Managing Anxious Patients Undergoing Magnetic Resonance Imaging: Evidence Versus Common Practice in Ireland

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Abstract

Aim: Adult patients undergoing Magnetic Resonance Imaging (MRI) often experience anxiety prior to and during scanning. While NICE guidelines exist for anxious paediatric patients undergoing MRI procedures, no formal guidelines have been developed for adults. The aim of this study was to compare current practices of managing anxious adult patients undergoing MRI procedures in a selection of Irish hospitals with a reviewed international evidence base.

Methods: A comprehensive literature review was conducted once search terms, the Boolean operators with which to pair them, and the parameters of our search were defined. The Cochrane Database, PubMed, Google Scholar and eMedicine databases were all utilised for the literature review. This knowledge base was then used to create a comprehensive survey, which our team used to conduct phone interviews with nine hospitals throughout Ireland regarding their existing protocols.

Results: The literature demonstrates the benefits of utilising oral, or if necessary, intravenous sedation in anxious patients, despite the potential adverse effects of such. However, no universally-approved or utilised protocols have been established in Ireland. Our survey of nine Irish hospitals found three hospitals with vague and open-ended departmental protocols. The remainder of surveyed hospitals referred anxious patients to their general practitioner for review prior to repeat scans on a case-by-case basis.

Discussion: Our study demonstrates the lack of a nationally implemented formal protocol in Ireland for anxious patients undergoing MRI procedures. Without a formal protocol in place, vague protocols prevail, costing the healthcare system and individual patients time and money. We would aim to build upon this research, consulting with international hospitals to create a formal and robust protocol.

Introduction

Magnetic Resonance Imaging (MRI) is considered to be one of the safest and diagnostically efficacious of all diagnostic radiological procedures (Kanal et al, 2007). Despite the excellent safety profile, anxious adult patients present a unique challenge. Although hospital staff may view an MRI procedure as routine, patients may experience mild, moderate, or severe anxiety. Anxiety and restlessness may result in poor image quality, reducing diagnostic utility of the images, as well as causing psychological and/or physical ramifications (Figure 1). Additionally, poor image quality may necessitate repeat scanning, creating a significant financial burden on healthcare systems. In order to avoid adverse outcomes, non-pharmacological interventions, sedation, and general anaesthetics may be employed. This study aims to examine existing data on MRI sedation options for the anxious adult patient population. Collating this data will allow the formulation of an MRI sedation protocol for anxious adults, which we will compare to current protocols in a surveyed set of Irish hospitals.

An MRI requires patients to remain still for up to an hour in a loud and confined space. Under these circumstances, a patient may be unable to complete the MRI or move too much to obtain viable diagnostic images, requiring a repeat scan, increasing their anxiety. Non-pharmacological techniques such as detailed explanation, sleep deprivation, video-based demonstration, telephone conversation with radiographer, prone positioning, and use of the patient's own music during scanning have all been shown to

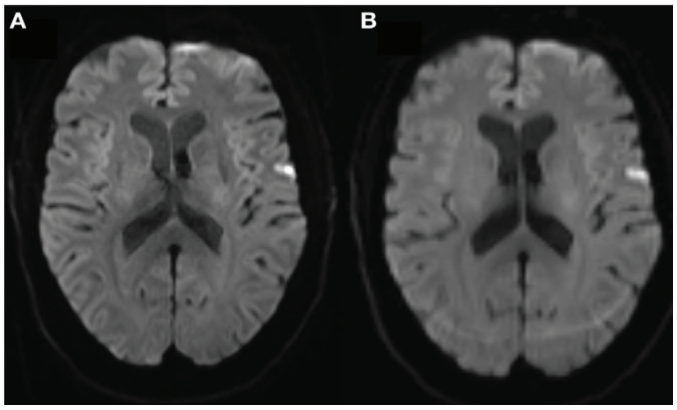

Figure 1: MRI images with, and without movement artifact, demonstrating the need for a movement-free scan to optimize diagnostic quality (Original image demonstrating movement artifact in 68-year-old patient with transient ischaemic attack symptoms lasting two hours, from article: Havsteen et al, 2017).

alleviate anxiety (Tugwell et al, 2017; Munn & Jordan, 2013).

When these non-pharmacological methods fail, the medical team should implement sedation. Although clinical studies regarding sedative drugs are available in the literature, no single drug is recommended as a universal standard (Levati et al, 2004). The choice of the type and level of pharmacological sedation depend on patient age, weight, cooperativity, and medical history. The benefits and the risks of sedation must be weighed against one another for the best patient outcome (Ali et al, 2013; Andre et al, 2015; Nabavizadeh, 2016). Over-sedation in MRI procedures could ultimately result in cardiorespiratory depression, post-procedure nausea and vomiting, disorientation, and sleep disturbance. Conversely, if the patient is inadequately sedated, poor image quality, along with the negative psychological consequences and increased costs due to multiple procedures, may result (Ali et al, 2013; Andre et al, 2015; Nabavizadeh, 2016).

Methods

In order to assess the literature, we found it necessary to define our search terms, the Boolean operators with which to pair them, and the parameters of our search. Our search terms were optimised to answer our research question: "What is the evidence for the use of sedation in anxious patients undergoing MRI?"

Sedation was defined under the search terms; sedation, anaesthesia and anxiolytics. This enabled us to create a wide definition around sedation in order to parse out the most relevant literature. MRI was searched for so as such to exclude other imaging modalities. Articles were analysed for their research methods using the evidence-based medicine pyramid, ranking at its peak meta-analyses and systematic reviews. The Cochrane Database, PubMed and Google Scholar were all utilised, as was eMedicine for its use in providing clinician guidelines. We chose to work through the first twenty results of each search engine, filtering through them by the aforementioned parameters. Duplicate results were then excluded between searches and between databases.Contingent on the findings from this review, a phone survey was created in collaboration with Dr. Anne Buckley (SpR, Radiology). In total, nine radiology departments were surveyed, providing insight into current MRI sedation protocols in Irish hospitals. Firstly, each hospital was asked how many anxious patients they would see per month who required intervention to complete the MRI, or who could not complete the procedure. Each hospital was then asked if they had an official protocol for anxious patients in place. If they had a protocol, they were then asked who administered the protocol and how exactly they did this. If the hospital did not have a formal protocol, they were then asked to explain what practices they employed for anxious patients in this setting. Of note, all hospitals noted that they found explaining the procedure to the patients alleviated anxiety and helped them in completing the MRI scan, regardless of having an existing protocol or not. Furthermore, each hospital was asked a series of questions regarding pharmacological measures employed for anxious patients. This series of questions included: 'Did the department administer sedative medications for anxious patients undergoing MRI?'; 'Was it the department who made the decision to administer sedation or did they refer patients to their general physician for a sedative prescription?'; 'Were sedative medications offered for outpatients only, inpatients only, or both types of patients?'; 'What sedative medications were administered to patients?'; 'What was the route of the sedative medication administration?'; 'What was the timing of administration with regards to the MRI?'; 'If they did not administer any medications, did the department have a referral pathway in place for patients to receive medication from their family practitioner for a future appointment?'.

Results

Findings from Literature Review

Healthcare professionals must record a comprehensive medical history and conduct a thorough clinical examination, including a physical status evaluation (American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists, 2002). In cases where sedation is deemed necessary, informed consent needs to be obtained from the patient (National Clinical Guideline Centre (NICE), 2010). Specialist advice is recommended before giving sedation if there is a concern about a potential airway or breathing problem. When sedation is necessary, adequate oxygen supply, airway equipment and drugs needed to support life during an emergency, must be readily available (National Clinical Guideline Centre, 2010).

As sedation can be psychologically distressing for patients, especially those with a predisposition to procedural anxiety, it is essential that they are offered information about their role in the procedure and what the healthcare professional will do (National Clinical Guideline Centre, 2010). Radiologists, anesthetists, emergency room physicians, and specialist nurses have administered sedatives in the MRI setting (Arlachov & Ganatra, 2012). Should the sedation team decide to administer sevoflurane, propofol or opioids combined with ketamine, they must ensure that the team member is appropriately trained (National Clinical Guideline Centre, 2010).

Several classes of sedative agents can be used for patients undergoing radiological procedures (Table 1). These include benzodiazepines, barbiturates, intravenous anaesthetics, inhalational anaesthetics and other sedative agents such as dexmedetomidine (Arlachov & Ganatra, 2012). Benzodiazepines are classically used as anxiolytic medications, and in this setting include midazolam, diazepam, lorazepam, and alprazolam (Arlachov & Ganatra, 2012). The literature identifies midazolam as the first-line benzodiazepine for inpatient use, due to its rapid onset of action and short elimination half-life (approximately 1-4 hours), and diazepam as the first-line benzodiazepine for outpatients (The Royal College of Radiologists, 2018). The typical dosing patterns for these medications for adults and geriatric or chronically ill patients have been previously outlined (Irish Pharmaceutical Healthcare Association, 2017; The Royal College of Radiologists, 2018; Medscape, 2018; Prescriber's Digital Reference, 2018). Flumazenil is an effective benzodiazepine reversal agent and may be administered as an IV infusion in the event of an overdose (Arlachov & Ganatra, 2012).

Barbiturates are a class of medications that can be used in the induction and maintenance of deep sedation. However, due to the higher rate of adverse respiratory effects, they are not frequently used (Levati et al, 2004; Mason et al, 2001). Additionally, the general anaesthetics propofol and ketamine are used in radiological procedures (The Royal College of Radiologists, 2018). Propofol is a primary sedative agent that can be used for MRI procedures, and ketamine is a fast acting anaesthetic and painkiller that induces a dissociative state (The Royal College of Radiologists, 2018). Due to the higher risk of adverse effects, these medications should only be administered by anaesthetists (Merola et al, 1995; The Royal College of Radiologists, 2018).

Inhalational anesthetics such as nitrous oxide and sevoflurane can also be used for radiological procedures. Nitrous oxide is a potent analgesic and dramatically reduces patient anxiety, but care must be taken when combining it with other sedatives as this may result in deep sedation (Litman et al, 1998). Sevoflurane can also be used for MRI sedation, but due to its rapid induction of general anaesthesia and short half-life, it is recommended that only anaesthetists administer it. Other sedative agents that have been used, but not rigorously tested, include dexmedetomidine, an alpha-2 agonist with sedative and analgesic properties (Arlachov & Ganatra, 2012).

The current guidelines stipulate that healthcare professionals must "monitor, interpret and respond to changes in depth of sedation, respiration, oxygen saturation, heart rate, pain, coping, distress, three-lead electrocardiogram, end tidal CO_2, and five-minute interval blood pressure readings", for patients undergoing moderate to deep sedation for an MRI procedure (National Clinical Guideline Centre, 2010). Immediately post-procedure patients must be monitored until they have a patent airway, show protective airway and breathing reflexes, are hemodynamically stable and are easily roused.

Survey of Irish Hospitals

Three of the nine hospitals had a protocol in place to

deal with an average of forty-five patients per month whose anxiety was significant and prompted clinicians to consider the use of sedation. Thus, an average of forty-five patients per month required some form of intervention (non-pharmacological or pharmacological), in order to complete the MRI procedure. All three hospitals with a set protocol differed in their approach to anxious patients. Cork University Hospital offered a tiered approach, where non-pharmacological methods were instituted first (verbally calm patient and allow them to bring approved family member or friend into MRI room), followed by oral sedation and then IV sedation if necessary. Letterkenny General Hospital offered only non-pharmacological methods of anxiolysis to patients such as verbal reassurance and a panic button. In order to receive oral sedation patients would be referred to their GP to get a prescription for a benzodiazepine, while IV sedation was not included in the protocol. The Aut Even Hospital in Kilkenny offered many non-pharmacological approaches for anxiolysis, along with elevation to oral sedation if required, but they did not provide IV sedation to patients.

The three hospitals who did maintain a protocol were vague and open-ended in nature, often referring to the judgement of the radiographer. We note that each of these three protocols were determined by a single radiologist or radiographer and were not peer reviewed. In all hospitals, if non-pharmacological procedures did not alleviate anxiety, the decision regarding use of sedation would rest with either the referring team or the patient's GP. Six hospitals would refer patients for whom non-pharmacological methods failed to relieve their anxiety to their GP for the prescription of a sedative medication. In this instance, the hospital often supplied the patient with a suggestion of a particular type of benzodiazepine to mention to their GP. Furthermore, two of the three hospitals with an established protocol and three hospitals without a formal protocol, did not have the capability to offer IV sedation to patients undergoing MRI procedures, highlighting the need for an adaptable protocol which takes into consideration staffing and financial resources.

Drug	Drug Class	Patient	Indication	Route
Midazolam	Benzodiazepine	Adult / Paediatric	Conscious (Light) Sedation	Intravenous
Diazepam	Benzodiazepine	Adult / Paediatric	Conscious (Light) Sedation	Oral / Intravenous / Intramuscular
Lorazepam	Benzodiazepine	Adult / Paediatric	Conscious (Light) Sedation	Oral / Intravenous
Termazepam	Benzodiazepine	Adult / Paediatric	Conscious (Light) Sedation	Oral
Pentobarbital	Barbiturate	Adult / Paediatric	Conscious (Light) Sedation	Oral / Intravenous / Intramuscular
Methohexital	Barbiturate	Adult / Paediatric	Procedural Anaesthesia	Intravenous / Intramuscular
Ketamine	General Anaesthetic	Adult	Procedural Anaethesia	Intravenous / Intramuscular
Propofol	General Anaesthetic	Adult / Paediatric	Procedural Anaethesia	Intravenous
Nitrous Oxide	General Anaesthetic	Adult / Paediatric	Procedural Anaethesia	Inhalational
Sevoflurane	General Anaesthetic	Adult / Paediatric	Procedural Anaethesia	Inhalational
Dexmedetomidine	Alpha-2 agonist	Adult	Procedural Sedation	Intravenous

Table 1: Drugs employed for sedation or general anesthesia.

In each surveyed hospital, all departments favoured explaining the procedure and reassuring the patient in order to help alleviate anxiety. All departments had some informal non-pharmacological procedures in place which were utilised if necessary. Examples include: presence of panic/safety buttons that allow patients to pause the scan and speak with the radiographer; allowing approved family member/friend into MRI room; allowing patient repositioning within the MRI machine. When an anxiolytic or sedative prescription was required, the particular oral benzodiazepine administered varied, and no information could be given regarding dosages, despite the existence of guidelines for such procedures.

Discussion

MRI is a safe, routine and highly accurate procedure, but one that can cause varying levels of anxiety in patients. The literature has described non-pharmacological and pharmacological methods to minimize emotional distress in this patient cohort. Based on this, we believe a definitive and universally accepted MRI protocol would be of value, and that research towards optimizing such a protocol would be beneficial. In order to be effective, this protocol would need to stratify patients based on the severity of their anxiety and on their ASA physical status, as this places restrictions on sedation (American Society of Anesthesiologists Task Force on Sedation and Analgesia by Non-Anesthesiologists, 2002).

From the results of our preliminary study we offer a potential protocol for use throughout Irish hospitals (Figure 2). We recommend explaining the MRI procedure in the most reassuring and preparative terms for all patients. Prior to an MRI procedure, the patient's GP or the specialist ordering the MRI should assess the patient's periprocedural anxiety. A series of questions regarding previous history of an MRI, how that procedure was tolerated, history of claustrophobia or panic attacks, or any specific medical phobias could flag potential anxiety. If any issues are raised, patients could be provided with more in-depth early non-pharmacological interventions to alleviate potential anxiety (Figure 2). We additionally recommend giving the patient a safety buzzer and the ability to communicate throughout the scan should they feel a sense of discomfort or unease.

Should these measures prove ineffective we recommend using IV sedation with midazolam for inpatients and oral diazepam for outpatients. In those situations where a patient's anxiety cannot be adequately controlled with oral benzodiazepines or the department is conducting an MRI on an inpatient, we recommend treatment with IV sedative medications such as IV benzodiazepines, IV barbiturates (pentobarbital or methohexital), or the general anaesthetics ketamine or propofol if necessary; under the guidance of an anaesthetist. We recommend that those general hospitals in Ireland who do not offer IV sedation for MRI procedures and have patients for who other anxiolytic measures have failed, to refer these patients to a larger tertiary centre.

We believe that to develop a robust and adaptable protocol, further research is required. The focus of this research would compare our proposed protocol with other international evidence-based protocols, as well as examining this protocol's effectiveness when implemented in Irish hospitals.

Limitations

The team was unable to survey all Irish tertiary and general hospitals with an operating MRI machine, potentially skewing the data. The survey was conducted over the phone with a radiographer or radiologist, not formally emailed to radiology departments. Due to time constraints of discussing departmental procedures over the phone, this may have altered operators' answers. Despite asking about sedative medication dosing, none of the departments were able to give a definitive answer to this, stating that it was up to the team caring for the patient. Furthermore, given the difference in hospital size, volume of patients served, and hospital staff available, some hospitals surveyed did not offer IV sedation for patients undergoing an MRI. As these hospitals were not able to provide this service, a formal protocol would necessitate either a referral pathway to a connected centre that offers this service, or an alternative treatment pathway within that centre.

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Conflict of Interest

Authors report no conflict of interest.

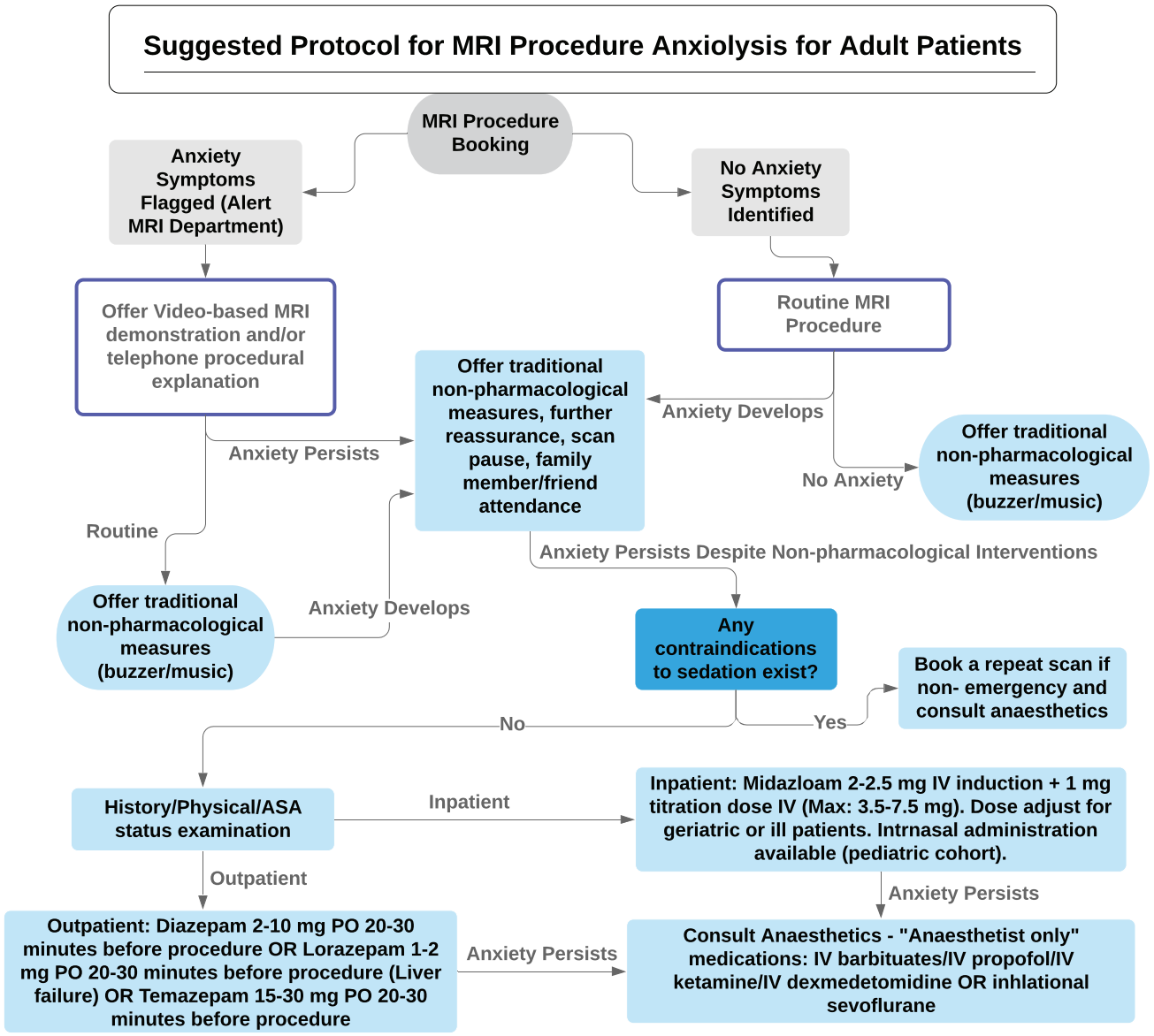

Figure 2: Proposed protocol for the treatment patients.

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