Clinical Significance of Increase in Red Blood Cell Distribution Width in Incident Dialysis Patients

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BACKGROUND

Red blood cell distribution width (RDW) is a robust marker of adverse clinical outcomes in various populations. However, the clinical significance of a progressive rise in RDW is undetermined in end-stage renal disease (ESRD) patients. The purpose of this study was to determine the prognostic importance of a change in RDW in ESRD patients.

METHODS

Three hundred twenty-six incident dialysis patients were retrospectively analyzed. Temporal changes in RDW during 12 months after dialysis initiation were assessed by calculating the coefficients by linear regression.

Patients were divided into two groups: an RDW-decreased group who had negative coefficient values (n = 177) and an RDW-increased group who had positive values (n = 149). The associations between rising RDW and mortality and cardiovascular (CV) events were investigated.

RESULTS (1)

Table 1. Clinical Characteristics

	RDW-decreased (n = 177)	RDW-increased (n = 149)	*P*
Age (years)	55.1 ± 12.8	58.4 ± 12.5	0.02
Male (%)	93 (52.5)	83 (55.7)	0.57
Diabetes (%)	102 (57.6)	96 (64.4)	0.21
Cause of ESRD (%)			0.84
Diabetes	103 (58.2)	95 (63.8)	
Hypertension	45 (25.4)	36 (24.2)	
Chronic GN	20 (11.3)	7 (4.7)	
Others	9 (5.1)	11 (7.4)	
Previous CV disease (%)	33 (18.6)	38 (25.5)	0.14
History of smoking (%)	57 (32.2)	44 (29.5)	0.60
BMI (kg/m^2)	23.7 ± 4.0	23.6 ± 4.2	0.97
Hemodialysis (%)	96 (54.2)	86 (57.7)	0.53
eGFR (mL/min/1.73m^2)	8.9 ± 6.2	9.5 ± 4.4	0.34
Follow-up years	3.3 ± 1.7	3.0 ± 1.7	0.08
Antihypertensive drugs (%)			
RAS blockers	135 (76.3)	114 (76.5)	0.96
Beta-blockers	100 (56.5)	85 (57.0)	0.92
Calcium channel blockers	109 (61.6)	98 (65.4)	0.43
Phosphate binders (%)			
Calcium-based	87 (49.2)	66 (44.3)	0.38
Non calcium-based	19 (10.7)	14 (9.4)	0.69
ESA (%)	167 (94.4)	136 (91.3)	0.28
ERI (U/kg/week/g/dL)	12.5 ± 16.2	16.8 ± 34.4	0.17
Iron replacement (%)	151 (85.3)	112 (75.2)	0.02
Statin (%)	70 (39.5)	50 (33.6)	0.26
Vitamin D analogue (%)	31 (17.5)	30 (20.1)	0.55

RESULTS (2)

Table 2. Laboratory and echocardiographic measurements

	RDW-decreased (n = 177)	RDW-increased (n = 149)	*P*
Baseline RDW (%)	14.8 ± 1.9	13.6 ± 1.1	<0.001
Follow-up RDW at 1 year (%)	13.5 ± 1.2	15.0 ± 1.6	<0.001
RDW-slope	-3.5 ± 3.6	3.6 ± 3.5	<0.001
SD of haemoglobin	1.4 ± 0.7	1.2 ± 0.5	0.02
CV of haemoglobin	0.14 ± 0.08	0.13 ± 0.06	0.03
Haemoglobin-slope	0.14 ± 0.17	0.12 ± 0.15	0.20
Residual SD of haemoglobin	1.11 ± 0.65	0.96 ± 0.51	0.03
Time-averaged laboratory data			
Haemoglobin (g/dL)	9.8 ± 0.9	9.8 ± 0.9	0.66
White blood cell count (10^3/mm^3)	7.8 ± 2.7	7.6 ± 2.3	0.54
Platelet count (10^3/mm^3)	218.3 ± 68.6	219.4 ± 73.8	0.89
RDW (%)	14.2 ± 1.2	14.4 ± 1.1	0.15
Iron (μg/dL)	70.1 ± 37.2	66.2 ± 36.2	0.35
TIBC (μg/dL)	216.4 ± 44.0	205.0 ± 44.0	0.03
Transferrin saturation (%)	32.2 ± 16.3	33.7 ± 18.9	0.48
Ferritin (ng/mL)	286.3 ± 315.6	328.1 ± 495.9	0.37
Vitamin B12 (pg/mL)[a]	804.9 ± 332.5	1013.7 ± 1274.8	0.11
Folate (ng/mL)[b]	13.4 ± 12.9	17.3 ± 20.3	0.14
Albumin (g/dL)	3.7 ± 1.3	3.7 ± 1.4	0.80
Total cholesterol (mg/dL)	175.1 ± 54.0	181.7± 58.5	0.30
Triglyceride (mg/dL)	152.5 ± 89.8	175.4 ± 146.0	0.09
LDL-cholesterol (mg/dL)	108.0 ± 37.4	117.7 ± 113.6	0.37
Calcium (mg/dL)	8.0 ± 0.9	8.2 ± 0.8	0.09
Phosphorus (mg/dL)	5.4 ± 1.6	5.0 ± 1.3	0.07
Log CRP (mg/dL)	0.7 ± 0.6	0.7 ± 0.6	0.44
Intact PTH (pg/mL)	272.9 ± 217.6	244.7 ± 174.4	0.21
Echocardiographic data[c]			
LV mass index (g/m$^{2.7}$)	56.2 ± 45.0	58.0 ± 38.5	0.74
LA diameter (mm^2)	41.2 ± 5.9	41.9 ± 6.9	0.48
LV ejection fraction (%)	55.7 ± 12.5	56.4 ± 12.0	0.71
E/E' ratio	14.5 ± 6.4	14.3 ± 5.5	0.84

[a]n = 186; [b]n = 181; [c]n = 235.

RESULTS (3)

Event-free survival rates for composite of end-points were compared after combining two factors: the baseline RDW value and change in RDW. Patients were subdivided into four groups: patients with baseline RDW ≤14.9% and RDW decrease (n = 115), those with baseline RDW ≤14.9% and RDW increase (n = 138), those with baseline RDW >14.9% and RDW decrease (n = 62), and those with baseline RDW >14.9% and RDW increase (n = 11).

Fig 1.

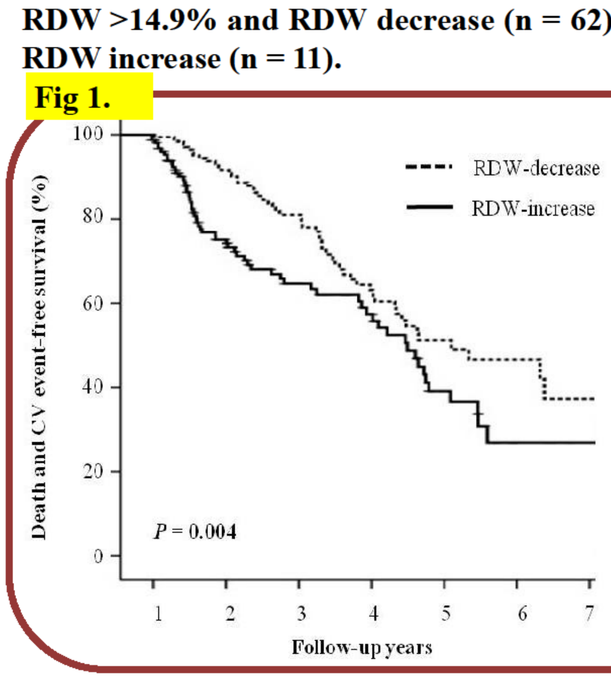

Fig 2.

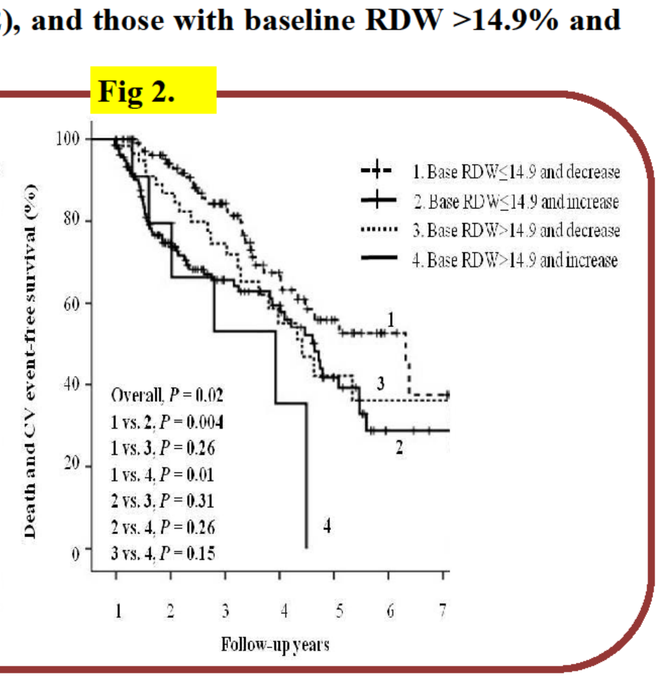

Table 3. Cox proportional hazard analysis for nonfatal CV events and deaths

	RDW-increased group (vs. RDW-decreased group)		
	HR	95% confidence interval	*P*
Model 1	1.76	1.20, 2.59	0.004
Model 2	1.75	1.17, 2.61	0.007
Model 3	1.75	1.17, 2.61	0.007
Model 4	1.72	1.03, 2.90	0.04

Model 1: unadjusted relative risk. N = 326.
Model 2: adjusted for for age, sex, diabetes, previous CV disease, baseline RDW and follow-up RDW at 1 year, and time-averaged haemoglobin, log CRP, intact PTH, iron, TIBC and ferritin levels. N = 280.
Model 3: adjusted for Model 2 plus SD, CV, and residual SD of haemoglobin levels, haemoglobin-slope, and RDW-slope. N = 280.
Model 4: adjusted for Model 3 plus vitamin B12 and folate levels. N = 155.

CONCLUSION

- In conclusion, a progressive rise in RDW predicted all-cause mortality and CV events in ESRD patients, independent of indices of anaemia, nutrition, haeomoglobin variability and traditional CV risks, as well as the baseline and follow-up RDW.
- RDW is a widely available and inexpensive test performed as part the complete blood cell count. The prognostic strength of a rising RDW may be greater than other expensive and clinically inaccessible markers.
- Therefore, monitoring the changes in RDW could be an additive predictor for adverse CV outcomes in ESRD patients.

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