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Red cell distribution width and mortality in patients with hip fracture treated with partial prosthesis

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Objective: This study aimed to determine the relationship between red cell distribution width (RDW) and mortality in patients that received a partial hip prosthesis.

Methods: The study included 316 patients (183 female and 133 male) that underwent surgery due to hip fracture and were followed up for ≥1 year. Mean age of the male and female patients was 77.50 years (range; 65–95) and 78.23 years (range; 65–100), respectively. The relationship between the RDW level at the time of presentation and mortality was evaluated.

Results: There was a significant relationship between mortality, and age (median age for man 77.50 and for woman 78.23) trochanteric fracture, and a high RDW level (>14.5%). In patients with these 3 characteristics the mortality rate was 2.8–fold higher than in the other patients.

Conclusion: RDW is a parameter measured via routine blood testing. We think that RDW measurement should be used in the planning of the treatment of hip fractures and in scoring systems used to estimate post–operative mortality.

Key words: Hip fracture; red cell distribution width (RDW); mortality.

Hip fracture is associated with increased mortality among elderly patients and is observed with increasing frequency with increased life expectancy. It was reported that 15%–20% of patients with hip fracture die within 1 year.[1,2] The main goal of treatment is to minimize morbidity and mortality in these fractures. In elderly patients with hip fracture many factors may affect mortality.[3-5]

Red cell distribution width (RDW) is a parameter of the routine haemogram. RDW is associated with increased mortality in individuals with cardiovascular disease.[6-8] When the relationship between mortality and RDW was investigated in individuals without cardiovascular disease RDW was observed to be a strong marker predictive of mortality in patients over 45 years.[9] Our review of the literature did not show any study

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on the relationship between orthopedic conditions and RDW.

The aim of this study was to evaluate the outcome of patients with hip fracture treated with partial hip replacement, and to analyze the relationship between RDW and mortality.

Patients and methods

The study included 316 patients (183 female and 133 male) who underwent a partial hip replacement surgery between November 2007 and February 2011. Mean age of the male and female patients was 77.5 years (range: 65–95 years) and 78.2 years (range: 65–100 years), respectively. The minimum follow–up time was 1 year. The relationship between the RDW level at presentation and mortality was investigated. Patients in which the RDW level increased following post-surgical complications were excluded from the study.

All surgeries were performed by senior surgeons. A standard posterior or lateral approach was used in all patients.[10] A cemented prosthesis was used in patients with a Singh index less than 5 and in patients who required calcar replacement. Antibiotic prophylaxis (1st–generation cephalosporin) was administered in all patients. In addition, daily 0.4 mg of subcutaneous low–molecular weight heparin (enoxaparin) was initiated for prophylaxis of deep vein thrombosis and administered for 10 days. All patients wore anti–embolic socks after the surgery.

The suction drain was removed on the first postoperative day and an exercise and rehabilitation program was introduced. All patients were mobilized within two days after the surgery. After discharge, the patients were regularly assessed at 6 weeks, 3 months, 6 months, and 1 year post surgery, and then yearly. Assessment was performed with anteroposterior and lateral X–rays of the hip, and Harris hip score.

Statistical analysis was performed using the chi-square and Kaplan Meier tests, and the Cox regression model. All analyses were performed using SPSS v.15.0 for Windows. The level of statistical significance was set at $p<0.05$.

Results

Among the patients, 121 (38.3%) died (62 female [33.9% of all female patients] and 59 male [44.4% of all male patients]), of which 104 (32.9%) died within 1 year of surgery (Table 1). Although the mortality rate was higher in the male patients, the difference between the genders was not significant ($p>0.05$). The mean Harris hip score was 81.4. There was a negative correlation between the age and clinical results of the patients: Patients aged ≤77 years had a higher Harris hip score (85.6) than those aged >77 years (75.8) ($p=0.02$). Mean age of the patients who died was 80.60 years (range: 65-100 years), versus 76.27 years (range: 65–98 years) in those who survived. As the median age of the entire patient population was 77 years, this was considered the age limit and the mortality rate was significantly higher in the patients aged >77 years ($p<0.0001$).

Mean hospitalization time prior to surgery was 3.56 days in the patients who died, versus 3.45 days in those who survived. Mean hospitalization time in the patients who died was 11.04 days, versus 10.54 days in those who survived. The mortality rate did not differ significantly between the patients aged ≤77 years and >77 years, nor did the relationship between mortality, and duration of hospitalization before surgery or total duration of hospitalization ($p>0.05$).

In total, 67 (21.2%) of the patients had a fracture in the intertrochanteric region and, according to Evans classification, in all cases the fracture was unstable with disrupted continuity of the posteromedial cortex. Among the patients, 249 (78.8%) had a fracture in the femoral neck and according to Garden classification, 51 of these patients had type–II fracture, 149 had type–III fracture, and 49 had type–IV fracture. In the overall series, 36 (53.7%) patients with a trochanteric fracture and 85 (34.1%) with a femoral neck fracture died. The mortality rate was significantly higher in patients with trochanteric fracture ($p=0.03$). Right hip fracture was noted in 163 (51.6%) and left hip fracture in 153 (48.4%) patients. Surgery was performed with the lateral approach in 135 patients (42.7%) and with the posterior approach in 181 patients (57.3%). Cemented prosthesis was implanted in 130 patients (41.1%) and non–cemented prosthesis was implanted in 186 patients (58.9%). Dislocation occurred in 9 patients (2.8%) and infection occurred in 9 (2.8%) (Table 2). There was no association between the mortality and fracture side, surgical approach and cementation ($p>0.05$).

An elevated RDW was observed in 128 patients (40.5%), of which 84 (69.4%) died. A significant correlation was noted between an elevated RDW level and mortality ($p<0.0001$) (Fig. 1). In addition, the mortality rate was 2.8 fold higher in patients older than 77 years whose RDW level was above 14.5.

Discussion

Along with advanced age, a decrease in physical capacity and accompanying systemic diseases increase the rate

Table 1. Postoperative mortality time.

Mortality time (day)	Age	Sex	RDW Level	Mortality time (day)	Age	Sex	RDW Level
0.	89	Male	Normal	87.	75	Female	Normal
0.	91	Female	High	87.	76	Male	Normal
1.	77	Male	High	87.	85	Female	Normal
1.	77	Female	High	88.	85	Female	High
2.	80	Female	High	95.	66	Female	High
2 .	88	Male	High	100.	96	Female	Normal
2.	89	Female	High	103.	93	Male	High
2.	89	Male	High	111.	91	Female	High
3.	70	Male	Normal	115.	93	Female	High
3.	88	Female	High	121.	84	Male	High
3.	95	Female	High	123.	89	Male	Normal
5.	82	Male	High	130.	80	Male	High
5.	83	Male	High	130.	84	Male	High
5.	83	Female	High	143.	81	Female	High
5.	86	Male	High	144.	84	Female	High
5.	94	Female	High	146.	79	Male	High
6.	77	Female	High	150.	78	Female	High
6.	82	Male	High	157.	75	Male	High
6.	82	Male	High	160.	71	Male	High
6.	83	Female	Normal	160.	72	Male	High
7.	73	Male	Normal	161.	72	Male	High
7.	77	Female	High	169.	81	Male	Normal
7.	82	Male	High	170.	79	Male	High
17.	100	Female	High	174.	76	Male	Normal
21.	95	Female	High	179.	82	Female	Normal
21.	81	Male	High	181.	85	Female	High
22.	87	Female	High	183.	82	Male	High
26.	83	Female	High	191.	80	Male	High
26.	80	Female	Normal	193.	83	Female	High
27.	74	Male	Normal	194.	95	Male	High
30.	69	Female	Normal	195.	85	Female	High
30.	70	Male	Normal	197.	88	Male	High
30.	70	Female	High	201.	91	Female	High
30.	83	Female	High	202.	85	Female	High
35.	99	Female	Normal	204.	88	Female	Normal
38.	87	Female	Normal	217.	86	Female	Normal
47.	92	Male	High	217.	88	Male	Normal
51.	77	Male	High	231.	83	Female	Normal
52.	77	Male	High	247.	85	Male	Normal
57.	89	Female	High	271.	84	Female	Normal
58.	84	Male	Normal	272.	80	Female	Normal
60.	74	Female	High	293.	76	Female	High
60.	77	Female	High	294.	90	Female	Normal
73.	72	Female	High	295.	80	Male	Normal
77.	86	Female	High	296.	71	Male	High
78.	94	Male	High	297.	69	Male	High
78.	68	Female	Normal	300.	70	Male	High
81.	73	Female	High	300.	72	Female	High
82.	76	Male	High	321.	67	Male	High
83.	83	Female	Normal	327.	68	Female	Normal
83.	80	Female	High	344.	65	Male	High
85.	81	Male	Normal	360.	65	Male	Normal

Table 2. Factors related to mortality.

Factors	Dead		Alive		Total	
	n	%	n	%	n	%
Surgical approach						
Posterior	65	53.7	116	59.5	181	57.3
Lateral	56	46.3	79	40.5	135	42.7
Fixation type						
Cemented	49	40.5	81	41.5	130	41.1
Cementless	72	59.5	114	58.5	186	58.9
Fracture type						
Trochanteric	36	29.7	31	15.9	67	21.2
Neck	85	70.3	164	84.1	249	78.8
Side						
Right	60	49.6	103	52.8	163	51.6
Left	61	50.4	92	47.2	153	48.4
Dislocation						
Present	1	0.8	8	4.1	9	2.8
Absent	120	99.2	187	95.9	307	97.2
Infection						
Present	4	3.3	5	2.6	9	2.8
Absent	117	96.7	190	97.4	307	97.2

of exposure to simple traumas, which increases the risk of hip fracture[4,11] Pande reported the 1–year mortality rate following hip fracture as 45%, versus 1% in a control group without hip fracture[12] Torruella reported a mortality rate of 40% in patients with hip fracture and 16.5% in their control group without hip fracture[13] Jalovaara reported that the mortality rate was 19% higher in patients that underwent non–cemented arthroplasty, when compared with a non-fracture control group.[14] A meta–analysis on mortality in patients with hip fracture revealed that a 1–year mortality rate of 25% in studies conducted in Europe.[15] In addition, Roche reported a 1–year mortality of 33%,[16] McLeod reported a 1–year mortality of 24.9%,[17] and Franzo reported a 1–year mortality of 25.3%.[18] Furthermore Şener reported that the 1–year mortality rate was 25% in hip fracture patients treated with partial prosthesis[1] In the present study the 1–year mortality was 32.9%.

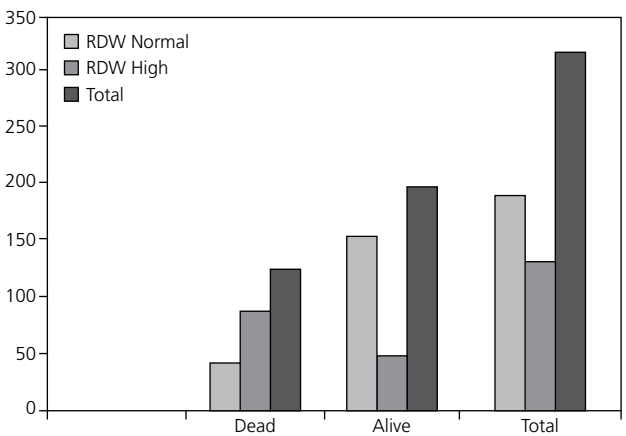

Fig. 1. RDW and mortality.

It is known that hip fractures occur 3 or 4–fold more frequently in females than in males.[12,17] Aharonoff reported that the 1–year mortality rate was 20.7% in males and 10.7% in females.[19] Fronzo[18] and Jiang[20] reported that the mortality rate was higher in males, whereas Alegre–Lopez reported a higher rate in females.[21] Kenzora reported that gender did not have a significant effect on mortality.[5] Oztürk reported that the mortality rate was higher in female patients, but that the difference was not significant.[22] In the present study the mortality rate was higher in male patients, but the difference between genders was not significant. Some studies report that the mortality rate is significantly higher in elderly patients with hip fracture.[5,18,20,21,23-25] Şener reported that advanced age increased the mortality rate significantly.[1] The present findings are in agreement with the literature for the association between advanced age and mortality in hip fracture patients. In our study the mean age of the patients who died was 80.6 years.

RDW is a complete blood count parameter, which is traditionally used to diagnose iron deficiency anemia. RDW has also been shown to be a marker for predicting mortality in several medical conditions. In hospitalized patients each 1–point increase in RDW was associated

with an increase in 1–year mortality with a probability ratio of 1.19.[26] It was reported that RDW is a strong determinant of mortality in the elderly, with and without age-related diseases, and that the total mortality risk increases by 1.14 times for each 1% increase in RDW.[27] Hunziker reported that RDW was a strong and independent parameter for estimation of mortality in hospitalized patients.[28]

It was reported that an elevated RDW at presentation to hospital is a determinant of mortality in patients with acute pancreatitis, sepsis, and septic shock.[29,30] Population–based studies reported that the RDW level is an important predictor of cardiac death and should be used to estimate renal functions.[6] In patients with coronary artery disease, heart failure, and community–acquired pneumonia an elevated RDW level was a prognostic factor associated with mortality.[7,31-33] It was also reported that an elevated RDW level could be used as a marker for predicting mortality in patients with acute pulmonary embolism, pulmonary hypertension, and peripheral artery disease.[8,34]

In the present study the correlation between mortality in elderly patients with hip fracture that received a partial prosthesis and had an elevated (>14.5) RDW level was stronger than those in the patients with lower RDW values. The RDW level was elevated in 128 of our patients, of which 84 (65.6%) died within 1 year. The RDW level was not elevated in 69.4% of our patient who died after 1 year. Analysis of the present study's data showed that an elevated RDW level was associated with mortality, independent of other factors, which might be because the patients in the present study were of advanced age and having additional systemic diseases. We think that additional larger–scale, multicenteric studies are needed to further clarify the relationship between an elevated RDW and mortality in patients with hip fracture.

Determining the risk status of the patients with hip fracture during preoperative evaluation may reduce the mortality rate. In the present study there was a strong correlation between elevated RDW levels (>14.5) and mortality. We think that the RDW level should be included as a parameter in the risk assessment scales. The RDW which is included in the hemogram test performed in all patients is a practical and cost–effective marker.

Conflicts of Interest: No conflicts declared.

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