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Dr. Daniah Naseer
MBChB, FICMS, Specialist of Anesthesia & Intensive Care, Ibn Al Nafees Cardiac Centre Hospital, Baghdad, Iraq

Dr. Sanna Fareed Qasim
MBChB, FICMS, Consultant of Anesthesia & Intensive Care, Child Welfare hospital, Medical City, Baghdad, Iraq

Dr. Jabbar Kadhim Jabbar
MBChB, FICMS, Specialist of Anesthesia and intensive care, Child Welfare Hospital, Medical City, Baghdad, Iraq

Dr. Marwan AlMashhadani
MBChB, DA, CABA&IC, Specialist of Anesthesia & Intensive Care, Medical City, Baghdad, Iraq

Corresponding Author:
Dr. Marwan AlMashhadani
MBChB, DA, CABA&IC, Specialist of Anesthesia & Intensive Care, Medical City, Baghdad, Iraq

The effect of recorded mother voice on emergence delirium after general anesthesia in pediatric patients

Dr. Daniah Naseer, Dr. Sanna Fareed Qasim, Dr. Jabbar Kadhim Jabbar and Dr. Marwan AlMashhadani

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Abstract
Background: Emergence delirium is a behavioral disturbance after general anesthesia in kids and might distress each patients and the primary caregivers, including mother and father and clinical staff, searching after the patients. Various scientific and emotional interventions had been investigated to lessen emergence of delirium; however, none are absolutely effective. This trial intends to evaluate whether or not the recorded mom voice can lessen this unfavorable post-anesthesia event.
Methods: This is a prospective examination performed in contributors aged two- eight years who're undergoing elective surgical procedure requiring general anesthesia. Participants became randomly assigned to one of two groups: individuals who are inspired to awaken by means of listening to their mom's recorded voice (M group, n = 25) or a stranger's voice (S group, n = 25) during anesthetic emergence. The primary final result is the initial emergence delirium score after extubation and 10 mins later in the post-anesthesia care unit (PACU). The secondary outcomes are hemodynamic parameters, which include heart rate and oxygen saturation for the duration of intra-operation, at time of cessation of anesthetics, after extubation, and 10 mins later in the post anesthetic care unit (PACU).
Results: The mom's voice decreased the Watcha scale. The assessment among the studied groups by means of Watcha scale confirmed that mean of the Watcha scale after 10 minutes of the stop of operation became decrease amongst maternal groups than that in the stranger group (1.56 verses 2.48, P = 0.001), also there have been noticed variations in means of Watcha scale ten minutes after the stop of operation between the 2 groups per age, gender, and period of surgery, kids within the M group had an obviously lower Watcha scale ($p< 0.05$) compared to those in the S group
Conclusion: The mom's voice decreased emergence delirium score and the occurrence of emergence delirium in pediatric patients in comparison with a stranger's voice after general anesthesia.

Keywords: Emergence delirium, watcha scale, pediatric anesthesia, mothers voice

Introduction
Delirium and agitation can occur as a child awakens, or emerges, from anesthesia. Emergence delirium (ED) which is reported in up to 80% of the pediatric population [1] may be distressing to the patient, parents, and caregivers, and can result in inadvertent removal of intravenous (IV) catheters, drains, and dressings, and rarely self-harm.

Factors linked with emergence delirium
- **Age:** The greatest occurrence of delirium, after anesthesia with sevoflurane, is found in preschool age children, in comparison with school-age children. Other research have showed those results and, seeing that then, the group that has received most studies interest is that from two to four years old [2].
- **Psychological:** Social and environmental factors involving the operation: Younger kids, those with impulsive and emotional behavior, people who are less sociable and whose parents are additional anxious, seem to be more liable to developing this clinical phenomenon [3] once children are separated from their parents and sent to the operating theatre alone, this can be traumatic and will increase the chance of emergence delirium [4].
- **Postoperative pain:** Postoperative pain has been one of the principal confounding factors once analyzing trigger factors for emergence delirium. In several studies, the utilization of preventive analgesia resulted in a considerable reduction in emergence delirium. The incidence of agitation has been noticed to be reduced when intravenous

ketorolac has been used intra-operatively in otorhinolaryngological surgical procedures of short period wherever top of the pharmacologic agent analgesic effectiveness was after emergence [5].

- **Type of surgery:** Otorhinolaryngological surgical procedures, like tonsillectomy, thyroidectomy and ophthalmological operations, seem to exhibit an enhanced incidence of agitation [3].
- **Inhaled and intravenous anesthesia:** Many studies are done to see whether or not emergence agitation affected by anesthetic technique or by the anesthetic used. Inspite of anesthesia depresses CNS inhibitory centers and causes imbalances in neurotransmitters like serotonin, dopamine and acetylcholine, this may be the cause of appearance of this adverse event.
- **Anesthetic premedication and adjuvant drugs:** The literature is conflicting whether premedication is capable of lowering the occurance of emergence agitation or not. The pharmaceutical most frequently used for kid premedication is midazolam.

Strategies to minimize emergence delirium

Numerous ways are investigated to reduce ED throughout the perioperative period; however, the results stay conflicting [6].

Pharmacologic prevention of ED

Three recent meta-analysis and many studies have recently focused the pharmacologic preventive strategies against ED [7] these studies found that many sedative and analgesic agents given routinely either systemically or by a regional route were found effective within the prohibition of ED. These preventive treatments contain: propofol given after finishing surgery [7] or by continuous administration throughout surgery [8]; intraoperative fentanyl [7]; ketamine hydrochloride (either systemically or by regional route) [7], clonidine (either systemically or by regional route) [9] dexmedetomidine (either systemically or by regional route), post-surgical midazolam, preoperative midazolam.

Non pharmacologic prevention of emergence delirium

Concerning the potent relation between pre surgical anxiety and post-surgical ED, most of non-pharmacologic prevention methods against ED have targeted on decreasing preoperative anxiety. Very important quantity of action is currently ready concerning the preoperative predictors of anxiety in kids and its prevention.

Several strategies are with success found to decrease kids and parents anxiety; they contain a quiet induction with reduced sensory stimuli, the music therapy, the distraction and hypnosis, videotapes data movies before induction and parent's information [10]. Parental presence throughout induction has been found inconstantly active in reducing kid anxiety [11].

Mothers sometimes spend a big quantity of time with their kids. Therefore, mothers is assumed to contribute to their children's emotional condition and neurological development.in previous study, maternal voice had special importance and increased involuntary attention [12]. Moreover, a mother's voice induced stronger activations in specific cerebral regions than an unknown voice in another study [13].

The score

Despite emergence delirium being a clinical identification, variety of rating scales are developed for diagnosis. The pediatric anaesthesia Emergence Delirium (PAED) scale, Watcha scale and Cravero scale have all been shown to correlate with one another to some degree, however each have their own advantages and disadvantages [14]. The pediatric anaesthesia Emergence Delirium (PAED) scale (Table 1) was represented by in 2004 [15] and is that the recognized normal for the diagnosis of ED. The scores for every of the 5 listed behaviours are additional to realize a complete score (maximum score of 20). The PAED scale isn't quick and {simple} to use in clinical practice. The Watcha scale (Table 2) is claimed to possess elevated overall sensitivity and specificity [14] and is additional easy to be used in a recovery room. A baby with a score of >2 on the Watcha score is considered to have emergence delirium. If the Cravero scale (Table 3) is used, ED is believed probably once a child scores four or five for a minimum of 3 min. each the Watcha and Cravero scores are simple to use. we tend to use the Watcha scale as a primary line PACU screening tool - if ED is suspected, and also the score on the Watcha scale is >2, the anaesthesia supplier is termed for additional assessment and treatment.

Table 1: Paediatric anaesthesia emergence delirium scale

Criteria	Not at all	Just a little	Quite a bit	Very much	Extremely	Score
The child makes eye contact with the caregiver / parent	4	3	2	1	0	
The child's actions are purposeful	4	3	2	1	0	
The child is aware of his/her surroundings	4	3	2	1	0	
The child is restless	0	1	2	3	4	
The child is inconsolable	0	1	2	3	4	
Total score						

Table 2: Watcha scale

Behaviour	Score
Asleep	0
Calm	1
Crying, but can be consoled	2
Crying, but cannot be consoled	3
Agitated and thrashing around	4

Table 3: Cravero emergence agitation scale

Behaviour	Score
Obtunded with no response to stimulation	1
Asleep but responsive to movement or stimulation	2
Awake and responsive	3
Ciykig (for >3 min)	4
Thrashing behavior that requires restraint	5

Aim of study

Study the outcome of recorded mother voice on emergence delirium after anaesthesia in paediatric patients using watcha scale.

Patient and method

After approval of Iraqi council of anesthesia and intensive care and ethical approval of patient's parents, the study was conducted in Al Kadhimiya H and Baghdad teaching hospital, the study lasts for 16 weeks from July to October of 2021.

Inclusion criteria

1. Age of Pediatric patients from 2-8 years.
2. An ASA physical status (PS) of I.
3. Patients undergo an elective procedures requiring general anesthesia and intubation (lower abdominal and lower limbs operations).
4. Gender: male or female.
5. Duration of operation 30-120 minutes.

Informed consent was obtained from the parents of the participants during preoperative period before surgery.

The exclusion criteria were as follows

1. Presence of severe developmental delays or neurologic diseases.
2. Deafness or hearing impairments.
3. Presence of contraindications to any drug are going to be utilized in this study like (increased intracranial pressure, open-globe injury, or a psychiatric or seizure disorder).
4. Maternal mutism.
5. Absence of the mother.

Randomized controlled trial to be conducted in participants aged 2-8 years who are undergoing elective surgery requiring general anesthesia. Participants are going to be indiscriminately appointed to 1 of 2 groups: those that are stimulated to wake up by listening to their mother's recorded voice (maternal group, m= 25) or a stranger's voice (stranger group, s = 25) throughout anesthetic emergence.

Voice recording was done by digital voice recorder before the operation in an exceedingly calm environment, the mother was asked to talk the subsequent sentences in her usual tone of voice and Iraqi language. (Name of child), wake up. Let' go home with mommy. Wake up. Open your eyes. Take a deep breath.

Anesthesia: After a patient entered the operating theatre, standard monitoring (pulse rate and SpO_2 by pulse oximetry) Anesthesia started with sevoflurane (5.0-6.0%) via a sealed face mask. Ketamine 1 mg/kg IV slowly, propofol (1.5-2.5) mg /kg in patient older than 3 years old and Atracurium (0.4-0.5) mg kg−1 was administered to facilitate intubation, Anesthesia was maintained with sevoflurane 1.5%, all patient received Paracetamol as analgesia intraoperatively.

The recorded mother's voice (Group M) or a stranger's voice (Group S) was delivered through the headphones. The pre-recorded message was repeated with 10 s intervals, and the volume set to a normal speech level (50-60 dB). The patients were excited to get up by light patting on the shoulder and also the recorded voice. No another stimulation was allowed. After gentle suctioning of oral secretions from the oropharynx, extubation was accurately performed when the participants were ready to breathe spontaneously and adapt verbal commands.

Hemodynamic parameters such as Pulse rate (PR) and oxygen saturation (SpO_2) were checked at several times: intra operation, at the time of stopping of anesthetics, at time of extubation, 10 minutes after extubation, ED scores were measured after extubation and 10 minutes after extubation by the Watcha scale.

Results

A total of 50 pediatric patients were recruited in this study. All of them were undergone elective surgery requiring general anesthesia they were randomly allocated to listen to either their mother's voice (M Group, included 25 patients) or a stranger's voice (S Group, included 25 patients) during anesthetic emergence.

In M group, patients' age ranged from 2 to 8 years with a mean of 4.63 and standard deviation (SD) of ±2.18 years, and 16 (64%) of patients aged ≤ 5 years. In S group, patients' age ranged from 2 to 8 years with a mean of 4.76±2.04 years, and 14 patients (56%) aged ≤ 5 years (Figure 1). Regarding gender, in both groups, the proportion of males was higher than females, 60% versus 40% in M group and 68% versus 32% in S group. Duration of surgery was > 1 hr. in 14 (56%) of M group and 13 (52%) of S group. Concerning types of surgery, in M group, undescended testis was the mostly recurrent surgery in 5 (20%) followed by inguinal hernia in 4 (16%), while inguinal and umbilical hernias were the mostly recurrent surgeries in 4 (16%) and 3 (12%) of S group, respectively (Table 4).

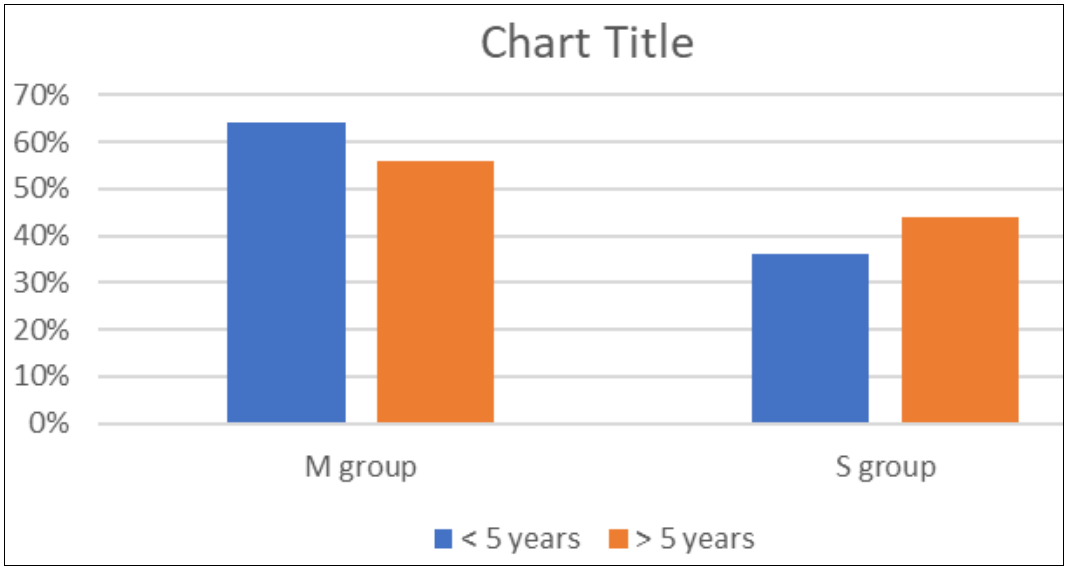

Fig 1: Distribution of study groups by age

Table 4: Distribution of the study groups by certain clinical characteristics

Clinical Characteristics	Study Group		Total (%) n= 50
	M Group n (%)	S Group n (%)	
Gender			
Male	15 (60)	17 (68)	32 (64)
Female	10 (40)	8 (32)	18 (36)
Duration of surgery			
< 1 hr.	11 (44)	12 (48)	23 (46)
>1 hr.	14 (56)	13 (52)	27 (54)
Type of surgery			
Inguinal Hernia	4 (16)	4 (16)	8 (16)
Undescended Testis	5 (20)	2 (8)	7 (14)
Appendectomy	3 (12)	2 (8)	5 (10)
Elongation of Achilles	3 (12)	3 (12)	5 (10)
Umbilical Hernia	1 (4)	3 (12)	4 (8)
Internal Fixation	1 (4)	2 (8)	3 (6)
Hypospadias	1 (4)	2 (8)	3 (6)
Others	7 (28)	8 (32)	15 (30)

The comparison between the study groups by certain demographic and clinical features showed that all the patients were comparable regarding their age (P= 0.832), gender (P= 0.556) and duration of surgery (P= 0.947) (Table 5).

Table 5: Comparison between study groups by age, gender, and duration of surgery

Characteristics	Study Group		p-Value
	M group Mean ± SD	S group Mean ± SD	
Age (years)	4.63±2.18	4.76±2.04	0.832
Duration of surgery(hr.)	1.2±0.72	1.19±0.72	0.947
Gender	N (%)	N (%)	
Male	15 (60)	17 (68)	0.556
Female	10 (40)	8 (32)	

Regarding the comparison in means of pulse rate between the studied groups, we noticed that there were no significant differences ($p \geq 0.05$) in means of heart rate in all times during and after operation (Table 6).

Table 6: Comparison between the study groups by means of heart rate

Time	Pulse rate		p-Value
	M group Mean ± SD	S group Mean ± SD	
Intraoperative	117.9±12.40	118.4±11.44	0.887
At Cessation of Anesthesia	119.5±16.13	118.3±12.47	0.77
After extubation	145.1±19.61	137.6±15.17	0.144
10 min. After extubation	132.1±21.34	132.2±16.13	0.982

Regarding the comparison in means of SpO_2 between the two groups, no significant differences ($p \geq 0.05$) were found in means of SpO_2 in all times during and after operation (Table 7).

Table 7: Comparison between the study groups by means of SpO_2

Time	SpO_2 (%)		p-Value
	M group Mean ± SD	S group Mean ± SD	
Intraoperative	99.88±0.33	99.75±0.87	0.082
At Cessation of Anesthesia	99.64±0.56	99.28±0.89	0.095
After extubation	98.52 ±0.96	98.24 ±0.66	0.237
10 min. After extubation	98.56 ±0.68	98.72±1.02	0.554

The comparison between the studied groups by means of Watcha scale showed that mean of Watch scale at the end of operation was lower among M group than that in S group, but this difference was not significant (P= 0.321). After 10 minutes of operation, children in the M group had a significantly lower mean of Watcha scale compared with those in S group (1.56 versus 2.48, P= 0.001) (Table 8).

Table 8: Comparison between the study groups by means of Watch scale

Time	Watcha Scale		p-Value
	M group Mean ± SD	S group Mean ± SD	
At End of Operation	1.40 ±1.19	1.72 ±1.06	0.321
After 10 min. later	1.56±0.58	2.48±0.87	0.001

In the present study, there have been noticed variations in suggests that of Watcha scale between the 2 groups per age, gender, and period of surgery. After ten minutes of operation, kids within the M group had an obviously lower Watcha scale ($p < 0.05$) compared to those in the S group (Table 9).

Table 9: Comparison in Watcha scale between the study groups by age, gender, and duration of surgery

Demographic & Clinical Charc.	Watcha Scale		p-Value
	M Group Mean ± SD	S Group Mean ± SD	
Age (years)			
<5	1.62 ±0.61	2.35±0.84	0.011
>5	1.44±0.52	2.63±0.92	0.003
Gender			
Male	1.40 ±0.63	2.47 ±0.87	0.001
Female	1.80±0.42	2.5±0.92	0.47
Duration of surgery			
<1 hr.	1.63 ±0.5	2.75±0.85	0.045
>1 hr.	1.5±0.65	2.69±0.63	0.001

Discussion

Among the most typical behavioral therapies, playing handheld video games or watching videos has the effect of alleviating preoperative anxiety like in lee's study [16], but they cannot be used for anaesthetized or unconscious children. In the case of pharmacologic interventions such as fentanyl, propofol, or dexmedetomidine, respiratory depression may be induced or recovery time prolonged because of its sedative effect. Parental presence within the operation room throughout anaesthetic emergence looks to be attractive, however there are several cases wherever this is often not possible, relying on the setting of the operation room. The existence of the mother or father in the operation room may also be a psychological burden for the medical staff [17].

There are several studies regarding the effect of parental presence on children's anxiety before anaesthetic induction, with evidence that it does not reduce anxiety in either children or parents, explained this phenomenon by suggesting that parent's anxiety during induction may be transferred to their children. Therefore, we found that listening to the recorded mother voice in a calm and stable environment lowers Watcha scores in paediatric patients after general anaesthesia, thereby leading to a reduction in the incidence of ED during the post-anaesthesia period, compared with listening to a stranger's voice [18].

Because the mother' voice could be a familiar stimulation related to feeding and soothing, it will induce positive emotional responses to her kid. Indeed, animal and human studies show that the association of negative emotions and the activation of specific brain regions such as the amygdala and hippocampus, might be diminished when the baby suddenly hears his/her mother's voice [19].

In clinical areas, the mother's voice showed positive

physiological and behavioural responses, especially in infants and neonates [20].

However, to our knowledge, our study looks like a study by Kim and colleagues [21].

Our study involves investigation under general anesthesia utilizing each ketamine, sevoflurane, however Kim's study was conducted under modest sedation using ketamine only [21].

Despite the continuing encouragement from the previous findings, however, there are no formally approved indications for its use within the paediatric population. Meanwhile, ketamine has been safely utilized in pediatric anesthesia for over 5 decades. It effectively reduced the incidence of emergence delirium in previous studies [22].

In Song's study, its scoring system (PAED) is subjective and should have within- observer variation. As a result of this scale is consists of a multi-questionnaire, an observer may considerably lose consistency once he observes a similar subject repeatedly. To catch up on this problem, they additionally measured the Watcha score that is easier to score than PAED [23].

We use the Watcha scale which is said to have the highest overall sensitivity and specificity[14] and is more user-friendly for use in a recovery room. A child with a score of >2 on the Watcha score can be considered to have emergence delirium.

Conclusion

ED scores was reduced in paediatric patients who heard their mother`s voice throughout the emergence period. Mother recorded voice may be a simple, complication-free, costless and practicable technique for the stopping of ED within the paediatric age-group after anaesthesia.

Recommendation

- This study recommends the healthcare practitioners to use the recorded mother voice as a way to reduce agitation and delirium in a child after general anesthesia post operation.
- We recommend to start a multicenter similar study with larger sample to evaluate the results and encourage a guideline to reduce the complications of emergence delerium.

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