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Red Cell Distribution Width: an Unacknowledged Predictor of Mortality and Length of Stay following Revision Arthroplasty

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INTRODUCTION

Red blood cell distribution width (RDW), a measure of variability in size of circulating erythrocytes, is routinely reported in complete blood cell analysis, and together with mean cell volume (MCV) has conventionally been used to distinguish the cause of anemia. It is calculated by (Standard deviation of MCV÷ mean MCV) x 100, with normal range being 11.5%-14.5%.

Several recent publications have described RDW as an independent predictor of adverse outcome and mortality in patients with different underlying medical conditions such as acute and chronic heart failure, peripheral artery disease, chronic pulmonary disease and acute kidney injury[1]. The purposes of this study were 1) to investigate possible relationship between RDW levels and length of stay (LOS) and mortality following revision total joint arthroplasty (TJA), and if that correlation existed, 2) to develop predictive models for LOS and mortality based on preoperative patient-related factors including RDW values.

MATERIALS AND METHODS

In this single institutional retrospective study, 2,261 patients who underwent revision hip or knee arthroplasty during 2000-2009 were included. Postoperative LOS and mortality at one, three, and twelve months were assessed. Patients with hereditary anemias were excluded because of their effect on RDW values. Multivariate analysis was built based on preoperative patient-related factors.

RESULTS

Strong correlation existed between preoperative and postoperative RDW values (Figure 1 and Table 1). Therefore, only preoperative RDW values were analyzed in this study to eliminate the potential confounding influence of surgical and postsurgical care. There was statistically significant yet weak correlation between RDW values and Charlson comorbidity index (CCI) (Spearman's ρ : 0.16, p=0.005). RDW values were higher in patients who died at one (15.4 versus 14.1, p=0.031), three (15.6 versus 14.1, p=0.002), and twelve (15.4 versus 14.1, p<0.001) months. In multivariate analysis age, male gender, CCI, and preoperative RDW values were independently correlated with mortality at all time points (Tables 2 and 3). Prediction models for LOS and mortality were developed (Figures 2 and 3).

FIGURES 1, 2 & 3

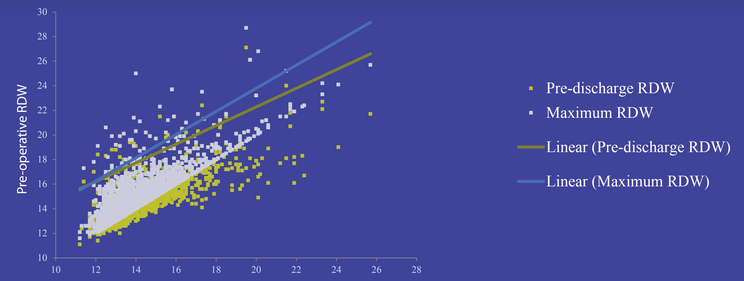

Figure 1: Correlation of pre- and post-operative RDW values.
RDW=Red blood cell distribution width.

Age	Points	CCI	Points	RDW	Points
20	0	0	0	12	0
30	2	1	12	14	14
40	4	2	25	16	37
50	6	3	38	18	43
60	10	4	50	20	47
70	10	5	62	22	51
80	19	6	75	24	55
90	48	7	88	26	59
100	78	8	100		

Gender	Points
female	0
male	5

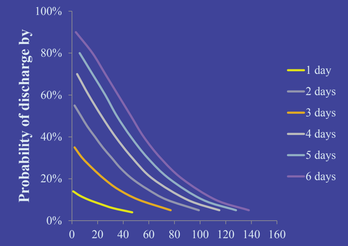

Figure 2: Prediction model and scroing system for LOS following revision arthroplasty based on the analyzed preoperative parameters.
CCI=Charlson comorbidity index; RDW=Red blood cell distribution width; LOS=Lenght of stay.

Age	Points	CCI	Points	RDW	Points
20	12	0	0	12	0
30	8	1	10	14	4
40	3	2	19	16	22
50	0	3	29	18	28
60	6	4	38	20	33
70	19	5	48	22	39
80	38	6	58	24	45
90	69	7	67	26	50
100	100	8	77		

Gender	Points
female	0
male	13

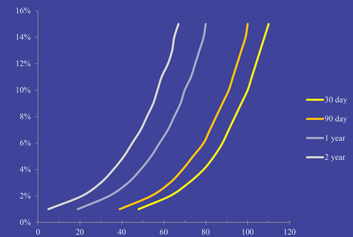

Figure 3: Prediction model and scroing system for postoperative mortality following revision arthroplasty based on the analyzed preoperative parameters.
CCI=Charlson comorbidity index; RDW=Red blood cell distribution width.

TABLES 1, 2 & 3

Comparisons	Spearman's correlation	p-value
Pre-operative vs Maximum	0.75	0.001
Pre-operative vs Pre-discharge	0.80	0.001
Maximum vs Pre-discharge	0.92	0.001

Table 1: Correlation of pre- and post-operative RDW values.
RDW=Red blood cell distribution width.

	Odds Ratio	95% CI	p-value
Age	0.87	0.67 - 1.07	<0.0001
Male Gender	6.74	1.16 - 12.64	0.0173
Charlson Comorbidity Index	17.29	13.63 - 21.06	<0.0001
Preoperative RDW	**13.89**	12.13 - 15.69	<0.0001

Table 2: Variables associated with LOS.
LOS=Lenght of stay; CI=Confidence interval; RDW=Red blood cell distribution width.

	Odds Ratio	95% CI	p-value
Age	1.08	1.06 - 1.10	<0.0001
Male Gender	1.70	1.15 - 2.52	0.0076
Charlson Comorbidity Index	1.54	1.33 - 1.77	<0.0001
Preoperative RDW	**1.34**	1.22 - 1.47	<0.0001

Table 3: Variables associated with post-operative mortality.
CI=Confidence interval; RDW=Red blood cell distribution width.

DISCUSSION

RDW is an inexpensive parameter that can serve as an independent predictor of mortality and LOS following revision TJA. Although RDW was correlated with CCI, it was an independent predictor of LOS and mortality. RDW should be analyzed as part of the routine perioperative work-up and used to counsel patients on their postoperative risk.

Higher RDW values (anisocytosis) might reflect the sum of multiple physiologic impairments that have considerable influence on erythrocyte progenitors ultimately leading to an adverse outcome[2].

REFERENCES

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2. Patel KV, Ferrucci L, Ershler WB, Longo DL, Guralnik JM. Red blood cell distribution width and the risk of death in middle-aged and older adults. *Arch Intern Med*. 2009;169(5):515-523.