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Prevalence of Metabolic Syndrome among Geriatric Multiple Myeloma Patients

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Abstract

Background: Multiple myeloma is a malignancy characterized by clonal proliferation of plasma cells in the bone marrow. Metabolic syndrome is known to contribute to systemic inflammation and cardiovascular risk. The convergence of these two pathological states in the same patient population raises questions about shared pathophysiological mechanisms.

Aim of Study: To assess the prevalence of Metabolic Syndrome among geriatric Multiple Myeloma patients and to find possible bidirectional effects between the 2 diseases.

Patients and Methods: The study included 45 geriatric Egyptian Multiple Myeloma patients, who were diagnosed as Multiple Myeloma through bone marrow aspirate/biopsy. All patients underwent geriatric assessment, comprehensive historytaking, physical examination and anthropometric measurements including waist circumference, weight, height & BMI. The following investigations were carried out: Fasting blood glucose, HbA1c, albumin, total protein, calcium, creatine, urea and fasting lipid profile (TG & HDL).

Results: Nearly half of the participants met the diagnostic criteria of Metabolic Syndrome (46.7%). Fasting blood glucose, HbA1c and triglycerideswere significantly high among patients with metabolic syndrome (*p*-value 0.038, 0.019 & <0.001 respectively). High density lipoprotein was significantly low among patients with metabolic syndrome (*p*-value 0.010). Waist circumference and triglyceride level were the most important predictors of metabolic syndrome. Significant negative correlation was noticed between total protein and (body mass index and waist circumference), (*p*-value <0.001 & 0.006 respectively).

Conclusion: This study demonstrates a high prevalence of metabolic syndrome among geriatric patients with multiple myeloma, with nearly half of the participants meeting diagnostic criteria, most notably associated with increased waist circumference and elevated triglyceride levels. These findings underscore the importance of integrating metabolic assessment into the routine care of elderly MM patients.

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Key Words: *Multiple myeloma – Metabolic syndrome – Geriatric patients.*

Introduction

MULTIPLE myeloma is part of the spectrum of plasma cell proliferative disorders, as emphasized in the National Comprehensive Cancer Network (NCCN) guidelines and is characterized by the abnormal increase of monoclonal immunoglobulins **[1,2].**

Historically, MM was diagnosed if clonal bone marrow plasma cells were ≥10% on bone marrow biopsy, or if a biopsy-proven plasmacytoma was present, along with at least one of the CRAB criteria: Serum calcium >0.25mmol/L (1 mg/dL) above the upper limit of normal or >2.75mmol/L (11mg/dL), Renal insufficiency (creatinine >2mg/dL or creatinine clearance 5mm, Anemia (hemoglobin less than 10g/dL or hemoglobin greater than 2g/dL below the lower limit of normal) or One or more osteolytic bone lesions on skeletal radiography, CT, or PET-CT often described as punched-out, round, radiolucent lesions **[3]**. In 2014, the diagnostic criteria for myeloma were expanded to include three additional biomarkers associated with near-inevitable progression to end-organ damage. This led to a new acronym, SLiM CRAB. The "S" in SLiM stands for 60% or higher bone marrow plasma cells that are clonal. The "Li" stands for light-chain ratio, with an involved:uninvolved serum-free light-chain ratio of 100 or more. And the "M" in SLiM stands for MRI, meaning more than one focal bone lesion on MRI. Accordingly, if an individual with 10% or more clonal plasma cells meets any of the SLiM CRAB criteria, that person, by definition, has multiple myeloma **[4,5]**. The initial therapy of patients with symptomatic MM depends on risk stratification of the MM, the patient's eligibility for autologous hematopoietic stem cell transplantation (HCT), and an assessment of the patient's pre-existing comorbidities **[6]**. Numerous combinations of chemotherapy,

targeted small molecule inhibitors, and monoclonal antibodies have been developed to use in treatment in multiple myeloma [7].

MM typically affects older adults, presenting with a range of constitutional symptoms and on top of them metabolic syndrome [5]. Metabolic syndrome (syndrome X, insulin resistance) is a multifactorial disease with multiple risk factors that arises from insulin resistance accompanying abnormal adipose deposition and function [8,9]. Hypertension, Impaired glucose metabolism, dyslipidemia and central obesity are the hallmark of this metabolic disturbance [10]. The MetS also encompasses additional conditions as: Impaired kidney function, hepatic steatosis, obstructive sleep apnoea, heart failure with preserved ejection fraction, polycystic ovary syndrome, chronic inflammation, sympathetic activation and hyperuricaemia [11].

The majority of MM patients are diagnosed between the ages of 65 and 74 years, and they frequently present with comorbid conditions, many of which include components of metabolic syndrome. Observational studies have identified an increased risk of developing MM among obese individuals (BMI between 28 and 31) and those with diabetes [12]. Hyperlipidaemia is another component of the Metabolic Syndrome and has been reported in patients with MGUS and MM, particularly the immunoglobulin (Ig)-A subtype [13]. Also, treatment of MM, including steroid therapy, chemotherapy, and bone marrow transplant, may exacerbate the features of metabolic syndrome, which is characterized by hyperglycemia, hypertension, dyslipidemia, and obesity. However, even prior to the initiation of steroid therapy, the prevalence of hypertension in MM patients is reported to be between 38% and 47% [12].

Accordingly, we carried out this observational study in Egypt, to assess prevalence of metabolic syndrome in MM patients, particularly among the geriatric population.

Patients and Methods

Our study is an observational cross-sectional analytical study which was carried over a duration from August/2024 till January/2025. The study included 45 Multiple Myeloma cases, who were consecutively recruited from internal medicine wards or internal medicine & hematology clinics, Cairo-University Hospital. Patients had an established diagnosis of MM through bone marrow aspirate/biopsy. The study population was geriatric Multiple Myeloma population which is defined as individuals aged 65 years and older [14].

Inclusion criteria were multiple myeloma patients above age of 65 and exclusion criteria were multiple myeloma patients below the age of 65, with secondary hypertension, type 1 diabetes, secondary or drug induced diabetes, cardiovascular disease secondary to rheumatic heart disease or congenital heart disease or presence of other malignancies.

Following the approval by the Institutional Review Board and Ethical Committee at Cairo University on 4.8.2024 with the acceptance code MS-245-2024, patients meeting inclusion and exclusion criteria were consecutively recruited into the study till desired number was reached. Informed consent was obtained from all participants. All included geriatric patients underwent geriatric history taking and geriatric assessment via the geriatric sheet. Comprehensive history-taking including Age, Diagnosis by myeloma, Duration of diabetes and/or hypertension were all noted. Physical examination was done to all patients including Blood pressure measurement, Waist circumference, Weight, Height and BMI.

According to guidelines from the National Heart, Lung, and Blood Institute (NHLBI) and the American Heart Association (AHA): Hypertension is diagnosed when blood pressure $\geq$ 140/90mm Hg [15]. BMI is defined as weight in kilograms divided by height in meters squared (kg/m^2). A BMI between 25 and 30 is considered overweight, and a BMI >30 is considered obese [16]. The recommended waist circumference thresholds for increased cardiometabolic risk is 40 inches (102cm) in men and 35 inches (88cm) in women; these cutoff values were derived from waist circumference values that correlated with a BMI of 30 kg/m^2 or greater [17].

The following investigations were carried out: Fasting blood glucose, HbA1c, Albumin, Total Protein, Total calcium, Creatine, Urea, Fasting Lipid Profile. According to ADA guidelines, the patient is considered to have dyslipidemia if Triglycerides $\geq$ 150mg/dL HDL-C <40mg/dL in men or <50mg/dL in women [18]. Prediabetes is considered when fasting blood glucose is (100-125) & HbA1c ranging from 5.7% to 6.4 % and patient is considered diabetic when fasting blood glucose is 126 or higher, & hbA1c 6.5 % or higher [19].

According to guidelines from the National Heart, Lung, and Blood Institute (NHLBI) and the American Heart Association (AHA), metabolic syndrome is diagnosed when a patient has at least 3 of the following 5 conditions: Fasting glucose $\geq$ 100mg/dL (or receiving drug therapy for hyperglycemia), Blood pressure $\geq$ 130/85mm Hg (or receiving drug therapy for hypertension), Triglycerides $\geq$ 150mg/dL (or receiving drug therapy for hypertriglyceridemia), HDL-C <40mg/dL in men or <50mg/dL in women (or receiving drug therapy for reduced HDL-C), Waist circumference $\geq$ 102cm (40 in) in men or $\geq$ 88cm (35 in) in women [10].

Multiple Myeloma was proven by bone marrow aspirate & biopsy. As outlined in the 2021 up-

dates to the International Myeloma Working Group (IMWG) criteria, bone marrow morphology typically includes the following:

1- Plasma Cell Infiltration: Bone marrow biopsy shows more than 10% plasma cells (though plasma cells below 10% can also be present in some patients, especially in early or smoldering disease). Plasma cells may be monoclonal, meaning they are all of the same type and often show clonal proliferation **[20].**

2- Plasma Cell Morphology: Plasma cells may exhibit abnormal morphology, such as: Basophilic cytoplasm and eccentric nuclei, Increased cytoplasmic granularity or prominent nucleoli, bizarre forms or multi-nucleation in some cases **[21].**

3- Clonality: There is usually evidence of monoclonal expansion of plasma cells, confirmed by immunohistochemistry (IHC) or flow cytometry, which identifies a dominant clone of plasma cells (e.g., all expressing the same immunoglobulin light chain) **[22].**

4- Bone Marrow Architecture: The normal bone marrow architecture may be disrupted by the infiltration of abnormal plasma cells. This disruption can manifest as hypercellularity (increased plasma cells) or, in advanced disease, hypocellularity (due to marrow fibrosis or suppression of normal hematopoiesis) **[23].**

5- Bone Marrow Plasma Cell Ratio: There is often a shift in the bone marrow plasma cell composition with increased presence of abnormal or immature plasma cells (e.g., plasmablasts or plasma cell precursors).

The presence of monoclonal immunoglobulin in the blood or urine (detected by serum protein electrophoresis or urine protein electrophoresis) and evidence of organ damage (such as lytic bone lesions, renal impairment, or hypercalcemia) are also key to the diagnosis of multiple myeloma in conjunction with bone marrow findings. These bone marrow features, along with clinical signs and laboratory results (such as the monoclonal protein in blood or urine), help in confirming the diagnosis of multiple myeloma **[24].**

Results

Among our 45 Multiple Myeloma patients near half of cases were females (44.4%). Mean age was 70±4 ranging from (65-77) year. Average body mass index was 28.3±3.7 and average waist circumference was110.9±14.2 (Table 1).

Table (2) shows that, near half of the patients had metabolic syndrome (46.7%). Average systolic blood pressure was 129.3±11.3 and average diastolic blood pressure was 79.6±8.2.

Table (1): Distribution of demographic data in the studied group.

	n=45 (%)
Sex:	
Female	20 (44.4)
Male	25 (55.6)
	Mean ± SD
Age	70±4
Body mass index (Kg/m^2)	28.3±3.7
Waist circumference (Cm)	110.9±14.2

SD: Standard deviation.

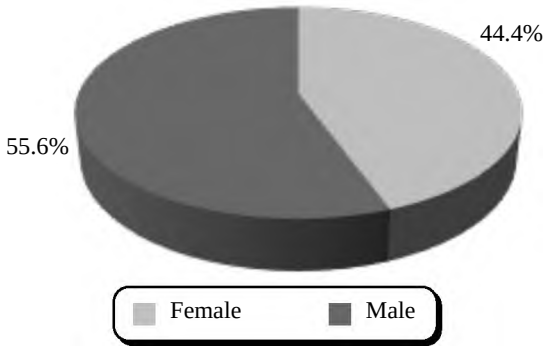

Fig. (1): Pie graph representing gender distribution of the patients.

Table (2): Clinical data of the patients.

	n=45 (%)
Metabolic syndrome:	
Yes	21 (46.7)
No	24 (53.3)
	Mean ± SD
Systolic blood pressure (mmHg)	129.3±11.3
Diastolic blood pressure (mmHg)	79.6±8.2

SD: Standard deviation.

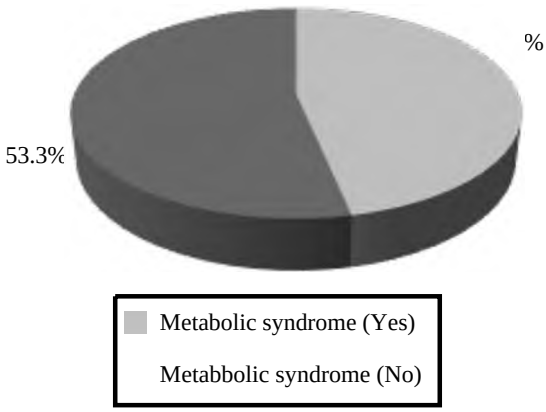

Fig. (2): Pie graph representing prevalence of metabolic syndrome among multiple myeloma patients.

Table (3) shows values of the different laboratory data done for the patients to evaluate multiple myeloma and metabolic syndrome and Fig. (3) is a Boxplot representing laboratory data of the multiple myeloma patients.

Table (3): Laboratory data of the patients.

	Mean ± SD
Fasting blood glucose (mg/dL)	100±28.5
HbA1C (%)	6.5±1.1
High density lipoprotein (mg/dl)	39.9±7.5
Triglycerides (mg/dl)	138.1±36.5
Albumin (g/dl)	3.3±0.5
Total Protein (g/dl)	10.1±2.3
Calcium (mg/dl)	8.6±0.8
Urea (mg/dL)	65.7±34.9
	Median (range)
Creatinine (mg/dL)	1.6 (0.8-7.2)

SD: Standard deviation.

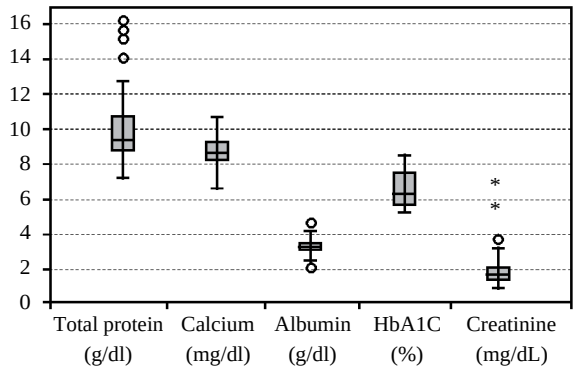

Fig. (3): Boxplot representing laboratory data of the multiple myeloma patients.

Table (4) shows that, there was no statistically significant difference in sex and age between patients with and without metabolic syndrome (*p*-value 0.140 & 0.625 respectively). Body mass index and waist circumference were significantly higher among patients with metabolic syndrome compared to patients without metabolic syndrome (*p*-value 0.037 & <0.001 respectively).

Table (4): Relation of metabolic syndrome to demographic data.

	Metabolic syndrome		*p*-value
	Yes n=21 (%)*	No n=24 (%)*	
Sex:			
Female	12 (60)	8 (40)	0.140
Male	9 (36)	16 (64)	
	Mean ± SD	Mean ± SD	
Age	70±4	70±3	0.625
Body mass index (Kg/m^2)	29.5±2.9	27.2±4.1	0.037
Waist circumference (Cm)	120.3±8.9	102.6±12.9	<0.001

SD: Standard deviation. *p*-value <0.05 is considered significant.

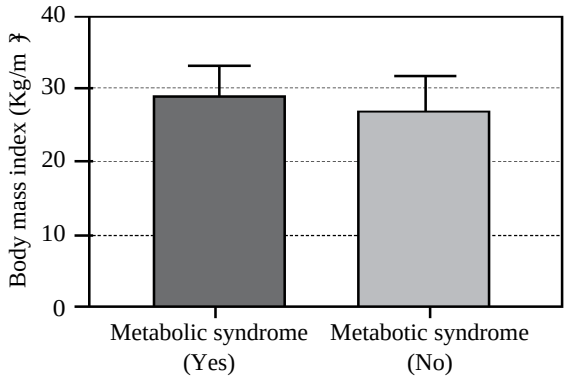

Fig. (4): Bar graph representing body mass index among patients with metabolic syndrome.

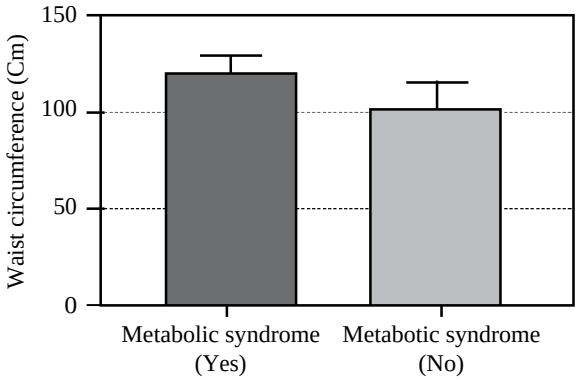

Fig. (5): Bar graph representing waist circumference among patients with metabolic syndrome.

Table (5) shows that, (fasting blood glucose, HbA1c and triglycerides) were significantly high among patients with metabolic syndrome (*p*-value 0.038, 0.019 & <0.001 respectively). High density lipoprotein was significantly low among patients with metabolic syndrome (*p*-value 0.010).

Table (5): Relation of metabolic syndrome to laboratory data.

	Metabolic syndrome		*p*-value
	Yes Mean ± SD	No Mean ± SD	
Systolic blood pressure (mmHg)	129.3±12.3	129.4±10.7	0.979
Diastolic blood pressure (mmHg)	81.7±8.3	77.7±7.8	0.106
Fasting blood glucose (mg/dL)	109.4±32.8	91.9±21.6	0.038
HbA1C (%)	7±1.2	6.2±0.8	0.019
High density lipoprotein (mg/dl)	36.9±6.5	42.5±7.5	0.010
Triglycerides (mg/dl)	160.6±38.1	119.3±22.1	<0.001
Albumin (g/dl)	3.2±0.5	3.3±0.5	0.416
Total Protein (g/dl)	10±1.9	10.2±2.7	0.788
Calcium (mg/dl)	8.5±0.7	8.7±0.9	0.428
Urea (mg/dL)	66.2±33.4	65.3±36.8	0.936
	Median (Range)	Median (Range)	
Creatinine (mg/dL)	1.5 (0.9-7.2)	1.7 (0.8-3.2)	0.697

SD: Standard deviation. *p*-value <0.05 is considered significant.

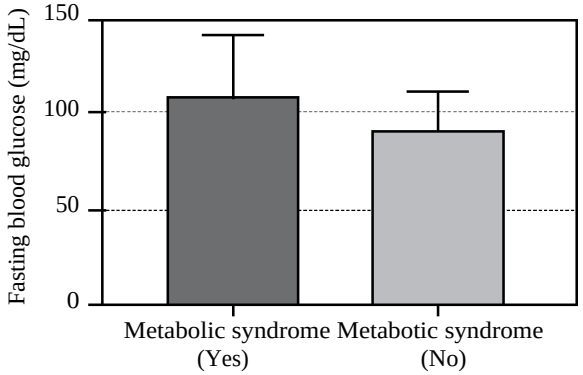

Fig. (6): Bar graph representing fasting blood glucose in relation to metabolic syndrome.

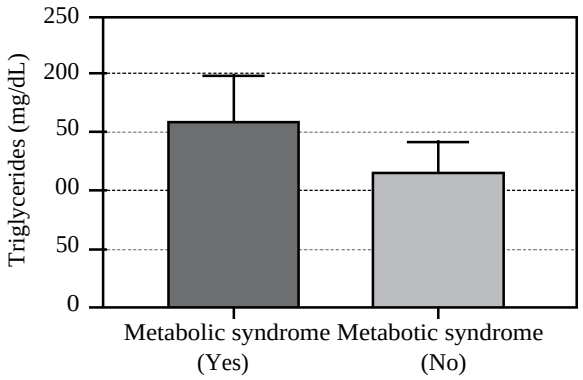

Fig. (7): Bar graph representing triglycerides in relation to metabolic syndrome.

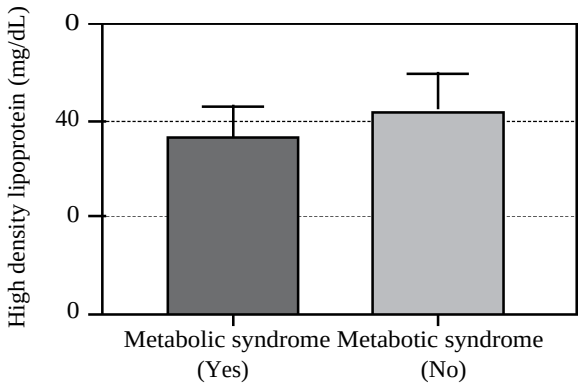

Fig. (8): Bar graph representing HDL in relation to metabolic syndrome.

Multivariate analysis:

To measure the independent effect of all factors that affect metabolic syndrome risk, factors which had significant level less than 0.100 were selected to enter into stepwise logistic regression.

The regression coefficient shows the effect of each variable after controlling the effect of other variables in the model. The model shows that waist circumference and triglyceride level were the most important predictors of metabolic syndrome.For every cm increase in waist circumference, the risk of metabolic syndrome increases by 16%. Also, for every unit increase in triglyceride level, the risk of metabolic syndrome increases by 7%.

Table (7) shows that, there was significant negative correlation between total protein and (body mass index and waist circumference), (*p*-value <0.001 & 0.006 respectively).

No other significant correlation was found between serum calcium or creatinine and metabolic syndrome variables.

Table (6): Shows the variables which were significant in the stepwise logistic regression.

Variables	B	SE	*p*-value	OR	95.0% CI for OR
Waist circumference (Cm)	0.15	0.05	0.002	1.16	1.06-1.27
Triglycerides (mg/dl)	0.07	0.02	0.008	1.07	1.01-1.12

B : Regression coefficient. OR: Odds ratio.
SE: Standard error. CI : Confidence interval.

Table (7): Correlation between protein with different factors.

All factors	Total Protein (g/dl)		Interpretation
	r	*p*-value	
Calcium (mg/dl)	0.11	0.457	Non-significant correlation
Age	-0.01	0.947	Non-significant correlation
Systolic blood pressure	-0.01	0.995	Non-significant correlation
Diastolic blood pressure (mmHg)	-0.14	0.345	Non-significant correlation
BMI (Kg/m^2)	-0.53	<0.001	Significant moderate negative correlation
Waist circumference (Cm)	-0.4	0.006	Significant fair negative correlation
High density lipoprotein (mg/dl)	0.15	0.323	Non-significant correlation
Triglycerides (mg/dl)	0.01	0.999	Non-significant correlation
Fasting blood glucose (mg/dL)	0.26	0.082	Non-significant correlation
HbA1C (%)	0.21	0.173	Non-significant correlation
Albumin (g/dl)	0.29	0.055	Non-significant correlation
Urea (mg/dL)	-0.27	0.078	Non-significant correlation
Creatinine (mg/dL)	-0.18	0.247	Non-significant correlation

r is the correlation coefficient & it ranges from -1 to +1.
p-value <0.05 is considered significant.

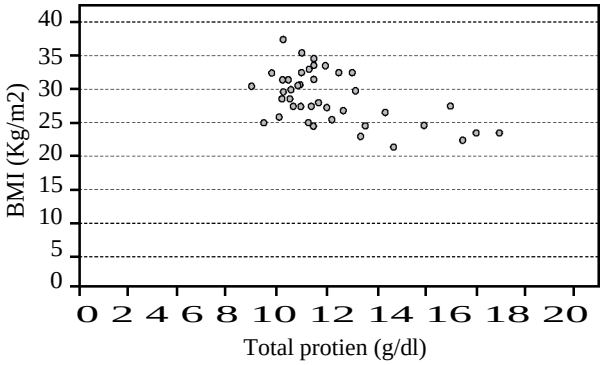

Fig. (9): Scatter plot diagram representing correlation between total protein and body mass index.

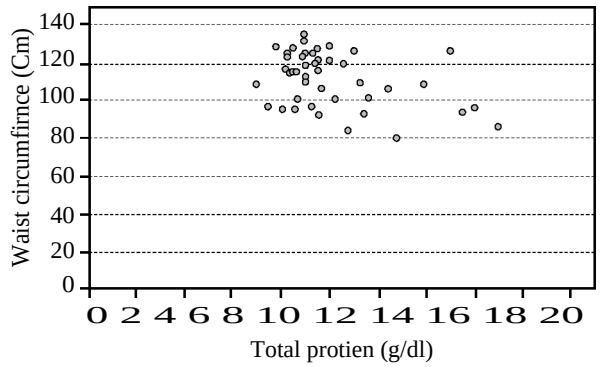

Fig. (10): Scatter plot diagram representing correlation between total protein and waist circumference.

Statistical methods:

Data management and analysis were performed using Statistical Package for Social Sciences (SPSS) vs. 27. Numerical data were summarized using means and standard deviations or medians and/or ranges, as appropriate. Categorical data were summarized as numbers and percentages. Estimates of the frequency were done using the numbers and percentages. Numerical data were explored for normality using Kolmogrov-Smirnov test and Shapiro-Wilk test. Chi square test was used to compare between the independent groups with respect to categorical data.

Comparisons between two groups for normally distributed numeric variables were done using the Student's *t*-test while for non-normally distributed numeric variables, comparisons were done by Mann-Whitney test. To measure the strength of association between the normally distributed measurements, Pearson's correlation coefficients was computed (r is the correlation coefficient & it ranges from –1 to +1), +1 indicates positive correlation, –1 indicates negative correlation, 0 indicates no correlation.

To measure the independent effect of different factors on metabolic syndrome, factors which had significance level less than 0.10 were selected to enter into stepwise logistic regression analysis. Logistic regression was done to give adjusted odds ratio and magnitude of the effect of different risk factors in relation to metabolic syndrome. Odds Ratio (OR) and 95% Confidence Interval (95% CI) were done also (95% CI that doesn't contain 1.0 is considered significant). All tests were two tailed & Probability (*p*-value) ≤0.05 is considered significant **[25].**

Discussion

Multiple myeloma is a malignancy characterized by clonal proliferation of plasma cells in the bone marrow, often associated with systemic manifestations such as anemia, bone lesions, renal impairment, and immunodeficiency. However, beyond these classical features, the metabolic profile of MM patients is gaining increasing attention **[26].**

Metabolic syndrome, a constellation of insulin resistance, central obesity, dyslipidemia, and hypertension, is known to contribute to systemic inflammation and cardiovascular risk. The convergence of these two pathological states in the same patient population raises questions about shared pathophysiological mechanisms and potential bidirectional effects **[27].**

Metabolic syndrome is increasingly recognized as a significant comorbidity among geriatric patients with multiple myeloma (MM), with prevalence estimates ranging from 30% to 60%, depending on diagnostic criteria and population studied **[28].** Aging, chronic inflammation, sedentary lifestyle, and corticosteroid-based therapies contribute to the development of metabolic syndrome in this population. Its presence is associated with worsened overall survival, increased cardiovascular risk, and complications related to both disease and treatment **[29].**

The present study investigated the prevalence and characteristics of metabolic syndrome (MetS) among elderly patients diagnosed with multiple myeloma (MM) at Cairo University Hospitals. With an observed prevalence of 46.7%, the findings reflect a concerning trend of metabolic comorbidities in geriatric hematological malignancy patients. These results are in line with emerging evidence that suggests a strong interplay between cancer biology and metabolic dysfunction, although this area remains relatively underexplored in older populations. In comparison to the normal population, prevalence of metabolic syndrome among the normal middle age and geriatric population (non-myeloma patients) was broadly previously studied among a huge study including 15 countries located in middle-east region. The pooled estimates of MetS varied in different areas with a range of 23.6% in Kuwait to 40.1% in U.A Emirates **[30].**

The demographic characteristics of the study population showed no significant difference between the MetS and non-MetS groups in terms of age and gender. This indicates that in the context of MM, metabolic syndrome may arise independent-

ly of chronological aging or sex-specific hormonal factors. This finding is consistent with Markus et al., who reports inconsistent associations between age/gender and MetS when adjusted for other parameters such as BMI, physical inactivity and treatment exposure *[12]*.

Similarly, Wildes et al., emphasized that in older adults with MM, geriatric impairments including metabolic comorbidities were prevalent regardless of chronological age, suggesting that biological age and functional status may be more relevant predictors than sex or calendar age. These findings highlight the complexity of metabolic syndrome development in MM patients, where disease-specific factors, treatment regimens (such as corticosteroids), and tumor-induced inflammatory pathways may play a more prominent role than traditional demographic predictors *[31]*.

Anthropometric measurements revealed that BMI and waist circumference were significantly higher among those with MetS. Central obesity, in particular, is a hallmark of the syndrome and is known to reflect visceral adipose tissue accumulation, which is metabolically active and contributes to chronic low-grade inflammation. This inflammation is of particular interest in MM patients, as cytokines such as interleukin-6 (IL-6) secreted by adipocytes and inflammatory cells are central to both MM pathogenesis and the development of insulin resistance. Elevated IL-6 not only supports myeloma cell survival and proliferation but also plays a critical role in dysregulating lipid metabolism, potentially explaining the high triglyceride levels observed in the MetS subgroup *[13]*.

This link between central obesity and inflammation in MM is well-documented in current literature. Ragbourne et al., highlighted how adiposity-driven inflammation, particularly mediated by cytokines like IL-6 and TNF-α, plays a dual role in promoting both metabolic syndrome and MM progression, noting that IL-6 is a key survival factor for myeloma cells. Additionally, increased levels of insulin-like growth factor 1 (IGF-1), another growth-promoting factor, have been associated with MM and insulin resistance, further cementing the biological bridge between cancer and metabolic syndrome *[13]*.

Gavriatopoulou et al., similarly described how obesity and visceral fat accumulation lead to the secretion of pro-inflammatory adipokines, fostering a microenvironment conducive to plasma cell proliferation and insulin resistance *[32]*.

Moreover, Lim et al., expanded on this by showing that IL-6 not only enhances myeloma cell growth but also contributes to dysregulated lipid metabolism and increased triglyceride synthesis, which could explain the elevated triglyceride levels observed in MM patients with MetS. These findings collectively reinforce the idea that central obesity is not merely a passive risk factor, but an active contributor to the metabolic and oncogenic landscape of multiple myeloma *[33]*.

From a laboratory standpoint, patients with MetS had significantly elevated fasting glucose, HbA1c, and triglycerides, with reduced HDL-C levels. These are classic metabolic alterations reflecting insulin resistance and impaired lipid metabolism. Elevated HbA1c confirms the presence of chronic hyperglycemia, which may be exacerbated by the pro-inflammatory state induced by MM and further worsened by corticosteroids commonly used in treatment regimens such as dexamethasone.The marked dyslipidemia, particularly hypertriglyceridemia and low HDL-C, further heightens cardiovascular risk, which is especially detrimental in elderly patients who may already have reduced functional reserve and pre-existing atherosclerotic burden.

These laboratory findings are strongly supported by the existing literature on metabolic dysfunction in multiple myeloma. Markus et al., found that MM patients exhibit a significantly increased incidence of diabetes, hypertension, and dyslipidemia including elevated triglycerides and reduced HDL-C compared to healthy controls, even before the initiation of treatment *[12]*.

In addition, Ragbourne et al., described how MM-related paraproteins and cytokine activity disrupt lipid metabolism, resulting in a characteristic pattern of dyslipidemia and insulin resistance, hallmarks of MetS *[13]*.

Moreover, Gavriatopoulou et al., also emphasized that corticosteroid-based therapies like dexamethasone exacerbate hyperglycemia and insulin resistance, compounding the metabolic burden in patients already at risk due to the inflammatory milieu of MM *[32]*.

Furthermore, Lim et al., noted that this metabolic dysregulation contributes not only to cardiovascular morbidity but also to adverse prognosis and treatment resistance in MM, particularly in the elderly with reduced physiological reserve. Together, these studies validate the clinical relevance of the metabolic alterations observed and their potential impact on both cardiovascular and cancer-specific outcomes *[33]*.

The lack of significant difference in blood pressure readings between groups may reflect the fact that most elderly patients, regardless of MetS status, tend to have elevated baseline blood pressure or be on antihypertensive medications, which could mask group differences. This suggests that blood pressure alone may not be a reliable discriminator for MetS in this particular population.

This interpretation aligns with findings reported in the literature. Markus et al., noted that while hypertension is common in both MM and smoldering

MM patients, its prevalence was already elevated at baseline even prior to treatment due to age-related vascular changes and the high burden of comorbidities in this population *[12]*.

Additionally, Wildes et al., observed that a substantial proportion of older adults with MM were on multiple medications, including antihypertensives, which can stabilize blood pressure readings and obscure true differences between subgroups *[31]*.

Ragbourne et al., also highlighted that blood pressure may not be as sensitive an indicator for MetS in elderly or cancer-afflicted populations compared to lipid and glycemic markers, especially given the influence of pharmacological interventions and age-related autonomic dysregulation. These findings collectively support the notion that while hypertension is a formal component of MetS, it may have limited discriminatory value in elderly MM patients and should be interpreted cautiously within the broader clinical and therapeutic context *[13]*.

A key strength of the study lies in its multivariate analysis, which identified waist circumference and triglyceride level as independent predictors of MetS. For every 1cm increase in waist circumference, the odds of MetS increased by 16%, and each unit rise in triglycerides raised the odds by 7%. These findings are clinically relevant because they highlight non-invasive, easily measurable indicators that can be used in clinical practice to stratify risk in MM patients. Moreover, this points toward potential therapeutic targets such as lifestyle interventions and lipid-lowering therapies that could mitigate MetS and potentially influence MM outcomes indirectly.

In the study by Wang et al., metabolic profiling identified lipid metabolism pathways, particularly those involving triglyceride regulation, as key determinants of MM prognosis, supporting the relevance of triglyceride levels not just as diagnostic markers, but also as prognostic indicators *[34]*.

Similarly, Lim et al., *[33]* and Gavriatopoulou et al., *[32]* emphasized that central obesity quantified through waist circumference is a robust surrogate for visceral adiposity, which fuels both systemic inflammation and MM pathogenesis. These markers are not only easy to measure in routine practice, but they also offer actionable targets for lifestyle modification or pharmacologic intervention. In fact, studies have shown that therapies like statins and metformin, which target lipid metabolism and insulin resistance respectively, may have dual benefits in improving metabolic profiles and enhancing MM outcomes. Therefore, the identification of waist circumference and triglycerides as independent predictors strengthens the call for integrating simple metabolic assessments into standard MM management, particularly in geriatric populations.

The analysis also explored correlations between total serum protein and anthropometric measures. A significant moderate negative correlation with BMI and a fair negative correlation with waist circumference were found, suggesting that higher degrees of obesity may be associated with lower serum protein levels. This could be attributed to a dilutional effect or to the malnutrition-inflammation complex, which is not uncommon in chronic disease states. With paraproteinemias and elevated serum proteins noted in blood malignancies, patients often suffer from malnutrition, weight loss and cachexia.

Gavriatopoulou et al., discussed how increased adiposity in MM patients may coexist with functional malnutrition, where excess fat mass masks underlying protein-energy deficiency, potentially exacerbated by systemic inflammation and catabolic stress. This can lead to lower serum protein levels despite high BMI or waist circumference, a paradox also noted in patients with other chronic inflammatory diseases. Furthermore, the dilutional hypothesis, especially in obese individuals with expanded plasma volume, has been proposed in previous studies as a possible explanation for relatively lower concentrations of circulating proteins, including albumin and total protein *[32]*.

In contrast, the analysis of calcium levels did not show any significant correlations, indicating limited involvement of mineral metabolism in the metabolic profile of these patients.Markus et al., noted that disturbances in calcium homeostasis in MM patients occur independently of MetS components and are more closely linked to disease severity and bone involvement. Thus, serum calcium appears to be a less informative marker in evaluating the metabolic profile of MM patients, especially in the absence of overt skeletal disease *[12]*.

The implications of these findings are substantial. MetS in MM patients has the potential to worsen prognosis by contributing to cardiovascular events, increasing treatment toxicity, and possibly affecting overall survival. Recognizing and managing MetS early could lead to better clinical outcomes and improved quality of life. This is particularly important in geriatric patients, who are often underrepresented in clinical trials and may not tolerate aggressive MM therapies well. Tailoring therapy to account for metabolic status could reduce complications and improve tolerance.

These implications are strongly echoed in the literature. Lim et al. *[33]* emphasized that metabolic dysregulation in MM particularly insulin resistance and dyslipidemia not only contributes to systemic inflammation but also correlates with drug resistance and inferior prognosis, especially in relapsed and refractory disease.

Gavriatopoulou et al., similarly highlighted that components of MetS may independently worsen

MM outcomes by amplifying treatment-related toxicities and exacerbating frailty in elderly patients. This is further supported by Wildes et al., ***[31]*** who showed that older adults with MM often exhibit geriatric vulnerabilities such as polypharmacy, impaired mobility, and comorbidities that directly influence their eligibility for intensive treatments like stem cell transplantation ***[32]***.

Importantly, Ragbourne et al., and Zhao et al., ***[35]*** noted that managing MetS through interventions like statins, metformin, or lifestyle modifications could not only reduce cardiovascular morbidity but may also provide adjunctive antitumor benefits. As such, early identification and targeted management of MetS in MM patients particularly in the elderly should be considered an essential part of personalized care strategies aimed at improving both survival and quality of life ***[13]***.

While this study provides important insights into the prevalence and predictors of metabolic syndrome among geriatric multiple myeloma patients, the study lacked a control group of age- and sex-matched individuals without multiple myeloma, which limits the ability to determine whether the observed metabolic alterations are specific to MM patients or reflect general trends in the elderly population. The inclusion of a control group would have allowed for better comparative analysis and more robust conclusions. However, we looked for prevalence of metabolic syndrome among the non-myeloma patients in the literature and included it in our discussion for a better visualization and comparison.

Conclusion:

In conclusion, this study demonstrates a high prevalence of metabolic syndrome among geriatric patients with multiple myeloma, with nearly half of the participants meeting diagnostic criteria most notably associated with increased waist circumference and elevated triglyceride levels. These findings underscore the importance of integrating metabolic assessment into the routine care of elderly MM patients, as the presence of metabolic syndrome may contribute to worsened clinical outcomes, heightened cardiovascular risk, and compromised treatment tolerance. Early identification and targeted management of metabolic abnormalities in this population could play a vital role in improving quality of life and potentially enhancing therapeutic efficacy.

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انتشار متلازمة التمثيل الغذائى بين مرضى الورم النقوى المتعدد المسنين

الورم النقوى المتعدد هو ورم خبيث يتميز بتكاثر استنساخى لخلايا البلازما فى نخاع العظم. ومن المعروف أن متلازمة الأيض تُسهم فى الالتهاب الجهازى وخطر الإصابة بأمراض القلب والأوعية الدموية. ويثير تقارب هاتين الحالتين المرضيتين لدى نفس الفئة من المرضى تساؤلات حول الآليات المرضية الفيزيولوجية المشتركة.

هدف العمل: تقييم انتشار متلازمة التمثيل الغذائى بين مرضى الورم النقوى المتعدد المسنين والعثور على تأثيرات ثنائية الاتجاه محتملة بين المرضين.

شملت الدراسة ٤٥ مريضًا مصريًا مسنًا مصابًا بورم النخاع المتعدد، شُخِّصوا بالورم من خلال سحب عينة من نخاع العظم. خضع جميع المرضى لتقييم طبى شامل، وسجلوا تاريخًا مرضيًا شاملًا، وفحصًا بدنيًا، وقياسات أنثروبومترية شملت محيط الخصر، والوزن، والطول، ومؤشر كتلة الجسم. وأُجريت الفحوصات التالية: سكر الدم الصائم، ومستوى الهيموغلوبين السكرى (HbA1c)، والألبومين، والبروتين الكلي، والكالسيوم، والكرياتين، واليوريا، ومستوى الدهون الثلاثية (TG & HDL).

النتائج: استوفى ما يقرب من نصف المشاركين المعايير التشخيصية لمتلازمة التمثيل الغذائى (٤٦,٧٪). كانت مستويات سكر الدم الصائم، والهيموغلوبين السكرى (HbA1c)، والدهون الثلاثية مرتفعة بشكل ملحوظ لدى مرضى متلازمة التمثيل الغذائى (القيمة الاحتمالية ٠,٠٣٨، ٠,٠١٩، ٠,٠٠١ على التوالى). كان البروتين الدهنى عالى الكثافة منخفضًا بشكل ملحوظ لدى مرضى متلازمة التمثيل الغذائي (القيمة الاحتمالية ٠,٠١٠). كان محيط الخصر ومستوى الدهون الثلاثية من أهم المؤشرات على متلازمة التمثيل الغذائى. ولوحظ وجود ارتباط سلبى كبير بين إجمالى البروتين ومؤشر كتلة الجسم ومحيط الخصر (القيمة الاحتمالية <٠,٠٠١، <٠,٠٠٦ على التوالى).

الاستنتاج: تُظهر هذه الدراسة ارتفاع معدل انتشار متلازمة التمثيل الغذائى بين مرضى المايلوما المتعددة المسنين، حيث استوفت ما يقرب من نصف المشاركين المعايير التشخيصية، وأبرزها زيادة محيط الخصر وارتفاع مستويات الدهون الثلاثية. تُؤكد هذه النتائج على أهمية دمج التقييم الأيضى فى الرعاية الروتينية لمرضى المايلوما المتعددة المسنين.