Abstract citation ID: gfae069.840

#2967

C-reactive protein/serum chloride ratio: a novel marker of all-cause mortality in prevalent chronic haemodialysis patients

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Background and Aims: Serum chloride (Cl-) is an emerging marker of mortality in hypertension, sepsis, heart failure and chronic kidney disease. The pathophysiological mechanism is unclear, but haemodynamic and inflammatory factors have been suggested. As C-reactive protein (CRP) is an established marker of inflammation and prognosis in haemodialysis patients, we sought to determine whether there is an association between the CRP/Cl- ratio and prognosis in these patients.

Method: Retrospective cohort study. We included n = 281 prevalent patients in our chronic haemodialysis programme between 19 January 2022 and 11 August 2022. The mean follow-up was 10 months. The sample was divided into quartiles according to CPR/Cl^{-} ratio values. Baseline demographic, analytical and bioimpedance data were collected (Table 1). Survival time was recorded in all patients and analysed using the Kaplan-Meier method.

Results: The median CPR/Cl^{-} ratio was 0.04 mg/mEq (0.02; 0.12). Women accounted for 31.8%. 28.9% had underlying diabetic nephropathy. Overall survival at 10 months was 87.9%. Patients who died had a higher CPR/Cl^{-} value [0.12 (0.04; 0.19)] vs [0.04 (0.02; 0.10)] ($p = 0.0005$). In addition, those in the fourth quartile had a lower probability of survival compared to the other quartiles ($p = 0.0011$, log-rank test) (Fig. 1).

Conclusion: Higher values of the CPR/Cl index were associated with higher all-cause mortality in our sample of prevalent haemodialysis patients.

Table 1: Baseline characteristics of patients according to quartile of C-reactive protein/serum chloride ratio.

Characteristics	All patients	qCPR/Cl^-=1 (<0.019 mg/mEq)	qCPR/Cl^-=2 (0.019-0.043 mg/mEq)	qCPR/Cl^-=3 (0.043-0.1182 mg/mEq)	qCPR/Cl^-=4 (>0.1182)	p value
Age (years)	70 (59; 77)	70 (60; 76)	73 (62; 78)	68 (58; 76)	70 (58; 77)	0.46
Female, n (%)	89 (31.8)	22 (31.4)	22 (31.4)	27 (38.6)	18 (25.7)	0.45
BMI (kg/m^2)	25.9 (22.75; 30.13)	25.9 (22.35; 29.3)	25.75 (22.65; 30.1)	26.15 (22.68; 30.73)	26 (23.5; 29.45)	0.90
Diabetic nephropathy, n (%)	81 (28.9)	24 (34.3)	17 (24.3)	18 (25.7)	22 (31.4)	0.54
MCI	9 (6.75; 11)	9 (6; 11)	9 (8; 11)	9 (5.5; 11)	9 (6; 12)	0.20
Follow-up time (days)	306 (240; 326)	316 (274; 326)	314 (273; 329)	295 (273; 325)	305 (178; 326)	0.19
Vascular Access (AVF) n(%)	165 (58.9)	39 (55.7)	38 (54.3)	45 (64.3)	43 (61.4)	0.6
IDWG (Kg)	2.1 (1.35; 2.8)	2.2 (1.3; 3)	2 (1.5; 2.6)	2.2 (1.33; 3)	2.1 (1.3; 2.7)	0.71
Diuretics, n (%)	124 (44.3)	33 (47.1)	27 (38.6)	32 (45.7)	32 (45.7)	0.74
Modality (OLHDF) n (%)	119 (42.5)	33 (47.1)	28 (40)	31 (44.3)	27 (38.6)	0.74
PhA	4.8 (4.2; 5.5)	4.9 (4.23; 5.5)	4.8 (4.3; 5.68)	4.8 (4.1; 5.38)	4.7 (3.92; 5.57)	0.47
ECW (litres)	20.2 (17.6; 22.63)	20.45 (17.27; 22.82)	19.4 (17.1; 21.38)	20.5 (18.35; 23.2)	20.6 (18.2; 23.05)	0.09
ICW (litres)	18.80 (15.4; 22.2)	19.3 (15.52; 23)	17.95 (15.03; 21.68)	19.1 (15.35; 21.7)	18.4 (15.5; 23)	0.56
Na^+ mEq/L	138 (136; 140)	139 (137; 140)	138 (137; 141)	138 (136; 140)	138 (136; 139)	0.09
Cl^- mEq/L	100 (97; 103)	101 (99; 104)	101 (97; 104)	100 (97; 102)	99 (97; 102)	0.03
$HCO3^-$ mmol/L	20.35 (18.8; 21.8)	20.45 (19.3; 22)	20.7 (18.83; 21.98)	20.1 (18.42; 21.2)	20.35 (18.8; 21.58)	0.59
CRP mg/L	4.29 (1.88; 11.46)	1.1 (0.69; 1.56)	2.8 (2.3; 3.67)	5.99 (4.96; 8.65)	18.88 (15.29; 29.28)	<.0001

The values are expressed as median (q25-q75) unless otherwise specified. BMI: body mass index; MCI: modified Charlson index; IDWG: interdialytic weight gain; OLHDF: online hemodiafiltration; PhA: phase angle; ECW: extracellular water; ICW: intracellular water.

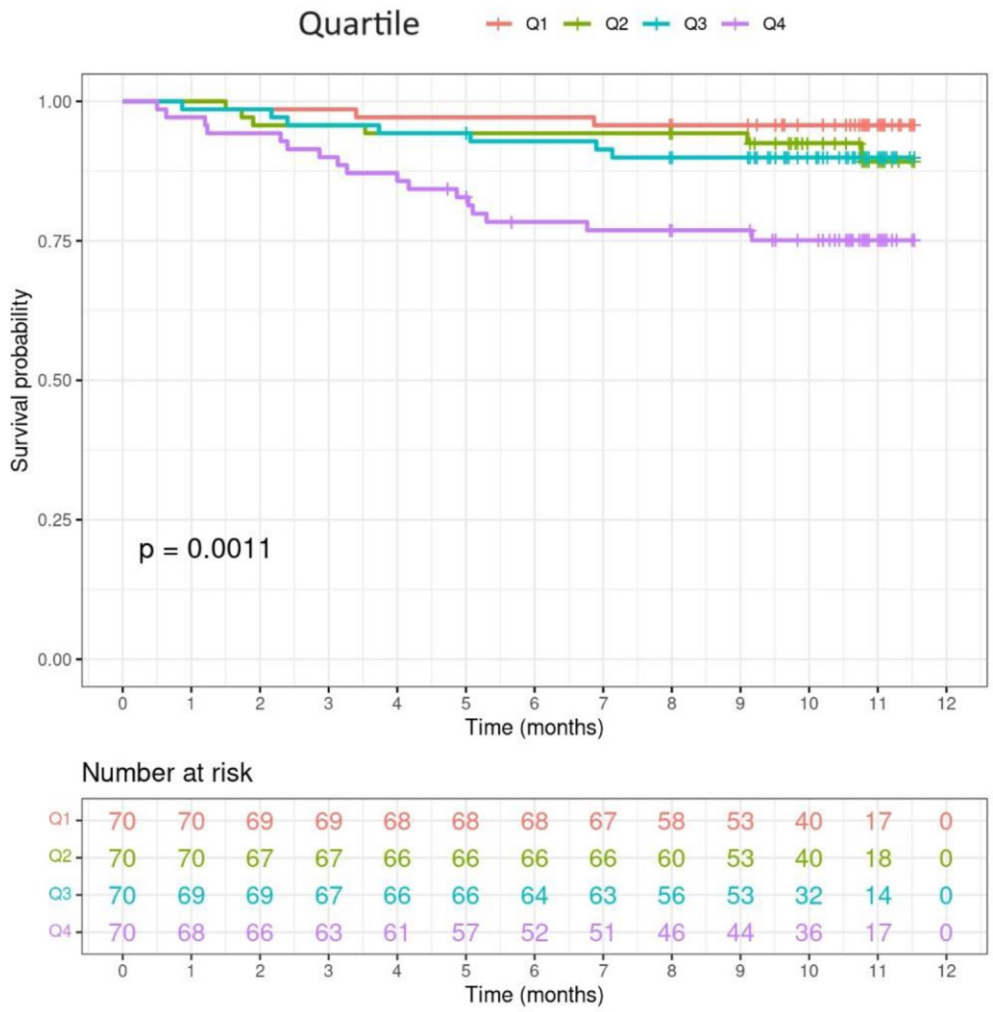

Figure 1: Cumulative all-cause survival by CPR/Cl^{-} ratio quartiles.