Sodium and chloride sieving coefficient during continuous venovenous hemofiltration (CVVH) in the critically ill patients

F. ZADEK[1], F. MULAZZANI[1], B. BRUNONI[1], A. ALTOMARE[2] F. MINOTTI[3], T. LANGER[1, 3], R. FUMAGALLI[1, 3]

(1) Department of Medicine and Surgery, University of Milan-Bicocca, Monza, Italy.
(2) Department of Pathophysiology and Transplantation, University of Milano Statale
(3) Department of Anesthesia and Intensive Care Medicine, Niguarda Ca'Granda, Milano, Italy.

INTRODUCTION

CVVH is applied in 8-12% of patients with acute kidney injury admitted to the intensive care unit. Solute removal through the filter is described by the sieving coefficient (SC). The sieving coefficients of sodium (SC_{Na^+}) and chloride (SC_{Cl^-}) are considered to be 1. Actual experimental data are however scarce. Aim of the present study was to measure the sodium and chloride SC both in vitro and in critically ill patients.

METHODS

Patients with indication of CVVH were enrolled. Regional anticoagulation was achieved with diluted citrate 18/0. Replacement solution (Phoxilium) was administered in post-dilution. In-vitro experiments were performed with the same setup, using 2 L of normal saline as reservoir volume. Electrolytes and hematocrit (Hct) were assessed (RAPIDPoint 500 Blood Gas System) *in-vitro* and *in-vivo* after 5 minutes from the CVVH beginning.
Samples were collected (1) pre-filter, after citrate infusion, (2) post-filter, before Phoxilium infusion, and (3) in the ultrafiltrate. The SCs and the differences in sodium and chloride concentration between sites 2 and 1 ($[Na^+]_{2\text{-}1}$ and $[Cl^-]_{2\text{-}1}$) were calculated. Osmolality was measured by the freezing-point technique in in-vivo samples.

RESULTS

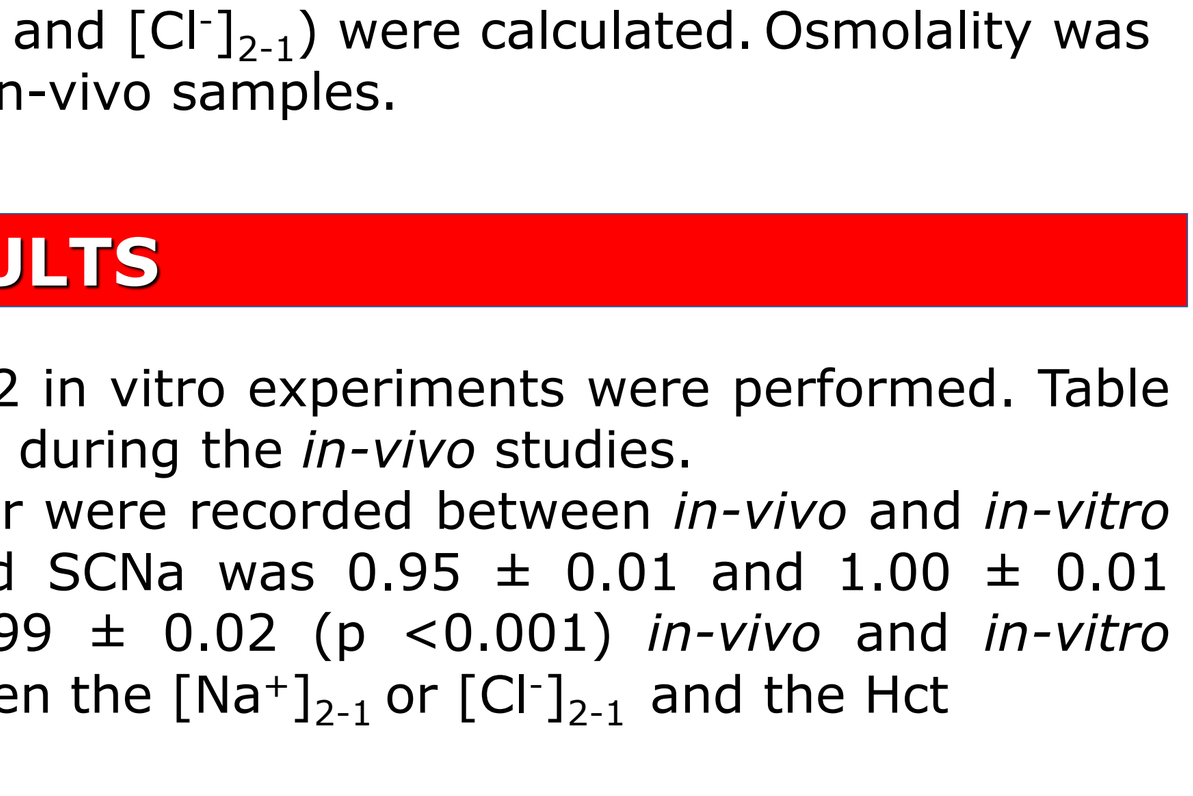
Twenty-seven patients were enrolled, while 12 in vitro experiments were performed. Table 1 summarizes the main parameters measured during the *in-vivo* studies.
Significant differences in Na^+ and Cl^- behavior were recorded between *in-vivo* and *in-vitro* experiments (Figure 1). Moreover, calculated SCNa was 0.95 ± 0.01 and 1.00 ± 0.01 ($p < 0.001$) and SC_{Cl^-} 1.06 ± 0.01 and 0.99 ± 0.02 ($p < 0.001$) *in-vivo* and *in-vitro* respectively. No relationship was found between the $[Na^+]_{2\text{-}1}$ or $[Cl^-]_{2\text{-}1}$ and the Hct ($p = 0.54$ and $p = 0.38$, respectively).

Table 1

In -Vivo Variables	Pre Filter (1)	Post Filter (2)	Ultrafiltrate (3)	p*
[Na^+] mmol/L	138 ± 6	141 ± 6	133 ± 6	p^a <0.001 p^b <0.001
[Cl^-] mmol/L	100 ± 5	97 ± 5	105 ± 6	p^a <0.001 p^b <0.001
Hct %	28 ± 6	38 ± 8	-	p^a <0.001
Alb g/dL	2.5 ± 0.6	3.2 ± 0.6	-	p^a <0.001
Glucose mg/dL	121 ± 42	121 ± 41	129 ± 45	p^a = 0.66 p^b <0.001
Osmolality mOsmol/kg	311 ± 17	312 ± 17	316 ± 27	p^a = 0.75 p^b = 0.40

*p^a: comparison between (1) and (2).
p^b: comparison between (1) and (3).

Figure 1



CONCLUSIONS

Sodium and chloride concentrations change across the filter and differ between filter and ultrafiltrate. The *in-vitro* SCs were in line with available data. However, the *in-vivo* SC_{Na^+} was slightly, but significantly lower than 1, while the in-vivo SC_{Cl^-} was slightly higher than 1.

REFERENCES

1. Hoste EAJ, Bagshaw SM, Bellomo R, et al. Intensive Care Med (2015)
2. Villa G, Neri M, Bellomo R, et al. Crit Care (2016)
3. Paquette F, Goupil R, Madore F, et al. Clinical Kidney Journal (2016)