CASE REPORT

Ketamine-Based Sedation Among Young Infants During MRI at Mzuzu Central Hospital: Initial Experience in a Resource-Limited Setting in Malawi

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Abstract

Background

Magnetic resonance imaging (MRI) in young infants requires effective immobilization to ensure diagnostic image quality. Although non-pharmacological approaches such as the feed-and-swaddle technique are widely recommended, they are not always successful. Sedation in neonates remains controversial, particularly in resource-limited settings. This study aimed to evaluate the feasibility and observed safety profile of intramuscular ketamine for MRI sedation in young infants at Mzuzu Central Hospital, Malawi.

Methods

This retrospective case series included five young infants (aged 3-90 days) who underwent abdominal MRI under ketamine sedation between August 2025 and March 2026. Diagnoses included three cases of congenital biliary atresia, one cloacal exstrophy, and one sacrococcygeal teratoma. All patients initially failed non-pharmacological sedation using the feed-and-swaddle technique alone. Sedation was performed by an experienced anesthesiologist using intramuscular atropine (0.01 mg/kg) followed by ketamine (4-5 mg/kg). MRI scans were performed using a 1.5 T system. Respiratory status was assessed via MRI respiratory gating waveforms. Clinical data were collected from medical records, including anesthesia records, and analyzed descriptively.

Results

All MRI examinations were successfully completed, with a mean scan time of 23 minutes. No clinically significant adverse events were observed, including oxygen desaturation or airway-related complications. No overt clinical signs suggestive of hemodynamic instability were noted. All images were of diagnostic quality as assessed by the radiologist. The target sedation depth was achieved in all cases without the need for additional dosing. The mean time to emergence was 40 minutes, and the mean time to full recovery was 94 minutes, with no cases of delayed recovery or agitation.

Conclusion

Intramuscular ketamine, when used with appropriate precautions, appears to be a feasible option and may represent a safe alternative for MRI sedation in young infants in resource-limited settings.

Keywords: Young infant; Ketamine; Magnetic resonance imaging; Sedation; Resource-limited setting

Introduction

Magnetic resonance imaging (MRI) plays a critical role in the evaluation of congenital anomalies in young infants. However, motion artifacts remain a major challenge, often necessitating effective immobilization strategies[1]. The feed-and-swaddle technique is widely recommended as a first-line approach due to its favorable safety profile, but its success is inconsistent, particularly in cases requiring prolonged imaging or involving unstable patients[1,2].

Sedation in young infants remains controversial because of immature respiratory control and increased susceptibility to airway complications[3]. In high-resource settings, agents such as dexmedetomidine are increasingly used due to their minimal respiratory depressant effects[4,5]. However, such agents are often unavailable in low- and middle-income countries.Mzuzu Central Hospital, a tertiary referral center in Malawi, faces significant resource constraints, including limited sedative options and lack of MRI-compatible monitoring equipment. In this context, intramuscular ketamine represents a potentially practical alternative for MRI sedation. However, evidence regarding its use in young infants in resource-limited settings remains limited.

Therefore, the aim of this study was to evaluate the feasibility and safety of intramuscular ketamine for MRI sedation in young infants in a resource-limited setting.

Study Design and Patients

This study was a retrospective case series conducted at Mzuzu Central Hospital. Between August 2025 and March 2026, five young infants (aged 3-90 days) underwent abdominal MRI under ketamine sedation. Diagnoses included three cases of congenital biliary atresia, one cloacal exstrophy, and one sacrococcygeal teratoma.

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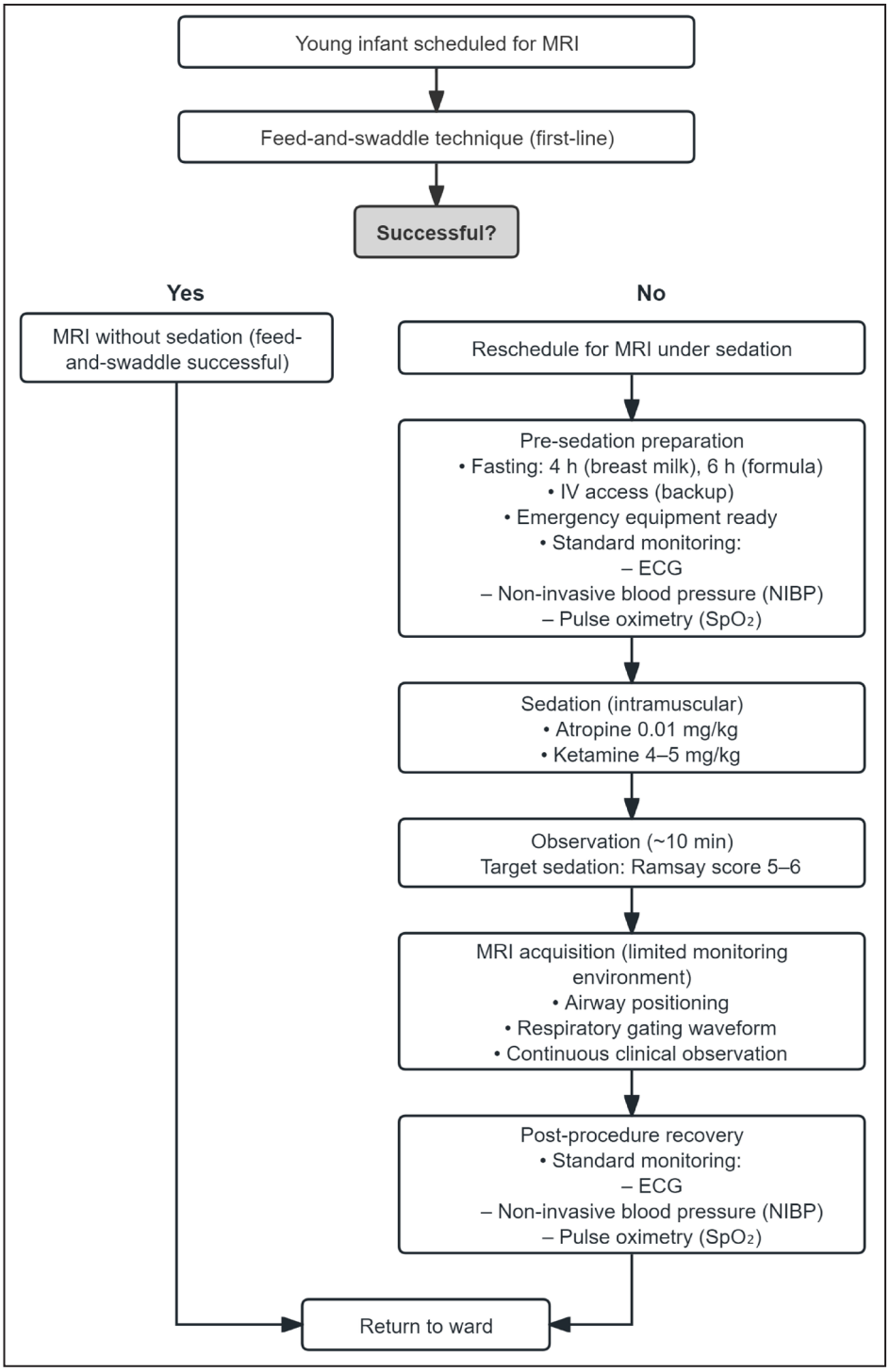

Figure 1. Workflow for MRI in young infants at Mzuzu Central Hospital

Young infants initially underwent non-pharmacological sedation using the feed-and-swaddle technique. If successful, MRI was performed without pharmacological sedation. If unsuccessful, patients were rescheduled for MRI under sedation.

For rescheduled patients, pre-sedation assessment and standard fasting were performed prior to the procedure. Baseline monitoring, intravenous access, and preparation of emergency resuscitation equipment were completed before intramuscular administration of atropine followed by ketamine. After a brief observation period, MRI was performed with respiratory monitoring using gating waveforms. Post-procedure recovery monitoring continued until full awakening, after which patients were returned to the ward.

All patients initially failed non-pharmacological sedation using the feed-and-swaddle technique alone.

Methods

All procedures were performed by an experienced anesthesiologist following a standardized protocol. Prior to sedation, all patients underwent pre-procedural preparation, including the establishment of intravenous access with a peripheral cannula for emergency use. After unsuccessful attempts at non-pharmacological sedation, all patients were rescheduled for MRI under sedation. Patients were managed according to established fasting guidelines, with a minimum fasting period of 4 hours for breast milk and 6 hours for formula feeding[6].

Baseline monitoring was conducted in the preparation area and included electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry (SpO_2).

Age-appropriate emergency resuscitation equipment for young infants was prepared and immediately available throughout the procedure. This included an Ambu bag, oxygen reservoir bag, suction devices, oropharyngeal airways,

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Table 1. Clinical characteristics and outcomes

Case	Age (days)	Weight (kg)	Sex	Diagnosis	Ketamine (mg/kg)	Scan time (min)	Time to emergence (min)	Time to full recovery (min)	Adverse events	Image quality
1	3	1.8	Indeterminate*	cloacal exstrophy	4	18	38	70	None	Diagnostic
2	11	1.8	F	sacrococcygeal teratoma	4	25	44	112	None	Diagnostic
3	12	2.7	F	congenital biliary atresia	5	24	42	95	None	Diagnostic
4	41	3.0	M	congenital biliary atresia	5	26	40	105	None	Diagnostic
5	90	5.6	F	congenital biliary atresia	4	20	36	86	None	Diagnostic

* **Indeterminate sex due to congenital anomaly (cloacal exstrophy)**

a laryngoscope with appropriately sized endotracheal tubes, and emergency medications such as epinephrine. The anesthesiologist remained in close proximity at all times, with readiness for immediate airway intervention if required.

Sedation was induced with intramuscular atropine (0.01 mg/kg) to reduce airway secretions, followed by intramuscular ketamine (4-5 mg/kg). After drug administration, infants were observed for approximately 10 minutes before transfer to the MRI suite to ensure adequate sedation depth. Sedation depth was assessed clinically using the Ramsay Sedation Scale by the attending anesthesiologist, with a target level of 5-6, which was considered sufficient for motion-free MRI acquisition.

MRI examinations were performed using a 1.5 Tesla scanner. Patients were positioned supine with a head-first orientation. A thin pad was placed under the shoulders to facilitate airway patency, and the head was gently rotated to one side to allow drainage of oral secretions. After sedation, infants were gently wrapped to maintain thermal comfort and provide supportive positioning during the MRI examination. Due to the lack of a dedicated pediatric coil, an 8-channel knee coil was used for image acquisition.

Continuous hemodynamic monitoring was not available within the MRI suite due to equipment limitations. Therefore, physiological stability during scanning was inferred from pre- and post-procedure assessments, together with continuous clinical observation and respiratory monitoring using MRI gating waveforms. The anesthesiologist continuously assessed breathing patterns, and the scan was interrupted if any abnormal respiratory pattern was detected.

Following completion of the MRI examination, all patients were transferred back to the preparation area for continued monitoring until full recovery, after which they were safely returned to the ward.

Adverse events were predefined and included oxygen desaturation (SpO_2 < 92%), airway obstruction requiring intervention, apnea, laryngospasm, bradycardia, hypotension, excessive secretions, and emergence agitation.

Clinical data, including patient characteristics, sedation outcomes, and adverse events, were collected from medical records, with peri-procedural and monitoring data extracted from anesthesia records, and analyzed descriptively.

Ethical approval was obtained from the institutional ethics committee (Approval No. MZUNIERC/DOR/26/39). Given the retrospective nature of this case series and the use of anonymized clinical data, the requirement for informed consent was waived. The overall workflow is illustrated in Figure 1.

Results

All five MRI examinations were successfully completed. The mean scan duration was 23 minutes (range: 18-26 minutes). No clinically significant adverse events were observed, including oxygen desaturation or airway obstruction. No overt clinical signs suggestive of hemodynamic instability were noted before or after scanning. All examinations yielded diagnostic-quality images, as determined by the attending radiologist.

The target sedation depth (Ramsay score 5-6) was achieved in all infants, and no additional ketamine dosing was required.

The mean time to emergence (defined as the first purposeful movement or eye opening) was 40 minutes (range: 36-44 minutes). The mean time to full recovery (defined as return to baseline consciousness and stable vital signs allowing safe transfer to the ward) was 94 minutes (range: 70-112 minutes). Recovery was uneventful in all cases, with no delayed emergence, agitation, or need for airway intervention during the recovery period. The clinical characteristics and sedation outcomes of the five cases are summarized in Table 1.

Discussion

This case series suggests that intramuscular ketamine can be used as a practical and effective sedation strategy for young infants during MRI examinations in a resource-limited setting. Despite ongoing concerns regarding sedation in infants younger than three months, all procedures in this series were completed without major observed adverse events and yielded satisfactory imaging outcomes.

In high-resource settings, dexmedetomidine has become a preferred agent for pediatric MRI sedation because of its minimal respiratory depressant effects and favorable

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safety profile[4]. Previous studies have also demonstrated its effectiveness in infants, with relatively stable hemodynamic profiles and a low incidence of airway complications[5]. However, dexmedetomidine was not available in our setting, which necessitated the use of alternative agents.

At our institution, available sedation options were limited to ketamine, propofol, and diazepam. Under these circumstances, ketamine was selected because of its rapid onset, reliable sedative effect, and relative preservation of spontaneous breathing and protective airway reflexes, which are particularly advantageous in young infants with limited physiological reserve. In contrast, propofol carries a higher risk of respiratory depression and hypotension, while diazepam may lead to prolonged sedation because of immature hepatic metabolism in this population[7,8].

In this context, ketamine represented a reasonable alternative, particularly for abdominal MRI, which requires relatively prolonged and stable sedation. Although ketamine may be associated with adverse effects such as hypersalivation and laryngospasm, these risks can be mitigated with appropriate precautions, including anticholinergic premedication and careful airway positioning[9,10].

An important consideration in our protocol was the dosing strategy of ketamine. A relatively higher intramuscular dose (4-5 mg/kg) was selected to ensure adequate depth and duration of sedation for abdominal MRI, which typically requires longer acquisition times compared to other imaging studies. Intramuscular administration was preferred over intravenous access to simplify workflow and reduce procedural distress in this age group. The chosen dose provided a predictable onset and sufficient duration of action, allowing completion of imaging without the need for additional dosing in all cases. Notably, no patient required supplemental dosing, indicating that the selected dosing regimen was sufficient to maintain adequate sedation throughout the procedure.

Another important limitation in our setting was the lack of MRI-compatible monitoring equipment. Hemodynamic parameters could not be continuously monitored within the MRI suite due to the lack of MRI-compatible equipment. As a result, physiological stability was assessed indirectly based on pre- and post-scan measurements, together with continuous clinical observation and respiratory monitoring using MRI gating waveforms. While this approach is suboptimal compared to standard monitoring, no overt clinical signs suggestive of hemodynamic instability were observed. All procedures were performed by an experienced anesthesiologist, which may have contributed to the favorable safety outcomes[11,12].

Overall, our findings support the feasibility of using intramuscular ketamine for MRI sedation in young infants in resource-limited settings when appropriate preparation and safety measures are implemented. These observations may be particularly relevant for similar clinical environments where access to advanced sedative agents and MRI-compatible monitoring equipment is limited. However, caution is warranted when extrapolating these results to different clinical environments or patient populations[13-15].

This study has several limitations that should be considered when interpreting the findings. First, the sample size was small, which limits the generalizability of the findings. Second, standard MRI-compatible physiological monitoring could not be implemented during scanning because of equipment constraints; instead, respiratory status was assessed using MRI gating waveforms in combination with direct clinical observation, which is less comprehensive than standard monitoring systems. Third, this was a single-center study without a control group. Larger prospective studies are therefore needed to further evaluate the safety and efficacy of this approach.

Conclusion

Intramuscular ketamine, when administered with appropriate precautions and experienced supervision, appears to be a feasible option and may represent a safe alternative for MRI sedation in young infants in resource-limited settings. Further studies with larger sample sizes are needed to confirm these findings.

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