

MRI and Epilepsy: Safety and Strategy for Optimal Patient Management

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ABSTRACT

Epilepsy is a chronic neurological disorder characterized by recurrent seizures, which can pose significant challenges in clinical management during diagnostic procedures such as MRI. This study highlights the critical role of the Medical Radiology Technician (MRT) in managing epileptic patients during MRI, given the high probability of seizures induced by visual, auditory, and stress-related stimuli. Through a literature review and analysis of current practices, protocols for monitoring and preventive measures—such as the use of noise-canceling headphones and eye masks—are defined. These interventions significantly reduce the risk of stimulus-induced seizures, up to 70% in predisposed patients. Furthermore, the study explores coordination between the MRT, nurse, radiologist, and anaesthesiologist for a timely response in case of seizures, with particular attention to the administration of anticonvulsant medications and respiratory support. This study underscores the importance of continuous training and monitoring, contributing to improved safety and tolerability of MRI examinations in patients with epilepsy.

INTRODUCTION

Epilepsy is a chronic neurological disorder characterized by recurrent seizures, caused by abnormal and sudden electrical activity of neurons in the brain, which can manifest in various forms, such as confusion episodes or generalized convulsions [1]. Seizures are classified as focal, involving a specific brain area, and generalized, affecting the entire brain [2]. Although epilepsy can stem from diverse causes, such as brain injuries, genetic anomalies, and cortical development defects [3], clinical management primarily relies on pharmacological therapy. However, in cases of drug-resistant epilepsy, surgical intervention may be a therapeutic option [4]. During MRI exams, the role of the Medical Radiology Technician (MRT) becomes crucial to ensure patient safety and reduce the risk of seizures triggered by stress or intense sensory stimuli [5]. The MRT, positioned behind the glass during the MRI procedure, must carefully monitor and interpret every signal from the patient. Separated physically from the MRI room, the MRT relies on visual monitoring tools and intercom communication to constantly assess the patient's condition and detect any signs of discomfort or pre-seizure symptoms. This physical separation requires highly coordinated management to intervene promptly in case of a seizure. For example, the MRT monitors parameters such as heart rate and oxygen saturation, which may indicate the onset of a seizure. Clear and reassuring communication through the intercom also enables the MRT to reduce the patient's anxiety level, a factor that can trigger seizures in patients particularly sensitive to external stimuli. Another

crucial aspect of the MRT's role is the preparation and use of emergency supplies. The MRT must ensure that oxygen and emergency medications, such as benzodiazepines, are always available in the MRI room and readily accessible if needed. Additionally, since the MRT is responsible for administering these medications under medical supervision, continuous training and updating are essential to ensure effective intervention in critical situations. In the MRI setting, certain stimuli, such as loud noises and the confined space of the MRI machine, can induce stress in epileptic patients, increasing the likelihood of seizures. To minimize these risks, the MRT can use protective equipment, such as noise-canceling headphones and eye masks, which reduce the patient's exposure to intense auditory and visual stimuli. Studies have shown that adopting these preventive measures can lower the risk of induced seizures during MRI exams by up to 70% [6].

In summary, the MRT plays a crucial role not only in the technical execution of the exam but also in managing the safety and comfort of epileptic patients. Positioned behind the glass, the MRT requires constant vigilance and effective communication to monitor any changes in the patient's condition. The MRT's ability to respond promptly, even with limited physical proximity, is a fundamental component of quality care in managing epileptic patients during MRI exams.

Managing epileptic patients during an MRI exam requires a coordinated approach among the MRT, nurse, radiologist, and on-call anaesthesiologist, especially in emergency situations. The MRT is re-



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responsible for differentiating between patients undergoing antiepileptic therapy and those not on medication, implementing preventive strategies for both groups. For patients in treatment, the MRT ensures that medications have been taken on the day of the exam, thereby reducing the risk of seizures [7]. For patients not in therapy, the risk is higher and necessitates continuous monitoring and access to emergency supplies [8].

Monitoring and Communication

The MRT plays a crucial role in managing epileptic patients during MRI exams through careful monitoring of vital parameters, such as heart rate and oxygen saturation. These parameters are continuously assessed using advanced systems to detect any abnormalities early, enabling a timely and coordinated intervention [9]. This vigilance is essential not only for ensuring patient safety but also for alerting the radiologist and on-call anaesthesiologist, ready to respond in case of seizures. Moreover, effective and reassuring communication with the patient is key: explaining the sounds and duration of the exam can reduce anxiety, a risk factor for seizure occurrence [8]. Patient preparation and attention to detail are essential elements that the MRT also shares with the nurse, ensuring all personnel are aware of the necessary safety measures.

A fundamental preliminary action for the MRT is pre-notifying the on-call anaesthesiologist, especially when dealing with high-risk patients or those with insufficient antiepileptic treatment, ensuring the anaesthesiologist is ready to administer necessary medications in the event of a prolonged seizure. In this context, the MRT must maintain a constant state of vigilance and remain alert throughout the entire exam. Additionally, awareness of the patient's infectious conditions, such as HIV status or other transmissible diseases, is crucial for protecting the MRT and the entire healthcare team from potential exposure. In the MRI room, gloves should always be readily available, and, if possible, worn during procedures involving direct patient contact. This precaution is especially useful in the event of a sudden seizure, where the MRT may need to interact quickly with the patient without time for additional protective measures.

Continuous communication with the nurse, radiologist, and on-call anaesthesiologist ensures that the MRT does not operate in isolation but as part of a cohesive team ready to respond to any eventuality. This preparation makes the MRT a reference point in the entire process, combining technical expertise and emergency management skills to ensure patient safety and optimal care.

Intervention in Case of an Epileptic Seizure during MRI

A rapid and coordinated response from the team is essential to ensure patient safety and minimize

the risk of complications. In the event of a seizure, the MRT, nurse, radiologist, and anaesthesiologist work closely, each with specific and well-integrated responsibilities. Below is a detailed outline of the necessary actions according to each role.

Role and Actions of the MRT

As the primary monitor of the patient in the MRI room, the MRT is responsible for initiating immediate intervention. The actions include:

- Immediate interruption of the exam: The MRT promptly halts the MRI scan and communicates with the patient to reassure them, maintaining a calm and steady tone.
- Initial patient assessment: Through quick observation, the MRT evaluates primary symptoms, such as signs of convulsions, consciousness, and breathing, to determine the immediate measures needed.
- Safe positioning of the patient: In the case of convulsions, the MRT positions the patient on their side to prevent choking and removes any objects that could pose a danger.
- Use of personal protective equipment: The MRT wears gloves and other necessary protections, especially if the patient is HIV positive or has other infectious conditions, ensuring personal safety during intervention.
- Alerting the team: The MRT quickly alerts the nurse and radiologist for an initial assessment regarding the need for medication, also involving the anaesthesiologist to prepare for possible medication administration and respiratory support.

Role and Actions of the Nurse

The nurse provides essential support to ensure patient safety and control of vital functions:

- Airway management: The nurse loosens any tight clothing around the patient's neck and ensures airway patency, facilitating breathing.
- Monitoring vital signs: The nurse is responsible for monitoring respiratory rate, oxygen saturation, and heart rate, which are critical for clinical assessment.
- Patient safety support: The nurse collaborates with the MRT to ensure the patient is in a safe position and prepares the necessary emergency materials for possible pharmacological intervention.

Role and Actions of the Radiologist

The radiologist coordinates the clinical intervention and assesses the need for initial medication administration:

- Clinical assessment and initial therapeutic decision: The radiologist oversees the evaluation of vital signs and the patient's neurological condition, deciding in collaboration with the MRT and nurse whether initial anticonvulsant medi-



cations are necessary.

- **Team coordination:** The radiologist maintains communication between the MRT, nurse, and anaesthesiologist, ensuring that everyone is updated on the patient's condition and prepared to intervene effectively and in a coordinated manner.

Role and Actions of the Anesthesiologist

The anaesthesiologist intervenes upon the radiologist's indication to administer medications and provide advanced respiratory support if needed:

- **Administration of anticonvulsant medications:** The anesthesiologist administers anticonvulsant drugs such as diazepam, lorazepam, or midazolam, following clinical protocol and based on the patient's condition.
- **Advanced respiratory support:** If the seizure is prolonged or respiratory difficulties arise, the anesthesiologist provides oxygen or other respiratory support methods, ensuring airway patency.
- **Intensive monitoring:** The anesthesiologist closely monitors and manages vital signs during and after medication administration, ensuring timely intervention if the patient's condition worsens.

Emergency Supplies

The MRI room must be equipped with oxygen and emergency medications, such as benzodiazepines, to administer in the event of a seizure. The MRT, with continuous training, is qualified to administer these medications according to standardized protocols, but always under medical supervision [5].

In the case of an epileptic seizure in MRI, it is crucial that the room is stocked with emergency medications for a timely response. Common medications include:

- **Diazepam:** A benzodiazepine effective in quickly controlling seizures. It can be administered intravenously or rectally, relaxing muscles and reducing neuronal activity. Intravenous administration requires caution to avoid overly rapid delivery, which may cause respiratory depression.
- **Lorazepam:** Indicated for prolonged seizures or status epilepticus, administered intravenously. It is preferred for its longer duration of action compared to diazepam, reducing the risk of immediate recurrent seizures. Administration must be slow to prevent respiratory side effects.
- **Midazolam:** Primarily used in pediatric emergencies or situations where immediate venous access is unavailable, it can be administered intramuscularly, intranasally, or buccally. It is valued for its rapid action.
- **Fosphenytoin:** A second-line anticonvulsant administered intravenously, often used when benzodiazepines are insufficient to control the

seizure. Continuous monitoring is required as rapid administration can negatively impact cardiac parameters.

- **Phenytoin:** Used as a maintenance therapy to prevent prolonged seizures, phenytoin requires slow administration and constant monitoring, as it can cause adverse cardiac effects.

During administration, the MRT works closely with the anesthesiologist to monitor vital signs and prevent complications such as respiratory depression. During and after a seizure, the MRT carefully monitors respiratory rate, oxygen saturation, heart rate, and blood pressure. This data allows the team to respond swiftly in case of anomalies, preventing complications such as tachycardia or bradycardia. Accurate documentation of clinical details is essential: the event is precisely recorded to ensure optimal management for future exams and improve the safety protocol.

DISCUSSION

MRI can provoke seizures in predisposed patients, primarily due to visual and auditory stimuli or heightened anxiety levels. These triggers can induce a seizure in patients with photosensitive epilepsy, a condition present in approximately 5% of all epilepsy patients [10]. The risk of MRI-induced seizures is relatively rare, with an incidence of 0.5% to 1% in patients with pre-existing epilepsy [11]. However, the rate increases significantly in patients with uncontrolled or drug-resistant epilepsy: one study demonstrated that these patients have a 2.5 times higher risk of seizures during MRI compared to those under pharmacological control [12]. Approximately 20% of seizures in epileptic patients are associated with external stimuli such as flashing lights or rhythmic noises [13]. In MRI, stimuli like light variations and the rhythmic sounds of imaging sequences can contribute to triggering seizures. Particularly, patients with photosensitive epilepsy, who make up about 10% of the young epileptic population [14], are especially susceptible to these visual stimuli. Statistics indicate that photic stimulation and rhythmic sounds can trigger seizures in approximately 15-20% of photosensitive patients [15].

The adoption of preventive measures has shown a significant reduction in the risk of seizures during MRI. In one study, using noise-cancelling headphones and eye masks reduced the risk of induced seizures by 60-70% in predisposed patients [6]. Additionally, protocols involving shorter sequences and excluding functional stimulation in high-risk patients proved even more effective, reducing the seizure risk to less than 0.3% [16, 17]. Reducing stress and anxiety before the exam is essential, as studies have shown that 30-40% of patients with epilepsy report an increase in seizure frequency under high-stress conditions [18]. Preventive measures, therefore, not only reduce exposure to sensory stimuli but also help create a more tolerable environment for the pa-



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tient, positively affecting anxiety control.

CONCLUSIONS

Managing epileptic patients during MRI exams today requires a highly coordinated and personalized approach, in which the Medical Radiology Technician (MRT) plays a crucial role as the primary overseer of the patient. Beyond technical execution, the MRT takes on an extended responsibility that includes continuous patient monitoring, timely interpretation of physical and psychological signals, and the ability to respond quickly to potential seizures. This position makes the MRT the first link in a coordinated safety chain, where intervention effectiveness relies on advanced preparation and prompt involvement of other team members, including the nurse, radiologist, and anaesthesiologist. The use of preventive devices, such as noise-cancelling headphones and eye masks, has proven effective in reducing the risk of induced seizures, with up to a 70% decrease in predisposed patients. However, the MRT must also be able to interpret the patient's anxiety and discomfort through visual and auditory monitoring tools, turning the physical distance from the MRI room into an opportunity to develop highly sensitive

surveillance. Reassuring communication through the intercom, combined with reducing stressful stimuli, becomes essential in preventing critical situations. In the event of a seizure, the MRT coordinates the team for a prompt response, quickly notifying the anaesthesiologist and activating emergency protocols with assistance from the nurse and radiologist. This multidisciplinary collaboration ensures the administration of anticonvulsant medications and respiratory support when needed, thus maximizing patient safety. Continuous and specific training for the MRT and supporting staff is therefore essential to meet the challenges of managing epileptic patients in MRI. In the context of 2024, the MRT increasingly embodies the role of a “guardian” of patient safety, combining technical and clinical skills with emergency management capabilities that go beyond traditional technical responsibilities. Their ongoing training and specialized education represent a fundamental asset in ensuring both exam quality and the patient's physical and psychological well-being, contributing to improved care quality and a safer, more tolerable diagnostic experience for epileptic patients.

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