Ain Shams University
Faculty of Medicine
Department of Anesthesia,
Intensive Care & Pain Management

A Study to evaluate the effect of Dexmedetomidine infusion versus Magnesium sulphate infusion on Emergence Delirium in pediatric patients undergoing lower abdominal surgery

Thesis

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By

Esraa Alaa El-Dien Mahmoud

M.B.B.Ch., Faculty of Medicine
Ain Shams University

Supervised by

Prof. Dr. Hany Mohamed Mohamed El Zahaby

Professor of Anesthesia, Intensive Care and Pain Management
Faculty of Medicine - Ain Shams University

Dr. Assem Adel Moharram Ahmed Moharram

Lecturer of Anesthesia, Intensive Care and Pain Management
Faculty of Medicine - Ain Shams University

Dr. Anis Fikry Anis Asaad

Lecturer of Anesthesia, Intensive Care and Pain Management
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
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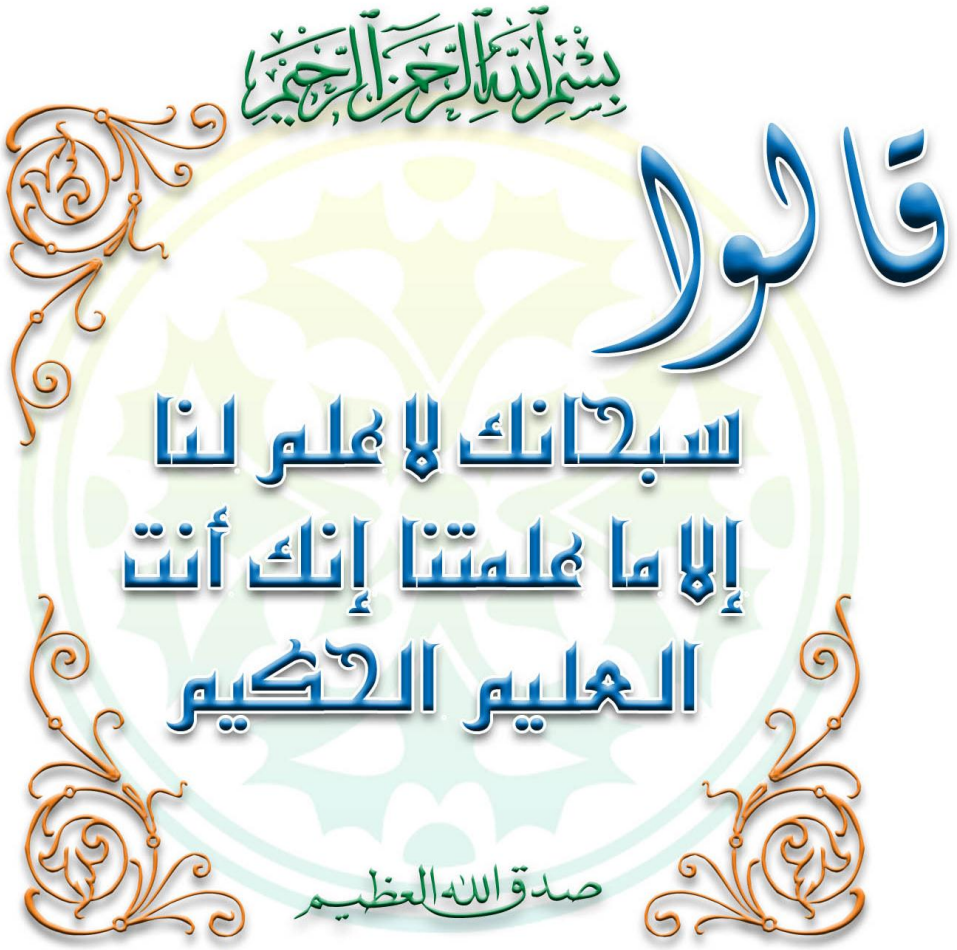

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List of Abbreviations

Abb.	Full term
ACTH	Adrenocorticotropic hormone
ADH	Antidiuretic hormone
ANOVA	A one-way analysis of variance
ASA	American society of anesthesia
BP	Blood pressure
Ca	Calcium
cAMP	Cyclic adenyl monophosphatase
CNS	Center nervous system
CYP 2A6	Cytochrome P450 system
DNA	Deoxy Ribo-Nucleic Acid
EAA	Excitatory amino acids
ECF	Extracellular fluid
ED	Emergence delirium
FLACC	Face, leg, activity, crying, consolability
GA	General anesthesia
K	Potassium
LAs	Local anesthetics
LMA	Laryngeal mask airway
LSD	Least Significant Difference
MAC	Minimum alveolar concentration
Mg+2	Magnesium
Na^+	Sodium
NE	Nor epinephrine
NMDA	N-methylD-aspartate
NNMDA	Non-competitive N-methyl D-Aspartate
NSAIDs	Non steroidal anti-inflammatory drugs

List of Abbreviations Cont...

Abb.	Full term
PA-aO2	Alveolar-arterial oxygen tension difference
PACU	Postoperative anesthesia care unit
PAED	Pediatric anesthesia emergence delirium
PRIS	Propofol related infusion syndrome
RNA	Ribonucleic Acid
SD	Standard deviation
SNS	sympathetic nervous system
TIVA	Total intravenous anesthesia
$t_{1/2}\ \beta$	Elimination half-life
$t_{V2}\ \alpha$	Redistribution half- life) 6 min
Vd	Dead space
Vt	Tidal volume

INTRODUCTION

Emergence delirium (ED) is a clinical state during emergence from general anesthesia in which patients are awake but have an altered mental state manifested as disorientation, inconsolability, confusion, and violent or harmful physical behavior. Its underlying cause remains unknown. Age, preoperative anxiety, anesthetic technique or agents, surgical procedure, pain and the use or not of adjunctive-medication have all been suggested to play a role in its development ***(Mason, 2017).***

ED usually occurs early in the recovery period (the first 30 min.) and is short-lived and self limiting. Variety of medications such as analgesics, opioids, α2-agonists, benzodiazepines have been used to control this state ***(Pradeep et al., 2017).***

The Pediatric Anesthesia Emergence Delirium (PAED) scale is a validated scale for evaluation of pediatric emergence delirium but is difficult to use in routine clinical practice. The Pediatric Anesthesia Emergence Delirium (PAED) scale was described as the standard for the diagnosis of ED ***(Lee, 2018).***

The incidence of ED is unclear, but has been reported as anywhere from 2-80%. When pain and other confounders are adequately controlled, the incidence is probably around 20-30% and thus there is a moderate correlation between PAED and

face, leg, activity, crying, consolability (FLACC) score of pain ***(Kocaturk and Keles, 2018).***

Dexmedetomidine is a highly selective α2-agonist with anxiolytic, sedative, and analgesic properties, that has been used to decrease postoperative analgesia and opioid consumption with its sedative effect and thus controlling Emergence delirium ***(Garg et al., 2018).***

Magnesium sulphate is a physiological calcium channel blocker and a non-competitive N-methyl D-Aspartate(NMDA) receptor antagonist with an anesthetic, antinociceptive and anticonvulsant effect that has been used intraoperative for its analgesic sparing effect and controlling postoperative pain associated agitation ***(Elsersy et al., 2017).***

AIM OF THE WORK

Evaluating the incidence and intensity of Emergence delirium in pediatric patients undergoing lower abdominal surgery after using either intravenous dexmedetomidine infusion or magnesium sulphate infusion during the surgery and till the discontinuation of inhalational anesthetic agent by the end of the surgery.

Chapter 1

PEDIATRIC ANESTHESIA

Pediatrics has different anatomical, physiological and pharmacological consideration. So they need specific care with respect to these differences from adults ***(Lu and Rosenbaum, 2014).***

Physiologic considerations

Physiological differences between pediatrics and adults are of important consideration when planning management of anesthesia in pediatric patients. Monitoring vital signs and organ function during the preoperative period is of special importance, as neonates and infants have decreased physiologic reserves ***(De Caen et al., 2015).***

Cardiovascular system

The process of growth demands a high metabolic rate. Thus, a higher cardiac index (compared with adult) is required to increase oxygen delivery to tissue. The main determinante of cardiac output is heart rate since the ventricle of neonates is poorly developed.

Infants tolerate heart rates of 200 beats min^{-1} with ease at birth (Table 1), resting cardiac output is approximately 200ml/kg/minute, after which it declines gradually to approximately 100ml/kg/minute by adolescence, so that drugs are distributed to and from their sites of action more rapidly ***(Vrancken et al., 2018).***

Table (1): Variation in heart rates (beat / min) with age ***(Parslow, 2015).***

Age	**Mean value** (beat / min)	**Normal range** (beat / min)
Neonate	140	100-180
1 year	120	80-150
2 years	110	80-130
6 years	100	70-120

Bradycardia may occur rapidly in response to hypoxemia and vagal stimulation. Immediate termination of the stimulus and treatment with oxygen and atropine are absolutely crucial. A heart rate of 60 beats/min in an neonate is considered a cardiac arrest and requires cardiac massage ***(Wyllie et al., 2015).***

Systemic vascular resistance is lower in infants due to the abundance of vessel-rich tissues in spite of having high cardiac index and this account for lower arterial blood pressure ***(Kluckow, 2018).***

The pressure increases from approximately 80/50mmHg at birth to the normal adult value of 120/70mmHg by the age of 16 years. Central neural block at start of anesthesia tends to produce no decrease in blood pressure in Children under the age of 8 years. Also fluid preload isn't crucial like adults, because venous pooling tends not to occur as venous capacitance cannot increase much. The reasons for this is the ill-developed sympathetic nervous system and so infants tend to be venodilated at rest, and so vasoconstrictive responses to hemorrhage are less in neonates than adults ***(Vrancken et al., 2018).***

Caudal anesthesia altered neither heart rate nor mean arterial blood pressure. However, significant increases in descending aortic blood flow and in stroke volume were associated with a decrease in lower body vascular resistance. These results propose that caudal anesthesia results in arterial vasodilation in the anesthetized location. The local anesthetic-induced sympathetic block is the probable cause of this vasodilation ***(Galante and Melchionda, 2013).***

Central nervous system

Cerebral metabolism develops rapidly in the early years, driven by cortical development, synaptogenesis, and rapid myelination, followed by equally dramatic changes in baseline and stimulated cerebral blood flow. Therefore, adult values for cerebral hemodynamics do not apply to children ***(Figaji, 2017).***

Blood volume is small by comparison, hypothermia develops easily, intracranial pressure (ICP) is lower, and blood pressure normograms are considerably different at different ages, with potentially important implications for cerebral perfusion pressure (CPP) thresholds ***(Figaji, 2017).***

Respiratory system

Control of respiration in newborn infants, especially premature neonates is ill-developed. The incidence of central apnea (defined as a cessation of respiration for 15 second or longer) is not uncommon in newborn infants especially with a drug with a sedative effect. Unlike the adult, hypoxia in the neonate and small child appears to inhibit rather than stimulate