CRRT: Acid-Base and Electrolytes Corrections

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Vicenza , 37 th course on AKI and CRRT

Agenda

- Infusion of Bicarbonate : So bad in 2019 ?
- Bicarbonate in CRRT : how to use it ?
- Hypernatremia : how to handle ?
- Hyponatremia : what to do ?
- Hyperphosphoremia : Someting to kook after..
- Hypophosphoremia : How to avoid ?
- Hypomagnesemia : What to do ?
- Calcium stores : something to worry about ?
- Conclusions/perspectives

Acid Base :Bicarbonate infusions

Sodium bicarbonate therapy for patients with severe metabolic acidaemia in the intensive care unit (BICAR-ICU): a multicentre, open-label, randomised controlled, phase 3 trial

	Control group (n=194)	Bicarbonate group (n=195)
(Continued from previous page)		
Physiological support†		
Invasive mechanical ventilation	160 (82%)	164 (84%)
Vasopressor support	156 (80%)	154 (79%)
Laboratory results		
Arterial pH	7·15 (7·11–7·18)	7·15 (7·09–7·18)
PaO_2-to-FiO_2 ratio (mm Hg)	229 (142–355)	264 (144–403)
$PaCO_2$ (mm Hg)	37 (32–42)	38 (33–42)
Serum bicarbonate (mmol/L)	13 (10–15)	13 (10–15)
Serum lactate (mmol/L)	5·3 (3·4–9·0)	6·3 (3·6–9·7)
Serum lactate ≥2 mmol/L at enrolment	152 (78%)	168 (86%)
Serum creatinine (mg/dL)	1·76 (1·21–2·48)	1·67 (1·11–2·33)
Blood urea nitrogen (mg/dL)	31 (20–48)	28 (20–45)

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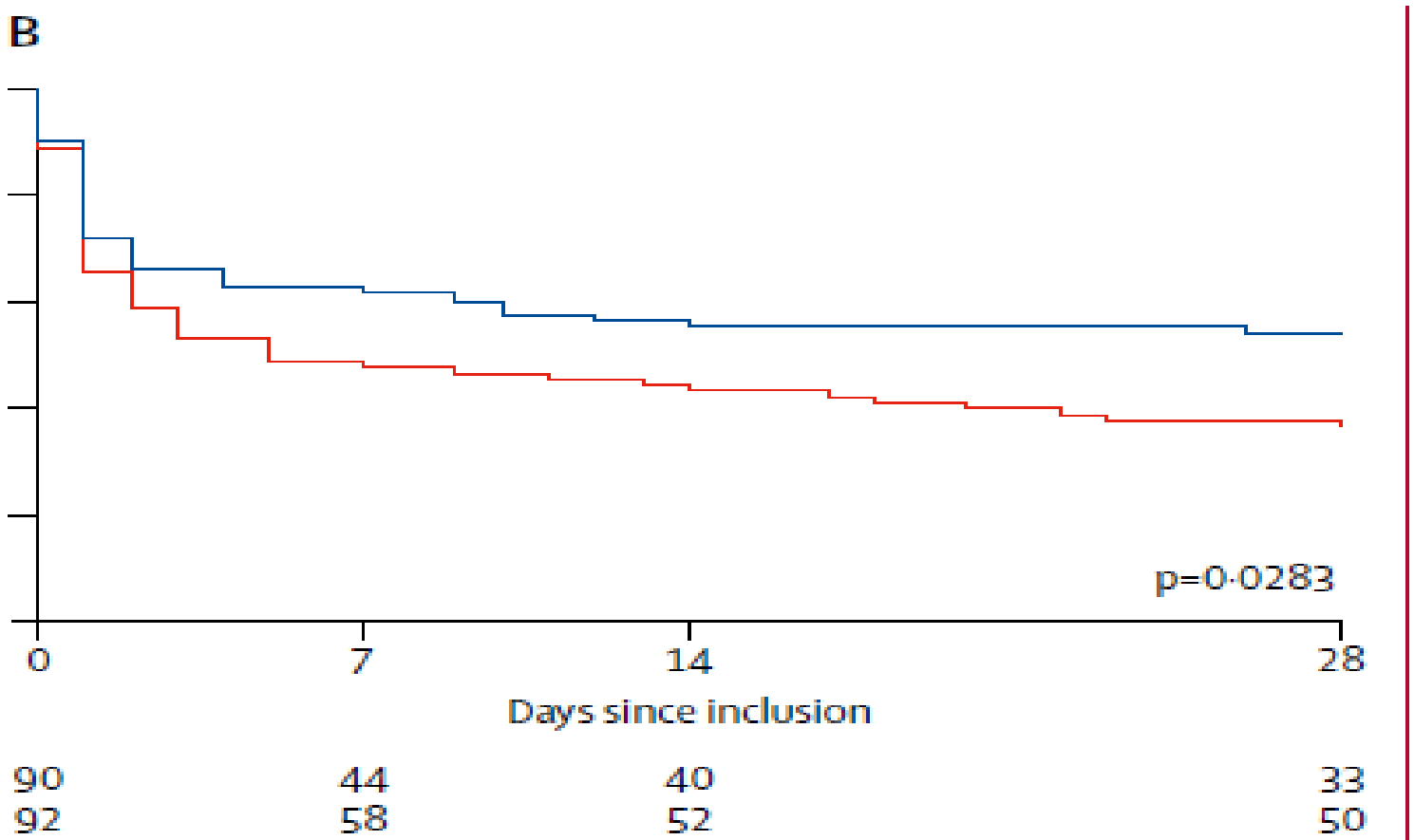

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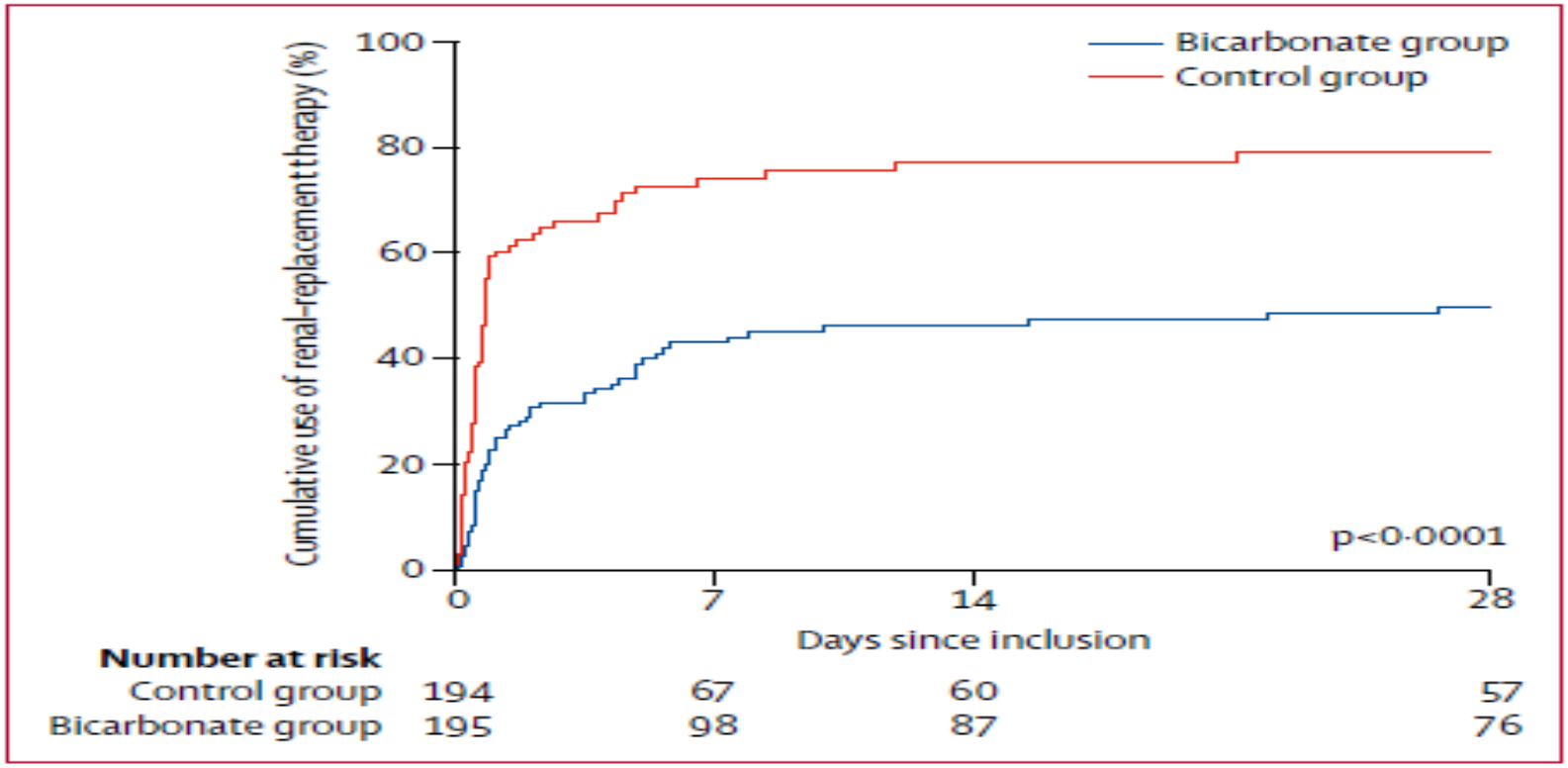

Figure 3: Cumulative use of renal-replacement therapy from enrolment to day 28 in in the overall population

Acid Base :Bicarbonate-How to do in CRRT

RESEARCH Open Access

Effect of continuous dialysis on blood pH in acidemic hypercapnic animals with severe acute kidney injury: a randomized experimental study comparing high vs. low bicarbonate affluent

Thiago Gomes Romano[1,2*], Luciano Cesar Pontes Azevedo[2,3], Pedro Vitale Mendes[2,3], Eduardo Leite Vieira Costa[2,4] and Marcelo Park[2,3]

Methods: We performed a randomized, non-blinded, experimental study. AKI was induced in 12 female pigs via renal hilum ligation and hypoventilation by reducing the tidal volume during mechanical ventilation with the goal of achieving a pH between 7.10–7.15. After achieving the target pH, animals were randomized to undergo isovolemic hemodialysis with one of two bicarbonate concentrations in the dialysate (40 mEq/L [group 40] vs. 20 mEq/L [group 20]).

Conclusions: A higher bicarbonate concentration in the dialysate of animals undergoing hypercapnic respiratory failure was associated with improved blood pH control without increasing the $PaCO_2$ levels.

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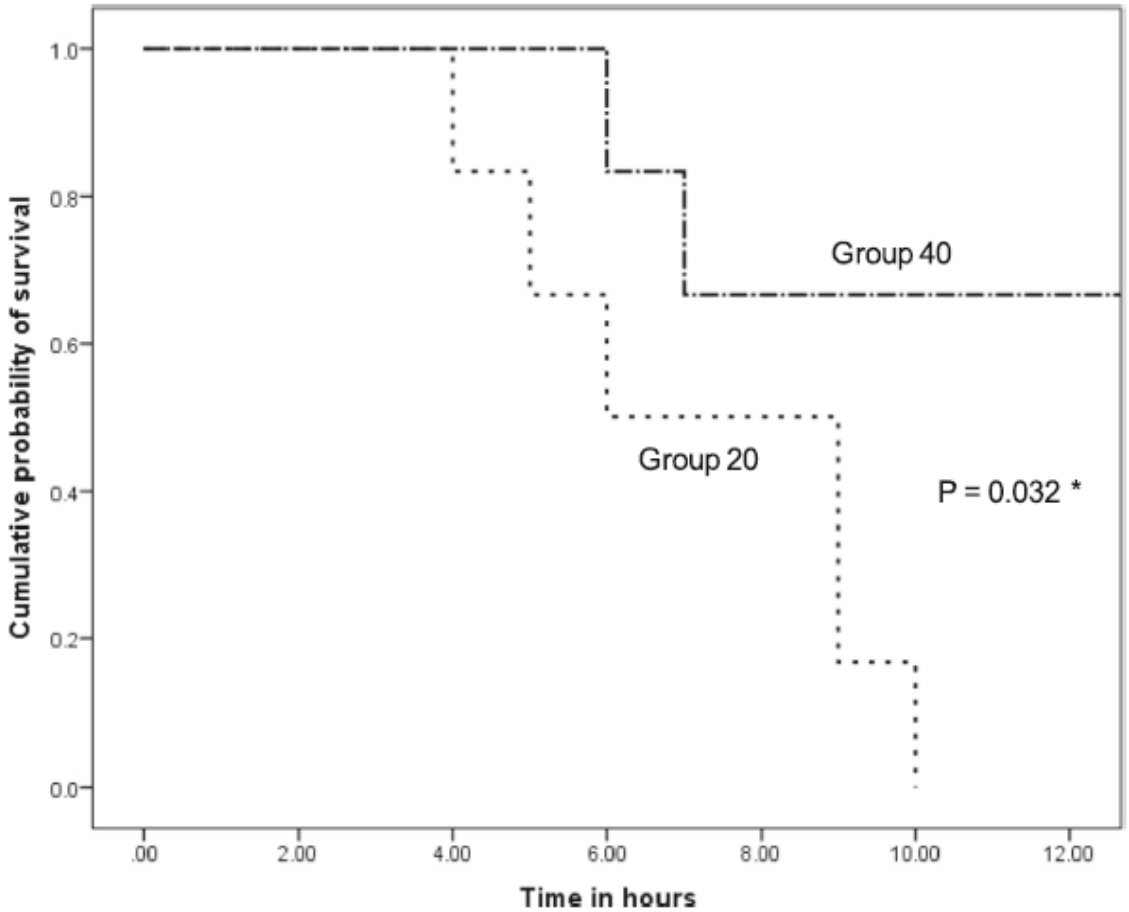

Electrolytes :Hypernatremia

Continuous venovenous hemofiltration using customized replacement fluid for acute kidney injury with severe hypernatremia

François Paquette, Rémi Goupil, François Madore, Stéphan Troyanov and Josée Bouchard

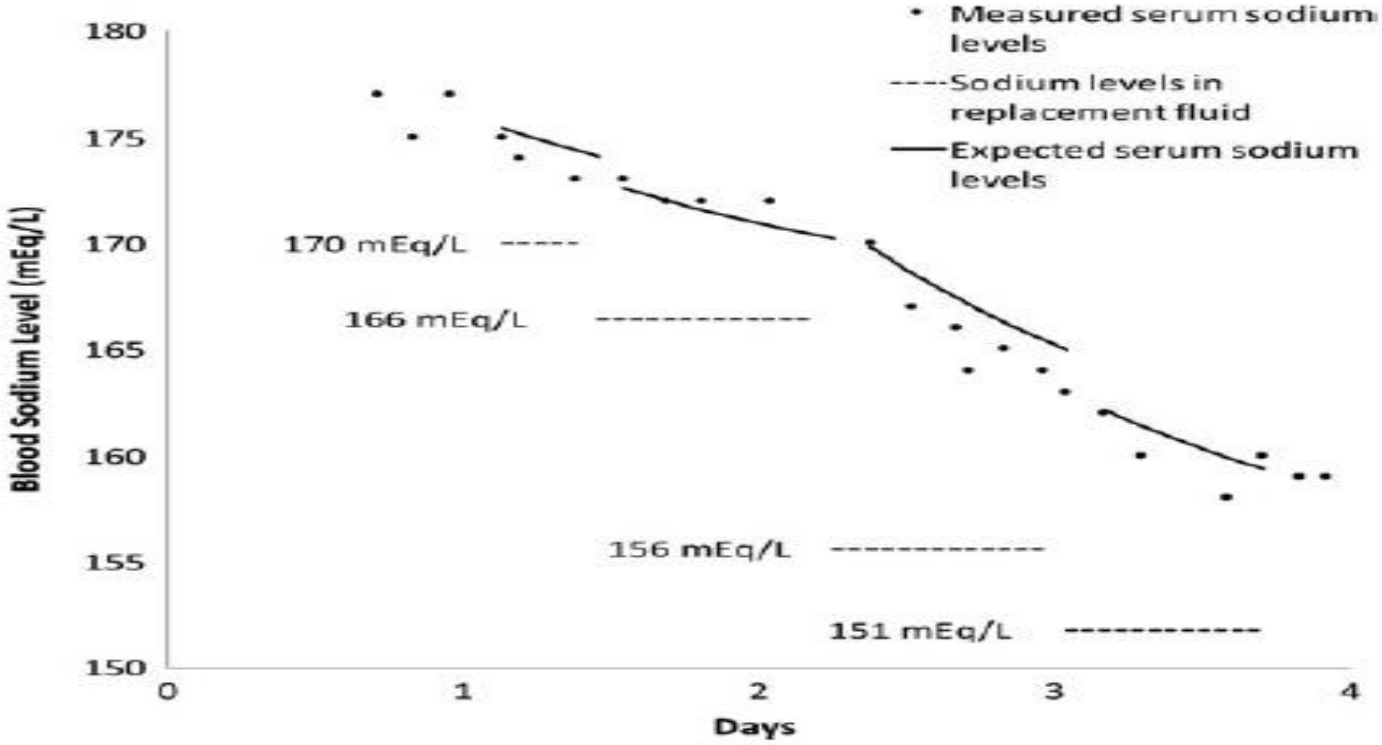

Fig. 1. Serum sodium concentrations before and during CVVH with customized RF solutions. The expected decline in serum sodium concentrations was calculated with the equation provided in the text.

Continuous venovenous hemofiltration using customized replacement fluid for acute kidney injury with severe hypernatremia

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Table 1. Target sodium concentrations in RF solution with required volume of 23% NaCl and 3% NaCl to add to the RF solution

Target final sodium concentration in RF	170 mEq/L	165 mEq/L	160 mEq/L	155 mEq/L	150 mEq/L	145 mEq/L
Volume of 23.4% NaCl to add in a 5-L bag of RF[a]	38 mL (150 mEq)	31 mL (125 mEq)	25 mL (100 mEq)	19 mL (75 mEq)	13 mL (50 mEq)	6 mL (25 mEq)
Volume of 3% NaCl to add in a 5-L bag of RF[b]	294 mL (150 mEq)	245 mL (125 mEq)	196 mL (100 mEq)	147 mL (75 mEq)	98 mL (50 mEq)	49 mL (25 mEq)

[a]1 mL 23.4% NaCl = 234 mg/mL × 17 mEq/g = 3.98 mEq NaCl/mL.

[b]1 mL 3% NaCl = 50 mg/mL × 17 mEq/g = 0.51 mEq NaCl/mL.

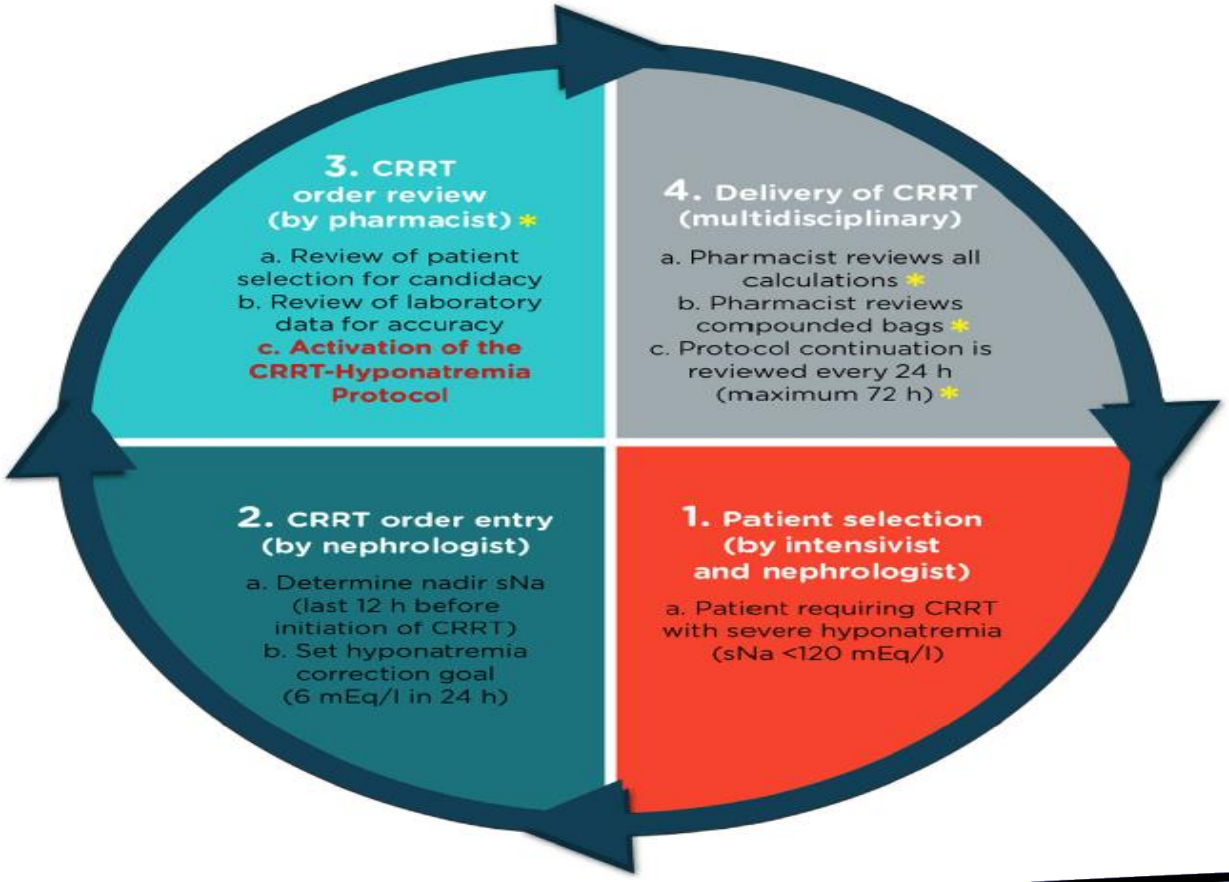
Electrolytes :Hyponatremia

A Multidisciplinary Approach for the Management of Severe Hyponatremia in Patients Requiring Continuous Renal Replacement Therapy

Check for updates

Javier A. Neyra[1], Victor M. Ortiz-Soriano[1], Dina Ali[2], Peter E. Morris[3] and Clayton M. Johnston[2]

[1]Department of Internal Medicine, Division of Nephrology, Bone and Mineral Metabolism, University of Kentucky, Lexington, Kentucky, USA; [2]Department of Pharmacy Practice and Science, University of Kentucky, Lexington, Kentucky, USA; and [3]Division of Pulmonary, Critical Care and Sleep Medicine, University of Kentucky, Lexington, Kentucky, USA



Electrolytes :Hyperphosphatemia

The relationship and threshold of serum phosphate with regard to the 28-day mortality risk in sepsis patients undergoing continuous renal replacement therapy

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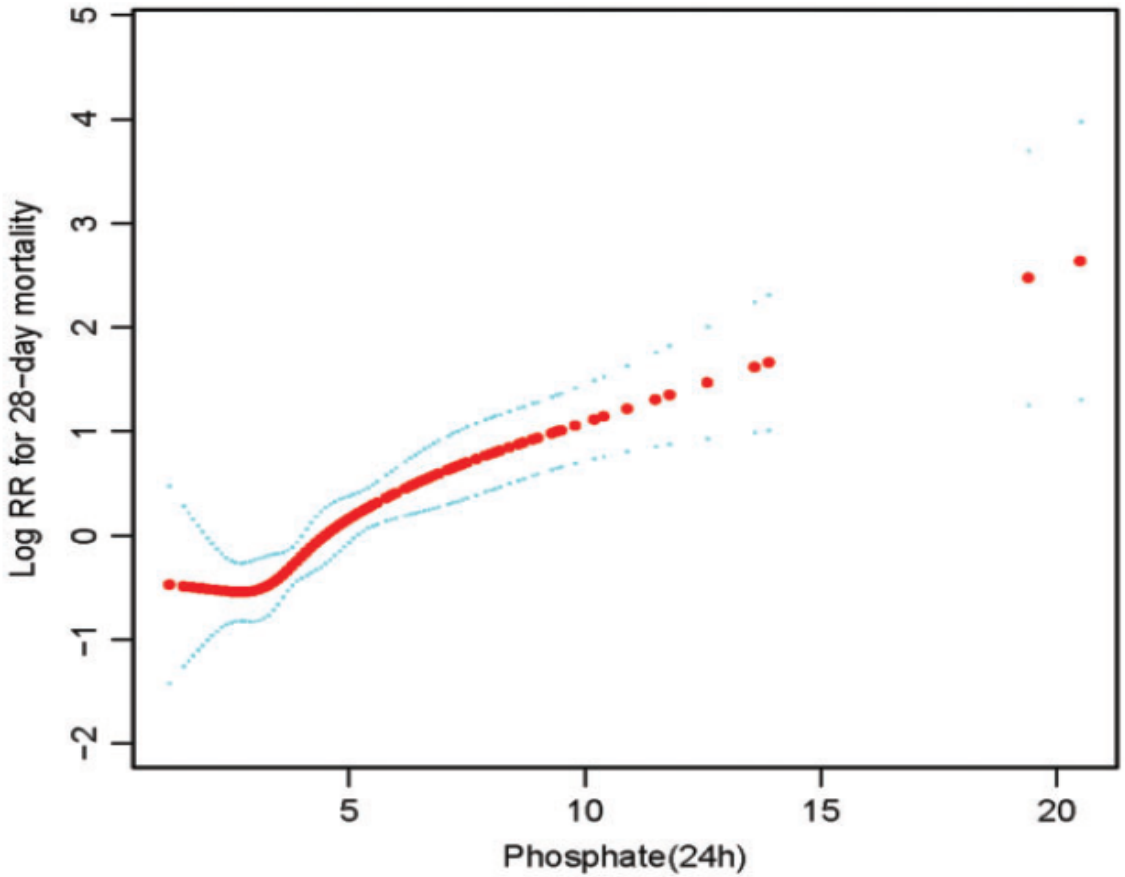

Figure 2. Adjusted smoothing function of the threshold effect analysis of phosphate (24 h) on 28-day mortality in patients ($n = 796$) with septic acute kidney injury undergoing continuous renal replacement therapy. The colour version of this figure is available at: http://imr.sagepub.com.

Electrolytes :Hypophosphatemia

Preventing Continuous Renal Replacement Therapy-Induced Hypophosphatemia: An Extended Clinical Experience with a Phosphate-Containing Solution in the Setting of Regional Citrate Anticoagulation

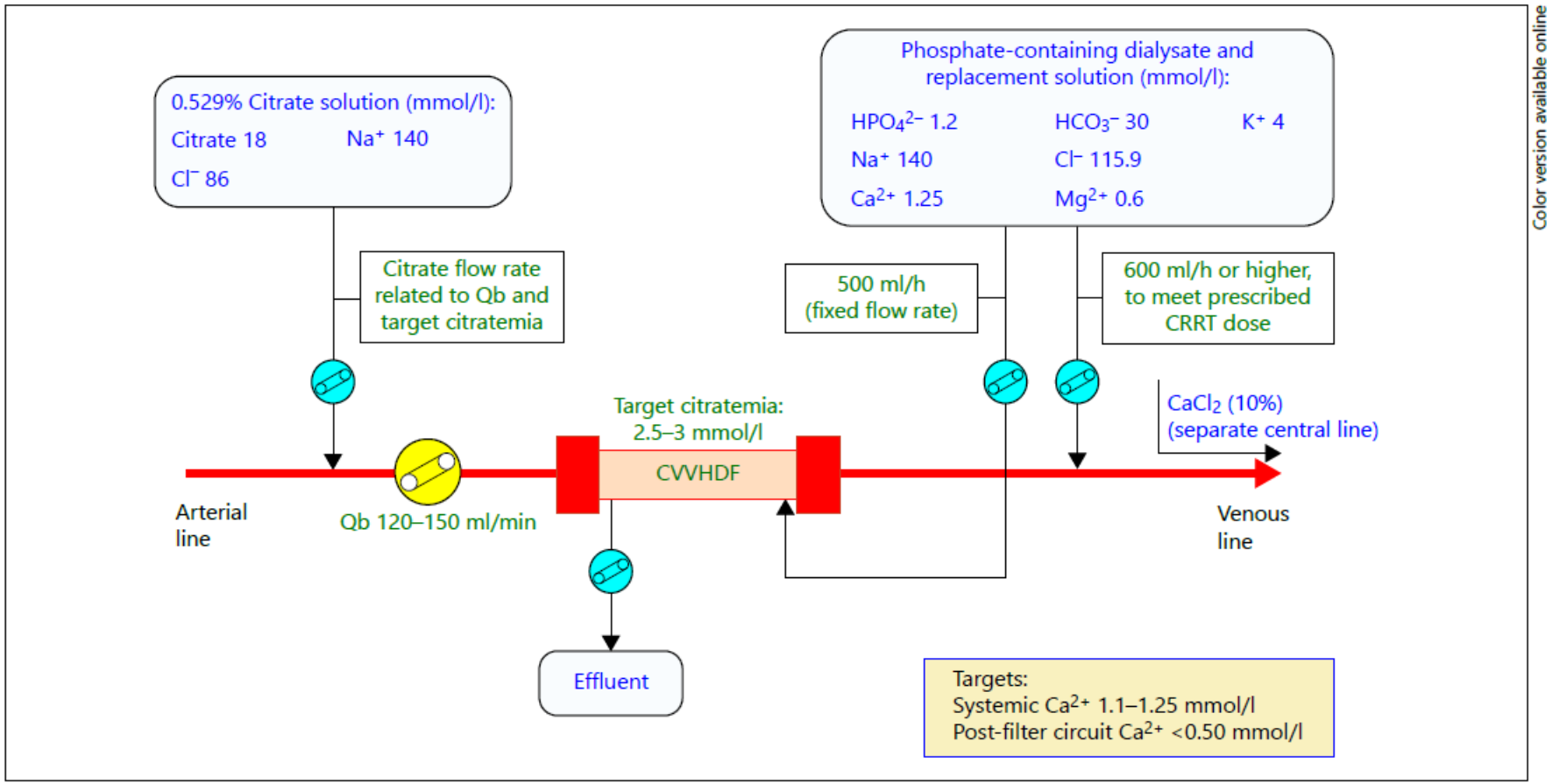

Fig. 1. RCA-CVVHDF circuit, RCA targets, and composition of citrate solution and phosphate-containing CRRT solution.

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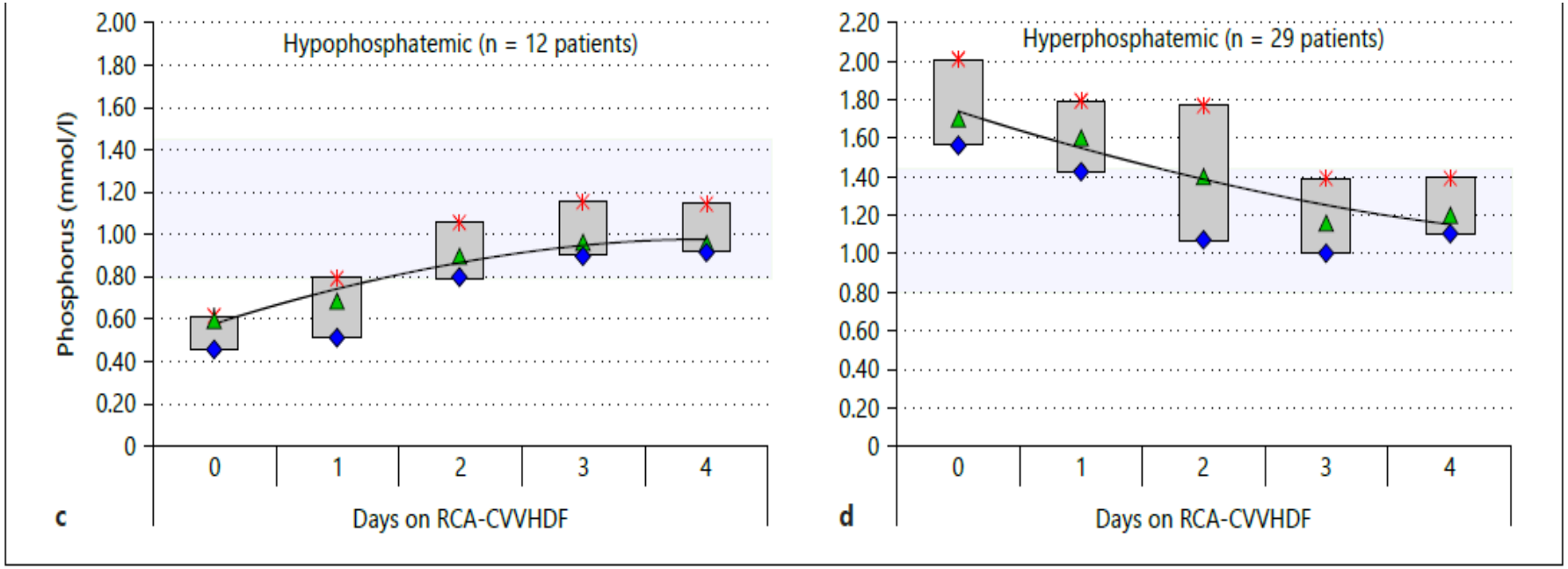

Fig. 2. a–d Serum phosphorus levels trend throughout RCA-CVVHDF days in all patients and in subgroups of patients stratified according to baseline values. The shaded area represents the range of normophosphatemia (0.81–1.45 mmol/l). Data is reported as median and IQR (q1–q3).

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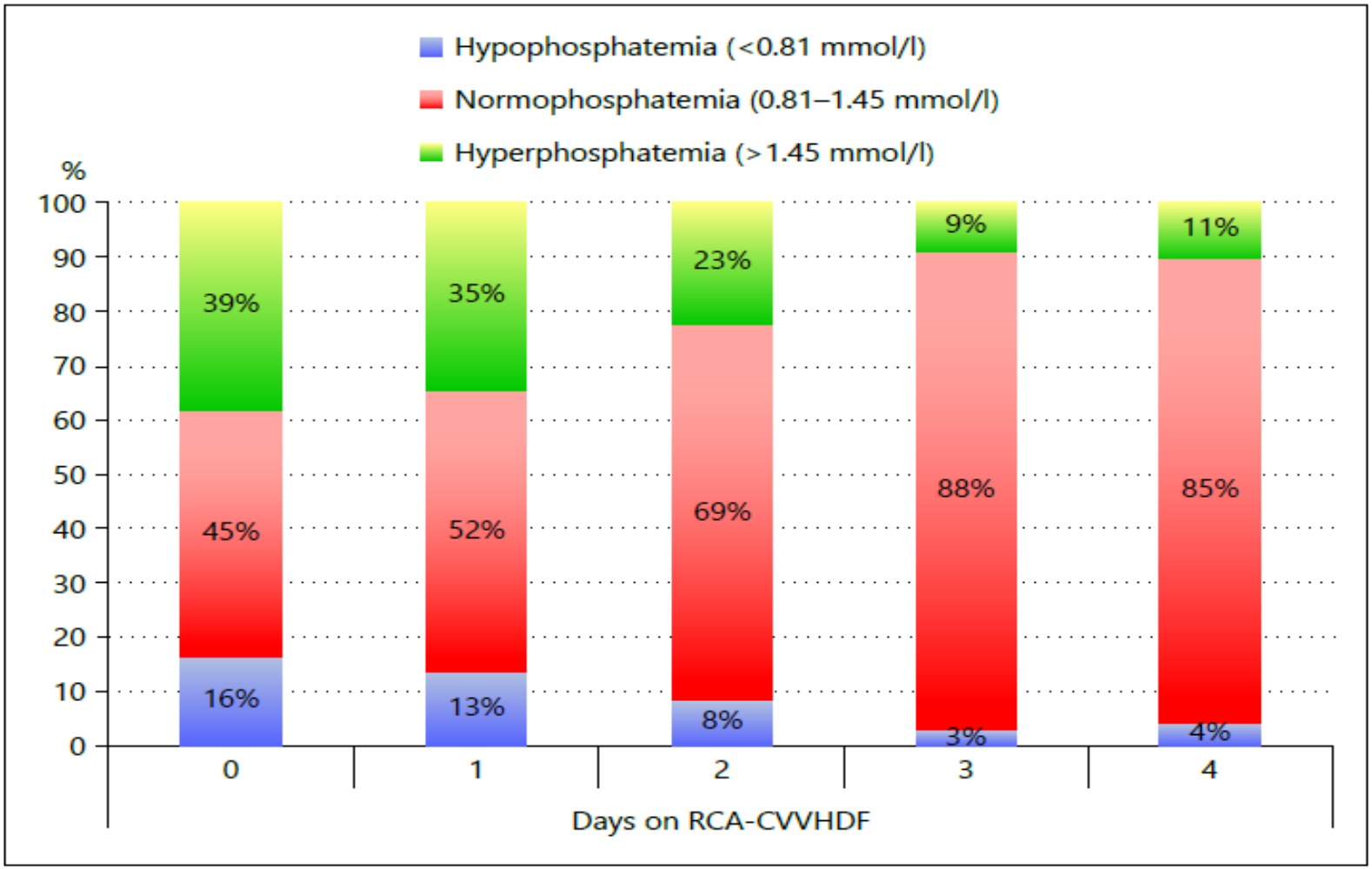


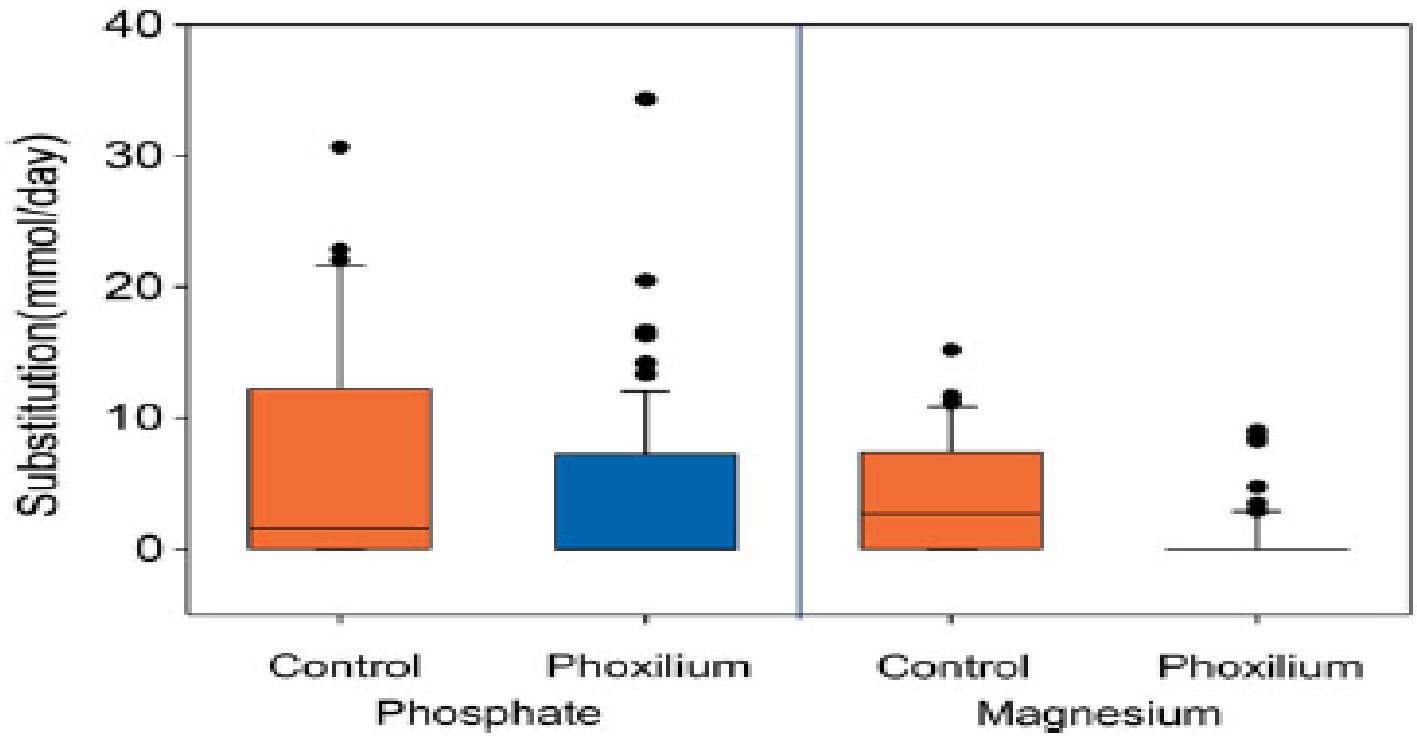
Color version available online

Electrolytes :Hypomagnesemia

ORIGINAL ARTICLE

Phoxilium® reduces hypophosphataemia and magnesium supplementation during continuous renal replacement therapy

Gabriela Godaly[1], Ola Carlsson[2,3], and Marcus Broman[4]



PLOS | ONE

RESEARCH ARTICLE

The Effects of High Level Magnesium Dialysis/Substitution Fluid on Magnesium Homeostasis under Regional Citrate Anticoagulation in Critically Ill

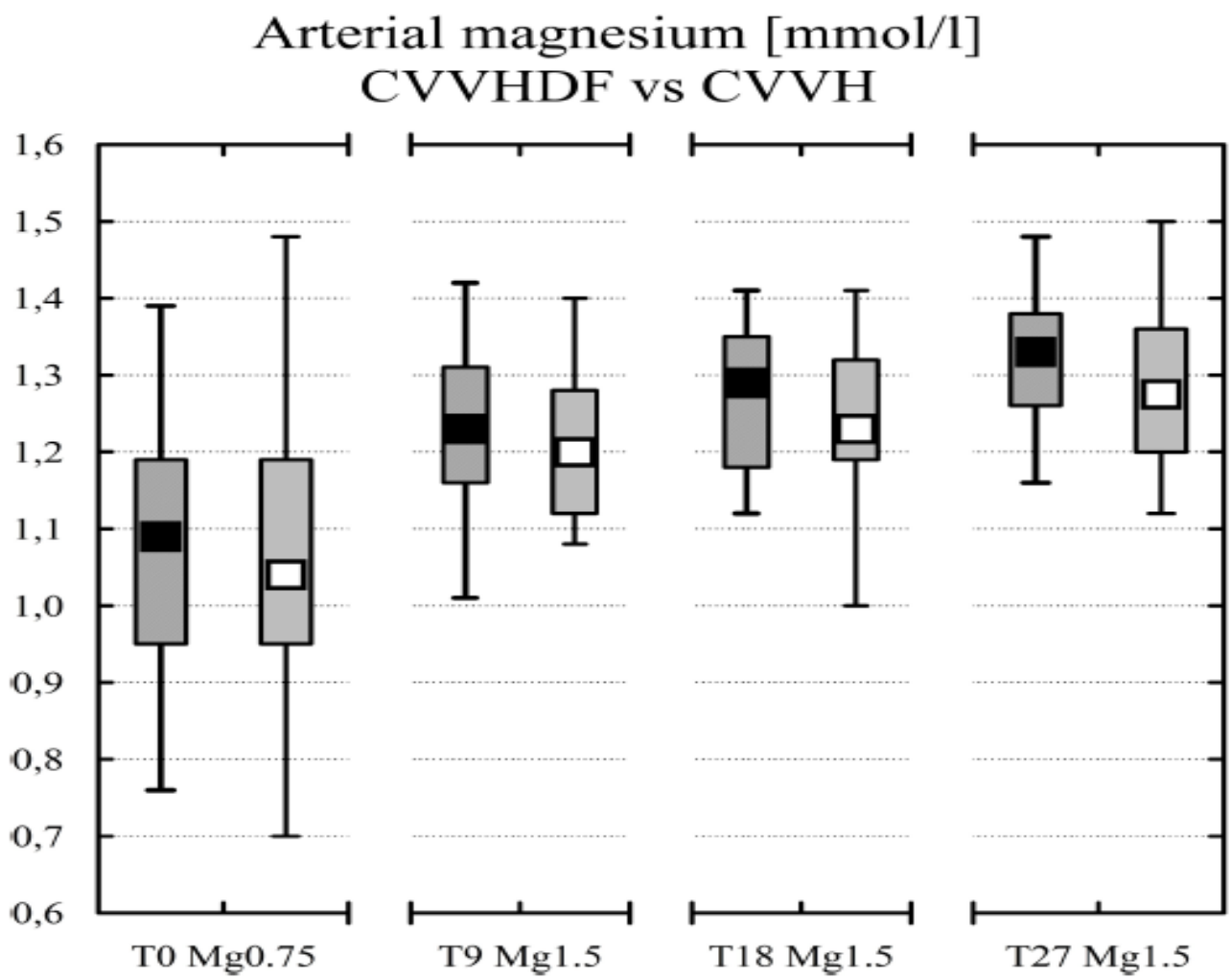


Fig 4. Arterial Mg levels in CVVHDF (black squares), CVVH (white squares) at each study time. Median, IQR in boxes, Min-Max in whiskers.

doi:10.1371/journal.pone.0158179.g004

Electrolytes :Hyperkaliemia

Original Research Article

When CRRT on ECMO Is Not Enough for Potassium Clearance: A Case Report

Canadian Journal of Kidney Health and Disease
Volume 4: 1–5
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DOI: 10.1177/2054358117722559
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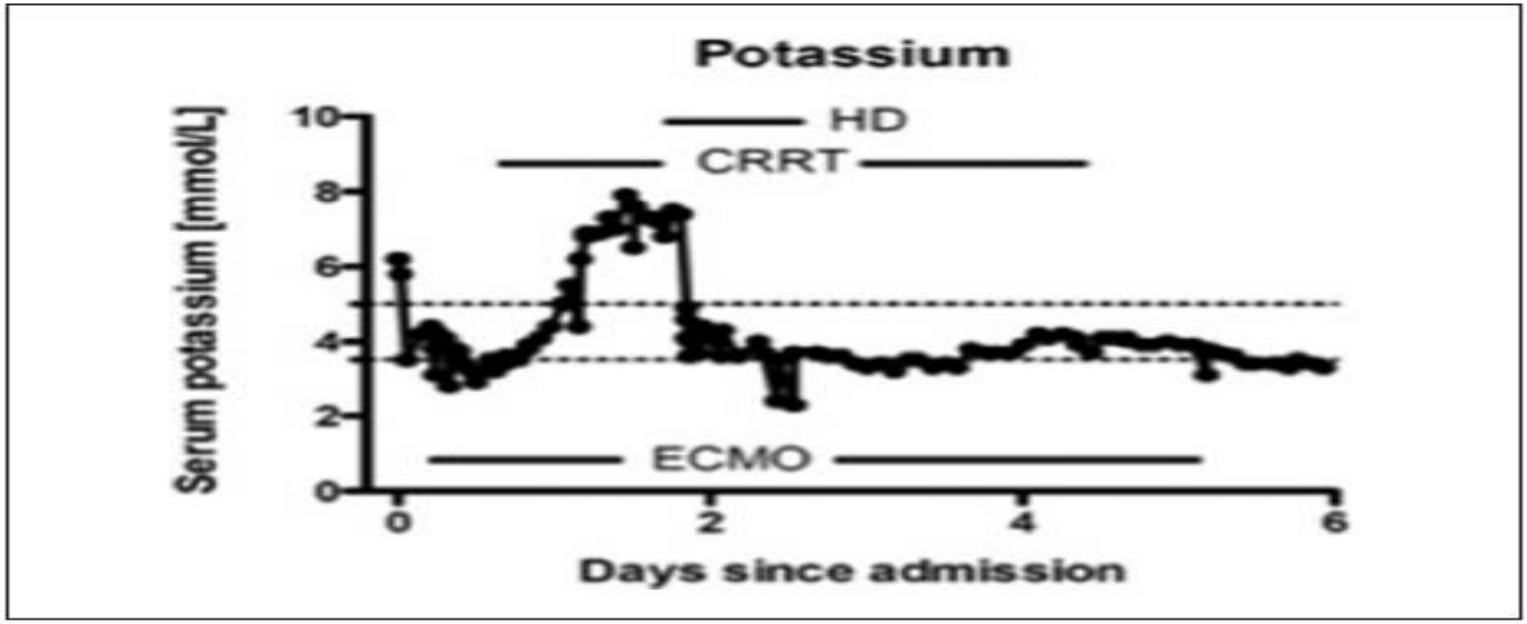
Janice A. Tijssen[1] and Guido Filler[1,2,3]



Given that potassium is best cleared by conventional hemodialysis, our choice was IHD. Second, consider separate vascular access to maximize the efficacy of the additional renal replacement therapy.

Electrolytes :Hypocalcemia

The gap between calculated and actual calcium substitution during citrate anticoagulation in an immobilised patient on renal replacement therapy reflects the extent of bone loss – a case report

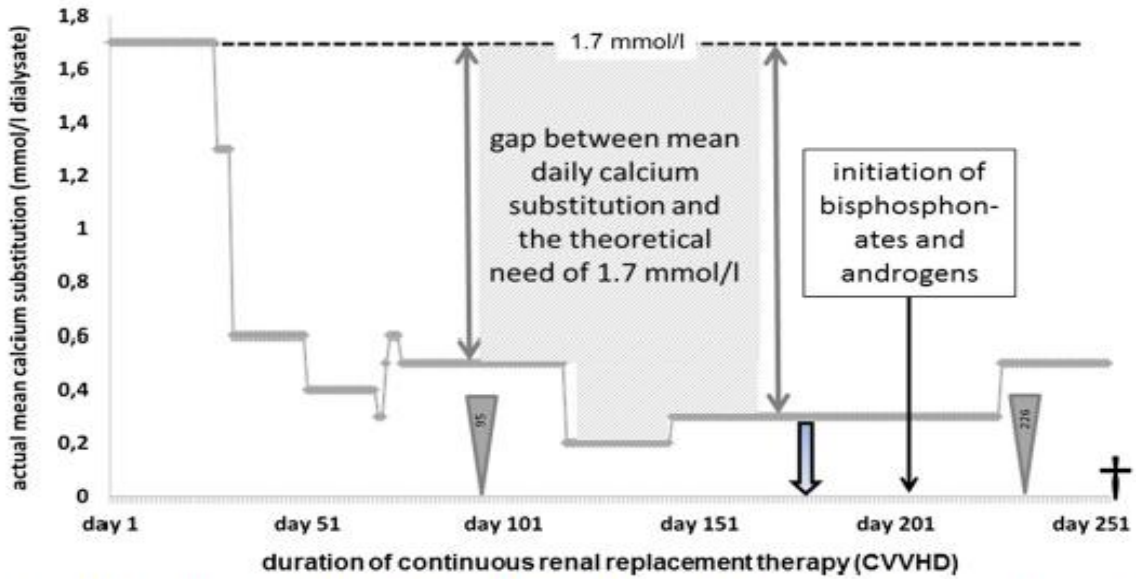


Figure 1 Daily mean need for calcium substitution per litre dialysate. Initial CVVHD required a calcium substitution of 1.7 mmol/l dialysate to maintain a serum ionised calcium level within physiological limits (dashed line). From day 27 of CVVHD requirement rapidly decreased. The lowest mean daily calcium substitution was 0.2 mmol calcium/l dialysate. The disparity between actual mean calcium substitution and the theoretical need of 1.7 mmol/l is shown for two days (grey flashes). The total disparity is the sum of these daily differences, shown in grey for a period of around 75 days. Broad arrows represent occurrence of spontaneous fractures. Computed tomographic imaging is indicated by grey triangles with related number showing days after start of dialysis. Death occurred at day 254 of CVVHD.

Conclusions – Take home messages

1) **Bicarbonate infusion can be given safely to delay CRRT**
2) **High bicarbonate load in CRRT do not increase PCO^2**
3) **Correction of Hyperphophoremia needs customisation**
4) **Hypophophoremia needs a multidiciplinary team**
5) **Hypomagnesemia can be corrected without supplementation**
6) **Refractory Hyperkaliemia may need a customized approach**
7) **In long Run CRRT, decalcification will occur..**
8) **Protocols are the key stone to correct these side effects**

BELIEVE THOSE WHO ARE SEEKING THE TRUTH.

DOUBT THOSE WHO FIND IT.

Andre Gide