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Corresponding Author Email:
donat.mwamba@cm-mongala.com

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Kibobo Kiekie Jean[1], Mpudi Masamba Lethy[1], Muamba Kalombo Donat[1], Kambembo Mwata Francis[2], Nganga Nkanga Mireille[1], Mbuyama Rebecca[2], Mukuku Cathy[2] & Muwonga Masidi Jérémie[1]

[1]Department of Clinical Biology, University Hospital of Kinshasa, Kinshasa, Democratic Republic of the Congo.
[2]Centre International de Diagnostic INOVIE-AFRICA-RDC, Kinshasa, Democratic Republic of the Congo.

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Abstract

Background:
Multiple myeloma is a plasma cell malignancy characterized by the clonal proliferation of bone marrow plasma cells and the production of monoclonal immunoglobulins. Characterization of the immunoglobulin profile is essential for diagnosis, disease classification, prognostic assessment, and therapeutic monitoring. However, data describing the immunoglobulin profile of multiple myeloma patients in sub-Saharan Africa remain limited. This study aimed to describe the electrophoretic and immunochemical profiles of patients with multiple myeloma in Kinshasa, Democratic Republic of the Congo.

Methodology:
A cross-sectional descriptive study with an exploratory analytical component was conducted at the INOVIE-AFRICA International Diagnostic Centre–DRC, Kinshasa, between July 2024 and August 2025. Thirty-three patients diagnosed with multiple myeloma according to the International Myeloma Working Group (IMWG) criteria underwent serum protein electrophoresis and serum immunofixation. Sociodemographic, clinical, radiological, and laboratory data were collected from medical records.

Results:
The mean age of the patients was 58.2 ± 13.6 years, and 54.5% were aged 60 years or older. Males predominated (63.6%). Anemia (57.6%) and bone pain (51.5%) were the most frequent clinical manifestations. Serum protein electrophoresis detected a monoclonal spike in 75.8% of patients, predominantly within the gamma globulin region (66.7%). Serum immunofixation demonstrated a monoclonal band in 93.9% of cases, confirming its superior diagnostic sensitivity. IgG-associated myeloma was the predominant immunochemical subtype, with IgG kappa accounting for 63.7% of cases and IgG lambda for 21.2%. Kappa light chains represented 74.2% of all monoclonal proteins identified by immunofixation. Patients with a detectable monoclonal spike were significantly older than those without a detectable spike (61.4 ± 12.4 vs. 48.0 ± 12.4 years; p = 0.012).

Conclusion:
Multiple myeloma in this cohort was predominantly characterized by secretory disease, with a marked predominance of IgG kappa monoclonal proteins. Serum immunofixation demonstrated greater diagnostic sensitivity than serum protein electrophoresis and proved essential for accurate immunoglobulin characterization.

Keywords:
Multiple Myeloma, Monoclonal Gammopathy, Immunoglobulin Profile, Serum Immunofixation, Serum Protein Electrophoresis, Democratic Republic Of The Congo

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Introduction

Multiple myeloma is a malignant plasma cell disorder characterized by the clonal proliferation of bone marrow plasma cells and the production of monoclonal immunoglobulins or their fragments. It represents approximately 10% of hematological malignancies and nearly 1% of all cancers worldwide, making it one of the most common plasma cell neoplasms [1,2]. Advances in diagnostic techniques and population aging have contributed to a steady increase in its reported incidence over recent decades [2].

The disease is clinically heterogeneous and may present with anemia, osteolytic bone lesions, renal dysfunction, hypercalcemia, recurrent infections, and constitutional symptoms. These manifestations largely result from plasma cell infiltration of the bone marrow and the pathological effects of monoclonal immunoglobulins on multiple organ systems. The classical CRAB criteria hyperCalcemia, Renal impairment, Anemia, and Bone lesions remain central to diagnosis and disease assessment [3,4].

The production of monoclonal immunoglobulins constitutes a hallmark of multiple myeloma and forms the basis of several diagnostic and monitoring strategies. The monoclonal protein (M-protein) may consist of intact immunoglobulins, most commonly IgG or IgA, less frequently IgM, IgD, or IgE, or may be composed solely of monoclonal free light chains [2,5]. Identification and characterization of these proteins are essential not only for confirming the diagnosis but also for subclassifying disease, monitoring treatment response, and detecting relapse.

Serum protein electrophoresis (SPEP) remains the primary screening tool for detecting monoclonal gammopathies through visualization of characteristic monoclonal spikes. However, its sensitivity is limited in patients with low-level monoclonal protein production or light-chain disease. Consequently, serum immunofixation electrophoresis (IFE) and serum free light-chain assays are recommended as complementary investigations because they provide greater sensitivity and permit precise identification of immunoglobulin heavy- and light-chain subtypes [5,6]. Furthermore, suppression of uninvolved immunoglobulins, referred to as immunoparesis, contributes significantly to the increased susceptibility to infections observed in patients with multiple myeloma [7].

Despite substantial advances in the diagnosis and management of multiple myeloma in high-income countries, important disparities remain in many low- and middle-income settings. In sub-Saharan Africa, access to specialized diagnostic techniques such as immunofixation and serum free light-chain assays remains limited, contributing to delayed diagnosis and underreporting of disease burden [8]. Consequently, epidemiological and biological data describing the immunoglobulin characteristics of multiple myeloma patients in this region remain scarce. In the Democratic Republic of the Congo, particularly in Kinshasa, few studies have evaluated the immunological profile of patients with multiple myeloma using modern laboratory techniques. Understanding local immunoglobulin patterns is important for improving diagnostic strategies, optimizing laboratory resource allocation, and generating baseline data for future clinical and epidemiological research.

Therefore, the present study aimed to describe the immunoglobulin profile of patients with multiple myeloma referred to the INOVIE-AFRICA International Diagnostic Centre–DRC in Kinshasa using serum protein electrophoresis and immunofixation. Additionally, the study sought to explore associations between electrophoretic findings and selected demographic, clinical, and biological characteristics. The findings provide preliminary evidence regarding the immunochemical spectrum of multiple myeloma in the Congolese population and contribute to the growing body of data from sub-Saharan Africa.

Methodology

Study Design

This study employed a cross-sectional descriptive design with an exploratory analytical component to characterize the immunoglobulin profile of patients diagnosed with multiple myeloma. The study was conducted over a 14-month period from July 2024 to August 2025. The primary objective was to describe the electrophoretic and immunofixation characteristics of monoclonal immunoglobulins among patients with confirmed multiple myeloma and to explore potential associations between immunological findings and selected sociodemographic, clinical, and biological variables.

Ethics

The study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki and internationally accepted standards for biomedical research involving human participants. Institutional authorization was obtained from the INOVIE-AFRICA International Diagnostic Centre–DRC and the referring healthcare facilities before data collection. Patient confidentiality was maintained throughout the study by anonymizing all collected information and assigning unique study identification numbers. No personal identifiers were retained in the study database. As the study involved retrospective review of routinely collected clinical and laboratory data, no additional interventions were performed on participants.

Setting

The study was carried out at the INOVIE-AFRICA International Diagnostic Centre–DRC, located in Kinshasa, Democratic Republic of the Congo. The center serves as a specialized referral laboratory receiving samples from multiple healthcare institutions throughout Kinshasa and surrounding regions. The laboratory is equipped with automated platforms for serum protein electrophoresis and immunofixation, allowing advanced characterization of monoclonal gammopathies. Clinical and laboratory information was obtained from patients referred to the center for diagnostic evaluation of suspected or confirmed multiple myeloma.

Participants

The study population consisted of patients diagnosed with multiple myeloma according to the diagnostic criteria established by the International Myeloma Working Group (IMWG 2014) [4]. Eligible participants were patients referred to the INOVIE laboratory during the study period for immunoglobulin characterization through serum protein electrophoresis and immunofixation. Patients were included irrespective of sex, provided that sufficient clinical and laboratory information was available for analysis. Cases with incomplete laboratory records or inadequate biological samples preventing immunoglobulin characterization were excluded. A convenience sampling approach was used, and all eligible patients meeting the inclusion criteria during the study period were consecutively enrolled. A total of 33 patients were included in the final analysis.

Variables

The primary outcome variables were the electrophoretic and immunochemical characteristics of monoclonal immunoglobulins, including the presence or absence of a monoclonal spike on serum protein electrophoresis, localization of the monoclonal spike,

presence or absence of a monoclonal band on immunofixation, immunoglobulin heavy-chain isotype (IgG, IgA, IgM, or others), and light-chain subtype (kappa or lambda). Secondary variables included sociodemographic characteristics (age and sex), clinical manifestations (anemia, bone pain, poor general condition, fever, physical asthenia, renal failure, dehydration, pathological fractures, and neurological disorders), radiological findings, and laboratory parameters including urea, creatinine, total protein concentration, hemoglobin level, serum calcium concentration, and bone marrow plasma cell percentage.

Data Sources / Measurement

Data were collected using a standardized data extraction form developed specifically for this study. Sociodemographic, clinical, biological, and imaging data were obtained from patients' medical records maintained at their referring institutions and laboratory records available at the INOVIE Diagnostic Centre. Venous blood samples were collected according to standard laboratory procedures and processed in the clinical chemistry and immunology laboratory. Serum protein electrophoresis (SPEP) was performed using capillary electrophoresis on the CAPILLARYS 3 OCTA analyzer (Sebia, France), which separates serum proteins into albumin, alpha-1, alpha-2, beta, and gamma globulin fractions. The presence and location of monoclonal peaks were determined from electrophoretic patterns. Serum immunofixation electrophoresis (IFE) was subsequently performed using the HYDRASYS 2 system (Sebia, France) on agarose gel. Immunofixation enabled identification of immunoglobulin heavy-chain classes (IgG, IgA, IgM) and light-chain types (kappa and lambda), thereby confirming monoclonal gammopathy and determining the immunoglobulin profile. All laboratory procedures were performed according to the manufacturers' recommendations and standard operating procedures of the laboratory. Internal quality control measures were implemented routinely before analytical runs to ensure accuracy and reliability of results. Radiographic findings were obtained from available imaging reports and classified according to the anatomical location of documented bone lesions.

Bias

Several measures were implemented to minimize potential sources of bias. Standardized eligibility criteria based on IMWG diagnostic recommendations were applied to all participants. Laboratory analyses were performed using validated automated systems under routine quality-control procedures, thereby reducing measurement bias. Data extraction was conducted using a predefined collection form to minimize information bias and ensure consistency across records. Nevertheless, the use of convenience sampling may have introduced selection bias, as only patients referred to the diagnostic center were included. In addition, reliance on medical records may have resulted in incomplete capture of some clinical variables. These limitations were considered when interpreting the findings.

Study Size

The study included all eligible patients diagnosed with multiple myeloma who were referred to the INOVIE-AFRICA International Diagnostic Centre during the study period and fulfilled the inclusion criteria. No formal sample size calculation was performed because of the exploratory nature of the study and the limited number of diagnosed cases available during the recruitment period. Consequently, the final sample comprised 33 patients.

Quantitative Variables

Continuous variables included age, urea concentration, creatinine concentration, total serum protein concentration, hemoglobin level, serum calcium level, and bone marrow plasma cell percentage. Prior to statistical analysis, distributions of continuous variables were assessed for normality using graphical methods and summary statistics. Normally distributed variables were summarized using mean and standard deviation, whereas non-normally distributed variables were summarized using median and interquartile range (IQR). Age was additionally categorized into two clinically relevant groups (<60 years and ≥60 years) for subgroup analyses.

Statistical Methods

Data were entered, cleaned, and analyzed using IBM SPSS Statistics version 25.0 (IBM Corp., Armonk, NY, USA). Descriptive analyses were performed to summarize participant characteristics and immunological profiles. Categorical variables were presented as frequencies and percentages, while continuous variables were expressed as mean ± standard deviation or median (interquartile range), depending on distribution characteristics. Comparative analyses were conducted to evaluate differences according to the presence or absence of a monoclonal spike on serum protein electrophoresis and according to immunofixation findings. Associations between categorical variables were assessed using Pearson's chi-square test or Fisher's exact test when expected cell frequencies were less than five. For continuous variables, independent-samples Student's t-test was used for normally distributed data, whereas the Mann–Whitney U test was applied for non-normally distributed variables. All statistical tests were two-tailed, and a p-value <0.05 was considered statistically significant. Because of the descriptive and exploratory nature of the study, analyses were intended to identify associations rather than establish causal relationships.

Results

Participants

A total of 33 patients with a confirmed diagnosis of multiple myeloma who underwent serum protein electrophoresis and serum immunofixation at the INOVIE-AFRICA International Diagnostic Centre–DRC between July 2024 and August 2025 were included in the final analysis. Complete demographic, clinical, laboratory, radiological, electrophoretic, and immunofixation data were available for all participants.

Descriptive data

The baseline sociodemographic, clinical, and biological characteristics of the study population are presented in Table 1. The mean age of the patients was 58.2 ± 13.6 years, with more than half of the participants (54.5%, n = 18) aged 60 years or older. Males predominated, accounting for 63.6% (n = 21) of the study population, while females represented 36.4% (n = 12).

Regarding clinical presentation, anemia was the most common manifestation, affecting 57.6% (n = 19) of patients, followed by bone pain in 51.5% (n = 17). Poor general condition was reported in 39.4% (n = 13), whereas fever and physical asthenia were observed in 30.3% (n = 10) and 24.2% (n = 8) of patients, respectively. Renal failure and dehydration each occurred in 12.1% (n = 4) of cases, while pathological fractures and neurological disorders were documented in 9.1% (n = 3) of patients.

Laboratory evaluation showed a median urea concentration of 16.6 mg/dL (IQR: 12.8–21.9), a median creatinine concentration of 1.08 mg/dL (IQR: 0.96–1.33), and a median total protein concentration of 70.5 g/L (IQR: 68.5–75.2). The mean hemoglobin level was 8.9 ± 2.0 g/dL, indicating substantial anemia within the cohort, while the mean

serum calcium concentration was 2.9 ± 0.6 mmol/L. Bone marrow examination revealed a mean plasma cell infiltration of 21.0 ± 7.5% (Table 1).

Radiographic findings are summarized in Table 2. Bone lesions were most frequently localized to the lumbar spine (21.2%, n = 7), followed by the pelvis and sternum (15.2% each, n = 5). Skull involvement was observed in 9.1% (n = 3) of patients, whereas clavicular, rib cage, and tibial lesions each accounted for 6.1% (n = 2). Femoral lesions were identified in one patient (3.0%). Notably, no radiographic bone lesions were documented in 18.2% (n = 6) of patients.

Outcome data

The primary outcome of the study was the characterization of the immunoglobulin profile using serum protein electrophoresis and serum immunofixation. The electrophoretic and immunochemical findings are presented in Table 3.

Serum protein electrophoresis detected a monoclonal spike in 25 of 33 patients (75.8%), whereas no detectable monoclonal spike was observed in 8 patients (24.2%). Among patients with a detectable monoclonal component, the majority of spikes were located in the gamma globulin region (66.7%, n = 22), while a smaller proportion migrated in the beta-2 globulin region (9.1%, n = 3).

Serum immunofixation demonstrated a monoclonal band in 31 patients (93.9%), confirming a substantially higher detection rate than serum protein electrophoresis. Only two patients (6.1%) showed negative immunofixation results. Analysis of monoclonal immunoglobulin subtypes revealed that IgG-associated myeloma was the predominant immunochemical pattern. IgG kappa was the most frequent subtype, occurring in 63.7% (n = 21) of patients, followed by IgG lambda in 21.2% (n = 7). Less common subtypes included IgA lambda (3.0%, n = 1), IgM kappa (3.0%, n = 1), and isolated free kappa light-chain disease (3.0%, n = 1).

Among the 31 patients with detectable monoclonal proteins, kappa-associated monoclonal proteins (IgG kappa, IgM kappa, and free kappa light chains) accounted for 74.2% (23/31), whereas lambda-associated monoclonal proteins (IgG lambda and IgA lambda) represented 25.8% (8/31), demonstrating a clear predominance of kappa light chains (Table 3).

Main results

Comparative analyses according to the presence of a monoclonal spike on serum protein electrophoresis are presented in Table 4. Patients with a detectable monoclonal spike were significantly older than those without a detectable spike (61.4 ± 12.4 years versus 48.0 ± 12.4 years; p = 0.012). Similarly, patients aged 60 years or older were significantly more likely to demonstrate a monoclonal spike than younger patients (64.0% versus 25.0%; p = 0.035).

No statistically significant association was observed between the presence of a monoclonal spike and sex distribution (p = 0.373). Likewise, none of the evaluated clinical manifestations, including anemia, bone pain, poor general condition, fever, physical asthenia, renal failure, dehydration, pathological fractures, or neurological disorders, differed significantly between patients with and without a detectable monoclonal spike (all p > 0.05).

Comparison of laboratory parameters also revealed no statistically significant differences between the two groups. Median urea concentrations, creatinine levels, and total protein concentrations were comparable irrespective of electrophoretic findings. Similarly, mean hemoglobin levels, serum calcium concentrations, and plasma cell percentages did not differ significantly between patients with and without a monoclonal spike (all p > 0.05).

the results indicate that multiple myeloma in this cohort was predominantly characterized by secretory disease, with monoclonal proteins identified in the vast majority of patients. Serum immunofixation demonstrated superior diagnostic sensitivity compared with serum protein electrophoresis, detecting monoclonal proteins in 93.9% of cases compared with 75.8% by electrophoresis alone. Furthermore, the immunoglobulin profile was dominated by IgG-kappa myeloma, while increasing age was the only factor significantly associated with the presence of a detectable monoclonal spike on serum protein electrophoresis.

Table 1: Sociodemographic Characteristics, Clinical Features, and Biological Parameters of Patients with Multiple Myeloma (n = 33).

Variables		n (%)
Age (years); Mean ± SD		58.2 ± 13.6
Age Group	<60 years	15 (45.5)
	≥60 years	18 (54.5)
Gender	Male	21 (63.6)
	Female	12 (36.4)
Clinical Features	Anemia	19 (57.6)
	Bone pain	17 (51.5)
	Poor general condition	13 (39.4)
	Fever	10 (30.3)
	Physical asthenia	8 (24.2)
	Renal failure	4 (12.1)
	Dehydration	4 (12.1)
	Pathological fracture	3 (9.1)
	Neurological disorder	3 (9.1)
Biological Parameters	Urea (mg/dL); Mediam (IQR)	16.6 (12.8–21.9)
	Creatinine (mg/dL); Mediam (IQR)	1.08 (0.96–1.33)
	Total protein (g/L); Mediam (IQR)	70.5 (68.5–75.2)
	Hemoglobin (g/dL); Mean ± SD	8.9 ± 2.0
	Calcium (mmol/L); Mean ± SD	2.9 ± 0.6
	Plasma cells (%); Mean ± SD	21.0 ± 7.5

Table 2: Location of Bone Lesions Detected on Radiography in Patients with Multiple Myeloma (n = 33).

Location of Bone Lesions	n (%)
Lumbar spine	7 (21.2)
None	6 (18.2)
Pelvis	5 (15.2)
Sternum	5 (15.2)
Skull	3 (9.1)
Clavicle	2 (6.1)
Rib cage	2 (6.1)
Tibia	2 (6.1)
Femur	1 (3.0)

Table 3: Electrophoretic Profile and Serum Immunofixation Findings in Patients with Multiple Myeloma (n = 33).

Variables		n (%)
Serum Protein Electrophoresis	Absence of monoclonal spike	8 (24.2)
	Presence of monoclonal spike	25 (75.8)
Location of Monoclonal Spike	Gamma globulin region	22 (66.7)
	Beta-2 globulin region	3 (9.1)
Serum Immunofixation	Absence of monoclonal band	2 (6.1)
	Presence of monoclonal band	31 (93.9)
Type of Monoclonal Band	IgG kappa	21 (63.7)
	IgG lambda	7 (21.2)
	IgA lambda	1 (3.0)
	IgM kappa	1 (3.0)
	Free kappa light chain	1 (3.0)
Light Chain Distribution among Immunofixation-Positive Patients (n = 31)	Kappa	23 (74.2)
	Lambda	8 (25.8)

Table 4: Comparison of General Characteristics According to the Presence of a Monoclonal Spike on Serum Protein Electrophoresis.

Variables		Absence of Spike (n=8)	Presence of Spike (n=25)	p-value
Age (years); Mean ± SD		48.0 ± 12.4	61.4 ± 12.4	0.012*
Age Group	<60 years	6 (75.0)	9 (36.0)	0.035*
	≥60 years	2 (25.0)	16 (64.0)	
Gender	Male	6 (75.0)	15 (60.0)	0.373
	Female	2 (25.0)	10 (40.0)	
Clinical Features	Anemia	3 (37.5)	16 (64.0)	0.182
	Bone pain	5 (62.5)	12 (48.0)	0.381
	Poor general condition	4 (50.0)	9 (36.0)	0.381
	Fever	3 (37.5)	7 (28.0)	0.461
	Physical asthenia	3 (37.5)	5 (20.0)	0.288
	Renal failure	2 (25.0)	2 (8.0)	0.241
	Dehydration	1 (12.5)	3 (12.0)	0.691
	Pathological fracture	0 (0.0)	3 (12.0)	0.422
	Neurological disorder	0 (0.0)	3 (12.0)	0.422
Biological Parameters	Urea (mg/dL); Mediam (IQR)	15.6 (12.0–38.6)	16.6 (12.1–22.0)	0.599
	Creatinine (mg/dL); Mediam (IQR)	1.1 (0.8–2.9)	1.1 (1.0–1.4)	0.867
	Total protein (g/L); Mediam (IQR)	68.9 (62.0–75.8)	73.6 (66.7–78.6)	0.290
	Hemoglobin (g/dL); Mean ± SD	8.5 ± 2.3	9.1 ± 2.0	0.494
	Calcium (mmol/L); Mean ± SD	2.8 ± 0.6	2.9 ± 0.6	0.725
	Plasma cells (%); Mean ± SD	23.0 ± 8.3	20.4 ± 7.3	0.396

*P<0.05 is considered statistically significant.

Discussion

This study provides one of the few contemporary descriptions of the immunoglobulin profile of patients with multiple myeloma in the Democratic Republic of the Congo and contributes valuable data from a resource-limited sub-Saharan African setting. The principal findings were the predominance of secretory multiple myeloma, the superior diagnostic yield of serum immunofixation compared with serum protein electrophoresis, and the predominance of IgG kappa monoclonal immunoglobulins among affected patients.

The mean age of 58.2 ± 13.6 years observed in the present study is lower than that commonly reported in North American and European populations, where the median age at diagnosis typically ranges between 65 and 70 years [2,9]. Similar observations have been reported in several African studies, suggesting that multiple myeloma may be diagnosed at a younger age in sub-Saharan Africa [13]. This apparent difference may be influenced by demographic characteristics, referral patterns, disparities in healthcare access, underdiagnosis among older individuals, and delayed presentation to specialized healthcare facilities. Consistent with previous reports, a male predominance was observed, with men accounting for nearly two-thirds of the study population [10].

The clinical profile of the patients was characterized predominantly by anemia and bone pain, which were present in 57.6% and 51.5% of cases, respectively. These findings are consistent with the established pathophysiology of multiple myeloma and align with previous studies describing anemia and skeletal manifestations as the most frequent presenting features of the disease [2,9]. Anemia is primarily attributable to bone marrow infiltration by malignant plasma cells and suppression of normal hematopoiesis, whereas bone pain results from osteolytic lesions generated through increased osteoclast activity and impaired osteoblast function. The relatively low prevalence of renal failure in this cohort compared with some international reports may reflect differences in disease stage at diagnosis, referral practices, or biological variability among patient populations [11].

A major finding of the present study was the detection of a monoclonal spike on serum protein electrophoresis in 75.8% of patients. Among positive cases, most monoclonal proteins migrated within the gamma globulin region, a finding consistent with the predominance of IgG-associated disease and with previous reports demonstrating that monoclonal proteins in multiple myeloma most frequently localize within the gamma fraction [2,9]. These results support the continued value of serum protein electrophoresis as a first-line screening tool for monoclonal gammopathies.

However, serum immunofixation identified monoclonal proteins in 93.9% of patients, substantially exceeding the detection rate achieved by serum protein electrophoresis alone. Importantly, although 24.2% of patients had no detectable monoclonal spike on serum protein electrophoresis, only 6.1% remained negative on immunofixation. This observation suggests that many electrophoresis-negative cases likely represented low-level secretory disease rather than true non-secretory myeloma and highlights the superior analytical sensitivity of immunofixation for detecting monoclonal proteins. These findings are consistent with recommendations from the International Myeloma Working Group, which advocate the combined use of serum protein electrophoresis, immunofixation, and serum free light-chain assays to maximize diagnostic accuracy [2,5].

The immunochemical profile observed in this study was dominated by IgG-associated myeloma, particularly the IgG kappa subtype, which accounted for 63.7% of all cases. IgG lambda represented the second most frequent subtype, whereas IgA lambda, IgM kappa, and isolated free kappa light-chain disease were uncommon. These findings are in agreement with large international series demonstrating that IgG myeloma is the predominant immunoglobulin subtype, followed by IgA-associated disease and less frequently light-chain-only myeloma [9,14]. The predominance of kappa over lambda light chains observed in the present study is also consistent with previously reported distributions of monoclonal gammopathies [15].

From a biological perspective, the predominance of kappa light chains may be explained by the sequential process of immunoglobulin gene rearrangement during B-cell maturation, in which kappa chain rearrangement generally precedes lambda chain rearrangement. Consequently, malignant plasma cell clones are more likely to express kappa light chains, resulting in the higher prevalence observed in both physiological and pathological conditions [14,15].

Age was the only variable significantly associated with the presence of a monoclonal spike on serum protein electrophoresis. Patients with detectable spikes were significantly older than those without detectable spikes. Although the underlying mechanism cannot be determined from this cross-sectional study, older age may be associated with greater tumor burden, increased monoclonal protein production, or more advanced disease at diagnosis. No significant associations were observed between electrophoretic findings and clinical manifestations or routine laboratory parameters, although these analyses may have been limited by the relatively small sample size.

Two patients demonstrated negative findings on both serum protein electrophoresis and immunofixation despite a diagnosis of multiple myeloma. These cases may represent non-secretory or oligo-secretory forms of multiple myeloma; however, definitive confirmation was not possible because serum free light-chain assays, urine immunofixation studies, and Bence Jones protein testing were not routinely available. Consequently, the possibility of very low monoclonal protein concentrations below the analytical detection threshold cannot be excluded.

Overall, the findings of this study demonstrate that the immunoglobulin profile of multiple myeloma patients in Kinshasa is broadly comparable to that reported in other regions of the world, with a predominance of IgG kappa monoclonal gammopathy. The study additionally highlights the diagnostic value of serum immunofixation and emphasizes the importance of expanding access to specialized laboratory investigations in resource-constrained healthcare settings.

Limitations

Several limitations should be considered when interpreting the findings of this study. First, the relatively small sample size (n = 33) may have limited statistical power and reduced the precision and generalizability of the observed estimates. Second, this was a single-center study conducted at a specialized referral diagnostic laboratory in Kinshasa; therefore, the study population may not be fully representative of all patients with multiple myeloma in the Democratic Republic of the Congo or other sub-Saharan African settings, introducing the possibility of referral and selection bias. Third, the cross-sectional design precluded assessment of temporal changes in immunoglobulin profiles, treatment responses, disease progression, and long-term clinical outcomes, thereby limiting causal and prognostic inferences. Fourth, serum free light-chain assays were not systematically performed, and urine immunofixation and Bence Jones protein analyses were not routinely available, which may have resulted in underdetection of oligo-secretory or light-chain-only

myeloma and limited comprehensive characterization of monoclonal protein secretion patterns. Fifth, although standardized laboratory procedures and internal quality-control measures were employed, pre-analytical and analytical factors such as specimen handling, transport conditions, storage duration, equipment maintenance, and inter-operator variability may have influenced laboratory measurements. Finally, several comparative analyses involved small subgroup sizes and low cell frequencies; therefore, some statistical comparisons may have been underpowered, and non-significant findings should be interpreted with caution. Future multicenter studies incorporating larger sample sizes, serum free light-chain measurements, urine immunofixation, and longitudinal follow-up are warranted to validate and extend these findings.

Conclusion

This study provides important preliminary data regarding the immunoglobulin profile of patients with multiple myeloma in Kinshasa, Democratic Republic of the Congo. Multiple myeloma in this cohort was predominantly characterized by secretory disease, with monoclonal proteins detected in the vast majority of patients and a clear predominance of the IgG kappa subtype. Serum immunofixation demonstrated substantially greater diagnostic sensitivity than serum protein electrophoresis and proved essential for accurate characterization of monoclonal gammopathies. The findings support the routine integration of immunofixation into the diagnostic evaluation of suspected multiple myeloma, particularly in settings where serum free light-chain assays are not readily available. Future multicenter studies incorporating larger sample sizes, serum free light-chain measurements, urine immunofixation, and longitudinal follow-up are needed to further characterize disease patterns and improve the diagnosis and management of multiple myeloma in sub-Saharan Africa.

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