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Occurrence and Management Strategies for Emergence Delirium in Children

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Abstract

Background: Emergence delirium (ED), or emergence agitation, is a common and challenging postoperative complication in children recovering from general anesthesia. It is characterized by restlessness, inconsolable crying, thrashing, and confusion, posing risks to patient safety and prolonging the recovery process. This study aimed to determine the incidence of ED, evaluate management strategies, and identify associated risk factors in pediatric patients.

Methods: A retrospective cohort study was conducted at the Department of Pediatric Anesthesiology, Indira Gandhi Institute of Medical Sciences, Puducherry. Medical records of 150 children aged 1–12 years who underwent elective or emergency general anesthesia between January and June 2025 were reviewed. Data collected included demographics, surgical and anesthetic details, postoperative behavioral observations, and interventions for the ED. Delirium incidence, severity, and management efficacy were analyzed using descriptive statistics, Chi-square tests, and ANOVA, with $p < 0.05$ considered significant.

Results: ED occurred in 31 of 150 children (20.7%). The highest incidence was observed in children aged 4–6 years (38.6%), followed by 1–3 years (29.5%), while children aged 7–12 years showed the lowest incidence (10.9%). Male and female patients were affected almost equally (21.6% vs. 19.4%). ED incidence was higher in emergency surgeries (27.3%) than in elective procedures (17.9%), although the difference was not statistically significant. Management strategies included dexmedetomidine (32.3%, 90% effective), propofol (19.4%, 83.3% effective), parental presence (25.8%, 75% effective), and distraction techniques (22.5%, 71.4% effective), with minimal complications reported.

Conclusion: Emergence delirium affects approximately one in five pediatric patients, with younger age being the primary risk factor. Both pharmacological and non-pharmacological strategies effectively manage ED, with dexmedetomidine showing the highest efficacy. Early identification of high-risk children and timely interventions can improve postoperative safety, reduce agitation, and enhance recovery, highlighting the need for standardized prevention and management protocols in pediatric anesthesia.

Keywords: Emergence delirium, pediatric anesthesia, dexmedetomidine, propofol, postoperative agitation, risk factors

Introduction

Emergence delirium (ED), also termed emergence agitation, is a frequent and challenging complication observed in children recovering from general anaesthesia. It is defined as a transient state of marked irritability, confusion, inconsolable crying, and purposeless physical activity, often accompanied by thrashing and aggressive behaviour during the immediate postoperative period [1]. Such manifestations can be distressing to caregivers and healthcare providers, and may also jeopardize patient safety by increasing the risk of self-injury, accidental removal of catheters, or disruption of surgical wounds [2].

The reported incidence of ED varies widely, ranging from 10% to 80% in paediatric patients, depending on age, anaesthetic technique, type of surgery, and the diagnostic criteria applied [3,4]. Children younger than five years are particularly vulnerable, with a peak incidence in preschoolers [5]. Although the exact pathophysiological mechanism remains unclear, multiple factors have been implicated. These include the use of low-solubility volatile anaesthetics such as sevoflurane and desflurane [6], rapid awakening from anaesthesia [7], preoperative anxiety [8], inadequate pain control [9], and certain types of surgical procedures such as otorhinolaryngologic or ophthalmic surgeries [10]. From a clinical perspective, ED is a significant perioperative concern. Besides patient safety risks, it can prolong recovery room stay, increase nursing workload, and result in emotional distress for parents and staff [11]. Moreover, repeated episodes may potentially affect a child's future response to anaesthesia and medical environments [12]. Thus, identifying high-risk groups and implementing preventive as well as therapeutic strategies are of paramount importance. Various pharmacological approaches, including the use of propofol, dexmedetomidine, clonidine, and opioids, along with non-pharmacological interventions such as parental presence and behavioural preparation, have been evaluated with variable success [13–15].

Given the clinical implications, the present study aims to (i) determine the incidence of ED in paediatric patients undergoing general anaesthesia, (ii) evaluate the efficacy of different management strategies, and (iii) identify risk factors associated with its occurrence. The insights gained are expected to inform better perioperative practices and contribute to safer paediatric anaesthetic care.

Materials & Methods

Study Setting: The study was carried out in the Department of Paediatric Anaesthesiology at Indira Gandhi Institute of Medical Sciences, Puducherry. IGIMS is a tertiary care teaching hospital that offers a wide range of surgical and anaesthetic services. Due to the high volume of paediatric surgeries performed, it provided an ideal setting for investigating the prevalence and management of emergence delirium.

Study Duration: The study included data collected over six months, from January 2025 to June 2025.

Sample Size: A total of 150 paediatric patients who underwent general anaesthesia were included. This sample size was chosen to ensure sufficient statistical power to assess the incidence of emergence delirium, associated factors, and treatment outcomes.

Inclusion Criteria

- Children aged 1 to 12 years.
- Patients undergoing elective or emergency surgical procedures under general anaesthesia.
- Postoperative monitoring for emergence of delirium symptoms as part of routine care.
- Availability of complete anaesthesia records and postoperative notes.

Exclusion Criteria

- Patients younger than 1 year or older than 12 years.
- Children receiving anaesthesia by methods other than general anaesthesia (e.g., regional or local).
- Incomplete medical records or missing essential data.
- Children with pre-existing neurodevelopmental or psychiatric disorders, which could confound the assessment of emergence delirium.

Data Collection

- Data were retrieved from medical and anaesthetic records of paediatric patients who received general anaesthesia during the study period. Information extracted included:

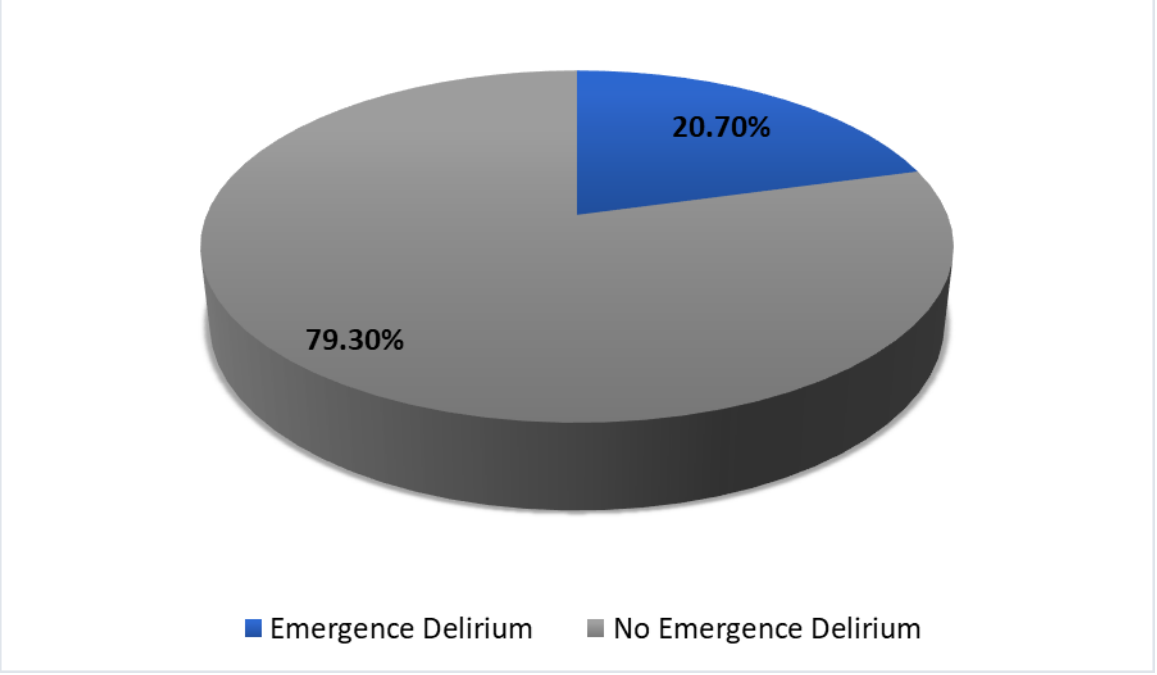
- Demographics (age, sex).
- Surgical details (type of procedure, duration).
- Anaesthetic details (drugs administered, dosage, and duration).
- Postoperative notes documenting behavioural symptoms such as anxiety, agitation, restlessness, or confusion.
- Management interventions, including pharmacological measures (e.g., propofol, dexmedetomidine) and non-pharmacological methods (e.g., parental presence, behavioural reassurance).
- Emergence delirium episodes were identified and categorized by anaesthesiologists and nursing staff based on postoperative recovery room documentation.

Variables: The primary variable was the incidence of emergence delirium, recorded as the number and proportion of children who developed symptoms. Delirium severity was classified as mild, moderate, or severe using clinical observations and standardized scales. Management strategies were classified as pharmacological or non-pharmacological. Other variables included patient age, sex, type of surgery, preoperative anxiety, and comorbid health conditions, which were evaluated as potential risk factors.

Statistical Analysis: All analyses were conducted using SPSS version 28.0. Descriptive statistics such as mean, standard deviation, frequencies, and percentages were used to summarize demographic and clinical variables. The Chi-square test was applied to explore associations between categorical variables (e.g., treatment method vs. delirium incidence). Independent t-test or ANOVA was used to compare continuous variables (e.g., age, recovery duration) across groups. A p-value < 0.05 was considered statistically significant.

Results

Figure 1: Incidence of Emergence Delirium and Demographic Characteristics (n = 150)



Out of 150 pediatric patients, 31 (20.7%) developed emergence delirium, while 119 (79.3%) showed no symptoms. This indicates that approximately one in five children experienced delirium during recovery from general anesthesia.

Table 1: Age distribution among the participants (n = 150)

Age Group	Number (%)	Emergence Delirium	No Emergence Delirium	Total (%)
1–3 Years	44 (29.3)	13 (29.5)	31 (26.1)	44 (29.3)
4–6 Years	56 (37.3)	17 (38.6)	39 (32.8)	56 (37.3)
7–12 Years	50 (33.4)	5 (10.9)	45 (37.9)	50 (33.4)

Out of 150 pediatric patients, the incidence of emergence delirium was highest in the 4–6 years age group (38.6%), followed by 1–3 years (29.5%). The lowest incidence occurred in the 7–12 years group (10.9%). These findings indicate that younger children, especially those between 1 and 6 years, are more prone to experiencing emergence delirium after general anesthesia.

Table 2: Gender distribution among the participants (n = 150)

Gender	Number (%)	Emergence Delirium	No Emergence Delirium	Total (%)
Male	88 (58.7)	19 (21.6)	69 (57.9)	88 (58.7)
Female	62 (41.3)	12 (19.4)	50 (42.1)	62 (41.3)

Among the 150 pediatric patients, 21.6% of males (19/88) and 19.4% of females (12/62) developed emergence delirium. This indicates that both genders were affected almost equally, with a slightly higher incidence in males, though the difference was not statistically significant.

Table 3: Incidence of Emergence Delirium by Type of Surgery (n = 150)

Surgery Type	Number (%)	Emergence Delirium	No Emergence Delirium	Total (%)
Elective	106 (70.7)	19 (17.9)	87 (82.1)	106 (70.7)
Emergency	44 (29.3)	12 (27.3)	32 (72.7)	44 (29.3)
Total	150 (100)	31 (20.7)	119 (79.3)	150 (100)

Of the 150 pediatric patients, emergence delirium occurred in 17.9% of elective surgeries (19/106) and 27.3% of emergency surgeries (12/44). Although the incidence was higher in emergency procedures, this difference was not statistically significant, suggesting that factors other than surgery type may also influence the development of emergence delirium.

Table 4: Management Strategies for Emergence Delirium (n = 31)

Management Strategy	Number of Patients (%)	Effectiveness (%)	Resolved Delirium (n, %)	No Effect / Partial Resolution (n, %)	Complications
Dexmedetomidine	10 (32.3)	90.0	9 (90.0)	1 (10.0)	None reported
Propofol	6 (19.4)	83.3	5 (83.3)	1 (16.7)	Mild sedation
Parental Presence	8 (25.8)	75.0	6 (75.0)	2 (25.0)	None reported
Distraction Methods	7 (22.5)	71.4	5 (71.4)	2 (28.6)	None reported
Total	31 (100)	—	—	—	—

Among the 31 patients who developed emergence delirium, dexmedetomidine was the most frequently used intervention (32.3%) and showed the highest effectiveness, resolving delirium in 90% of cases. Propofol was used in 19.4% of cases and successfully resolved symptoms in 83.3%, with mild sedation reported as a complication in one patient. Non-pharmacological strategies, including parental presence (25.8%) and distraction techniques (22.5%), were also effective, resolving delirium in 75% and 71.4% of cases, respectively, with no significant complications. These findings indicate that both pharmacological and non-pharmacological interventions are effective, with dexmedetomidine showing the greatest efficacy.

Discussion

Emergence delirium (ED), also referred to as emergence agitation, is a transient postoperative behavioral disturbance characterized by restlessness, inconsolable crying, thrashing, and confusion in children recovering from general anesthesia. In the present study of 150 pediatric patients aged 1–12 years, the overall incidence of ED was 20.7%. This finding is consistent with previously reported incidences ranging from 10% to 80%, depending on patient age, type of surgery, anesthetic technique, and assessment tools, as described by Sikich et al and Lerman et al and Vlajkovic et al and Sindjelic et al [1,2]. The relatively moderate incidence observed in our cohort may be attributed to advances in anesthetic practice, improved perioperative pain control, and vigilant postoperative monitoring. The highest incidence of ED in our study was observed in children aged 4–6 years (38.6%), followed by those aged 1–3 years (29.5%), while the lowest incidence occurred in the 7–12-year age group (10.9%). This age-related distribution closely parallels findings reported by Cravero et al. and Bajwa et al., who identified preschool-aged children as the most vulnerable group for ED [5,4]. Furthermore, Aono et al. and Kain et al. proposed that the increased susceptibility in younger children may be related to immature central nervous system development, limited cognitive understanding of the perioperative experience, and heightened separation anxiety [6,8]. In contrast, older children demonstrate improved emotional regulation and cognitive adaptability, which likely explains the reduced incidence of ED in the 7–12-year age group.

In the present study, ED occurred slightly more frequently in males (21.6%) than females (19.4%), although this difference was not statistically significant. This observation aligns with studies by Vlajkovic and Sindjelic and Mason, both of whom reported no significant gender-based differences in ED incidence [2,12]. Although earlier research by Aono et al. suggested a marginally higher incidence in boys [6], contemporary evidence indicates that gender alone is not a major determinant of ED, with perioperative factors playing a more influential role. The incidence of ED was higher in emergency procedures (27.3%) compared to elective surgeries (17.9%), though this difference did not reach statistical significance. This trend is consistent with observations by Dahmani et al. and Voepel-Lewis et al., who highlighted that emergency surgeries are often associated with increased anxiety, inadequate preoperative preparation, and heightened psychological stress, all of which may predispose children to ED [3,9]. The urgency of emergency interventions, coupled with unfamiliar surroundings and limited psychological reassurance, may further exacerbate postoperative agitation. Nevertheless, our findings suggest that age and anesthetic technique are stronger predictors of ED than surgical urgency alone.

The role of anesthetic agents in the development of ED is well established. Volatile anesthetics such as sevoflurane and desflurane have been strongly associated with a higher incidence of ED due to their rapid emergence profile and low blood–gas solubility. Studies by Cravero et al. and Bajwa et al. demonstrated that these agents can result in abrupt awakening and transient confusion, particularly in children with immature coping mechanisms [5,4]. Similarly, Davis et al. reported a higher rate of agitation following sevoflurane anesthesia compared to halothane [7]. Although the present study did not stratify ED incidence based on specific anesthetic agents, the observed pattern is consistent with these pharmacological findings. Among the 31 children who developed ED, dexmedetomidine was the most frequently administered pharmacologic intervention (32.3%) and demonstrated high efficacy, resolving ED in 90% of cases. This outcome is consistent with findings reported by Sun et al., Kim et al., and Mason, who emphasized the sedative, anxiolytic, and analgesic properties of dexmedetomidine without significant respiratory depression [13,14,12]. Propofol, administered in 19.4% of cases, successfully resolved ED in 83.3% of patients, corroborating earlier studies by Abu-Shahwan and Aouad and Nasr, which supported the use of low-dose propofol at the end of surgery to attenuate emergence agitation [10,11].

Non-pharmacological interventions also played an important role in ED management. Parental presence (25.8%) and distraction techniques (22.5%) were effective in resolving ED in 75% and 71.4% of cases, respectively. These findings reinforce the conclusions of Kain et al., who emphasized that parental presence and behavioral distraction significantly reduce both preoperative anxiety and postoperative agitation in children [8]. Such strategies are safe, cost-effective, and easily implementable, making them valuable adjuncts in pediatric anesthesia practice. Overall, the findings of this study support existing literature indicating that younger age, perioperative anxiety, and anesthetic technique are key predictors of ED. Although gender and surgical urgency were not statistically significant predictors in our cohort, the slightly higher incidence observed in emergency procedures aligns with observations by Dahmani et al. and Voepel-Lewis et al. [3,9]. These results highlight the importance of psychological preparedness and individualized anesthetic strategies in minimizing ED risk.

Clinical Implications

The results of this study underscore the need for a multimodal approach to the prevention and management of emergence delirium. Dexmedetomidine should be considered the first-line pharmacologic agent, with propofol serving as an effective alternative when appropriate. Non-pharmacological interventions, particularly parental presence and distraction techniques, should be routinely incorporated into perioperative care, especially for preschool-aged children. Preoperative psychological preparation and anxiety-reduction strategies are also essential. These recommendations are supported by the work of Dahmani et al. and Mason, who emphasized that such measures significantly improve recovery quality and safety in pediatric anesthesia [15,12].

Limitations

This study has certain limitations. Its retrospective design relies on the accuracy and completeness of medical records, which may introduce documentation bias. Additionally, the single-center setting may limit the generalizability of the findings. The lack of stratification based on anesthetic agents, surgical duration, and preoperative anxiety scores further restricts detailed risk analysis. Future prospective, multicenter studies are warranted to validate these findings and to develop standardized protocols for ED prevention and management.

Conclusion

Emergence delirium is a common postoperative complication in pediatric patients, affecting approximately 20% of children recovering from general anesthesia, with younger age (1–6 years) being the most significant risk factor. Gender did not influence incidence, and emergency procedures were associated with a slightly higher, though not statistically significant, occurrence. Effective management requires a multimodal approach, with dexmedetomidine demonstrating the highest pharmacological efficacy, followed by propofol. Non-pharmacological strategies, such as parental presence and distraction techniques, have also proven beneficial. Early identification of high-risk children and timely interventions can improve safety, reduce postoperative agitation, and enhance recovery, underscoring the need for standardized prevention and management protocols.

Conflict of Interest: Nil

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