Sodium to potassium ratio during urinary electrolytes continuous monitoring as a surrogate of intravascular volume trends and cardiac output in mechanically ventilated piglets: preliminary data from a preclinical trial

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Introduction

The renin angiotensin aldosterone system (RAAS) is one of the homeostatic systems activated in hypoperfusive syndromes [1,2]. RAAS activation leads to an increased urinary sodium and to a decreased urinary potassium excretion, acting on the distal tubule. Urinary sodium to potassium ratio (Na^+_u/K^+_u) could thereby be a good index of RAAS activation and, secondly, blood volume, as already shown by other studies in the literature[3,4].

Materials & Methods

We performed a continuous monitoring of urinary sodium and potassium in an experimental setting carried out on 10 mechanically ventilated pigs. We compared the Na^+_u/K^+_u with several hemodynamic variables collected at the same timepoint. We observed the trends in time of their mean values and, then, we performed the linear regressions.

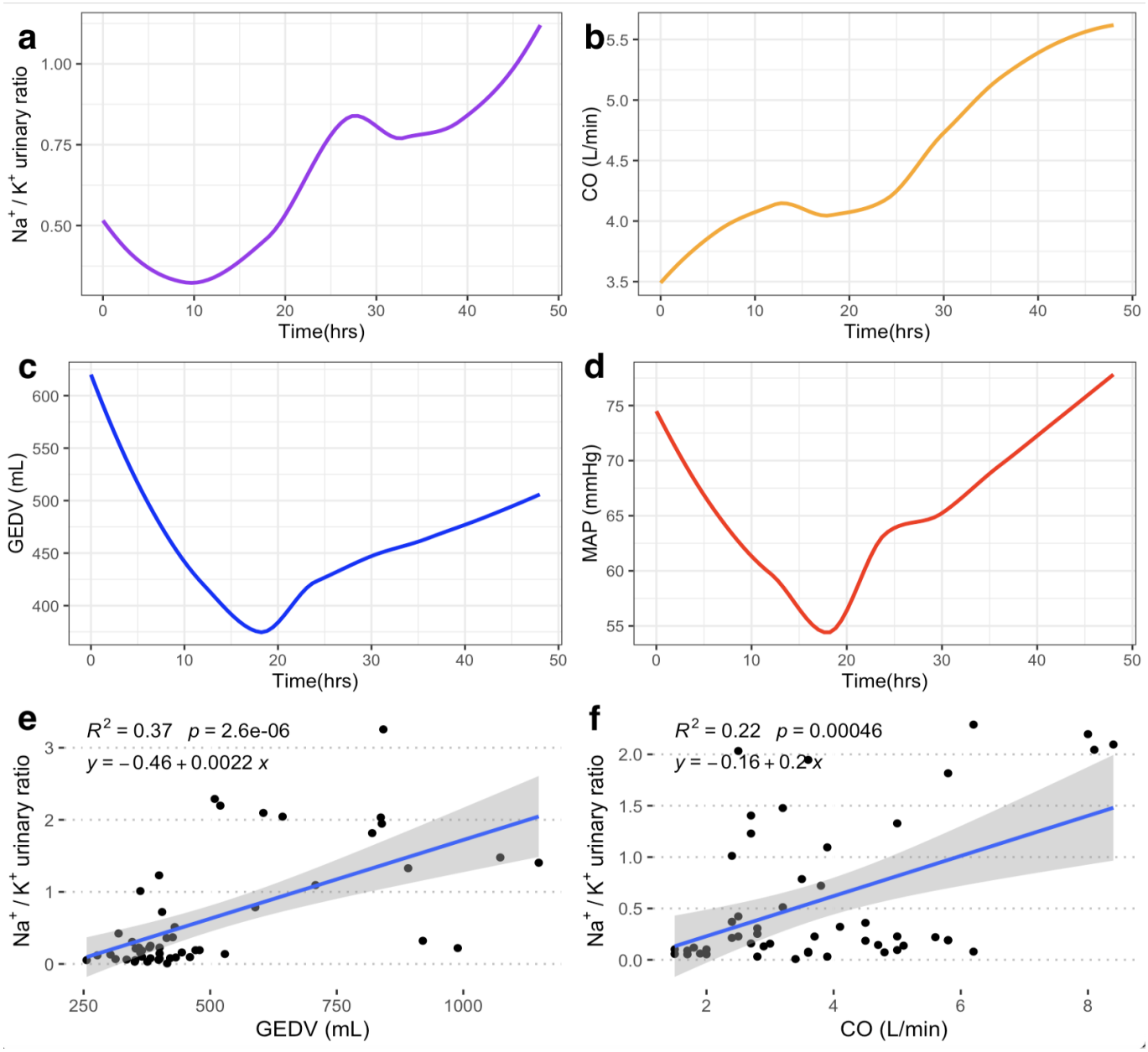
Results

The trend in time of the Na^+_u/K^+_u agrees suggestively with cardiac output (CO), mean arterial pressure (MAP) and GEDV [Figure 1; panel a, b, c, d]. The linear regressions between these variables and Na^+_u/K^+_u show a R^2 of 0.22, 0.34 and 0.22 (respectively, CO, GEDV and MAP with Na^+_u/K^+_u), with a significant p (<0.001) [Figure 1; panel e, f]. However, the dynamic indexes of fluid responsiveness are not equally associated with the Na^+_u/K^+_u .

Discussion and Conclusion

Na^+_u/K^+_u values reflect cardiac output and cardiac preload indexes. This correlation could be direct expression of the RAAS fluctuations in time.

Continuous monitoring of urinary electrolytes could provide precious information about blood volume and the necessity of fluid therapy in non-critically ill patients undergoing mechanically ventilation, especially when advanced hemodynamic monitoring is not in place. In these situations, urinary electrolytes and particularly their trend in time can be source of precious information, with a low grade of invasiveness.


a
Na+ / K+ urinary ratio
1.00
0.75
0.50
0
10
20
30
40
50
Time(hrs)
b
CO (L/min)
5.5
5.0
4.5
4.0
3.5
Time(hrs)
c
GEDV (mL)
600
550
500
450
400
Time(hrs)
d
MAP (mmHg)
75
70
65
60
55
Time(hrs)
e
R2 = 0.37 p = 2.6e-06
y = −0.46 + 0.0022 x
Na+ / K+ urinary ratio
3
2
1
0
250
500
750
1000
GEDV (mL)
f
R2 = 0.22 p = 0.00046
y = −0.16 + 0.2 x
Na+ / K+ urinary ratio
2.0
1.5
1.0
0.5
0.0
2
4
6
8
CO (L/min)