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Original Research Article

Safety and efficacy of del Nido cardioplegia in adult cardiac surgery: experience in NICVD

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ABSTRACT

Background: Cardioplegia is used to induce and provide a depolarized diastolic cardiac arrest to provide a motionless surgical field. Del Nido cardioplegia solution has been used extensively in congenital heart surgery for more than 20 years and more recently for adults. This observational study was performed to assess the safety and efficacy of del Nido cardioplegia in adult cardiac surgery patients.
Methods: Total 140 adult patients selected for cardiac surgical procedure i.e., coronary artery bypass grafting (CABG), valve surgery, or CABG with valve surgery no need requiring cardiopulmonary bypass (CPB) were purposively allocated into two groups: a) del Nido cardioplegia (n=70) and b) blood cardioplegia (n=70). Primary outcomes assessed myocardial preservation.
Results: The study compared del Nido (A) and blood cardioplegia (B) groups. Mean ages were 49.5±7.86 and 48.9±6.79 years, respectively (p=0.5641). BMI (26.98±2.3 vs 27.2±2.14 kg/m^2, p=0.4846) and comorbid factors, including smoking (48% versus 51%) were similar. Differences were lower hemoglobin in A (males: 11.7±1.18 versus 13.6±0.55; females: 10.2±0.58 versus 12.2±0.21, p<0.0001) and CPB/ACC times for isolated CABG (A: 112.40±15.75/78.45±11.65 versus B: 123.8±18.55/86.28±15.26 minutes, p=0.0001). Post-operatively, more blood loss occurred in A, but they had shorter mechanical ventilation, ICU stay, and hospital stay durations. Other variables, like 30-day mortality, were similar.
Conclusions: Evidence from this study suggests del Nido cardioplegia use in routine adult cases may be safe, result in comparable clinical outcomes, and streamline surgical workflow. The trend for troponin should be investigated further because it may suggest superior myocardial protection with the del Nido solution.

Keywords: Adult cardiac surgery, Del Nido cardioplegia, Efficacy, Safety

INTRODUCTION

Smooth and complete recovery of heart from ischemic arrest and acquisition of functional integrity following cardiac surgery using cardiopulmonary bypass (CPB) mostly depends upon optimum myocardial protection strategy.[1] After the introduction of potassium induced diastolic cardiac arrest by Melrose in 1950, research and technical strategies have been ongoing to improve myocardial protection and prevent ischemic injury.[2-4] Over time the hypothermic and hyperkalaemia cardioplegia solutions have evolved to become the standard practice in most cardiac surgery centres of the world.[5] The principles behind the standard myocardial protection are hypothermia and hyperkalaemia induced reduction of metabolic and electrical activity of heart.

These provide the surgical team with a still, bloodless field essential for their precise surgical execution.[6] Despite the multitude of reported cardioplegia systems, there is a lack of clear consensus on composition, route, and technique.[5-7] There are several types of blood cardioplegia that differ in their electrolyte and drug additives which are supplemented to stabilize the membrane potential. Some examples are Buckberg solution, Plegisol solution, and St. Thomas solution.[9] In the early 1990s, del Nido cardioplegia (DNC) was introduced which consists of a calcium-free and potassium-rich non-glucose-based solution with electrolyte composition identical to that of extracellular fluid providing longer duration of cardiac arrest.[10] The ingredients of DNC are mixed with highly oxygenated blood and crystalloid solution with a ratio of 4 times crystalloid to 1 time blood.[11] This solution has been purported to preserve intracellular high-energy phosphates and intracellular pH and reduce calcium ion influx during and after ischemic arrest and led to its increased use across paediatric congenital cardiac surgery programs.[12,13] However, crystalloid part of DNC may be linked with haemodilution that causes problems in blood conservation strategy. This disadvantage can be resolved by substituting the crystalloid part of DNC with whole blood being drawn from the oxygenator.[14] Whole-blood DNC has many additional attributes such as free radical scavenging, better oxygen delivery, and reduction in the degree of haemodilution and myocardial edema.[15] The convenience offered by a single-dose cardioplegia strategy is the avoidance of interruption of the flow of surgery and, more importantly, a significant reduction in the cross-clamp time. Intraoperative peak glucose value and insulin requirement have also been reported to be lower with del Nido cardioplegia, which can have prognostic significance. There have reports of lesser incidence of atrial fibrillation and ventricular tachyarrhythmias. The requirement of defibrillations was less with use of this technique.[16] Multiple observational studies have suggested that the del Nido solution is associated with safety and efficacy in adult surgical procedures.[8,17-22] In our institution, modified St. Thomas blood cardioplegia (BC) has been the standard solution for cardiac arrest in adult cardiac surgery. The purpose of this retrospective observational study was to compare the del Nido cardioplegia protocol with an existing conventional whole blood-based cardioplegia strategy in routine coronary artery bypass grafting (CABG), valve surgery, and CABG with valve surgery.

Objective

To assess the safety and efficacy of del Nido cardioplegia in adult cardiac surgery patients.

METHODS

In this retrospective observational study, we reviewed the database of patients who underwent elective cardiac surgical operations under cardiopulmonary bypass and required cardioplegic arrest. We included all adult patients having isolated CABG surgery, isolated single or double valve surgery and concomitant CABG and valve surgery in the department of cardiac surgery of National Institute of Cardiovascular Diseases, Dhaka from January 2017 to December 2022. We excluded the patients having redo cardiac surgery, emergency surgery and unstable preoperative hemodynamic. One hundred and forty patients were included in the study. They were divided into two groups of which 70 patients received del Nido cardioplegia (group A) and 70 patients received blood cardioplegia (group B). The choice of cardioplegia depended on the operating surgeon. General anesthesia was induced and maintained following institutional protocol. All cardiac operations were performed through standard midline sternotomy. After surgery, patients were transferred to the ICU and provided standardized postoperative care. Data were analysed using the SPSS version-26 (SPSS, Inc., Armonk, NY, USA). Quantitative variables were presented as means±SD, while median and range were used to express the data that were not normally distributed. Qualitative variables such as gender, smoking, and diabetes were presented as frequency and percentage. Means/medians were compared using independent Student's t-test or Mann-Whitney U-test, whichever was applicable. Categorical variables between the two groups were compared using Chi-square test. A probability value of less than 0.05 was considered significant.

RESULTS

Table 1 showed pre-operative patient characteristics. The mean age of the study sample (group A: del Nido cardioplegia) was 49.5±7.86 years and that for the group B (blood cardioplegia) was 48.9±6.79 years which showed no significant difference (p=0.5641). Both sexes were homogenously distributed between the two groups but with a male predominance (86% versus 88%; p=0.6741). The groups were not different in respect of BMI (26.9±2.3 versus 27.2±2.14 kg/m^2, p=0.4846). The mean hemoglobin level among group A males was significantly lower than that among group B (11.7±1.18 versus 13.6±0.55; p<0.0001). The same was true for females (10.2±0.58 versus 12.2±0.21; p<0.0001). In our study, the commonest co-morbid factor was smoking in both groups (48% versus 51%; p=0.6716). It was followed by hypertension (43% versus 47%; p=0.5697), diabetes mellitus (38% versus 41%; p=0.6642) and dyslipidemia (34% versus 35%; p=0.882). Other co-morbid factors were family history of CAD (10% versus 8%), past history of CVA (4% versus 3%), COPD (11% versus 9%), history of MI (45% versus 47%), PVD (9% vsersu 8%) and renal dysfunction (10% versus 14%). All were identically distributed between the groups (p>0.05). In this study the mean left ventricular ejection fraction (LVEF) was similar in both groups (46±5.7% versus 47±7.2; p=0.2775). Pre-operative angiographic study demonstrated that majority of the patients had triple vessel diseases (TVD) in each group (76% and 72% respectively). The rest had double vessel diseases (DVD) and left main diseases (LMD) which were similarly distributed among the two groups (p>0.05).

Table 1: Preoperative characteristics of the study population.

Variables	Group A: del Nido cardioplegia (n=100)	Group B: blood cardioplegia (n=100)	P value
Age, years$^{\#}$	49.5±7.86*	48.9±6.79*	0.5641^{ns}
Male, n (%)$^{¥}$	86 (86)	88 (88)	0.6741^{ns}
BMI (kg/m²)$^{\#}$	26.98±2.3*	27.2±2.14*	0.4846^{ns}
Haemoglobin (gram/dl)$^{\#}$	12.3±1.9*	11.9±2.1*	0.1594^{ns}
Troponin I (ng/ml)$^{\#}$	0.03±0.005*	0.029±0.006*	0.2019^{s}
Hypertension, n (%)$^{¥}$	43 (43)	47 (47)	0.5697^{ns}
Diabetes mellitus, n (%)$^{¥}$	38 (38)	41 (41)	0.6643^{ns}
Smoking, n (%)$^{¥}$	48 (48)	51 (51)	0.6714^{ns}
Dyslipidaemia, n (%)$^{¥}$	34 (34)	35 (35)	0.8818^{ns}
Family H/O CAD, n (%)$^{¥}$	10 (10)	08 (08)	0.6212^{ns}
Past H/O CVA, n (%)¶	04 (04)	03 (03)	1.0000^{ns}
COPD, n (%)$^{¥}$	11 (11)	09 (09)	0.6374^{ns}
History of MI, n (%)$^{¥}$	45 (45)	47 (47)	0.7766^{ns}
PVD, n (%)$^{¥}$	09 (09)	08 (08)	0.7798^{ns}
Renal dysfunction, n (%)$^{¥}$	10 (10)	14 (14)	0.3841^{ns}
Serum Creatinine	0.88±0.14*	0.86±0.16*	0.3480^{ns}
Arrhythmia, n (%)$^{¥}$	14 (14)	16 (16)	0.6921^{ns}
LVEF (%)$^{\#}$	44±5.7*	43±7.2*	0.2775^{ns}
NYHA class II or III, n (%)$^{¥}$	16 (16)	14 (14)	0.6921^{ns}
CCS angina class III or IV, n (%)$^{¥}$	27 (27)	24 (24)	0.6265^{ns}
Isolated CABG, n (%)$^{¥}$	43 (43)	39 (39)	0.5652^{ns}
AVR, n (%)$^{¥}$	13 (13)	15 (15)	0.6836^{ns}
MVR, n (%)$^{¥}$	32 (32)	34 (34)	0.7636^{ns}
DVR, n (%)$^{¥}$	09 (9)	10 (9)	0.8094^{ns}
CABG plus valve surgery, n (%)¶	03 (03)	02 (02)	1.0000^{ns}

*Data are presented as the mean±SD for continuous variable. $^{\#}$Student's t-Test, $^{¥}$Chi-square (χ^2) Test, ¶Fisher's exact test, s = significant, ns = non-significant. AVR: aortic valve replacement; CCS: Canadian Cardiovascular Society Angina Class; COPD: chronic obstructive pulmonary disease; CVA: cerebrovascular accident; DVD: double vessel disease; DVR: double valve replacement; LMD: left main disease; LVEF: left ventricular ejection fraction; MI: myocardial infarction; MVR: mitral valve replacement NYHA: New York Heart Association; PVD: peripheral vascular disease; TVD: triple vessel disease.

Table 2: Comparison of CPB time and ACC time in the different surgeries.

Surgery	Cardioplegia	Mean CPB time (minutes)$^{\#}$	P value	Mean ACC time (minutes)$^{\#}$	P value
Isolated CABG$^{\#}$	Del Nido cardioplegia	112.40±15.75*	0.0001^{s}	78.45±11.65*	0.0001^{s}
	Blood cardioplegia	123.8±18.55*		86.28±15.26*	
AVR$^{\#}$	Del Nido cardioplegia	100.2±13.55*	0.0001^{s}	65.5±10.35*	0.0001^{s}
	Blood cardioplegia	110±12.4*		74.2±11.5*	
MVR$^{\#}$	Del Nido cardioplegia	92±11.9*	0.0001^{s}	62±8.55*	0.0001^{s}
	Blood cardioplegia	108±12.6*		70.6±9.65*	
	Del Nido cardioplegia	154.2±19.46*	0.0001^{s}	115.6±18.9*	0.0001^{s}
DVR$^{\#}$	Blood cardioplegia	168.5±17.9*		132.6±16.7*	
CABG plus valve$^{\#}$	Del Nido cardioplegia	156.8±14.75*	0.0001^{s}	117.5±14.4*	0.0001^{s}
	Blood cardioplegia	174.6±13.5*		129.6±16.8*	

*Data are presented as the mean±SD for continuous variable. $^{\#}$Student's t-Test; s = significant. ACC: aortic cross clamp; AVR: aortic valve replacement; CABG: coronary artery bypass graft surgery; CPB: cardiopulmonary bypass; MVR: mitral valve replacement; DVR: double valve replacement.

The distribution of NYHA and CCS angina classes between the two groups were also homogenous (p>0.05). Most of the patients of both groups underwent isolated CABG surgery (43% versus 39%; p=0.5652). This was followed by MVR (32% versus 34%), AVR (13% versus 15%), DVR (9% versus 10%) and combined CABG plus valve procedure (3% versus 2%). So, pre-operative characteristics were statistically similar among the two groups (p>0.05).

Table 3: Comparison of intraoperative data between two groups.

Intraoperative variables	Del Nido cardioplegia (n=100) n (%)	Blood cardioplegia (n=100) n (%)	P value
Number of doses of cardioplegia#	1.46 ± 0.21*	3.95 ± 2.8*	<0.0001s
Hb_1 on CPB#	7.1±1.5*	7.6±1.3*	0.0126s
Hb_2 on CPB#	7.3±1.4*	7.8±1.6*	0.0197s
Hb_3 on CPB#	8.7±1.4*	9±1.2*	0.1053ns
Blood transfusion¥	94 (94)	85 (85)	0.0379s
Whole blood transfusion			
1 bag¥	36	32	0.9286ns
2 bags¥	43	41	0.7388ns
3 bags¥	13	11	0.8617ns
4 bags¶	02	01	1.0000ns
Electrical activity during arrest (%) ¥	05 (05)	18 (18)	0.0040s
VT/VF after release of aortic cross clamp¥	11 (11)	19 (19)	0.1131ns
Number of defibrillations			
1¶	04 (04)	07 (07)	0.5371ns
2¶	02 (02)	02 (02)	1.0000ns
3¶	00 (00)	01 (01)	1.0000ns
Lignocaine injection to control arrhythmia¥	10	17	0.1475ns
Temporary pacing¥	14	21	0.1927ns
Number of hours temporary pacing#	3±1.5*	5±1.3*	0.0002s

*Data are presented as the mean ± SD for continuous variable. #Student's t-test, ¥ Chi-square (χ^2) Test, ¶ Fisher's exact test, CPB = cardiopulmonary bypass, VT = Ventricular Tachycardia, VF = Ventricular Fibrillation, s= significant, ns = Non-significant

Table 4: Postoperative data.

Postoperative variable	Del Nido cardioplegia (n=100) n (%)	Blood cardioplegia (n=100) n (%)	P value
Total bleeding (ml) #	508 ± 65*	485 ± 70*	0.0170s
Whole blood transfusion			
1 bag¥	38 (38)	36 (36)	0.7696ns
2 bags¥	08 (08)	07 (07)	0.7883ns
3 bags¶	03 (03)	02 (02)	1.0000ns
4 bags¶	02 (02)	01 (01)	1.0000ns
Troponin I level, ng/ml, (2 hours post-op)	1.8±0.18*	2.2±0.15*	0.0001s
Troponin I level, ng/ml (12 hours post-op)	2.6±1.18*	4.2±1.25*	0.0001s
Troponin I level, ng/ml (24 hours post-op)	2.4±1.28*	7.2±2.2*	0.0001s
Post-operative LVEF (%) #	43±6.4*	42±4.8*	0.2128 ns
Prolonged use of inotropes¥	08 (08)	15 (15)	0.1208 ns
Ventilation time, hours#	8.5±3.4*	10.2±2.5*	0.0001s
ICU stay (days)#	4.6±1.8*	5.5±1.6*	0.0002s
Post-operative hospital stays (days)#	7.8±1.4*	8.6±1.2*	0.0001s
30 days mortality, n (%) ¶	02 (02)	03 (03)	1.0000ns
Re-exploration for bleeding¶	02 (02)	01 (01)	1.0000ns
Stroke¶	01 (01)	01 (01)	1.0000ns
Pulmonary complications¥	08 (08)	10 (10)	0.6212ns
Perioperative MI¶	02 (02)	02 (02)	1.0000ns
New onset of arrhythmia¥	10 (10)	12 (12)	0.6513ns
Surgical site infection¥	06 (06)	05 (05)	0.7564ns
Renal dysfunction (AKI)¥	18 (18)	20 (20)	0.7185ns

*Data are presented as the mean ± SD for continuous variable. #Student's t-Test, ¥ Chi-square (χ^2) test, ¶ Fisher's exact test, AKI= Acute kidney injury, MI= myocardial infarction, LVEF= left ventricular ejection fraction, s= significant, ns = non-significant.

Table 2 showed the comparison between cardiopulmonary bypass (CPB) time and aortic cross clamp (ACC) time required for different surgical procedures. For isolated CABG operation, the mean CPB time and ACC time of del Nido cardioplegia group were 112.40±15.75 minutes and 78.45±11.65 minutes respectively. On the other hand, these were 123.8±18.55 minutes and 86.28±15.26 minutes for blood cardioplegia group which were significantly higher than del Nido group (p=0.0001). The same was true for MVR, AVR, DVR and combined CABG plus valve operations. This was due the fact that surgical procedures were interrupted by frequent intake of blood cardioplegia. Table 3 compared intraoperative variables of the two groups. Because of long duration of action average doses of cardioplegia was significantly (p<0.0001) less in del Nido group than blood cardioplegia group. During cardiopulmonary bypass hematocrit was checked several times in arterial blood gas. Among three samples the first two average hemoglobin levels were significantly lower in el Nido group. Per-operatively more patients in Ddel Nido group required transfusion (p=0.0379). The large volume of crystalloid used in del Nido is responsible for the hemo-dilution. But the requirement of per-operative transfusion was similar in both groups. During aortic cross-clamp spontaneous electrical activity was more commonly observed in blood cardioplegia group (p=0.0040). After release of aortic cross clamp, more patients of blood cardioplegia group developed ventricular tachycardia or fibrillation but the difference was not statistically significant (p=0.1131). Similarly measures needed to control ventricular arrhythmias e.g. defibrillation, lignocaine injection, temporary pacing more commonly required in blood cardioplegia group though these were not statistically significant. Again, patients having temporary pacing dependent bradycardia of blood cardioplegia group required more time to recover (3±1.5 versus 5±1.3 hours, p=0.0002). Table 4 compared post-operative variables of the two groups. The post-operative blood loss was significantly greater in del Nido group. Two patients of del Nido group and one of blood cardioplegia group required re-exploration for bleeding (p=1.0000). But the requirement of whole blood transfusion was similar in both the groups. Troponin I level was monitored three times (2, 12 and 24 hours) post-operatively. It gave an idea about myocardial injury during aortic cross-clamp. The rise of troponin I was significantly greater in blood cardioplegia group (p=0.0001). However post-operative average left ventricular ejection fractions were not statistically different between the groups (p=0.2128). Although, more patients of blood cardioplegia group required prolonged inotropic support but that was not statistically significant (p=0.1208). On the other hand, mechanical ventilation time, ICU stay and post-operative hospital stay were significantly lower in del Nido group (p<0.05). Other post-operative variables i.e. 30 days mortality, stroke, pulmonary complications, perioperative MI, surgical site infection, surgical site infection, renal dysfunction (AKI) similarly distributed between two group.

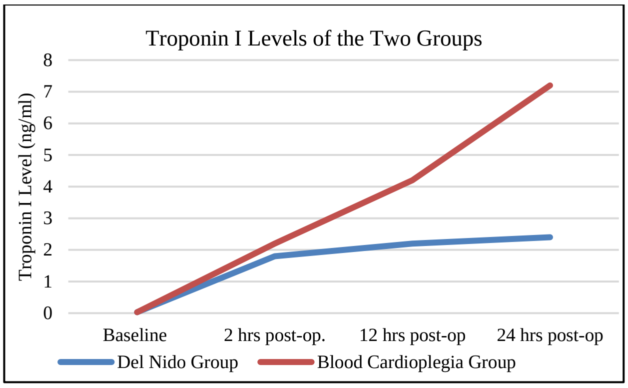

Figure 1: Comparison of mean troponin I levels among the two treatment groups.

DISCUSSION

Several cardioplegic solutions with different chemical composition have been developed since the first report of elective cardiac arrest by Dr. Melrose in 1955.[26] But there is no consensus on the best cardioplegic solution. The chemical composition has been modified in various ways to minimize the ischemic myocardial injury during the cardioplegic arrest. The present study evaluated the safety of del Nido cardioplegia in adult patients undergoing cardiac surgery. In this male predominant study the average age of patients were 49.5±7.86 years for del Nido cardioplegia group and 48.9±6.79 years for blood cardioplegia group. Although the average age of patients varies according to countries all the studies showed a male predominance. In a study performed in USA average age were 65.3±7.89 years for del Nido cardioplegia group and 65.1±9.1 years for blood cardioplegia group.[24] In the study of Pakistan these were 50.92±9.426 years and 50.42±10.389 years respectively.[26] In India these were 48.2±13.1years and 46.7±13.5 years respectively.[25] So, the age range is similar in Bangladesh, Pakistan and India but higher in USA. In our study, pre-operative average hemoglobin levels were similar, i.e. 12.3±1.9 gram/dl for del Nido cardioplegia group and 11.9±2.1 gram/dl for blood cardioplegia group. Other studies also showed similar findings.[24,25] The patients of both groups of our study had similar pre-operative left-ventricular ejection fraction, i.e. 44±5.7% for del Nido cardioplegia group and 43±7.2% for blood cardioplegia group (p=0.2775). In the study performed by Ad et al in USA showed a higher baseline left ventricular ejection fraction i.e. 54.3±11.9% for del Nido cardioplegia group than 57.6±11.4 for blood cardioplegia group (p=0.187).[24] Thyagarajan et al from India had similar findings i.e. 61.50±9.83 .33% and 62.27±11.17% respectively (p=0.3301).[27] In another Indian study by George et al these were also similar i.e. 58.8% and 58.5% respectively (p=0.842).[25] Our study showed identical distribution of co-morbid factors between the groups (p>0.05). Other studies in abroad had similar findings.[24-27] Coronary artery bypass graft (CABG) surgery was the commonest performed procedure of our patients in both groups. It was closely followed by mitral valve replacement (MVR). But the study in USA showed that aortic valve surgery was commonly performed after CABG.[24] This study showed that for each of the operative procedure (CABG, AVR, MVR, DVR, CABG plus valve) the cardiopulmonary bypass (CPB) time and aortic cross clamp (ACC) time were significantly lower in del Nido cardioplegia group. Shah et al from Pakistan and Thyagarajan et al from India reported similar findings.[26,27] However George et al from India showed that the CPB and ACC time were not significantly different between the two groups; opposite to our findings.[25] As del Nido cardioplegia is long acting so during operation it was taken less frequently than blood cardioplegia. This fact was also supported by Thyagarajan and George et al.[25,27]

In our study initial haemoglobin levels were significantly lower in del Nido group because of hemo-dilution but the third one was similar. So, more patients of del Nido group required blood transfusion. However, George et al showed that there was no significant difference between the per-operative average haemoglobin levels and so, transfusion requirements were also not different.[25] Spontaneous electrical activity was more commonly noted in blood cardioplegia group (p=0.0040) during cardioplegic arrest. However, when cross clamp was released, ventricular arrhythmias were found to be similarly distributed among the groups. And so, the use of defibrillation, lignocaine injection, temporary pacing were also similar. Another important finding was that patients of del Nido cardioplegia group required less time to recover from bradycardia. In the study of George et al all these findings were similar.[25] Although the post-operative blood loss was more in del Nido cardioplegia group but the transfusion requirements were similar in both the groups of our study. These findings were similar to that of George et al. In their study the requirement of red blood cell, fresh frozen plasma and platelet was similar among the two groups.[25] Our study showed that myocardium was better preserved with del Nido cardioplegia as post-operative troponin I levels were lower. Ad et al in their study showed similar finding.[24] In a study using other biochemical markers (e.g. CK-MB and LDH) of myocardial damage del Nido cardioplegia was found to be better cardioprotective.[26] However, as mentioned in our study, Thyagarajan et al also showed average post-operative left ventricular ejection fraction (LVEF) and need for prolonged inotropic support were similar in both groups.[27] Although our study found mechanical ventilation time, ICU stay and post-operative hospital stay were significantly lower in del Nido group, George et al showed no significant difference between the two groups regarding these variables.[25] However, Thyagarajan et al and Shah et al in their study mentioned the post-operative hospital stay was significantly lower in del Nido group, similar to our finding.[26,27] Again, similar to our study George et al showed post-operative complication rates were not different among the two groups.[25]

Our present study has several limitations. Sample size was small and patients were selected purposefully. Patients were not randomly assigned to either group. High-risk patients have not been included. The variations in cardioplegia technique may not provide comparable results. The duration of follow up of this study was limited. Clinical outcomes were restricted to 30-days mortality. Patients were not followed up for medium and long-term results. As a single institutional study the conclusions may not be applicable in general because of differences in practice patterns of other centres. Other factors such as variations in surgical skill, patient difference in extent or severity of disease and echocardiography reports although unavoidable should also be considered.

CONCLUSION

An ideal cardioplegic solution should achieve rapid diastolic arrest of heart to facilitate a motionless heart suitable for to surgical intervention and decreases myocardial metabolic demand. Upon reperfusion, injury to the myocardium should be minimized with swift return to normal activity. Evidence from this study showed that del Nido cardioplegia provides better myocardial protection and surgical workflow, less ICU and hospital stay and comparable clinical outcomes when compared to blood cardioplegia. Our data clearly advocate the safety and efficacy of del Nido cardioplegia for adult cardiac patients. This study supports expanding the use of del Nido cardioplegia to routine adult cardiac cases as it is safe, efficacious and can improve uninterrupted surgical workflow with comparable clinical outcomes. Further randomized, multicenter trials comparing different solutions in different cardiac procedures need to be done to validate these results.

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REFERENCES

1. Allen BS. Myocardial protection: a forgotten modality. Eur J Cardio-Thorac Surg. 2020;57:263-70.
2. Reitz BA. Myocardial protection during cardiac surgery. Annu Rev Med. 1982;33:151-62.
3. Melrose DG, Dreyer B, Bentall HH, Baker JBE. Elective cardiac arrest. Lancet. 1955;266:21-3.
4. Cordell AR. Milestones in the development of cardioplegia. Ann Thorac Surg. 1995;60:793-6.

5. Fallouh HB, Chambers DJ. Is blood versus crystalloid cardioplegia relevant? Significantly improved protection may require new cardioplegic concepts. Interact Cardio Vasc Thorac Surg. 2008;7:1162-3.
6. Gunnes S, Jynge P. Fundamentals of the past: Cardioplegia: The first period revisited. In: Podesser BK, Chambers DJ, eds. New Solutions for the Heart. An Update on Advanced Perioperative Protection. 1st edn. Germany: Springer Verlag/Wien; 2011:15 40
7. Sá M, Rueda FG, Ferraz PE, Chalegre ST, Vasconcelos FP, Lima RC. Is there any difference between blood and crystalloid cardioplegia for myocardial protection during cardiac surgery? A meta-analysis of 5576 patients from 36 randomized trials. Perfusion. 2012;27:535-46.
8. Ovrum E, Tangen G, Tollofsrud S, Oystese R, Ringdal MA, Istad R. Cold blood versus cold crystalloid cardioplegia: a prospective randomised study of 345 aortic valve patients. Eur J Cardiothorac Surg. 2010;38:745-9.
9. Chatrath R, Kaul TK, Walker DR. Myocardial protection during cardioplegia in open heart surgery: A review. Can J Anaesth. 1980;27:381-8.
10. Matte GS, Pedro J. History and use of del Nido cardioplegia solution at Boston Children's Hospital. J Extra-Corpor Technol. 2012;44:98.
11. Li Y, Lin H, Zhao Y, Li Z, Liu D, Wu X, et al. Del Nido cardioplegia for myocardial protection in adult cardiac surgery: a systematic review and meta-analysis. Asaio J. 2018;64:360-7.
12. Harvey B, Shann KG, Fitzgerald D, Mejak B, Likosky DS, Puis L, et al. International pediatric perfusion practice: 2011 survey results. J Extra Corpor Technol. 2012;44:186-93.
13. Kotani Y, Tweddell J, Gruber P, Pizarro C, Austin EH, Woods RK, et al. Current cardioplegia practice in pediatric cardiac surgery: a north American multi-institutional survey. Ann Thorac Surg. 2013;96:923-9.
14. Ota T, Yerebakan H, Neely RC, Mongero L, George I, Takayama H, et al. Short-term outcomes in adult cardiac surgery in the use of del Nido cardioplegia solution. Perfusion 2016;31:27-33.
15. Owen CM, Asopa S, Smart NA, King N. Microplegia in cardiac surgery: systematic review and meta-analysis. J Card Surg. 2020;35:2737-46.
16. Valooran GJ, Nair SK, Chandrasekharan K, Simon R, Cyril Dominic C. del Nido cardioplegia in adult cardiac surgery - scopes and concerns. Perfusion. 2016;31(1):6-14.
17. Yerebakan H, Sorabella RA, Najjar M, Castillero E, Mongero L, Beck J, et al. Del Nido cardioplegia can be safely administered in high-risk coronary artery bypass grafting surgery after acute myocardial infarction: a propensity matched comparison. J Cardiothorac Surg. 2014;9:141.
18. Timek T, Willekes C, Hulme O, Himelhoch B, Nadeau D, Borgman A, et al. Propensity matched analysis of del Nido cardioplegia in adult coronary artery bypass grafting: initial experience with 100 consecutive patients. Ann Thorac Surg. 2016;101:2237-41.
19. Smigla G, Jaquiss R, Walczak R, Bonadonna D, Kaemmer D, Schwimer C, et al. Assessing the safety of del Nido cardioplegia solution in adult congenital cases. Perfusion. 2014;29:554-8.
20. Mick SL, Robich MP, Houghtaling PL, Gillinov AM, Soltesz EG, Johnston DR, et al. Del Nido versus Buckberg cardioplegia in adult isolated valve surgery. J Thorac Cardiovasc Surg. 2015;149:626-36.
21. Guajardo Salinas GE, Nutt R, Rodriguez-Araujo G. Del Nido cardioplegia in low risk adults undergoing first time coronary artery bypass surgery. Perfusion. 2017;32:68-73.
22. Sorabella RA, Akashi H, Yerebakan H, Najjar M, Mannan A, Williams MR, et al. Myocardial protection using del Nido cardioplegia solution in adult reoperative aortic valve surgery. J Cardiac Surg. 2014;29:445-9.
23. Maruti H, Chin HC, Sivalingam S, Raja N, Shaffie MSM, Namasiwayam TK, et al. Safety and effectiveness of del Nido cardioplegia in comparison to blood based St. Thomas cardioplegia in congenital heart surgeries: a prospective randomized controlled study. World J Pediatr Congenit Heart Surg. 2020;11(6):720-6.
24. Ad N, Holmes SD, Massimiano PS, Rongione AJ, Fornaresio LM, Fitzgerald D. The use of del Nido cardioplegia in adult cardiac surgery: A prospective randomized trial. J Thorac Cardiovasc Surg. 2018;155(3):1011-8.
25. George G, Varsha AV, Philip MA, Vithayathil R, Srinivasan D, Princy FX, et al. Myocardial protection in cardiac surgery: del Nido versus blood cardioplegia. Ann Card Anaesth. 2020;23:477-84.
26. Shah A, Khan AH, Ahmed H, Naveed A, Khan F, Iqbal J, et al. Comparison of post-operative outcomes following del Nido cardioplegia versus howards cardioplegia in adult cardiac surgery at Pakistan Institute of Medical Sciences. Int J Cardiovasc Thorac Surg. 2020;6(1):1-6.
27. Thyagarajan BK, Sreenivasan A. Safety and efficacy of del Nido cardioplegia compared with conventional blood cardioplegia in isolated coronary artery bypass surgery- a retrospective study in a tertiary care academic centre in Kerala, India. J Evid Based Med Healthcare. 2021;8(14):909-14.

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