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OPEN ACCESS

NL Journal of Medical and Pharmaceutical Sciences

(ISSN: 3108-0502)

Volume 2 Issue 1 February 2026

Research Article

Unraveling the Clinical, Biological and Immunopathologic Landscape of Multiple Myeloma in Eastern Algeria: A Retrospective Insight

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doi: 10.71168/NMP.02.01.123

Received Date: January 15- 2026 **Publication Date:** January 31- 2026

Abstract: Multiple myeloma, also known as Kahler's disease is a hematological malignancy characterized by the proliferation of malignant plasma cells, often accompanied by the secretion of monoclonal immunoglobulins or their respective light or heavy chain fragments.

The objective of this retrospective descriptive study was to elucidate the clinical and biological characteristics of multiple myeloma in eastern Algeria, as well as to evaluate the utility of electrophoresis and immunofixation techniques in the confirmation of this disease.

The results reveal that mean age of our patients was 63 (± 11) years with a predominance of females with a sex ratio of (0.35). Bone pain was the hallmark of the disease in our patients, and anemic syndrome was noted in (81%) with different antecedents.

The results also show that the anemia was normocytic normochromic. The diagnosis of Multiple Myeloma was confirmed by electrophoresis of serum proteins and immunofixation which shows a monoclonal peak in (85%) of cases, with a predominance of the IgG kappa isotype, (43%) of cases, (81%) of patients were at stage III according to the prognostic classification of Salmon and Durie.

The findings reported in this study have the potential to enhance the clinical management of multiple myeloma patients throughout the various stages of the disease, from initial diagnosis to monitoring disease progression. Effective utilization of electrophoresis and immunofixation techniques is crucial in this process, facilitating the collaboration and communication between treating physicians and laboratory specialists to confirm an accurate diagnosis

Keywords: Malignant plasma cell, Multiple myeloma, Immunoglobulin, Electrophoresis immunofixation, M protein.

Introduction

Abbreviations

CVA: Cerebro Vascular Accident.
ESR: Erythrocyte Sedimentation Rate.
HB: Hemoglobin.
MCV: Mean Corpuscular.
MM: Multiple Myeloma.
RBC: Red Blood Cells.

Multiple Myeloma (MM), or Kahler's disease, is a B-cell neoplasm characterized by the malignant proliferation of plasma cells, primarily affecting the bone marrow (Avet-Loiseau, 2019). Clinically, it is often revealed by bone pain in majority of the cases, alongside with visceral manifestations, particularly affecting kidney function [3].

Additionally, it presents with bone marrow failure, predominantly impacting the erythroid lineage [4]. Immunologically, the condition is marked by the secretion of a complete monoclonal immunoglobulin or light chains called para-protein or M-protein, and is further associated by a secondary immune deficiency [6].

Multiple myeloma is a malignancy originating from B lymphocytes. It is marked by the clonal proliferation of neoplastic plasma cells, primarily within the bone marrow [1]. Clinically, it presents with skeletal complications, with bone pain being the most common initial symptom. Visceral organ involvement, particularly kidney dysfunction, is also frequently observed [3]. The disease is further complicated by bone marrow failure syndrome, particularly affecting erythroid compartment, leading to anemia [4]. Immunologically, multiple myeloma is characterised by the secretion of monoclonal immunoglobulins or free light chains, known as M-protein, and is associated with secondary immunodeficiency [6].

Multiple myeloma exhibits a predilection for the geriatric population, with increased incidence around 70years age. Epidemiological studies consistently reported age-specific increase in the incidence rates of this malignancy and its underlying mechanisms remain an active area of investigation because of multiple factors: cumulative genetic insults, impaired immune surveillance, and age-related changes in the bone marrow microenvironment, which may facilitate plasma cell transformation and proliferation [6].

The etiology of multiple myeloma remains debatable, and recent advancement has implicated chromosomal abnormalities that contribute to the multisystemic complications observed in this condition. Moreover, epigenetic dysregulation, including aberrant DNA methylation and histone methylation/acetylation patterns, represent emerging mechanisms that appear to be more prevalent in advanced stages of this disease [8]. The pathogenic progression of multiple myeloma is also closely linked to growth factor support derived from the bone marrow microenvironment, engaging myeloma cells in bidirectional crosstalk with various cellular components through adhesion molecules such as fibronectin, laminin, collagen, selectins, and integrins (VCAM1, ICAM) [9].

Multiple myeloma constitutes 80% of monoclonal gammopathies, ranking second in frequency after lymphomas, accounting for approximately 10% of hematological malignancies and one to two percent of all cancers [10]. Two distinct staging systems are employed: the Durie-Salmon staging, stratifying patients into three categories based on the CRAB criteria (hypercalcemia, renal impairment, anemia, and bone lesions). , and the International Staging System (ISS), a prognostic index incorporating serum β2-microglobulin and albumin levels to define three risk groups [13].

The diagnostic workup for multiple myeloma involves a multi-pronged approach, including radiographic evaluation for osteolytic lesions, bone marrow aspiration/biopsy, and comprehensive biochemical/hematological assessments [15]. However, serum and urine protein electrophoresis coupled with immunofixation for isotype and light chain characterization represent pivotal techniques for establishing the diagnosis. Cytogenetic analyses have further explained the specific chromosomal rearrangements implicated in disease pathogenesis [12].

This study aimed to assess the clinical and biological characteristics of multiple myeloma, with a particular emphasis on evaluating the utility of serum protein electrophoresis and immunofixation in confirming disease involvement among patients presenting to the hematology department at the hospital of Batna.

Methods

We conducted a retrospective chart review involving 27 patients with multiple myeloma (MM), diagnosed and managed at the Department of Hematology, University Hospital of Batna, Algeria. The cohort consisted of adult patients aged 35 years and older, presenting with Kahler's disease and monoclonal gammopathy.

Data acquisition was facilitated by a comprehensive evaluation of medical records within the hematology department at the aforementioned institution. The collated data were subjected to statistical analysis using IBM SPSS Statistics 21 software. Descriptive statistical methods were employed to assess the sociodemographic and biological profiles of the patients. Additionally, the chi-square test was utilized to assess potential associations between variables of interest with a statistical significance at the p-value<0.05.

Results

Among the study participants (n=27), females were accounting for 74% (n=20) of the patients, while males were 26% (n=6); The calculated male-to-female ratio was 0.35 (p=0.012). The age at diagnosis ranged from 35 to 90 years, with a mean of 63.88 (± 11 years SD).

The highest frequency of cases 41% (n=11) was observed in the 60-69-year age group (p=0.001). A significant proportion 40.74% (n=10) of the cases originated from the eastern region, an urban area (p=0.003).

Sociodemographic analysis revealed that the majority 74% (n=20) of female patients were housewives, while the male patients exhibited a diverse occupational distribution (p=0.074).

Table 1: Representative table of the different characteristics of patients with of multiple myeloma

Characteristic	Percentage (%)	p-value
Profession		**0.074**
Housewife	74%	
Taxi driver	4%	
Teacher	4%	
Retired	7%	
Safety officer	4%	
Without profession	7%	
Farmer	4%	
Medical antecedents		**0.070**
Cerebrovascular accident (CVA)	4%	
None	19%	
Colopathy	7%	
Heart disease	7%	
Surgery	11%	
Diabetes	15%	
Goiter	11%	
Hypertension with goiter	11%	
Solitary plasmacytoma	4%	
Rheumatism	7%	
Clinical manifestations		**0.001**
Anemia	81%	
Bone involvement	100%	
Hypercalcemia	26%	
Renal insufficiency	37%	
Infection	30%	
Bone marrow infiltration	81%	
Hemoglobin (g/dL)		**0.001**
Hb < 8.5	48%	
8.5 ≤ Hb < 10	33%	
Hb > 12	12%	
Blood smear		**0.044**
Rouleaux formation	41%	
Anisopoikilocytosis	11%	
Dacrocytes	22%	
Normocytic	26%	
Red blood cell count ($\times 10^6/\mu L$)		**0.044**
1.1 < RBC < 2.0	22%	
2.1 < RBC < 3.0	33%	
3.1 < RBC < 4.0	26%	
RBC > 4.1	7%	
Erythrocyte sedimentation rate (mm/h)		**0.032**
ESR < 30	15%	
30 ≤ ESR ≤ 100	30%	
ESR > 100	55%	
Mean corpuscular volume (fL)		**0.010**
MCV < 80	29%	
80 ≤ MCV < 95	58%	
MCV > 100	13%	

Regarding medical antecedents, 19% (n=5) of the patients had no documented pre-existing conditions. However, the majority presented with comorbidities, and diabetes mellitus being the most prevalent 15% (n=4), often coexisting with other pathologies such as Parkinson's syndrome, hypertension, and thrombotic events. Eleven percent (n=3?) of patients had a history of hypertension coexisting with goiter. Additionally, we observed a single case 4% of solitary plasmacytoma progressing to multiple myeloma (p=0.07). In terms of clinical manifestations, bone pain emerged as the predominant presenting symptom, followed by anemia and evidence of bone marrow infiltration, observed in 81% (n=22) of cases.

Anemia was a prevalent manifestation in our cohort, observed in 81% (n=22) of cases (p=0.001). The mean hemoglobin level was 8.48 g/dL ± 2.5. Evaluation of the erythroid lineage revealed a mean red blood cell (RBC) count of 2.3 x 10^6 cells/mm^3 ± 0.86 x 10^6, with 55% of patients exhibiting RBC counts below the threshold of 3 x 10^6 cells/mm^3, (p=0.044). Blood smear analysis revealed morphological abnormalities, with the most frequent being red blood cells in rolls, observed in 41% of cases. Our results also demonstrated that the erythrocyte sedimentation rate (ESR) at the first hour was accelerated in 85% of the studied cases, with a mean rate of 96 mm/1h ± 33 mm/h (p=0.032). Furthermore, the mean corpuscular hemoglobin concentration (MCHC) was elevated in 50% of cases, and the mean corpuscular volume (MCV) was elevated in 58% of cases. The mean MCV was 88.54 fl ± 6.3, and the mean MCHC was 33% (p=0.010) (Table1).

The present study investigates alterations in the serum concentrations of various globulin protein fractions and albumin within a cohort of patients. The results reveal deviations from normal levels, manifesting as either elevated (hyperglobulinemia) or diminished (hypoglobulinemia) concentrations, across the different globulin types. Notably, hypoalbuminemia, characterized by a serum albumin concentration below the reference range, was observed in 59% of the cases examined.

Regarding the globulin fractions, 26% of patients exhibited hyperalpha1-globulinemia, defined as elevated levels of alpha1-globulins. Concurrently, 37% of individuals displayed hyperalpha2-globulinemia, indicative of increased concentrations of alpha2-globulins. The beta1-globulin fraction was also affected, with 26% of subjects presenting hyperbeta1-globulinemia, characterized by elevated beta1-globulin levels. Furthermore, a substantial proportion 44% of the cohort demonstrated hypergammaglobulinemia, reflecting an excess of gamma globulins. Notably, 15% of the patients exhibited a normal protein profile, with no detectable abnormalities in the concentrations of albumin or any of the globulin fractions (Fig1).

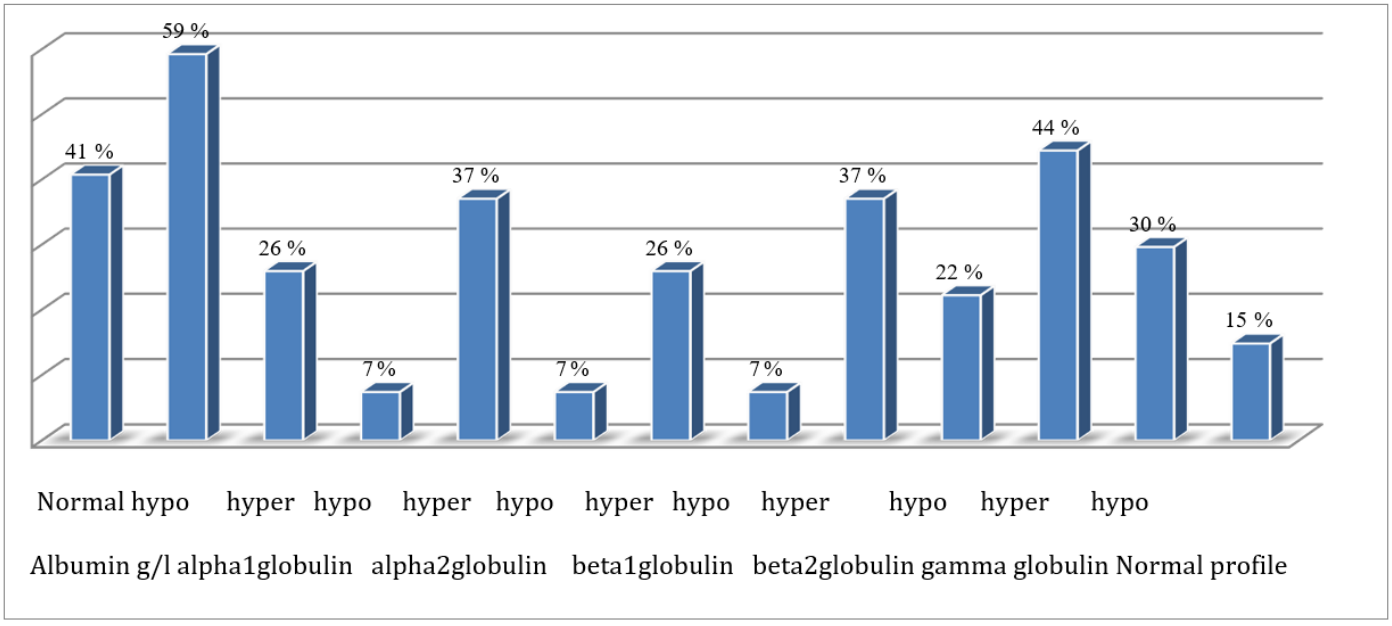

Figure 1: Graphic distribution of patients according to type of electrophoretic peak, each type of globulin had its hypo and /or hyper-expression in serum samples.

This study analyzed also serum protein electrophoretic patterns, and the findings are presented in (Table 2). The myelogram, an examination of the bone marrow aspirate, was conducted Among these, 15% exhibited medullary infiltration by plasma cells less than 10%, while the remaining 85% demonstrated significant infiltration ranging from 10% to 70%. This high rate of substantial bone marrow involvement is consistent with the advanced stage of the disease in the majority of the cohort. Notably, only 37% of the cases exhibited dystrophic plasma cells, which are characterized by morphological abnormalities and are often associated with more aggressiveness.

Table 2: Representation of different characteristics of patients with Multiple Myeloma

Characteristic	Percentage (%)	P value
Myelogram		0.045
Plasma cell < 10%	15%	
Plasma cell > 10%	85%	
Bence Jones		**0.71**
Negative	33%	
Positive	67%	
Type of monoclonal peak		**0.045**
ALPHA	22%	
BETA	33%	
GAMMA	41%	
Fusion BETA-GAMMA	4%	
Electrophoresis		**0.045**
Positive	85%	
Negative	15%	
Light chain		**0.016**
Kappa chain	73%	
Lambda chain	27%	
Immunoglobulin Type		**0.003**
IgG	44%	
IgA	18%	
IgD	4%	
IgM	4%	
Light chain	15%	
Negative Profile	15%	

In 22% of the cases, where protein electrophoresis of urine (PBJ) was performed, 67% had detectable monoclonal light chains of the kappa type, although this finding did not reach statistical significance (p=0.71). The presence of monoclonal light chains in urine is a hallmark of multiple myeloma and other plasma cell dyscrasias, and their identification aids in diagnosis and monitoring.

Serum protein electrophoresis revealed abnormalities in various zones of the electrophoretic pattern. In the alpha zone, 22% of patients exhibited a peak or elevated levels, indicating an excess of alpha globulins. The beta zone displayed abnormalities in 33% of patients, with a peak or elevated levels noted. The gamma zone showed the highest incidence of abnormalities, with 41% of patients demonstrating a peak or elevated levels, suggesting hypergammaglobulinemia, a characteristic finding in multiple myeloma due to the proliferation of monoclonal immunoglobulin-producing plasma cells. Notably, in 4% of cases, a fusion or overlapping between the beta and gamma zones was observed, potentially indicating the presence of monoclonal gammopathy or related disorders. Among the 85% of cases with significant medullary infiltration, a predominance of light kappa chains was observed in 73% of cases, while the lambda chain predominated in 27% (p=0.016). This skewed distribution of light chain types is a common finding in multiple myeloma and can aid in disease characterization and monitoring.

The electrophoresis technique was instrumental in diagnosing and monitoring the disease, with 85% of cases exhibiting a positive electrophoretic profile. The correlation between the disease and a positive electrophoretic profile was highly significant (p=0.01).

Furthermore, the study noted a predominance of IgG monoclonal proteins 44%, followed by IgA 18%, and light chains 15%, while IgD and IgM were less common 4% each (p=0.003). This distribution of monoclonal protein types is consistent with the known patterns observed in multiple myeloma, with IgG and IgA being the most prevalent isotypes.

The analysis of the 85% of cases with significant bone marrow infiltration by plasma cells revealed distinct patterns in the distribution of immunoglobulin isotypes and light chain types. The IgG kappa chain was the predominant monoclonal protein, observed in 43% of cases. In contrast, the IgG lambda chain was less prevalent, detected in only 9% of cases. Regarding the IgA isotype, 17% of patients exhibited monoclonal proteins with kappa light chains, while 4% had lambda light chains. The less common IgM and IgD isotypes were both found in association with lambda light chains, each accounting for 4% of cases (Fig 2).

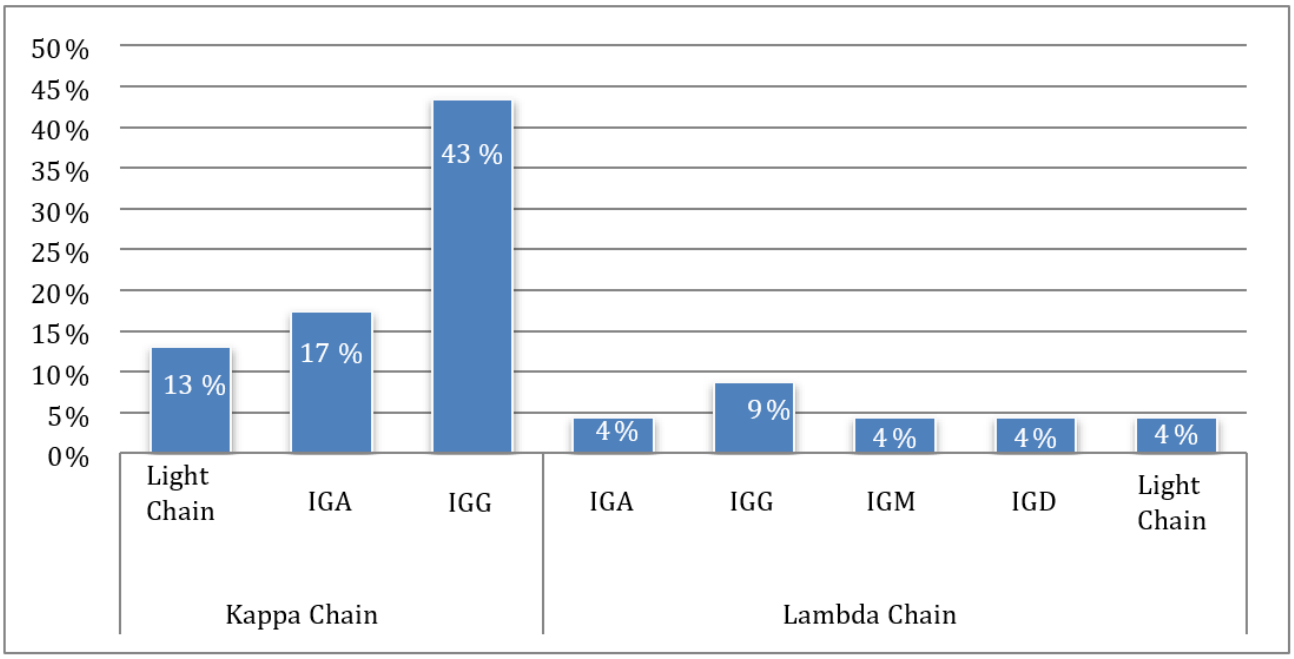

Figure 2: Distribution of Patients According to Light Chain Type and Heavy Chain Type

Classification according to Salmon and Durie

In our study, MM is classified according to the Durie and Salmon classification, stage IIIA is noted in 18 patients 66%, stage IIIB 15%, MM with light chain in 15% and non-secretary MM in 4 % (Table 3).

Table 3: Distribution of patients according to Durie–Salmon classification

Durie and Salmon classification	Frequency (n)	Percentage (%)
MM Stage III A	18	66
MM Stage III B	4	15
MM with light chain disease	4	15
MM non-secretory	1	4
Total	27	100

Discussion

In our study on multiple myeloma, we observed an unusual predominance of female cases. The average age at diagnosis was 63.8 years. Primary clinical signs included bone pain, anemia, and renal failure, alongside comorbidities such as diabetes and cardiovascular disease. No environmental or occupational risk factors were identified. Our findings are consistent with existing studies on biological markers, underscoring the importance of serum protein electrophoresis and Bence Jones protein testing in accurate diagnosis. Multiple myeloma is a hematological malignancy primarily affecting the B-cell lineage and characterized by a diverse array of biological variations. In our study cohort, we observed a notable female predominance, with 74% of cases occurring in females, yielding a male-to-female ratio of 0.35, which was statistically significant (p=0.012). This finding deviates from several other Tunisian studies [6], that reported a male predominance, with a male-to-female ratio of 1.1. The discrepancy in our gender distribution may be attributed to the relatively small sample size and potential selection bias inherent in our single-institution study conducted during the years.

The age distribution in multiple myeloma has been extensively studied, and our findings are consistent with the existing literature. We observed a statistically significant peak incidence (p=0.001) in the 60-69-year age group, with a mean age of 63.8 years at diagnosis. These results align with several Tunisian studies [3,12,15] that reported a mean age of approximately 62 years for multiple myeloma patients.

Multiple myeloma is a disease predominantly affecting the elderly population, with the highest incidence rates observed in individuals aged 65 years and older [16]. The risk of developing multiple myeloma increases with age, potentially due to the accumulation of genetic and epigenetic alterations in plasma cells over time [17] Additionally, age-related immune dysregulation and decreased immune surveillance may contribute to the proliferation of malignant plasma cell clones [18]. While the precise etiology of multiple myeloma remains elusive, several risk factors have been identified, including genetic predisposition, exposure to ionizing radiation, and specific occupational exposures [18]. However, the observed gender distribution in our cohort may also be influenced by environmental, lifestyle, or hormonal factors, which warrant further investigation.

In our study, 40.74% of patients resided in an urban area. However, multiple myeloma is generally described as being more prevalent among farmers than urban dwellers. No specific risk factor related to the environment or occupation could be clearly identified in our patients, contrary to the findings reported in studies by [7] These studies suggest the existence of risk factors such as exposure to certain chemicals in agricultural settings. In contrast, the works of [5] have demonstrated that multiple myeloma depends on several factors, including age, ethnicity, and race.

The urban-rural divide in the distribution of multiple myeloma cases has been a subject of interest in epidemiological studies. While the disease has been traditionally associated with rural and agricultural settings, possibly due to environmental exposures or occupational factors, the increasing urbanization and changing lifestyle patterns may contribute to the observed shift in the disease's geographic distribution [19] Furthermore, access to healthcare facilities and early diagnosis may vary between urban and rural populations, potentially influencing the reported incidence rates [20].

In our study, the occupation could not be determined due to the predominance of female patients, all of whom were housewives. However, a study conducted in Côte d'Ivoire [21] found that all socio-professional categories were represented, with a particular predominance of farmers 24%. Bone pain is a characteristic manifestation of multiple myeloma, resulting from the infiltration of the bone marrow by malignant plasma cells and the subsequent bone destruction. Anemia is primarily related to the inhibition of erythropoiesis by myeloma cells and increased hemolysis. Renal failure is a frequent complication, caused by the nephrotoxicity of monoclonal immunoglobulin light chains. The lack of a clear association between occupation and multiple myeloma in our cohort could be attributed to the predominance of housewives, limiting the diversity of occupational exposures. However, it is essential to note that occupational risks may be more relevant in male-predominant cohorts or populations with a higher representation of specific industries or agricultural activities [20].

In our cohort, 81% of patients had pre-existing medical or surgical conditions, which is consistent with the literature) While some studies have established a relationship between multiple myeloma and certain conditions such as heart disease and infections [24] this association was not significantly demonstrated in our study, The observed comorbidities, such as diabetes mellitus, cardiovascular diseases, and infections, align with the known risks and complications associated with multiple myeloma. The disease itself, as well as its treatments, can contribute to the development or exacerbation of various comorbid conditions, underscoring the importance of comprehensive patient management and supportive care [25].

The most frequently observed clinical manifestations in our sample were bone pain (100% of cases), anemia (81% of cases), and renal failure (37% of cases), which aligns with various studies [28]. The observed comorbidities, such as diabetes mellitus, cardiovascular diseases, and infections, align with the known risks and complications associated with multiple myeloma. The disease itself, as well as its treatments, can contribute to the development or exacerbation of various comorbid conditions, underscoring the importance of comprehensive patient management and supportive care [26].

In our series, an elevated erythrocyte sedimentation rate (ESR) was observed in 85% of patients. These findings are consistent with previous studies [29] which reported a mean ESR of approximately 100 mm. Furthermore [30] noted an ESR > 100 mm in 77.7% of cases.

This elevated ESR can be attributed to the increased production of monoclonal or polyclonal immunoglobulins, as suggested by [30]. However, it is crucial to note that the ESR may remain within normal limits in cases of light chain multiple myeloma (LCMM) or non-secretory myeloma, where monoclonal protein levels are relatively low [31].

The mean hemoglobin level in our cohort was 8.48 ± 2.5 g/dL, with twenty-two patients exhibiting a hemoglobin level ≤ 10 g/dL. The anemia was characterized as normocytic normochromic, as determined by the mean corpuscular volume (MCV) and mean corpuscular hemoglobin concentration (MCHC) values. These findings are consistent with studies by [15,24].

Several mechanisms contribute to the development of anemia in multiple myeloma patients.

These include suppression of erythropoiesis due to the proliferation of plasma cells in the bone marrow, as well as a lack of erythropoietin secretion secondary to renal failure, as described by [32], Additionally, recent studies have highlighted the role of monoclonal immunoglobulins in interfering with erythropoiesis and promoting hemolysis, further exacerbating anemia [33].

Peripheral blood smear examination revealed that the most common abnormality was the presence of rouleaux formation, observed in 41% of patients. This finding is comparable to the study by [32], which reported rouleaux formation in 70% of cases. This phenomenon occurs due to the modification of the membrane potential of red blood cells, leading to the adsorption of proteins onto the cell surface, causing the cells to agglutinate and form stacks, as described by [35]. The increased concentration of serum proteins, particularly monoclonal immunoglobulins, in multiple myeloma patients is a key contributing factor to this phenomenon [36].

Rouleaux formation can contribute to the observed increase in ESR, as the stacking of red blood cells facilitates their sedimentation [37]. However, it is crucial to recognize that ESR is a non-specific marker and can be elevated in various inflammatory, infectious, and malignant conditions. Therefore, ESR findings should be interpreted in conjunction with other clinical and laboratory data for accurate diagnosis and monitoring of multiple myeloma [37].

Recent studies have also highlighted the potential diagnostic and prognostic significance of rouleaux formation and other morphological abnormalities in multiple myeloma [38] demonstrated that the presence of rouleaux formation, along with other specific peripheral blood smear findings, can aid in the early detection of multiple myeloma and differentiation from other plasma cell dyscrasias.

The myelogram constitutes a decisive step in the diagnostic process of MM, it makes it possible to highlight an abnormal plasma cell infiltration quantitatively and qualitatively; as well as the presence of dystrophic plasma cells. The richness of bone morrow, 89% had a marrow rich in cells, and 85% had a plasma cell infiltration greater than 10%. This plasma cell infiltration is normal in 63% of case. These results is comparable with [24]. In our study 85% of the cases presented with monoclonal gammopathy or para proteinemia. EPS is normal in 15% of patients. Among the 23 positive cases of M band that we studied, there was an M peak in the gamma region in 41%, the M peak found in the alpha1globulin zone is (26%), these results comparable with those of (Hypo-gamma-globulinimia is found in 30% of cases and which is comparable with the results of many investigators), and which is explained by reflection of medullary invasion by a plasmocytic clone [36].

Fusion of beta and gamma which represents 4% of cases does not reflect a biclonal gammopathy, but the presence of polymerized IgA in this patient following a strong glycosylation which explains the migration in the two bands [36].

As we note a hypo albuminemia in 49%. Hypoalbuminaemia is due to renal albumin leakage reflecting renal damage, these results are however incomplete for the determination of the type of monoclonal gammopathies and an IF is essential to determine the isotype of the monoclonal protein [6]. For this we have associated it with Immunofixation, which makes it possible to identify and characterize a monoclonal immunoglobulin detected by EPS estimated in 5%) of cases and the distribution of our patients shows a predominance of the IgG isotype. light chain kappa by a frequency of 43% of cases while 9% with IgG lambda.

These results are consistent with numerous studies [6,15,28]. While they found 26.6% IgG kappa, 19.14% IgG lambda, 21.3% IgA lambda and 13.8% IgA kappa. Patients with a peak IgM, and IgD are 4%. According to the literature; Lambda light chain IgD MM accounts for 2% of myelomas found mainly in males under 65 years old [24]. In our series, we did not find IgE MM, which are very rare; it is the last estimate if the concentration is greater than 10^6 IU / ml [36].

The urinary monoclonal free light chain is referred to as PBJ (Bence Jones Protein); these proteins appear when the resorption capacity of the proximal tubule is exceeded or in the event of intrinsic nephrotoxicity of the monoclonal free light chains (CLLs) leading to glomerular or tubular lesions [36]. Bence Jones proteinuria was investigated in 6 patients, accounting for 22% of the cohort. In 4 patients 66%, the test was positive, with 3 patients 75% exhibiting the kappa type and 1 patient 25% exhibiting the lambda type, which is inconsistent with the findings of [39].

The prognostic evaluation of multiple myeloma (MM) necessitates the inclusion of beta 2-microglobulin and the level of albuminemia (the international staging system, ISS) [14]. Conversely, the Salmon and Durie classification assesses the tumor burden based on the scoring of bone lesions and the rate of the monoclonal component [40] According to this classification, 66% of patients were diagnosed at stage III A, 15% at stage IIIB, and 15% with light chain MM. Non-secretory MM accounted for 4% of cases, which aligns with the findings of [15]. Our study corroborates the classical evidence that light chain myeloma and non-secretory myeloma are exceptional cases [36]. The predominance of stage III cases is attributable to delays in consultation or diagnosis diagnosis [6].

The study of the correlation between multiple myeloma and serum protein electrophoresis shows that in 85% of cases, the diagnosis is appropriately established by SPE, which reveals an abnormal profile or a peak in one of the three regions. In 4 patients 15%, the diagnosis is made by investigating Bence Jones proteins [41].

Serum protein electrophoresis is an integral part of the management of multiple myeloma, both in diagnosis, in the evaluation of the response to treatment, or in the detection of relapse. It is recommended by the Francophone Myeloma Intergroup (IFM, 2016). It allows the detection of an abnormality in the electrophoresis profile, enabling:

- Confirmation of the monoclonal character and estimation of the concentration of the monoclonal component by integrating the electrophoretic peaks (quantification and typing of myeloma).
- Regular monitoring to determine the speed and level of response to treatment.
- Assessment of disease progression or relapses.

To characterize the monoclonal component, immunofixation is mandatory, without the latter being quantified [42].

Conclusion

Our study highlights the complexity of multiple myeloma, particularly its diverse clinical presentation and unique gender distribution, including a notable female predominance. Serum protein electrophoresis and immunofixation proved to be essential for diagnosis and confirming the monoclonal proteins. While no clear occupational risk factors were identified, the findings emphasize the need for personalized management to address both the disease and its associated comorbidities. Further research is needed to explore the rising incidence, especially in younger individuals, and to improve early détection and patient outcomes.

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Citation: Rima Saad Bouzid.,et al. "Unraveling the Clinical, Biological and Immunopathologic Landscape of Multiple Myeloma in Eastern Algeria: A Retrospective Insight". NL Journal of Medical and Pharmaceutical Sciences 2.1 (2026): 18-27.