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Original Article

Modified Single-Patch Technique Versus Two-Patch Technique in Infants with Complete Atrioventricular Septal Defect

Mohamed Ahmed Elgazzar, Hany Mohamed Elrakhawy, Mohamed Mohamed Saffan, Basem Mofreh Abdelgawad, Mohamed Elsayed Omar, Abdelhamid Fathi Sherif

Department of Cardiothoracic Surgery, Faculty of Medicine, Banha University, Banha, Egypt

Abstract

Background: There are many techniques in repairing complete atrioventricular septal defect including: double patch technique, classic single patch technique and modified single patch technique. It is still debated which of these techniques is superior to the other one, our objective was to contrast the outcomes following surgery between the modified single patch and double patch techniques for repair of complete atrioventricular septal defect.

Methods: This study includes 100 infants who underwent complete atrioventricular septal defect repair. Individuals were split into patients repaired with modified single patch as group A (n= 50), and patients repaired with double patch as group B (n= 50).

Results: Group B showed significantly higher Cardiopulmonary bypass time (110 ±12 vs. 88 ±8 min, P < 0.001) Aortic cross clamp time (81 ±7 vs. 61 ±5 min, P < 0.001), ICU stay (10 ±1 vs. 9 ±1 day, P < 0.001), hospital stay (17 ±2 vs. 15 ±1 day, P < 0.001), and drainage amount (310 ±98 vs. 194 ±80, P < 0.001). No changes observed among groups of the study in other operative or postoperative statistics.

Conclusion: Modified single-patch repair and two-patch repair did not yield significantly different results in the total correction of atrioventricular septal defects.

KEYWORDS

Atrioventricular Canal;
Double Patch;
Modified Single Patch

Article History

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Introduction

Surgery is thought to be the only successful treatment for atrioventricular septal defects. Several procedures exist to correct a complete atrioventricular septal defect (CAVSD), involving the double patch method, the classic single patch method, and the modified single patch method [1].

It is still debatable whether a double patch is better than a single patch, however both the modified single patch method (MP) and the double patch method (DP) have positive postoperative and long-term results [2].

The modified single patch method and the double patch method had been compared by numerous centers, but it remained unclear which one was clearly superior to the other [3].

As a result, our goal was to contrast the postoperative outcomes of the modified single patch approach and the double patch technique for correction CAVSD.

Corresponding author: Mohamed Elsayed Omar mohamed.omar@fmed.bu.edu.eg

Patients and Methods

This research, which involved 100 patients with CAVSD, was an interventional, randomised investigation. Between January 2020 and January 2023, data were retrieved.

The study population was split into two groups:
Group (A): consisted of 50 patients with CAVSD who underwent surgical correction using the modified single patch method.
Group (B): consisted of 50 patients with CAVSD who performed double patch corrective surgery.

Inclusion Criteria were both sexes, stable vital signs at admission and prior to surgical intervention, Patients who had additional ventricular septal defects (VSD) and patients who performed prior Pulmonary artery banding (PAB) were involved.

Exclusion Criteria were patients with renal failure or any organ failure prior to surgery, Patients planned for redo operation and Patients who had associated fallot tetralogy, Eisinminger syndrome and Epstein anomaly were excluded.

Surgical techniques: The median sternotomy incision was used as the standard incision in all patients under general anesthesia. If necessary, the thymus gland is dissected and one or both lobes are removed to allow for better exposure. In order to prepare a patch for repair, the pericardium was opened to the right of the midline and is still unharvested, general assessment of the cardiac anatomy, including ventricular balance, Direct cannulation of the aorta, both cavae, and insertion of a vent into the right superior pulmonary vein, cardiopulmonary bypass was started, Patent ductus arteriosus (PDA) was routinely detected and ligated in all cases before bypass.

Two techniques were used for repair as follows:
1) Modified single-patch technique

Cold saline testing was done to identify the cleft's edges and the place where the left superior and inferior bridging leaflets converge. For the VSD repair, the right ventricular surface's ventricular septum had mattress sutures placed across it. These VSD correction stitches were then tied after being passed through the pericardial patch lower rim that had been cut to atrial septal defect (ASD) size, dividing the atrioventricular (AV) valve leaflets into tricuspid and mitral components. The new anterior mitral leaflet's cleft was then sealed with numerous simple sutures. Saline was then injected into the left ventricle to test the mitral valve.

2) Double patch technique

Measurements of the VSD were taken, the interventricular patch, whether pericardial or synthetic, was cut, and leaflet stay and marking sutures were applied. The patch was sewn to the crest of the ventricular septum on the right side using a continuous 5-0 or 6-0 polypropylene suture.The marking suture on the anterior edges of the coapting surfaces of the left superior leaflet (LSL)-left inferior leaflet (LIL)complex was passed through the appropriate point of the edge of the interventricular patch.

For both techniques: The interatrial patch, was then cut to the proper size and shape, and its initial insertion was completed.

The anterior edges of the LSL and LIL were enclosed between the patch above and the patch below using interrupted mattress sutures made of 5-0 or 6-0 polypropylene.

The line of attachment between the leaflet patch and atrial septal patch was then sewn. During this process, extreme care was taken to ensure that the alignment of the leaflets of the left AV valve was perfect and distortion-free.

After a successful repair, we move on to closing the right atriotomy, stopping cardiopulmonary bypass (CPB), starting a protamine infusion, decannulating the patient, achieving hemostasis, and closing the sternum.

Study data

Demographic information, clinical information, and specific echocardiographic parameters were all provided prior to surgery. The kind of procedure, cross-clamp and bypass times, and surgical problems were all included in the intra-operative data. Early postoperative information comprised clinical, echocardiographic data, intensive care unit (ICU), hospital stay and postoperative complications.

Statistical analysis

Using SPSS version 28, data management and statistical analysis were conducted (IBM, Armonk, New York, United States). Using the Kolmogorov-Smirnov test, the Shapiro-Wilk test, and direct data visualization techniques, quantitative data were evaluated for normalcy. The means and standard deviations of quantitative data were used to summarize them. Numbers and percentages were used to represent a categorical set of data. Using the independent t-test, quantitative data were compared between the study groups or according to complications within each group. The Fisher's exact test or the Chi-square test was used to compare categorical data. Each and every statistical test has two sides. P values under 0.05 were regarded as significant.

Results

General characteristics

Group B demonstrated significantly higher age (11 ±2 vs. 9 ±2 years, P = 0.012) and weight (9.1 ±2.2 vs. 7.9 ±1.8 kg, P = 0.004) than group B. No significant difference was observed regarding sex (P = 0.295) (Table 1).

No significant differences were observed regarding Rastelli classification (P = 0.509), VSD diameter (P = 0.065), ASD diameter (P = 0.803), LV regurge severity (P = 0.582), Down syndrome (P = 0.517), and increased cardiothoracic (CT) ratio (P = 0.349) (Table 2).

Table 1: General characteristics of the studied groups. Data are presented as mean ±SD or number (percentage)

	Group A (n = 50)	Group B (n = 50)	P-value
Age (years)	9 ±2	11 ±2	0.012
Sex			
Males	30 (60)	35 (70)	0.295
Females	20 (40)	15 (30)	
Weight (kg)	7.9 ±1.8	9.1 ±2.2	0.004

Intraoperative findings

Group B showed significantly higher cardiopulmonary bypass (CPB) time (110 ±12 vs. 88 ±8 min, P < 0.001) and aortic cross clamp (ACC) time (81 ±7 vs. 61 ±5 min, P < 0.001) than group A (Table 3).

Postoperative findings

Group B revealed significantly higher intensive care unit (ICU) stay (10 ±1 vs. 9 ±1 day, P < 0.001), hospital stay (17 ±2 vs. 15 ±1 day, P < 0.001), and drainage amount (310 ±98 vs. 194 ±80, P < 0.001). In contrast, no significant difference was observed regarding intubation time (P = 0.811) (Table 4).

Table 2: Baseline clinical characteristics of the studied groups. Data are presented as mean ±SD or number (percentage)

	Group A (n = 50)	Group B (n = 50)	P-value
Rastelli classification			
A	37 (74)	34 (68)	0.509
B	2 (4)	1 (2)	
C	11 (22)	15(30)	
VSD diameter (mm)	8.6 ±1.6	9.2 ±1.7	0.065
ASD diameter (mm)	15.2 ±2.1	15.3 ±1.9	0.803
LV regurge			
Mild	4 (8)	3 (6)	0.582
Moderate	35 (70)	31 (62)	
Severe	11 (22)	16 (32)	
Down syndrome	33 (66)	36 (72)	0.517
Increase CT ratio	36(72)	40 (80)	0.349

ASD: atrial septal defect; CT: cardiothoracic; LV: left ventricular; VSD: ventricular septal defect

Table 3: Intraoperative characteristics of the studied groups. Data are presented as mean SD or number (percentage)

	Group A (n = 50)	Group B (n = 50)	P-value
CPB time (minutes)	88 ±8	110 ±12	<0.001
ACC time (minutes)	61 ±5	81 ±7	<0.001

CPB: Cardiopulmonary bypass; ACC: Aorta cross-clamp

Complications

No substantial changes were observed among groups of the study concerning all complications, including tamponade (P = 0.436), pacemaker (P = 1.0), pneumonia (P = 1.0), chylothorax (P = 1.0), re-intubation (P = 1.0), LV regurge (P = 1.0), and mortality (P = 1.0). (Table 5).

Discussion

At this research, group A age ranged from 7 months to 11 months with mean age (9±2) months while in group B it varied from 9 months to 13 months with mean age (11 ±2) months , As regarding weight, It varied from (6) kg to (11) kg with mean weight (7.9 ±1.8) kg in group A while in group B it varied from (7) kg to (13) kg with mean weight (9.1 ±2.2) kg, compared to Yildirim and colleagues, who published their results in 2015 , Based on age at repair, children were split into 2 groups: Group A, mean age (7.7 ± 8.6 months), mean weight (6.7 ± 3 kg) and Group B mean age (9.9±12.5months), mean weight (7.2 ± 3.8 kg) [4]. The same also for pan et al, who published their results in 2014 with mean age (5.6 ± 3.4) months and average weight (5.9 ± 2.2) kg in group A while in group B mean age (6.0 ± 3.1) with mean weight (6.2 ± 1.9) kg [5].

Age and weight difference between different study groups may be related to improved circumstances and more experience in younger infants and neonates and postoperative care, encouraging surgeons for operating on lower body weights.

In Egypt, complete atrioventricular septal defect (CAVSD) repair is frequently carried out between the ages of 6 and 12 months with encouraging outcomes. But some patients need surgery sooner because they experienced heart failure or failed to thrive, moreover, some surgeons still like to complete the pulmonary artery banding first before performing the whole surgical repair.

Regarding Rastelli classification, group A consisted of 37 patients (74%) of type A, 2 patients (4%) of type B, and 11 patients (22%) of type C, whereas group B consisted of 34 patients. 68% of type A and 1 patient of type B (2%) and 15 patients (30%) of type C. No substantial changes were seen concerning Rastelli classification (P = 0.509).

In comparison to Ugaki and colleagues who published their results in 2014 among 29 patients in group A 18 patients were of Rastelli type A .1 patient of type B and 10 patients of type C while in group B among 22 patients, 15 patients were of Rastelli type A .1 patient of type B and 6 patients of type C [6].

No substantial changes were seen concerning VSD diameter (P = 0.065) and increased cardiothoracic ratio (P = 0.349). These results are similar to Al Senaidi et al, Pan et al, Ugaki et al, who published their results in 2014 also similar to Shi et al, Yildirim et al, who puplished their results in 2015 who reported that there was no discernible variation between the two groups in the sizes of the VSD [4-8]. In individuals who underwent the MP method, a smaller VSD size was

Table 4: Postoperative characteristics of the studied groups. Data are presented as mean SD or number (percentage)

	Group A (n = 50)	Group B (n = 50)	P-value
ICU stay (days)	9 ±1	10 ±1	<0.001
Hospital stay (days)	15 ±1	17 ±2	<0.001
Drainage amount (ml)	194 ±80	310 ±98	<0.001
Intubation time (hours)	55 ±11	55 ±10	0.811

ICU: intensive care unit

Table 5: Complications in the studied groups. Data are presented as number (percentage)

	Group A (n = 50)	Group B (n = 50)	P-value
Tamponade	2 (4)	5 (10)	0.436
Pacemaker need	2 (4)	1 (2)	1.0
Pneumonia	7 (14)	8 (16)	1.0
Chylothorax	1 (2)	1 (2)	1.0
Reintubation	4 (8)	5 (10)	1.0
LV regurge	2 (4)	3 (6)	1.0
Mortality	3 (6)	2 (4)	1.0

LV regurge: left ventricular regurge

noted according to Backer et al who published their results in 2007 [9].

As regarding ASD diameter, it varied from 12 mm to 18 mm with mean ASD diameter 15.2 ±2.1 mm in group A while in group B it varied from 13 mm to 18 mm with mean ASD diameter 15.3 ±1.9 mm.

As regarding left ventricular (LV) regurge severity, 4 individuals (8%) with mild regurge were present, 35 patients (70%) with moderate regurge and 11patients (22%) with sever regurge in group A while in group B there were 3 patients (6%) with mild regurge,31 patients (62%) with moderate regurge and 16 patients (32%) with sever regurge. There were 33 patients (66%) diagnosed as Down syndrome in group A compared to 36 patients (72%) in group B. Comparing to results yildirm et al, who published their results in 2015 there were (53.1%) of patients had Down syndrome in group A and (47.1%) in group B, According to LV regurge severity were 15.6% of cases with mild regurge, (43.8%) with moderate regurge and (34.4%) with sever regurge in group A while in group B there were (11.8%)) with mild regurge, (35.3%) with moderate regurge and (52.9%) with sever regurge [4].

Group B showed significantly higher CPB time (110 ±12 vs. 88 ±8 min, P < 0.001) and ACC time (81 ±7 vs. 61 ±5 min, P < 0.001) than group A. Ugaki and colleagues reported a study on 51 patients between 2005 and 2011 with complete AV septal defect to compare the outcomes of modified single-patch and two-patch technique in repairing them. Single patch was used in 29 while the two-patch was used in 22 patients [6].

It was discovered that the modified single-patch repair required significantly less time for cross clamping and bypassing. In 2014, Ugaki et al. and Pan et al. presented their single-center outcomes for the repair of CAVSD in 98 patients using the MP and DP approaches. ACC times and CPB times were noticeably lower in the MP Group [5, 6]. Yildirim et al. additionally observed reduced CPB times and ACC times with the MP method [4].

Group B revealed significantly higher ICU stay (10 ±1 vs. 9 ±1 day, P < 0.001), hospital stay (17 ±2 vs. 15 ±1 day, P < 0.001), and drainage amount (250 ±95vs. 194 ±80, P < 0.001). In contrast, no substantial changes were seen regarding intubation time (P = 0.811). Similar results are reported by Dongxu Li et al who published their results in 2017 and Yildirim et al., 2015 [4, 10].

Cardiac tamponade was one of the postoperative complications that affected 2 patients (4%) in group A and 5 patients (10%) in group B, Reintubation was needed in 4 patients (8%) in group A and 5 patients (10%) in group B, chylothorax was noted in 1 patient (2%) in group A and also 1 patient (2%) in group B, temporary pacemaker was needed in 2 patients (4%) in group A and 1 patient (2%) in group B.

Chest infections were diagnosed in 7 patients (14%) in group A, and 8 patients (16%) in group B. Wound infections were noted in 12 patients (24%) in group A and 14 patients (28%) in group B.

As regarding LV regurge, 2 patients (4%) developed significant severe regurge post operative in group A compared to 3 patients (6%) in group B.

Four patients (8%) died in group A, two patients suffered from chest infection with prolonged ventilation progressing to acute respiratory distress syndrome, one case died because of renal failure and one case suffers from low cardiac output with impaired contractility with increased inotropic support, compared to 3 patients (6%) died in group B, one case died after exploration for tamponade, two case died after prolonged ventilation following sever chest infection.

There were no substantial changes among groups of the study regarding all complications, including tamponade, pacemaker, pneumonia, chylothorax, re-intubation, LV regurge and mortality.

Backer and colleagues compared the modiefied single-patch approach to the two-patch approach which performed on 55 infants with CAVSD between January 2000 and June 2006. A modified single-patch technique was used on 26 patients, while a two-patch technique was used on 29 patients. One death (liver failure on postoperative day 130) reported in the modified single-patch group while in the group with the two patches, nobody passed away. Cross-clamp and cardiopulmonary bypass times were faster in the modified single-patch group.

According to serial echocardiography, the degree of postoperative left or right AV valve insufficiency was the same. One patient (4%) in the modified single-patch group required a second procedure for mitral incompetence as opposed to three patients in the two-patch group. There were no patients in the modified single-patch group who needed another surgery to treat a third-degree atrioventricular block or a residual VSD. Due to a third-degree AV block, one patient in the two-patch group needed a pacemaker, while another needed reoperation for persistent VSD. None of the patients in either group needed a second procedure for left ventricular outflow tract blockage [11].

According to Deraz et al., there have been no discernible differences in the rates of mortality, reoperation, or postoperative complete heart block between the two techniques, and both have positive early and late results [1].

Seok Jeong and colleagues conducted a report on 61 patients who underwent biventricular correction of CAVSD at the Sejong General Hospital between January 1997 and December 2006. The standard one/two-patch technique was used to 43 patients, whereas the modified single-patch technique was used to 18 patients. They concluded that Compared to the double patch approach, the modified single-patch technique can be employed with less mortality and morbidity [12].

According to Loomba et al. 2019, Treatment of CAVSD using the modified single-patch repair is effective. In comparison to two-patch repair, this technique can be performed efficiently with less CPB and cross clamp time and without an increase in adverse postoperative outcomes such pacemaker placement, extended hospital stays, reoperation, or mortality. The length of the ICU stay, total length of hospital stay, and duration of mechanical ventilation were comparable between the two methods [13].

Study limitations

Cases were operated by different surgeons and results were limited to the short-term period.

Conclusion

When compared to two-patch repair, the modified single-patch repair can be carried out successfully with less CPB, ACC, ICU, and hospital stay. However, mortality and post-operative complications were similar between the two techniques.

Conflict of interest: Authors declare no conflict of interest.

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