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Research Article

Del Nido Cardioplegia against Blood Cardioplegia Comparative Study of 200 Patients of Mitral Valve Surgery in Our Institute Grant Medical College, Mumbai

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Abstract

Cardioplegia is an integral and essential method of myocardial protection for patients of all ages requiring cardiac surgery in which the heart must be stopped. St. Thomas solution is widely used. Researchers at the University of Pittsburgh developed a novel formulation for myocardial protection in the early 1990s, led by Pedro Del Nido, and since then modifications have made but known as Del Nido cardioplegia solution. Retrospective study and comparison is made between patients undergoing mitral valve replacement and cardioplegia used was del nido for 100 patients and ST Thomas in 100 patients from 2015 - 2017 at our institute Grant Medical College, Mumbai. The results shows that Del Nido cardioplegias efficacy is comparable to ST Thomas cardioplegia. The time required to repeat cardioplegia is 30 minutes in ST Thomas but in Del Nido no need to repeat which provides continuity while operating. Secondly prevention of influx provides good myocardial protection. The safety and efficacy is comparable to St Thomas along with CPB time, Cross Clamp time and volume required is less. Del Nido cardioplegia can be good choice for mitral valve surgery with advantages like cost effectiveness and feasibility. Choice of future is Del Nido cardioplegia.

Keywords: *Del Nido Cardioplegia; Blood Cardioplegia*

Introduction

Cardioplegia is an integral and essential method of myocardial protection for patients of all ages requiring cardiac surgery in which the heart must be stopped. St. Thomas solution is widely used. Researchers at the University of Pittsburgh developed a novel formulation for myocardial protection in the early 1990s, led by Pedro Del Nido, and since then modifications have made but known as Del Nido cardioplegia solution.

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Aims

To compare safety, efficacy and advantages of Del Nido cardioplegia solution against blood cardioplegia in mitral valve surgery. Del Nido was initially used in pediatric population and scope has enhanced from there to adult cardiac surgery.

Material and Methods

Retrospective study and comparison is made between patients undergone mitral valve replacement and cardioplegia used was Del Nido for 100 patients and St Thomas in 100 patients from 2013 to 2018. Patient selected in both group are in age range of 18 - 44 years, 64 males and 36 females in both group, isolated severe calcific mitral stenosis with mild to moderate PH with left atrial clot 22 and without left atrial clot 78 with LA size in range of 3.5 cm to 5.5 cm with normal ejection fraction and in sinus rhythm. All surgeries were performed using standard general anaesthesia protocol, midline sternotomy approach, employing cardiopulmonary bypass with mild systemic hypothermia (30 to 34°C). Surgical technique used was intermittent horizontal mattress 2-0 ethibond pledgeted sutures. Comparison is made in regards to cardiopulmonary bypass time, cross clamp time, cardioplegia volume, requirement of supports, requirement of shock, ICU stay and hospital stay. Retrospectively data was collected on the above variables and analysed using routine statistical analysis.

For preparing Del Nido cardioplegia we use plasmolyte instead of D 5% and ringer lactate. Plasmolyte is more alkalotic and contain slightly lore potassium (Table 1). Other extra contents are magnesium and lidocaine for better action than the St Thomas cardioplegia (Table 2).

	Normal Saline	Lactated Ringer's Solution	Plasma-Lyte pH 7.4
Sodium (mEo/1)	154	130	140
Potassium (mEq4)	**0**	4	5
Calcium (mEg/1)	0	3	0
Magnesium (mEg/1)	0	0	3
Chloride (mEg/1)	154	109	98
Lactate (mEg/1)	0	28	0
Gluconate (mEq/l)	0	0	23
Acetate (mEq/1)	0	0	27
Osmolarity (rmOsm/l)	308	275	294
pH	5.50	6.75	7.40

Table 1: *Plasmo-Lyte Composition.*

St Thomas	Del Nido
D 5%	Plasmolyte
4:1 Blood/crytsolloid	1:4 Blood/crystalloid
Kcl 20 meq	Kcl 26 meq
$NAHCO_3$ 30 meq	$NAHCO_3$ 13 meq
Mannitol 12.5 meq	Mannitol 3.3 meq
-	Mg++2 meq/I
-	1% Lidocaine (0.36 mmol/lit)
Duration of action 25 minutes	Duration of action 90 minutes

Table 2: *Composition of cardioplegias.*

Results

Mean Age Group was 20 - 40 years in Double valve replacement with 20 were male and 30 were female. In del nido group of DVR the CPB time, cross clamp time was slightly less as compared to blood cardioplegia. The volume required, post op support, potassium levels and urine output is better maintained as compared to blood cardioplegia.

As duration of action of Del Nido cardioplegia is 90 minutes so no need of repeat the dose but St Thomas has to be repeated after 25 minutes. Volume of Del Nido cardioplegia is less but that of St Thomas is more as repeat dose was required. The DC shock was required in only 10 patients of Del Nido group as compared to 30 patients in St Thomas group which indicates better myocardial protection in Del Nido group (Table 3).

Parameters	St Thomas	Del Nido
Age (years)	18 - 44 (27)	18 - 44 (27)
BSA (m^2)	1.3 - 1.7	1.3 - 1.7
Cross clamp Time (Minutes)	50 - 55	40 - 45
CPB (Minutes)	70 - 75	60 - 65
Repeat dose required	Yes	No
Volume (Litres)	2	1
Requiring DC shock	30	10

Table 3: *Parameters Comparison-Intraopt.*

Post opt parameter comparison also shows dopamine support, duration of ventilator stay, ICU stay and postopt stay was less in Del Nido group as compared to St Thomas group (Table 4).

Parameters	St Thomas	Del Nido
Dopamine (ug/hour)	10 - 12	4 - 6
Duration of Ventilatory support (Hours)	6 - 8	4 - 5
ICU Stay (Days)	3.5	2.8
Postopt Stay (Days)	14	10

Table 4: *Parameters Comparison-Post opt.*

Discussion

It is theorized that the lidocaine content in DN serves to increase Na^+ channel blockade and minimize the potential for Na^+ window current [1]. This, in addition to its Mg^{2+} content acting as Ca^{2+} antagonist, may represent an important mechanism of benefit of DN cardioplegia [2]. An effective reduction in intracellular calcium as a result of this mechanism has been demonstrated in animal hearts arrested with DN solution - diastolic intracellular calcium levels [3] were significantly lower in DN hearts compared to standard WB solution [4], without a negative contractile effect after recovery [5]. Other Possible actions include coronary vasodilation to improve cardioplegia delivery, prevention of reperfusion arrhythmias [6].

A single dose of del Nido cardioplegia contains 26 mEq/L of potassium chloride, 13 mL of 1% lidocaine [7], 3.2 g/L of 20% mannitol, 2g of 50% magnesium sulfate, 13 mEq/L of sodium bicarbonate, and 1000 mL of Plasma-Lyte A [8]. It is delivered 1:4 with oxygenated patient's blood to crystalloid del Nido cardioplegia can be delivered antegrade if the duration of the operation will be limited and if there is no significant coronary artery disease or aortic insufficiency to limit the distribution of cardioplegia [9]. It is generally used in a single-dose fashion and has been in use for nearly two decades at Children's Hospital Boston for both adult and pediatric surgeries [10]. Its patent has expired and the del Nido cardioplegia can be prepared by any in-house pharmacy. Our experience with its use in adult patients at the Grant Medical College began in 2015.

Drawbacks of Study

Even with strict selection criteria, in certain patients mitral valve was so much calcific that it has required 5 - 10 minutes more as compared to average time. Operating surgeon variability kept below 10%.

Conclusion

Del nido cardioplegia solution is safe and effective in even adult valvular cardiac surgeries. Lesser volume required, surgery continuity maintained and have better CPB parameters in terms of serum potassium level and urine output as compared to blood cardioplegia in achieving myocardial protection.The above results shows that del nido cardioplegias efficacy is comparable to St Thomas cardioplegia. The time required to repeat cardioplegia is 90 minutes which provides continuity while operating. Cross Clamp time and volume required is less. Del Nido cardioplegia reduces the incidence of spontaneous activity during cardioplegic arrest. Del Nido cardioplegia can be good choice for adult cardiac surgery. It is also cost effective and feasible. Further randomized clinical trial study of the clinical benefit of DN with single-dose administration, effect on cytoprotective mechanisms of membrane stabilization, and dosing regimen in this sick population is warranted.

Consent

Informed consent has been obtained.

Funding

No funding was required for this study.

Conflict of Interest

No potential conflict of interest exist.

Ethical Approval

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

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