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Comparison of Clinical and Laboratory Characteristics Between Surgically and Non-Surgically Treated Multiple Myeloma Patients with Spinal Involvement

Spinal Tutulumu Olan Multipl Miyelom Hastalarında Cerrahi Uygulanan ve Uygulanmayan Olguların Klinik ve Laboratuvar Özelliklerinin Karşılaştırılması

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Abstract: This study aimed to compare the clinical, demographic, and laboratory characteristics of multiple myeloma patients with spinal involvement who underwent surgical versus non-surgical management.This retrospective, single-center cohort study included 46 multıple myeloma patients with radiologically confirmed spinal involvement who were treated at Private Ümit Hospital between 2013 and 2025. Eighteen patients underwent surgical intervention, while 28 were managed medically. Demographic data, presenting symptoms, and laboratory parameters were compared between groups. Data were analyzed using SPSS 25.0. Normality was assessed by the Shapiro–Wilk test, and appropriate statistical tests (Student's t-test, Mann–Whitney U, chi-square) were applied. The mean age was 63.3 ± 6.0 years in the surgical group and 67.3 ± 8.7 years in the non-surgical group. Back or low back pain was the most frequent presenting symptom in surgically treated patients, while systemic manifestations such as fatigue, weight loss, and diffuse musculoskeletal pain predominated in the non-surgical group. Laboratory comparisons revealed significantly higher BUN ($p = 0.025$), beta-2 microglobulin ($p = 0.008$), and ISS scores ($p = 0.034$) in the non-surgical cohort, indicating a greater systemic disease burden. No significant intergroup differences were observed in other biochemical parameters. Multiple myeloma patients with spinal involvement who undergo surgery tend to have lower systemic disease activity and better renal function compared to those treated conservatively. The presence of neurological or pain symptoms due to proximity to neural structures may lead to earlier diagnosis in these patients.

Keywords: Multiple myeloma; spinal involvement, beta-2 microglobulin; International Staging System

Özet: Bu çalışmanın amacı, spinal tutulumu bulunan multipl miyelom hastalarında cerrahi uygulanan ve uygulanmayan olguların klinik, demografik ve laboratuvar özelliklerini karşılaştırmaktır. Bu retrospektif, tek merkezli kohort çalışmasına 2013–2025 yılları arasında Özel Ümit Hastanesi'nde tanı almış toplam 46 spinal tutulumlu multiple miyelom hastası dahil edildi. On sekiz hastaya cerrahi tedavi uygulanırken, 28 hasta medikal olarak yönetildi. Her iki grupta da yaş, cinsiyet, semptom profili ve laboratuvar parametreleri karşılaştırıldı. Veriler SPSS 25.0 programı ile analiz edildi. Normallik Shapiro–Wilk testiyle değerlendirildi; uygun durumlarda Student t-testi, Mann–Whitney U testi ve ki-kare testleri kullanıldı. Cerrahi grup ortalama 63,3 ± 6,0 yaş, cerrahi dışı grup ise 67,3 ± 8,7 yaş ortalamasına sahipti. Cerrahi hastalarda başvuru semptomu sıklıkla bel/sırt ağrısı iken, cerrahi dışı grupta yorgunluk, kilo kaybı ve yaygın kas-iskelet ağrıları ön plandaydı. Laboratuvar karşılaştırmalarında üre ($p = 0.025$), beta-2 mikroglobulin ($p = 0.008$) ve ISS skorları ($p = 0.034$) cerrahi dışı grupta anlamlı olarak yüksek bulundu. Bu bulgular, cerrahi yapılmayan hastalarda sistemik hastalık yükünün daha fazla olduğunu göstermektedir. Diğer biyokimyasal parametreler açısından anlamlı fark izlenmedi. Spinal tutulumu olan multipl miyelom hastalarında cerrahi uygulanan olgular genellikle daha düşük sistemik hastalık aktivitesine ve daha iyi böbrek fonksiyonlarına sahiptir. Spinal bölgede erken nörolojik veya ağrı semptomlarının ortaya çıkması, bu hastalarda tanının daha kısa sürede konmasını sağlayabilir.

Anahtar Kelimeler: Multipl miyelom, spinal tutulum, beta-2 mikroglobulin, ISS skoru

Ethics Committee Approval: The study was approved by Private Umit Hospital Non-Interventional Clinical Research Ethics Committee (Decision No: 33, Date: 28.08.2025).

Informed Consent: Written informed consent was obtained from all participants prior to their inclusion in the study.

Authorship Contributions:GB: Conceptualization, methodology, investigation, patient recruitment, data collection, interpretation of the results, writing – original draft, and critical revision of the manuscript, FS: Statistical analysis, data curation, formal analysis, validation of the results, and review of the statistical methods.VA: Supervision, study design, methodology, interpretation of the findings, manuscript review and editing, and final approval of the manuscript.

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1. Introduction

Multiple myeloma (MM) is a plasma-cell malignancy characterized by uncontrolled clonal proliferation within the bone marrow, leading to diffuse osteolytic destruction and skeletal fragility (1). The spine is the most commonly affected site, with vertebral lesions identified in up to 70 % of cases (2,3). As the disease advances, pathological vertebral collapse and epidural extension frequently result in back pain, spinal instability, and neurological deficits due to spinal cord compression (4). These complications significantly impair mobility, independence, and overall quality of life.

With the advent of proteasome inhibitors, immunomodulatory agents, and autologous stem-cell transplantation, survival outcomes in MM have markedly improved (5, 6). However, spinal involvement continues to pose major clinical challenges. The management of vertebral myeloma lesions requires a careful balance between systemic disease control and local stabilization. Radiotherapy remains the mainstay of palliative treatment, yet its efficacy in restoring mechanical stability is limited (7). Consequently, surgical decompression and fixation are often indicated in patients with rapid neurological deterioration, intractable pain, or radiographic evidence of instability (8-10).

The decision to operate must consider multiple factors, including the extent of systemic disease, International Staging System (ISS) stage, bone quality, and overall patient condition (11,12). Previous studies have demonstrated that surgical stabilization not only relieves pain but can also enhance neurological recovery and prolong survival in appropriately selected patients (13,14). Nevertheless, comparative data between surgically and conservatively managed MM patients with spinal involvement remain scarce.

The aim of this study was not to evaluate the efficacy of surgical treatment, but to compare the baseline clinical, demographic, and laboratory characteristics of multiple myeloma patients with spinal involvement who underwent surgical or non-surgical management.

2. Materials and Methods

Study Design and Ethic Approval:

It was a retrospective, single-center cohort analysis of patients diagnosed with MM between January 1, 2013, and August 1, 2025, at Private Umit Hospital. Ethical approval was obtained from the Ethics Committee of Private Umit Hospital (Approval No: 33, dated August 28, 2025). Every patient signed a written consent before their data joined the registry. No financial incentives were offered.

Patient Selection:

A total of 326 MM cases were identified during this period. Patients without spinal involvement (n = 280) were excluded from the analysis. The final study population consisted of 46 patients with radiologically confirmed spinal involvement. Among these, 18 patients underwent surgical treatment for spinal lesions, while 28 patients were managed conservatively but had vertebral involvement detected by PET-CT, MRI, or CT. Surgical intervention was performed in patients presenting with one or more of the following indications:

- progressive neurological deficit
- radiological spinal cord or nerve root compression
- mechanical instability
- pathological vertebral collapse
- intractable pain resistant to conservative treatment
- requirement for tissue diagnosis

Laboratory parameters including alkaline phosphatase (ALP), hemoglobin, calcium (Ca), blood urea nitrogen (BUN), creatinine, lactate dehydrogenase (LDH), immunoglobulin level (Ig-L), albumin, beta-2 microglobulin (B2M), free kappa/lambda ratio (fK/L), and International Staging System scores (ISS) were recorded and compared between the groups.

Details of Surgery:

The surgically treated group included not only cases operated in our neurosurgery department but also patients who had undergone spinal surgery in external centers and were subsequently referred to our hematology unit. Of the 18 surgical cases, five patients underwent percutaneous vertebroplasty and biopsy, three patients had open biopsy alone, and ten patients received posterior stabilization with decompression and biopsy.

The surgical cohort was heterogeneous and consisted of patients treated for different spinal manifestations of MM. Procedures included vertebroplasty with biopsy, open biopsy, decompression, and instrumented stabilization according to the clinical presentation and radiological findings.

Statistical Analysis

All data were analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive statistics were expressed as mean ± standard deviation (SD) or median (interquartile range, IQR) for continuous variables and as frequencies and percentages for categorical variables.

The Shapiro–Wilk test was used to assess the normality of data distribution. For comparisons between the surgical and non-surgical groups, the Student's t-test was applied to normally distributed variables, while the Mann–Whitney U test was used for non-normally distributed variables. The chi-square test or Fisher's exact test was used for categorical data, as appropriate.

A p-value < 0.05 was considered statistically significant.

3. Results

3.1.Patient Demographics

A total of 46 patients diagnosed with multiple myeloma and spinal involvement were included in the study. Among them, 18 patients underwent surgical intervention, whereas 28 were treated conservatively. The mean age of the surgical group was 63.28 ± 5.99 years, while that of the non-surgical group was 67.25 ± 8.70 years, indicating a slightly younger profile among surgically treated patients. Male predominance was observed in both groups, consistent with the general demographic distribution of spinal myeloma cases.

3.2.Clinical and Disease-Related Features

In the surgical cohort, the most frequent symptom at presentation was back or low back pain, observed in the majority of patients, followed by radicular or myelopathic symptoms in three cases. Clinical history was incomplete in five surgically treated patients due to missing records. Conversely, patients managed without surgery predominantly presented with systemic manifestations such as fatigue, weight loss, generalized pain, and musculoskeletal discomfort involving the hips and shoulders.

3.3.Laboratory Findings

Comparative analysis of laboratory parameters revealed that BUN levels were higher in the non-surgical group (20.28 ± 6.40 mg/dL) than in the surgical group (16.82 ± 6.30 mg/dL). Similarly, beta-2 microglobulin (B2M) levels were elevated in the non-surgical cohort (7.08 ± 4.88 mg/L) compared to the surgical group (3.99 ± 1.99 mg/L), reflecting higher systemic disease activity. Creatinine levels tended to be higher in non-surgical patients (1.18 ± 0.49 mg/dL) than in surgically treated ones (0.95 ± 0.40 mg/dL).

The mean ALP values were comparable between groups (100.94 ± 36.62 U/L in surgery vs. 90.21 ± 37.56 U/L in non-surgery). Hemoglobin was slightly higher in surgically treated patients (11.37 ± 1.42 g/dL) than in the non-surgical group (10.75 ± 1.79 g/dL).

Serum calcium and albumin levels were similar in both groups (Ca: 9.87 ± 1.06 vs. 9.65 ± 0.79 g/dL; Alb: 38.61 ± 8.47 vs. 37.52 ± 6.39 mg/dL). The mean LDH was 172.0 ± 54.05 U/L in the non-surgical group and 169.5 ± 53.42 U/L in the surgical group, showing no relevant difference. The Ig-L were slightly higher in conservatively managed patients (3940 ± 2700 mg/dL) compared to surgically treated ones (3118 ± 2518 mg/dL).

The free kappa/lambda (fK/L) ratio was markedly elevated in the non-surgical group (106.1 ± 421.8) relative to the surgical group (27.9 ± 54.8), indicating higher monoclonal activity.

The mean ISS score was 1.78 ± 0.81 in the surgical group and 2.32 ± 0.82 in the non-surgical group, indicating more advanced disease among conservatively managed patients.

All demographic, clinical, and laboratory findings of the surgical and non-surgical groups are summarized in Table 1.

3.4.Statistical Analysis

Normality of distribution for all continuous variables was evaluated using the Shapiro–Wilk test. The results indicated that most biochemical parameters (ALP, Ca, BUN, CREA, Ig-L, Albumin, B2M, fK/L, and ISS) deviated significantly from normality ($p < 0.05$), whereas Hg, and LDH followed a normal distribution (Table 2). Accordingly, independent-samples t-tests were used for normally distributed variables and Mann–Whitney U tests for non-normally distributed variables.

Comparative analysis revealed that the mean Hg ($t = -1.227$, $p = 0.226$) and LDH ($t = 0.155$, $p = 0.877$) levels did not differ significantly between the groups (Table 3). Among the non-normally distributed parameters, BUN ($U = 352.0$, $p = 0.025$), B2M ($U = 369.5$, $p = 0.008$), and ISS ($U = 341.0$, $p = 0.034$) demonstrated statistically significant differences between the surgical and non-surgical groups (Table 4). Specifically, the non-surgical group exhibited higher BUN and B2M levels and a greater ISS score, suggesting more advanced systemic disease burden (Fig.1-3).

Other laboratory values, including ALP ($U = 171.0$, $p = 0.070$), Ca ($U = 211.0$, $p = 0.361$), CREA ($U = 329.5$, $p = 0.083$), Ig-L ($U = 302.5$, $p = 0.260$), Albumin ($U = 216.0$, $p = 0.424$), and fK/L ratio ($U = 221.5$, $p = 0.500$), showed no statistically significant differences between the two groups (Table 4).

Table 1. *Descriptive statistics of demographic and laboratory variables in surgical and non-surgical groups.*

Parameters	Group	N	Mean	SD	SE	Coefficient of variation
BUN	nonsurgery	28	20.282	6.405	1.210	0.316
	surgery	18	16.817	6.295	1.484	0.374
B2M	nonsurgery	28	7.076	4.879	0.922	0.689
	surgery	18	3.992	1.993	0.470	0.499
ISS	nonsurgery	28	2.321	0.819	0.155	0.353
	surgery	18	1.778	0.808	0.191	0.455
age	nonsurgery	28	67.250	8.703	1.645	0.129
	surgery	18	63.278	5.998	1.414	0.095
ALP	nonsurgery	28	90.214	37.556	7.097	0.416
	surgery	18	100.944	36.623	8.632	0.363
Hg	nonsurgery	28	10.754	1.788	0.338	0.166
	surgery	18	11.367	1.417	0.334	0.125
Ca	nonsurgery	28	9.649	0.788	0.149	0.082
	surgery	18	9.872	1.055	0.249	0.107
CREA	nonsurgery	28	1.182	0.492	0.093	0.416
	surgery	18	0.949	0.395	0.093	0.416
LDH	nonsurgery	28	172.021	54.051	10.215	0.314
	surgery	18	169.500	53.417	12.590	0.315
Ig-L	nonsurgery	28	3,940.036	2,700.120	510.275	0.685
	surgery	18	3,118.444	2,518.548	593.627	0.808
Albumin	nonsurgery	28	37.525	6.391	1.208	0.170
	surgery	18	38.606	8.475	1.997	0.220
fK/L	nonsurgery	28	106.097	421.755	79.704	3.975
	surgery	18	27.904	54.766	12.909	1.963

Table 2. *Test of normality (Shapiro–Wilk) for continuous variables.*

Parameters	W	p
ALP	0.783	< .001
Ca	0.924	.005
BUN	0.925	.006
CREA	0.895	< .001
Ig-L	0.916	.003
Albumin	0.859	< .001
B2M	0.841	< .001
fK/L	0.282	< .001
ISS	0.897	< .001
age	0.972	.340
Hg	0.980	.601
LDH	0.960	.110

Table 3. *Independent-samples t-test results for normally distributed variables.*

	t	df	p
Hg	-1.227	44	.226
LDH	0.155	44	.877

Note. Student's t-test.

Table 4. *Mann–Whitney U test results for non-normally distributed variables.*

Independent Samples T-Test

Parameters	U	df	p	
ALP	171.0		.070	
Ca	211.0		.361	
BUN	352.0		.025	x
CREA	329.5		.083	
Ig-L	302.5		.260	
Albumin	216.0		.424	
B2M	369.5		.008	x
fK/L	221.5		.500	
ISS	341.0		.034	x

.[x]: Statistically Significiant.(p< 0.05)

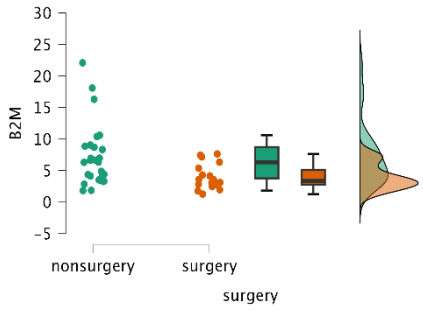

Figure 1. *Comparison of B2M levels between surgical and non-surgical groups.*

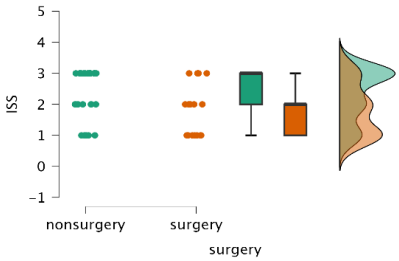

Figure 2. *Comparison of ISS levels between surgical and non-surgical groups.*

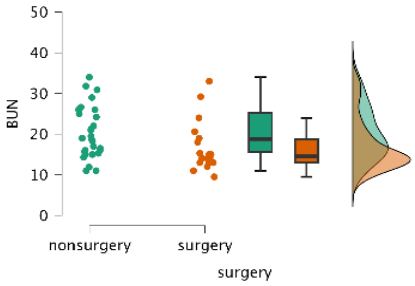

Figure 3. *Comparison of BUN levels between surgical and non-surgical groups.*

4. Discussion

The present study compared the clinical, biochemical, and disease-related characteristics of MM patients with spinal involvement who underwent surgical versus conservative management. Our findings demonstrated that surgically treated patients were generally younger, had lower ISS, and exhibited lower B2M and BUN levels compared to conservatively managed counterparts. These results suggest that surgical intervention was preferentially performed in patients with less advanced systemic disease and relatively preserved organ function.

Elevated B2M and BUN levels in the non-surgical group indicate higher tumor burden and renal impairment, consistent with more advanced MM. B2M is a well-established prognostic biomarker that correlates with disease stage, tumor load, and overall survival in MM patients. Similarly, increased BUN and creatinine levels reflect impaired renal function, a common complication of MM due to light-chain nephropathy and hypercalcemia. The lower ISS scores in surgically treated patients further support the notion that candidates for surgery typically present with better performance status and lower systemic disease activity, enabling them to tolerate invasive procedures.

Interestingly, despite the systemic disease differences, laboratory markers directly associated with bone turnover—such as ALP and Ca—did not differ significantly between groups. This finding aligns with reports suggesting that spinal involvement in MM may occur independently of serum calcium and ALP fluctuations.

This study has several limitations. First, its retrospective, single-center design introduces potential selection bias, particularly regarding surgical eligibility and clinical decision-making. Because treatment allocation was based on clinical judgment rather than randomization, comparisons between surgical and non-surgical groups should not be interpreted as evidence of treatment effect. Second, the surgical cohort was heterogeneous and included patients undergoing vertebroplasty, biopsy, decompression, and stabilization procedures for different clinical indications. Third, functional outcomes, pain scores, neurological recovery, and postoperative survival data were not consistently available and therefore could not be analyzed. Finally, the relatively small sample size limits the generalizability of our findings. Despite these limitations, the study provides descriptive insight into the clinical and laboratory characteristics of multiple myeloma patients with spinal involvement managed with different treatment approaches.

Future multicenter, prospective studies incorporating standardized functional and radiological scoring systems (e.g., SINS, Tokuhashi) are warranted to better delineate surgical indications and outcomes. Additionally, integrating molecular and cytogenetic markers could further refine prognostic stratification and guide personalized treatment strategies for MM patients with spinal involvement.

5. Conclusion

In conclusion, MM patients undergoing spinal surgery in this cohort exhibited lower systemic disease activity and better renal and hematologic profiles compared with non-surgical patients. In this cohort, surgically treated multiple myeloma patients with spinal involvement demonstrated lower B2M, BUN, and ISS scores compared with non-surgically managed patients. These findings suggest differences in baseline systemic disease burden between the two groups and should not be interpreted as evidence of treatment effect. This clinical feature likely facilitates faster diagnosis and timely intervention compared to other skeletal localizations.

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