Complete Atrioventricular Septal Defect: Comparison of One-Stage Primary Repair With Two-Stage Surgical Strategy

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Abstract:

Background: Complete Atrioventricular Septal Defect (CAVSD) is a congenital heart disease treated by surgical repair. There are two strategies for surgery: 1) Primary repair at lower ages (one-stage repair). 2) PA banding in lower age and then complete repair after normalization of PAP (Two-stage repair).The purpose of this study was comparison of mortality rate and short term complications of these two strategies.

Patients and Methods: This Cohort study covered 90 patients by CAVSD from a single center that underwent surgical repair from September, 2005 to October 2010. Forty seven patients operated by one-stage repair and 43 patients by two-stage method. Patients were compared based on preoperative data (age, sex, weight, Down's syndrome, Pulmonary Artery Pressure"PAP" and Preoperative EF) intraoperative data (data of Pulmonary Artery "PA" banding, CPB time and aortic cross clamp time) post operative data (post op EF, residual septal defects, residual AV valve regurgitation, ICU stay time and tracheal intubation time) short term complications (Pulmonary complications, bleeding, CHB) and hospital mortality rate.

Results: There were no significant differences among two groups concerning age, sex, weight, PAP and Preoperative EF. Failure rate of PA banding was 9.4% in two-stage group.CPB time and aortic cross clamp time in one- stage repair were significantly lower than two-stage repair (P=0, P=0.002). ICU stay and tracheal intubation time in one-stage repair were significantly lower than two-stage repair (P=0, P=0).There were no significant differences among the two groups concerning post operative EF, and residual septal defects. Severe TR was higher in two-stage repair group (P=0.016). Pulmonary complications were lower in one-stage repair group.The. hospital mortality rate in one-stage repair was 6.4% and in two-stage repair was 16.3% (P=0.136). The risk factors for mortality were increased CPB time and aortic cross clamp time.

Conclusions: This study demonstrated that one-stage primary repair of CAVSD is a safe method with lower mortality rate and short term complications than two-stage repair and it can be considered as the preferable strategy in CAVSD repair in lower ages.

Key words:Complete Atrioventricular Septal Defect; Primary Repair; Two Stage Repair; Pulmonary Artery Banding.

Introduction:

There are two surgical methods to treat CAVSD. The first method is the traditional method which has been common from long ago; in which patients in lower ages undergo a pulmonary artery banding(PAB) , and after a while once the PA pressure is normal the total correction operation is done [1]. In this way, they can partly control the pulmonary artery pres-

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sure; however since the anatomical defects remain high to the older ages, can affect the physiology of the heart. The second method -which is now more commonly done in the world- the total correction operation is done all at once in the lower ages. In this method not only the PH correction takes place and doesn't remain for long ,but also the previous anomalies are corrected in the lower ages the normal physiology of the heart will be preserved or will get back to normal sooner [2,3].

Table 1: Demographic information

Variable	Mean	P
Age of PAB (two-stage)	7.7±4.3 month	0.340
Age of repair (two-stage)	38.2±18.5 month	
Period interval from PAB to secondary repair (two-stage)	30.4±17.7 month	
Age of repair (one-stage)	10.2±4.1 month	
Weight at time of PAB (two-stage)	4.9±1.5 Kg	0.611
Weight at time of secondary repair (two-stage)	12.5±4.8 Kg	
Weight at time of primary repair (one-stage)	6.3±2 Kg	

G. Stellin and his colleagues introduced the total correction surgery before 3 months of age as the ideal method to treat CAVSD [4].In study of MJ Uddin, the primary repair of AV Canal before increased pulmonary vascular resistance was associated with reduced mortality [5].The aim of this study was to compare two methods of one-stage and two- stage surgical correction, in terms of feasibility and outcome.

Material and Methods

From September 2005 to October 2010, 90 patients underwent the restoration surgery for CAVSD in Rajaei Heart Center. 47 patients (52.3 %) underwent one- stage restoration surgery (group one) and 43 patients (47.7 %) underwent the two- stage restoration surgery (Group two). 60% of patients were male and 58.9 % were suffering from Down Syndrome.

The two groups were comparable in terms of age, sex, weight, intensity of PH, anatomic type and the amount of common atrioventricular valve regurgitation, and didn't have significant statistical difference.

Statistical analysis

Comparisons between groups were made using the Fisher exact test for categorical data and an unpaired 2-tailed t test for continuous variables. A p value less than 0.05 was considered significant. All calculations were performed using StatView software (SAS Inc, Cary, NC).

Results

1. Intraoperative results:

In the two-stage group after the PAB surgery in 4 patients (9.4 %), PAB failed to reduce pulmonary artery pressure. The mean time for CPB in one- stage surgeries was 104.8 ± 22.9 minutes and in the two- stage surgeries it was 129 ± 24.8 minutes, which was significantly more in the second group (P=0). This is natural that in the second surgery a considerable time is spent to set the adhesions free from inside pericardial and especially the P.A debanding will increase theCPB time.

The mean aortic cross clamping time for group one,was 69.2 ± 20.7 minutes and the in the group two, it was 82.5 ± 21.7 minutes, which was again meaningfully more in the second group (P=0). Although the increased time for aortic cross clamping and CPB has proven complications which comes along with an increase in mortality and morbidity.

2. ICU information:

The mean ICU stay time in group one, was 5.4 ± 2.1 days and in overall two surgeries in group two, it was 10.2 ± 3.2 days which was significantly less in group one (P=0). Reducing the time of ICU stay not only reduces the complications after surgery but also cuts down on hospital costs considerably.

The mean time of tracheal intubation in group one, was 39 ± 12.3 hours meanwhile in the overall two operations in group two, it was 85.5 ± 19.6 hours (P=0). Obviously reduced time of tracheal intubation is in association with reduced pulmonary complications.

3. Echocardiographic results after surgery:

5 patients from group one and 4 patients from group two developed Small Residual VSD (P=ns)Also two patients from group 2 developed Small Residual ASD (P=ns).11 patients from group one and 7 patients from group two were suffering from Moderate MR and one case in group 2 from Severe MR (P=ns).

Also 6 cases from group one and 8 cases from group two were suffering from Moderate TR, and 1 case from group

one and 3 cases from group two from Severe TR; in which the amount of Severe TR was meaningfully higher in group 2 (P=0.016). The reason could be that the previous PAB leads to RV Dilatation and dilatation of tricuspid valve ring and so tricuspid repair wasn't desirable. 7 patients from group2 (17.1 %) developed pulmonary artery stenosis, which although this one again is of the complications of the previous PAB .

4- Complications:

The overall pulmonary complications were more in the two-stage surgeries than the one-stage surgeries: Atelectasis in group one 9 cases and in group two 20 cases (P = 0.047).

Pneumonia in group one 3 cases and in group two 8 cases (P = 0.058).

Prolonged intubation in group one 11 cases and in group two 16 cases (P = 0.335).

Reintubation in group one 4 cases and in group two 9 cases(p = 0.094).

Although it was predictable that staying long in ICU and being readmitted in ICU in the two-stage group would have more complications.

The complete heart block happened for 2 cases in group one and 4 cases in group two (p=ns). Finally in 3 cases PPM had to be embedded (1 case from group one and 2 cases from group two)

Bleeding rate in group1, was 2.1 percent and in group 2, it was 7 percent. (P=ns)

5. Mortality:

Mortality rate was overall 10 cases (11.1 %) in which 3 cases (6.4 %) were from group one and 7 cases (16.3 %) were from group two. Although the differences were not statistically significant, but they were worthy of attention. (P=ns)

Among death cases, in group two 2 cases following PAB (4.6 %) and 5 cases following the second surgery (12.1 %) happened. Among death cases following PAB in one case, the cause of death was PH Crisis due to an unsuccessful PAB, and in the other case Sepsis following Pneumonia. In death cases following the second surgery in group two 2 cases died due to sepsis, 2 other cases because of HF and one case due to PH crisis. In this recent case however PAB was done, but patient still had a significant PH before the second surgery which shows an unsuccessful PAB.

Cause of death in one-stage surgeries was in one case DIC and in two other cases HF. Time of death in above mentioned cases were 12 hours until 40 days after the surgery.

The results of this survey showed that death has a meaningful relation with CPB time as if the mean of the CPB time in mortality cases was 136 ± 32.2 minutes whereas in other cases it was 114.1 ± 26.1 minutes. (P=0.030) We could also see a meaningful association between death and aortic cross clamp time, in a way that the mean time of aortic cross clamp in mortality cases was 94.3 ± 12.1 minutes and in other cases it was 73.5 ± 11.2 minutes. (P=0.021)

6. Follow up:

86 patients (95 %) were followed up and underwent serial echocardiography. The follow up time was between 2 to 60 months with a mean 34.4 ± 12.5 months.

Table 2:one-stage repair versus two-stage repair data

Variable	One-stage repair	Two-stage repair	P
Preoperative EF	68.7±8.2 %	71.3±9.2 %	0.259
Mean pulmonary artery pressure	50.6±9.2 mmHg	52.4±12.2 mmHg	0.769
Mean CPB time	104.8±22.9 minute	129±24.8 minute	0
Mean aortic cross clamp time	69.2±20.7 minute	82.5±21.7 minute	0.002
Mean ICU stay time	5.4±2.1 day	10.2±3.2 day	0
Mean tracheal intubation time	39±12.3 hour	85.5±19.4 hour	0
Postoperative EF	60.7±9.9 %	60.4±10.2 %	0.606

Discussion:

The results of our survey showed that the hospital mortality rate in CAVSD restoration surgery was 11.1 % whereas in similar studies mortality rate was reported to be about 10 to 15[6,9,10,12,13,14]. In this study mortality in the two-stage method (16.3 %) was reported more than the one-stage method (6.4%). Although the differences were not statistically significant, but they're clinically important and worthy of attention. This study also showed that mortality is in direct relation with CPB time and aortic cross clamp time, and increase in CPB time and aortic cross clamp time will increase mortality rate after surgery. CPB time is mentioned as a risk factor also in similar studies like Kobayashi's[2].

In this study the mean time of ICU stay and the time of tracheal intubation in both groups were similar to the studies which have been done in the world [15,17],and there are not much of significant differences among the two groups, although these two criterions in overall two surgeries in group 2,was significantly more than group 1.

The pulmonary complications including atelectasis, pneumonia, prolonged intubation, and reintubation was more in group two comparing to group one. The results of our survey showed that CPB time and aortic cross clamp time were significantly more in group 2 comparing to group 1.

Although in the two-stage surgical method a considerable time is spent to set the adhesions free from inside pericardial and also the PA debanding, and the increased time of CPB and aortic cross clamp considering the results of our survey and other similar studies will increase mortality and morbidity. Some supporters of the two-stage repair believe that the restoration of atrioventricular valve in lower ages and low weight would not be so satisfying[8,16], but the results of our survey showed that the remaining regurgitation rate of mitral and tricuspid valves after surgery doesn't really have significant differences; in addition the severe TR rate was higher in group two that the reason could be dilatation of the tricuspid ring and the right ventricle following the previous PAB surgery.

We should also add the complications of PAB to the above mentioned cases. In our study PAB failed in 9.4 % of cases and couldn't lower the pressure of PA.PAB also paved the way for PA stenosis after restoration surgery in 17.1 % of cases. However PAB still plays an important role in complex congenital heart diseases, but this is not recommended for CAVSD routinely[7]. This type of surgery is only recommended in cases in which the patient suffers from severe heart failure or in severe non-cardiac diseases requiring surgical intervention and also in unbalanced ventricles[8,11].

Our advice is that if it is required to have a two-stage operation, shorten the interval between the PAB and the total correction surgery so that it doesn't lead to adverse effects on right heart performance and the tricuspid valve.

It must be acknowledged that our study had the following limitations as well:1-Although we have studied all the cases of CAVSD in this center during the mentioned period, but it seems if we want to reach definitive results, more studies with larger sample size is required to be done.2-In this study patients underwent operations by different surgeons that although there's not much difference in methods and skills of surgeons, but the results are affected anyway.3-Comparing to similar studies, the period of follow up is shorter in this study, so in order to study the complications more accurately it's better to have studies following this one.

Conclusion:

The overall results of our survey considering the results of similar studies suggest that the one-stage surgical repair method in treatment of CAVSD is done with less mortality and more acceptable clinical complications comparing to the two-stage method that could be done in patients with lower ages and low weight. On the other hand comparing to the two-stage repair which requires two times being bedridden in hospital and operation room, spending more money and the probability of mortality and morbidity, the one-stage repair seems to be more reasonable.

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