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Association of the Hemoglobin, Albumin, Lymphocyte, and Platelet (HALP) Score With Renal Recovery in Newly Diagnosed Multiple Myeloma: A Retrospective Study

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Abstract

Objective: The hemoglobin–albumin–lymphocyte–platelet (HALP) score reflects nutritional-inflammatory status and is a prognostic marker in several malignancies. Its potential association with renal recovery in newly diagnosed multiple myeloma (MM) remains unclear. We investigated the relationship between baseline HALP score and renal recovery in patients with newly diagnosed MM.

Methods: We retrospectively evaluated 133 consecutive patients with newly diagnosed MM. Renal response analyses were restricted to 56 patients meeting prespecified baseline eGFR criteria. Renal recovery was defined by modified International Myeloma Working Group (IMWG) criteria using the last available follow-up eGFR. The median follow-up was 15 months (interquartile range [IQR], 6.5-20.75). The HALP score was evaluated using group comparisons, receiver operating characteristic (ROC), correlation, and logistic regression analyses.

Results: In the renal outcome cohort (n = 56), 37 (66.1%) achieved renal recovery and 19 (33.9%) experienced nonrecovery. The median HALP score did not differ significantly between the recovery and nonrecovery groups (27.66 [IQR, 20.85–45.95] vs 22.82 [IQR, 9.90–54.94]; P = .364). HALP score discrimination for renal recovery was limited (area under the curve [AUC], 0.575; 95% CI, 0.435–0.706; P = .422). An exploratory cutoff of >18.91 yielded a sensitivity of 81.1% and specificity of 47.4%. HALP ≥18.91 was not significantly associated with renal recovery in univariable analysis (odds ratio [OR], 3.12; 95% CI, 0.91–10.64; P = .069) but showed a significant association after multivariable adjustment (OR, 4.32; 95% CI, 1.13–16.58; P = .033). The HALP score did not correlate with ΔeGFR (r = −0.058; P = .671).

Conclusions: The continuous HALP score showed limited discrimination for renal recovery. However, an exploratory threshold of ≥18.91 was associated with recovery after multivariable adjustment. Given the modest sample size, wide CI, and nonsignificant ROC analysis, this threshold-based finding requires confirmation in larger independent cohorts.

Keywords: Biomarkers, Estimated glomerular filtration rate, HALP score, Kidney injury, Multiple myeloma, Renal outcome, Renal recovery

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Multiple myeloma (MM) is a hematologic malignancy that leads to several organ complications, including renal impairment.[1,2] Renal involvement is a frequent and clinically significant manifestation of MM, often influencing both therapeutic decisions and long-term outcomes.[3] Renal impairment in MM arises through several pathogenic mechanisms, including light-chain cast nephropathy, hypercalcemia, dehydration, infections, exposure to nephrotoxic agents, and high tumor burden.4 Because renal recovery has important therapeutic and prognostic implications, there is growing interest in identifying practical biomarkers that help estimate the likelihood of kidney function improvement.

The hemoglobin–albumin–lymphocyte–platelet (HALP) score is a composite index derived from routinely available laboratory measurements.[5] By integrating hemoglobin concentration, serum albumin, lymphocyte count, and platelet count, it reflects nutritional status, systemic inflammation, immune competence, and hematologic condition. Evidence from previous studies suggests that the HALP score provides prognostic information across several malignancies, particularly with respect to survival and treatment response. In MM, abnormalities such as anemia, hypoalbuminemia, immune dysregulation, and chronic inflammation are common manifestations of the disease and reflect both disease burden and the patient's overall clinical condition.[6]

These components are also relevant to renal outcomes. Anemia and hypoalbuminemia reflect nutritional status and overall clinical condition, whereas lymphocyte and platelet abnormalities accompany systemic inflammation and hematological dysregulation.[5,6] Thus, the HALP score captures aspects of systemic clinical status that could potentially be associated with renal recovery. However, such an association remains uncertain, as renal recovery in MM is influenced by several disease-specific and renal factors.[7]

Previous studies in MM have primarily evaluated the prognostic significance of the HALP score for overall survival and general clinical outcomes.[8] In contrast, its potential utility in predicting renal outcomes remains entirely unexplored, despite the fact that renal recovery critically influences patient prognosis. While renal recovery depends on multi-factorial elements such as baseline kidney function, the severity and reversibility of renal injury, hematological response, disease burden, treatment effectiveness, and supportive care,[7] a simple, routine biomarker could optimize patient stratification. Therefore, we investigated whether the baseline HALP score provides incremental prognostic value for renal recovery in patients with newly diagnosed MM.

Methods

Study Design and Population

Medical records of adult patients diagnosed with multiple myeloma from January 2019 to November 2024 at a tertiary referral center were retrospectively reviewed to obtain demographic characteristics, comorbidities, disease-related variables, treatment characteristics, and follow-up outcomes. This study was approved by the Scientific Research Ethics Committee of Bursa City Hospital (Approval No. 2024-20/9; November 27, 2024).

Patients were eligible if they were ≥ 18 years of age and had sufficient baseline laboratory, renal function, and follow-up data for the planned analyses. Overall, 246 newly diagnosed patients were screened. Patients with missing laboratory variables required for calculation of the HALP score, unavailable renal function or follow-up data, or incomplete clinical records were excluded. After application of the eligibility criteria, 133 patients constituted the overall study cohort (**Figure 1**).

The primary categorical renal-response analysis was restricted to patients with baseline eGFR < 50 mL/min per 1.73 m², as patients with baseline eGFR ≥ 50 mL/min per 1.73 m² were considered nonevaluable for the prespecified modified International Myeloma Working Group (IMWG)-based renal-response categories. Accordingly, 56 patients constituted the renal outcome cohort. The overall cohort was retained for secondary analyses evaluating continuous changes in renal function.

Disease stage was classified according to the International Staging System (ISS) and Revised International Staging System (R-ISS). Cytogenetic abnormalities were recorded from available fluorescence in situ hybridization (FISH) results.[9]

HALP Score Calculation

Baseline laboratory values obtained before initiation

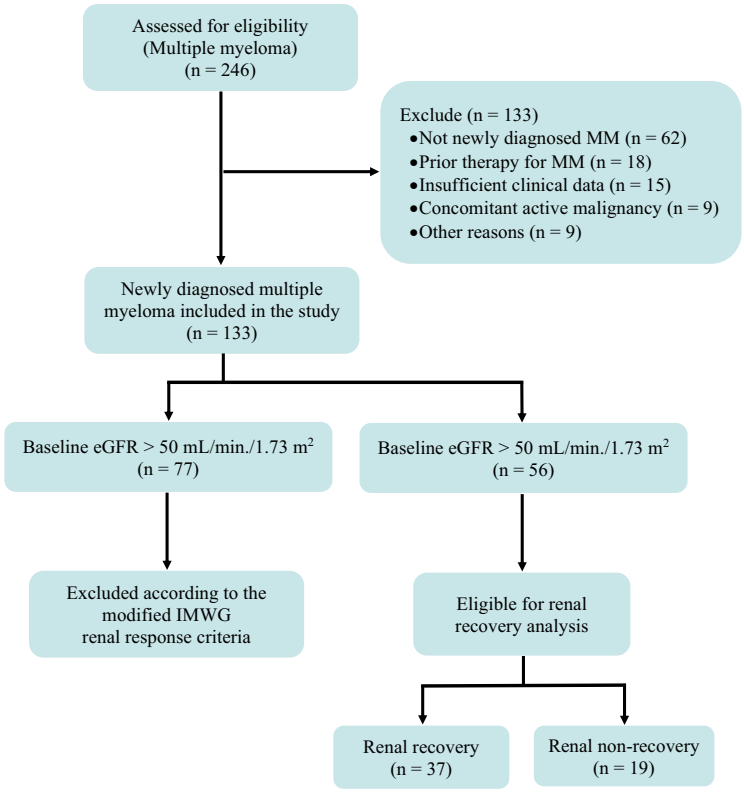


Figure 1. Flow Diagram of Patient Selection, Eligibility Assessment, and Stratification Based on Baseline Renal Function

Modified IMWG renal response criteria indicate that patients with eGFR >50 mL/min per 1.73 m² are not eligible for renal response assessment. Renal recovery analysis was performed exclusively in patients with baseline eGFR ≤50 mL/min per 1.73 m².
eGFR indicates estimated glomerular filtration rate; IMWG, International Myeloma Working Group; MM, multiple myeloma.

of anti-myeloma therapy were used to calculate the HALP score. Hemoglobin values, originally recorded in g/dL, were converted to g/L by multiplying by 10 before calculation. HALP scores were calculated directly from the original laboratory components using the standard formula:[5]

HALP = Hemoglobin (g/L) × Albumin (g/L) × Lymphocyte count (per μL) ÷ Platelet count (per μL)

The HALP score was analyzed primarily as a continuous variable. Any threshold derived from receiver operating characteristic (ROC) analysis was considered exploratory because it was generated and evaluated within the same cohort.

Renal Function and Renal-Response Assessment

Renal function was assessed using estimated glomerular filtration rate (eGFR, mL/min per 1.73 m²), calculated with the Chronic Kidney Disease Epidemiology Collaboration (CKD-EPI) equation.10 Baseline eGFR was the value recorded at diagnosis before initiation of anti-myeloma therapy, and follow-up eGFR was the last available value during the observation period. Follow-up duration was calculated from the date of diagnosis to the last clinical assessment or death and was summarized as median and interquartile range (IQR). Because the best post-treatment renal value was unavailable, renal response was operationalized using the last follow-up eGFR and was therefore described as a modified IMWG-based renal response.[7]

Complete renal response was defined as an improvement from baseline eGFR < 50 to follow-up eGFR ≥ 60 mL/min per 1.73 m². Partial renal response was defined as an improvement from baseline eGFR < 15 to follow-up eGFR 30–59 mL/min per 1.73 m². Minor renal response was defined as an improvement from baseline eGFR < 15 to 15–29 mL/min per 1.73 m² or from baseline eGFR 15–29 to 30–59 mL/min per 1.73 m². Patients meeting any of these criteria were classified as having renal recovery. Patients with baseline eGFR < 50 mL/min per 1.73 m² who did not meet

any response criterion were classified as having renal nonrecovery, whereas patients with baseline eGFR ≥ 50 mL/min per 1.73 m² were considered not evaluable for the categorical renal-response endpoint.

Hemodialysis status was assessed separately. Patients were categorized as never requiring hemodialysis, remaining dialysis dependent at the final assessment, or achieving dialysis independence. Dialysis independence was considered a clinically relevant indicator of renal improvement and was reported separately. As a secondary continuous renal outcome, change in eGFR was calculated as ΔeGFR = follow-up eGFR - baseline eGFR. A positive ΔeGFR alone was not considered renal recovery unless the prespecified modified IMWG-based response threshold was met.

Hematological response was documented after 2 to 4 cycles of therapy and categorized as complete response (CR), very good partial response (VGPR), partial response (PR), stable disease (SD), or progressive disease (PD) according to current multiple myeloma response criteria.2 For exploratory analyses, CR, VGPR, and PR were grouped as a good hematological response, whereas SD and PD were grouped as poor or no response.

Statistical Analysis

Statistical analyses were conducted using IBM SPSS Statistics, version 28.0 (IBM Corp), and, where required for penalized or robust analyses, supplementary statistical software R and the IBM SPSS Statistics-Integration Plug-in for R. Continuous variables are presented as mean (standard deviation [SD]) or median (IQR), as appropriate, and categorical variables as frequency and percentage. Primary categorical renal-response analyses were restricted to evaluable patients with baseline eGFR <50 mL/min per 1.73 m². Renal-recovery and renal-nonrecovery groups were compared using the independent-samples *t* test or Mann–Whitney *U* test for continuous variables and Pearson chi-square or Fisher exact test for categorical variables, as appropriate. Variable-specific denominators were reported when data were missing. The discriminatory performance of the HALP score for renal recovery was evaluated using ROC analysis, with the area under the curve (AUC) and its 95% confidence interval (CI) reported. Higher HALP values were specified as indicating a greater likelihood of renal recovery. An exploratory cut-off was estimated using the Youden index, together with sensitivity and specificity; however, this threshold was interpreted cautiously because it was derived and tested in the same cohort.

For regression analyses, renal recovery was coded as the event (1), whereas renal nonrecovery was coded as the reference outcome (0). Odds ratios (ORs) greater than 1 therefore indicate higher odds of renal recovery. Potential predictors were first examined in univariable analyses. Given the limited number of renal nonrecovery events, a parsimonious multivariable model was prespecified, with HALP retained as the primary exposure and clinically relevant covariates selected without stepwise procedures. Components of the HALP score were not entered simultaneously with the composite score. Penalized logistic regression was used if required because of sparse data or separation. ORs, 95% CIs, and P values were reported. Analyses investigating the association between HALP score and renal recovery were restricted to patients with baseline eGFR < 50 mL/min per 1.73 m². Patients with baseline eGFR ≥ 50 mL/min per 1.73 m² were treated as nonevaluable for the renal recovery endpoint and were excluded from these analyses.

In secondary analyses including the full cohort, the association between HALP and ΔeGFR was examined using Spearman rank correlation. Follow-up eGFR was also evaluated as a continuous outcome with adjustment for baseline eGFR and prespecified clinical covariates. All tests were 2-sided, and $P < .05$ was considered statistically significant.

Results

Among the 133 patients with newly diagnosed multiple myeloma included in the overall study cohort, 56 patients met the prespecified criteria for renal-response assessment and constituted the renal outcome cohort. Of these patients, 37 (66.1%) achieved renal recovery during follow-up, whereas 19 (33.9%) were classified as having renal nonrecovery.

Baseline Characteristics According to Renal Recovery

Baseline demographic, clinical, laboratory, disease-related, and treatment characteristics according to renal

Table 1. Baseline Demographic, Clinical, Laboratory, Disease-Related, and Treatment Characteristics According to Renal Recovery Status

Variable	Overall (n = 56)	Renal nonrecovery (n = 19)	Renal recovery (n = 37)	*P* value
Age, mean (SD), y	67.29 (9.29)	67.05 (11.95)	67.41 (7.79)	.908
Male sex, No. (%)	24 (42.9)	6 (31.6)	18 (48.6)	.222
Diabetes mellitus, No. (%)	12 (21.4)	4 (21.1)	8 (21.6)	>.99
Hypertension, No. (%)	26 (46.4)	9 (47.4)	17 (45.9)	.920
Coronary artery disease, No. (%)	11 (19.6)	3 (15.8)	8 (21.6)	.732
Nephrotic syndrome, No. (%)	3 (5.4)	1 (5.3)	2 (5.4)	>.99
Cerebrovascular disease, No. (%)	3 (5.4)	2 (10.5)	1 (2.7)	.263
Malignancy, No. (%)	2 (3.6)	1 (5.3)	1 (2.7)	>.99
Myeloma type, No. (%)				
IgG kappa	15 (26.8)	4 (21.1)	11 (29.7)	.543
IgG lambda	7 (12.5)	3 (15.8)	4 (10.8)	.679
IgA kappa	10 (17.9)	4 (21.1)	6 (16.2)	.72
IgA lambda	7 (12.5)	3 (15.8)	4 (10.8)	.679
IgM kappa	1 (1.8)	1 (5.3)	0 (0.0)	.339
Kappa light chain	6 (10.7)	2 (10.5)	4 (10.8)	>.99
Lambda light chain	9 (16.1)	2 (10.5)	7 (18.9)	.703
Biclonal disease	1 (1.8)	0 (0.0)	1 (2.7)	>.99
ISS stage, No. (%)				.493
I	2 (3.8)	0	2 (5.9)	
I	8 (15.4)	4 (22.2)	4 (11.8)	
III	42 (80.8)	14 (77.8)	28 (82.4)	
R-ISS stage, No. (%)				.176
I	1 (1.9)	0	1 (2.9)	
II	25 (48.1)	6 (33.3)	19 (55.9)	
III	26 (50.0)	12 (66.7)	14 (41.2)	
WBC count, median (IQR), per µL	5930 (4595–7807.5)	6450 (4730–8885)	5820 (4455–7300)	.276
Lymphocyte count, median (IQR), per µL	1750 (1193–2368)	2020 (940–2770)	1750 (1350–2195)	.755
Hemoglobin, median (IQR), g/dL	8.25 (7.22–10.20)	8.80 (7.50–11.90)	7.90 (7.22–10.05)	.109
Hematocrit, median (IQR), %	24.85 (21.80–30.05)	26.00 (22.30–33.60)	23.80 (20.50–29.80)	.107

(continued)

Table 1. Baseline Demographic, Clinical, Laboratory, Disease-Related, and Treatment Characteristics According to Renal Recovery Status (continued)

Variable	Overall (n = 56)	Renal nonrecovery (n = 19)	Renal recovery (n = 37)	*P* value
Platelet count, mean (SD), × 10^3 per μL	185.60 (97.44)	235.15 (113.84)	160.16 (77.87)	.005
LDH, median (IQR), U/L	169.5 (118.0–250.5)	162.0 (115.0–254.0)	172.0 (118.0–250.0)	.924
Uric acid, median (IQR), mg/dL	7.7 (5.78–9.8)	7.6 (5.2–8.8)	8.0 (6.0–11.15)	.171
Total protein, median (IQR), g/L	82.5 (68.6–98.87)	74.3 (69.9–95.7)	87.4 (65.0–106.65)	.416
Albumin, mean (SD), g/L	33.63 (8.32)	33.41 (9.79)	33.74 (7.6)	.889
Baseline eGFR, median (IQR), mL/min/1.73 m^2	22.6 (13.7–34.45)	31.3 (11.8–37.3)	19.6 (13.7–34.0)	.762
Baseline eGFR category, No. (%)				
eGFR <15	15 (26.8)	5 (26.3)	10 (27.0)	.955
eGFR 15–29	17 (30.4)	3 (15.8)	14 (37.8)	.099
eGFR 30–49	24 (42.9)	11 (57.9)	13 (35.1)	.103
Proteinuria, baseline, median (IQR), mg/d	500 (300–500)	500 (300–500)	500 (150–650)	.685
Proteinuria, follow-up, median (IQR), mg/d	300 (0–500)	300 (145–650)	300 (0–500)	.412
Hemodialysis status, No. (%)	11 (19.6)	8 (42.1)	3 (8.1)	.004
Preexisting kidney disease etiology, No. (%)				
Etiology documented	8 (14.3)	3 (15.8)	5 (13.5)	>.99
Diabetes mellitus	6 (10.7)	3 (15.8)	3 (8.1)	.397
Hypertension	5 (8.9)	2 (10.5)	3 (8.1)	>.99
Calcium, median (IQR), mg/dL	10.2 (9.3–12.2)	10.1 (9.1–10.7)	10.8 (9.4–12.65)	.141
Phosphorus, mean (SD), mg/dL	4.19 (1.09)	4.43 (1.03)	4.08 (1.11)	.306
Sodium, median (IQR), mmol/L	138 (134–140)	138 (134–141)	138 (136–140)	.924
Potassium, mean (SD), mmol/L	4.35 (0.71)	4.54 (0.62)	4.25 (0.74)	.143
Total cholesterol, mean (SD), mg/dL	141.9 (62.2)	161.2 (74.72)	133.19 (54.81)	.164
Triglycerides, median (IQR), mg/dL	110.5 (77.75–170.0)	126.5 (77.5–209.8)	110.5 (77.25–167.75)	.633

(continued)

Table 1. Baseline Demographic, Clinical, Laboratory, Disease-Related, and Treatment Characteristics According to Renal Recovery Status (continued)

Variable	Overall (n = 56)	Renal nonrecovery (n = 19)	Renal recovery (n = 37)	*P* value
HDL cholesterol, median (IQR), mg/dL	33.0 (26.5–43.0)	39.5 (22.75–53.5)	33.0 (27.0–38.0)	.351
LDL cholesterol, median (IQR), mg/dL	64.0 (48.0–117.5)	74.5 (49.5–123.25)	61.0 (46.5–102.25)	.262
Ferritin, median (IQR), ng/mL	464.5 (195.5–789.0)	286.0 (103.0–505.0)	614.0 (308.0–954.0)	.002
Iron, median (IQR), µg/dL	59.0 (44.25–86.0)	54.0 (39.0–84.0)	62.0 (46.0–90.0)	.226
TIBC, mean (SD), µg/dL	231.5 (62.2)	234.2 (73.79)	230.05 (56.41)	.811
PTH, median (IQR), pg/mL	30.55 (9.35–92.53)	59.3 (11.43–118.25)	18.95 (9.0–70.55)	.201
CRP, median (IQR), mg/L	9.6 (2.63–26.45)	6.9 (2.0–29.9)	11.6 (2.85–26.4)	.452
Procalcitonin, median (IQR), ng/mL	0.17 (0.11–0.28)	0.18 (0.12–0.28)	0.16 (0.10–0.26)	.528
Beta-2 microglobulin, median (IQR), mg/L	12.16 (6.25–16.89)	14.85 (5.21–21.21)	11.29 (6.46–15.50)	.256
Bone marrow plasma cells, median (IQR), %	60 (32.75–88.75)	65 (20–90)	60 (40–86.25)	.556
FISH abnormality, No. (%)	20 (36.4)	10 (52.6)	10 (27.8)	.068
Treatment, No. (%)				
Bortezomib	54 (98.2)	18 (100)	36 (97.3)	>.99
ASCT	20 (40.0)	7 (43.8)	13 (38.2)	.710
Response after 2–4 cycles, No. (%)				
Complete remission	1 (2.0)	0	1 (2.9)	>.99
VGPR	22 (43.1)	8 (47.1)	14 (41.2)	.689
Partial remission	27 (52.9)	9 (52.9)	18 (52.9)	>.99
Progressive disease	1 (2.0)	0	1 (2.9)	>.99
Mortality, No. (%)	22 (39.3)	4 (21.1)	18 (48.6)	.045

Abbreviations: ASCT, autologous stem cell transplantation; CRP, C-reactive protein; eGFR, estimated glomerular filtration rate; FISH, fluorescence in situ hybridization; HDL, high-density lipoprotein; ISS, International Staging System; LDH, lactate dehydrogenase; LDL, low-density lipoprotein; PTH, parathyroid hormone; R-ISS, Revised International Staging System; TIBC, total iron-binding capacity; VGPR, very good partial response; WBC, white blood cell.

Group comparisons were performed using the independent-samples *t* test for normally distributed continuous variables, the Mann–Whitney *U* test for nonnormally distributed continuous variables, and the Pearson χ^2 test, Fisher exact test, or Fisher–Freeman–Halton test for categorical variables, as appropriate. Percentages were calculated using available data. For variables with missing observations, the available-case denominators were as follows: ISS and R-ISS, n = 52 (renal nonrecovery, n = 18; renal recovery, n = 34; FISH, n = 55 (n = 19 and n = 36, respectively); bortezomib use, n = 55 (n = 18 and n = 37); ASCT, n = 50 (n = 16 and n = 34); and hematological response after 2–4 cycles, n = 51 (n = 17 and n = 34).

Table 2. Renal, Laboratory, and Follow-Up Parameters According to Renal Recovery Status

Variable	Overall (n = 56)	Renal nonrecovery (n = 19)	Renal recovery (n = 37)	*P* value
Baseline eGFR, median (IQR), mL/min per 1.73 m²	22.6 (13.7–34.9)	31.3 (11.8–37.3)	19.6 (13.7–34.3)	.762
Follow-up eGFR, median (IQR), mL/min per 1.73 m²	53.65 (36.33–69.8)	36.0 (11.6–52.7)	63.0 (46.6–78.15)	<.001
ΔeGFR, median (IQR), mL/min per 1.73 m²	27.0 (11.4–42.5)	3.0 (0.1–14.3)	37.0 (27.0–50.9)	<.001
Baseline creatinine, median (IQR), mg/dL	2.56 (1.76–3.62)	1.91 (1.52–4.00)	2.60 (1.93–3.51)	.377
BUN, median (IQR), mg/dL	34.0 (24.93–50.28)	34.0 (24.9–52.6)	33.8 (26.5–48.7)	.856
Follow-up duration, median (IQR), mo	15.0 (6.5–20.75)	13.0 (5.0–20.0)	16.0 (7.0–23.5)	.533

Abbreviations: BUN, blood urea nitrogen; ΔeGFR, change in estimated glomerular filtration rate; eGFR, estimated glomerular filtration rate.

Group comparisons were performed using the Mann–Whitney *U* test.

recovery status are presented in Table 1. The mean (SD) age of the renal outcome cohort was 67.29 (9.29) years, and 24 patients (42.9%) were male. Age, sex, diabetes mellitus, hypertension, coronary artery disease, and other major comorbidities did not differ significantly between the renal recovery and nonrecovery groups.

There were no significant differences between the groups with respect to myeloma subtype, ISS stage, or R-ISS stage. Most hematological and biochemical parameters were also comparable between the groups. However, mean (SD) platelet counts were significantly lower in patients who achieved renal recovery than in those with renal nonrecovery (160.16 [77.87] vs 235.15 [113.84] × 10^3/μL; *P* = .005). Conversely, median (IQR) ferritin levels were significantly higher in the renal recovery group (614 [308–954] vs 286 [103–505] ng/mL; *P* = .002).

Hemodialysis status differed significantly between the groups. Hemodialysis was present in 8 of 19 patients (42.1%) with renal nonrecovery compared with 3 of 37 patients (8.1%) who achieved renal recovery (*P* = .004). FISH abnormalities were numerically more frequent in patients with renal nonrecovery than in those with renal recovery (52.6% vs 27.8%), although this difference did not reach statistical significance (*P* = .068).

Treatment characteristics and hematological response after 2 to 4 cycles were generally comparable between the groups. Bortezomib use was observed in 100% of the nonrecovery group and 97.3% of the recovery group (*P* > .99), while autologous stem cell transplantation was performed in 43.8% and 38.2% of patients, respectively (*P* = .71). Mortality was observed in 4 patients (21.1%) in the nonrecovery group and 18 patients (48.6%) in the recovery group (*P* = .045) (**Table 1**).

Renal Outcomes

Renal and follow-up parameters according to renal recovery status are summarized in **Table 2**. Median (IQR) baseline eGFR was 22.6 (13.7–34.9) mL/min per 1.73 m² in the overall renal outcome cohort. Baseline median (IQR) eGFR did not differ significantly between patients with renal nonrecovery and those with renal recovery (31.3 [11.8–37.3] vs 19.6 [13.7–34.3] mL/min per 1.73 m²; *P* = .762).

Follow-up median (IQR) eGFR was significantly higher in the renal recovery group than in the nonrecovery group (63 [46.6–78.15] vs 36 [11.6–52.7] mL/min per 1.73 m²; *P* < .001). Similarly, the increase in eGFR during follow-up was substantially greater among patients who achieved renal recovery, with a median (IQR) ΔeGFR of 37 (27–50.9) mL/min per 1.73 m² compared with 3 (0.1–14.3) mL/min per 1.73 m² in those without renal recovery (*P* < .001).

Baseline median (IQR) creatinine (2.6 [1.93–3.51]

Table 3. Association Between HALP Score and Renal Recovery

Variable	Overall (n = 56)	Renal nonrecovery (n = 19)	Renal recovery (n = 37)	*P* value
HALP score, median (IQR)	29.93 (17.75–48.27)	22.82 (9.90–54.94)	27.66 (20.85–45.95)	.364
HALP category, No. (%)				.064
HALP < 18.91	15 (26.8)	8 (42.1)	7 (18.9)	
HALP ≥ 18.91	41 (73.2)	11 (57.9)	30 (81.1)	

Abbreviations: HALP, hemoglobin, albumin, lymphocyte, and platelet score.

Group comparisons were performed using the Mann–Whitney U test for nonnormally distributed continuous variables, and the Pearson χ^2 test for categorical variables.

vs 1.91 [1.52–4.00] mg/dL; *P* = .377), BUN (33.8 [26.5–48.7] vs 34.0 [24.9–52.6] mg/dL; *P* = .856], and follow-up duration (16 [7–23.5] vs 13 [5–20] months; *P* = .533] were comparable between the renal recovery and nonrecovery groups (**Table 2**).

Association Between HALP Score and Renal Recovery

The relationship between HALP score and renal recovery is presented in **Table 3**. The median (IQR) HALP score was 29.93 (17.75–48.27) in the overall renal outcome cohort. Although the median (IQR) HALP score was numerically higher in patients who achieved renal recovery than in those with renal nonrecovery (27.66 [20.85–45.95] vs 22.82 [9.90–54.94]; *P* = .36), the difference was not statistically significant.

Using the exploratory HALP cutoff of 18.91, a higher proportion of patients in the renal recovery group scored at or above the threshold compared with those in the nonrecovery group (30/37 [81.1%] vs 11/19 [57.9%]; *P* = .064) (**Table 3**). Although this distribution demonstrated a trend toward significance, it

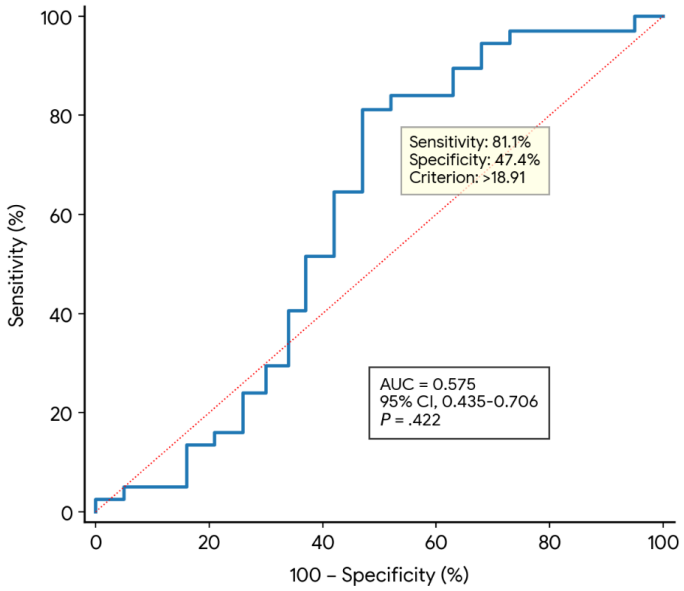


Figure 2. Receiver Operating Characteristic (ROC) Curve Analysis of the HALP Score for Predicting Renal Recovery

The diagonal dashed line represents chance-level discrimination. The HALP score showed limited discriminatory ability for predicting renal recovery (AUC, 0.575; 95% CI, 0.435–0.706; *P* = .422). The optimal cutoff criterion and corresponding sensitivity and specificity values are detailed within the plot.

AUC indicates area under the curve; CI, confidence interval; HALP, hemoglobin, albumin, lymphocyte, and platelet score.

Table 4. Renal Outcomes According to HALP Group

Variable	Overall (n = 56)	HALP <18.91 (n = 15)	HALP ≥ 18.91 (n = 41)	*P* value
Hemodialysis status, No. (%)	11 (19.6)	4 (26.7)	7 (17.1)	.461
Baseline eGFR, median (IQR), mL/min per 1.73 m²	22.6 (13.7–34.9)	25.0 (7.7–34.0)	19.6 (14.45–37.0)	.410
Follow-up eGFR, median (IQR), mL/min per 1.73 m²	53.65 (36.33–69.8)	54.4 (15.3–63.0)	52.9 (39.3–74.5)	.149
ΔeGFR, median (IQR), mL/min per 1.73 m²	27.0 (11.4–42.5)	22.1 (3.0–34.0)	28.4 (14.45–47.25)	.162
Mortality, No. (%)	22 (39.3)	5 (33.3)	17 (41.5)	.581
Follow-up duration, median (IQR), mo	15.0 (6.5–20.75)	20.0 (11.0–30.0)	13.0 (5.0–19.0)	.088

Abbreviations: ΔeGFR, change in estimated glomerular filtration rate; eGFR, estimated glomerular filtration rate; HALP, hemoglobin, albumin, lymphocyte, and platelet score.

Group comparisons were performed using the Mann–Whitney *U* test for nonnormally distributed continuous variables, and the Pearson χ^2 test or Fisher exact test for categorical variables, as appropriate. Percentages were calculated using available data.

did not reach the alpha threshold. Conversely, HALP-scores below 18.91 were observed in 42.1% of patients with renal nonrecovery and 18.9% of those with renal recovery.

ROC analysis showed limited discriminatory ability of the HALP score for predicting renal recovery, with an AUC of 0.575 (95% CI, 0.435–0.706; *P* = .422). The optimal cutoff value according to the Youden index was > 18.91, yielding a sensitivity of 81.1% and a specificity of 47.4% (**Figure 2**).

Renal Outcomes According to HALP Category

Renal outcomes according to the exploratory HALP threshold are shown in **Table 4**. Hemodialysis status was not significantly different between patients with HALP < 18.91 and those with HALP ≥ 18.91 (26.7% vs 17.1%; *P* = .46). Similarly, baseline median (IQR) eGFR (25 [7.7–34.0] vs 19.6 [14.45–37.0] mL/min per 1.73 m²; *P* = .410), follow-up median (IQR) eGFR (54.4 [15.3–63.0] vs 52.9 [39.3–74.5] mL/min per 1.73 m²; *P* = .149), and ΔeGFR (22.1 [3.0–34.0] vs 28.4 [14.45–47.25] mL/min per 1.73 m²; *P* = .162) did not differ significantly between the HALP groups.

No significant difference was observed in mortality between patients with HALP < 18.91 and those with HALP ≥ 18.91 (33.3% vs 41.5%; *P* = .581). Follow-up median (IQR) duration tended to be longer in the HALP < 18.91 group (20 [11–30] vs 13 [5–19]

Table 5. Logistic Regression Analysis for Renal Recovery

Variable	Univariable analysis OR (95% CI)	*P* value	Multivariable analysis OR (95% CI)	*P* value
Male sex	2.05 (0.64–6.56)	.225	3.24 (0.85–12.37)	.086
Hypertension	0.94 (0.31–2.86)	.920	—	—
Baseline eGFR	0.99 (0.95–1.03)	.601	0.97 (0.93–1.02)	.255
HALP ≥ 18.91	3.12 (0.91–10.64)	.069	4.32 (1.13–16.58)	.033

Abbreviations: CI, confidence interval; eGFR, estimated glomerular filtration rate; HALP, hemoglobin, albumin, lymphocyte, and platelet score; OR, odds ratio.

Hypertension was not included in the multivariable model based on prespecified statistical criteria. Reference categories were female sex, absence of hypertension, and HALP score <18.91. Renal recovery was coded as 1 (event) and renal nonrecovery as 0; therefore, an OR >1 indicates higher odds of renal recovery.

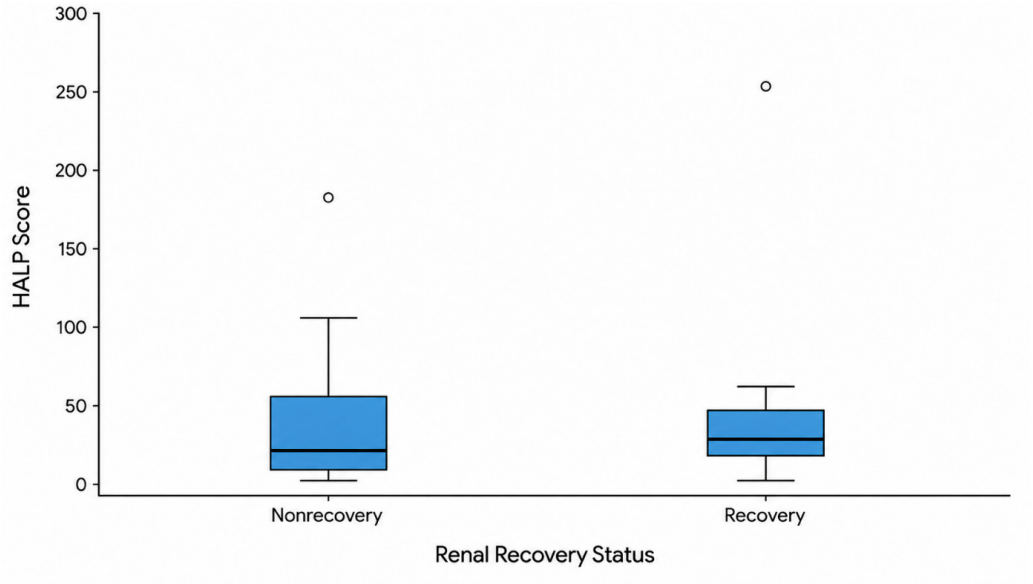


Figure 3. Distribution of HALP Scores According to Renal Recovery Status

HALP scores were higher in patients with renal recovery than in those with renal nonrecovery; however, this difference was not statistically significant (median [IQR], 27.66 [20.85–45.95] vs 22.82 [9.90–54.94]; *P* = .36, Mann–Whitney U test).
HALP indicates hemoglobin, albumin, lymphocyte, and platelet score.

months; *P* = .088), although this difference did not reach statistical significance (T**able 4**). Consistent with these findings, Spearman correlation analysis demonstrated no significant association between HALP score and ΔeGFR (r = −.058; *P* = .671).

Predictors of renal recovery were evaluated using logistic regression analysis (**Table 5**). In univariable analysis, male sex was associated with an OR of 2.05 (95% CI, 0.64–6.56; *P* = .225), hypertension with an OR of 0.94 (95% CI, 0.31–2.86; *P* = .920), and baseline eGFR with an OR of 0.99 (95% CI, 0.95–1.03; *P* = .601). Patients with HALP ≥ 18.91 had approximately three-fold higher odds of renal recovery in univariable analysis, although this association did not reach statistical significance (OR, 3.12; 95% CI, 0.91–10.64; *P* = .069).

In the multivariable logistic regression model, HALP ≥ 18.91 was independently associated with higher odds of renal recovery (OR, 4.32; 95% CI, 1.13–16.58; *P* = .033). Male sex showed a nonsignificant trend toward higher odds of renal recovery (OR, 3.24; 95% CI, 0.85–12.37; *P* = .086), whereas baseline eGFR was not independently associated with renal recovery (OR, 0.97; 95% CI, 0.93–1.02; *P* = .255) (**Table 5**).

The distribution of HALP scores according to renal recovery status is illustrated in **Figure 3**. HALP scores were higher in patients with renal recovery than in those with renal nonrecovery, although this difference was not statistically significant (median [IQR], 27.66 [20.85–45.95] vs 22.82 [9.90–54.94]; *P* = .36).

Discussion

The present study evaluated the association between the HALP score and renal recovery in patients with newly diagnosed MM who were eligible for renal response assessment. The main finding was that the HALP score, when analyzed as a continuous variable, did not differ significantly between patients with and without renal recovery and showed limited discriminatory performance in ROC analysis. In addition, HALP was not significantly correlated with the magnitude of change in eGFR during follow-up. However, when an exploratory ROC-derived threshold was applied, HALP ≥18.91 was associated with higher odds of renal recovery after multivariable adjustment. This finding should be interpreted cautiously, particularly because the overall discriminatory performance of HALP was limited and the threshold was derived and evaluated within the same cohort.

Renal dysfunction in patients with newly diagnosed MM may result from several disease-related and potentially reversible processes, including free light chain-mediated tubular injury, cast nephropathy, hypercalcemia, volume depletion, and other disease- or treatment-related factors.[11-13] Accordingly, renal recovery is likely determined by a complex interplay between the severity and reversibility of kidney injury, underlying renal reserve, myeloma burden, and response to therapy.[14] Recent studies have similarly emphasized the importance of disease-specific factors, particularly free light chain burden and its reduction during therapy, hematological response, and severity of renal dysfunction, in determining renal recovery.[15,16] In our study, however, baseline eGFR was not significantly associated with renal recovery in either univariable or multivariable analysis. This may partly reflect the restricted range of baseline kidney function in the renal response cohort, as only patients meeting the prespecified renal impairment criteria were included in these analyses.

FISH abnormalities did not differ significantly between patients with and without renal recovery (52.6% vs 27.8%). Given the incomplete availability of FISH data and the limited sample size, this finding should be considered exploratory and interpreted cautiously.

The HALP score integrates hemoglobin, serum albumin, lymphocyte count, and platelet count into a single composite index reflecting nutritional status, systemic inflammation, hematological condition, and immune competence.[5,13] Previous studies have demonstrated a potential prognostic role for HALP across several malignancies, and studies specifically involving patients with MM have suggested an association between lower HALP scores and adverse survival outcomes.[8,17] However, these studies primarily addressed overall prognosis rather than organ-specific outcomes. Renal recovery in patients with MM may therefore represent a more mechanistically specific endpoint that is not fully captured by a broad nutritional–inflammatory index.

In the present study, median HALP scores did not differ significantly between patients who achieved renal recovery and those who did not, and ROC analysis demonstrated limited discrimination, with an AUC of 0.575. Nevertheless, the exploratory threshold of 18.91 yielded a different signal. Patients with HALP ≥18.91 had higher odds of renal recovery after adjustment for sex and baseline eGFR (OR, 4.32; 95% CI, 1.13-16.58; $P = .033$), whereas the corresponding association in univariable analysis was nonsignificant. Importantly, the wide confidence interval indicates considerable uncertainty regarding the magnitude of this association. Furthermore, the threshold had relatively high sensitivity but low specificity, and the overall ROC analysis was not statistically significant. Therefore, the identified cutoff should not be regarded as an established clinical threshold but rather as an exploratory finding requiring external validation.

The apparent discrepancy between the continuous and threshold-based analyses deserves particular consideration. The absence of a significant continuous association suggests that HALP does not demonstrate a clear graded relationship with renal recovery across its entire range. One possibility is that particularly low HALP values identify a subgroup with greater systemic vulnerability, whereas differences above this level may carry little additional renal prognostic information. Alternatively, the threshold-based association may reflect sample-specific characteristics, particularly given the relatively small number of renal nonrecovery events. In addition, platelet count was significantly lower in patients who achieved renal recovery, whereas hemoglobin, albumin, and lymphocyte counts did not differ significantly between the groups. Because platelet count constitutes the denominator of the HALP formula, differences in platelet count may have contributed to the observed distribution of HALP values. This observation should also be interpreted cautiously, as the individual component comparisons were unadjusted.

The biological determinants of kidney recovery in patients with MM are likely to extend beyond systemic inflammatory and nutritional status. Previous studies have identified the extent of light-chain reduction, hematological response, histopathological severity of cast nephropathy, and baseline renal injury as relevant determinants of renal outcome.[14,15,17] More recent cohorts have similarly demonstrated that renal response is closely related to free light chain burden, reduction in free light chains during treatment, and effective control of the underlying myeloma.[18,19] These observations support the concept that disease-specific mechanisms have a stronger influence on renal recovery than a general systemic index such as HALP.

In the current analysis, neither hypertension nor

baseline eGFR was independently associated with renal recovery in the current renal response cohort. Male sex showed a nonsignificant trend toward greater odds of renal recovery after multivariable adjustment. Consequently, these findings should not be interpreted as evidence of independent effects of sex, hypertension, or baseline eGFR. Chronic kidney disease and its associated comorbidities may nevertheless influence renal reserve and susceptibility to kidney injury in broader populations,[10,20] but the present study was not sufficiently powered to establish such relationships within this selected cohort.

Hemodialysis was substantially more frequent among patients who did not achieve renal recovery. This finding is clinically plausible, as the need for dialysis may reflect greater severity of kidney injury or reduced reversibility of renal dysfunction. Avoidance of long-term dialysis dependence remains an important therapeutic objective in MM-associated renal impairment.[19] However, when patients were categorized according to the exploratory HALP threshold, hemodialysis status, baseline eGFR, follow-up eGFR, and ΔeGFR did not differ significantly between HALP groups. These findings, together with the limited ROC performance and the absence of a significant correlation between continuous HALP and ΔeGFR, argue against considering HALP a standalone marker of renal prognosis.

Taken together, our findings differ from studies in which HALP has demonstrated prognostic value for survival in patients with MM.[8,16] This distinction may reflect differences in the clinical endpoint being evaluated. Overall survival integrates disease burden, treatment response, comorbidity, nutritional status, and systemic inflammation, all of which may be represented to some extent by HALP. Renal recovery, in contrast, depends heavily on the nature and reversibility of myeloma-related kidney injury and the effectiveness and timing of myeloma-directed therapy.[14-19] Therefore, a biomarker associated with overall prognosis may not necessarily demonstrate strong discriminatory ability for renal recovery.

Strengths and Limitations

The inclusion of a well-defined cohort of patients with newly diagnosed MM and the focused evaluation of patients eligible for renal response assessment represent strengths of the present study. Renal outcomes were evaluated both categorically and continuously, and the association of HALP with renal recovery was examined using complementary approaches, including group comparisons, ROC analysis, correlation analysis, and multivariable logistic regression.

Despite these strengths, several limitations must be acknowledged. First, this was a retrospective, single-center study with a relatively small renal response cohort, including only 19 patients with renal nonrecovery. This limited number of events reduced statistical precision, as reflected in the wide confidence interval surrounding the adjusted HALP estimate, and may limit the generalizability of our findings. Second, the HALP cutoff of 18.91 was derived and evaluated within the same cohort; therefore, this threshold may be subject to optimism and should be considered exploratory until externally validated. Third, HALP did not demonstrate significant discrimination in ROC analysis or a significant continuous association with either renal recovery or ΔeGFR, which limits the strength of the conclusions that can be drawn from the threshold-based finding. Fourth, serum free light chain levels and kinetics, urinary monoclonal light-chain excretion, and kidney biopsy findings were not consistently available for all patients. These factors are directly related to the pathophysiology and reversibility of MM-associated renal injury and may provide stronger renal prognostic information than systemic composite indices.[12,15,16,19] Finally, because the best posttreatment renal value was not consistently available, renal response was operationalized using the last available follow-up eGFR as a modified IMWG based endpoint. This approach may differ from studies evaluating the best achieved renal response and should be considered when comparing our results with previous cohorts.

Conclusions

In patients with newly diagnosed MM eligible for renal response assessment, the HALP score showed limited ability to discriminate between patients with and without renal recovery when evaluated as a continuous marker. However, an exploratory HALP threshold of ≥18.91 was associated with higher odds of renal recovery after multivariable adjustment. Given the modest sample size, wide CI, limited ROC performance, and

data-derived nature of the threshold, this finding should be considered hypothesis-generating rather than evidence of an established predictive cutoff. Larger multicenter studies with external validation and comprehensive assessment of free light chain kinetics and other disease-specific renal markers are required to clarify whether HALP provides incremental information for renal outcome assessment in MM.

Declarations

Ethics Approval and Informed Consent

The Bursa City Hospital Scientific Research Ethics Committee approved this retrospective study (approval number: 2024-20/9) on November 27, 2024. The study protocol conformed to the ethical guidelines of the Declaration of Helsinki. Because the analysis used anonymized retrospective data, the ethics committee waived the requirement for informed consent.

Conflict of Interest Disclosures

The authors have no conflicts of interest to disclose.

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Data Sharing Statement

The datasets analyzed during the current study are not publicly available due to patient privacy and institutional restrictions but are available from the corresponding author on reasonable request.

Author Contributions

Study Conception: NNÖŞ, SS; Study Design: NNÖŞ, SS; Supervision: NA, MU; Funding: None; Materials: None; Data Collection and/or Processing: ÖÖG, EA; Data Analysis and/or Data Interpretation: HO; Literature Review: NNÖŞ; Manuscript Preparation: NNÖŞ, SS; Critical Review: TE, YA. All authors read and approved the final manuscript.

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Not Available

Declaration of Generative Artificial Intelligence in the Writing Process

The authors declare that no generative artificial intelligence (AI) or AI-assisted technologies were used in the writing or preparation of this manuscript. All scientific content, data analysis, and manuscript text were generated solely by the authors, who maintain full accountability for the accuracy and integrity of the work.

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References

1. Ludwig H, Miguel JS, Dimopoulos MA, et al. International Myeloma Working Group recommendations for global myeloma care. Leukemia. 2014;28(5):981-992. doi:10.1038/leu.2013.293
2. Rajkumar SV. Multiple myeloma: 2024 update on diagnosis, risk-stratification, and management. Am J Hematol. 2024;99(9):1802-1824. doi:10.1002/ajh.27422
3. Dimopoulos MA, Terpos E, Chanan-Khan A, et al. Renal impairment in patients with multiple myeloma: a consensus statement on behalf of the International Myeloma Working Group. J Clin Oncol. 2010;28(33):4976-4984. doi:10.1200/JCO.2010.30.8791
4. Kundu S, Jha SB, Rivera AP, et al. Multiple Myeloma and Renal Failure: Mechanisms, Diagnosis, and Management. Cureus. 2022;14(2):e22585. doi:10.7759/cureus.22585
5. Farag CM, Antar R, Akosman S, Ng M, Whalen MJ. What is hemoglobin, albumin, lymphocyte, platelet (HALP) score? A comprehensive literature review of HALP's prognostic ability in different cancer types. Oncotarget. 2023;14:153-172. doi:10.18632/oncotarget.28367
6. Qian C, Liu J, Meng C, Cheng J, Wu B, Liao J. The significant prognostic value of the hemoglobin, albumin, lymphocyte, and platelet (HALP) score in digestive system cancers: a systematic review and meta-analysis. BMC Cancer. 2025;25(1):1577.

doi:10.1186/s12885-025-15068-x
7. Dimopoulos MA, Merlini G, Bridoux F, et al. Management of multiple myeloma-related renal impairment: recommendations from the International Myeloma Working Group. Lancet Oncol. 2023;24(7):e293-e311. doi:10.1016/S1470-2045(23)00223-1
8. Zhang KS, Lyu DL, Shi L. [Significance of HALP Score as a Prognostic Indicator for Newly Diagnosed Multiple Myeloma]. Zhongguo Shi Yan Xue Ye Xue Za Zhi. 2025;33(2):442-446. doi:10.19746/j.cnki.issn.1009-2137.2025.02.019 [Article in Chinese]
9. Palumbo A, Avet-Loiseau H, Oliva S, et al. Revised International Staging System for Multiple Myeloma: A Report From International Myeloma Working Group. J Clin Oncol. 2015;33(26):2863-2869. doi:10.1200/JCO.2015.61.2267
10. Kidney Disease: Improving Global Outcomes (KDIGO) CKD Work Group. KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease. Kidney Int. 2024;105(4S):S117-S314. doi:10.1016/j.kint.2023.10.018
11. Leung N, Gertz MA, Zeldenrust SR, et al. Improvement of cast nephropathy with plasma exchange depends on the diagnosis and on reduction of serum free light chains. Kidney Int. 2008;73(11):1282-1288. doi:10.1038/ki.2008.108
12. Hutchison CA, Cockwell P, Stringer S, et al. Early reduction of serum-free light chains associates with renal recovery in myeloma kidney. J Am Soc Nephrol. 2011;22(6):1129-1136. doi:10.1681/ASN.2010080857
13. Xu H, Zheng X, Ai J, Yang L. Hemoglobin, albumin, lymphocyte, and platelet (HALP) score and cancer prognosis: A systematic review and meta-analysis of 13,110 patients. Int Immunopharmacol. 2023;114:109496. doi:10.1016/j.intimp.2022.109496
14. Rüsing LZ, Kozakowski N, Jeryczynski G, et al. Renal outcome in multiple myeloma patients with cast nephropathy: a retrospective analysis of potential predictive values on clinical and renal outcome. Hematology. 2024;29(1):2311600. doi:10.1080/16078454.2024.2311600
15. Ludwig H, Dimopoulos MA, Terpos E, et al. Parameters Associated With Renal Recovery and Survival in Myeloma Patients With Acute Renal Failure to Cast Nephropathy. Am J Hematol. 2026;101(1):56-69. doi:10.1002/ajh.70104
16. Li S, Zhang M, Liu J, et al. Risk nomogram for assessing renal recovery in patients with newly diagnosed multiple myeloma-related renal impairment. Curr Probl Cancer. 2023;47(4):100962. doi:10.1016/j.currproblcancer.2023.100962
17. Solmaz S, Uzun O, Sevindik OG, et al. The effect of haemoglobin, albumin, lymphocyte and platelet score on the prognosis in patients with multiple myeloma. Int J Lab Hematol. 2023;45(1):13-19. doi:10.1111/ijlh.13958
18. Katagiri D, Hagiwara S, Minami E, et al. Factors associated with recovery of renal function in patients with multiple myeloma who were treated with hemodialysis. Nephron Clin Pract. 2011;117(1):c28-c32. doi:10.1159/000319644
19. Royal V, Leung N, Troyanov S, et al. Clinicopathologic predictors of renal outcomes in light chain cast nephropathy: a multicenter retrospective study. Blood. 2020;135(21):1833-1846. doi:10.1182/blood.2019003807
20. Tsai WC, Wu HY, Peng YS, et al. Risk Factors for Development and Progression of Chronic Kidney Disease: A Systematic Review and Exploratory Meta-Analysis. Medicine (Baltimore). 2016;95(11):e3013. doi:10.1097/MD.0000000000003013