

Title : URINE AND SERUM K⁺ AFTER K⁺ CARDIOPLEGIA IN MAN

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Introduction. Potassium cardioplegia is an effective myocardial preserving technique and is now being used extensively in heart surgery. After clamping the aorta, potassium is injected either directly into the coronary ostia or indirectly into the aortic root and complete cardiac standstill ensues. Potassium in significant amounts is repeatedly injected and it is a cause for concern because of potential post bypass hyperkalemia and arrhythmias. This study was done to determine the effect of potassium cardioplegia on serum and urine potassium during and after bypass.

Method. A control group of 4 males and 2 females 34-60 y/o scheduled to undergo coronary bypass (4), mitral valve replacement (1) and mitral annuloplasty (1), was compared to a study group of 20 males and 4 females 40-73 y/o scheduled to undergo coronary bypass (14), mitral valve (3) and aortic valve replacement (6), and mitral commissurotomy (1). All were medicated with morphine .1 mg/Kg and scopolamine .4 mg about 90 minutes before induction. Anesthesia was induced and maintained with diazepam, fentanyl, pancuronium, and N₂O in oxygen supplemented occasionally with halothane. Lactated Ringers solution was given to maintain normal ventricular filling pressure. The pump was primed with 3 liters of Plasmalyte (Na=140, K=5, Mg=3, Cl=98, acetate=27, and gluconate=23, mEq/L) albumin 75 gm, heparin 8,000 u, calcium chloride 1.2 gm, and THAM 20 gm. Myocardial preservation in the control group was achieved by whole body cooling down to 20-30°C and in the study group by cardioplegic injections of 500-750 ml of cold blood to which potassium 30 mEq/L was added and given at 30 minute intervals. No diuretics were given during the study to either group. The following were measured or derived A) just prior to bypass, B) every 15 minutes during bypass and C) during the first post bypass hour: 1) Serum and urine potassium levels. 2) Urine output. 3) Total urine excretion of potassium and sodium.

Results. (See tables) Mean serum potassium was within normal limits in both groups at all times. However, serum potassium was higher in the study group during bypass ($p < 0.05$) and after ($p < 0.025$). Some individuals in the study group had serum potassium as high as 5.9 mEq/L and others as low as 3.3 mEq/L after bypass. Urine potassium excretion was significantly higher in the study group during bypass ($p < 0.025$) and after ($p < 0.05$). Serum Na was higher in the study group during bypass ($p < 0.0005$) and after ($p < 0.005$). Urine Na level and excretion were higher in the control group after bypass ($p < .05$ for both). No significant differences were found in 1) urine output during bypass (control 549 ± 100 , study 542 ± 59 ml/hr) and after (control 393 ± 119 , study 338 ± 40 , ml/hr), and 2) urine potassium level during bypass (control 13 ± 2.3 , study 20 ± 1.9 mEq/L) and after (control 37 ± 11 , study 39 ± 3 mEq/L). Mean total potassium cardioplegic dose was 46 ± 21 mEq. Bypass time was longer in the study group (144 ± 55 vs

93 ± 39 minutes, $p < 0.0125$).

Discussion. No cases of severe persistent hyperkalemia occurred in either group. This data suggests that no particular measures such as diuretic or insulin are required to protect patients from 50 or less mEq of cardioplegic potassium injections. Sodium lower excretion and higher serum level in the study group were probably due to the higher potassium excretion. This is in agreement with the concept of Na-K excretion interdependency.

References.

1. Levitsky S, Feinberg H: Intraoperative protection of the myocardium. Surg Annu 10:305-320, 1978.
2. Swales JD: Sodium Metabolism in Disease. Loyd-Luke Ltd., London 1975, pp. 272-298.

	Control	Study
K, mEq/L		
Pre CPB	$3.85 \pm .13$	$3.98 \pm .09$
On CPB	$4.30 \pm .18$	$4.80 \pm .15$
Post CPB	$3.66 \pm .17$	$4.14 \pm .09$
Na, mEq/L		
Pre CPB	138 ± 1.2	$136 \pm .6$
On CPB	133 ± 1.2	$137 \pm .4$
Post CPB	134 ± 1.2	$138 \pm .4$

Table 1: Changes in serum K and Na after potassium cardioplegia. Mean \pm Standard Error.

	Control	Study
K, mEq/hr		
Pre CPB	$3.8 \pm .2$	$3.0 \pm .1$
On CPB	$7.4 \pm .6$	13.0 ± 1.1
Post CPB	6.7 ± 1.2	11.0 ± 1.0
Na, mEq/L		
Pre CPB	69 ± 16	53 ± 9.4
On CPB	121 ± 6	120 ± 3.0
Post CPB	102 ± 5	86 ± 6
Na, mEq/hr		
Pre CPB	4.9 ± 1.0	$4.4 \pm .6$
On CPB	60 ± 8.0	58 ± 10
Post CPB	45 ± 15	32 ± 4.9

Table 2: Changes in urine K and Na after potassium cardioplegia. Mean \pm Standard Error.