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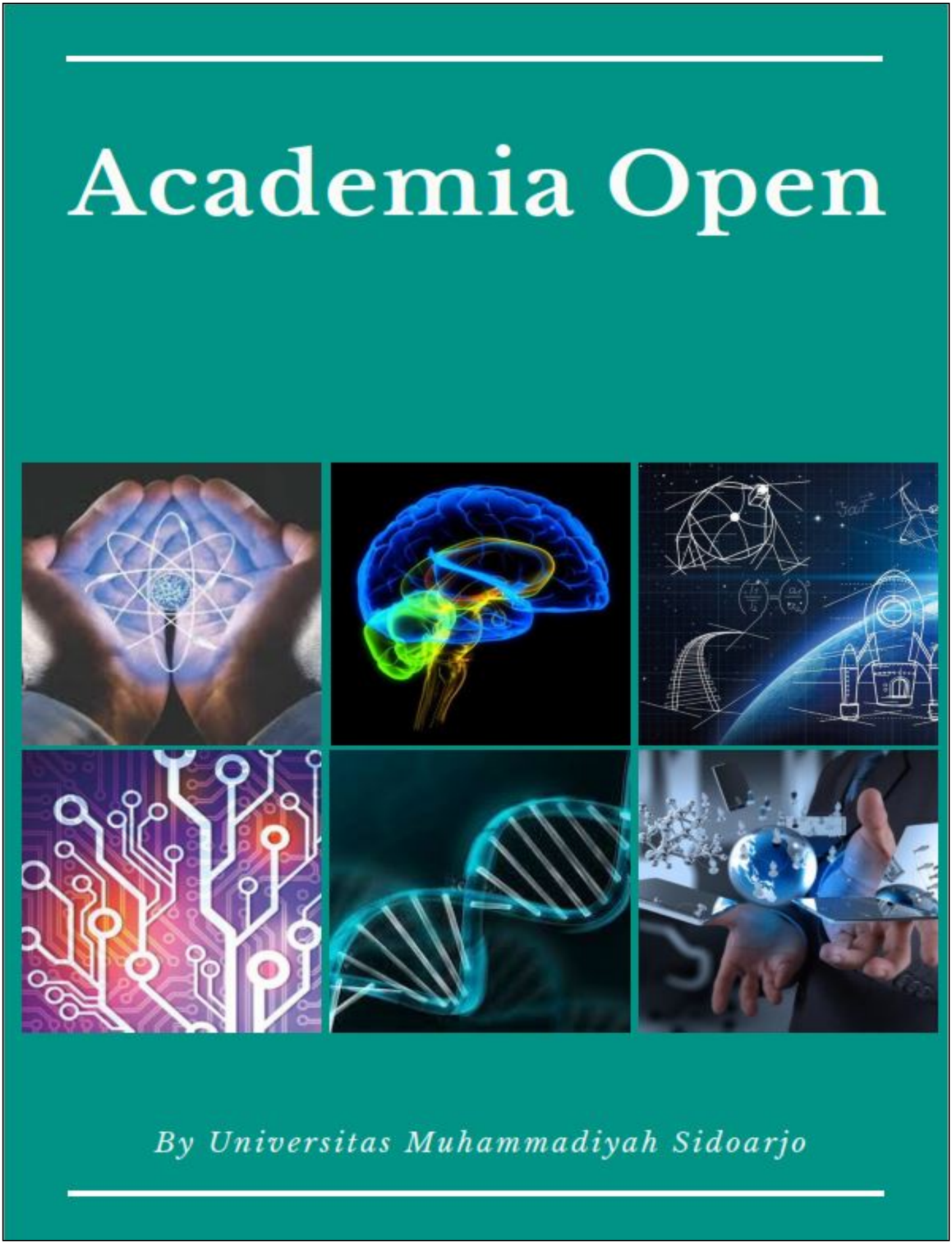

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Effective Sedation Strategies for Pediatric MRI: A Comprehensive Analysis

Strategi Sedasi yang Efektif untuk MRI Pediatrik: Analisis Komprehensif

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Abstract

This study presents a structured sedation program for pediatric patients undergoing MRI, aiming to optimize safety and resource utilization. A total of 1857 children were included, with 48 admitted to the RCU, leaving 1809 for analysis. Children under 5 received oral sedation, while those 6 and older were assessed by referring physicians for sedation eligibility. The protocol involved chloral hydrate and paraldehyde, with a backup plan for intravenous sedation or general anesthesia overseen by an anesthetist consultant. Among 1039 scans, 597 were unsedated, and 442 were sedated successfully. Oral sedation failed in 50 cases (6.9%), predominantly in younger children (87% under 5 years). Notably, 2 out of 5 subjects using chloral hydrate experienced respiratory issues. This systematic approach led to efficient resource use and safe outcomes, highlighting the importance of tailored sedation protocols in pediatric imaging.

Highlights:

- Reduced oral sedation failure rate to 6.9% in pediatric MRI.
- Anesthetist consultation enhances safety in MRI sedation procedures.
- Structured program optimizes resources and ensures safe outcomes in pediatrics.

Keywords: Pediatric MRI, Sedation Program, Anesthetist Consultation, Oral Sedation, Resource Utilization

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Introduction

A highly common pediatric radiological exam is magnetic resonance imaging (MRI). This diagnostic test usually requires that the child be perfectly immobile for a variable length of time ranging from minutes to almost one hour. Additionally, it must be performed in a highly magnetic and enclosed area with substantial noise and lack of space, which can make the patient feel claustrophobic. As a result, sedation may be required to guarantee the successful completion of the imaging process.

Generally, the age group 1-5 years and those with mental retardation or developmental delay are patients who need sedation for most of their imaging procedures [1]. Also worth mentioning is that older children who experience significant anxiety or fear, despite reassurance, can benefit from sedation. The line distinguishing between sedation and anesthesia is sometimes blurred; it may be seen as a continuous spectrum that covers complete wakefulness to anesthesia.

Light anesthesia has been defined in the UK as deep sedation; it is required that only an anesthesiologist or, at a minimum, an anesthesia provider should administer the drugs [2]. There is a great likelihood that sedation programsmay not be safe, and for that reason, there must be meticulous planning to avoid safety risks, selection of patients who are likely to benefit from this type of intervention, adequate monitoring procedures that should be followed every time during the process by all professionals involved, including the use of proper equipment with training on how it should work [3].

This kind of excellence, unfortunately, does not always come about, as was shown by a study in Scotland [4]. When it comes to MRI usage among the young patient population, especially taking into account an individual’s age and mental capacity as well as their level of anxiety associated with the test administration, one has to be very careful. This is because when sedation becomes the determinant factor that would ensure its success, it should also be noted that sedation should not be equated to anesthesia, and some procedures should not utilize guidelines associated with anesthesia [5].

Adherence to the set regulations and good practice guidelines is essential to minimize the risk of sedation-related problems. Moreover, successful planning, patient selection, diligent supervision, and the use of proper equipment and personnel training also deserve proper consideration [6]. Only by following these important procedures can any radiology department achieve high-quality services in treating pediatric patients needing MRIs. Although some progress has been made to comply with these standards according to recent research findings in this area, the continuing struggle towards further improving standards illustrates that current quality levels are not yet satisfying [7].

While sedation programs significantly differ in organizational requirements and financial impacts, various issues may result in organizational deficiencies that can hinder the delivery of a safe and efficient MRI sedation service as well as have cost implications [8]. Yet, it is uncertain what level of organizational structure is needed to safely and efficiently provide MR sedation service with cost-effectiveness even though there has been high demand for a complete dedicated sedation team specifically for MRI scanning recently [9]. The main goal of this program is intended to improve the criteria used in selection, preparation, monitoring, and management of children requiring MRI scans. Thus, this research aims to evaluate the effectiveness and safety of these procedures.

Method

Between April 2015 and March 2022, 1857 children were scheduled for elective or semi-urgent MRI scans at Al Sheikh Zayed Hospital and Al Yarmouk Teaching Hospital. In these hospitals, the MRI scanner suite is non-ferromagnetic and equipped with full anesthesia and monitoring capabilities. A team comprising radiographers and a part-time Registered Sick Children's Nurse (RSCN) operates this facility. The most frequent mode of sedation given during the implementation of the structured sedation program (SSP) at these hospitals was oral sedation among children aged 1 to 5 years old [10].

However, for infants aged less than one year, the first interventions are correct wrapping and allowing them to sleep, with sedation as a last resort if these fail. But if patients are six years old or older, oral sedation is only given when the referred physician thinks their level of cooperation is inadequate. Furthermore, yet less importantly in comparison to the decision of the physician on call from the inpatient unit at the hospital ward where you are going through your admission process and who ultimately signs off consent forms, if any use whatsoever else on whatsoever means might have happened between these medical professional decisions made about the patient’s state that particular day, regardless without interposing themselves into the determining actor but instead seeking counsel from parents concerning individual welfare measures most suitable considering how many other factors should be taken into consideration concurrently, among them being age group differences based on cognitive development stage levels themselves, including differences involving abilities relating to the ability to understand the issue comprehensively. For instance, prior understanding potential implications, though not necessarily agreed upon by all parties involved, leading sometimes even taking place conflicts between what oughts lead differently

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ways outcome wanted desired concerns response precipitated statement this crucial area history while great care taken to ensure complete compliance with relevant laws and regulations locally as internationally agreed-upon ethical standards. The pertinent question debated time and again publicly or non-publicly depending on the case, for example, a person affected by such debate, religious groups opposing some procedures on scientific grounds, at least overall latter in case without exception – in fact, there also have been instances reported just quite recently, e.g., a few months back, whereby private practitioners were involved in unlawful activities regarding pharmaceuticals advertising. We don't know how widespread the problem goes, but definitely something must not happen, especially in this industry responsible for lives and well-being of people usually paying their earned salaries honestly deserve better! The decision was made that ... And to whom you report is no longer up for debate either now or here because that part of our job has become a settled matter without recourse against the authority who made these decisions today itself already legally binding once finalized after signature sheets were cleared yesterday at 12 o'clock noon so that we can ensure the accuracy of the record of everything that comes out later, reflecting exactly what happened then or how it went down then. There is nothing more to worry about now, nothing left unsaid which remains hidden at the moment under the cover of darkness, leaving so much unspoken until someone sheds light upon those secrets buried deep down within the heart filled with the purest intentions, wanting nothing less but transparency and open conversation between two individuals sitting across each other at the table, ready to listen carefully to their stories, equally eager to share their own story too, striving to build bridges, connect minds, touching souls, turning strangers into friends, forging lifelong connections over shared dreams, aspirations, common struggles, victories, triumphs, bonding over good food, great conversation, wonderful music, timeless laughter that echoes throughout the room, enveloping warmth, comfort that permeates every pore of the skin, bringing solace, peace amidst the chaos around us, reminding us all what truly matters above all else: happiness, love, respect towards one another, recognizing and appreciating the difference in each other, adding diversity and beauty to life, enriching experiences, giving perspective never considered before, opening doors to possibility, hope for a better world for future generations, yet unborn ones who will inherit the legacy we are creating together today, making a lasting impact tomorrow, even in the next millennia ahead, shaping the destiny of humanity how we want to shape it, taking responsibility today to make sure we leave behind a positive legacy for future generations, thereby ensuring they flourish and thrive with the same opportunities and freedoms we enjoyed ourselves, while walking paths paved for us, learning from the mistakes of our forefathers, with foresight preventing certain kinds of disasters that may occur on a similar scale down the line, otherwise doing our best efforts to avoid the same fate happening twice, which in turn requires understanding the context of the situation before making judgment calls either way, etc.

When children were left inadequately sedated after receiving oral sedation, as well as those originally referred for general anesthesia, the MRI requests of these patients would be reviewed by a consultant anesthetist. It was up to this anesthetist to determine whether the procedure should take place under their care with either general anesthesia or intravenous sedation based on individual patient factors such as age, type and length of scan, co-morbidities, and specific airway problems.

On a weekly basis, half a day was set aside by the anesthetist to provide IV sedation or general anesthesia. Informed consent was obtained from the parents or, in the case of adequate age, the patients themselves, in all instances.

Thus, MRI scanning sedation services may be more costly or organizationally demanding based on their needs and related costs. Although it is not yet clear whether there should be a sedation team specifically for MRIs, the need has been steadily increasing. In response, at our hospitals, an organized approach was developed for patient selection, pre-procedural evaluation, monitoring during the procedure, and post-procedural care. The purpose of this study was to assess the effectiveness and safety of this system for sedation.

Children aged 1 to 5 years were primarily sedated orally, while other interventions were introduced for babies below 1 year old. In the case of children aged 6 years and above, they received oral sedation based on their level of cooperation. The ultimate decision to administer oral sedation was made by the admitting physician after consultation with the patient and parent. Children who did not sedate adequately with the oral method or those referred for general anesthesia had a second opinion with a consultant anesthetist before choosing a suitable form of sedation.

Patient-specific considerations that played a part in the decision-making process included the patient's age, the type of exam and its duration, underlying medical conditions, and the presence of specific airway issues. The anesthetist reserved half a day per week for administering intravenous sedation or general anesthesia.

On the day of the scan, all patients in need of sedation or general anesthesia were admitted to the ward as day cases where they underwent assessment and general health evaluation performed by our medical team. A detailed assessment was then conducted to determine the appropriate level of sedation or anesthesia required, ensuring the safety and well-being of these patients. For individuals not requiring sedation, they were taken straight to the MRI scanner waiting lounge until it was their turn for the scan.

In order to ensure that patients receiving general anesthesia are prepared for the procedure, there is a well-established protocol. A minimum fasting duration of six hours before the procedure is required in accordance with hospital policies. This pre-procedure fasting time helps decrease any risk of aspiration during the course of it.

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Another specific protocol used when oral sedation is mandatory includes administering patients with a sedative called oral chloral hydrate 30 minutes prior to the scanning. This medication plays a critical role in pacifying the patients and ensuring their cooperation throughout the process.

A system of cooperation had been established between the ward and scanner teams so that as soon as the sedation took effect, patients were immediately invited for the scan. However, in cases where some subjects were not adequately sedated with the initial oral therapy, additional paraldehyde had to be administered in the scanner waiting room (rectally). For patients who still did not achieve sufficient sedation after receiving extra medication, they would be referred for scanning during sessions supervised by an anesthetist.

With the presence of an anesthetist, the sessions were held, ensuring a highly professional monitoring system to maintain optimal levels of sedation for patient comfort and safety. One protocol was followed, where oral chloral hydrate at 90mg/kg body weight was given half an hour before starting the procedure. Additionally, in some cases, rectal paraldehyde at 0.3ml/kg body weight with an equal volume of olive oil was also administered just before the procedure.

This regimen of drugs permitted sedation at the right level for the patients when intravenous sedation was needed on a case-by-case basis. When intravenous sedation was required, a different protocol was followed. Patients were given an injection of either midazolam at doses of 0.2-0.5 mg per kilogram or propofol at doses of 0.5 mg per kilogram, depending on their weight. To achieve a level of sedation that did not affect the procedure and was in line with it, propofol was also infused with a maximum dosage of 3 mg per kg body weight per hour. These medications help to induce a state of sedation that is conducive to the procedure.

Either sevoflurane inhalation induction or propofol IV induction was utilized for patients in need of general anesthesia. When the patient had been anesthetized, a laryngeal mask airway was inserted and used to keep the airway open and facilitate breathing. Anesthesia was maintained by a combination of 66% nitrous oxide in oxygen and isoflurane delivered via an anesthetic circuit, ensuring that the patient was in deep sedation during the process.

After administering oral sedation, patients were monitored by the ward staff, particularly the staff nurse who accompanied them to the scanner room. The patients' oxygen saturation and heart rate were continuously monitored during sedation until the recovery stage. This ensured that any complications could be identified quickly and addressed immediately.

In the periods supervised by anesthetists, RSCN monitored the post-procedure condition of patients under IV sedation or general anesthesia. She was specially trained to monitor the vital signs of the patients receiving sedation and anesthesia. An ODA was also present for these supervised sessions to provide any assistance if required.

Careful and continuous patient monitoring was in place to ensure that there were no sudden changes in the body due to the condition of their health or the effects of the test. All vital signs – ECG, O2 saturation, heart rate, and blood pressure (non-invasive) – were monitored at every point in time, guaranteeing a patient’s safety and well-being during the procedure, as well as early identification of any complications that may arise.

Results and Discussion

A. Result

Within the study period, a population of one thousand eight hundred fifty-seven pediatric patients ranging from 5 months to 19 years of age has been included for data analysis. However, the forty-eight patients who were from the critical care unit and had their airway secured by tracheal intubation were excluded from further analysis. The remaining 1809 children, consisting of 977 boys and 832 girls, none sedated in 57.4%. Table 1 shows a detailed description of the number of patients who received MRI without sedation or MRI with sedation, by groups and ages.

The overall success rate was estimated at 77% with the aid of oral and intravenous sedation, as well as general anesthesia. Remarkably, oral sedation delivered a 93% success rate, but in this case only an anesthesiologist supervising for injectable medication could ensure MRI screening. Meanwhile, 27% of the children undergoing intravenous sedation and 73% placed under general anesthesia had successful MRI scanning accomplished by a consultant anesthetist. Additionally, among the remaining population of pediatric patients, 87% (657 out of 756) underwent one of these procedures.

In an age bracket of 5 years or younger, about 10% needed sedation, whereas only 4.5% in a group of individuals who were eleven years old required the same assistance. The oral sedation patient group reported only one adverse effect. A notable fact is that within this particular group, two patients showed severe respiratory depression as evident through their respiratory rate falling under 12 breaths per minute and arterial oxygen saturation dropping

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to less than 92%.

Due to this fact, these patients had to remain in the hospital for a considerably prolonged time, during which they were monitored for an interval of 12 to 18 hours following the scan. One important point is that the two patients had received only chloral hydrate as a sedative before their scans..

Table 1 MRI scan subjects categorised by age and sedative type. Numbers (%) represent values. Patients with numbers in between two brackets require general anaesthesia or intravenous sedation if oral sedation does not work for them..

Sedation/anaesthesia	< 1 years	1–5 years	6–10 years	≥11 years	Total
None	15 (7.4)	84 (15.2)	345 (80.2)	595 (95.5)	1039 (57.4)
Oral sedation (successful)	181 (89.2)	423 (76.5)	64 (14.9)	9 (1.4)	677 (37.4)
Intravenous sedation	2 (1.0)	9 (1.6)	7 (1.6)	7 (1.1)	25 (1.4)
[failed oral sedation]	[2]	[9]	[4]	[1]	[16]
General anaesthesia	5 (2.5)	37 (6.7)	14 (3.3)	12 (1.9)	68 (3.8)
[failed oral sedation]	[5]	[20]	[9]	[0]	[34]
Total	203 (100)	553 (100)	430 (100)	623 (100)	1809 (100)

Table 1. *MRI scan subjects categorised by age and sedative type*

B. Discussion

Sedation during CT and MRI for the pediatric population is one of the most common medical procedures. It has been recognized in the professional community that any good MRI service must include sedation at an efficient level of compliance. Therefore, it is a clear guideline on what is expected of every facility that offers such a service to have in place an organized and efficient pediatric sedation program which would guarantee the safety and success of their procedures.

Nonetheless, the operationalization of these programs is not uniform; this lack of practice deviates from the preferred protocol, creating a noticeable vacuum in the pediatric sedation area. The history of the Sedation Service Program (SSP) came into being while considering such situations. Recently, there has been an increasing need for MRI sedation programs with a particular focus on implementing a comprehensive and dedicated team that is solely responsible for sedating patients during MRI scans; this demand is seen in the works of Hollman et al.

In establishing an elaborate pediatric sedation program, a sedation room and a team of registered nurses, a second-year pediatric resident, and a pediatric critical care attending physician were used. Our program might not be as complex as theirs in terms of the staff but has nonetheless been effective and can be considered successful. It is important to recognize that age alone does not dictate whether sedation is appropriate for pediatric patients; levels of anxiety play a role in addition to neurodevelopmental maturity factors.

An extensive review of pediatric sedation practices for CT scanning in the United States by Keeter et al. revealed that over 80% of infants required sedation during the process. Similarly, our data showed a significant decrease in the number of children needing sedation as they aged. Specifically, almost all patients less than a year old required sedation, while fewer than 5% of those 11 or older did. Thus, it can be concluded that age alone does not sufficiently determine the need for sedation among pediatric patients.

With proper wrapping methods and allowing the infant to fall asleep both before and during the procedure, many babies have been scanned without receiving any medication. This has been an effective and safe way to ensure that the infants are comfortable, while still obtaining accurate images using MRI scans. The largest portion of MRI demand—57%—comes from patients who do not require sedation.

In order to achieve enhanced efficiency and greater patient satisfaction, it is highly recommended that the service offered to this specific group of patients be tailored for improvement. The optimization of MRI service may involve various steps such as providing full pre-procedure patient education, especially when working with pediatric patients to calm them down before the procedure, offering a child-friendly play area at the facility level, and improving collaboration between units and the scanning unit. Implementation of these actions can greatly reduce patient anxiety and possibly decrease sedation requirements, leading to cost savings.

An anesthetist assesses all MRI requests for patients who were noncompliant with oral sedation in the past or those

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referred specifically for general anesthesia to ensure that sedation is used correctly. In this way, it is guaranteed that a decision on the type of sedation and its suitability is made competently, impartially, and considering individually defined patient needs and circumstances. The cost of an MRI scan in our hospital under general anesthesia is considerably higher than those conducted with intravenous/oral sedation or no sedation.

There is a significant cost difference that highlights the value of identifying alternative strategies to general anesthesia when possible in efforts to reduce financial strains on patients and healthcare systems. Sedation is usually required for imaging procedures in 1- to 5-year-old patients. However, we have successfully established a system, our successful scanning protocol (SSP), that has allowed us to conduct MRI scans without sedation in 84 of these children.

Although we had generally been sending 25 children who were referred to our program for imaging with sedation, but instead received the intravenous method, it might be less labor-intensive than the model that Hollman et al suggest. Therefore, our approach has been safe and efficient at attaining these outcomes. We need to always analyze what we do because by doing this, in case of our clients, we give the best possible care through comprehensive and competent practice. Variations in the use of sedatives show a wide range [11].

Chloral hydrate is the sedation agent in our institution because it is perceived to be broad and safe. It should be kept in mind, nonetheless, that this may not be common practice in the United States. The dose of chloral hydrate used can differ and can range from 50 to 100 mg/kg; we would like to note that there are reports of administration of 125 mg/kg dosages as well [12].

In assessing the success of our oral sedation program, it is significant that a success rate of 93% has been found. This number is in contrast with the rates reported in various literature for chloral hydrate as the primary agent of sedation(6,16),. Additionally, no adverse critical incidents were encountered in the group supervised by an anesthetist. However, in the oral sedation group, two cases of respiratory depression were reported, thus resulting in a critical incident rate of 0.3% per cohort [13].

When compared to other groups using high-dose chloral hydrate as their primary sedation agent, our rate of adverse events is actually lower than theirs [14]. Safety certainly plays a vital role in any sedation program, so we have to be confident that we are safe. In our case, implementing a separate MRI sedation team at present does not seem warranted since the implementation would not substantially reduce costs or improve patient safety.

The study by Morton and Oomen [15] is devoted to a key part of sedation practice, which is patient choice, their preparation, and monitoring throughout the application of sedative substances. The research that they undertake seeks to develop a detailed protocol that will serve as a safeguard for medical staff administering the sedation process. It is crucial to ensure that those supervising sedated children have appropriate pediatric resuscitation training, techniques for monitoring the effectiveness of sedation, and skills necessary for providing the necessary level of care [16]. Although discussing various facets of the management of procedural sedation, they do not directly address the role of personnel involved in it and their responsibility concerning patient selection or the number reached at any given time [17].

This gap leaves the way open for others to look further and explore more deeply. Observing outcomes in Morton and Oomen’s unit, such as morbidity rates and total success rate, after the adoption of their protocol would be interesting. Our research indicates that it is highly recommended that a Sedation Safety Protocol (SSP) be used for MRI scan purposes. It has been conclusively established through our research that implementing an SSP is not only effective but also ensures the safety and efficacy of the sedation process [18]. Referring to a standalone pediatric sedation unit or a dedicated sedation team does not appear to be imperative for the success of the program. Our findings point towards the fact that with the Sedation Safety Protocol (SSP) implementation, desired results can be attained, and an enhanced level of patient safety during sedation procedures can be maintained. When creating sedation programs, one must take into account factors such as context and available resources because every healthcare facility has unique needs and circumstances that determine the success of such initiatives.

A lot of work needs to be done for us to find out more about how well various sedation protocols can balance the benefits and disadvantages, ultimately making them effective in supporting patient care and recovery. Moreover, upcoming studies should delve into the persisting effects and resistance to discontinuation of Sedation Safety Protocol (SSP) use so that it remains reliable and safe throughout the medical industry.

Conclusion

The implementation of a structured sedation program (SSP) for pediatric patients undergoing MRI scans has demonstrated significant effectiveness and safety outcomes. Through meticulous patient selection based on age, cooperation level, and medical considerations, along with the utilization of oral sedation, intravenous sedation, or general anesthesia as appropriate, the program achieved successful sedation in the majority of cases while ensuring optimal resource utilization. However, challenges such as oral sedation failure in younger children and occasional respiratory issues with specific medications underscore the need for ongoing refinement and monitoring of sedation protocols. Future research should focus on evaluating long-term outcomes, including morbidity rates

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and sustained success with SSP adoption, while also exploring ways to enhance patient care and recovery within sedation practices, taking into account contextual variations and resource availability across healthcare settings. Additionally, investigating the durability and adaptability of SSPs over time remains a crucial area for further exploration to ensure continued patient safety and quality of care in pediatric sedation for MRI procedures.

References

1. S. Weiss, "Sedation in Paediatric Patients for Nuclear Medicine Procedures," Seminars in Nuclear Medicine, vol. 23, pp. 190–198, 1993.
2. K. Johnson, "Report of a Joint Working Party Sedation and Anaesthesia in Radiology," The Royal College of Anaesthetists and the Royal College of Radiologists, London, 1992.
3. R.F. Charlton, "Report of an Expert Working Party of the Standing Dental Advisory Committee General Anaesthesia, Sedation, and Resuscitation in Dentistry (The Poswilo Report)," London: General Council, 1990.
4. R. Sidhu, "Commission on the Provision of Surgical Services. Report of the Working Party on Guidelines for Sedation by Non-Anesthetists," London: Royal College of Surgeons, 1993.
5. C. Merola, C. Albarracin, P. Lebowitz, R. S. Bienkowski, and S. M. Barst, "An Audit of Adverse Events in Children Sedated with Chloral Hydrate or Propofol During Imaging Studies," Paediatric Anaesthesia, vol. 5, pp. 375–378, 1995.
6. S. B. Greenberg, E. N. Ferber, and C. L. Aspinall, "High Dose Chloral Hydrate Sedation for Children Undergoing C.T.," Journal of Computer Assisted Tomography, vol. 15, pp. 467–469, 1991.
7. N. S. Morton and G. J. Omen, "Towards Safer Sedation of Children," in Acute Paediatric Pain Management, N. S. Morton, Ed. London: W.B. Saunders, 1998.
8. G. A. Hollman, M. K. Elderbrook, and B. VanDenLangenberg, "Results of a Pediatric Sedation Program on Head MRI Scan Success Rates and Procedure Duration Times," Clinical Pediatrics, vol. 34, pp. 300–305, 1995.
9. S. Keeter, R. M. Benator, S. M. Weinberg, and M. A. Hartenberg, "Sedation in Pediatric CT. National Survey of Current Practice," Radiology, vol. 175, pp. 745–752, 1990.
10. B. A. Cook, J. W. Bass, S. Nomizu, and M. E. Alexander, "Sedation of Children for Technical Procedures: Current Standard of Practice," Clinical Pediatrics, vol. 31, pp. 137–142, 1992.
11. D. M. Fisher, "Sedation of Pediatric Patients: An Anesthesiologist's Perspective," Radiology, vol. 175, pp. 613–615, 1990.
12. J. D. Strain, L. A. Harvey, L. C. Foley, and J. B. Campbell, "Intravenously Administered Pentobarbital Sodium for Sedation in Pediatric CT," Pediatric Radiology, vol. 16, pp. 105–108, 1986.
13. C. B. Caldwell and D. M. Fisher, "Sedating Pediatric Patients: Is Propofol a Panacea?," Radiology, vol. 186, pp. 9–10, 1993.
14. W. S. Ball Jr. and G. S. Bisset, "Proper Sedation Essential to MRI in Children," Diagnostic Imaging, vol. 11, pp. 108–111, 1990.
15. A. M. Hubbard, R. I. Markowitz, B. Kimmel, M. Kroger, and M. B. Bartok, "Sedation for Pediatric Patients Undergoing CT and MRI," Journal of Computer Assisted Tomography, vol. 16, pp. 3–6, 1992.
16. L. Marti-Bonmati, O. Ronchera Oms, C. Casillas, C. Poyatos, C. Torrijo, and N. V. Jimenez, "Randomised Double-Blind Clinical Trial of Intermediate Versus High-Dose Chloral Hydrate for Neuroimaging of Children," Neuroradiology, vol. 37, pp. 687–691, 1995.
17. N. S. Morton and G. J. Oomen, "Development of a Selection and Monitoring Protocol for Safe Sedation of Children," Paediatric Anaesthesia, vol. 8, pp. 65–68, 1998.
18. L. Lowrie, A. H. Weiss, and C. Lacombe, "The Pediatric Sedation Unit: A Mechanism for Pediatric Sedation," Pediatrics, vol. 102, p. E30, 1998.

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