



COMPARISON OF CARDIOPLEGIA : DEL NIDO VERSUS ST. THOMAS SOLUTION WITH RESPECT TO INOTROPIC SUPPORT IN POST CARDIO PULMONARY BYPASS PERIOD

Cardiology

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ABSTRACT

Cardioplegia is integral and important part of myocardial protection. Various cardioplegia solutions and strategies have been devised over last 50 years. Del Nido and St Thomas II solution are common cardioplegias used worldwide. Del nido can be used for 60 to 90 minutes but St Thomas II needs to be repeated every 20 minutes. This study compared both these cardioplegias with respect to inotropic support needed in post cardiopulmonary bypass period. Statistical analysis was done using SPSS version 10. The cross clamp time, cpb time and number of cardioplegia repeated was significantly less in del nido group, however, no significant difference was noted in view of inotropic supports and VIS score.

KEYWORDS

Aim :

To determine whether DN cardioplegia and ST solution has same effect on requirement of inotropic support in post cardiopulmonary bypass period

INTRODUCTION :

In open heart surgery, myocardial protection remains the cornerstone which determines the post operative myocardial recovery. Ideal cardioplegia and precise cardioprotective strategy are still under research and debate. Dr. Pedro del Nido developed in 1990 cardioplegia, now known as del Nido cardioplegia (DN) which causes depolarising arrest of myocardium during cardiac surgery¹. St. Thomas' solution no. II (ST) is a well known crystalloid cardioplegia however needs frequent dosing. Any delay in subsequent dose results in myocardial acidosis affecting postoperative course of patient². DN induces longer period of myocardial arrest and decreases need for frequent dosing³. Although there has been great improvement in surgical technique and cardioplegia, inotropic support is most of the times required for low cardiac output and myocardial stunning during and after weaning from cardiopulmonary bypass to prevent myocardial dysfunction^{4,5}.

In this study we compare use of 2 different cardioplegia and their effect on need for inotropic support in post bypass period. Wernovsky and colleagues proposed the use of inotropic score (IS) to measure pharmacologic cardiovascular support given to infants after open heart surgery⁶. Gaies proposed vasoactive inotropic score (VIS) to evaluate outcome after cardiac surgery⁷ which included parameters of Wernovsky score (Dopamine + Dobutamine + Epinephrine) and included Milrinone + Vasopressin + Norepinephrine dose. Few studies have validated the use of these scores in adults also⁸.

Materials and methods :

Patient population : A randomised prospective study was conducted at Cardiovascular and Thoracic Surgery Department, Seth GS Medical College and KEM Hospital. All patients, both adult and paediatric, undergoing open heart surgery for intracardiac repair (ICR) of atrial septal defect (ASD), ventricular septal defect (VSD), tetralogy of Fallot (TOF), aortic valve replacement (AVR), mitral valve replacement (MVR), double valve replacement (DVR) and on pump coronary artery bypass grafting (CABG) from January 2012 to January 2017 were included in the study. Consecutive patients were randomised into 2 cohort groups based on type of cardioplegia administered during surgery into DN and ST.

Data analysis was done for number of times cardioplegia was administered, aortic cross clamp duration, duration of total bypass, requirement of defibrillation, use of inotropes while and post weaning from cardiopulmonary bypass, decrease in ejection fraction (EF), serum lactate levels, vasoactive inotropic score (VIS), urine output, clinical and inflammatory markers (CRP). All surgeries were performed using standardised institutional protocol. From amongst the cohorts of DN and ST, sub cohorts were made according to the

surgeries conducted. Using statistical software, patients in each sub cohort were matched for their age, sex and body surface area to yield comparable sub cohorts for each surgery mentioned above.

Further statistical analysis was done on this matched groups using SPSS version 10. Wernovsky vasoactive inotropic score was used as an indicator of post operative myocardial function. Continuous variables were reported as mean \pm standard deviation and compared using the independent samples t-test. Categorical variables were reported as frequency and percentage of the total group and compared using Pearson's test or Fischer's exact test where applicable. All p values less than 0.05 were considered significant.

RESULTS :

A total of 1000 patients were included in the study. In DN group following patients underwent surgery : ASD 72 (14.4%), VSD 75 (15%), TOF 61 (12.2%), CABG 76 (15.2%), AVR 74 (14.8%), MVR 96 (19.2%) and DVR 46 (9.2%). In ST group following patients underwent surgery : ASD 80 (16%), VSD 76 (15.2%), TOF 56 (11.2%), CABG 81 (16.2%), AVR 72 (14.4%), MVR 92 (18.4%) and DVR 43 (8.6%). The overall mean age of patients was 31.26 \pm 6.72 years (range 3-71 years). All other demographic characteristics of the patients in the study groups were similar. In cases mentioned above, there was statistically significant less aortic cross clamp time, cardiopulmonary bypass time, number of DC shocks, number of repeated cardioplegias in patients who received DN as compared to ST. However when compared to inotropic support requirement while weaning from and in post bypass period, there was increased need for inotropic support in ST group 78.8% as compared to DN 73.4%. However, the difference was not statistically significant (p = .74)

Table 1. Comparison of variables and their p-value.

Variable	Procedure	DN	ST	P-value
CC time, mean \pm SD (min)	Total	81.36 \pm 25.11	94.12 \pm 28.39	0.013
CPB time, mean \pm SD (min)	Total	135.71 \pm 36.41	142.98 \pm 40.76	0.042
No. of doses of cardioplegia, mean \pm SD (range)	Total	1.71 \pm 0.58	2.85 \pm 1.21	0.021
Intraoperative DC shocks, n(%)	Total	136 (27.2)	164 (32.8)	0.921
Inotropic support, n(%)	Total	367 (73.4)	394 (78.8)	0.740
Decrease in EF, n(%)	Total	52 \pm 3	50 \pm 2	0.729
S. Lactate levels	Total	6.3 \pm 3.4	7.5 \pm 3.1	0.634
VIS score	Total	14.6 \pm 3.6	16.2 \pm 4.1	0.664
CRP	Total	7.2 \pm 4.4	8.9 \pm 4.7	0.676

Table 2. Baseline Demographics

Variable	DN	ST	P-value
Total n	500	500	
CABG, n(%)	76 (15.2)	81 (16.2)	
DVR, n(%)	46 (9.2)	43 (8.6)	
AVR, n(%)	74 (14.8)	72 (14.4)	
MVR, n(%)	96 (19.2)	92 (18.4)	
ASD, n(%)	72 (14.4)	80 (16)	
VSD, n(%)	75 (15)	76 (15.2)	
TOF, n(%)	61 (12.2)	56 (11.2)	
Age (years)	30.66 +/- 7.23	32.18 +/- 6.33	0.71
Gender (male), n(%)	289 (57.8)	266 (53.2)	0.57
BSA	1.21 +/- 0.06	1.18 +/- 0.09	0.69

DISCUSSION :

Cardioplegia solutions are vital in myocardial protection during cardiac surgery. DN decreases need for repeated administration of cardioplegia. Its use in pediatric surgery is well documented. However, only recently it has been in wide use in adult cardiac surgery. This in turn leads to decreased CC and CPB time. Uninterrupted surgery helps in decreasing infection, post operative complications including mortality, less requirement of inotropes. In this study, we have compared DN and ST cardioplegia and observed its effects on various clinical parameters and studied their statistical significance. Both cohorts were comparable on the basis of age, sex and BSA.

Shorter CC and CPB time was evident in patients in whom DN was utilized. This can be attributed to reduced requirement of repeated doses of cardioplegia. When statistical significance was compared for CC, CPB and repeated doses of cardioplegia, the difference was statistically significant with DN was better than ST. Single dose of cardioplegia was required in almost 65% of our cases in DN group. Lower rates of immediate and delayed post operative complications such as decrease in EF, raised serum lactate levels, raised CRP levels, decrease in urine output, raised VIS score was noted more in ST group. However, difference was not statistically significant between the 2 cardioplegia groups. Better myocardial protection and calcium handling took place with respect to DN as compared to ST.

However the difference between the 2 groups was not statistically significant. Superiority of DN vs ST could not be proved statistically with respect to need for inotropic support in post operative period.

CONCLUSION :

Our study demonstrated that patients who received DN had less need for inotropic support in post operative period as compared to ST group. However the differences were not statistically significant.

REFERENCES

- Matte GS, del Nido PJ. History and use of del Nido cardioplegia solution at Boston Children's Hospital. *JECT* 2012; 44: 98-103.
- Graffigna AC, Nollo G, Pederzoli C, Ferrari P, Widescott L, Antolini R. Continuous monitoring of myocardial acid-base status during intermittent warm blood cardioplegia. *EUR J Cardiothorac Surg* 2002; 21: 995-1001.
- Charrete K., Gerrah R, Quaegebeur J, Chen J, Riley D, Mongero L, Corda R, Bacha E. Single dose myocardial protection technique utilising del Nido cardioplegia solution during congenital heart surgery procedures. *Perfusion* 2012; 27: 98-103.
- Breisblatt WM, Stein KL, Wolfe CJ, et al. Acute Myocardial dysfunction and recovery : a common occurrence after coronary bypass surgery. *J Am Coll Cardiol* 1990; 15: 1261-9.
- Bolde J, Hammermann H, Hempelmann G : What is the place of phosphodiesterase inhibitors? *Eur J Anaesthesiol Suppl* 1993, 8:33-37.
- Wernovsky G, Wypij D, Jonas RA, Mayer JE, Jr, Hanley FL, Hickey PR, Walsh AZ, Chang AC, Castaneda AR, Newburger JW, et al. Postoperative course and hemodynamic profile after the arterial switch operation in neonates and infants. A comparison of low-flow cardiopulmonary bypass and circulatory arrest. *Circulation*. 1995;92(8):2226-2235.
- Michael G. Gaies, Howard E. Jeffries, Robert A. Niebler, et al. Vasoactive inotropic support (VIS) is associated with outcome after infant cardiac surgery : analysis from the pediatric cardiac critical care consortium (PC4) and virtual PICU system registries. *Pediatric Criti Care Med*. 2014 Jul; 15(6): 529-537.
- PP. K. Waghlikar, A. Golden, R. Kashyap, et al. Vasoactive inotrope score predicts morbidity and mortality in adult patients with congenital heart disease undergoing cardiac surgery. *American journal of Respiratory and Critical care medicine* 2013;187:A1585.