ORIGINAL ARTICLE OPEN ACCESS

CLINICAL OUTCOMES OF MODIFIED DEL NIDO CARDIOPLEGIA IN ADULT AND PEDIATRIC CARDIAC SURGERY A MULTI CENTER STUDY.

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ABSTRACT

Objective: This multicenter cross-sectional study evaluates the clinical outcomes of modified Del Nido cardioplegia in adult and pediatric patients undergoing cardiac surgery.

Study design: A cross-sectional study

Place and Duration of the Study: Allied Health Sciences, Superior University, Lahore, the duration of the study was six months form jan 2024 to june 2024

Methodology: A total of 194 patients (60.8% adults, 39.2% pediatrics) were included, analyzing demographic data, intraoperative parameters, and postoperative outcomes. Key metrics included CPB time, cross-clamp time, cardioplegia volume, left ventricular ejection fraction (LVEF) at discharge, and hospital stay.

Result: This study analyzed 194 patients (60.8% adults and 39.2% pediatrics) undergoing cardiac surgery, with adults having a mean age of 43.19 ± 17.65 years and pediatric patients averaging 6.51 ± 3.49 years (P = 0.001). Males predominated in both groups (41.8% adults, 22.2% pediatrics; P = 0.06), and adults exhibited higher weights (62.9 ± 15.9 kg vs. 16.6 ± 8.3 kg, P = 0.001) and body surface areas (1.63 ± 0.4 m^2 vs. 0.67 ± 0.2 m^2, P = 0.001). NYHA class I was significantly more common in pediatrics (92.1% vs. 73.7%, P = 0.005), while smoking history was exclusive to adults (18.4%, P = 0.001). Intraoperatively, adults had longer CPB times (103.2 ± 44.4 min vs. 73.53 ± 41.1 min, P = 0.001) and aortic cross-clamp times (67.5 ± 32.6 min vs. 52.2 ± 32.6 min, P = 0.002), with higher cardioplegia volume and duration (972.4 ± 427.5 ml vs. 393.7 ± 250.9 ml, P = 0.001; 62.9 ± 30.1 min vs. 48.5 ± 31.2 min, P = 0.001). Postoperatively, pediatric patients had higher LVEF at discharge (62.5 ± 4.7% vs. 55.9 ± 9.1%, P = 0.001), while hospital stays were similar (5.7 ± 1.6 days vs. 6.2 ± 2.1 days, P = 0.08). Regression analysis identified CPB time, cardioplegia volume, and cross-clamp time as significant predictors of LVEF at discharge (P < 0.001), emphasizing the critical role of intraoperative management, particularly minimizing CPB time, in optimizing postoperative outcomes.

Conclusion: This study highlights significant differences in intraoperative and postoperative outcomes between adult and pediatric cardiac surgery patients, with CPB time, cross-clamp time, and cardioplegia volume influencing LVEF at discharge. Optimizing intraoperative management is crucial to improving cardiac function and recovery in both groups.

Keyword: Modified del nido cardioplegia, Adult, pediatric, cardiac surgery, bypass

How To Cite This Article: **Rehman NU,Naseem C, Ullah A, Ayub A, Naib A, Tayyeb M**. Clinical outcomes of modified Del Nido cardioplegia in adult and pediatric cardiac surgery: A multicenter study: Original article. **J Bacha Khan Med Coll**. 2024;5(2):**122-133.**

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Received: 18th September, 2024
Revised: 19th October, 2024
Accepted: 28th November, 2024
Published: 1st January, 2025
DOI: https://doi.org/10.69830/jbkmc.v5i02.170

INTRODUCTION

Modern cardiac surgery is dependent on myocardial protection, which includes many methods to preserve heart function. Preoperative preparation, anesthesia, CPB treatment, topical cooling, surgery, and hemodynamic stability are included. Myocardial protection and cardioplegia are different yet often used interchangeably(1). Electromechanical cardiac arrest during surgery, called cardioplegia, protects the myocardium. To limit myocardial injury and optimize results, the surgeon, anesthesiologist, and perfusionist must work together. Del Nido cardioplegia is becoming more popular due to its effectiveness and unique formulation(2).Del Nido cardioplegia, created for juvenile cardiac surgery, has a 4:1 crystalloid-to-blood ratio and is single-dose. Pediatric patients benefit from reduced cross-clamp time and uninterrupted surgical workflows. It has been shown to diminish myocardial damage markers like Troponin T and Troponin I and improve postoperative outcomes including shorter ICU stays and mechanical ventilation(3, 4). O'Brien et al. found that Del Nido cardioplegia protects the heart better than modified Buckberg in children. Despite its benefits, randomized trials of St. Thomas cardioplegia reveal that frequent dosage intervals in traditional solutions may reduce myocardial rewarming and metabolic stress, providing an anti-inflammatory benefit(5).In adult cardiac surgery for valve replacement and CABG, del Nido cardioplegia is utilized instead of blood. Adult studies demonstrate Del Nido lowers cardiopulmonary bypass, cross-clamp, and postoperative atrial fibrillation while sparing the myocardium. Sorabella et al. found that Del Nido had similar cross-clamp, bypass, and complication rates to blood cardioplegia in adult reoperative aortic valve surgeries(6, 7). Loberman and Ziazadeh found that Del Nido cardioplegia works in minimally invasive and complex adult operations. It may also predict surgical recovery by lowering intraoperative glucose and insulin consumption(8, 9).Further research compares Del Nido cardioplegia to other treatments in specialized settings. In CABG procedures, Guajardo Salinas et al. showed that Del Nido could perform like blood cardioplegia. Ziazadeh et al. found that minimally invasive aortic valve procedures lowered aortic cross-clamp times and protected the myocardium(10, 11). Del Nido required fewer doses and defibrillations than Buckberg cardioplegia, although postoperative consequences were similar, according to Ramanathan et al. Despite these promising results, Valooran et al. and others recommend prospective, randomized trials to standardize techniques and determine Del Nido cardioplegia's best uses in adults. De Nido cardioplegia is a versatile and successful myocardial protection strategy for children and adult cardiac operations. Its single-dose formulation, shortened cross-clamp periods, and improved postoperative results make it a good blood cardioplegia alternative(12, 13). Despite its efficacy in numerous studies, more study is needed to optimize its use and address concerns about its performance in specific surgical circumstances. Del Nido cardioplegia, supported by strong data and defined practices, will improve patient care and outcomes as cardiac surgery progresses.To examine the clinical efficacy of modified Del Nido cardioplegia in adult and pediatric cardiac surgery through a multicentered cross-sectional study.

MATERIALS AND METHODS

This Multi Center descriptive cross- sectional study was conducted to evaluate the clinical outcomes of modified Del Nido cardioplegia in adult and pediatric cardiac surgeries. Ethical approval obtained form superior University **IRB/FAHS/ALLIED-S/10/24/MS/RS-** 3516. The study was carried out over a period of four months at the Departments of Cardiac Surgery at Lady Reading Hospital (LRH) and Pak Medical Center and Hospital in Peshawar. A total of 194 patients were included in the study, with the sample size determined based on a 20.4% proportion of postoperative inotropic support as a clinical outcome, a 95% confidence level, and a power of 1.5%. Consecutive (non-probability) sampling was employed to select participants who met the specified inclusion criteria, which included pediatric patients with congenital heart diseases, stable adults undergoing isolated or combined CABG or valve surgeries, and individuals capable of providing informed consent.Patients with previous cardiac surgeries, preoperative inotropic or mechanical circulatory support,implanted pacemakers, or specific pulmonary conditions were excluded to minimize confounders and bias. Ethical considerations were strictly followed, including obtaining informed consent from all adult participants or the guardians of pediatric patients. Comprehensive preoperative assessments, including clinical histories, anesthetic evaluations, and review of medical records, were conducted to ensure suitability for the procedure. Median sternotomy with open-heart cardiac surgery was performed, and antegrade Del Nido cardioplegia was administered via the aortic root at 8°C to 12°C. Cardioplegia was repeated if cardiac activity resumed before 90 minutes.The primary outcomes assessed included the use of intra-aortic balloon pumps (IABP), extracorporeal membrane oxygenation (ECMO), and mortality. Secondary outcomes included postoperative left ventricular ejection fraction (LVEF), inotrope index, estimated glomerular filtration rate (eGFR), creatine kinase-MB (CK-MB) levels, and lactate monitoring at baseline, ICU admission, and 24- and 48-hour intervals post-admission. Additional metrics such as ICU and hospital stay duration, ventilator time, blood transfusions, dialysis requirements, stroke incidence, reoperations, and surgical site infections were also analyzed. Lactate levels were measured every three hours using arterial blood gas analysis to monitor metabolic status and guide clinical decisions.The study's data gathering was thorough, covering patient demographics, surgical procedures, and immediate results. The following patient demographic and clinical data were painstakingly recorded: sex, age, underlying disease, history of prior cardiac surgery, and EuroSCORE II (European System for Cardiac Operative Risk Evaluation). We also took note of the patient's history of echocardiographic abnormalities before surgery, the type of ischemic heart disease they were diagnosed with, and whether they were using an intra-aortic balloon pump or extracorporeal membrane oxygenation.Cardiopulmonary bypass (CPB) support and aortic cross-clamping (ACC) duration, intraoperative transfusions, estimated blood loss, total operating time, cardioplegic solution type and quantity, and the necessity of defibrillation or pacing during CPB weaning were all part of the intraoperative data set. Specific information regarding the grafts utilized for CABG was also gathered, such as the quantity of distal anastomoses and the utilization of Y-composite grafts.Readmission rates, 30-day mortality, 30-day ventilator-dependent duration, 30-day surgical complications, 1-year major adverse cardiac and cerebrovascular events, and the need for postoperative extracorporeal membrane oxygenation or intra-aortic balloon pump support were among the early postoperative outcomes. To further evaluate myocardial protection, we also looked at postoperative echocardiographic results and peak cardiac enzyme levels (CK-MB and troponin I).Criteria for patient selection in traditional coronary artery bypass grafting (CABG) and myocardial protection strategies Patients at our center are chosen for conventional CABG based on a preoperative low left ventricular ejection fraction (LVEF) and/or suboptimal distal coronary bed condition. Consequently, over 20% of patients with ischemic heart disease necessitating CABG get traditional CABG.All patients received traditional coronary artery bypass grafting under general anesthesia. The procedure commenced with a standard median sternotomy, succeeded by central cannulation, executed subsequent to the harvesting of the grafts. Patients in the blood cardioplegia group received an initial administration of 1,000 mL of blood cardioplegia with a 4:1 blood dilution, administered antegrade at 4 °C. 200 mL doses were administered retrogradely every 15–20 minutes as needed. Upon completion of the final anastomosis, 500 mL of warm blood was administered in a retrograde manner. Conversely, individuals in the del Nido cardioplegia cohort were administered a singular antegrade dosage of 1,000 mL del Nido at a 1:4 blood dilution and at a temperature of 4 °C (1). If the estimated ACC duration exceeded 90 minutes, a further 500 mL dose was delivered retrogradely 60 minutes after the original dose. Both groups had mild hypothermia (32–34 °C) and topical cooling techniques during the surgery.

Comparison of blood cardioplegia with Del Nido cardioplegia This study classified patients into two cohorts according to the type of cardioplegic solution utilized during surgery. The blood cardioplegia cohort comprised patients who received surgery utilizing blood cardioplegia from August 2019 to November 2021. The del Nido cardioplegia group comprised patients who received del Nido cardioplegia from December 2021 to March 2023. This divide was predicated on the transition between the two cardioplegic methodologies. A thorough comparative analysis was conducted between the two groups. This investigation concentrated on assessing preoperative patient attributes, intraoperative factors, and early postoperative results.

Data were analyzed using SPSS version 26.0.

Quantitative variables such as age and BMI were expressed as mean ± SD, while categorical variables were summarized as frequencies and percentages. The association between categorical variables was evaluated using the chi-square test, with a p-value <0.05 considered significant. Linear regression analysis was performed to assess correlations between quantitative variables. The findings were presented through detailed tables and graphs, offering a comprehensive insight into the clinical outcomes of modified Del Nido cardioplegia in cardiac surgery patients. This study provided valuable data for optimizing cardioplegia strategies and improving patient outcomes in both pediatric and adult populations.

RESULTS

The demographic analysis highlights significant differences between adult and pediatric patients in the study. Adults accounted for 60.8% (mean age 43.19 ± 17.65 years), while pediatrics made up 39.2% (mean age 6.51 ± 3.49 years), with a highly significant age difference (p=0.001). Male patients were more common in both groups (41.8% in adults and 22.2% in pediatrics), though the gender distribution difference was not statistically significant (p=0.06). Adults had a higher mean weight (62.9 ± 15.9 kg) and body surface area (1.63 ± 0.4 m²) compared to children (16.6 ± 8.3 kg and 0.67 ± 0.2 m², respectively), both with significant p-values (p=0.001). Most patients resided in rural areas, but residence showed no statistical significance (p=0.24). Adults were more frequently classified as NYHA Class II/III (26.3%) than children (7.9%), with a significant association (p=0.005). Chronic kidney disease was predominantly Stage 1-2 in both groups, with no significant difference (p=0.11). Smoking was exclusively reported among adults (18.4%), marking a significant distinction (p=0.001). Ejection fraction was lower in adults (53.3 ± 7.6%) compared to children (58.3 ± 8.6%), also statistically significant (p=0.001). Other factors, such as prior cardiac surgery, preoperative ventilator support, and inotropes, were rare and comparable between groups (p>0.05).

Table 1: Baseline Characteristics and Preoperative Clinical Factors of Adults and Pediatric Patients Undergoing Cardiac Surgery with Modified Del Nido Cardioplegia

Demographics	Adults N= 118 (60.8%)	Paediatrics N =76 (39.2%)	*P*-value
Age in years, Mean (± SD)	43.s19 (17.65)	6.51(3.49)	0.001
Gender of the patient			
Male	81(41.8%)	43 (22.2%)	0.06
Female	37 (19.1%)	33 (17.1%)	
Height in cm, Mean (± SD)	163.7 (7.7)	162.8 (14.4)	0.59
Weight in kg, Mean (± SD)	62.9 (15.9)	16.6 (8.3)	0.001
Body Surface Area in m², Mean (± SD)	1.63 (0.4)	0.67 (0.2)	0.001
Residence			
Urban	57(29.4%)	32(16.5%)	0.24
Rural	61(31.4%)	44(22.7%)	
New York Heart Association (NYHA) Classification			
Class I	87 (73.7%)	70 (92.1%)	0.005
Class II and Class III	31 (26.3%)	06 (7.9%)	
Chronic Kidney Disease			
Stage 1-2	111(94.1%)	75 (98.7%)	0.11
Stage 3-4	07 (5.9%)	01 (1.3%)	
Previous Cardiac Surgery			
Yes	01(0.8%)	01 (1.3%)	0.63
No	117(99.2%))	75 (98.7%)	
Preoperative Ventilator Support			
Yes	01 (0.8%)	01 (1.3%)	0.63
No	117 (99.2%))	75 (98.7%))	

Preoperative Inotropes			
Yes	01 (0.8%)	01 (1.3%)	0.63
No	117 (99.2%))	75 (98.7%))	
Ejection Fraction (%), Mean (± SD)	53.3 (7.6%))	58.3(8.6%))	0.001
Smoking History			
Yes	14 (18.4)	0 (0%)	0.001
No	104 (81.6)	76 (100%)	

The intraoperative and postoperative variables highlight notable differences between adult and pediatric patients. Adults had significantly longer CPB times (103.2 ± 44.4 min vs. 73.53 ± 41.1 min, p=0.001), aortic cross-clamp times (67.5 ± 32.6 min vs. 52.2 ± 32.6 min, p=0.002), and infused MDN cardioplegia volumes (972.4 ± 427.5 ml vs. 393.7 ± 250.9 ml, p=0.001). Cardioplegia time was also longer in adults (62.9 ± 30.1 min vs. 48.5 ± 31.2 min, p=0.001), while body temperature during CPB was slightly lower (28.4 ± 1.4°C vs. 28.9 ± 2.1°C, p=0.03). Postoperatively, left ventricular ejection fraction (LVEF) at discharge was significantly higher in pediatric patients (62.5 ± 4.7% vs. 55.9 ± 9.1%, p=0.001). Mortality and complications such as AKI, dialysis, reintubation, stroke, reoperation, surgical site infection, and new-onset atrial fibrillation were rare in both groups, with no significant differences (p>0.05). Postoperative hospital stays were slightly longer for adults but not statistically significant (6.2 ± 2.1 days vs. 5.7 ± 1.6 days, p=0.08). Adults experienced slightly more adverse events, including use of intra-aortic balloon pumps (6.8% vs. 1.3%, p=0.07), though these differences were not statistically significant.

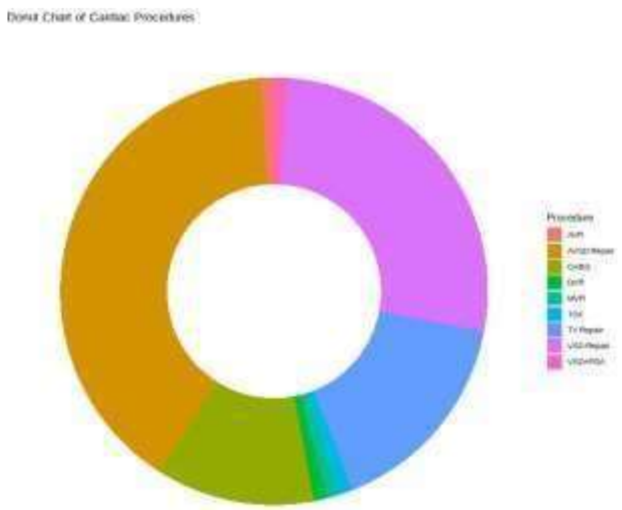
Table 2:Intraoperative and Postoperative Outcomes of Adults and Pediatric Patients Undergoing Cardiac Surgery with Modified Del Nido Cardioplegia

Variable	Adults N= 118 (60.8%)	Paediatrics N =76 (39.2%)	*P*-value
Intraoperative Variables			
CPB Time in min, Mean (± SD)	103.2 (44.4)	73.53 (41.1)	0.001
Aortic Cross-Clamp Time in min, Mean (± SD)	67.5 (32.6)	52.2 (32.6)	0.002
Infused MDN Cardioplegia Volume in ml, Mean (± SD)	972.4 (427.5)	393.7 (250.9)	0.001
MDN Cardioplegia Time in min, Mean (± SD)	62.9 (30.1)	48.5 (31.2)	0.001
Body Temperature in degree C, Mean (± SD)	28.4 (1.4)	28.9 (2.1)	0.03
Minimum Hematocrit during CPB in %, Mean (± SD)	26.1(1.9)	26.5 (2.0)	0.17
Postoperative Outcomes			
Postoperative Hospital Stay in days, Mean (± SD)	6.2(2.1)	5.7 (1.6)	0.08
LVEF at Discharge in percentage, Mean (± SD)	55.9(9.1)	62.5(4.7)	0.001
Death, n (%)			
Yes	2 (1.7%)	0(0%)	0.25
No	116 (98.3)	76(100%)	
IABP, n (%)			
Yes			
No	110 (93.2%)	75(98.7)	
AKI, n (%)			
Yes	09(7.6%)	02 (2.6%)	0.14
No	109(92.4%)	74 (97.4%)	
Dialysis, n (%)			
Yes	03 (2.5%)	01(1.3%)	0.55
No	115 (97.5%)	75(98.7%)	
Reintubation, n (%)			
Yes	03 (2.5%)	0 (0%)	0.16
No	115 (97.5%)	76 (100%)	
Stroke after Bypass, n (%)			
Yes	02 (1.7%)	0 (0%)	0.25

No	116(98.3%)	76 (100%)	
Reoperation, n (%)			
Yes	03 (%)	0	0.16
No	115(	76	
Surgical Site Infection, n (%)			
Yes	03 (2.5%)	0 (0%)	0.16
No	115 (97.5%)	76 (100%)	
New Onset of Atrial Fibrillation, n (%)			
Yes	03	01	0.55
No	115	75	

The pie chart illustrates the distribution of various cardiac surgical procedures, showing VSD Repair accounts for 27% of all procedures, followed by AVSD Repair as the most common at 40%. Other significant procedures include TV Repair at 16% and CABG at 12%. The remaining procedures - MVR, AVR, DVR, VSD+PDA, and TOF - each represent smaller percentages (1-3%) of the total corrections performed. This distribution suggests that septal defect repairs (VSD and AVSD) constitute the majority of cardiac surgeries performed, making up 67% of all procedures in the dataset **(Figure 1)**

Figure 1: Distribution of surgical procedures among patients.



The analysis shows significant associations between intraoperative variables and both postoperative hospitals stay and left ventricular ejection fraction (LVEF) at discharge. CPB time, aortic cross-clamp time, infused MDN cardioplegia volume, and cardioplegia time are all positively correlated with postoperative hospital stay, with CPB time (R=0.24, p=0.001) and infused MDN cardioplegia volume (R=0.48, p=0.001) having the strongest effects. Similarly, these variables also correlate significantly with LVEF at discharge, with infused MDN cardioplegia volume showing the highest correlation (R=0.48, p=0.001). The regression models demonstrate that these variables explain up to 23% of the variance (R^2=0.23), indicating their clinical relevance. The p-values for all associations are significant (p≤0.01), confirming the robustness of the findings.

Table 3: Correlation and Regression Analysis with Post operative hospital stay and Score as LVEF at Discharge

Independent Variable (Intraoperative Variables)	Dependent Variable	Mean (±SD)	R	R^2	F	B (95% CI)	*p*-value
CPB time in min	Post operative hospital stay in days	91.5 (45.4)	0.24	0.05	111.9	5.1 (4.48-5.56)	0.001
Aortic cross clamp time in min		61.5 (33.4)	0.18	0.03	6.4	5.4 (4.8-5.9)	0.01
Infused MDN cardioplegia volume in ml		745.7 (464.2)	0.48	0.23	59.9	4.5 (4.06-4.9)	0.001
MDN Cardioplegia Time		57.24 (31.2)	0.17	0.03	5.59	5.4 (4.8-5.9)	0.01
CPB time in min	LVEF at Discharge	91.5 (45.4)	0.23	0.05	10.5	62.3 (59.7-64.9)	0.001
Aortic cross clamp time in min		61.5 (33.4)	0.28	0.08	17.1	62.9 (60.5-65.3)	0.001
Infused MDN cardioplegia volume in ml		745.7 (464.2)	0.48	0.23	58.1	64.9 (63.1-66.9)	0.001
MDN Cardioplegia Time		57.24 (31.2)	0.26	0.07	14.2	62.5 (60.1-64.9)	0.001

CPB: Cardiopulmonary bypass, MDN: Modified Del Nido Cardioplegia

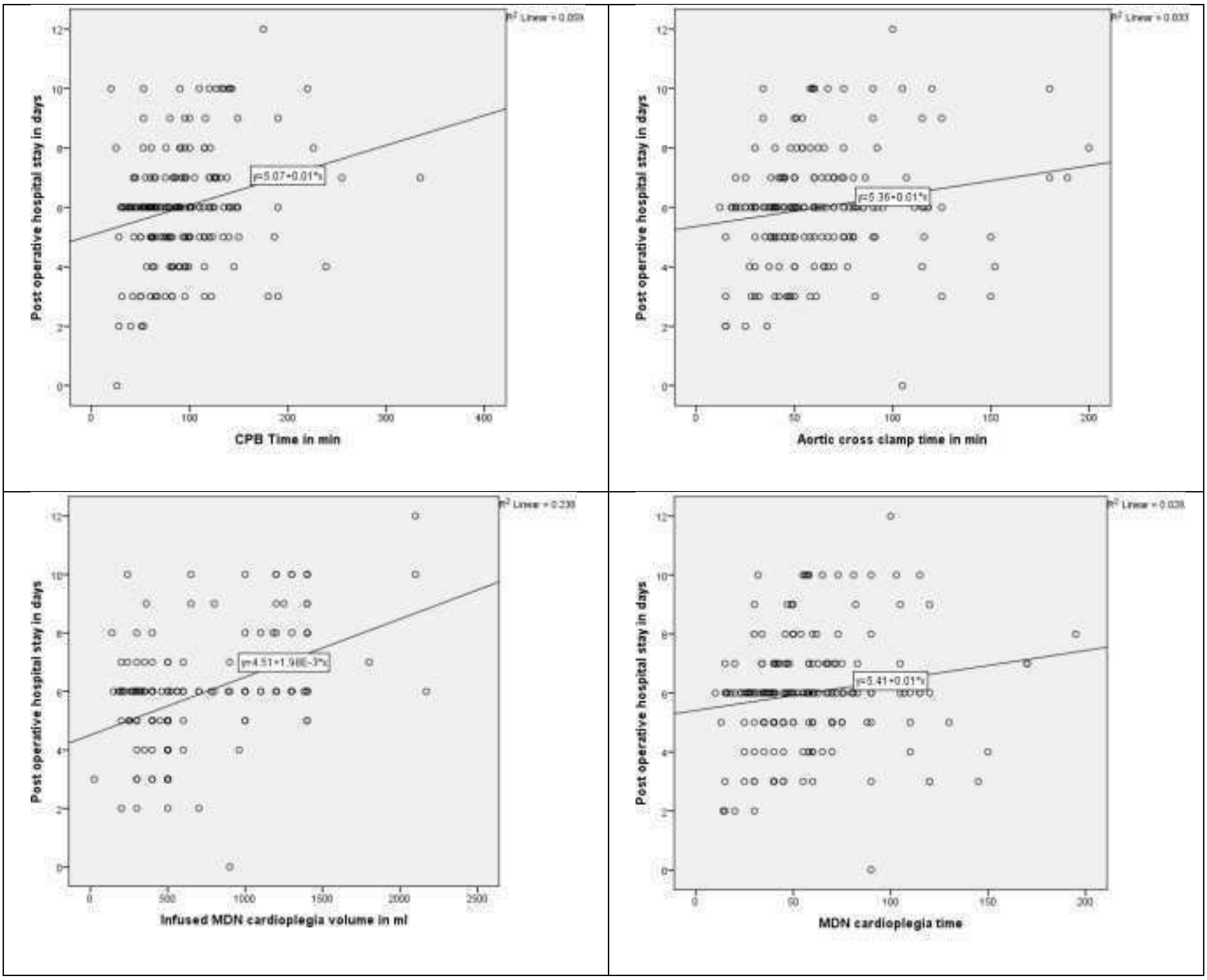


Figure 2: Scatterplots Analysis of CPB time in min, Aortic cross clamp time in min, Infused MDN cardioplegia volume in ml and MDN Cardioplegia Time with Post operative hospital stay in days

indicate a statistically significant positive correlation between CPB Time (Min) and Post Operative Hospital stays (days), with a Pearson correlation coefficient of 0.242 and a p-value of 0.001. This suggests that as the CPB Time increases, the Post Operative Hospital stays also tend to increase. Additionally, there is a statistically significant positive correlation between Aortic Cross Clamp Time (Min) and Post Operative Hospital stays (days), with a Pearson correlation coefficient of 0.181 and a p-value of 0.012. This implies that as the Aortic Cross Clamp Time increases, the Post Operative Hospital stays also tend to increase. However, the analysis did not find a statistically significant correlation between Infused MDN Cardioplegia Volume (ml) and Post Operative Hospital stays (days)
(**Figure. 2**).

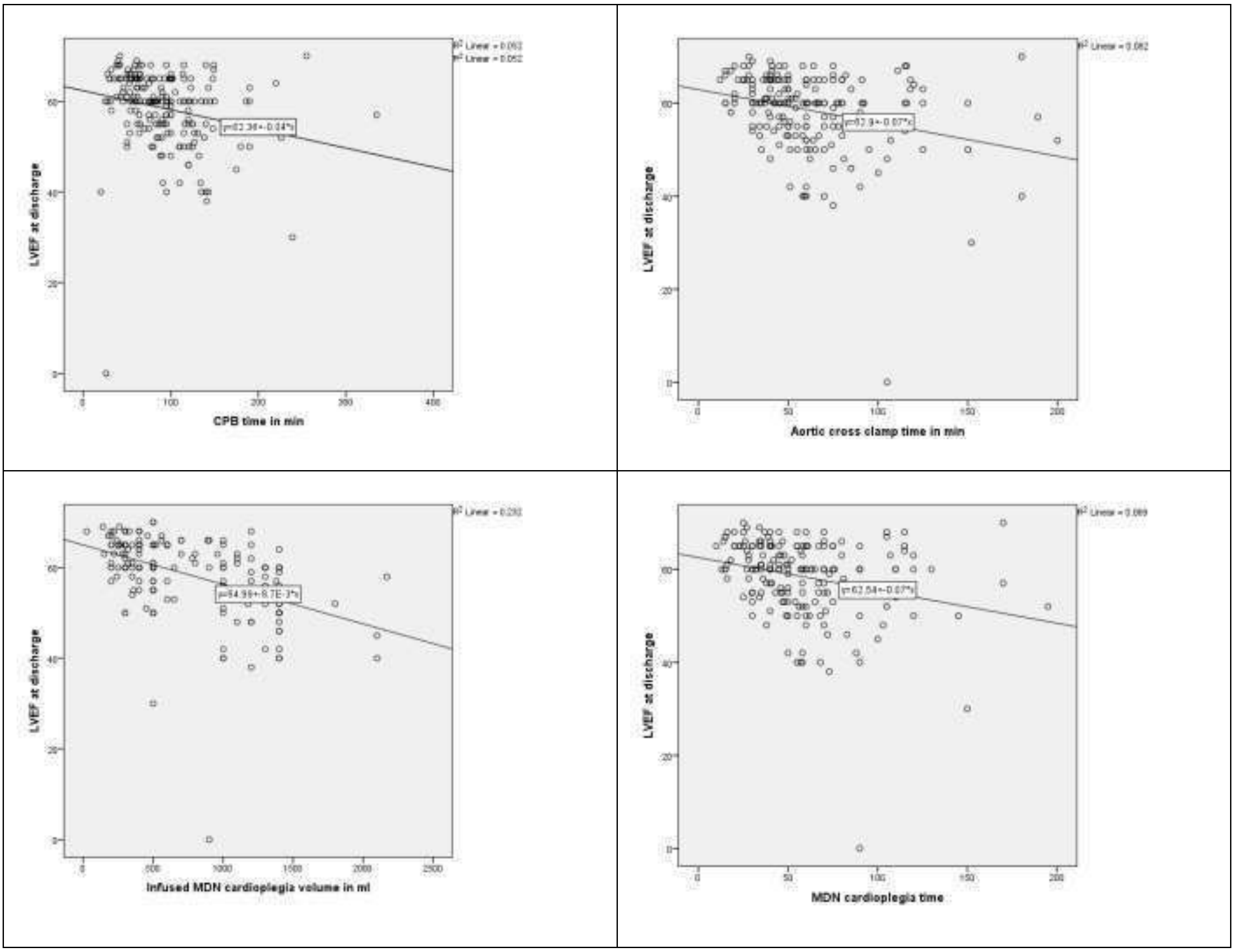


Figure 3: Scatterplots Analysis of CPB time in min, Aortic cross clamp time in min, Infused MDN cardioplegia volume in ml and MDN Cardioplegia Time with LVEF at Discharge

The regression analysis reveals a statistically significant model with CPB Time (Min) as the predictor variable ($F(1, 192) = 10.559$, $p = 0.001$), explaining 5.2% of the variance in LVEF at Discharge ($R^2 = 0.052$, Adjusted $R^2 = 0.047$). The standardized regression coefficient (Beta) for CPB Time is -0.228, while the unstandardized coefficient is -0.042 (95% CI: -0.068 to -0.017, $p = 0.001$), indicating that for each minute increase in CPB Time, LVEF at Discharge decreases by 0.042 units on average. This negative relationship demonstrates that longer CPB times are associated with lower Left Ventricular Ejection Fraction (LVEF) at discharge, supporting the hypothesized relationship between these variables and suggesting that minimizing CPB time might be beneficial for post-operative cardiac function.

(Figure 4)

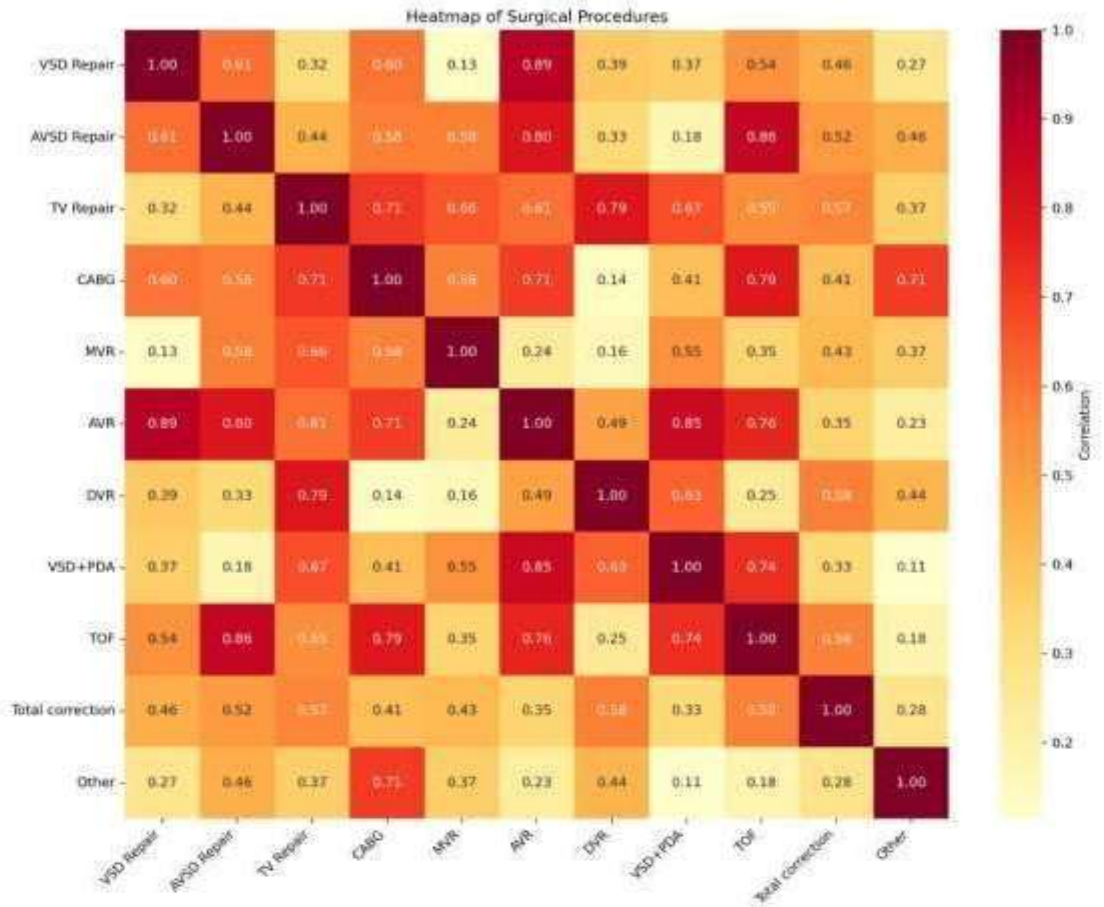


Figure 4 A correlation heatmap showing the relationships between all surgical procedures. The darker the color, the stronger the correlation between procedures. The diagonal is always 1.0 as it represents the correlation of a procedure with itself.

DISCUSSION

Our findings indicated that both groups exhibited equivalent 30-day mortality and morbidity rates. Likewise, the occurrence of new- onset atrial fibrillation and the duration of hospital and ICU admissions demonstrated no significant differences between the groups. These results align with a prior study that reported comparable early postoperative outcomes and lengths of hospital and ICU stays among propensity-matched patients undergoing isolated CABG, contrasting those who received del Nido cardioplegia with those who received blood cardioplegia(14, 15).Cardiopulmonary bypass (CPB) operations can cause early ischemia damage to the anterior cardiac chamber (ACC) and myocardial reperfusion injury after clamp removal, making myocardial protective measures crucial. Thus, blood cardioplegia is the preferred cardioplegic solution worldwide, so selection and formulation are crucial. Del Nido cardioplegia, first used in children surgery, is now used in adult cardiac procedures due to its safety and efficacy. The best cardioplegia treatment for adults is still debated(16). Del Nido cardioplegia was compared to typical blood cardioplegia in CABG patients for early postoperative clinical outcomes and myocardial protection. This study examined postoperative LVEF, changes in LVEF (comparing pre- and post-surgery levels), cardiac enzyme levels before and after surgery, and CPB weaning defibrillation frequency(17).Using magnesium and lidocaine, del Nido cardioplegia has been shown to prevent calcium- induced hypercontraction and reperfusion damage in rats. Lidocaine protects the heart by upregulating anti-apoptotic genes, lowering intracellular calcium binding, reducing inflammation, increasing oxygen transport, and promoting cell survival. A full functional and biochemical review suggests del Nido cardioplegia may protect the heart better(18, 19). The del Nido group exhibited superior troponin I changes after surgery (2.8(-0.4; 4.2) vs. 4.5(2.9; 7.4) ng/mL, p = 0.004) but similar LVEF changes. Del Nido cardioplegia patients needed defibrillation less often after CPB weaning, showing superior cardiac protection after reperfusion than blood cardioplegia patients. Due to insufficient myocardial protection, cardiopulmonary bypass weaning may need defibrillation(20, 21). Our findings suggest that del Nido cardioplegia improves CABG treatments over blood cardioplegia.The cohort given del Nido cardioplegia needed far less cardioplegic solution for antegrade and retrograde administration. The technique takes longer because greater cardioplegia requires longer intervals during coronary anastomosis. Del Nido cardioplegia requires lower maintenance dosages, reducing surgical interruptions. Del Nido cardioplegia patients needed fewer defibrillations, which may have reduced surgical interruptions. By reducing interruptions, the ACC time dropped by 13.5 minutes and the surgical time by 28 minutes. In light of rising hospital expenditures and protracted operation times, del Nido cardioplegia may optimize surgery and reduce patient costs(22, 23). Traditional multivessel coronary artery disease management uses antegrade and retrograde cardioplegic administration. However, antegrade infusion alone for cardioplegia produced identical postoperative outcomes to causing cardiac arrest with antegrade infusion and sustaining it with retrograde infusion, consistent with past research. However, previous study has evaluated cardioplegic administration strategies and postoperative outcomes, finding different results(24, 25). A study of three-vessel disease patients following CABG found that retrograde cardioplegia preserved left ventricular stroke work index better than antegrade administration. In retrospective investigations of early clinical outcomes in three-vessel disease patients, combined antegrade and retrograde cardioplegia treatment showed a stronger myocardial protective effect over antegrade-only administration. Blood and St. Thomas' Hospital solutions were used in these studies instead of the lidocaine-inclusive del Nido solution, which has cardiac protecting properties(26).Therefore, myocardial protection after CABG depends on the cardioplegic solution for multivessel disease, not the delivery method. Del Nido cardioplegia experiments may resolve this dispute. High-risk surgery patients' outcomes were validated by further research. Del Nido and blood cardioplegia had similar early post-operative mortality and morbidity in all subgroups. Troponin I raised less in del Nido cardioplegia patients, especially those with left main disease. In del Nido, this subgroup had considerably greater postoperative LVEF(27–29). Del Nido cardioplegia patients over 70 needed less defibrillation than blood cardioplegia patients. As indicated in the Methods, our strict conventional CABG selection criteria for ischemic heart disease patients caused the study's retrospective design and low participant count. This single-surgeon study is the first to examine del Nido cardioplegia in routine CABG, decreasing variability and bias(30). Future research will need large-scale prospective studies for more complete and universal insights. The subgroup analysis's tiny sample size calls into question del Nido cardioplegia's superiority in high-risk patients.

CONCLUSION

In conclusion, this study highlights significant differences in demographic, intraoperative, and postoperative variables between adult and pediatric patients undergoing cardiac surgery. Adults experienced longer CPB and aortic cross-clamp times, as well as higher cardioplegia volumes, which were identified as key predictors of postoperative LVEF. Despite these differences, pediatric patients demonstrated better postoperative cardiac function, as reflected by higher LVEF at discharge. These findings emphasize the importance of meticulous intraoperative management, particularly minimizing CPB and cross-clamp times, to optimize cardiac outcomes and improve recovery in both adult and pediatric patients.

CONFLICT OF INTEREST

No conflict of interest exists, according to all authors.

ETHICAL APPROVAL: Ethical approval obtained form superior University IRB/FAHS/ALLIED-HS/10/24/MS/RS-3516

AUTHOR CONTRIBUTIONS

NUR: Conceptualization, study design, and manuscript drafting.
CN: Data collection, methodology development, and manuscript writing.
AU: Statistical analysis, data interpretation, and editing of the manuscript.
AA: Literature review, validation, and critical revisions.
AN: Supervision and quality assurance of the study.
MT: Overall coordination, final approval, and critical revisions.
WA: Formatting, visualization, and final editing of the manuscript.

All authors have read and approved the final version of the manuscript.

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