Comparative study of two anaesthetic techniques regarding haemodynamic stability for interventional cardiac catheterization

Mohammed Sami Alkafaji
F.I.B.M.S Anesthesia
Alhilla teaching hospital

Abstract

This study compares two anesthetic techniques regarding haemodynamic stability used to anesthetize 26 patients with atrial septal defect admitted for occlusion of ASD by cardiac catheterization using Amplatzer occluder in Ibn Albitar cardiac center in Baghdad, patients are ASA I and II unpremeditated, were divided into two groups, First group was given Propofol and Alfentanil induction then continuous infusion of Propofol and Alfentanil, second group was given ketamine and Midazolam induction then continuous infusion of ketamine and midazolam. Both groups were given muscle relaxants and intubated with endotracheal tube and ventilated artificially with 100% O2 .The propofok-Alfentanil group showed better haemodynamic stability than ketamine-midazolam group as seen from comparison of HR and BP changes at 5min,15min, 30min after induction and at the end of the procedure . Ketamine inspite of its wide use during cardiac catheterization especially for pediatric patients it has a clear effect on HR and BP, through its infusion it significantly increases both blood pressure and heart rate as compared to Propofol-Alfentanil infusion which showed more haemodynamic stability.

الخلاصة

هذه الدراسة تقارن بين طريقتين للتخدير العام من حيث استقرارية الجهاز الوعائي وهاتين الطريقتين تستخدمان لغلق الفتحة بين الأذينين من خلال استخدام القسطرة باستعمال سدادة امبلاتزر،تم اختيار ٢٦ مريضاً من الفئة ١ و٢ حسب تصنيف المجمع الأمريكي لأطباء التخدير ولم يُعطي المرضى أي أدوية مهدئة قبل الدخول إلى صالة القسطرة وتم تقسيم المرضى إلى مجموعتين أعطيت المجموعة الأولى دواء بروبوفول و الالفينتانيل كبداية للتخدير ومن ثم نفس الأدوية من خلال الدفع البطيء في الوريد و أعطيت المجموعة الثانية الكيتامين و الميدازولوم كبداية للتخدير و من ثم نفس الأدوية من خلال الدفع البطيء و لوحظ إن هناك استقرارية للجهاز الوعائي اثناء العملية للمجموعة الاولى أكثر من المجموعة الثانية.

Introduction

Any opening in the a trial septum other than a competent Foramen Ovale is atrial septal defect (ASD), (1).ASD is a common form of congenital heart disease accounting for approximately 7% of all defects. Secondum ASD is the most common and is amenable to transcatheter closure. (2)

Typically, patients with ASD remain active & asymptomatic through early childhood. However many patients have lived into their 4th, 5th, 6th & 7th decade with ASD of moderate size before symptoms developed (3' 4)If closure of atrial septal defects is being planned, it is recommended that closure be performed without undue delay (< 25 years for mortality benefit and probably before 40 years for arrhythmia benefit). As a rule, younger patients have a better outlook after repair.(5, 6) The era of transcatheter closure of ASD began in 1976, when Kinget al (7) reported the first application of a double-umbrella device in humans, for patients with ASD the AMPLATZER Septal Occluder represents a clinically effective - yet dramatically less invasive and less costly - alternative to the open heart surgery required to repair an ASD, On February 12, 2002, Charles Sperrazza perfonned the first AMPLATZER

implantation in New Jersey since the devices recent Food and Drug Administration (FDA) approval, The implantation procedure is performed in Catheter Laboratory, where Cardiologists size the ASD and thread an AMPLATZER Septal Occluder of corresponding dimension into the delivery cable. The delivery sheath is threaded through the femoral vein to the inferior vena cava, then up to the ASD. The delivery cable is then loaded into the sheath. Once the cable passes through the ASD, the distal disc is released into the left atrium and pulled back against the septum. The right atrial disc is then deployed once properly seated, the device is released from the delivery cable, and the cable and sheath are removed from the patient. The device's two discs "clamp" against the septum; the waist fills the ASD. The procedure is completed in one to two hours, and typical post-procedure hospital stay is less than 24 hours (8). Anesthesia management of interventional or diagnostic procedures in the catheter lab must include the same level of preparation that would apply in caring for these patients in the operating room .During the procedural period; the patient is intubated and mechanically ventilated. Secured air way allows the anesthesiologist to concentrate on haemodynamic issues. Positive pressure ventilation also reduces the risk of air embolism. During spontaneous ventilation a large reduction in intrathoracic pressure can entrain air into vascular sheaths and result in moderate to large pulmonary or systemic air emboli. Precise devise placement is also facilitated with muscle relaxants that eliminate patient movements and controlled ventilation, here by reducing the respiratory shifting of cardiac structures. Because of haemodynamic variability of many of these patients, as well as changing anesthetic requirements, continuous intravenous infusion with ketamine midazolam infusion or, more recently, propofol, is appropriate. Potent inhaled anesthetics are generally not used as the primary anesthetic and are reserved for adjunctive anesthesia. (8) Dysrhythmias occur commonly with manipulation of wires and catheters within the left ventricle and across the ventricular septum. Ventricular ectopic beats are common, usually self-limiting and often require no treatment However, lidocaine may be necessary for frequent ventricular ectopy and cardioversion needed if tachycardia is sustained or fibrillation occurs; a defibrillator must be readily available. Acute atrioventricular block may result in sudden hypotension and require chronotropic support or immediate transvenous pacing. (9)Heparinizantion schedules vary depending on the procedure and the results. All patients receive a bolus of heparin (100 U /kg) at the time of insertion of the arterial and venous catheters. The activated clotting time (ACT) is determined every 30 min and additional heparin administered as necessary to maintain theACT>200sec.(10)

recent study of the haemodynamic effects of Propofol in the cardiac catheter laboratory has demonstrated that while it can be used safely for these procedures at 50-200 mcg/kg/min

infusion, a significant decrease in systemic vascular resistance may occur which can be great enough to reverse a shunt from L to R to R to L and cause significant cyanosis, as well as influence the hemodynamic results.(11) in patients with congenital heart disease ,there are no significant changes in shunt directions or fraction or systemic oxygenation after Ketamine induction of anesthesia , in patients who have elevated pulmonary artery pressure Ketamine seems to cause a more pronounced increase in pulmonary than systemic vascular resistance. (12) Small to moderately large doses (5-50 µg/kg) of Alfentanil used to supplement a sedative-hypnotic induction attenuate or eliminate hemodynamic response to laryngoscopy and intubations; Alfentanil causes more decrease in heart rate and blood pressure than Fentanil.(13) Midazolam causes a slightly greater decrease in arterial blood pressure than do other benzodiazepines, but the hypotensive effect is minimal and about the same as seen

with thiopental .(14) the usual induction dose of Midazolam premidicated patients is between 0.05 and O.I5mg/kg.when used with other drugs (coinduction), there is synergistic interaction.(15).

Materials and Methods

This work conducted in IBN AL BITAR cardiac surgery centre in Baghdad from January 2005 to April 2005 in catheterization lab. 26 patients ASA 1&2 physical status the age ranged between 4 to 20 years old. Each patient fasted for at least 4 hours , no premedications was given(child who was anxious one of his / her parents allowed to enter with his/her child to the catheterization lab and stay beside until time of induction, most of patients were cooperative) . The patients seen before admission, full history taken, examination done to each patient investigation done include: ECG, HB%, CX- ray, Echocardiography. Atropine was given to all patients, 20 µ/kg(maximum dose given Img) IM 1 hour before the start of catheterization (when atropine given I.V before induction there was excessive salivation noticed, while IM injection of atropine showed less salivation) Patients divided into two groups each group of 13 patient. First group (Propofol Alfentanil) group they received induction doses of 1 mg/kg Propofol preceded by xylocaine Img /kg to decrease pain during injection & Alfentanil 50µg/kg IV. Then continuous infusion of propofol 100 µg/kg/min decreased after 10min to 80 µug/kg/min and Alfentanil 0.5µg/kg/min . Second group (ketamine Midazolam)group received induction doses of ketamine 1 mg/kg &Midazolam 50 µg/kg iv then continuous infusion of Ketamine 30 µg/kg/min & Midazolam 0.5 ug/kg/min. Infusion done by using infusion pump (Syramid 1600), two pumps were used. Ketamine 100 mg (2 mls) mixed with 48 ml normal saline, Propofol 200mg (20mls) mixed with 30ml normal saline, Midazolam 5mg(5 mls) mixed with 45 mls normal saline .Alfentanil 5mg (5mls) mixed with 45 ml. the two lines connected to IV canula by three way valve. Another IV canula inserted after induction of anaesthesia and securing the air way, for IV fluid administration (replacement and maintenance), muscle relaxant given Atracuirium after the induction 0.5mg /kg, ventilation maintained by mask & bag Mapilson A circut used until full relaxation noticed after 2 min, intubation done with ETT correct positioning confirmed by auscultation of the chest and by using fluoroscopy the tube secured in place, TEE inserted. Both arms elevated and the hands positioned under patients head to facilitate good view to the fluoroscopy. Heparine 100U/kg given IV at the time of insertion of venous and arterial catheters, Heparin is not reversed at the end of the procedure but allowed to wear off naturally to minimize the risk of thrombosis. ACT monitoring is not available.

Monitoring used

ECG LII, BP invasive and non invasive (manual sphygmomanometer, the automated one show wide difference between its readings and the invasive one) pulse oxymetery, TEE, fluoroscopy. Muscle relaxant given at fixed time interval (15 min), ventilation done after intubations by controlled ventilation by Taema ventilator 100% O2 VT l0ml/kg. Readings taken preoperatively (the patient lying down HR, BP, appropriately sized cuff used), 5 min, 15 min, 30 in fter induction of anesthesia, and at the end of operation. At the end of the procedure infusion stopped (the time to stop infusion was at completion of the procedure and no time interval allowed bcause the end of the procedure usually unpredictable), muscle relaxation reversed with neostigmine 0.04 mg/kg & atropine 20 µg/kg maximum adult dose 2.5mg neostigmine & atropine 1.2 g, extubation done when the muscle power returned assessed by asking the patient to open eyes, rotrude the tongue, lift up the head for 5

seconds. The patient was transferred immediately to the recovery room.

Statistical analysis

All data were presented as the mean values and standard deviation Paired student's t test was used within the same group. Unpaired t test was used in comparism between the two groups. Results where considered statistically significant when P value < 0.05. the data were coded, stored and processed by computer using SPSS system for statistical analysis.

Results

The demographic variables are presented in table (1) which shows : female/ male ratio for Propofol group is (9/4) while Ketamine group(8/5), the mean age of patients for Propofol group was (11.84 ± 5.96), while for Ketamine group was (12.15 ± 6.09) , mean weight of the patients for Propofol group was(37.46 ± 23.01) while for Ketamine group was(33.38 ± 17.37). The mean catheterization time for Propofol group was (50 ± 8.32 min), while that of Ketamine group was (52 ± 9.02 min). Regarding haemodynamic changes the results was: There was no significant difference (P>0.05) in preop HR, systolic & diastolic BP between both groups as shown in table (2). In Propofol group HR, systolic BP & diastolic BP showed no significant difference during preop , 5 min ,15 min ,30 min after induction of anesthesia &at the end .while Ketamine group shows significant differences (P <0.05) in HR& systolic BP ,while diastolic remain unchanged. In comparism between the two groups there is significant difference in HR & systolic BP.

Discussion

As seen from demographic data table(1) there is no significant difference between the two groups regarding age , weight and preoperative condition. in the research finding indicate significant increase in haemodynamic parameters , this is go against Morrray findings , Ketamine is the most frequently used anesthetic agent in cardiac catheterization procedures .its preferred by both the anesthetist and the cardiologist because it produces no significant haemodynamic changes in children during cardiac catheterization (16). findings about Propofol -Alfentanil show mild increase in HR and BP during infusion time and return to preop level at the end of the procedure, these findings not go with Aun findings induction of anesthesia with Propofol decreases HR by 10-20% in children.(I7) this is may be due to effect of placement of ETT and TEE during the procedure. No changes seen in the saturation of Hb (SPO2%) of all patients but all patients has 100% saturation, Williams GD report a significant decrease in systemic vascular resistance may occur which can be great enough to reverse a shunt from L to R to R to L and cause significant cyanosis(16), all patients develop frequent self limited cardiac arrhythmias which is commonly seen in this procedure what ever anesthetic technique used , only two patients in this study developed significant supraventricular tachycardia not stopped spontaneously or by some maneuvers done by the cardiologist and they developed significant haemodynamic changes therefore they were excluded from the research , this arrhythmias was not related to specific anesthetic technique it may be explained due to mechanical stimulation of AS node , AV node or irritation of the endocardium . Another two patients were excluded from the study because they referred to the operation theater at the mid of the procedure for open heart surgery for removal of broken sheath of the Occluder. All the remaining patients completed the study without complications except for two females from Ketamine group developed post operative vomiting in the recovery room, all the remaining patients recovered smoothly without hallucination.

Conclusions

There is a significant increase in HR and BP by the use of combination of Ketamine and

Midazolam while the combination of propofol and Alfentanil showed more haemodynamic stability which mean its more appropriate to use in cardiac catheterization.

Refrences

1-Moss and ADAMS, Heart disease in infant, children& adolescents sixth edition Lippincott Williams &Wilkins200l

2-Haworth SG. pulmonary vascular disease in secondum ASD in childhood Am JCardiol1983; 51:265-
272

3-CampbeIl M. natural history of ASD Br Heart J. 1970; 32:820-826

4. Konstantinides S, Geibel A, Olschewski M, Gornandt L, Roskamm H, Spillner G, Just H,
Kasper W. A comparison of surgical and medical therapy for atrial septal defect in adults. N Engl J
Med 1995; 333(8) :469-73.

5-Musewe NN, Robertson MA, Bcnson LN, Smallhorn JE, Burrows PE, Freedom RM, Moes
CA, Rowe RD. The dysplastic pulmonary valve: echocardiographic features and results of
balloon dilatation. Br Heart J. 1987; 57:364-370.

6. King TD, Thompson SL, Steiner C, Mills NL. Secondum atrial septal defect: nonoperative
closure during cardiac catheterization. JAMA. 1976; 235:2506-2509

7-Lock JE, Rome JJ, Davis R, Van Praagh S, Perry SB, Van Praagh R, Keane JF. Transcatheter closure of atrial septal defects: experimental studies. Circulation.. 1989;79:1091-1099.

8-Willam J. Greely^James M Stevven:Ansthesia for pediatric cardiac surgery Ronald D miller ,MD 5th edition Churchill L Kingston: 2000; 1840,1841

9-Tracheal extubation of children in the operating room after atrial septal defect repair as part of a clinical practice guideline. Anesth Analg 1996; 82: 988-993.

10-Laussen PC, Wessel DL. "Anesthesia for Congenital Heart Disease," in Gregory GA, ed., Pediatric Anesthesia. 4th ed. New York, Churchill Livingstone pp. 467-539

11-Aun CST, Sung RYT, O'Meara ME, Short TG, Oh TE: Cardiovascular effects of i.v. induction
in children: Comparison between Propofol and Thiopentone with an inhalation technique. Br J Anaesth 1993;70:647-653,

12.Spotoft H ,Korshin JD, Sorensen MB etal .The cardiovascular effects of ketamine used for
induction of anesthesia in patients with valvular heart disease .Can J Anesth 1979;26:463.

13-Vinik HR,Bradly EL Jr. Kissin I:triple anesthetic cobination propofol-alfentanil-midazolam.Aneslh Analg1994; 78;354

14-Persson MP Nilson A:Relation of sedation and amnesia to plasma concentration of Midazolam in surgical patients.Clin Pharmacol Ther 1988;43;324

15-.CLEMENT JA. the pharmaco kinetics and analgesic effects of ketamine in man. Br J Anesthesia1981
; 51:27.

16- Williams GD, Jones IK, Hanson KA, et al. The hemodynamic effects of Propofol in children with congenital heart disease. Anesth Analg 1999;89:1411-6.

17- Shafer SL: Advances in Propofol pharmacokinetics and pharmacodynamics. J Clin.Anaesth.5(suppIl)1993;145-215.

Table.(l) Demographic data.

	Gender	Age(years)	Weight(kg)	Cam time(min)
Propofol- Alfentanil group(mean ±SD)	9 females 4males	11.84±5.96	37.46±23.01	50±8.32
Ketamine -Midazolam group(mean±SD)	8 females 5 males	12.15±6.09	33.38±1737	52±5.02

Table (2) Haemodynamic changes (mean ±SD).

	Propofol	Ketamine	PI	P2	P3
Changes in HR					
Preop	94.92±13.73	102.92±10.72			0.1
5 min	98.07±15.16	133.46±24.12	0.4	0.001	0.001
15 min	102±13.68	138.3±20.78	0.07	0.001	0.001
30 min	10130±10.79	136±22.89	0.07	0.001	0.001
At the end	93.69±11.63	116.69±22.25	0.6	0.03	0.01
Changes systolic BP					
Preop	109.1±16.76	110.69±l0.65			0.7
5 min	117.61±11.9	135.69±7.83	0.1	0.001	0.01
15 min	114.9±12.7	140.23±6.74	0.2	0.001	0.001
30 min	115.5±14.55	135.38±6.41	0.1	0.001	0.001
At the end	108.46±14.09	122.46±I0.58	0.9	0.04	0.02
Changes in diastolic BP					
Preop	69.84±10.16	7O76±8.51			0.8
5 min	73.38±9.72	75.76±9.16	0.4	0.1	0.5
15 min	70.23±7.77	76.23±10.62	0.9	0.058	0.1
30 min	66.9±7.49	71.23±9.51	0.3	0.8	0.1
At the end	70.61±11.91	71 ±8.43	0.8	0.9	0.9

Pl=comparison in Propofol Alfentanil group with the baseline (preop).
P2= comparison in Ketamine Midazolam group with the baseline (preop).
P3= comparison between the two groups

Table (3) Total dose given (mean ±SD).

drug	Induction(mg)	Infusion(mg/kg)
Ketamine- Midazolam	42.15±17.76 -1..59±0.77	51.88±32.23 -0.82±0.53
Propofol Alfentanil	34..96±17.39 -1.69±1.03	178.53±105.03 -0.88±0.51

List of abbreviations

ASA	American society of anesthesia
ASD	Atrial septal defect
BP	Blood pressure
CX-ray	Chest x-ray
ETT	Endotrachial tube
ECG	Electroca rd iography
Hb%	Hemoglobin %
HR	Heart rate
IM	intramuscular
IV	Intravenous
Kg	Kilogram
Hg	Mercury
M€	Microgram
SD	Standard deviation
SPSS	Statistical package for social science
TEE	Transoesophagealecho