Monosodium Aspartate for Use in Cardioplegia Solutions

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Cardioplegia

Elective procedure to halt cardiac mechanical activity temporarily

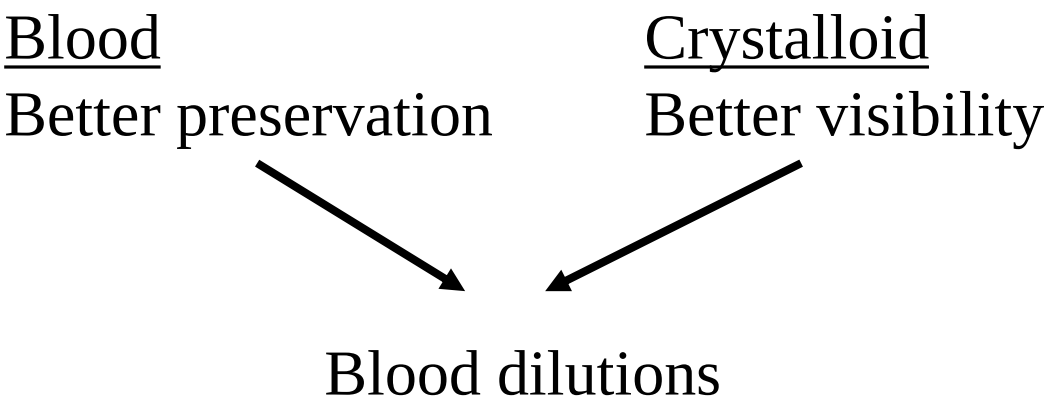
Contractility is controlled by interference with electrical activity

- “Resting” membrane potential is set by

$$\frac{[K^+]_o}{[K^+]_i}$$

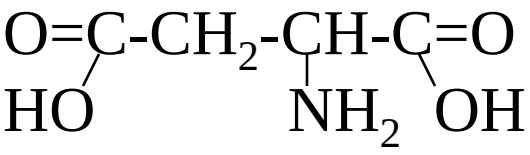
- Raising extracellular potassium depolarizes the membrane and interrupts the electrical rhythm of the heart.

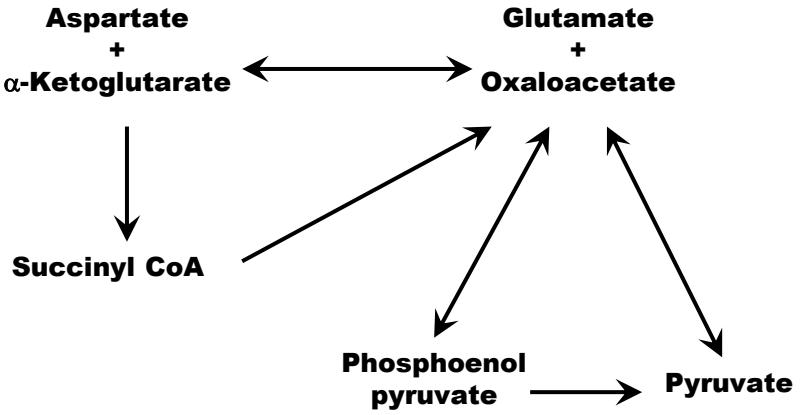
Cardioplegia solutions have evolved through experience, not controlled clinical trials



Aspartic acid

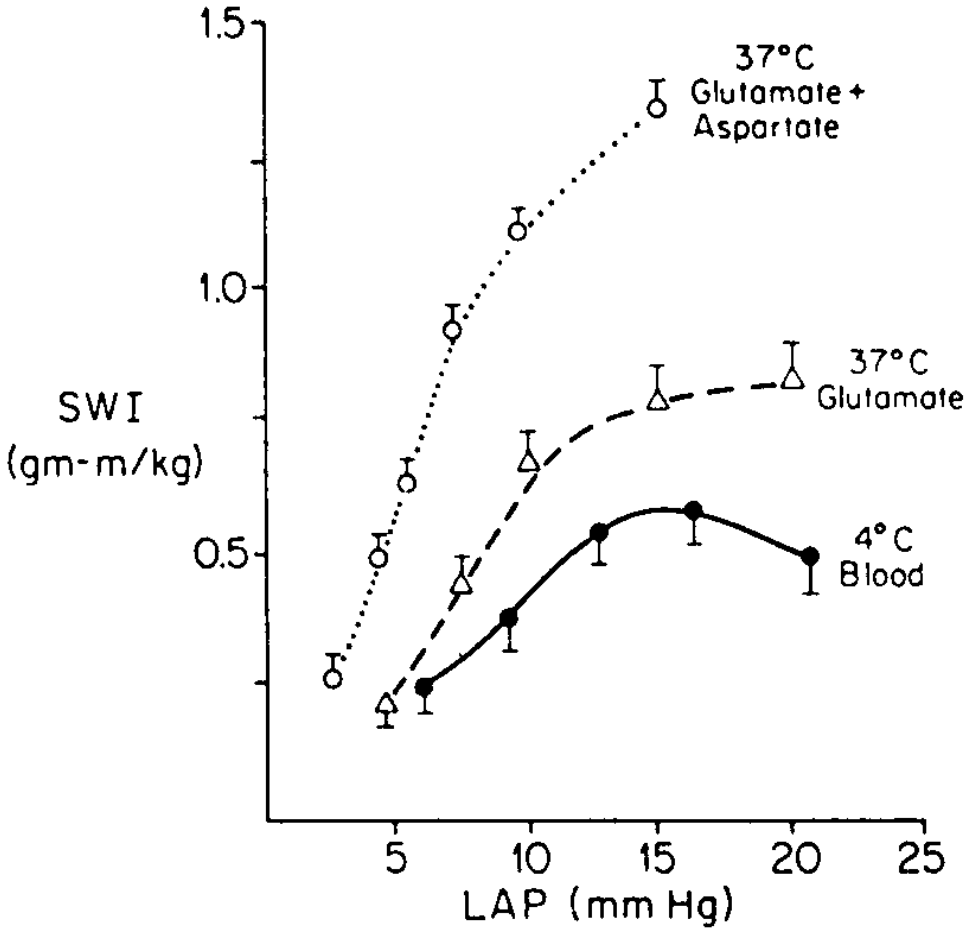
- Non-essential amino acid





- Part of respiratory chain
- CNS transmitter

Aspartate aids recovery of function in a reperfusion model



Sample cardioplegia solutions

Purpose	Substance	For	Final composition
Cold induction	KCl THAM CPD D5 + 1/4 NS	K^+ pH Ca^{++} Osmolarity	18-20 mEq/L 7.7-7.8 0.5-0.6 mM 340-360 mOsm
Warm induction	KCl THAM CPD Glucose Glutamate/Aspartate D5W	K^+ pH Ca^{++} Osmolarity	20-25 mEq/L 7.5-7.6 0.15-0.25 mM >400 mg% 13 mM each 380-400 mOsm
Cold maintenance	KCl THAM CPD D5 + 1/4 NS	K^+ pH Ca^{++} Osmolarity	8-10 mEq/L 7.7 0.5-0.6 mM 340-360 mOsm
Warm reperfusion	KCl THAM CPD Glucose Glutamate/Aspartate D5W	K^+ pH Ca^{++} Osmolarity	8-10 mEq/L 7.5-7.6 0.15-0.25 mM >400 mg% 13 mM each 380-400 mOsm

Specifications

	Na Glutamate (NF)	**Na Aspartate (Supplier)**
Assay	99.0-100.5%	98.5-101%
pH	6.7-7.2	6.0-7.5
Heavy metals	≤20 ppm	≤10 ppm
NH_4	—	≤0.02%
SO_4	—	≤0.03%

Clinical experience

- Loop et al., 1992: Less morbidity among 819 consecutive cases with blood cardioplegia with aspartate and glutamate than in 2582 concurrent consecutive cases with crystalloid cardioplegia.
- Buckberg et al., 1995: 1.6% total mortality among 1474 cases in 4 centers.

Safety

- Aspartate is a natural amino acid with plasma levels to ~30 μM.
- Total circulating levels of amino acids equivalent to ~3 mM.
- High aspartate and glutamate during maintenance leads to peripheral vasodilation.

Recommendation

- Use of aspartate is supported by clinical experience, if not controlled studies
- No safety concerns evident in literature
- No role for potassium salt

- Sodium aspartate should be approved for pharmacy compounding