Effect of perioperative sodium bicarbonate on postoperative acute kidney injury in infective endocarditis patients

Jin Sun Cho, Young Ran Kang, Sung Yeon Ham, Young Lan Kwak
Department of Anesthesiology and Pain Medicine, Yonsei University College of Medicine

Background

- **Acute kidney injury (AKI)** following cardiac surgery is associated with inflammation, oxidative stress, and generation of oxygen free radicals.
- Patients with infective endocarditis (IE) have a high risk of AKI due to systemic inflammation and infection.
- **Sodium bicarbonate** has intrinsic natriuretic effects and ability to alkalize tubular fluid, increasing oxygen delivery and reducing oxidative stress by free radical formation.
- We investigated whether perioperative sodium bicarbonate infusion could attenuate AKI in IE patients undergoing valvular heart surgery

Methods

Inclusion criteria

- IE patients (> 20 years) undergoing elective valvular heart surgery with cardiopulmonary bypass

Exclusion criteria

- LV ejection fraction less than 30%, congestive heart failure, renal insufficiency (eGFR < 15 ml/min per 1.73m²)

Study groups

- **Control group:** saline infusion
- **Bicarbonate group:** sodium bicarbonate was administered at a loading dose of 0.5 mmol/kg for 1 h commencing with anesthetic induction, followed by an infusion rate of 0.15 mmol/kg/h for 23 h..

Primary outcome:

- the incidence of AKI during the first postoperative 48 h

Secondary outcomes

- serum creatinine level and glomerular filtration rate during the postoperative 5 days, and major morbidity endpoints

Results

Table 1. Patient characteristics

	Control group (n = 33)	Bicarbonate group (n = 29)	P-value
Age (years)	54.4 ± 15.9	53.8 ± 14.6	0.881
Sex (M:F)	24:9	17:12	0.118
Body mass index (kg/m ²)	22.0 ± 3.5	22.0 ± 3.3	0.991
Hypertension	7	10	0.307
Diabetes mellitus	4	3	0.758
Congestive heart failure	1	0	0.329
Chronic renal failure	1	2	0.514
Cerebrovascular disease	4	3	0.758
ACEi/ ARB	4/ 5	6/ 4	0.419/ 0.800
β-blockers	6	7	0.653
calcium channel blockers	2	4	0.344
diuretics	10	13	0.317
Redo	3	5	0.389
Complex heart surgery	5	6	0.569
Preoperative ejection fraction (%)	64.5 ± 8.6	66.6 ± 7.1	0.303
EuroSCORE	5.5 ± 3.5	6.1 ± 3.1	0.487
Cleveland Clinic Score*	1.5 ± 1.0	1.9 ± 0.7	0.097
Anesthesia time (min)	273.4 ± 78.0	264.2 ± 105.4	0.703
Cardiopulmonary bypass time (min)	123.0 ± 53.0	112.2 ± 77.6	0.529

Table 2. Incidence of acute kidney injury

AKIN classification	Control group (n = 33)	Bicarbonate group (n = 29)	P-value
None (n)	26 (79%)	20 (69%)	0.459
Stage 1 (n)	6 (18%)	5 (17%)	0.833
Stage 2 (n)	1 (3%)	2 (7%)	0.514
Stage 3 (n)	0	2 (7%)	0.137
Any category	7 (21%)	9 (31%)	0.459

Table 3. Serum creatinine and glomerular filtration rate

Variables	Time points	Control group (n = 33)	Bicarbonate group (n = 29)	P Group × Time
Serum creatinine (mg/dl)	T0	0.83 ± 0.23	0.85 ± 0.24	0.077
	T1	0.77 ± 0.26*	0.73 ± 0.23*	
	T2	0.95 ± 0.32*	1.03 ± 0.42*	
	T3	0.90 ± 0.34	1.19 ± 0.70*†	
	T4	0.84 ± 0.31	1.15 ± 0.75*	
	T5	0.80 ± 0.26	1.03 ± 0.69	
Glomerular filtration rate (ml/min per 1.73 m ²)	T0	92.2 ± 32.4	86.9 ± 36.9	0.083
	T1	103.6 ± 40.9*	102.7 ± 44.4*	
	T2	83.1 ± 34.0*	78.7 ± 40.8	
	T3	90.1 ± 39.3	72.5 ± 38.8*	
	T4	96.5 ± 38.7	77.3 ± 40.3	
	T5	99.5 ± 34.2	84.9 ± 44.7	

Table 4. Postoperative outcomes

	Control group (n = 33)	Bicarbonate group (n = 29)	P value
Composite of morbidity endpoints	8	11	0.369
permanent stroke	3	0	0.073
hemostatic reoperation	3	4	0.681
acute kidney injury	4	9	0.102
ventilator care >48 h	1	2	0.550
deep sternal wound infection	0	1	0.312
in-hospital mortality	1	0	0.312
Duration of ventilator care (hour)	18 [14, 19]	16 [9, 22]	0.991
Duration of ICU stay (day)	2 [2, 3]	2 [1, 3]	0.881
Duration of hospital stay (day)	23 [18, 34]	19 [16,32]	0.524

Conclusions

Perioperative sodium bicarbonate administration did not demonstrate the favourable impact on renal function in IE patients undergoing cardiac surgery.