A Comparative Study between Different Sedation Regimens in Diagnostic Pediatric Cardiac Catheterization

A thesis

Submitted for partial fulfillment of MD degree in Anesthesiology

Presented by

Noura Mohamed Youssri Ahmed Mahmoud
(M.B.B.Ch) Ain Shams University
(M.Sc) Degree in Anesthesiology
Faculty of Medicine - Ain Shams University

Supervised by

Professor Doctor/ Amir Ibrahim Salah
Professor of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Professor Doctor/ Bassel Mohamed Essam Nour El Din
Professor of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Doctor/ Ahmed Mohamed El Sayed El Hennawy
Assistant Professor of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Doctor/ Sahar Mohammed Talaat
Assistant Professor of Anesthesiology and Intensive Care
Faculty of Medicine - Ain Shams University

Faculty of Medicine
Ain Shams University
2015

Contents

List of Abbreviations

AAP	American Academy of Pediatrics
AAPD	American Academy of Pediatric Dentists
ACEP	American College of Emergency Physicians
ANOVA	Analysis of Variance
Ao	Aorta
AoP	Aortic Pressure
AS	Aortic Stenosis
ASA	American Society of Anesthesiologists
ASD	Atrial Septal Defect
AVSD	Atrio Ventricular Septal Defect
BIS	Bispectral index
BUN	Blood Urea Nitrogen
CBC	Complete Blood Count
CHD	Congenital Heart Diseases
CHF	Congestive Heart Failure
CMRI	Cardiac Magnetic Resonance Imaging
CO	Cardiac Output
COA	CoArctation
CT	Computer Tomography
d-TGV	d-Transposition of the Great Vessels
DTP	Demerol Thorazine Phenergan
DORV	Double Outlet Right Ventricle
ECG	ElectroCardioGram

ED	Emergence Delirium
Hb	Hemoglobin
HR	Heart Rate
IPPV	Intermittent Positive Pressure Ventilation
IQR	Interquartile Range
JCAHO	Joint Commission on Accreditation of Healthcare Organization (US)
LA	Local Anesthetic
LAP	Left Atrial Pressure
MAP	Mean Arterial blood Pressure
MRA	Magnetic Resonance Angiography
MRI	Magnetic Resonance Imaging
Mv	Mixed systemic venous blood
PA	Pulmonary Artery
PACU	Post Anesthetic Care Unit
PAED	Pediatric Anesthesia Emergence Delirium scale
PAP	Pulmonary Artery Pressure
PDA	Patent Ductus Arteriosus
PEE	Positive End Expiratory Pressure
PFO	Patent Foramen Ovale
PGE1	Prostaglandin E1
PONV	Postoperative Nausea and Vomiting
PS	Pulmonary Stenosis
PSA	Procedural Sedation and Analgesia
PV	Pulmonary Vein

PVR	Pulmonary Vascular Resistance
RAP	Right Atrial Pressure
RR	Respiratory Rate
RV	Right Ventricle
RVOT	Right Ventricular Outflow Tract
SD	Standard Deviation
SpO2	digital Oxygen Saturation
SVR	Systemic Vascular Resistance
TAPVR	Total Anomalous Pulmonary Venous Return
TGA	Transposition of the Great Arteries
TOF	Tetralogy Of Fallot
VO_2	Oxygen Consumption (mL/minute),
VSD	Ventricular Septal Defect
Q p	Pulmonary flow
Q s	Systemic flow

List of Tables

List of Figures

Introduction

Heart diseases are relatively common congenital anomalies, they occur in approximately 0.4 to 1% of all live births ***(Marelli et al., 2007)***. Since pediatric cardiac catheterization is one of the gold standards for detailed diagnosis of congenital cardiac anomalies, to resolve complex anatomy and measure different hemodynamic parameters, they have been commonly performed during the past recent years ***(Bernard et al., 2011)***.

Cardiac catheterization requires a co-operative, calm and motionless patient, to avoid complications especially perforation. Considering the typical nature of the pediatric age group, sedation is often required in pediatric catheterization ***(Bernard et al., 2011)***.

The primary goals of sedation during pediatric cardiac catheterization are to insure immobility and cardiac vascular stability, as perturbations in hemodynamic parameters may lead to changes in intra-cardiac pressures, and pattern of intra-cardiac and extra-cardiac shunts, thus interfering with evaluation of the congenital heart disease, and type of surgical intervention needed ***(Malik et al., 2011)***. The hemodynamic parameters can also be significantly altered by supplemental O2, hypo or

hyperventilation, as well as positive pressure ventilation. Therefore, a spontaneously breathing patient on room air is preferred by the cardiologist. In order to achieve these goals different anesthetic drugs have been used. The most recent and commonly used agents are ketamine, propofol and dexmedetomidine ***(Abbas et al., 2012)***.

Ketamine is one of the commonest drugs used for sedation in pediatric cardiac catheterization, because of its combined sedative and analgesic effects, and its ability to maintain respiratory drive and airway reflexes. However, it has significant side effects including prolonged recovery time, hemodynamic alterations such as tachycardia, hypertension, and tendency to increase pulmonary vascular resistance, and emergence delirium ***(Roelofse, 2010)***.

Propofol is characterized by both smooth induction of sedation, short duration of action, and rapid recovery. However, its diminishing effect on systemic vascular resistance and mean arterial pressure can limit its use in children with congenital heart diseases ***(Akin et al., 2005)***.

Dexmedetomidine is a selective α2 adrenergic agonist, with sedative, analgesic, and anxiolytic effects, that has been recently used in various procedural sedation in the pediatric group. The

fact that it has minimal effect on respiration and hemodynamic parameters makes it particularly suitable for sedation during pediatric cardiac catheterization, but not as a sole agent **(Munro et al., 2007)**.

Recently, combinations of different sedative agents are preferred to single agents, as they reduce the doses for each individual agent, thereby minimizing their side effects on hemodynamics and respiration, which are the primary objectives during pediatric cardiac catheterization ***(Ülgey et al., 2012)***.

Aim of the work

This study clinically evaluated and statistically compared different techniques used in sedation for diagnostic pediatric cardiac catheterization in order to figure out the most possible ideal technique for this kind of procedure with most benefits and least side effects.

Chapter (1): Pediatric Cardiac Catheterization

Cardiac catheterization and angiography have transformed the care of children with congenital heart diseases (CHD) and have greatly increased the safety and efficacy of surgery for CHD. Cardiac catheterization opened the way for study of the heart in a manner analogous to what ECG had done for its electrical function a ½ century earlier ***(Braunwald, 2003)***.

The history of catheterization dates back to 1844, when Claude Bernard inserted a mercury thermometer into the carotid artery of a horse and advanced it through the aortic valve into the left ventricle to measure blood temperature ***(Bourassa, 2005)***.

Later in 1929, Werner Forssmann, a German surgeon, performed the 1st cardiac catheterization on living human by inserting a urological catheter in his own forearm and guided it into his right atrium. In return, he was fired from his position at the hospital but later won the Nobel Prize in 1956 ***(Forssmann, 1929; Braunwald, 2003)***.

The use of cardiac catheterization and angiography as a diagnostic tool was first described in man by Cournand and in children with congenital heart disease by Bing et al in 1947 ***(Cournand and Ranges, 1941; Bing et al., 1947)***.

Interventional catheterization was first developed in 1953 by Rubio-Alvarez to treat pulmonary stenosis ***(Rubio-Alvarez et al., 1953)***. In 1966 Rashkind and Miller performed a balloon atrial septostomy which was the first pediatric and the first intra cardiac transcatheter procedure ***(Rashkind and Miller, 1966; Abbas et al, 2012)***.

Types of pediatric cardiac catheterization

There are 2 types of pediatric cardiac catheterization. The first is used for determination of detailed cardiac anatomy and measurement of physiological pressures values and shunt volume (Diagnostic catheterization) and the second is for treatment of certain structural heart defects non surgically using specially designed catheters and implantable devices delivered through cardiac catheters (Therapeutic catheterization) ***(Park, 2014)***.

All diagnostic catheterizations may lead to the necessity for an interventional procedure. As a consequence, the capability to proceed with the interventional procedure should be a requirement of the individual and institution that will perform the diagnostic

portion of the catheterization. Individual centers must assess their abilities as they relate to this ability when determining which catheterization cases they might perform ***(Feltes et al., 2011)***.

Diagnostic Cardiac Catheterization and Angiocardiography:

Cardiac catheterization and angiocardiography usually constitute the final definitive diagnostic test for most cardiac patients ***(Park, 2014)***.

Due to progresses in the field of noninvasive imaging procedures –transthoracic and transoesophageal echocardiography as well as cardiac computer tomography (CT) and magnet resonance imaging (MRI) – anatomic situation of the patient is usually well known. For this reason, in a lot of cases diagnostic cardiac catheterizations only have to be performed for preoperative evaluations to determine physiological pressure values and shunt volumes as well as oxygen saturation in the different sections of the circulation (***Vittinghoff, 2009)***.