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Original Article

Analysis of Risk Factors Associated with Early Mortality in Total Anomalous Pulmonary Venous Connection (TAPVC) Repairs Performed Over a Period of 10 Years – A Retrospective Observational Study

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ABSTRACT

Objectives: Total anomalous pulmonary venous connection (TAPVC) is a congenital cardiac malformation. If it is not repaired surgically, the chances of survival of the patient are meager. Due to the improved perioperative care and surgical techniques, the overall results have also improved. Our study assesses the risk factors in relation to early mortality in TAPVC repairs performed over a period of 10 years by a single surgeon in our institute.

Material and Methods: Eighty-eight patients who were surgically treated for TAPVC at our institute over a period of 10 years from June 01, 2009, to May 31, 2019, by a single surgeon formed the basis of this retrospective observational study. The study protocol was reviewed and approved by the Institutional Ethics Committee. The information regarding patient demographic details, pre-operative evaluation, surgical procedure, post-operative course, and follow-up after discharge was retrieved by searching operation theatre (O.T) registries, medical record sections, and finally by patient follow-up in outpatient department/telephonic follow-up.

Results: Mean age and weight at surgery were 10.82 months and 5.27 kg, respectively. Out of 88, 64 (72.7%) were male patients and 24 (27.3%) were female patients. About 25% of the participants had age ≤1 month. The TAPVC type was supracardiac in 46.6% cases, cardiac in 24 (27.3%), infracardiac in 14 (15.9%), and mixed in 9 (10.2%). Of the 88 TAPVC patients, 33 (37.5%) were obstructed at the time of operation. Twenty-nine (33%) patients had to be taken up for emergency TAPVC repair. Out of the 88 patients, 33 had pre-operative pulmonary artery hypertension (PAH). Thirteen (14.8%) patients were on mechanical ventilation preoperatively and 18 (20.5%) patients required pre-operative inotropic support. Mean cardiopulmonary bypass (CPB) time in our study was 63.36 min, and cross-clamp duration was 34.4 min. Patients required to be ventilated postoperatively for an average of 4.18 days (±2.17 standard deviation [SD]). Mean intensive care unit (ICU) and hospital stay were 8.01 days (±3.63 SD) and 17.8 days (±10.47 SD), respectively. Eleven (12.5%) patients died postoperatively. Out of these, eight had age of <1 month ($P < 0.001$). Furthermore, the mean weight of the patients with early mortality is 3.85 kg (±2.17 SD), while the mean weight of the surviving patients is 5.48 kg (±3.35 SD), ($P < 0.05$). All of the 11 mortalities had at least some PAH in the post-operative period. However, 16 out of the surviving 77 patients had PAH ($P < 0.001$).

Conclusion: Supracardiac type was the most common subtype of TAPVC in our study (46.6%) followed by cardiac (27.3%). Early mortality was 12.5%, while late mortality was 3.9%. Age <1 month, low weight at the time of surgery, pre-operative obstructed pulmonary veins, pre-operative need of mechanical ventilation, pre-operative inotrope requirement, repair of TAPVC on an emergency basis, and post-operative PAH were important risk factors for early mortality. Gender, TAPVC type, pre-operative ventricular function, pre-operative PAH, associated cardiac lesions, CPB time, aortic cross clamp time, duration of ICU stay, duration of hospital stay, and post-operative ventricular function have not been found to have any statistically significant association with early mortality in our study.

Keywords: Congenital heart defects, Hospital mortality, Pulmonary veins, Risk factors

INTRODUCTION

Total anomalous pulmonary venous connection (TAPVC) is a congenital heart defect that occurs in 1–3% of children with cardiovascular malformations.[1] It consists of an abnormally patent channel between the pulmonary circuit and systemic venous circuit formed during the fetal development. A right to left shunt in the form of either a patent foramen ovale or an atrial septal defect is necessary for the survival of the infant.[2] It is a life-threatening congenital cardiac malformation that requires surgical therapy. It is classified into the following types, based on the location of the abnormal drainage of pulmonary veins into the systemic circulation: supracardiac, 45%; infracardiac, 25%; cardiac, 25%; and mixed, 5%.[3]

Uncorrected TAPVC has a mortality rate of more than 78% in infancy.[4] Although various published studies have documented early post-operative mortality varying from <10% to 50%, the mortality rates have become relatively better over the last couple of decades, mostly as a result of advancement of management strategies, both medical and surgical.[5-7] Infants with complex TAPVC lesions with other associated severe cardiac abnormalities have poorer prognosis as compared with simple TAPVC with biventricular anatomy without any other severe cardiac malformation.[5,6] Post-operative morbidities after TAPVC repair include arrhythmias, pulmonary hypertension, and residual stenosis in pulmonary veins or at the anastomosis.[6,8]

MATERIAL AND METHODS

Eighty-eight patients who had undergone surgical treatment for TAPVC over the course of 10 years, beginning on June 1, 2009 and ending on May 31, 2019, and who had been operated on by a single surgeon, formed the basis of this study. The protocol for the study was checked out by the Institutional Ethics Committee. On April 23, 2020, the approval for the institute's ethical clearance was granted (Reference Number: IECPG-113/April 23, 2020). For the purpose of publication of study data, informed consent was granted by the guardians of every participant. There was no conflict of interests.

All patients who underwent surgical treatment for TAPVC by a single surgeon during a period of 10 years, beginning on June 1, 2009 and ending on May 31, 2019, are being considered for inclusion in this study. There were no exclusion criteria.

The information regarding patient demographic details, pre-operative evaluation, surgical procedure, post-operative course, and follow-up after discharge was retrieved by searching O.T registries, medical record sections, and finally by patient follow-up in outpatient department/telephonic follow-up.

Definitions

Diagnosis for our study was based on echocardiography report. Preoperatively, pulmonary veins were deemed obstructed if there were echocardiographic data that indicated a significant gradient between the pulmonary veins and their point of drainage (flow acceleration 2 m/s by echocardiography). If the patient's condition warranted surgery within a day of coming to the hospital, it was labeled as "Emergency" surgery. Post-repair pulmonary venous obstruction was diagnosed by clinical presentation or during routine radiographic surveillance. Isolated or simple TAPVC was diagnosed if the patient had TAPVC in association with a secundum atrial septal defect or a patent ductus arteriosus, or both. Patients were classified as having single-ventricle or two-ventricle physiology by whether their anatomy was deemed suitable for a two-ventricle or single-ventricle repair.

Early mortality was defined as death within 30 days of an operation or within the primary hospitalization.[9]

Surgical technique

All the cases were done through routine institution of cardiopulmonary bypass and moderate hypothermia with adequate myocardial protection. Once on bypass, patent ductus arteriosus (PDA) was identified and ligated. Similarly, the vertical vein was looped in patients with infracardiac connections or obstructed TAPVC after initiating bypass.

In patients with supracardiac type, right pleura was completely opened and the heart was lifted superiorly and rightwards into the right pleural cavity.[10] Common chamber of pulmonary veins and the corresponding part of the left atrium were opened and a good sized anastomosis was made (about 3 cm). Atrial septal defect was closed. The vertical vein was ligated in the infracardiac and obstructed TAPVC patients.

In patients with cardiac type of circuit, the roof of coronary sinus was incised to connect it freely to the left atrium as described by Malm.[11] Patch closure of atrial septal defect (ASD) along with the coronary sinus was done subsequently, taking care not to injure conduction tissue.

In patients with infracardiac connection, heart was lifted superiorly and common chamber was anastomosed to left atrium. Ligation of vertical vein was done in all infracardiac TAPVC patients.

RESULTS

Patient demographics

A total of 88 patients who underwent TAPVC repair were studied. Mean age and weight at surgery were 10.82 months and 5.27 kg, respectively [Table 1]. Out of 88, 64 (72.7%) were male patients and 24 (27.3%) were females [Table 2]. About

Table 1: Distribution of the participants in terms of age and weight (*n*=88).

Age (months)	
Mean (SD)	10.82 (17.34)
Median (IQR)	3.5 (1.38–12)
Range	0.07–84
P-value	0.0731
Weight (kg)	
Mean (SD)	5.27 (3.26)
Median (IQR)	4.05 (3.18–6.78)
Range	1.8–19.9
P-value	0.0142

[1]:Wilcoxon–Mann–Whitney U-Test, 2: Kruskal–Wallis test. SD: Standard deviation, IQR: Interquartile range

Table 2: Distribution of the participants in terms of gender, TAPVC type, obstruction, and timing of surgery (*n*=88).

Gender	**Frequency**	**Percentage**	***P*-value**
Male	64	72.7	0.635[1]
Female	24	27.3	
TAPVC type	**Frequency**	**Percentage**	***P*-value**
Supracardiac	41	46.6	
Cardiac	24	27.3	
Infracardiac	14	15.9	
Mixed	9	10.2	
Obstruction	**Frequency**	**Percentage**	***P*-value**
Present	33	37.5	0.004[1]
Absent	55	62.5	
Timing of surgery	**Frequency**	**Percentage**	***P*-value**
Emergency	29	33.0	0.001[2]
Elective	59	67.0	

[1]: Pearson Chi-squared test, [2]: Fisher's exact test. TAPVC: Total anomalous pulmonary venous connection

25% of the participants had age ≤1 month. The TAPVC subtype was supra-cardiac in 46.6% cases, cardiac in 24 (27.3%), infra-cardiac in 14 (15.9%), and mixed in 9 [Table 2]. Of the 88 TAPVC patients, 33 (37.5%) were obstructed at the time of operation [Table 2]. The association of obstruction with infra-cardiac TAPVC was statistically significant ($P = 0.004$). Twenty-nine (33%) patients had to be taken up for emergency TAPVC repair [Table 2].

Perioperative data

Out of the 88 patients, 33 had pre-operativePAH. Thirteen (14.8%) patients were on mechanical ventilation preoperatively and 18 (20.5%) patients required pre-operative inotropic support [Table 3]. The mean total cardiopulmonary bypass (CPB) time for all patients was 63.36 min, and mean cross-clamp duration was 34.40 min [Table 4]. The vertical vein was left open in 34 cases (38.6%). Postoperatively, ventilation was required for an average of 4.18 days (±2.17 Standard deviation [SD]). Mean intensive care unit (ICU) stay was 8.01 days (±3.63 SD). Mean hospital stay was 17.8 days (±10.47 SD) [Table 4].

Table 3: Distribution of the participants in terms of pre-operative mechanical ventilation, pre-operative inotropes (*n*=88).

Pre-operative mechanical Ventilation	**Frequency**	**Percentage**	***P*-value**
Yes	13	14.8	<0.001[1]
No	75	85.2	
Pre-operative inotropes	**Frequency**	**Percentage**	***P*-value**
Yes	18	20.5	<0.001[1]
No	70	79.5	

[1]: Fisher's Exact test

Table 4: Distribution of the participants in terms of CPB time, AOX time, duration of mechanical ventilation, ICU stay, and hospital stay (*n*=88)

CPB time (minutes)	
Mean (SD)	63.36 (12.21)
Median (IQR)	62 (55–70)
Range	42–96
P-value	0.630[1]
AOX time (minutes)	
Mean (SD)	34.40 (8.45)
Median (IQR)	32.5 (28–40.25)
Range	21–59
P-value	0.702[1]
Duration of mechanical ventilation (days)	
Mean (SD)	4.18 (2.17)
Median (IQR)	4 (2.75–6)
Range	1–12
P-value	0.130[1]
ICU stay (days)	
Mean (SD)	8.01 (3.63)
Median (IQR)	8 (5–9)
Range	3–22
P-value	0.460[1]
Hospital stay (days)	
Mean (SD)	17.80 (10.47)
Median (IQR)	17 (11–23)
Range	4–91
P-value	0.911[1]

[1]: Kruskal–Wallis test. ICU: Intensive care unit, SD: Standard deviation, IQR: Interquartile range, CPB: Cardio-pulmonary bypass, AOX: Aortic cross clamp

Post-operative outcome

In the post-operative period, three patients developed pneumonia, which was managed conservatively and these patients responded with appropriate upgradation of antibiotics. Fifteen (17%) patients developed low cardiac output in the immediate post-operative phase which was managed conservatively initially. However, in two patients, extracorporeal membrane oxygenation had to be instituted, out of which one did not survive. Peritoneal dialysis was instituted in 15 (17%) patients in the post-operative period.

Table 5: Distribution of the participants in terms of hospital mortality (*n*=88).

Hospital mortality	Frequency	Percentage	*P*-value
Yes	11	12.5	0.298[1]
No	77	87.5	

[1]: Fisher's Exact test

Eleven (12.5%) patients were tracheostomized for prolonged requirement of mechanical ventilation. In subgroup analysis, none of these post-operative complications had any statistically significant difference among the four TAPVC types.

Two (2.3%) patients developed diaphragmatic palsy, 1 (1.1%) developed chylothorax, and 2 (2.3%) had supraventricular tachycardia in post-operative period, which were managed conservatively.

Eleven (12.5%) patients died postoperatively [Table 5]. Out of these, eight had age of <1 month ($P < 0.001$) [Table 6]. Furthermore, the mean weight of the patients with early mortality is 3.85 kg (±2.17 SD), while the mean weight of the surviving patients is 5.48 kg (±3.35 SD), ($P < 0.05$). All of the 11 mortalities had at least some PAH in the post-operative period. However, 16 out of the surviving 77 patients had PAH ($P < 0.001$) [Table 6]. Our study found three late mortalities, two of which were infra-cardiac TAPVC subtypes, while the third was of mixed TAPVC type.

Table 6: Analysis of various parameters as risk factors for early mortality.

Parameters	Early mortality		*P*-value
	Yes (*n*=11) (%)	No (*n*=77) (%)	
1. Age			
<1 month	8 (72.7)	14 (18.2)	<0.001[1]
>1 month	3 (27.3)	63 (81.8)	
2. Gender			
Male	9 (81.8)	55 (71.4)	0.720[1]
Female	2 (18.2)	22 (28.6)	
3. Weight (kg)	3.85±2.17	5.48±3.35	0.002[2]
4. TAPVC subtype			
Supracardiac	4 (36.4)	37 (48.1)	0.298[1]
Cardiac	2 (18.2)	22 (28.6)	
Infracardiac	4 (36.4)	10 (13.0)	
Mixed	1 (9.1)	8 (10.4)	
5. Obstruction	9 (81.8)	24 (31.2)	<0.001[1]
6. Pre-operative mechanical ventilation	6 (54.5)	7 (9.1)	<0.001[1]
7. Pre-operative inotropes	9 (81.8)	9 (11.7)	<0.001[1]
8. Emergency surgery	9 (81.8)	20 (26.0)	<0.001[1]
9. Pre-operative PAH	4 (36.4)	29 (37.7)	1.000[1]
10. Post-operative PAH	11 (100)	16 (20.7)	<0.001[1]
11. Pre-operative LV dysfunction	0	2 (2.6)	1.000[1]
12. Post-operative LV dysfunction	1 (9.1)	3 (3.9)	0.161[1]
13. CPB time (minutes)	62.64±14.97	63.47±11.88	0.850[2]
14. AOX time (minutes)	37.55±9.32	33.95±8.29	0.256[2]
15. ICU stay (days)	9.00±3.69	7.87±3.63	0.357[2]
16. Hospital stay (days)	13.73±7.89	18.38±10.70	0.076[2]

[1]: Fisher's Exact test, [2]: Wilcoxon–Mann–Whitney U-test. TAPVC: Total anomalous pulmonary venous connection, PAH: Pulmonary artery hypertension, ICU: Intensive care unit, CPB: Cardiopulmonary bypass, LV: Left ventricular, AOX: Aortic cross clamp

In the sub-group analysis, four out of the 41 supracardiac TAPVC cases (9.8%) died, two out of 24 cardiac (8.3%), four out of 14 infracardiac (28.6%), and one out of 9 (11.1%) mixed type of TAPVC cases had early mortality. This distribution was not statistically significant [Table 6].

Out of the 11 patients who died, 9 (81.8%) had pre-operative obstructed TAPVC, while 24 (31.2%) out of the surviving 77 patients had obstruction preoperatively. This difference was statistically significant ($P < 0.05$) [Table 6].

Six (54.5%) patients among the 11 who died, were on mechanical ventilation preoperatively, while 7 (9.1%) out of the surviving 77 patients were on mechanical ventilation preoperatively. This has been found to be statistically significant ($P < 0.001$) [Table 6].

Nine (81.8%) out of the 11 mortalities needed pre-operative inotropic support, while 9 (11.7%) out of the surviving 77 patients needed inotropic support preoperatively. This was statistically significant ($P < 0.001$) [Table 6].

Nine (81.8%) out of the 11 mortalities needed emergency surgery, while two were operated on an elective basis. Twenty (26%) out of the surviving 77 patients required emergency surgery, while 57 were operated on an elective basis. This was statistically significant ($P < 0.001$) [Table 6].

All of the 11 mortalities had at least some PAH in the post-operative period. Six (54.5%) out of these 11 had mild PAH, 1 (9.1%) had moderate, and 4 (36.4%) had severe PAH. However, 16 out of the surviving 77 patients had PAH ($P < 0.001$) [Table 6].

In our study, there was only one patient with single ventricle physiology (unbalanced atrioventricular defect) who underwent TAPVC repair along with bidirectional Glenn procedure. The patient developed low cardiac output in the post-operative period and succumbed on the 13th post-operative day.

Gender, TAPVC type, pre-operative ventricular function, pre-operative PAH, associated cardiac lesions, CPB time, aortic cross clamp time, duration of ICU stay, duration of hospital stay, and post-operative ventricular function have not been found to have any statistically significant association with early mortality in this study [Table 6].

DISCUSSION

Recent reports of TAPVC repair have indicated that surgical outcomes have improved over the past three decades.[5,12-14] This has largely been a result of better pre-operative management, minimization of invasive pre-operative work-up, operative advancements, and better post-operative care.

The median age of children with TAPVC undergoing surgery in our study was 3.5 months, which is comparable to most of the other similar studies.[14-17] However, some studies had early presentation of cases for surgery.[18-20] On the contrary, in some studies, the age of children undergoing surgery was found to be comparatively more.[21,22] The reason for this delay is contemplated to be a lack of widespread prenatal diagnosis, delayed postnatal diagnosis, and referral and scarcity of tertiary care centers offering pediatric cardiac surgery services. The median weight of children with TAPVC undergoing surgery in our study was 4.05 kg, which is comparable to most of the other similar studies.[6,14-23] The gender distribution in our study is also comparable to most of the other similar studies.[6,14,17,19,22,23]

The TAPVC anatomy in our study was supracardiac in 41 (46.6%) cases, cardiac in 24 (27.3%), infracardiac in 14 (15.9%), and mixed in 9 (10.2%). This is comparable to the observations of some similar studies.[14,17,19,20] However, certain other studies demonstrated much higher incidence of supracardiac type of TAPVC.[6,15,18,22] This can be explained by relatively fewer number of cases being studied, leading to some amount of bias.

In our study, obstructed TAPVC cases being operated were 37.5%. This finding was comparable to that observed by other studies. For example, Lemaire *et al*. reported 45% obstructed TAPVCs in their study,[14] while Choudhary *et al*.[15] and Kelle *et al*.[18] reported 49% and 29%, respectively. Hancock *et al*.,[6] Yong *et al*.,[19] and Harada *et al*.[17] reported higher incidence of obstruction in their studies while Elamry *et al*.[22] reported that only 15.7% obstructed TAPVC in their study.

About 33% of cases in our study had to be operated as emergency procedures. This was comparable to the findings of Harada *et al*.[17] Choudhary *et al*.[15] reported 20.5% as emergency procedure and Yong *et al*.[19] reported it to be 19.1%. However, Hancock *et al*.[6] had 53% of cases which were operated as emergency.

The need for pre-operative mechanical ventilation and pre-operative inotropes was not reported in most of the studies. In our study, 14.8% cases required pre-operative mechanical ventilation, while this data for Yong *et al*.[19] and Harada *et al*.[17] was 57% and 36.3%, respectively. In our study, 20.5% cases needed pre-operative inotropes, while 34% cases in the study by Harada *et al*.[17] and 48% in that by Hancock *et al*.[6] required pre-operative inotropes.

The average CPB time and aortic cross clamp time in our study was comparatively lesser than most of the studies.[6,16,23]

The duration of mechanical ventilation, ICU stay, and hospital stay in our study was comparable to most of the similar studies.[15,18,19,22,23]

The early mortality in our study has been found to be 12.5%, which is comparatively lesser than most of the similar studies. Sugano *et al*.[20] reported an in-hospital mortality of 34%, while Choudhary *et al*.[15] and Hancock *et al*.[6] reported

an early mortality of 23.3% and 24%, respectively. Lemaire *et al*.[14] reported early mortality in their study to be 21.1%, while Domadia *et al*.[24] and Sakamoto *et al*.[21] reported early mortality to be 18% and 18.27%, respectively. Adzamli *et al*.[23] reported that the in-hospital mortality in their study was only 7.5%. This can be attributed to the fact that they included only supracardiac type of TAPVC in their study, which has been known to have much lesser incidence of obstruction and better post-operative results. Similarly, Xiang *et al*.[16] reported only 7.7% early mortality in their study. They included only mixed type of TAPVC, excluding infracardiac TAPVCs which are a known risk factor for poor post-operative outcome. Elamry *et al*.[22] studied only those cases which were operated on an elective basis, excluding all the emergency cases. Consequently, the early mortality reported by them was only 5.7%. Kelle *et al*.,[18] Yong *et al*.,[19] and Harada *et al*.[17] reported very good post-operative results in their studies, with early mortality of 12%, 7.9%, and 2.7%, respectively.

In our study, it has been found that age <1 month, low weight of the patient at the time of surgery, pre-operative obstructed pulmonary veins, pre-operative need of mechanical ventilation, pre-operative inotrope requirement, repair of TAPVC on an emergency basis, and post-operative PAH are statistically significant risk factors for early mortality. Gender, TAPVC type, pre-operative ventricular function, pre-operative PAH, associated cardiac lesions, CPB time, aortic cross clamp time, duration of ICU stay, duration of hospital stay, and post-operative ventricular function have not been found to have any statistically significant association with early mortality in our study.

This summation of correlations has been different from those observed in previously published literature. Yong *et al*.[19] found increased CPB time and age <1 month as important risk factors for early deaths, while Sakamoto *et al*.[21] demonstrated in their study that the risk factors are weight of the child <2 kg at the time of operation and post-operative pulmonary vein obstruction. Choudhary *et al*.[15] found that the statistically significant risk factors for early mortality in TAPVC repair cases are post-operative PAH crisis, emergency repair of TAPVC, and weight of the child <25th percentile. Hancock *et al*.[6] reported obstructed TAPVC and single ventricle physiology to be risk factors for in-hospital mortality. Chowdhury *et al*.[25] reported age <1 month, obstructed pulmonary vein preoperatively, hypoplastic pulmonary vein, post-operative PAH crisis, post-operative low cardiac output syndrome, and vertical vein ligation during surgery to be the significant risk factors for early mortality after TAPVC repair. Ricci *et al*.[26] studied recurrent pulmonary vein obstruction after TAPVC repair and found the risk factors for early mortality to be age <6 months and persistent PAH after reoperation. Domadia *et al*.[24] found that the presence of heterotaxy syndromes was significantly correlated with early mortality. St Louis *et al*.[27] reported that only pre-operative obstruction of pulmonary vein is a significant risk factor for in-hospital mortality. Liufu *et al*.[28] concluded that pre-operative pulmonary vein obstruction, increased duration of post-operative mechanical ventilation need, and TAPVC repair on an emergency basis are correlated significantly with early mortality.

Bayya *et al*. reported only 0.9% early mortality in their study. However, they included only isolated TAPVC patients without any associated lesion. Furthermore, it is not mentioned whether they included cases which were operated on emergency basis.[29]

Shentu *et al*., in their study, reported overall, mortality of 25 patients (10%), at a median of 0.26 months. In their study, lower weight, greater last arterial lactate level before surgery, emergency surgery, non-cardiac connection type, long CPB, and cross-clamping time were associated with death.[30]

Talwar *et al*. have reported no early or late deaths among 98 patients operated for TAPVC.[31] However, a noteworthy difference is that they studied patients who presented and were operated after their first decade of life.

On the other hand, Tailor *et al*. reported a mortality of 5.4% in their study.[32] However, only early mortality was mentioned.

Higher CPB time and obstructed TAPVC were reported by Beers *et al*. as risk factors for mortality. However, they found that cardiac type of TAPVC was protective, while our study does not demonstrate any significant correlation between type of TAPVC and mortality.[33]

Wang *et al*. concluded in their study that higher CPB time was the only independent risk factor for the early post-operative mortality. However, it has not been mentioned whether obstructed TAPVC patients were taken into account.[34]

Neonatal age group and preoperatively ventilated patients had significant risk of early mortality and bleeding in mixed cyanotic patients may also lead to early mortality in ICU.[35-38]

Limitations

This study has some limitations. First, patients in this cohort tended to be older at presentation and there was possibility that more critically ill newborns may die before referral, potentially reflecting a selection bias. In addition, other unmeasured variables influenced by the era effect may potentially affect the results. Furthermore, exact dosage and duration of use of inotropes could not be ascertained for all the cases in our study. Retrospective nature and a relatively small sample size are other limitations.

CONCLUSION

Following conclusions can be drawn from the present study with regard to the association of risk factors with the early mortality:

1. Age <1 month, low weight at the time of surgery, pre-operative obstructed pulmonary veins, pre-operative need of mechanical ventilation, pre-operative inotrope requirement, repair of TAPVC on an emergency basis, and post-operative PAH were statistically significant risk factors for early mortality.
2. Although early mortality was highest in infracardiac type, the correlation of TAPVC sub-type with mortality was not found to be statistically significant.
3. Gender, TAPVC type, pre-operative ventricular function, pre-operative PAH, associated cardiac lesions, CPB time, aortic cross clamp time, duration of ICU stay, duration of hospital stay, and post-operative ventricular function have not been found to have any statistically significant association with the early mortality in our study.

Ethical approval: The research/study approved by the Institutional Review Board at Institutional Ethics Committee, AIIMS, New Delhi, number IECPG-113/April 23, 2020, dated April 23, 2020.

Declaration of patient consent: The authors certify that they have obtained all appropriate patient consent.

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