EGYPTIAN JOURNAL OF ANAESTHESIA
2022, VOL. 38, NO. 1, 357–364
https://doi.org/10.1080/11101849.2022.2087279

Dexmedetomidine decreases stress post-operative in pediatrics

Taha Magdy AllamFarrag, Mai Abd El Fattah Ahmed Madkour, AbdelhayAbdelgayed Abdelhay Ebade and Victor Farouk JaccoubMetry

Surgical ICU and Pain Management, Faculty of Medicine, Cairo University, Giza, Egypt

ABSTRACT

Introduction: Tracheal extubation causes hypertension and tachycardia. These associated hemodynamic changes are due to sympathetic discharge due to epipharyngeal and laryngeal stimulation.(1)

Aim of work: Dexmedetomidine is an effective sedative and analgesic agent, it helps in opioid sparing and multimodal techniques in pediatric anesthesia and reduces the toxicity of common anesthetics, and it has been approved by the end of 1999 by the FDA for human use for sedation in the intensive care unit (ICU). Dexmedetomidine is notable for its ability to provide sedation without risk of respiratory depression and can provide cooperative or arousable sedation. ***The aim of this study*** is to assess the effect of administering dexmedetomidine near the end of surgery ***versus*** a control group regarding the change in circulatory reflexes (represented by MAP) and the incidence of adverse events such as cough, laryngeal spasm or desaturation.

Study design: This study was designed as a prospective randomized controlled study. It was conducted in the Pediatrics orthopedic surgery theatre (Abo El Reesh pediatric Hospital) belonging to Cairo university hospitals on 70 patients divided into two groups 35 patients each and aged from 3–12 years planned for elective isolated limb anomaly correction.

Result: Dexmedetomidine injection near the end of the operation decreased the stress induced during extubation with almost no change in HR or MAP and less cough score, which indicated smoother extubation.

Conclusion: Dexmedetomidine is a potent alpha 2 receptor agonist, having analgesic and sedative effects and sparing usage of opioids without compromising respiratory reflexes or attenuating cardiovascular response during extubation.

ARTICLE HISTORY
Received 27 January 2022
Revised 16 May 2022
Accepted 4 June 2022

KEYWORDS
Dexmedetomidine; pediatrics; post-operative; analgesics; sedation; fentanyl

1. Introduction

Tracheal extubation, as well as intubation, causes hypertension and tachycardia. These associated hemodynamic changes during extubation and emergence from anesthesia are due to sympathetic discharge due to epipharyngeal and laryngeal stimulation. This increase in sympathetic activity may result in hypertension, tachycardia and arrhythmias. The increase in blood pressure (BP) and heart rate (HR) is transitory (lasting 5–15 min), variable but unpredictable and is more hazardous to patients with pre-existing hypertension, myocardial insufficiency or cerebrovascular diseases. Hypertension can result in the increase in brain edema or intracranial hematoma formation, which may give rise to herniation. [1] The incidence of coughing and sore throat at emergence ranges from 38 to 96%. Upper airway obstruction (UAO) includes laryngeal spasm, edema, hemorrhage, trauma and vocal cord paralysis/dysfunction. One-third of cases of pulmonary aspiration occur after extubation. [2]

Multiple studies were performed smooth extubation using different drugs, lidocaine 1 mg/kg is shown to reduce hemodynamic changes on extubation, and diltiazem 0.1–0.2 mg/kg IV given 2 min before extubation is an effective method for blunting cardiovascular responses to tracheal extubation. [3] Labetalol and fentanyl effectively blunt hemodynamic response to tracheal extubation in patients and can be safely used. [4]

Dexmedetomidine is an effective sedative and analgesic agent; it helps in opioid sparing and multimodal techniques in pediatric anesthesia and reduces the toxicity of common anesthetics, which may impair the brain development of babies and young children. Dexmedetomidine induces sedation that more closely resembles physiological sleep in terms of EEG; it has been shown to be effective in reducing emergence delirium, an issue that is seen especially in the pediatric population. It has also been shown to reduce acute postsurgical pain and opioid use. Most importantly, it does all these things without reducing the respiratory drive. [5]

Dexmedetomidine is an anxiolytic with an elimination half-life of 2 hours. It is notable for its ability to provide sedation without the risk of respiratory depression (unlike other commonly used drugs such as propofol and fentanyl) and can provide cooperative or arousable sedation. Similar to clonidine, it is a highly

CONTACT Victor Farouk JaccoubMetry dr.vfjacob@gmail.com Surgical ICU and Pain Management, Faculty of Medicine, Cairo University, Giza, Egypt

selective and potent agonist of Alpha 2 (α2) adrenergic receptors in certain parts of the brain, which in a dose-dependent manner, reduces arterial blood pressure and heart rate. [6]

Dexmedetomidine increases the activity of gamma-aminobutyric acid neurons. It also has analgesic effects at the spinal cord level and other supraspinal sites. Unlike other hypnotic agents such as propofol, dexmedetomidine can be used to help decrease the opioid needs for people in pain even while having good analgesia. [6]

In the past decade, the clinical applications of dexmedetomidine have expanded with reports of its use as a premedication before anesthesia and as an adjunctive drug intra-operatively and post-operatively to attenuate emergence complications including delirium, shivering and pain in the perioperative period and also for sedation, analgesia, hemodynamic management and airway management in the ICU. [7]

The aim of this study is to assess the effects of administering dexmedetomidine at the end of surgery in attenuation of the stress response during extubation in pediatrics.

2. Methodology

This study was designed as a prospective blinded randomized controlled study. It was conducted in the Pediatrics orthopedic surgery theatre (Abo Elreesh Pediatric Hospital) belonging to Cairo university hospitals after getting approval from the anesthesia department research committee and obtaining informed consent from the parents or legally authorized people during the period between June 2020 and October 2020.

Study population: inclusion criteria (Figure 1)

- Pediatrics of age 3–12 years ASA I–II.
- Elective orthopedic surgery.
- Pediatric patient with isolated limb anomaly where iatrogenic fracture will be performed to the bone for correction and repair.

2.1. Randomization

Seventy patients were randomly divided into 2 groups in a double blinded manner, 35 patients each using computer-generated random numbers allocated in the 2 groups under closed opaque envelopes. The details of the series were unknown to the investigators, while the group assignment was kept in a set of concealed envelopes, each bearing only the case number on the outside (Figure 1),

- Preoperative assessment for patients undergoing orthopedic surgery with detailed history taking, clinical examination and investigations in the form of complete blood count, coagulation profile, liver functions and renal functions.

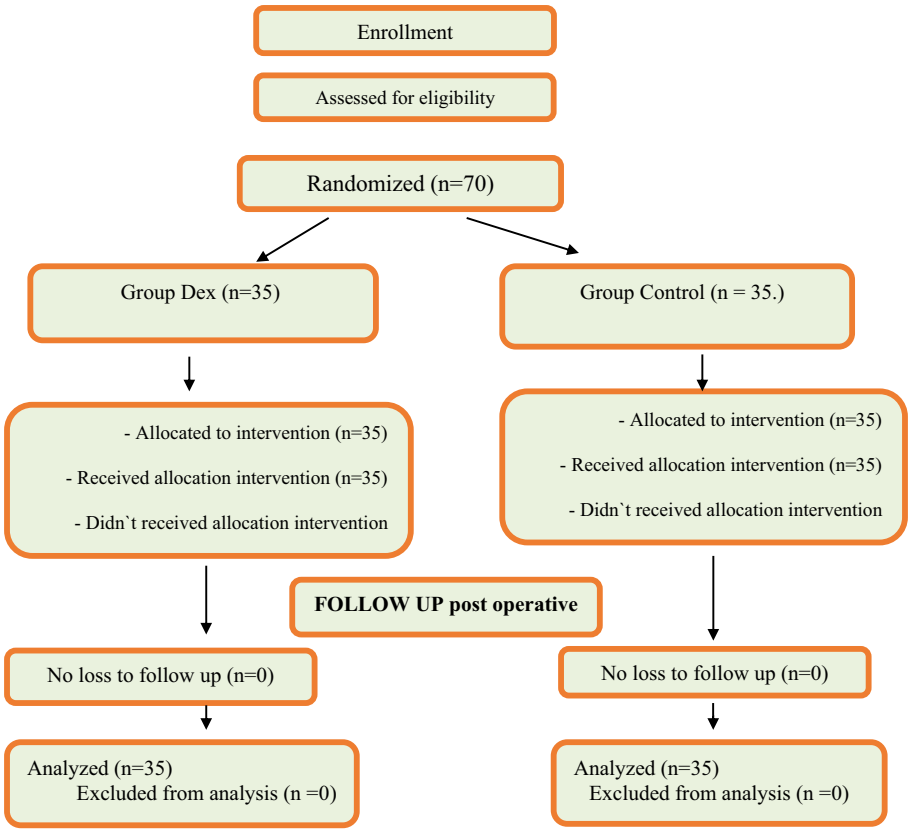

Figure 1. CONSORT flow diagram of the study. [11].

- ***Intramuscular (IM)*** **–** atropine 0.02 mg/kg and midazolam 0.05 mg/kg were given as premedication to all participants half an hour before surgery.

Once the patient arrived to the operating room, basic monitor was applied in the form of non-invasive blood pressure (NIBP), pulse oximeter and electrocardiograph ECG and baseline values of mean arterial pressure MAP, ***peripheral oxygen saturation SpO2*** and heart rate HR were recorded:

- Anesthesia was induced by inhalation of sevoflurane at ***6%*** in oxygen.
- Then, an intravenous line was secured.
- Intravenous fentanyl 1 mcg/kg and atracurium 0.5 mg/kg were administered.
- Ventilation was performed using an appropriately sized disposable plastic mask.
- Ventilation was maintained until adequate relaxation.
- Direct laryngoscopy was used to intubate the patient using ETT appropriate for the patient's age.
- Patient's body temperature and end tidal carbon dioxide were recorded after intubation.
- Patient vitals (HR, SBP, DBP and MAP) were recorded after induction and before and after intubation.
- Patients were maintained on controlled mechanical ventilation with a mixture of isoflurane 1%-1.5% in oxygen.
- A peripheral nerve stimulator was connected to monitor the neuromuscular blockade.
- A warmer applied to each patient to prevent hypothermia.

At the end of the surgery, patients received the prepared drug syringe intravenously. ***The anesthesiologist, who had prepared the study drug, was not involved in data collection*** (Figure 1):

- **Group D (Dexmedetomidine)** received dexmedetomidine when the surgeon started closure of the muscular layers – at a dose of 0.5 mcg/kg, slowly injected intravenously over 5 minutes in a non-labeled 20 ml syringe.
- **Group C (Control)** received 0.9% saline, slowly injected intravenously over 5 minutes in a non-labeled 20 ml syringe.

Heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure were recorded (Tables 2, 3, 4 and 5).

- **Before giving** the injected drug for both groups
- **1, 5, 7 and 10 min** after administration of drug
- **Every 2 min** after extubation.

2.2. PACU (on arrival, 10 and 30 min)

2.2.1. Discharge to ward (4, 8 and 12 hrs)

Possible adverse effects during and after the administration of dexmedetomidine and during the post-operative period such as arrhythmia, allergy to Dexmedetomidine, bradycardia, tachycardia, hypotension, hypertension, vomiting and dry mouth were recorded.

Atropine at a dose of 0.01 mg/kg IV bolus was given for bradycardia if the HR according to age decreased to less than 1st percentile (the least normal heart rate expected for age).

The expected (1^{st}-99^{th}) percentile for the children heart rate:

• Preschooler (3–5 years): 80–140 bpm

• School-aged child (5–12 years): 70–120 bpm

Inhalational anesthetic was closed, and the patient was prepared for extubation when meeting its criteria:

- Adequate oxygenation – SpO2 > 95%

- Adequate ventilation VT – 5 ml/kg and ***spontaneous RR 20–30 breath/min (according to age)***

- Normovolemic and normothermic.

2.3. Sustained 5 seconds head lift (in older children ≥ 8 years)

Conventional neuromuscular blockade reversal was given – neostigmine at a dose 0.05 mg/kg and atropine 0.01 mg/kg diluted and given slowly over 1 min.

BP and HR ***were*** recorded, and number and severity of coughs ***were*** recorded using the following three categories of cough scores:

- Mild (single cough)

- Moderate (more than one episode of unsustained less than 5 seconds of coughs)

- Severe (sustained episode of coughs more than 5 seconds).

The formula for calculating the cough score in this study is as follows:

Cough score = (number of mild coughs × 1) + (number of moderate coughs × 2) + (number of severe coughs × 3). [8]

Neurologically Intact follows verbal commands (if old enough), crying, movement, intact cough/ gag reflex – extubation was performed – then the patient was discharged to the **P**ost-**A**nesthesia **C**are **U**nit (PACU) after 10 min of extubation where he/she stayed for 30 min.

In the Post-anesthesia care unit (PACU), the patient was assessed for the following:

- Hemodynamic – HR, SBP, DBP and MAP (Tables 2, 3, 4 and 5)
- Adverse events recorded in both groups (Table 6).
- Cough score (Table 11)

- Pain score using the **Wong-Baker Faces pain rating** [9] scale, where **0** denotes the least pain and **10** denotes the worst pain.
- Sedation score recorded using **Aono's four-point scale** [9] – every 10 min in PACU until being discharged from there (Table 7).

Later, the patient discharged to the ward using **modified Alderet's score that should be ≥ 9** (Table 1), and we followed up the patient in which he/she was monitored for HR, BP and pain every 4 hours for the next 12 hours at least.

For post-operative analgesia, paracetamol 15 mg/kg/6 hours was given and morphine 0.1 mg/kg IV (***according to patient's demand***) would be given with severe pain (FPS-R > 6) to be titrated 0.05 mg/kg every 15 minutes to achieve the desired response (FPS-R < 4) with a maximum dose of ***0.25 mg/kg over 45 minutes total time*** and to be repeated according to patient's demand after that by 6 hours at least (Table 8).

The study aims to illustrate the difference in circulatory reflexes (represented by MAP) from the time of stopping inhalational anesthetics and maximum value measured over the first 5 minutes after extubation and drug administration.

2.4. Statistical methods

The sample size was calculated using the following formula for the sample size n:

$n = N \times X/(X + N - 1)$,

where

$X = Za/2^2 \times p \times (1\text{-}p)/MOE2$

in which Za /2 is the critical value of the normal distribution at a/2 (for a confidence level of 95%, a is 0.05 and the critical value is 1.96),

MOE is the margin of error,

P is the sample proportion and N is the population size.

Data management and statistical analysis were performed using the **Statistical Package for Social Sciences (SPSS, IBM) version 24**. Numerical data were summarized using means and standard deviations or medians and ranges. Data were explored for normality using the **Kolmogorov-Smirnov** test and **Shapiro-Wilk test**. Categorical data were summarized as percentages. Comparisons between the 2 groups with respect to normally distributed numeric variables (MBP, HR, age, . . .) were performed using the **independent t-test**. Not normally distributed numeric variables (NRS Score) were compared by the **Mann-Whitney** test; overtime comparison in each group was

Table 1. Modified Aldrete score [10].

Discharge criteria	Score
Activity: able to move voluntarily	
Four extremities	2
Two extremities	1
Zero extremities	0
Respiration	
Able to deep breath and cough freely	2
Dyspnea, shallow or limited breathing	1
Apnea	0
Circulation	
Blood pressure ± 20% of preanesthetic level	2
Blood pressure ± 20–50% of preanesthetic level	1
Blood pressure ± 50% of preanesthetic level	0
Consciousness	
Fully awake	2
Arousable on calling	1
Not responding	0
Oxygen saturation	
More than 92% on room air	2
Needs oxygen inhalation to maintain oxygen saturation > 90%	1
Oxygen saturation < 90% even with oxygen supplementation	0

An Aldrete score ≥ 9 is required for discharge

Table 2. Mean HR along data recording in both groups.

	Dex (n = 35)		Control (n = 35)		
HR	Mean	SD+	Mean	SD+	P value
Baseline	142	9	136	13	0.042
After induction	149	6	150	6	0.711
Before giving drug	124	7	122	8	0.164
1 min after giving drug	114	6	132	6	<0.001
5 min after giving drug	113	5	127	7	<0.001
7 min after giving drug	111	5	128	6	<0.001
10 min after giving drug	113	4	127	6	<0.001
Before extubation	120	4	142	6	<0.001
At extubation	121	5	144	4	<0.001
2 min of extubation	119	4	136	4	<0.001
4 min of extubation	117	3	132	4	<0.001
6 min of extubation	114	3	128	3	<0.001
8 min of extubation	116	3	124	3	<0.001
10 min of extubation	115	2	125	3	<0.001
PACU arrival	115	4	126	4	<0.001
10 min at PACU	115	4	125	4	<0.001
30 min at PACU	115	4	126	4	<0.001
4 h after discharge	118	2	127	2	<0.001
8 h after discharge	119	2	125	3	<0.001
12 h after discharge	106	3	114	3	<0.001

SD+: standard deviation, p ≤ 0.05 is considered statistically significant, analysis performed by an independent t test

Table 3. Mean SBP along data recording in both groups.

	Dex (n = 35)		Control (n = 35)		
SBP	Mean	SD+	Mean	SD+	P value
Baseline	86.1	7.5	84.5	6.4	0.360
After induction	92.1	8.7	96.0	8.9	0.069
Before giving drug	95.3	8.3	92.9	7.7	0.226
1 min after giving drug	94.2	3.8	93.4	4.1	0.404
5 min after giving drug	91.5	2.8	94.4	4.5	0.002
7 min after giving drug	92.1	2.2	94.9	3.9	0.001
10 min after giving drug	92.5	2.5	94.8	2.8	<0.001
Before extubation	94.6	2.7	103.1	3.7	<0.001
At extubation	98.5	2.8	106.4	4.4	<0.001
2 min of extubation	94.6	2.2	101.2	3.1	<0.001
4 min of extubation	93.5	2.3	97.8	3.2	<0.001
6 min of extubation	93.3	2.0	97.4	3.8	<0.001
8 min of extubation	93.3	2.7	97.3	3.2	<0.001
10 min of extubation	93.4	2.7	97.9	2.7	<0.001
PACU arrival	93.5	2.6	96.3	2.3	<0.001
10 min at PACU	92.6	2.5	97.7	2.4	<0.001
30 min at PACU	93.6	2.3	97.1	1.7	<0.001
4 h after discharge	94.9	2.9	99.3	2.9	<0.001
8 h after discharge	94.8	2.9	99.3	2.3	<0.001
12 h after discharge	96.1	2.6	98.4	3.2	0.001

SD+: standard deviation, p ≤ 0.05 is considered statistically significant, analysis performed by an independent t test

Table 4. Mean DBP along data recording in both groups.

	Dex (n = 35)		Control (n = 35)		
DBP	Mean	SD+	Mean	SD+	P value
Baseline	52.2	8.4	52.8	7.4	0.729
After induction	57.2	8.0	58.9	9.3	0.420
Before giving drug	58.1	5.8	57.7	5.9	0.777
1 min after giving drug	54.1	5.3	55.4	4.7	0.274
5 min after giving drug	52.6	5.6	56.7	4.4	0.001
7 min after giving drug	50.2	4.7	56.1	4.9	˂0.001
10 min after giving drug	51.6	3.8	50.6	4.3	0.335
Before extubation	55.7	3.3	59.2	3.6	˂0.001
At extubation	55.5	3.7	57.9	4.8	0.019
2 min of extubation	53.5	2.9	54.3	2.7	0.219
4 min of extubation	51.8	2.7	54.4	2.5	˂0.001
6 min of extubation	52.3	2.5	53.9	3.0	0.015
8 min of extubation	52.4	2.2	53.5	2.7	0.055
10 min of extubation	52.7	2.7	53.6	2.5	0.175
PACU arrival	51.9	2.3	56.0	2.7	˂0.001
10 min at PACU	52.2	2.1	55.5	2.5	˂0.001
30 min at PACU	51.8	2.1	56.7	1.6	˂0.001
4 h after discharge	53.4	1.9	58.3	1.5	˂0.001
8 h after discharge	53.6	3.7	54.1	3.9	0.553
12 h after discharge	52.1	3.2	54.2	2.9	0.004

SD+: standard deviation, p ≤ 0.05 is considered statistically significant, analysis performed by an independent t test

performed by the **Friedman test** followed by the **Dunn test**. For categorical variables, differences were analyzed using the chi square test and **Fisher's exact** test when appropriate. All p-values are two-sided. P-values ≤ 0.05 were considered significant.

3. Results

From 70 enrolled patients, 70 patients were recruited. Patients were classified randomly into two groups, **Group D** (n = 35) and **Group C** (n = 35). The mean age was 7.2 ± 2.9 in group D and 7.3 ± 2.7 in group C. Along data recording in both groups concerning patient's hemodynamics, SBP, DBP, MAP and HR, changes at induction were not significant at all, and there was a significance between both groups later on the HR aspect (P Value < 0.001) as shown in Table 2, although the difference was not big between both groups on the MAP aspect (but almost statistically significant p value <0.001) as shown in Table 5.

Table 5. Mean MAP along data recording in both groups.

	Dex (n = 35)		Control (n = 35)		
MAP	Mean	SD+	Mean	SD+	P value
Baseline	63.5	6.4	63.4	5.5	0.963
After induction	68.8	7.7	71.3	8.6	0.221
Before giving drug	70.5	5.3	69.4	5.1	0.410
1 min after giving drug	67.5	3.8	68.1	3.5	0.487
5 min after giving drug	65.6	3.6	69.2	3.3	<0.001
7 min after giving drug	64.2	3.3	69.0	3.5	<0.001
10 min after giving drug	65.2	2.7	65.3	3.1	0.837
Before extubation	69.8	2.7	74.1	3.3	<0.001
At extubation	68.7	2.1	73.8	2.8	<0.001
2 min of extubation	67.2	2.1	69.9	2.3	<0.001
4 min of extubation	65.7	1.9	68.9	2.1	<0.001
6 min of extubation	65.9	2.0	68.4	2.3	<0.001
8 min of extubation	66.0	1.8	68.1	2.2	<0.001
10 min of extubation	66.3	2.0	68.3	1.9	<0.001
PACU arrival	65.8	1.8	69.4	2.1	<0.001
10 min at PACU	65.7	1.7	69.6	1.7	<0.001
30 min at PACU	65.8	1.7	70.2	1.3	<0.001
4 h after discharge	67.2	1.7	72.0	1.4	<0.001
8 h after discharge	67.3	2.7	69.2	2.7	0.006
12 h after discharge	66.7	2.2	68.9	2.2	<0.001

SD+: standard deviation, p ≤ 0.05 is considered statistically significant, analysis performed by an independent t test

Table 6. Adverse effects recorded in both groups.

		Dex (n = 35)		Control (n = 35)		
		No	%	No	%	p value
Hypotension	No	34	97.1	35	100	1.000[a]
	Yes	1	2.9	0	0	
Bradycardia	No	33	94.3	35	100	0.493[a]
	Yes	2	5.7	0	0	
Tachycardia	No	35	100	9	25.7	<0.001
	Yes	0	0	26	74.3	
Nausea and vomiting	No	33	94.3	35	100	0.493[a]
	Yes	2	5.7	0	0	

p≤ 0.05 is considered statistically significant, analysis done by Chi square test, a: analysis done by fisher exact test

4. Discussion

In our study, a single dose of dexmedetomidine has shown to attenuate airway and circulatory reflexes with no difference regarding incidence of breath holding or ***desaturation that was monitored by the peripheral oxygen saturation using the pulse oximeter.***

This result is compatible with the study performed by ***Guler G et al.*** [12] that concluded that single-dose bolus injection of dexmedetomidine before tracheal extubation attenuates airway-circulatory reflexes without desaturation or breath holding.

To our knowledge, this is the first study to use dexmedetomidine (dex) to assess its effect at a low bolus dose of 0.5 mcg/kg given slowly over 10 min on attenuation of the stress response during extubation and follow-up of patients post-operatively ***without being deeply***

Table 7. Aono's four-point scale as sedation assessment in both groups in the PACU.

Aono's four-point scale		Dex (n = 35)		Control (n = 35)		
		No	%	No	%	p value
PACU immediate	Calm (+1)	32	91.4	1	2.9	<0.001
	Not calm but could easily be calmed (+2)	3	8.6	24	68.6	
	Not easily calmed, moderately agitated (+3)	0	0	10	28.6	
10 min	Calm (+1)	32	91.4	1	2.9	<0.001
	Not calm but could easily be calmed (+2)	3	8.6	24	68.6	
	Not easily calmed, moderately agitated (+3)	0	0	10	28.6	
30 min	Calm (+1)	32	91.4	1	2.9	<0.001
	Not calm but could easily be calmed (+2)	3	8.6	24	68.6	
	Not easily be calmed, moderately agitated (+3)	0	0	10	28.6	

Table 8. Pain score in both groups ***using the Faces Pain Scale – Revised (FPS-R).***

	Dex			Control			
Pain score	Median	Minimum	Maximum	Median	Minimum	Maximum	p value 1
PACU arrival	0^{A}	0	2	0^{A}	0	4	<0.001
10 min at PACU	0^{A}	0	2	0^{A}	0	4	<0.001
30 min at PACU	0^{A}	0	2	2^{C}	0	4	<0.001
4 h after discharge	2	2	4	4^{B}	2	6	<0.001
8 h after discharge	6^{B}	4	8	6^{B}	2	8	0.140
12 h after discharge	2^{B}	2	8	2^{C}	2	8	0.080
p value 2		<0.001			<0.001		

p ≤ 0.05 is statistically significant, p value 1: comparing 2 groups at each time point by the Mann-Whitney test, p value 2: comparing overtime in each group by the Friedman test, similar upper case letters are statistically not significant

sedated with its analgesic effect, which decreases the need of opioids and their undesired adverse effects in the ward for at least 12 hours post-operatively.

Tracheal extubation is almost always associated with the increase in sympathoadrenal activity, which may result in hypertension, tachycardia and arrhythmias. This hemodynamic stimulus is associated with the increase in the plasma adrenaline concentration parallel with the increase in BP. Tracheal extubation is associated with acute, transient, significant and undesirable hemodynamic and airway responses that may persist in the recovery period. Stimulation of the respiratory tract at the supraglottic and subglottic levels and an increase in the release of circulatory catecholamines produce these responses. [13]

Various drugs and techniques are used to reduce airway and circulatory responses during extubation, but none have satisfied the needs for smooth extubation without vigorous changes in hemodynamics. "Deep extubation" is a useful technique in circumstances where coughing on the tracheal tube is undesirable. However, it carries risks of aspiration and obstruction and needs to be carried by experienced personnel to avoid and deal with any rising complication. The reflexes range from tachycardia, hypertension, coughing, bucking, agitation, bronchospasm, laryngospasm, laryngeal edema, negative pressure pulmonary edema and arrhythmias. [14]

Almost all studies are performed in the adult age group or test emergence agitation in the pediatrics age group. We have conducted our study on the aspect of smooth extubation and painless period for the child post-operatively, which helps in quicker mobilization, and thus while leaving the hospital, which was applicable in our patients.

In our study, dexmedetomidine was injected slowly near the end of the operation in attempt to avoid possible adverse effects although the patient who suffered bradycardia required atropine injection and 2 patients who suffered transient initial hypotension resolved with no pharmacological intervention.

According to Ali et al. [15], the dexmedetomidine group showed a longer time to extubation and discharge from PACU, they used dexmedetomidine at a dose of 0.3 mcg/kg, and their extubation time was 12.8 ± 1.95 min, while in our study, it was 12.3 ± 2.7 min; the time for the modified Aldrete score >9 in their study was 17.1 ± 2.5 min, while in our study, it was 14.6 ± 2.56, suggesting that there is no difference from using the dose of 0.3 mcg/kg vs 0.5 mcg/kg at all (Tables 9 **&** 10).

In other studies, ***Shukry et al. and Isik et al.*** [16,17] showed too longer time for discharge from the PACU after dexmedetomidine administration reaching 49.9 min. While there is a slight reducion in the time of extubation of around 10 minutes was observed after stopping the volatile gases.

Moreover, Aono's four-point scale is almost the same as in our study although Shukry used dexmedetomidine infusion and Isik used bolus IV dose of 1 mcg/kg.

Concerning patients' hemodynamics, SBP, DBP, MAP and HR, changes at induction were not significant at all, and there was significance between both groups later on the HR aspect (P value < 0.001) (Table 2), although the difference was not big between both groups on the MAP aspect (but almost statistically significant at p values <0.001 (Table 3).

Table 9. Extubation time in both groups.

	Dex (n = 35)		Control (n = 35)		
	Mean	SD+	Mean	SD+	P value
Time of operation (min)	106.6	8.9	108.2	11.6	0.506
Extubation time	12.3	2.7	6.9	1.6	<0.001

Table 10. Time in minutes needed by the modified Aldrete score to be more than 9.

	Dex (n = 35)		Control (n = 35)		
	Mean	SD+	Mean	SD+	P value
Modified Aldrete score >9	14.63	2.56	6.3	1.55	0.02

Cough reflex was significantly different in both groups where it was less than three coughs in the dexmedetomidine group in almost all the 35 patients, but it was more than three coughs in the control group (Table 11).

Table 11. Cough score in both groups.

	Dex	Control
Cough ≤ 3	35	5
Cough > 3	0	30

In healthy children, the severity of hypotension varies directly with the dose of dexmedetomidine. When a loading dose between 0.5 and 1 mcg/kg dexmedetomidine is administered over 10 min as the sole sedative, SBP decreases as the dose increases, reaching a maximum decrease of 30% from baseline at 1 mcg/kg [18].

Several adult [19,20] and pediatric [21] studies have demonstrated that dexmedetomidine spares opioid requirements during and after surgery, in our study, we have used IV fentanyl during induction for all participants, and then near the end of surgery, we give one group dexmedetomidine, and the other group used traditional analgesia after getting to PACU. We have discovered that the group given dexmedetomidine spared opioids use for around 6–8 hours post-operatively; moreover, low opioids dose was enough, morphine at a dose of 0.1 mg/kg; on the other hand, the other group started opioids intake 2–4 hours within discharge from PACU with a dose of 0.15 mg/kg receiving top up of 0.05–0.1 mg/kg 20–30 min later after the initial dose of morphine.

A meta-analysis of the perioperative analgesic effect in children, infants and neonates showed that intraoperative dexmedetomidine administration was associated with reduced post-operative opioid consumption in the post-anesthetic care unit (PACU) [risk ratio (RR) ¼ 0.31; 95% confidence interval (CI), 0.17–0.59] and decreased pain intensity (standardized mean difference = −1.18; 95% CI, −1.88 to −0.48) but had no effect upon post-operative nausea and vomiting (RR ¼ 0.67; 95% CI, 0.41–1.08). The optimal bolus dose was 0.5 mcg/kg or more. [22]

During extubation using dexmedetomidine, the patient although regained all his reflexes, no cough occurred at all during endotracheal tube removal and hence less laryngeal irritation and augmentation for stress response during extubation as well as less incidence of sore throat. [22]

5. Conclusion

Dexmedetomidine is a potent alpha 2 receptor agonist, having analgesic effects sparing the use of opioids on discharge and sedative effects without compromising respiratory reflexes and attenuating cardiovascular response during extubation. The use of dexmedetomidine in the perioperative period has a positive impact and outcome for the patient and his relatives with decreasing parents' concerns after discharge from the operation room.

(According to pain scoring – Table 8 ***– patients of the dexmedetomidine group did not need opioids after discharge in the PACU and for at least 6–8 hours, while the control group patients needed opioids within 2–4 hours after discharge as their FPS – R ≥ 6)***

Disclosure statement

No potential conflict of interest was reported by the author(s).

ORCID

Mai Abd El Fattah Ahmed Madkour http://orcid.org/0000-0003-3670-0298

Authors' contributions

All the authors of this research paper have directly participated in the planning, execution or analysis of this study.

Recommendations

Further studies are required to assess the use of dexmedetomidine in the post-operative period and assessment of pain to decrease post-operative anesthesia complication and use least required doses of opioids for early mobilization and shortest hospital stay.

References

[1] Bellon M, Le Bot A, Michelet D, et al. Efficacy of intraoperative dexmedetomidine compared with placebo for postoperative pain management: a meta-analysis of published studies. Pain Ther. 2016;5(1):63–80.
[2] Karmarkar S, Varshney S. Tracheal extubation. Contin Educ Anaesth Crit Care Pain. 2008 Dec 1; 8(6):214–220.
[3] Mikawa K, Nishina K, Maekawa N, et al. Attenuation of cardiovascular responses to tracheal extubation: verapamil versus diltiazem. Anesth Analg. 1996;82:1205–1210.
[4] Younes M, Mahareak A, Salem E, et al. Attenuation of cardiovascular responses to tracheal extubation with labetalol. Al-Azhar Assiut Med J. 2017;15(4):216
[5] Mason KP, Lerman J. *Dexmedetomidine in children*: current knowledge and future applications. Anesth Analg. Lippincott Williams and Wilkins. 2011;113:1129–1142.
[6] Makkar JK, Bhatia N, Bala I, et al. A comparison of single dose dexmedetomidine with propofol for the prevention of emergence delirium after desflurane anaesthesia in children. Anaesthesia. 2016 Jan 1; 71(1):50–57.
[7] Sottas CE, Anderson BJ. *Dexmedetomidine*: the new all-in-one drug in pediatrics anesthesia?. Current Opinion Anesthesiol. Lippincott Williams and Wilkins. 2017;30:441–451.
[8] Ki YM, Kim NS, Lim SH, et al. The effect of lidocaine spray before endotracheal intubation on the incidence of cough and hemodynamics during emergence in children. Korean J Anesthesiol. 2007;53(3):S1.
[9] Drendel AL, Kelly BT, Ali, et al. "Pain assessment for children: overcoming challenges and optimizing care". Pediatr Emerg Care. 2011August;27(8):773–781. PMID 21822093.
[10] Anuj Jain, Muralidhar V, Sanjeev A, et al. A prospective observational study comparing criteria-based discharge method with traditional time-based discharge method for discharging patients from post-anaesthesia care unit undergoing ambulatory or outpatient minor surgeries under general anaesthesia. Indian J Anaesth. 2018 Jan;62(1):61–65.

[11] Rafael Sarkis-Onofre, Poletto-Neto V, Sérgio Cenci M, et al. CONSORT endorsement improves the quality of reports of randomized clinical trials in dentistry. Clin Epidemiol. 2020 Jun;122:20–26.
[12] Guler G, Akin A, Tosun Z, et al. Single dose dexmedetomidine attenuates airway and circulatory reflexes during extubation. Acta Anaesthesiol Scand. 2005;49:1088–1091.
[13] Lowrie A, Johnston PL, Fell D, et al. cardiovascular and plasma catecholamines response at tracheal extubation. Br J Anaesth. 1992;68:261–262.
[14] Cho HY, Kim CH, Han JI, et al. The effect of fentanyl and remifentanil on the side effects after sevoflurane anesthesia in. Children Undergoing Herniorrhaphy. Korean J Anesthesiol. 2007;53(5):609
[15] Ali WA, Mohammed AK, Elshorbagy HM. Dexmedetomidine versus ketofol effect on the incidence of emergence agitation associated with sevoflurane-based anesthesia in children undergoing orthopedic surgery. Egypt J Anaesth. 2016;32(3):277–284
[16] Shukry M, Clyde MC, Kalarickal PL, et al. Does dexmedetomidine prevent emergence delirium in children after sevoflurane based general anesthesia? Paediatr Anaesth. 2005 Dec;15(12):1098–1104.
[17] Berrin I, Arslan M, Dogan Tunga A, and Omer Kurtipek. Dexmedetomidine decreases emergence agitation in pediatric patients after sevoflurane anesthesia without surgery. Paediatr Anaesth. 2006 Jul;16(7):811.
[18] Petroz GC, Sikich N, James M, et al. A phase I, two-center study of the pharmacokinetics and pharmacodynamics of dexmedetomidine in children. Anesthesiology. 2006;105:1098–1110.
[19] Hall JE, Uhrich TD, Barney JA, et al. Sedative, amnestic, and analgesic properties of small-dose dexmedetomidine infusions. Anesth Analg. 2000;90:699–705.
[20] Arain SR, Ruehlow RM, Uhrich TD, et al. The efficacy of dexmedetomidine versus morphine for postoperative analgesia after major inpatient surgery. Anesth Analg. 2004;98:153–158.
[21] Sun Y, YeH XY, Xia Y, et al. Clinical efficacy of dexmedetomidine in the diminution of fentanyl dosage in pediatric cardiac surgery. Minerva Pediatr. 2017;69:181–187.
[22] Xiao L, Miao Z, Feng -J-J, et al. Efficacy of dexmedetomidine on postoperative nausea and vomiting: a meta-analysis of randomized controlled trials. Int J Clin. Exp Med. 2015;8(6):8450–8471.