobility level, patient's scheduling issues, and staffing issues. Technologists may be more reluctant to ask patients to change if those patients have difficulty changing by themselves. When technologists are running behind schedule due to double bookings, emergency additions, or are short staffed, they may choose not to change patients to try to save time and catch up. To find out which factors truly affect technologist's practices, further surveys should be conducted.

The high percentage (78%) of technologists who had heard of, or encountered, burn incidence could be due to a related story in the Canadian popular press where a patient undergoing a breast MRI in an Ontario hospital site felt a burning sensation on her legs during the scan. After removing the yoga pants, she was wearing, she tried the scan again, and this time with no burning sensation [6]. These types of stories tend to spread quickly among the MR technologist community. However, even with this level of awareness, only about 56% of the technologists surveyed would always ask patients to get changed into hospital attire for all examinations.

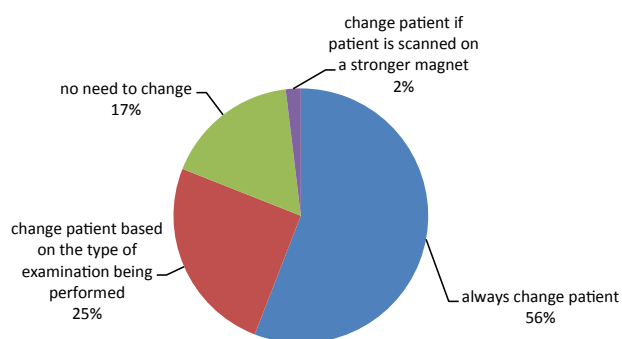


Figure 1. Technologist practices distribution pie chart.

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