Addis Ababa University
College of Health Sciences
School of Medicine
Department of Anesthesia

The incidence and associated risk factors of emergence agitation in pediatric patients after general anesthesia at Addis Ababa governmental hospitals from February- May 2021 (Prospective observational study)

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A thesis submitted to the Department of Anesthesia, School of Medicine, College of Health Sciences, Addis Ababa University, in partial fulfillment of the requirements for MSc in clinical anesthesia.

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Abstract

Background: Emergence agitation (EA) is a post-operative complication immediately after surgery and characterized by phenomenon that includes restlessness, disorientation, non-purposeful movement, inconsolability, and thrashing during early recovery from general anesthesia. The occurrence rate of emergence agitation is high, which may lead to prolongation of hospital stay, physical damage and as well as psychological trauma which may need intervention

Objective: To assess the incidence and associated risk factors of emergence agitation in pediatric patients aged 2-12 years old after general anesthesia at Addis Ababa governmental hospitals, Addis Ababa, Ethiopia.

Methods: A prospective observational study was conducted at selected Addis Ababa governmental hospitals, Addis Ababa, Ethiopia from February 1, 2021 to May 30, 2021. Elective patients with ASA I and II, age 2-12 years old patients who Underwent General Anesthesia had been studied. Data collection methods include anesthesia record sheets, obtained information from responsible anesthetists and, PACU follow-up by using a pre-tested questionnaire. Collected data then inserted and analyzed using SPSS version 26. Bivariate logistic regression analysis was carried out to examine the predictor of the outcome variable. Variables with a p-value less than 0.2 on Bivariate logistic analysis were taken to multivariable-logistic regression analysis and a p-value of <0.05 considered statistically significant.

Results: The incidence of post-operative emergence agitation in this study was 49 %(197/402). Age (2-6 years old) [AOR= 1.71, (95%CI): (1.02-2.88], EENT surgery [AOR=11.62, (95%CI): (3.2-41.99)], uncooperative and restless parental separation behavior [AOR=2.22, (95%CI) (1.14-9.11)], Perioperative regional block [AOR=0.33, (95%CI): (0.15-0.75). duration of surgery < 1 hour [AOR=2.35, (95%CI): (1.21-4.55)], moderate pain [AOR=3.77, (95%CI): (1.57-9.07)] and severe pain [AOR=11.2, (95%CI): (4.46-28.13)] were significantly associated with post-operative emergence agitation after general anesthesia.

Conclusion and Recommendations: Incidence of post-operative emergence agitation after general anesthesia in the pediatric age group was high in Addis Ababa governmental hospital. Age, surgical specialty, parental separation behavior, duration of surgery and pain was predictive factors. But giving perioperative regional block had a protective effect. So, all anesthetists and PACU nurses should know the risk factors associated with post-operative emergence agitation after general anesthesia, and able to develop a strategy to manage the problem. Giving regional block as pain management should be considered.

Keywords: emergence agitation, general anesthesia, pediatric anesthesia

Certification

The undersigned to certify that this thesis is my original work for partial fulfillment of MSc in anesthesia and any literature used here is cited and acknowledged. And I understand plagiarism is not tolerable.

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Abbreviations and Acronyms

AOR- Adjusted Odds Ratio

ASA- American Society of Anesthesiologists

COR- Crude Odds Ratio

EA- Emergence Agitation

ED- Emergence Delirium

EENT- Ear, Eye, Nose, and Throat

ENT- Ear, Nose, and Throat

ETB- Ethiopian Birr

ETT- Endo Tracheal Tube

GA- General Anesthesia

ICU- Intensive Care Unit

LMA- Laryngeal Mask Airway

OR- Operation Room

PACU-Post Anesthesia Care Unit

PAED-Pediatric Anesthesia Emergence Delirium

RCT- Randomized Control Trial

TASH- Tikur Anbessa Specialized Hospital

UOGCSH- University Of Gondor Compressive Specialized Hospital

USA- United States of America

1. Introduction

1.1 Background

Pediatric patients are more likely to experience post-operative complications, but the exact incidence of these complications in children is unknown. Post-operative nausea and vomiting, and respiratory complications are commonest in pediatrics. Post-operative shivering, delirium and agitation are also common problem seen in patient who took general anesthesia while Cardiac complications are less frequent in pediatrics without associated cardiac problem[1].

Emergence agitation (EA) also termed as emergence delirium, perceptual disruption and psychomotor excitement or agitation during early post anesthetic period, is one of the post-anesthesia care unit (PACU) complications of pediatrics immediately after general anesthesia[2,3]. It is an unnecessary dissociative movement of a child when awakening from general anesthesia. EA was studied and identified as a common post-anesthetic problem in children in the early 1960s by Eckenhoff et al.[4].

Emergence agitation is characterized by immediate post-operative inconsolability, irritability, uncooperativeness, crying, thrashing, moaning or incoherency[5–7]. If emergence agitation occurs, it can cause harm to the child such as fall, wound dress removal, bleeding, self-injury, or parental distress that may need interventions to treat the cause[5].

Research conducted in Ethiopia showed that 52.3% of pediatric patients experienced emergence agitation[8], although studies conducted on assessment of the incidence and risk factors for EA showed that the incidence extends from 10% to 80%[6,7,9]. There is a higher frequent incidence in children than in all postoperative patients, with more increasing incidence in preschool children[5]. It occurs mostly within the first 30 minutes of emergence from anesthesia[6].

Pediatric EA is preventable as well as treatable. Being aware of the cause is important to prevent EA. There are many pharmacologic as well as non-pharmacologic methods of prevention and treatment. Pharmacologic treatment includes Propofol induction, opioid maintenance, multimodal analgesia, ketamine, and regional blocks. Preoperative behavioral preparation for surgery is among non-pharmacologic ways of management[10].

The probable predisposing factors for post-operative emergence agitation are Age, the induction time behavior of children, parental separation behavior, Types of surgery, Types of induction and maintenance anesthesia, and Post-operative pain. Post anesthesia emergence agitation is still main challenge for anesthesia providers and post anesthesia care unit (PACU) nurses in the clinical area[11–13].

1.2 Statement of the problem

Emergence agitation (EA) is a well-stated clinical occurrence, especially in children. It is characterized by confusion, irritability, and disorganization, inconsolable, crying, and increased PACU staying time[7]. EA as post-anesthetic complications is still a challenging phenomenon[14].

EA has a higher prevalence rate in pediatric age group than in all other post-operative patients. The research done in different areas showed variable incidence rate, which range from 10% to 80%[5].

Emergence agitation is accompanied by clinical adverse effects including pull-out of the intravenous cannula, injury to a surgical wound site, unintentional removal of naso-gastric tube, falling from bed, physical injury, and also may lead to high extent psychological distress for the patient family and health care providers[4,5].

Different kinds of literature specified many risk factors as probable cause for emergence agitation. According to this difficult parental separation behavior, early school-age children and, isoflurane maintenance is associated with emergence agitation. In addition to that types of procedure(ENT), duration of surgery(short duration), premedication, Postoperative pain are also factors associated with emergence agitation[4,6,12].

Scholars advocate preoperative psychological preparation, parental presence during induction, perioperative caudal block administration, and Propofol IV administration before extubation as some of the recommended diminution or prevention mechanisms[5,7,13,14]. No matter management of emergence agitation is feasible as expressed in researches there`s still a high prevalence of the problem[7,16].

The incidence of emergent agitation varies greatly in different literatures[10]. There is also inconsistency in their outcomes, according to studies.

1.3 Justification of the study

According to many studies, emergence agitation is a known risk factor for post-operative physical harm, prolonged hospital stay, and psychological injury. Within 30 minutes following the operation, it occurs. However, EA mostly resolves spontaneously[4,17]. And also it has been shown by researchers that the incidence of emergence agitation was high up to 80%.

Despite evidence of a high incidence of the problem and its consequences, most responsible health professionals, in my observation, do not place a high value on prevention and treatment, in Addis Ababa governmental hospitals. This research will raise their awareness of the issue.

As far as my search knowledge there is no research done on a similar topic in my study area. The Research conducted in Ethiopia (more related to my study area and lifestyle) uses a small sample population and also done in a different setup.

In general, the goal of this study is to determine the incidence of the problem, as well as the primary risk factors linked with the occurrence of emergence agitation, for which different studies have failed to reach the same conclusion as a risk factor. And put timely prevention and treatment precaution guidance in the context of Addis Ababa governmental hospitals, Addis Ababa, Ethiopia.

This study will guide the anesthesia provider, PACU caregivers, health institutions, and other stakeholders to facilitate a good environment that is most likely to minimize or prevent and/ treat post general anesthesia emergence agitation. Also, at the end of the conclusion of this thesis, it can be used as a reference baseline for further countrywide study.

2. Literature review

2.1 Incidence of post-operative emergence agitation

The study done in Thailand over 250 patients showed that 43.2% had emergence agitation, from this 29.6% were related to adverse effects like pulling of the surgical drain, self-injury, and

injury to staff with peak period 9.6 + 6.8 minutes[5]. According to a prospective study conducted by T. Voepel-Lewis, et al in the USA, in children who underwent daycare surgery for lower abdominal procedures the incidence was 10%. The incidence of emergence agitation is common within the first 10 minutes. But also may happen later, so close monitoring of the pediatric patient in PACU is crucial[17].

According to Mohkamkar M, et al, a cross-sectional descriptive and analytic study done in Iran on 747 children aged 3-7 years with ASA class I-II showed that 134 children (17.9%) had EA. This study clarified that the emergence agitation prolongs hospital stay with significant adverse effects[4]. Another Cross-sectional descriptive and analytic study was done in Dr. Soetomo Hospital, Surabaya, Indonesia in 105 children aged 1-12 years with ASA class I-II, the incidence of EA which is scored by PAED > 10 is high (40%)[7].

A retrospective cohort study was done in King Abdullah Specialist Children Hospital, Riyadh, Saudi Arabia on 413 medical charts of children age <14 years old, who underwent general anesthesia, the incidence of emergence delirium was 6.6% with varying incidence with each risk factor[18].

Research done in the University of Gondor specialized hospital (UOGSH), Ethiopia showed that 52.3% of pediatric patients experienced emergence agitation. In this, prospective follow-up study, 153 pediatric populations aged 2-9 years old was included. In addition to that, the patients who experience emergence agitation also show adverse events like surgical dress and IV cannula removal[8].

2.2 Associated factors of post-operative emergence agitation

A prospective follow up study conducted in UOGSH by D. Eshetie et al, assessing the incidence and associating factors of emergence agitation, found that factors associated with the occurrence of EA were the preschool age group of children (p=0.005), difficult parental separation behavior (p=0.025), and isoflurane maintenance (p= 0.001)[8]. According to Mohkamkar M, et al, cross-sectional descriptive and analytical study, types of surgical procedure especially Otorhinolaryngological surgical procedures(p=0.001), short duration of surgery(p=0.022),

pain($p< 0.05$), and induction behavior of children($P<0.005$) were associated with higher rates of post anesthetic emergence agitation[4].

A study done by Andriyanto et al, to assess the incidence and associated risk factors, concluded that perioperative anxiety ($p = 0.006$) and postoperative pain ($p=0.035$) a risk factor for the incidence of the emergence of agitation. It is critical to provide precautions and prior warnings about these factors to manage emergence agitation[7].

A prospective observational study done in Thailand found that demographic factors especially ages between 2–5 years old (0.026) and difficult parenteral separation behavior ($p< 0.001$) had a strong correlation with emergence agitation. The purpose of this study was to determine the incidence and risk factors of EA. So, anesthetists who are responsible for pediatric anesthesia should be aware of preoperative, intraoperative, and postoperative related risk factors to decrease the prevalence of EA.[5] Also, according to (medicine 2017), preschool children (2 – 5 years old) are the more exposed group to developing the emergence delirium. The most vulnerable age group for developing the emergence delirium is preschool toddlers (2-5 years)[19].

A retrospective cohort study was done by Aldakhil, et al, on 413 medical charts of children aged below 14 years who underwent general anesthesia. When compared to those who did, ED was significantly associated with patients who did not take Dexmedetomidine ($p = 0.003$), as was preoperative anxiety (lower preoperative emotion expression score $p = 0.035$ and higher preoperative arousal score($p = 0.02$)[18].

A prospective, randomized, double-blind study conducted in Lebanon found that the frequency of emerging agitation was 4.9% for those who received preoperative caudal anesthesia, while it was 59% for those who did not receive preoperative caudal anesthesia and were maintained with only fentanyl. Caudal analgesia was significantly lower emergence agitation than intraoperative fentanyl. Caudal anesthesia has been proven in reducing emergence agitation by inducing analgesia or pain control[15].

According to akihiro kanaya et al, Review article done in Japan, many risk factors were associated with the emergence of agitation. Preschool age, pain, Sevoflurane inhalation, and ENT procedures are among the main factors. Opioids and Propofol are good agents for the

prevention of the incidence of emergence agitation. Management of EA should focus on preventing and treating underlying cause[10]. Another article review done by da Silva LM et al, for the improvement of prevention and treatment, stated that sadden awakening, pain, induction behavior, short duration of surgery, premedication, and type of anesthesia were probable causes for emergence agitation. Although no single factor causes agitation, it is critical to keep a close eye on the patient until he or she meets the criteria for discharge[6].

Conceptual framework

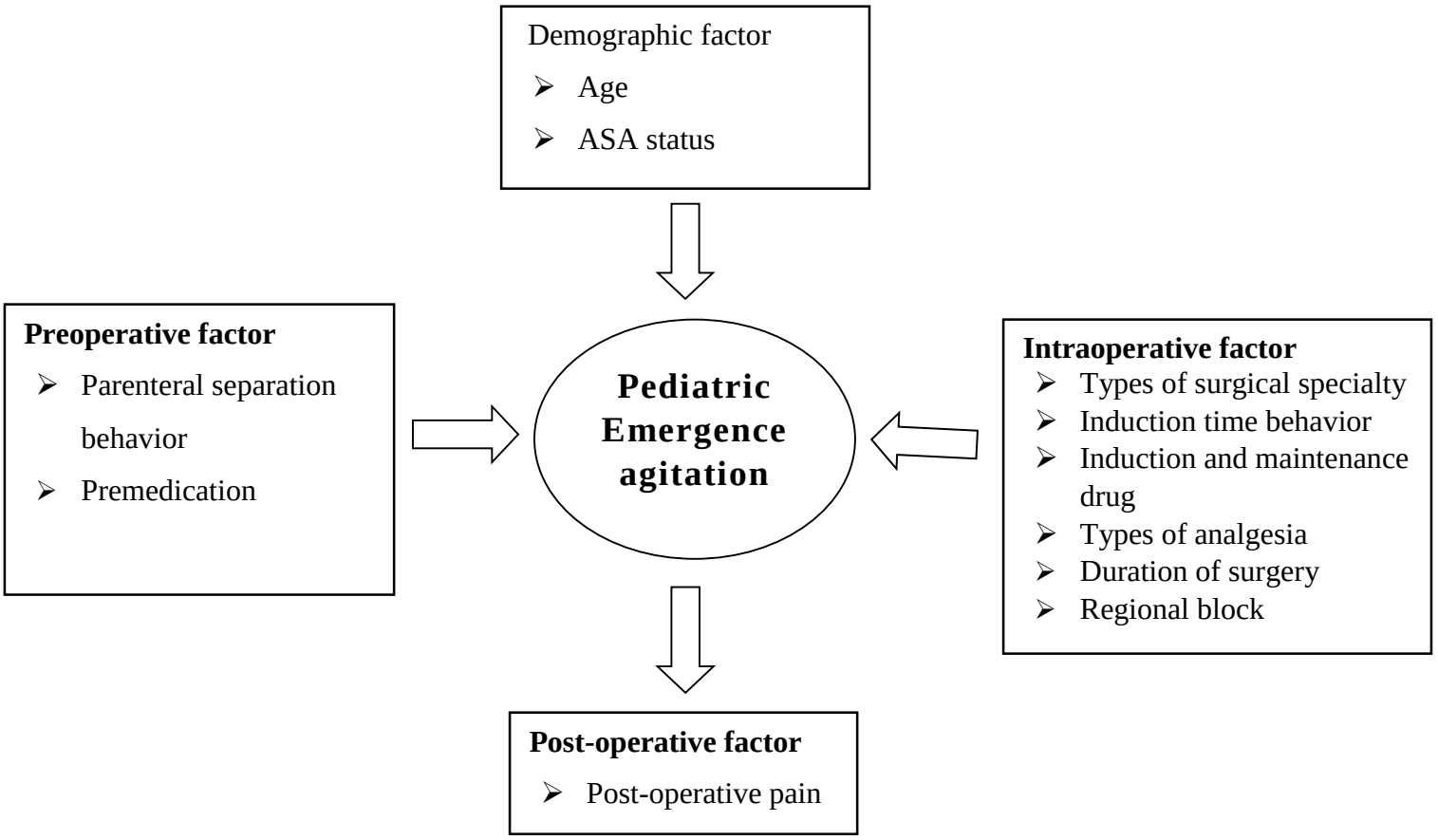

Figure 1: a conceptual framework

3. Objectives

3.1 General objective

- To assess the incidence and associated risk factors of emergence agitation in pediatric patients after general anesthesia at Addis Ababa governmental hospital, Addis Ababa, Ethiopia

3.2 Specific objectives

- To assess the incidence of emergence agitation in pediatrics aged 2-12 years old after general anesthesia.
- To determine risk factors associated with emergence agitation in pediatrics aged 2-12 years old after general anesthesia.

4. Method and materials

4.1 Study area

This study was conducted at four Addis Ababa governmental hospitals, Addis Ababa, Ethiopia. Addis Ababa is the capital city of the Federal Democratic Republic of Ethiopia and has 13 governmental hospitals and more than 40 private hospitals. Our study was conducted at Tikur Anbessa specialized hospital (TASH), Yekatit 12 Hospital Medical College, St. Paulo's hospital millennium medical college, and Menelik II memorial referral hospital. In addition to health care service, all these hospitals serve as teaching and referral hospitals for health students.

Tikur Anbessa specialized hospital is a multi-specialist tertiary care teaching hospital in Ethiopia, opened in 1972 and, in 1998 transferred to school by FMOH since then it became a university teaching hospital. TASH is now the main teaching hospital for clinical and preclinical training of most disciplines. It has over 700 beds, 12 operation theatres, and serving as a teaching and referral hospital. It has 2 OR tables reserved for pediatric surgeries and additional tables for ENT procedures that serving pediatric patients.

St. Paul's millennium medical college was established in 1968 and now expands itself to a teaching hospital. It provides medical specialty services to patients with more than 700 beds.

Menelik II referral hospital is also the oldest and multi-specialist referral hospital in Addis Ababa city since 1902 E.C. it's a site for adult and pediatric ophthalmic surgical procedures. Menelik II referral hospital has 1 major and 1 ophthalmic OR table for pediatric procedures. Yekatit 12 medical college also one of the specialized teaching hospitals located in Addis Ababa, Ethiopia. It has 9 departments with 6 units and has more than 260 beds.

4.2 Study design and study period

The prospective observational study is conducted from February 1 – May 30, 2021.

4.3 Population

4.3.1 Source population

All pediatric surgical patients who underwent surgery under general anesthesia at Addis Ababa governmental hospitals within study period.

4.3.2 Study population

All pediatric patients aged 2-12 years old who underwent General anesthesia in Tikur Anbessa specialized Hospital, Yekatit 12 medical college, St. Paulo's hospital millennium college, and Menelik II referral hospital within the study period.

4.4 Inclusion and Exclusion criteria

4.4.1 Inclusion criteria

- ASA I and II patients aged 2-12 years old who underwent General anesthesia

4.4.2 Exclusion criteria

- Patient with a history of mental impairment and/or developmental delay.
- Sedated patient and/ mechanically ventilated after surgery
- Patients who were transferred to other sites than PACU

4.5 Sample size and sampling technique

4.5.1 Sample size calculation

The sample size for the incidence of pediatric emergence agitation was calculated as follows:-

The sample size was determined based on a previous study proportion of pediatric emergence agitation(52.3%), which was taken from a study conducted in the University of Gondar comprehensive specialized Hospital (UOGCSH), Ethiopia[8].

A single proportion formula with a 95% level of significance, 5% margin of error, and 5% for incomplete or contingency data were used as parameters to determine sample size [20].

$n= \frac{(za/2)^2 p(1-p)}{w2}$…Where; n is the sample size, Z is the statistic corresponding to the level of confidence, P is expected prevalence, and d is precision (corresponding to effect size).

Then by substituting the single population proportion formula our total sample size were

n= ($\frac{(1.96)^2(0.523)\,(0.477)}{(0.05)^2}$...where α=5%, p=52.3%=0.523, q=1-p= (1- 0.523) =0.477 and w=0.05

n= 383

n = 402 …….by adding 5% as contingency

4.5.2 Sampling procedure

A situational analysis was done based on the Recorded logbook of pediatric surgery under general anesthesia for three months (September – November 2020) in each hospital. According to this 270 elective surgeries in TASH, 100 in Yekatit 12 medical college, 250 in Minillik II memorial referral hospital, and 80 in St. Paul's hospital millennium medical college per three months were undergone elective surgery on average. Finally, the sample size was allocated proportionally to all hospitals based on their average three months report.

So during the study period, a total of 700 patients underwent elective surgery. Since the calculated sample size is 402, 700 divided by 402 is 1.75

The systematic random sampling technique was used during data collection on each Hospital after the first case selected on the lottery method and every kth (2nd) patient was chosen for the study during the study period.

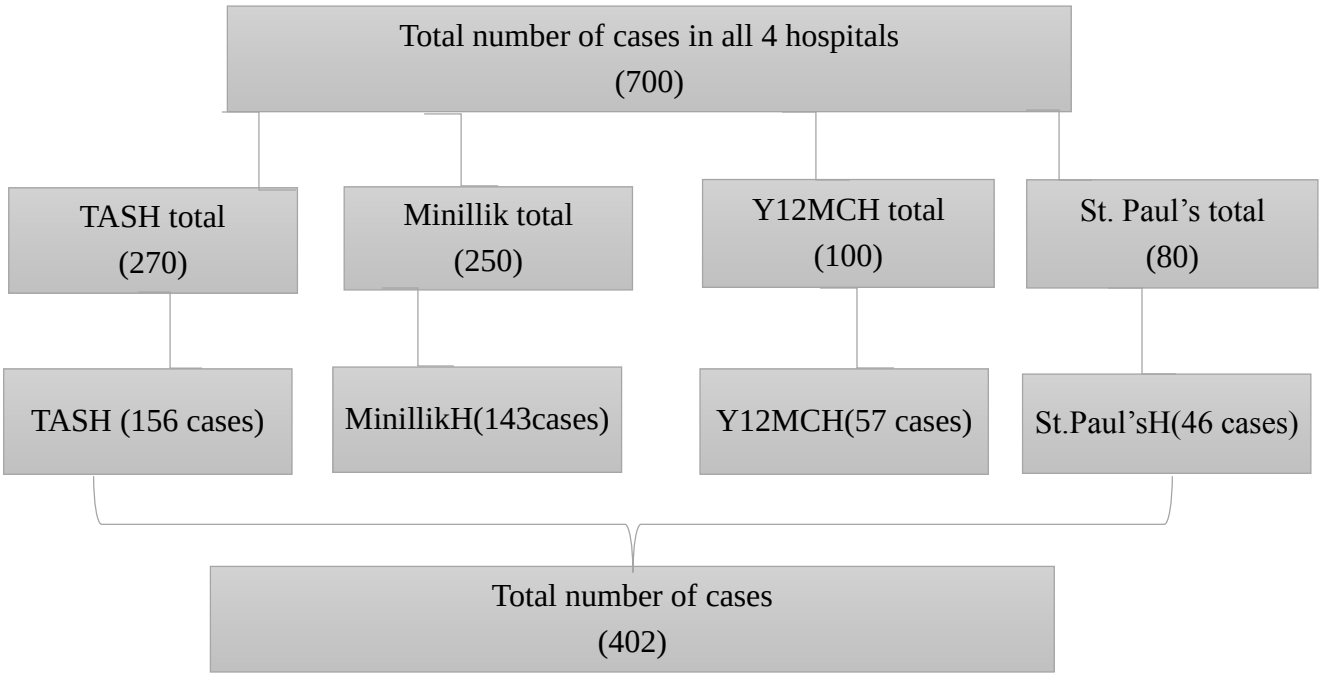

Figure 2: Sampling procedure

4.6 Methods of data collection

Data were collected from the selected study population in a study period by using a pretested questionnaire. Preoperative and intraoperative child's behavioral status was recorded by using given parameter and also all measurements that have been taken to manage general anesthesia were recorded. Then, patient's emergence behavioral status within 30 minutes at PACU were observed and recorded by using appropriate measurement tool (at 5^{th} min, at 10^{th} min at 15^{th} min, at 20^{th} min, at 25^{th} min, and at 30^{th} min). Anesthesia management for pediatric surgery under general anesthesia in the study hospital was carried out by anesthesia professionals, MSc anesthesia holders, MSc anesthesia students, and Anesthesiology residents.

After patient arrival to the post-anesthesia care unit, the presence of agitation was assessed at the 5^{th}, 10^{th}, 15^{th} 20^{th} 25^{th}, and 30^{th} minute by using given criteria based on the Watcha scoring technique. A presence of emergence agitation then was defined by a Watcha score of 3 & 4, although a Watcha score of 1 and 2 was concluded as the absence of emergence agitation. Also, post-operative pain was assessed by Facial expression, leg movement, activity, crying, and consolidation (FLACC) score of pain parameter in line with agitation measurement.

Preoperative and Intraoperative data were collected by two trained anesthetists. Postoperative data were also collected by two trained post anesthesia care unit nurses and the trained anesthetist had supervised the completeness of the data daily.

4.7 Study variables

4.7.1 Dependent variable

- Emergence agitation

4.7.2 Independent variables

- Demographic factors
  - Age
  - Sex
  - BMI
  - ASA status
- Pre-operative and Intraoperative related factors
  - Premedication
  - Pre-operative parental separation behavior
  - Types of surgical specialty
  - Induction time behavior
  - Types of induction anesthesia
  - Types of intraoperative analgesia
  - General anesthesia induction technique
  - Maintenance anesthesia
  - Duration of surgery
- Post-operative related factors
  - Post-operative pain
  - Full bladder

4.8 Operational definitions

Anxiety: a behavior the child that shows worrying, nervousness or unease about surgery and pain.

Anxious: feeling or showing worry, being concerned for operation

Calm: when pediatrics patient not showing the sign of nervousness, anger, emotions, violence or confrontation activity before and during of induction of anesthesia.

Consoled: feeling comfortable

Cooperative: a child is looking comfortable for surgery

Duration of anesthesia: the time-bound from induction of anesthesia to transfer of the patient to the PACU.

Duration of surgery: the time-bound from incision to dressing of the surgical wound.

Emergence agitation: children scoring 3 or 4 after general anesthesia using Watcha soring scale will be interpreted to have emergence agitation.

Emergence delirium: activities that interchangeably used with terms of emergence agitation

Induction time behavior: is a type of behavior that a patient experiences during induction of anesthesia[4].

- Cooperative
- Anxious
- Uncooperative

Pre-operative parental-separation behavior: a behavior or an activity a child shows at the time of separation from his parents or caretakers before entering to the operation room[4].

- Cooperative
- Anxious
- Uncooperative

Systemic random sampling: Individuals are taken at regular intervals down the list starting point is chosen at random.

Types of surgical specialty: category of specialty of the performed surgical procedure

Uncooperative: a child is not looking comfortable for surgery or refuses to enter OR

Types of induction anesthesia: drug administrated at the time of induction

Watcha scale: one of the pediatric delirium measurement tools with known parameters, which is simpler to use and sensitive than others. It contains four parameters each defining patients characteristics, 0= asleep, 1= calm, 2= crying but can be consoled, 3=crying but can't be consoled, 4= agitated and crushed around. The score of 0, 1 and 2 show no agitation or delirium while 3 and 4 show the presence of it[21].

The pain FLACC scale: the Face, Legs, Activity, Cry and Consolability scale

It incorporates 5 pain behaviors that make up the scale's name. Each behavior is scored from 0 to 2, with the highest possible cumulative score being 10 (most pain).0 = Relaxed and comfortable, 1–3 = Mild discomfort, 4–6 = Moderate pain, and 7–10 = Severe discomfort or pain[22].

4.9 Data quality assurance

To assure the quality of data, training on the objectives and relevance of the study and brief Orientations on the assessment tools had been provided for data collectors. After giving the training for those data collectors, data was collected based on the structured and pretested questionnaire. During data collection, each questioner had been revised by the investigator for being complete and appropriate

4.10 Data processing and analysis

4.10.1 Data analysis

Data had been coded and then entered, cleaned and edited to Statistical package for Social Sciences (SPSS) software version 26.0. Using SPSS basic descriptive statistics like frequency was done for socio-demographic variables, independent risk factors and incidence of emergence agitation. Bivariate logistic regression analysis was carried out to examine the predictors of the outcome variable. Variables with a p-value less than 0.2 on Bivariate logistic analysis were taken to multivariable-logistic regression analysis and a p-value of <0.05 was considered as a cutoff point for statistical significance. Then the result was presented by the text, tables, graphs, and pictures.

4.11 Ethical Considerations

Ethical clearance and approval were obtained from the ethical review committee, Anesthesia Department, Addis Ababa University. Permission to conduct the study also had been obtained from Tikur Anbessa specialized hospital, Yekatit 12 medical college, St. Paul`s hospital medical college and Minillik II referral hospital. After explaining all pertinent information, assent was obtained from the patient's caregivers before the questionnaire. The obtained data will be used for study purposes, and Confidentiality and anonymity will be ensured.

4.12 Result dissemination

The result of the study will be submitted to the college of health science of Addis Ababa University, Tikur Anbessa specialized hospital, Yekatit 12 medical college, St. Paul's hospital medical college, Menelik II referral hospital, Ethiopian Anesthetist Association and other responsible bodies. And also, efforts will be done to publish the findings of the study and disseminated them through different journals and scientific publications.

5. Result

5.1 Socio-demographic characteristics of the patient

A total sample of 402 with a response rate of 100% pediatric population was included in the study. The mean age of the study population was 5.47±3.36 standard deviation. The total number of the male was 238 and female was 164, male accounting 60.4% while female 39.6. From the sample 299 (74.4%) had normal body mass index and 92 children were underweight and 11 children were overweight.

5.2 Preoperative characteristics of patients

From the total study population, 67.7% of children were ASA I, and the most frequent surgical procedure performed were general surgery (36.8%) and urology (21.9 %), also the list frequent surgery was plastic surgery. From the sample, the majority of the patients haven't given sedative premedication with sedatives (90.8%) and 47% were cooperative preoperatively while 16.2% of patients were uncooperative and restless during parental separation (Table 2).

Table 1: Preoperative characteristics of the patients who underwent surgery under general anesthesia in Addis Ababa governmental hospitals from February 1– May 30, 2021

Variable		Frequency	Percentage
ASA	I	272	67.7
	II	130	32.3
Types of surgical specialty	ENT surgery	74	18.4
	Orthopedic surgery	57	14.2
	Plastic surgery	14	3.5
	Urologic surgery	88	21.9
	General surgery	148	36.8
	Others	21	5.2
Premedication	Yes	37	9.2
	No	365	90.8
Cooperation in the preoperative area (parental separation behavior)	Cooperative/calm	189	47
	Anxious/fearful	148	36.8
	Uncooperative/restlessness	65	16.2

5.3 Intraoperative anesthesia and surgery related data of the patient

Out of the total population, 47% of the patients were calm during induction and only 7.7% of patients were sedated preoperatively. The patients who were given intraoperative regional block or caudal block were 11%. Although, 58% of the procedures took more than one hour, the remaining 42% of the case lasts within one hour (Table 2)

Table 2: Intraoperative anesthesia and surgery related data of the patient who underwent surgery under general anesthesia in Addis Ababa governmental hospitals, February 1 – May 30, 2021

Variables		Frequency (%)	Percentage
Cooperation at induction (induction time behavior)	Cooperative/calm	189	47
	Anxious/fearful	151	37.6
	Uncooperative/restlessness	31	7.7
	Previously sedated	31	7.7
GA technique	GA with facemask	83	20.6
	GA with LMA	2	0.5
	GA with ETT	317	78.9
Induction Technique	IV	391	97.3
	Inhalational	11	2.7
Induction agent	Ketamine	36	9
	Propofol	128	31.8
	Thiopentone	6	1.5
	Ketamine with Propofol	218	54.2
	Halothane	14	3.5
Intraoperative analgesia	PCM	74	18.4
	Opioid	222	55.2
	Other	106	26.4
Maintenance	Isoflurane	223	55.5
	Halothane	105	26.1
	TIVA	74	18.4
Perioperative regional block	Yes	47	11.7
	No	355	88.3
Duration of surgery	< 1 hr.	169	42
	≥1 hr.	233	58

5.4 Post-operative related data of the patient

From the study population, 53% of the patient didn't experience signs of pain while 13% had severe pain (figure 3)

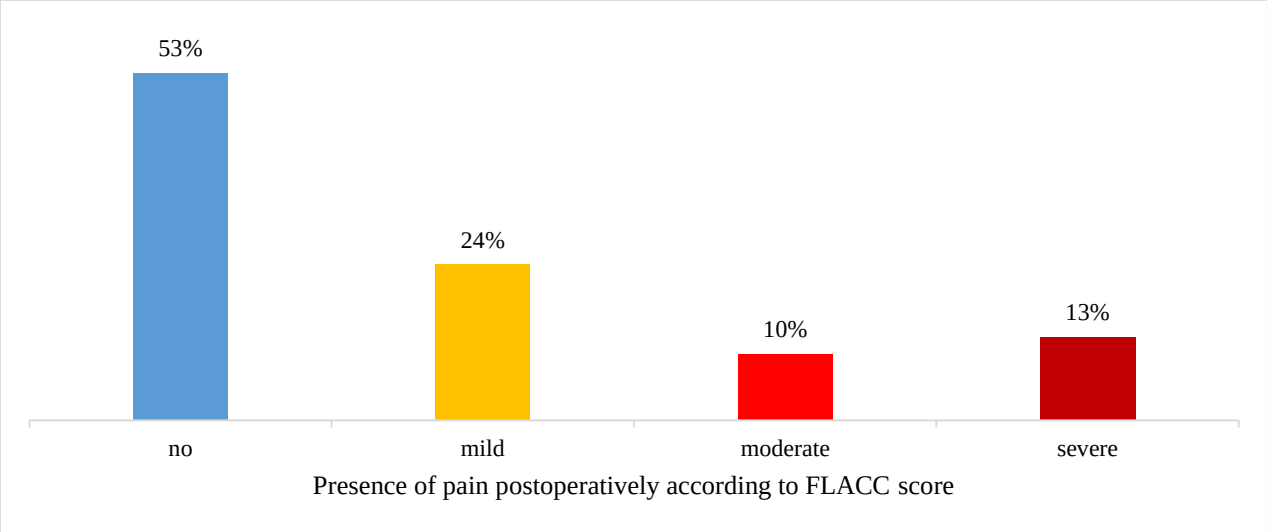

Figure 3: The severity of Post-operative pain of the patients who underwent surgery under general anesthesia in Addis Ababa governmental hospitals from February 1– May 30, 2021

5.5 Incidence of post-operative emergence agitation

In this study, the incidence of emergence agitation was 49.0% meaning 197/ 402. The majority of the patients developed agitation within 15 minutes and 21% of agitated patients experienced self-harm (figure 4 and 5)

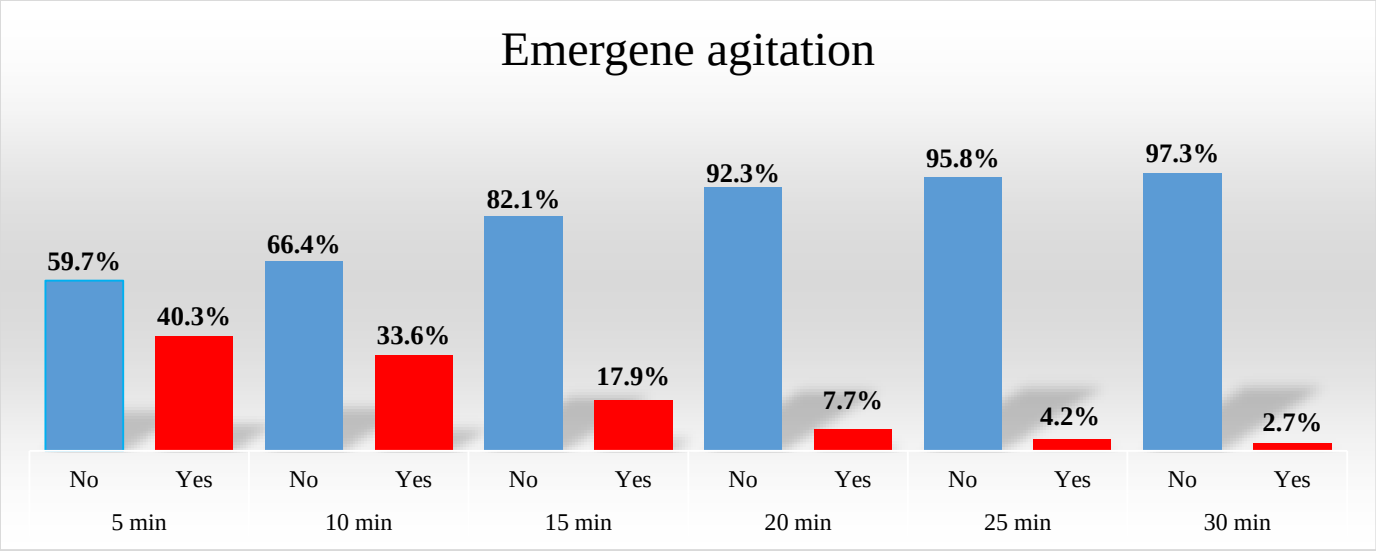

Figure 4: Post-operative emergence agitation at follow up time who underwent surgery under general anesthesia in Addis Ababa governmental hospital from February 1 – May 30, 2021

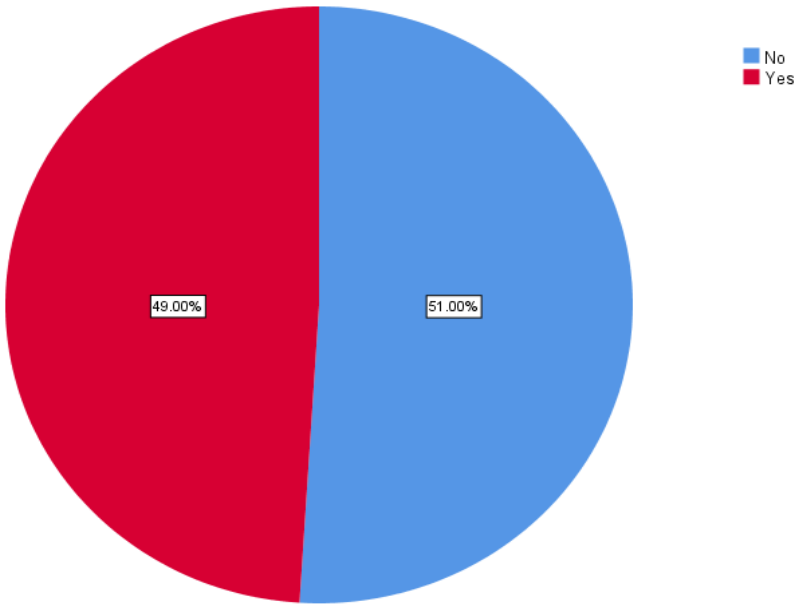

Figure 5: Incidence of post-operative emergence agitation who underwent surgery under general anesthesia in Addis Ababa governmental hospitals from February 1 – May 30, 2021

5.6 Factors associated with post general anesthesia emergence agitation

The bivariate analysis of this study shows that age between 2-6 years old; surgical specialty of which EENT surgery, Orthopedic surgery, Plastic surgery, General surgery, and urologic surgery; uncooperative parental separation behavior and preoperative fearfulness; uncooperative and anxious behavior during induction; general anesthesia with face mask; intraoperative maintenance with isoflurane; patient not taking perioperative regional block; duration of surgery less than 1 hour; and presence of mild, moderate and severe post-operative pain had an association with post anesthesia emergence agitation with a p-value of less than 0.2.

When adjusted to other variables, age between 2-6 years old, EENT surgery, uncooperative parental separation behavior, perioperative regional block, surgical duration less than < 1hour, moderate pain, and severe pain were significantly associated with emergence agitation (Table 3).

According to this, age between 2-6 years old had 2 times greater risk to develop post anesthesia emergence agitation [AOR= 1.71, (95%CI): (1.02-2.88)], when compared with 7-12 years old patient who underwent surgery with general anesthesia.

From the surgical specialties, EENT surgery had 11 times more risk of developing Post general emergence agitation [AOR=11.62, (95%CI): (3.2-41.99)] than other surgeries

This study showed that the patient who was uncooperative and restless before surgery was 2 times more likely to develop post general anesthesia emergence agitation than a calm and cooperative patient[AOR=2.22, (95%CI) (1.14-9.11)].

In this study Patients who given perioperative regional block were less likely to develop emergence agitation, thus Patients who were given perioperative regional block showed a reduction of 76.7% in odds of having emergence agitation compared to those who not given regional block [AOR=0.33, (95%CI) : (0.15-0.75)].

In this study, the procedure that took less than 1 hour was two times more likely to develop emergence agitation [AOR=2.35, (95%CI): (1.21-4.55)] when compared with a procedure that took more than or equal to 1 hour.

When compared to no pain, post-operative moderate pain was 4 times more likely to develop emergence agitation [AOR=3.77, (95%CI): (1.57-9.07)], and severe pain was 11 times more likely to develop emergence agitation [AOR=11.2, (95%CI): (4.46-28.13)].

Table 3: Multivariable analysis of Factors associated with post general anesthesia emergence agitation at Addis Ababa governmental hospitals from February 1 – May 30, 2021.

Variables		Emergence agitation (n %)		COR(95%CI)	AOR(95%CI)	p-value
		Yes	No			
Age	**2-6**	**139(57.2)**	**104(42.8)**	**2.33(1.54-3.5)**	**1.71(1.02-2.88)**	**0.042**
	7-12	58(36.5)	101(63.5)	1	1	
Types of surgical specialty	**EENT surgery**	**54(73)**	**20(27)**	**8.64(2.8-26.68)**	**11.62(3.2-41.99)**	**<0.001**
	Orthopedic surgery	32(56.1)	25(43.9)	4.09(1.32-12.71)	3.24(0.86-12.23)	0.082
	Urologic surgery	35(40)	53(60)	2.11(0.71-6.29)	3.38(0.92-12.35)	0.065
	General surgery	64(43.3)	84(56.7)	2.43(0.84-7.00)	3.24(0.93-11.20)	0.063
	Plastic surgery	7(50)	7(50)	3.2(0.75-13.65)	5.27(0.92-29.96)	0.061
	Others	5(23.8)	16(76.2)	1	1	
Cooperation in the preoperative area (parental separation behavior)	Cooperative/calm	74(39)	115(61)	1	1	
	Anxious/fearful	78(52.7)	70(47.3)	1.73(1.12-2.67)	1.44(0.62-3.35)	0.393
	Uncooperative/restlessness	**45(69.3)**	**20(30.7)**	**3.49(1.91-6.38)**	**2.22(1.14-9.11)**	**0.027**
Cooperation at induction (induction time behavior)	Cooperative/calm	75(39.7)	114(60)	1	1	
	Anxious/fearful	83(54.9)	68(45.1)	1.85(1.20-2.86)	1.58(0.67-3.72)	0.291
	Uncooperative/ restlessness	22(70.9)	9(29.1)	3.71(1.62-8.51)	2.11(0.60-7.362)	0.240
	Previously sedated	17(54.8)	14(45.2)	1.84(0.86-3.96)	0.93(0.256-3.40)	0.917
GA technique	GA with facemask	47(56.7)	36(43.3)	1.47(0.9-2.39)	1.9(0.96-3.79)	0.064
	GA with LMA	1(50)	1(50)	1.12(0.07-18.18)	1.90(0.09-37.27)	0.672
	GA with ETT	149(47)	168(53)	1	1	

Maintenance	Isoflurane	118(52.9)	105(47.1)	1.56(0.97-2.49)	1.76(0.98-3.16)	0.057
	TIVA	35(47.3)	39(52.7)	1.24(0.68-2.26)	1.22(0.56-2.62)	0.611
	Halothane	44(41.9)	61(58.1)	1	1	
Perioperative regional block	Yes	11(23.4)	36(76.6)	**0.27(0.14-0.56)**	**0.33(0.15-0.75)**	**0.008**
	No	186(52.4)	169(47.6)	1	1	
Duration of surgery	**< 1 hr.**	**92(54.4)**	**77(45.6)**	**0.68(0.46-1.02)**	**2.35(1.21-4.55)**	**0.011**
	≥1 hr.	105(45)	128(55)	1	1	
Post-operative pain	No	84(39.2)	130(60.8)	1	1	
	Mild	48(50)	48(50)	1.54(0.96-2.51)	1.73(0.98-3.05)	0.058
	Moderate	**26(63.4)**	**15(36.6)**	**2.68(1.34-5.36)**	**3.77(1.57-9.07)**	**0.003**
	Severe	**39(76.5)**	**12(23.5)**	**5.03(2.49-10.15)**	**11.2(4.46-28.13)**	**<0.001**

AOR- adjusted odd ratio, COR-crude odd ratio, CI- confidence interval.

6. Discussion

Post emergence agitation also referred to as post-operative delirium is a major concern in a pediatric population the incidence ranging from 10% to 80 as stated in different literatures[4].

This study aimed to assess the incidence and risk factor of post-operative emergence agitation in the 402 pediatric population aged 2-12 who underwent surgery under general anesthesia. To manage the consequences, it is necessary to first identify the cause and risk factors. According to this study, the incidence of emergence agitation was 49% which is between 10% - 80%. And from the variables age (2-6) years old, ENT surgery, uncooperative parental separation behavior, duration of surgery less than 1 hour and post-operative pain (moderate and severe) had an association with emergence agitation, while perioperative caudal block decreases the risk.

In line with some previous studies, our study incidence was comparable. In the studies conducted in Thailand, and UOGSH, the reported incidences were 43.2%, and 52.3%, respectively[5,7,8]. Our study was higher than the study conducted in Indonesia. This study was done on a pediatric patients aged 1- 12 years old on aiming to assess the incidence and risk factors of EA. The incidence was 40%[4]. Another descriptive and analytical study conducted in Iran has found the incidence of emergence agitation to be 17.9%[3]. This study was done on pediatric patients aged 2-9 to assess the incidence and risk factor of emergence agitation. A prospective cohort study conducted in the USA, the incidence of EA was 10%[13]. The study was done on surgical outpatients who underwent general anesthesia.

The incidences of above-mentioned researches showed a minimal to huge difference with our studies. This variation might be due to the quality of standard, measurement tools used, and studied age range[10,12,21]. Emergence agitation is more common in children than in all post-operative patients, with a higher incidence in younger age groups[9]. Pediatric emergence agitation measurement tools are more contentious; all tools available today have limitations[21].

In this study Age being 2-6 years old (p= 0.042) was strongly associated with post-operative emergence agitation, when compared with age between 7-12 years old. Thus, 2- 6 years old child was 2 times more likely to develop emergence agitation after general anesthesia than children aged 7-12 years old. This study was in line with a prospective follow-up study done in UOGSH

(P = 0.05) and a prospective observational study done in Thailand (p=0.026). this may be because of early school child is psychologically immature and less able to adapt new environment than older children[3].

Also, in our study, the types of surgery (ENT surgery) had a strong association with postoperative emergence agitation (p=< 0.001). It's 11 times more risk for developing emergence agitation than other surgeries. This result was comparable with a cross-sectional descriptive and analytical study done in Iran (p=0.001)[4] and prospective cohort studies done in the USA (P< 0.001)[16]. This might be related to so-called ``sense of suffocation`` during emergence and this would cause emergence agitation[10].

A patient who was uncooperative and restless during parental separation (p= 0.027) showed a strong association with post-operative emergence agitation after general anesthesia when compared with a calm and cooperative patient in our study. The uncooperative and restless child was 2 times more risk for development of emergence agitation than calm or cooperative patient. A similar conclusion was reached by D. Eshetie et al (p=0.025)[8],L Andriyanto et al (p=0.06)[7] and A Saringcarinkul et al (0.006)[5].

In this study, the patient who was given perioperative caudal analgesia (p= 0.08) was less likely to develop emergence agitation when compared with those not given. Thus, patients who were given perioperative regional block showed a reduction of emergence agitation 76.7% when compared to patients who were not given regional block. This outcome is in a similar way to the prospective study done in Lebanon; thus, the frequency of emergence agitation was 4% with caudal analgesia while 49% without caudal analgesia. This could be because caudal analgesia gives prolonged post-operative analgesia[23,24].

It was also determined in this study that the duration of surgery less than 1 hour (p = 0.011) had a strong association with post emergence agitation after general anesthesia when compared with the duration of surgery lasting ≥ 1 hour. Duration of surgery < 1 hour was 2 times higher risk for development of EA than the duration of surgery ≥ 1 hour. This result of our study was in line with the study done by M Mohkamkar et al[4]. The study showed the short duration (< 1 hour) of

surgery (p=0.022) had a strong association with post emergence agitation. This is due to inhalational drug washout occurring quickly before the analgesic agent reaches peak efficacy[25].

Our study revealed that the presence of pain, depending on its severity, had a strong association with post-operative emergence agitation after general anesthesia. According to this moderate pain (p=0.003) had 4 times more risky for the development of emergence agitation, and severe pain (p=< 0.001) had 11 times riskier when compared with no pain. this analysis result is then supported by the studies conducted by L Andriyanto et al (p= 0.035)[7], M Mohkamkar et al (p=<0.05)[4] and is also comparable with a prospective observational study conducted in Brazil (p< 0.005)[26]. This might be the fact that inadequate pain is a risk factor of emergence agitation and its management minimizes the occurrence of the problem[12]

Isoflurane maintenance was strongly associated with emergence agitation[8],[16]. But in our study, maintenance with isoflurane had no association with EA. The incidence of EA with isoflurane maintenance is 52.9. This may be due to most patients in this study were maintained with isoflurane.

6.1 Strength of the study

- ✓ Sample size calculation was more accurate and we got the appropriate sample size in a given period
- ✓ We used pretested questionnaire and some amendments were done
- ✓ There was strict prospective follow-up
- ✓ We got more or less diversified types of pediatric surgery.
- ✓ There were adequate literature on this topic to compare and contrast

6.2 Limitation of the study

- ✓ Measurement tools are more subjective and controversial.
- ✓ Poor standard of PACU in some hospitals.
- ✓ Resource scarcity

7. Conclusion and recommendation

7.1 Conclusion

- ✓ Incidence of post-operative emergence agitation after general anesthesia in the pediatric population is very high in Addis Ababa governmental hospital
- ✓ Early school-age, uncooperative and restless parental separation behavior, short duration of surgery, and moderate and severe pain were strongly associated with emergence agitation.

7.2 Recommendation

For anesthetist

- ✓ All anesthetists at Addis Ababa Governmental hospital should know risk factors associated with postoperative emergence agitation after general anesthesia.
- ✓ An appropriate perioperative regional block should be administered.
- ✓ The uncooperative and restless patients should be treated.

For PACU caretakers

- ✓ The possible reason for emergence agitation should be ruled out early and appropriate management should be taken.

For researcher

- ✓ Further study might be needed in each specialty.

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Annexes

I. Information sheet

Title of the research: The incidence and associated risk factors of emergence agitation in pediatric patients after general anesthesia at Addis Ababa governmental hospitals from February-May 2021. (Prospective observational study)

Name of investigator: Teketel Abebe

Names of the institution: Addis Ababa University, college of health science school of medicine, department of anesthesia.

Purpose of project: the aim of this study is to improve health planning on safe emergence during recovery from general anesthesia. The information gained from this research will help to improve pediatric management

Procedure: data was collected from four selected Addis Ababa governmental hospitals by using pretested and standard questionnaire. Data were obtained by observation patient preoperative intraoperative and post-operative characteristics and recording anesthesia managements.

Risks of study: there is no risk for patient in this study. There was no interferences with anesthesia management during data collection process.

Personnel information: For any questions further information you can contact the principal investigator:

Name: Teketel Abebe
Tel: +251924749163
E-mail: abebeteketel@gmail.com

Advisors:

1. Mr. Sileshi Abiy(BSc, MSc in ACA)
   Email: sileabiy@gmail.com
2. Mrs. Lemlem Getachew (BSc, MSc in ACA)
   Email: woldemariamlemlem@yahoo.com

With thanks!

II. consent form:

Dear participant:

Hello, my name is **…….. ,** I am here on behalf of Teketel Abebe, a student at Addis Ababa University, school of medicine department of anesthesia. He is conducting a research on `The incidence and associated risk factors of emergence agitation in pediatric patients after general anesthesia at Addis Ababa governmental hospitals`.

The purpose of this questionnaire is to gather information on to assessing the incidence and associated risk factors of emergence agitation in pediatric patients after general anesthesia at Addis Ababa governmental hospital, Addis Ababa, Ethiopia, from February 1 –May 30, 2021. The assessment should take only observing the child's behavior and recording without any harm to your child. The study is aimed at to improve on health planning on safe emergence during recovery from general anesthesia. Since the study is not linked with any financial aid there is no direct incentives paid as a result of your child taking part in the study.

There is no risk to take part in the study, all information is confidential. Their names will not keep in the form. Moreover, this research thesis is approved by Ethical review board of AAU and college of health science, department of Anesthesia. I would like to assure you that your child name will not be written on this form and all the Information gathered will be kept strictly confidential. You can decide whether your child to take Part in this study or not.

Are you volunteer to participate in this study?

A. Yes B. No

If you are volunteer the observation will be started.

Date of data collection.....

Name of data collector..... signature.....

Name of supervisor..... signature.....

For any questions or concerns you can contact the principal investigator:

Name: Teketel Abebe

Tel: +251924749163

E-mail: abebeteketel@gmail.com

III. Questionnaire:

Instruction: For each question, please circle the number of alternative (s) that fit the response, and fill the black space provided or choice from the given alternatives

Data code _____ MRN_____

I. Socio demography related data

Serial no.	Question	Response	Code
1	Age	…….years old	
2	Sex	A) M B) F	
3	Weight	___ _ _ _ _ _ _ _ kg	
4	Height	_ _ _ _ _ _ _ _ _m	
5	BMI	_ _ _ _ _ _ _ _ _ _ _Kg/m2	
6	ASA classification	A) ASA (I) B) ASA (II)	
7	If Any coexisting disease	A) Yes B) No	
7.1	If yes for above question, Specify	_ _ _ _ _ _ _ _ _ _ _	
8	Any medication taking Currently	A) Yes B) No	
8.1	If yes for above question, Specify	_ _ _ _ _ _ _ _ _ _ _ _	

II. Preoperative related data

Serial no.	Question	Response	code
11.	Diagnosis	……	
12.	Types of surgical specialty	A) ENT/maxillofacial B) Orthopedics C) urology D) general E) other specify……	
13.	Premedication used	A) Yes B) No	
14.	If yes for above question	A) Sedative B) analgesic C) both D) other specify……	

15. Cooperation in preoperative area:

Question	Response	Code
Cooperation in preoperative area (parental separation behavior)	1= Cooperative/calm 2= Anxious/fearful 3= Uncooperative/restless	

III. Intraoperative anesthesia and surgery related data

20. Cooperation at induction

Question	Response	Code
Cooperation at induction (induction time behavior)	1= Cooperative/calm 2= Anxious/fearful 3= Uncooperative/restless 4= previously Sedated	

Serial no.	Question	Response	Code
21.	Type of induction agent	A) IV B) Inhalation	
21.1	Specify drug and dose for above question	Drug…….Dose…….	
22.	Anesthesia technique used	A) sedation with face mask B) GA with LMA C) GA with ETT D)other	
23.	Analgesics used	A) Paracetamol suppository B) Fentanyl C) Morphine D) Pethidine E) Other Specify …….....	
24.	Maintenance of Anesthesia	A) Halothane B) Isoflurane C) Sevoflurane D)TIVA E) Other agent	
25.	Perioperative regional is given	A) Yes B) No	
26.	If yes for above question	Specify……	
27.	Any other drugs given intraoperative	A) Yes B) No	
27.1	If yes for above question	Specify……	
28.	Duration of surgery	……min/……...hr.	

16. post-operative behavior

Level of Emergence agitation observed in recovery room as per Watcha behavior scale for emergence delirium

Serial No.	Question	Response	Code
31	5th minute	0= sleep 1= calm 2= crying but can be consoled/ comfortable 3= crying, cannot be consoled/ not comfortable 4= agitated and thrashing around	
32	10th minute	0= sleep 1= calm 2= crying but can be consoled/ comfortable 3= crying, cannot be consoled/ not comfortable 4= agitated and thrashing around	
33	15th minute	0= sleep 1= calm 2= crying but can be consoled/ comfortable 3= crying, cannot be consoled/ not comfortable 4= agitated and thrashing around	
34	20th minute	0= sleep 1= calm 2= crying but can be consoled/ comfortable 3= crying, cannot be consoled/ not comfortable 4= agitated and thrashing around	
33	25th minute	0= sleep 1= calm 2= crying but can be consoled/ comfortable 3= crying, cannot be consoled/ not comfortable 4= agitated and thrashing around	
33	30th minute	0= sleep 1= calm 2= crying but can be consoled/ comfortable 3= crying, cannot be consoled/ not comfortable 4= agitated and thrashing around	

35. Presence of post-operative pain as per FLACC score

Question	Response	5th min	10th min	15th min	20th min	25th min	30th min
Faces	0 = No particular expression or smile 1 = Occasional grimace or frown; withdrawn, disinterested 2 = Frequent to constant frown, clenched jaw, quivering chin						
Legs	0 = Normal position or relaxed 1 = Uneasy, restless, tense 2 = Kicking or legs drawn up						
Cry	0 = No cry (awake or asleep) 1 = Moans or whimpers, occasional complaint 2 = Crying steadily, screams or sobs; frequent complaints						
Activity	0 = Lying quietly, normal position, moves easily 1 = Squirming, shifting back and forth, tense 2 = Arched, rigid, or jerking						
Consolability	0 = Content, relaxed 1 = Reassured by occasional touching, hugging, or being talked to. 2 = Difficult to console or comfort						
Total							

17. Post-operative related data

Serial no.	Question	Response	Code
36.	Any adverse effect self-harm during recovery stay	A) Yes B) No	
36.1	If yes for above question Specify	……	
37.	Medications given to combat adverse effect/ to calm down	A) Yes B) No	
37.1	If yes for above question Specify types of drugs used	……..	
38.	Forces used to calm down the patient	A) Yes B) No	
39.	Post-operative analgesia used	A) Yes B) No	
40.	Does the patient have nausea and vomiting during recovery room stay?	A) Yes B) No	
41.	Is there any factor ruled out as cause for patient not being calm?	A) Yes B) No	
41.1	If yes for above question specify	……..	
42.	Recovery duration	…….	

IV. Appendix

I. ASA- American Society of Anesthesiologists physical status classification

Defined as:

 ASA class I: normal healthy patient except the surgical complaint he had

 ASA class II: A patient with the mild systemic disease a patient with a mild systemic disease but not functional limitation (controlled systemic illness)

 ASA class III: a patient with the severe systemic disease with substantive functional limitation

 ASA class IV: a patient with severe systemic disease that is a constant threat to life

 ASA class V: the moribund patient who is not expected to survive without the operation

(Adopted from miller 7th edition)

II. Watcha behavioral scale, scoring of emergence agitation/delirium

Description	Level
Asleep	0
Calm	1
Crying, but can be consoled	2
Crying, but can't be consoled	3
Agitated and thrashing around	4

It defines emergence delirium at a score of 3 and 4

III. Pain assessment tool (FLACC scoring)

CATEGORIES	Scoring		
	0	1	2
Faces	No particular expression or smile	Occasional grimace or frown; withdrawn, disinterested	Frequent to constant frown, clenched jaw, quivering chin
Legs	Normal position or relaxed	Uneasy, restless, tense	Kicking or legs drawn up
Cry	No cry (awake or asleep)	Moans or whimpers, occasional complaint	Crying steadily, screams or sobs; frequent complaints
Activity	Lying quietly, normal position, moves easily	Squirming, shifting back and forth, tense	Arched, rigid, or jerking
Consolability	Content, relaxed	Reassured by occasional touching, hugging, or being talked to; distractable	Difficult to console or comfort

0 = comfortable, 1–3 = Mild discomfort, 4–6 = Moderate pain, and 7–10 = Severe pain