

Predictors of vasopressin induced hyponatremia in infants following congenital heart surgery

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Background

Hyponatremia is associated with increased hospital morbidity and mortality and occurs in about 25% of hospitalized children. Vasopressin has become increasingly used to treat hypotensive shock following cardiac surgery due to its unique vasoconstrictive properties compared to catecholamines. However, vasopressin use has also been associated with increased incidence of hyponatremia, of which neonates are at particular high risk due to immature renal function.

Objectives

Determine the effect and risk factors leading to hyponatremia and sodium variability in infants receiving vasopressin in the immediate postoperative period following congenital heart surgery.

Aims

- Assess whether infants receiving vasopressin post-cardiac surgery are more likely to have hyponatremia than infants who do not receive vasopressin.
- Evaluate if vasopressin use is associated with increased sodium variability.
- Identify potential risk factors for hyponatremia in infants who receive vasopressin.

Methods

75 consecutive infants < 90 days of age who underwent their first cardiac surgery involving cardiopulmonary bypass at a single center between 2018-2020 were included in this retrospective analysis. Maximum and minimum serum sodium levels were collected for the first 5 postoperative days as well as daily vasopressin dose ranges and cumulative vasopressin dose. Comparisons across postoperative days within- and between- patients who received vasopressin were examined using mixed effects linear regression.

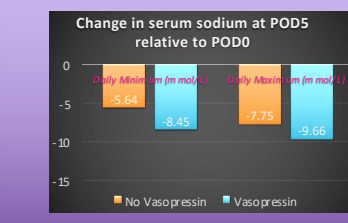
Results

Demographics: 36 of the 75 patients received vasopressin during the study. Mean age ranged from 14-24 days. Groups were equivalent in terms of gestational age, weight, total diuretic dose, supplemental sodium load, RACHS-1 score, and mortality.

Differences: The vasopressin group had a corrected age younger by 12 days, increased total fluid intake by 81mL/kg and had a net fluid balance more negative by 68mL/kg ($p<0.05$).

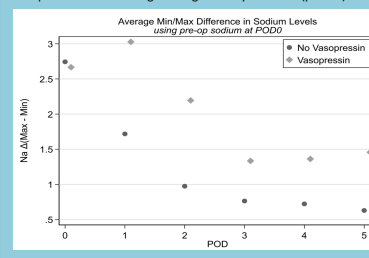
Clinical findings:

(1) There was an overall decrease in serum sodium among all patients relative to baseline serum sodium levels ($p<0.001$).

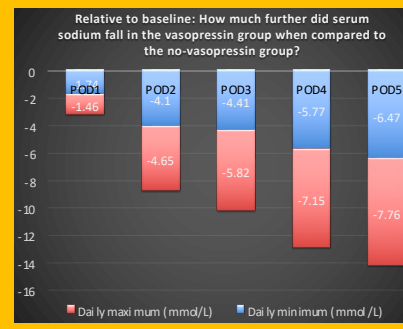
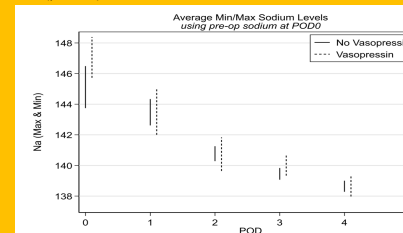


(3) The vasopressin group showed increased variability between daily sodium minimum and maximum levels on day 1 and 2 (POD1 1.31mmol/L and POD2 1.227mmol/L) relative to control ($p<0.05$).

(4) By POD3, both within- and between- group sodium variability compared to baseline began to significantly decrease ($p<0.05$).



(2) The vasopressin group had an increased fall in sodium from preoperative levels compared to the no vasopressin group that was significant beyond the first postoperative day (POD1) and increased over time ($p<0.001$).



Events: There were 7 events of moderate-severe hyponatremia (sodium <130mEq) in the vasopressin group and 2 in the control group ($p=0.10$).

Risk factors:

- Cumulative vasopressin dose was a risk factor for sodium variability.
- Not associated: age, volume of modified ultrafiltration, or total diuretic dose.

Conclusions

- Vasopressin use in infants after cardiac surgery involving cardiopulmonary bypass is associated with overall increased risk of hyponatremia as well as increased variability in serum sodium levels in the early postoperative period.
- Vasopressin was associated with an increased risk for wide fluctuations in daily sodium early postoperatively, which decreases over time and suggests progression to sodium equilibrium.
- Hyponatremia appears to also be associated with cumulative vasopressin dose.
- Age, preoperative weight, and total diuretic dose were not associated with increased sodium variability or risk for hyponatremia in this study.

Significance

- Infants following cardiac surgery should be monitored for hyponatremia in the early postoperative period regardless of vasopressin administration.
- One should consider monitoring sodium levels more frequently in post-operative infants receiving vasopressin and especially those with a higher cumulative vasopressin dose.
- Further research may provide insight as to how to best mitigate the effects of vasopressin on sodium variability.