Original Article

Effect of Corrective or Palliative Procedures on Arterial to End-tidal Carbon Dioxide Pressure Difference in Pediatric Cardiac Surgery

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Abstract

Background: The normal small difference (3–5 mmHg) between arterial (partial pressure of carbon dioxide [$PaCO_2$]) and end-tidal carbon dioxide pressure ($ETPCO_2$) increases in children with congenital heart disease. The present study was conducted to evaluate the effect of corrective or palliative cardiac surgery on this difference (known as DPCO2). **Patients and Methods:** In a prospective study, 200 children (aged <12 years old) candidate for corrective or palliative cardiac surgery were studied. Using arterial blood gas measurement and simultaneous capnography, $DPCO_2$ was calculated at various intra- and postoperative periods. $DPCO_2$ values were compared within and between corrective or palliative procedures. **Results:** Corrective and palliative procedures were carried out on 154 and 46 patients, respectively. Initial $DPCO_2$ was higher than normal values in corrective or palliative procedures (15.50 ± 13.1 and 10.75 ± 9.1 mmHg, respectively). $DPCO_2$ was higher in patients who underwent palliative procedure, except early after procedure. The procedure did not have any effect on the final $DPCO_2$ in palliative group. Although $DPCO_2$ decrease was significant in the corrective group, it did not return to normal values. Operation time was longer, and the need to inotropic support was higher in corrective procedures; however, longer periods of ventilatory support were needed in the palliative group. Complication rate and Intensive Care Unit stay time were the same in two operation types. **Conclusions:** $DPCO_2$ did not change after palliative cardiac procedures. $DPCO_2$ decreased after corrective procedures; however, it did not return to normal values at early postoperative period. Thus, $DPCO_2$ may not have any clinical value in monitoring the quality of corrective or palliative procedures.

Keywords: Arterial to end-tidal carbon dioxide pressure difference, congenital heart diseases, end-tidal carbon dioxide pressure, pediatric cardiac surgery

Introduction

In normal cardiopulmonary physiology, there is a small difference between arterial blood and end-tidal respiratory carbon dioxide tensions; this difference ($DPCO_2$) is about 3–5 mmHg.[1,2] This small difference is due to the high solubility of the CO_2 gas in alveolocapillary membrane. Similar to adults, there is such an acceptable correlation in neonates and children.[3-6] In some conditions and diseases, $DPCO_2$ may increase significantly because of increase in thickness or decrease in effective surface of alveolocapillary membrane (increased dead space ventilation). McSwain measured DPco2 in 56 mechanically ventilated pediatric patients and calculated the dead space to tidal volume ratio (VD/VT). There was a strong correlation between end-tidal carbon dioxide pressure ($ETPCO_2$) and partial pressure of arterial carbon dioxide ($PaCO_2$) in various VD/VT ranges; $DPCO_2$ increased predictably with increasing VD/VT ratio.[7] During anesthesia, increased dead space ventilation usually causes $DPCO_2$ rise up to 10 mmHg. In children with congenital heart diseases (CHD), $DPCO_2$ is abnormal; in fact, the rate of increase in $DPCO_2$ is correlated with the severity of physiologic derangement. Choudhury *et al*. studied the $DPCO_2$ value and effect size of hyperventilation on $PaCO_2$ in children scheduled for correction of their underlying cardiac defect. They reported increased $DPCO_2$ in both cyanotic and acyanotic patients and

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showed reduced effect of hyperventilation on $PaCO_2$ setup. They also concluded that increased pulmonary artery pressure (PAP) or pulmonary blood flow (PBF) is important as right-to-left shunt in these findings.[8] CHDs are the most common inborn diseases with about 50% requirement for surgical intervention.[9] Incomplete surgical intervention (corrective or palliative) is the most common cause of early or late postoperative morbidity and mortality.[10,11] A review of the intraoperative transesophageal echocardiographic (IOTEE) reports of the patients who underwent ventricular septal defect (VSD) closure revealed that the rate of residual VSD is 37%.[9] *Yang* in a retrospective study reported the rate of residual VSD on IOTEE as 33%.[11] Most of residual VSDs are closing spontaneously;[11] however, early diagnosis can lead us to act in appropriate time. Although IOTEE is sensitive enough to detect most of the residual defects, its use, especially in small children, needs a high level of skill.[10-13] We hypothesized that after corrective or palliative surgeries, preoperative $DPCO_2$ should have a normal value or be reduced, respectively. In a prospective clinical study on children with CHD who were candidate for cardiac surgery, simultaneous arterial blood PCO_2 and end-tidal PCO_2 were measured and $DPCO_2$ was calculated and compared intra- and postoperatively between and within two corrective and palliative procedures.

Patients and Methods

This study was a single-center, cross-sectional study without any additional intervention (the invasive blood sampling and respiratory capnometry performed using previously placed instruments those are routine in cardiac surgery). The study first was approved by the Research Ethical Board of Tabriz University of Medical Sciences and then the investigators got a Registration number (IRCT201606011127N5) from Iranian Registry committee of Clinical Trials (www.irct.ir). Written informed consent approval was obtained from all parents preoperatively.

After approval from the local institutional ethics committee and obtaining written preoperative informed consent from all parents, infants and children (<12 years) with CHD, candidate for elective cardiac surgery, were studied prospectively in a about 12-month period from May 2014 to May 2015. The purposed sample size was 200 cases. Patients with preoperative diabetes mellitus, renal, hepatic, cerebral, or respiratory diseases were excluded from the study. Patients' cyanosis and clubbing severity were graded by an anesthesiologist colleague using the following scales and graphs [Figures 1 and 2].

The patients were prepared for surgery as a routine practice. Considering body weight, premedication was done by midazolam or promethazine syrup or intramuscular morphine 30 min before induction of anesthesia. Anesthesia was induced intravenously using ketamine, 2 mg/kg; midazolam, 0.1 mg/kg; fentanyl, 3 μg/kg; and cisatracurium, 0.2 mg/kg. Trachea was intubated after 3–5 min (using an appropriately sized cuffed or uncuffed endotracheal tube). In any case without intravenous line *in situ*, the child was first sedated by intramuscular ketamine, and then intravenous access was done. Basic monitoring started simultaneously with anesthesia induction. Then, arterial and central venous catheterizations were done. Mechanical ventilation performed using a Dräger Fabius anesthesia machine in pressure- or volume-controlled modes. Anesthesia was maintained with continuous infusions of midazolam 50 μg/kg/h, fentanyl 5 μg/kg/h, and cisatracurium 2 μg/kg/min. Mainstream capnography (Novametrix CO_2SMO Model 7100 $ETCO_2$ SpO_2 Monitor) was performed intra- and postoperatively, continued to tracheal extubation.

Arterial blood gas (ABG) was analyzed in 10 min after induction (T1), about 10 min before (T2), 10 min after cardiopulmonary bypass (CPB) (T3), and at the end of surgery (T4), intraoperatively. $ETPCO_2$ was recorded simultaneously. In off-pump surgeries, T2 and T3 were considered as 10 min before and 10 min after the procedure, respectively. Only ABG parameters and $ETPCO_2$ of first three ICU stay days up to preextubation period were used postoperatively (T5). Data of the surgery, CPB, and hemodynamic status were collected in intra- and postoperative periods and compared regarding corrective and palliative procedures

Statistics

The data were analyzed using SPSS statistical software (version 16.0. Chicago, SPSS Inc). Normally distributed parametric variables were compared, using the independent groups' Student's *t*-test, and Chi-square test was used for nonparametric data. $ETPCO_2$ changes during the study were analyzed via repeated measures of ANOVA. The two-way ANOVA test was used to compare the differences over time between the two groups and paired groups' *t*-test was used to compare basic and preextubation $DPCO_2$ values in various palliative procedures. $P < 0.05$ was considered statistically significant.

Results

Two hundred children (96 male and 104 female) aged 1–144 months were enrolled in this study. Corrective and palliative procedures were done on 154 (77%) and 46 (23%) patients, respectively. The operations covered a wide range of palliative and corrective procedures. The CHDs were as follows: tetralogy of Fallot (TOF), VSD, pulmonary stenosis (PS), atrial septal defect (ASD), VSD/PS, ASD/PS, ASD/tricuspid stenosis, transposition of great arteries (TGA), patent ductus arteriosus, atrioventricular septal defect, aortic stenosis, total anomalous pulmonary venous connection, and coarctation of aorta. Patients who underwent palliative procedures were younger than corrective group patients ($P = 0.012$). Clubbing severity was the same in two groups ($P = 0.243$); however, cyanosis was more severe in the palliative group ($P = 0.001$). CPB was used more in corrective than palliative procedures (96.8% vs. 30.4%). The study showed that the operation time

and requirement to inotropic support were high in corrective procedures; nevertheless, longer period of ventilatory support was needed in the palliative group. Intensive Care Unit (ICU) stay time and morbidity and mortality rates were identical in both groups [Tables 1 and 2].

Table 2 and Figure 3 represent the $DPCO_2$ at various periods of the study. Except immediately after CPB and at the end of surgery, there were significant differences between palliative and corrective groups. $DPCO_2$ was higher, almost at anytime, in patients who underwent palliative procedure. Changes in $DPCO_2$ were not significant in the palliative group at any time; however, comparing with the primary value, $DPCO_2$ decreased significantly in the corrective group patients prior to the extubation period. Table 3 shows the basic and preextubation $DPCO_2$ values in various palliative procedures; the type of palliative procedure did not have any effect on final $DPCO_2$.

Discussion

The current study covered a wide range of children aged 1–144 months with a wide spectrum of cardiac anomalies. In the majority of patients (77%), corrective procedures were performed. There was a trend in performing palliative procedures in younger and more cyanotic children. This was predictable because traditionally palliative procedures are performed in patients with more complex anomalies or low weight patients.

In patients with normal cardiopulmonary function, there is a good correlation between $ETPCO_2$ and arterial carbon dioxide

Table 1: Comparison of the data in palliative and corrective procedures

	Procedural group		Total	*P*
	Palliative (*n*=46)	Corrective (*n*=154)		
Gender (male/female)	21 (25)	75 (79)	96 (104)	0.716
Age (month), mean±SD	11.31±18.5	22.58±28.2	19.99±26.6	0.012*
Weight (kg), mean±SD	8.26±6.6	11.99±9.3	11.13±8.9	0.013*
Height (cm), mean±SD	68.33±13.8	77.29±21.1	75.23±20.0	0.007*
Hemoglobin (g/dl), mean±SD	13.55±3.2	13.17±2.9	13.25±3.0	0.449
WBC (×1000), mean±SD	10.43±3.5	9.83±3.1	9.971±3.2	0.268
Platelet (×1000), mean±SD	279.13±105.3	296.92±96.9	292.83±98.9	0.286
Severity of cyanosis, *n* (%)				
Acyanotic	16 (34.8)	102 (66.3)	118 (59)	0.001*
Grade 1	8 (17.4)	23 (14.9)	31 (15.5)	
Grade 2	10 (21.8)	14 (9.1)	24 (12)	
Grade 3	7 (15.2)	8 (5.2)	15 (7.5)	
Grade 4	5 (10.8)	7 (4.5)	12 (6)	
Using CPB (yes/no)	14/32	149/5	163/37	0.001*
Operation time (min), mean±SD	202.56±67.9	254.90±75.2	243.18±76.6	0.001*
Mechanical ventilation time (h), mean±SD	34.77±40.0	22.74±25.4	25.43±29.6	0.019*
ICU stay (day), mean±SD	6.28±6.3	5.36±3.6	5.56±4.4	0.225
Need to inotropic support, *n* (%)	27 (58.7)	122 (79.2)	149 (74.5)	0.005*
Morbidity, *n* (%)	22 (47.8)	53 (34.4)	75 (37.5)	0.099
Mortality, *n* (%)	4 (8.7)	8 (5.2)	12 (6)	0.320

*P<0.05. SD: Standard deviation, WBC: White blood cell, CPB: Cardiopulmonary bypass, ICU: Intensive Care Unit

Table 2: Arterial to end-tidal carbon dioxide pressure differences ($DPCO_2$) in palliative or corrective procedures at various periods

Procedures	$DPCO_2$ (mmHg)							
	After induction	PreCPB*	PostCPB†	End surgery	ICU day 1	ICU day 2	ICU day 3	Before extubation
Palliative (*n*=46)	15.50±13.1 (*n*=46)	14.61±12.9 (*n*=46)	12.30±11.2 (*n*=46)	12.22±12.1 (*n*=46)	13.21±9.4 (*n*=46)	13.66±10.6 (*n*=27)	13.61±7.0 (*n*=12)	13.74±6.7 (*n*=46)
Corrective (*n*=154)	10.75±9.1 (*n*=154)	10.02±9.1 (*n*=154)	10.86±7.5 (*n*=154)	10.89±8.5 (*n*=154)	10.12±8.1 (*n*=154)	9.52±7.9‡ (*n*=72)	9.1±5.3‡ (*n*=23)	8.70±4.6‡ (*n*=154)
Total	11.84±10.3 (*n*=200)	11.08±10.3 (*n*=200)	11.24±8.4 (*n*=200)	11.20±8.9 (*n*=200)	10.83±8.4 (*n*=200)	10.47±8.5 (*n*=99)	10.14±5.8 (*n*=35)	9.81±5.5 (*n*=200)
P	0.006§	0.007§	0.313	0.403	0.030§	0.038§	0.040§	0.001§

*In off-pump operations, the value was measured 10 min before the procedure, †In off-pump operations, the value was measured 10 min after the procedure, ‡Significant difference with basic (after induction) value (P<0.01), §Significant differences between palliative and corrective groups. CPB: cardiopulmonary bypass, ICU: Intensive Care Unit, $DPCO_2$: difference PCO_2

Table 3: Basic and final arterial to end-tidal carbon dioxide pressure differences ($DPCO_2$) in various palliative procedures

Palliative procedure	*n* (%)	After induction	Before extubation	*P*
Annular patch	4 (8.7)	16.00±12.7	13.50±3.4	0.717
Blalock-Taussig's shunt	8 (17.4)	14.25±16.6	15.13±6.2	0.793
Annular patch/Blalock-Taussig's shunt	10 (21.7)	14.30±13.4	12.90±6.4	0.769
Total cavopulmonary connection	2 (4.3)	9.00±1.4	12.50±0.7	0.087
Pulmonary artery banding	6 (13.0)	19.50±13.6	13.5±7.7	0.364
Pulmonary artery banding/atrial septectomy	4 (8.7)	17.50±10.72	9.75±1.5	0.202
Glenn's shunt	12 (26.1)	15.50±12.9	13.63±6.5	0.676
Total	46	15.50±13.1	13.74±6.7	0.375

$DPCO_2$: difference PCO_2

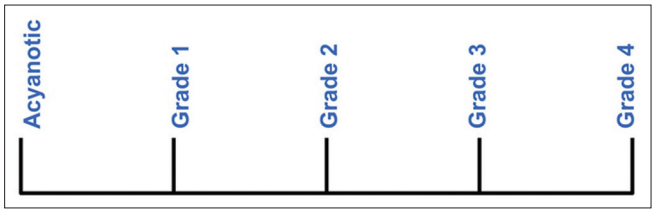

Figure 1: The visual analog scale of cyanosis severity

pressure ($PaCO_2$); thus, end-tidal capnometry is widely used in clinical practice to estimate $PaCO_2$. Today, the end-tidal capnometry has become a basic and standard procedure for respiratory monitoring during anesthesia and recovery,[14,15] ICU,[16-18] and at emergency departments (ED).[19,20] Takano *et al.* studied the utility of the portable capnometer in general wards or in-home care practice in spontaneously breathing patients and reported that expiratory capnometry gives a reliable estimate of $PaCO_2$ and can be useful to evaluate the respiratory condition of spontaneously breathing patients.[21] Yosefy *et al*. aimed to verify whether $ETPCO_2$ can accurately predict $PaCO_2$ and variables that may affect this correlation in patients who referred to ED for respiratory distress. They reported a good correlation between $ETCO_2$ and $PaCO_2$, and showed that $DPCO_2$ had an inverse correlation with age.[19] In some anesthetized patients or other patients with increased pulmonary dead space, $DPCO_2$ may increase significantly.[7] In most CHD patients, because of abnormal cardiopulmonary physiology, $DPCO_2$ increases; thus, it is often recommended to monitor $PaCO_2$ directly for respiratory setup.[16,22]

CHDs are the most common congenital diseases. In order to improve cardiopulmonary physiology and/or quality of life, many corrective or palliative surgical procedures are used. Conventionally, it is predicted that after corrective or palliative surgeries, $DPCO_2$ should reach a normal value or be reduced, respectively. Bhat and Abhishek reported a strong correlation between mainstream $ETCO_2$ and $PaCO_2$ in mechanically ventilated newborns. In neonates with lung disease, this correlation was weak; surfactant therapy improved the correlation.[4] Mehta *et al*. showed a correlation between increase in $DPCO_2$ and the severity of lung disease in neonates and children receiving mechanical ventilation. They recommended that blood gases should be measured in these patients until the lung disease is healed.[17]

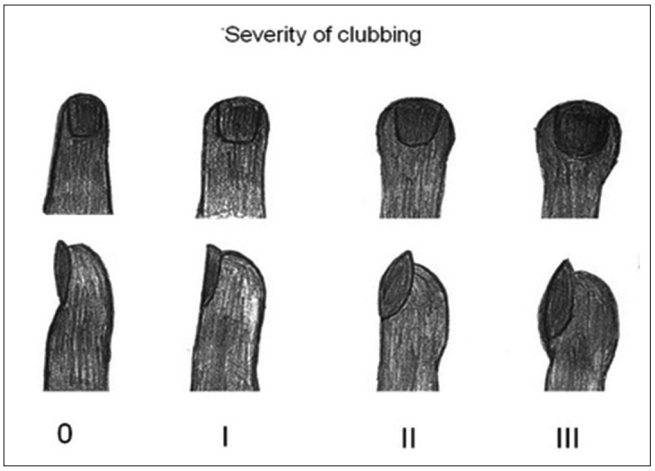

Figure 2: Grading of the clubbing severity

Incomplete corrections or nonadequate palliative operations are common reasons for postoperative mortality and morbidity.[10,11,23] Hanna *et al*. in a retrospective review of IOTEE on 690 patients reported a residual VSD with significant left-to-right shunt in 260 patients (37%). Twenty-four patients (9.2%) returned to CPB again in the same surgery.[10] Furthermore, most of these defects are trivial and resolve spontaneously, but early diagnosis could lead us to a correct way. Guzeltas *et al*. reviewed the perioperative TEE records of 265 pediatric patients with CHD. In 5 (1.8%) patients, the surgical plan was changed following preoperative TEE; in 12 patients (4.5%), CPB reinitiated because of residual defects identified by IOTEE. They concluded that perioperative TEE causes a significant reduction in mortality and morbidity.[13] IOTEE is a sensitive modality to detect residual problems; however, it requires high level of skill, especially in younger children. In Hanna's study, 125 of residual VSDs were not detected by IOTEE, and from 13 defects requiring reoperation during the same hospitalization, only five were detected by IOTEE.[10]

In infants and children with normal cardiopulmonary physiology, $DPCO_2$ is low and $ETPCO_2$ is used as a valuable predictor of $PaCO_2$. Tingay *et al.* in mechanically ventilated neonates without lung disease showed an acceptable agreement between $ETPCO_2$ and $PaCO_2$ postsurgically.[24] Trevisanuto *et al.* reported a good correlation between mainstream $ETPCO_2$

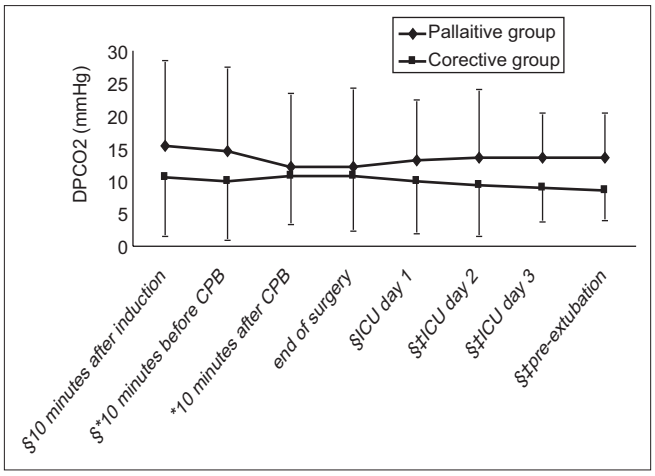

Figure 3: Arterial-end-tidal carbon dioxide pressure differences in palliative or corrective procedures at various times. *In off-pump operations, the value was measured 10 min before the procedure. † In off-pump operations, the value was measured 10 min after the procedure. ‡ Significant difference with basic (after induction) value ($P < 0.01$). § Significant differences between palliative and corrective groups

and $PaCO_2$ in 143 very low birth weight newborns (VLBWN); however, the agreement was poor and negatively influenced by the severity of pulmonary disease. They concluded that capnography should not replace $PaCO_2$ in ventilated VLBWN, but it may exert a role to detect trends of $PaCO_2$.[25] Naidu, in review of seven studies about using $ETPCO_2$ in mechanically ventilated neonates, showed a good correlation between $ETPCO_2$ and $PaCO_2$. He concluded that $ETPCO_2$ is a valuable trending tool, and especially in patients with underlying lung disease, it cannot be completely replaced with the gold standard serial ABG analyses.[26] Amuchou Singh and Singhal in a retrospective study showed a good correlation and agreement between $EtCO_2$ and $PaCO_2$ in mechanically ventilated extremely low birth weight newborns.[27] In such as lung disease in most children with CHD, $DPCO_2$ may increase.[14,19]

CHDs increase lung dead space, intra- or extrapulmonary shunts, and ventilation/perfusion mismatching (V/Q mismatch).[28] Although the main effects of these problems reflect on O_2 exchange (cyanosis), in lower degrees, CO_2 exchange may be affected. In anesthetized patients, because of mechanical ventilation, muscle paralysis, and positioning, $DPCO_2$ increases. It is expected that the $DPCO_2$ rises more significantly in CHDs; the present study indicated this (11.84 mmHg vs. normal 1–5 mmHg value). Right-to-left intracardiac shunt is the most common explanation for this finding in CHDs.[28] Lungs are bypassed and venous blood with high CO_2 content flows directly to arterial side, increasing $DPCO_2$. In increased PBF, blood runs very speedy through capillaries without enough time for gas exchanges in alveolocapillary system; this may increase the $DPCO_2$. The main purpose of surgery is to correct the cardiopulmonary physiology. Thus, the present study hypothesized that $DPCO_2$ should reach normal values or decrease after successful corrective or palliative procedures. The findings showed that palliative procedures do not have any corrective effect on $DPCO_2$, and corrective procedures have only an imperfect effect on $DPCO_2$, which may be due to the continuation of extrapulmonary shunts or increased PBF. In most patients with preoperative pulmonary artery hypertension (PAH) (generally PBF increases too), a few days or weeks for remission of PAH are required. Thus, in such cases, $DPCO_2$ may be higher than normal in early postoperative period. The results support the findings of Choudhury and Short. Choudhury studied the effect of hyperventilation on $DPCO_2$ in children with CHD who were scheduled for correction of their CHD. They concluded that $DPCO_2$ can be increased in both cyanotic and acyanotic diseases. They showed that, as in right-to-left shunting, increased PAP and PBF cause disturbance in carbon dioxide homeostasis, and hyperventilation has little effect on reducing $PaCO_2$.[8] Short studied the ability of arterial oxygen saturation in prediction of $DPCO_2$ in children with congenital cyanotic heart disease during cardiac surgery.[28] They reported that observed values were much greater than predicted $DPCO_2$, concluding that in such pulmonary hypo-perfusion with right-to-left intracardiac shunting, pulmonary hyper-perfusion caused by large left-to-right shunts increases the $DPCO_2$.

Normal small systemic to pulmonary collateral blood flow may get significantly high values in patients with underdeveloped native pulmonary circulation. This abnormal pulmonary flow comes from aorta and other systemic arteries can affect patient's $DPCO_2$ that may continue for a long time after cardiac surgery.[29,30] $ETPCO_2$ reflects the amount of blood flow from lungs circulation; thus, in low cardiac output states, $DPCO_2$ may be affected in low cardiac output patients. Our study did not consider this important aspect.

The current results showed a higher initial $DPCO_2$ in palliative group patients, which may be due to more severe cardiopulmonary derangement in these patients, as they were younger and had more severe cyanosis. Another important finding was similar $DPCO_2$ in palliative and corrective groups in early post-CPB period. Conventionally, immediately after weaning from CPB, there are a lot of problems; most of them usually recover in a few minutes or hours. Thus, in early post-CPB period, the definitive results of intervention may not be apparent, and $DPCO_2$ should not be used as an indicator of incomplete surgery or replace IOTEE.

Furthermore, in many pathologic conditions, $DPCO_2$ increases, but there is a stable reliable relationship between $ETPCO_2$ and $PaCO_2$. In the current study, $DPCO_2$ was very unstable in palliative group, supporting Lazzel and Tugrul studies.[22,31] Lazzel and Burrows studied the stability of $DPCO_2$ during various times of surgery in children with various types of CHD and reported that it is generally stable intraoperatively although some patients may demonstrate large individual variations.[22] In children with cyanotic CHD, $DPCO_2$was not stable. They concluded that $ETPCO_2$ cannot be used during surgery to reliably estimate $PaCO_2$ in children with cyanotic CHD. The unstable $DPCO_2$ in cyanotic CHD is also reflected

in Tugrul *et al.*'s study;[31] in a prospective clinical study, they investigated the relationship between $ETPCO_2$ and PBF augmentation achieved by insertion of a Blalock-Taussig shunt in cyanotic children with TOF. They reported a significant negative correlation between $DPCO_2$ and arterial oxygen saturation and recommended that $ETPCO_2$ alterations offer an alternative intraoperative tool to monitor PBF during systemic to pulmonary shunt procedures. Russell and Graybeal reported that $ETPCO_2$ does not provide a stable reflection of $PaCO_2$ during craniotomy;[14] however, some others do not agree with him.[16,32] Heines *et al.* studied it in mechanically ventilated postcardiac surgery patients and concluded that there is a good correlation between $ETPCO_2$ and $PaCO_2$, but it is not valid to estimate $PaCO_2$.[16] Therefore, expiratory capnography cannot be used to replace serial blood gas analyses completely and may be solely a good cardiopulmonary trend monitor. In other words, an abnormal $DPCO_2$ is a reflection of abnormal cardiopulmonary physiology.

Conclusions

$DPCO_2$ is higher than normal values in all CHDs. It does not change after palliative cardiac procedures. $DPCO_2$ decreases significantly after corrective procedures; however, it does not return to normal values at early postoperative period. Thus, $DPCO_2$ does not have any clinical value in monitoring the quality of corrective or palliative procedures. $ETPCO_2$ cannot completely be replaced with the gold standard technique (serial blood gas analyses) in pediatric cardiac surgeries.

Contribution details

EB, SF, and AY were contributed to the concept of study. They planned the study frame. EB and SF were responsible for preoperative visit and premedication. MM, SA, and YE provided the intraoperative anesthetic management. EB, SF, and AY managed the patient as long they were in postcardiac Pediatric Intensive Care Unit. EB, SF, and YE participated in the data collection and recording in perioperative period. EB and SF had the responsibility of to supervise the study and controlled data validity periodically. EB and SF by close working with a social medicine specialist were responsible for data handling and analyzing. EB, SF, SA, and YE prepared the manuscript for publish. All authors reviewed and approved the final version of the manuscript.

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Conflicts of interest

There are no conflicts of interest.

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