



ORIGINAL ARTICLE

Del Nido Cardioplegia for patients of adult congenital heart disease.

Zaigham Rasool Khalid¹, Nabeel Ahmad², Abdul Razzaq Mughal³

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ABSTRACT... Objective: To assess the efficacy of del Nido cardioplegia for patients of adult congenital heart diseases undergoing cardiac surgery. **Study Design:** Descriptive Observational Case Series. **Setting:** Department of Paediatric Cardiac Surgery, Faisalabad Institute of Cardiology, Faisalabad. **Period:** October 2019 to September 2021. **Material & Methods:** All consecutive patients of age fifteen years or above who underwent open-heart surgery for congenital heart disease by using ante grade del Nido cardioplegia during the study period were included. Dedicated hospital database used to retrieve the data of patients regarding type of surgery for CHD and operative or postoperative outcome parameters. The data was entered in excel sheet and descriptive analysis done. **Results:** One hundred and twenty five patients underwent open heart bypass surgery for congenital heart disease by using del Nido cardioplegia during the study period. Majority of patients were male (n=83, 66.4%) with male to female ratio 1.97:1. Sixty eight percent patients were less than thirty years of age. Primary repair of TOF was the most frequently performed surgery (49.6%, n=62) while 28.8% had repair of VSD. Average bypass time was 136 ± 57 minutes and average cross clamp time of 103 ± 44 minutes. Total duration of mechanical ventilation was 6.6 ± 11.9 hours, ICU stay of 38 ± 34 hours and stay in the hospital of 5.2 ± 2.6 days. Cardiac tamponade was seen in 0.8% of patients (n=1) while moderate LV systolic dysfunction in 1.6 % of patients. **Conclusion:** Del Nido cardioplegia solution is as safe as conventional blood cardioplegia with short ventilation time, ICU stay and lowest postoperative complications.

Key words: Del Nido Cardioplegia, Congenital Heart Disease, Tetralogy of Fallot, Ventricular Dysfunction.

INTRODUCTION

Cardiac arrest by cardioplegia (CP) is one of the most important reproducible and safe methods of myocardial protection during cardiac surgery. Myocardial protection of the heart during cardiac surgery is of utmost importance and a real challenge for both perfusionist and cardiac surgeon. Hypothermia, potassium induced diastolic arrest of heart along with ventricular offloading are the major concept that form the basis of myocardial protection.^{1,2}

Potassium-based, cold blood Cardioplegia has become the most popular CP technique. Melrose² and Gerbode³ were the first who reported about the use of potassium citrate to induce cardiac arrest in humans. The use of del-Nido (DN) cardioplegia in pediatric as well as adult cardiac surgery is well known as it prevents the ischemia-

reperfusion injury after the cardiac surgery.⁴ The efficacy of DN cardioplegia is well observed in pediatric cardiac surgeries as it gives protection to the immature cardiomyocytes. The mechanical ventilation, intensive care unit stay and hospital stay are significantly lower in those cases where DN cardioplegia has been used.^{5,6,7} Post cross-clamp removal decrease in the rate of defibrillation in all weight categories of paediatric patients has been observed in the DN cardioplegia group.⁸ Similarly the aortic cross clamp and bypass time is shorter and left ventricular ejection fraction is better preserved in the DN group as compared to St Thomas solution group.⁹ Among propensity matched adult patients undergoing aortic or mitral surgery, who received either del Nido or Buckberg cardioplegia solution, aortic clamp, bypass, and operating room times, peak glucose level and insulin requirements were shorter in the

1. MBBS, FCPS (Surgery), FCPS (Cardiac Surgery), Assistant Professor Paediatric Cardiac Surgery, Faisalabad Institute of Cardiology, Faisalabad.

2. MBBS, FCPS (Cardiac Surgery), Senior Registrar Cardiac Surgery, Faisalabad Institute of Cardiology, Faisalabad.

3. MBBS, FCPS (Paediatrics), FCPS (Paediatric Cardiology), Associate Professor Paediatric Cardiology, Faisalabad Institute of Cardiology, Faisalabad.

Correspondence Address:

Dr. Zaigham Rasool Khalid
Department of Paediatric Cardiac Surgery
Faisalabad Institute of Cardiology, Faisalabad.
zaighamdr@yahoo.com

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DN group.¹⁰

The data about the use of del Nido cardioplegia in adult congenital heart surgery patients in our part of the world is scanty. The aim of our study is to determine the efficacy of del Nido cardioplegia for patients of adult congenital heart diseases undergoing cardiac surgery

MATERIAL & METHODS

It was a descriptive observational case series conducted in Paediatric Cardiac Surgery department of Faisalabad Institute of Cardiology (FIC) Faisalabad. All consecutive patients of any gender (male, female, transgender), age fifteen years zero days or above who underwent open-heart surgery for congenital heart disease by using ante grade del-Nido cardioplegia from October 2019 to September 2021 were enrolled in the study. Ethics committee of the Institute approved the study (13-2019/DME/FIC/FCS) and there was no conflict of interest. Those CHD patients who underwent redo surgery, emergency or emergent operations or those having complex congenital heart anomalies requiring more than one operation were excluded from the study.

In our institute, the data of all type of cardiac surgeries is routinely entered in a dedicated data base and can be retrieved when required. The base line personal data like name, father name, residential area, and contact details including residential address and hospital registration number for record purpose retrieved from the dedicated hospital database. The Clinical data including age (years), weight in kilograms (Kg), height in centimeter (cm), gender (male/ female/ transgender) and type of CHD surgery was retrieved. Operative details like cross clamp and bypass time, number of doses of del-Nido cardioplegia, need for defibrillation after opening of cross clamp and pacing requirement were recorded. Postoperative parameters including total duration of mechanical ventilation (hours), intensive care unit stay (hours), low cardiac output syndrome (LCOS) and reopening due to excessive bleeding was noted. Trans-thoracic Echocardiography in post operative period was done in all patients by dedicated paediatric

cardiologist of the institute and ventricular function as well as tamponade was noted. The hospital stay duration (days) of patients, any morbidity in the form of neurological events or renal injury and mortality were also noted. All the parameters were entered in to an investigator designed Proforma, collected data entered in excel sheet and then descriptive analysis done. The Mean and standard deviations were calculated for quantitative variables like cross clamp time, bypass time and duration of hospital stay while qualitative variables like age and outcome parameters were expressed as frequencies and percentages.

All patients underwent open heart cardiac surgery through median sternotomy after standard anesthesia and monitoring. Aorto-bicaval cannulation was done to establish Cardio Pulmonary Bypass (CPB) after adequate heparinization. Antegrade del Nido cardioplegia was given through aortic root either with cardioplegia delivery system or with pressurized bag in a dose of $20\text{ mL}\cdot\text{kg}^{-1}$ at a temperature between 8°C and 12°C . The CP was repeated after 90 minutes or if there was cardiac activity before 90 minutes. Surgical correction of congenital heart disease was carried out with appropriate hypothermic CPB support. Adequate rewarming was achieved to terminate CPB. Various operative and postoperative parameters were recorded and analyzed.

The main constituents and the relative electrolyte concentration of DN cardioplegia used during all these surgeries was as described by Valooran GJ et al.¹¹

RESULTS

One hundred and twenty five consecutive patients who underwent open-heart cardiac surgery for CHD by using del-Nido cardioplegia were enrolled according to inclusion criteria. Majority of the study subjects were male ($n=83$, 66.4%) with male to female ratio 1.97:1. Sixty eight percent of the subjects were less than thirty years of age ($n=85$). Table-I shows baseline characteristics of the patients including gender, age, weight and height.

Base Line Parameters	No. (%)
Total Study Subjects	125 (100)
Gender	
Male	83 (66.4)
Female	42(33.6)
Age (Years)	
15-30	85 (68)
31-45	25 (20)
46-61	15 (12)
Weight (kg)	
14-40	35 (28)
41-66	60 (48)
67-92	30 (24)
Height (cm)	
85-150	46 (36.8)
151-180	79 (63.2)

Table-I. Baseline characteristics

Primary repair of tetralogy of Fallot (TOF) was the most frequently performed surgery (49.6%, n=62) followed by repair of ventricular septal defect (VSD) which was performed in 28.8% of patients (n=36). The relative frequency of different type of surgeries performed is shown in the Figure-1

Type of congenital heart disease surgeries performed

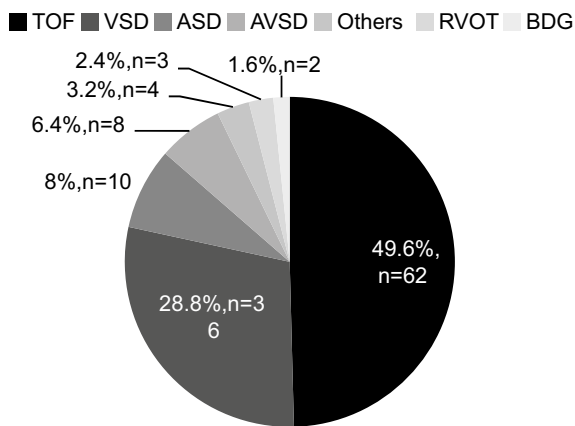


Figure-1. Type of congenital heart surgeries performed

below.

As regard operative parameters and outcome variables, average bypass time was 136 minutes ±57 minutes while average cross clamp time was 103 ± 44 minutes. The temperature was 32 °C ranging from 28 to 32 °C.

As regard postoperative parameters, total

duration of mechanical ventilation was 6.6 ±11.9 hours while stay in intensive care unit was 38 ±34 hours. Duration of inotropic support was 24.38 ± 40.03 hours and hospital stay was 5.2 ± 2.6 days while chest drainage was 729 ± 525 ml. No incidence of delayed chest closure, sepsis, renal failure, peritoneal dialysis, neurological injury or prolonged mechanical ventilation (>72h) were found. Pre and post repair echocardiography done to evaluate the adequacy of surgical repair, any change in cardiac function, and any new finding. Two patients developed moderate left ventricular systolic dysfunction after surgery. The outcome variables are described in Table-II.

Outcome Parameters	No. (%)
Need for temporary pacing	6 (4.8)
Re-opening due to bleeding	7 (5.6)
Cardiac tamponade	1 (0.8)
LV dysfunction (moderate)	2 (1.6)

Table-II. Outcome parameters

DISCUSSION

Faisalabad Institute of Cardiology (FIC) is a tertiary cardiac care institute, which provides almost all kind of diagnostic and treatment facilities including cardiac surgery to infants, children, adolescents and adults who have congenital heart disease (CHD). In this descriptive study in grown up patients undergoing elective congenital cardiac surgery we found that myocardial protection was generally safe with the use of del Nido cardioplegia in this group of patients as suggested by the postoperative outcomes including intensive care unit or hospital stay.¹⁰ The total CPB and aortic cross clamp times in our study was a little longer than the mentioned in the relevant studies.^{12,13} The interruptions due to administration of repeated cardioplegia doses are less frequent in case of del Nido cardioplegia, which is obviously more desirable.^{14,15}

With single dose of cardioplegia, there is possibility of returning of the cardiac activity, it was rare to have the cardiac/ electrical activity during the period while the aorta was cross clamped.¹¹ There were rare occasions of the return of the activity which was understandable, as in the cases of high pulmonary venous return

where there were significant aorto-pulmonary collateral in cases of grown up TOF and patients undergoing aortic valve repair where the delivery of cardioplegia through aortic root was not very efficient.

Post operative indicators like ventilation time, inotropic support, ICU stay, need for blood transfusion was also good in our study, which correlates well with the results in patients of adult cardiac surgery and in the same group in other publications.^{11,16}

Although the del Nido cardioplegia contains more crystalloids comparing with the conventional cardioplegia, but the total amount of crystalloids transfused is less due to single dose. Therefore, it does not result in dilutional anemia, and this can also be managed easily by ultrafiltration.^{17,18}

CONCLUSION

As there is no significant complication and no mortality in our study, therefore it is concluded that del Nido cardioplegia solution is safe technique for achieving cardioplegic arrest in low-risk (RACHS 1 and 2) grownup congenital cardiac surgery cases.



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REFERENCES

- Bigelow WG, Lindsay WK, Greenwood WF. **Hypothermia; its possible role in cardiac surgery: An investigation of factors governing survival in dogs at low body temperatures.** *Ann Surg.* 1950; 132(5):849-66.
- Melrose DG, Dreyer B, Bentall HH, Baker JB. **Elective cardiac arrest.** *Lancet.* 1955;269(6879):21-2. DOI: 10.1016/s0140-6736(55)93381-x
- Gerbode F, Melrose D. **The use of potassium arrest in open cardiac surgery.** *Am J Surg* 1958; 96: 221-227.
- Matte GS, del Nido PJ. **History and use of del Nido cardioplegia solution at Boston Children's Hospital.** *J Extra Corpor Technol.* 2012;44(3):98-103.
- Talwar S, Bhoje A, Sreenivas V, Makhija N, Aarav S, Choudhary SK, et al. **Comparison of del Nido and St Thomas Cardioplegia Solutions in Pediatric Patients: A Prospective Randomized Clinical Trial.** *Semin Thorac Cardiovasc Surg.* 2017; 29(3):366-74.
- Charette K, Gerrah R, Quaegebeur J, Chen J, Riley D, Mongero L, et al. **Single dose myocardial protection utilizing del Nido cardioplegia solution during congenital heart surgery procedures.** *Perfusion.* 2012; 27:98-103.
- Govindapillai A, Hua R, Rose R, Friesen CH, O'Blenes SB. **Protecting the aged heart during cardiac surgery: Use of del Nido cardioplegia provides superior functional recovery in isolated hearts.** *J Thorac Cardiovasc Surg.* 2013; 146:940-48.
- Buel ST, Striker CW, O'Brien JE. **del Nido versus St. Thomas Cardioplegia Solutions: A Single-Center Retrospective Analysis of Post Cross-Clamp Defibrillation Rates.** *J Extra Corpor Technol.* 2016; 48(2):67-70.
- Mishra P, Jadhav R, Mohapatra C, Khandekar J, Raut C, Ammannaya G, et al. **Comparison of del Nido cardioplegia and St. Thomas Hospital solution – two types of cardioplegia in adult cardiac surgery.** *Kardiocirurgia i Torakocirurgia Polska/Polish Journal of Thoracic and Cardiovascular Surgery* 2016;13(4): 295-99. doi:10.5114/kitp.2016.64867
- Mick SL, Robich MP, Houghtaling PL, Gillinov AM, Soltesz EG, Johnstar DR, et al. **Del nido versus Buckberg cardioplegia in adult isolated valve surgery.** *J Thorac Cardiovasc Surg* 2015; 149:626-36; discussion 634-6.
- Valooran GJ, Nair SK, Chandrasekharan K, Simon R, Dominic C. **del Nido cardioplegia in adult cardiac surgery—scopes and concerns.** *Perfusion.* 2016; 31:6-14.
- Loberman D, Neely RC, Fitzgerald D, et al. **Modified del Nido cardioplegia in adult cardiac surgery; safety and efficacy.** *J Cardiol Curr Res* 2014, 1: 00042.
- Kim WK, Kim HR, Kim JB, et al. **del Nido cardioplegia in adult cardiac surgery: Beyond single-valve surgery.** *Interact Cardiovasc Thorac Surg.* 2018; 27:81-7.
- Ad N, Holmes SD, Massimiano PS, et al. **The use of del Nido cardioplegia in adult cardiac surgery: A prospective randomized trial.** *J Thorac Cardiovasc Surg.* 2018; 155:1011-8.
- Govindapillai A, Hancock Friesen C, O'Blenes SB. **Protecting the aged heart during cardiac surgery: Single-dose del Nido cardioplegia is superior to multi-dose del Nido cardioplegia in isolated rat hearts.** *Perfusion.* 2016; 31:135-42.

16. Ziazadeh D, Mater R, Himelhoch B, Borgman A, Parker JL, Willekes CL, Timek TA. **Single dose Del Nido cardioplegia in minimally invasive aortic valve surgery.** Semin Thorac Cardiovasc Surg 2017 Nov 2. pii: S1043-0679(17)30287-3. doi: 10.1053/j.semtcvs.2017.10.001.
17. Ota T, Yerebakan H, Neely RC, Mongero L, George I, et al. **Short-term outcomes in adult cardiac surgery in the use of del Nido cardioplegia solution.** Perfusion. 2016; 31:27-33.
18. Hamad R, Nguyen A, Laliberte E, Bouchard D, Lamarche Y, et al. **Comparison of del Nido cardioplegia with blood cardioplegia in adult combined surgery.** Innovations (Phila). 2017; 12:356-62.

AUTHORSHIP AND CONTRIBUTION DECLARATION

No.	Author(s) Full Name	Contribution to the paper	Author(s) Signature
1	Zaigham Rasool Khalid	Operating surgeon, Principle investigator, Wrote methodology, and did data analysis, Results.	
2	Nabeel Ahmad	Data collection, Wrote introduction & Discussion.	
3	Abdul Razzaq Mughal	Did all post operative echo-cardiography, Collected relevant data, Abstract and references writing.	