Intermittent antegrade cardioplegia: Implications for donor heart preservation

Experimental Surgical Services

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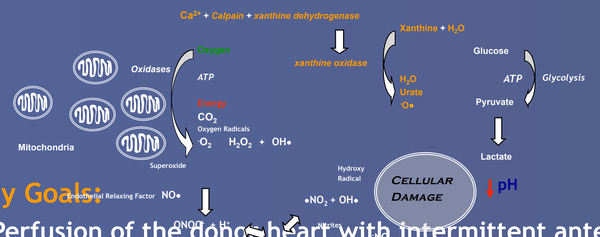
Introduction:

Despite intense effort to increase awareness of organ donation, a slight decline in the number of suitable donor hearts has occurred in the last 10 years. A major problem in donor heart procurement is the limited time a donor heart remains viable, thus some donor hearts are removed from the donor pool. The global ischemia induces glycolysis cumulating in oxygen radical formation, lactic acidosis and irreversible cellular injury.

Biochemical Pathways of Metabolite Formation



Study Goals:

Perfusion of the donor heart with intermittent antegrade cardioplegic solution will raise myocardial pH and improve myocardial perfusion

Methods and Materials:

- Porcine hearts were flushed with a ribose based cardioplegic solution and stored at 9.2˚C for 6.1 ±0.6 hrs in the Asporto device (Hibernicor, LLC).
- Control hearts (Group 1, n = 9) did not receive additional perfusion, experimental hearts (Group 2, n = 8) received intermittent antegrade cardioplegia (150 ml, q30 min, 150 ml/min).
- Khuri pH probes were placed into the LV and RV myocardium for continuous measurement.
- Following removal from the device, contrast enhanced T-1 weighted MR imaging was performed in the short axis view. Peak contrast enhancement was used as a measurement of viable microvasculature. Wet/dry weight was then measured.

Figure 1: The Hibernicor Asporto heart preservation device consists of a lighweight pump, touchscreen microcontroller, and insulated thermo-electric cooler powered by 120 VAC or 12 VDC which maintains a temperature between 4.5 and 10˚C.

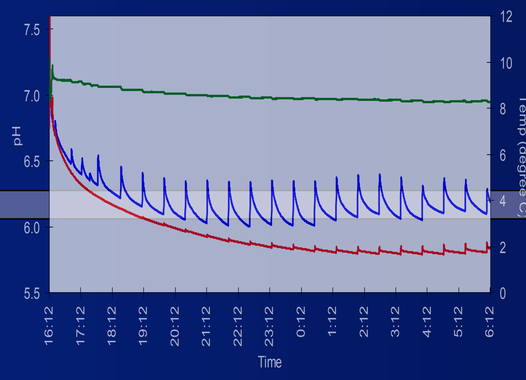


Figure 2: Intermittent antegrade cardioplegia causes a rise in pH in Group 2 hearts that is more apparent in the LV (blue line) as compared to the RV (red line). The temperature (green line) remained stable at 9˚C.

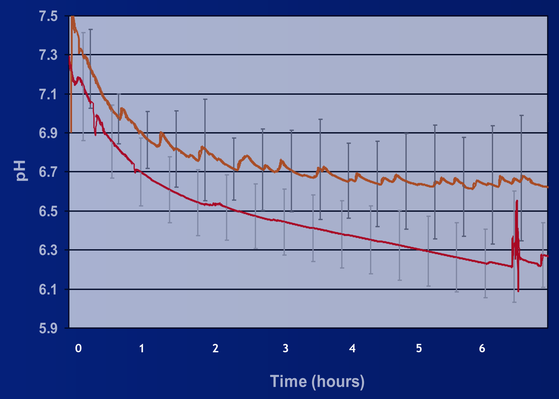


Figure 3: LV myocardial pH of the Group 1 control hearts (red line) immediately following one liter of antegrade cardioplegic solution. Intermittent antegrade cardioplegia of Group 2 experimental hearts (orange line) maintained a significantly higher pH ($p < .005$).

Results:

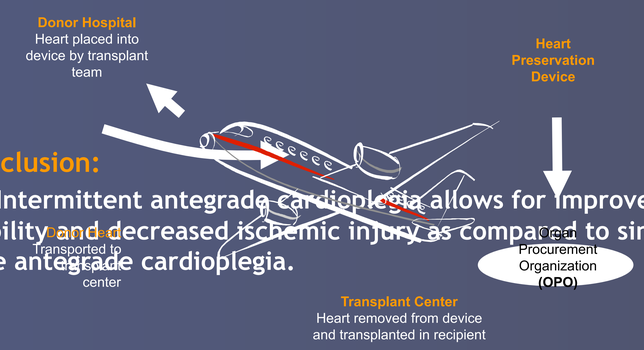
In both groups, myocardial LV pH decreased. In Group 1 hearts with only single dose of antegrade cardioplegia, pH decreased to 6.2 ±0.2 as compared to Group 2 hearts with intermittent antegrade cardioplegia where the pH at the end of 6 hours was 6.7 ±0.3. The mean pH difference was 0.55 ($p < .005$). The RV had a similar pH response to perfusion ($p = .02$). MR contrast imaging showed no differences in peak perfusion enhancement in the 2 groups, Group 1 = 62%, Group 2 = 40% (p = NS). There was also no difference of the wet/dry weight ratio.

Discussion:

Use of intermittent antegrade cardioplegia as opposed to a single antegrade dose may lead to improved preservation of the donor heart. This may have a favorable effect on the number of potential donors by allowing for longer distance procurement.

Opportunities with improved donor heart preservation

- Fewer marginal hearts
- HLA based donor-recipient matching
- Higher transplant success rates



Conclusion:

Intermittent antegrade cardioplegia allows for improved viability and decreased ischemic injury as compared to single dose antegrade cardioplegia.

Financial Disclosure: Dr. Rivard is a member of Hibernicor LLC.