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General Medicine

CLINICAL PROFILE OF INFECTION IN MULTIPLE MYELOMA: A HOSPITAL-BASED OBSERVATIONAL STUDY

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ABSTRACT **BACKGROUND** Multiple myeloma (MM) is a plasma cell malignancy associated with profound immune dysfunction — notably hypogammaglobulinemia and impaired cell-mediated immunity — resulting in high susceptibility to infections. Infections remain a leading cause of morbidity and early mortality in MM, particularly during the first year of diagnosis and periods of intensive treatment.**OBJECTIVE** To study the clinical profile of infections and identify the types, common sites/sources, and outcomes of infections in patients with multiple myeloma attending the Department of Medicine at Assam Medical College and Hospital, Dibrugarh. **METHODS** A hospital-based observational (cross-sectional) study was conducted over one year (September 2024 – September 2025) in the Department of Medicine, Assam Medical College and Hospital. Thirty diagnosed cases of multiple myeloma with documented infections were enrolled following IMWG diagnostic criteria. Detailed clinical, laboratory, microbiological, and radiological data were collected and analysed using SPSS v21.0. **RESULTS** Of 30 patients, 60% were male and 46.7% were aged 61–75 years. Advanced disease (ISS Stage III) was present in 46.7%. Bacterial infections predominated (60%), with gram-negative organisms — Escherichia coli and Klebsiella pneumoniae — being the most frequently isolated pathogens. The respiratory tract (40%) and urinary tract (23.3%) were the most common infection sites. Most infections occurred during bortezomib-based therapy, and complete recovery was achieved in 60% of patients. **CONCLUSIONS** Infections in multiple myeloma are frequent, predominantly bacterial, affect the respiratory and urinary tracts, and occur during active treatment in patients with advanced disease. Early recognition of risk factors and prompt microbiological evaluation with appropriate antimicrobial therapy are essential to reduce morbidity and mortality.

KEYWORDS :

INTRODUCTION

Multiple myeloma (MM) is a plasma cell dyscrasia characterized by the clonal proliferation of plasma cells in the bone marrow, leading to overproduction of monoclonal immunoglobulins or light chains. It represents approximately 1% of all malignancies and 10–15% of hematological malignancies worldwide. The disease predominantly affects the elderly, with a median age of diagnosis of approximately 65 years and a slight male predominance. In Asia, the incidence is approximately 1.1 per 100,000 people compared to 4.1 per 100,000 in western countries; India reports about 1 case per 100,000 population.

Clinical manifestations arise from bone marrow infiltration, monoclonal protein production, and resultant end-organ damage. The presenting signs are anaemia, bone pain, pathological fractures, renal failure, and hypercalcemia. Among these, infectious complications represent one of the most common and harmful co-morbidities encountered in MM patients. The infectious complications do not only lead significantly to the morbidity, but also they are the primary cause of death.

The immune dysfunction underlying MM is both humoral and cellular in nature. Clonal expansion inhibits normal polyclonal immunoglobulin synthesis, leading to hypogammaglobulinemia and impaired antibody-mediated response. Cell-mediated immunity is also significantly compromised, with reported dysfunctions of T cells, natural killer cells, and antigen-presenting cells. Dysfunction of neutrophils, in the absence of extreme neutropenia, also leads to disrupted innate immune defense response.

Therapeutic interventions further increase the risk. Corticosteroids, immunomodulatory drugs (IMiDs), proteasome inhibitors, and monoclonal antibodies though improve survival, they increase susceptibility to viral and opportunistic pathogens. Infections are most prevalent during induction therapy and during the intensive stages of treatment.

In the Indian context, patients often present at an advanced disease stage with suboptimal nutritional status, elevated baseline comorbidity, and exposure to a distinct spectrum of community-acquired pathogens, including a higher burden of gram-negative organisms and tuberculosis. Despite this, published data on the clinical epidemiology of infections in MM patients from Northeast India remain sparse. The present study was therefore conducted at Assam Medical College and Hospital (AMCH), Dibrugarh, to characterize the clinical profile, microbiological spectrum, and outcomes of infections in this patient population.

Materials and Methods

Study Design and Setting

A hospital-based observational (cross-sectional) study was conducted in the Department of Medicine, Assam Medical College and Hospital (AMCH), Dibrugarh, Assam, India, over one year (27 September 2024 to 26 September 2025). AMCH is a tertiary care referral center serving the northeastern region of India. Ethical clearance was obtained from the Institutional Ethics Committee (Human) of AMCH prior to study commencement. Written informed consent was obtained from all enrolled participants.

Study Population and Sample Size

All patients aged >12 years with a confirmed diagnosis of multiple myeloma (per IMWG 2014 criteria) and a documented infection occurring during MM treatment or within six months of diagnosis were eligible. The sample size of 30 was calculated using a reference infection prevalence of 17.9% in MM patients, with a 95% confidence interval and 15% margin of error.

Inclusion and Exclusion Criteria

Included: all IMWG-confirmed MM patients aged >12 years with documented bacterial, viral, or fungal infection during or within six months of MM diagnosis, who had received MM-directed therapy (chemotherapy, IMiDs, proteasome inhibitors, monoclonal antibodies, or stem cell transplantation) and provided informed consent.

Excluded: patients aged ≤12 years; coexisting malignancy; non-secretory myeloma; MGUS; HIV/AIDS; prior splenectomy or splenic dysfunction; severe comorbidities (decompensated cardiac failure, COPD, chronic liver disease); pregnancy; or refusal of consent.

Clinical Assessment

A structured proforma captured demographic data, presenting complaints, comorbidities, and detailed MM treatment history. Full clinical examination with vital signs was documented. Infection was defined by the presence of body temperature ≥37°C and/or isolation of

a microbial agent, together with compatible clinical features and/or laboratory evidence (leukocytosis, neutrophilia, or elevated CRP relative to baseline).

Laboratory and Microbiological Investigations

Haematological indices were determined using a Sysmex XN-550 analyser. Biochemical parameters were serum creatinine, calcium, LDH, albumin, uric acid, and CRP were quantified using VITROS 5600 dry-slide technology. Serum ferritin and beta-2 microglobulin were measured by chemiluminescence immunoassay.

Blood cultures were processed using the BacT/ALERT automated microbial detection system. Urine samples were cultured on blood agar, chocolate agar, and MacConkey agar; growth of $>10^5$ CFU/mL was considered significant. Sputum and wound swabs were subjected to Gram staining, culture, and antimicrobial susceptibility testing. Serum beta-2 microglobulin was determined by CLIA two-site sandwich immunoassay.

Radiological Investigations

Plain radiographs of the skull, spine, pelvis, and long bones were obtained in all patients. Plain CT and high-resolution CT (HRCT) chest were performed in selected cases ,particularly for suspected pneumonia, pleural effusion, or complex bone disease.

Disease Staging

Disease stage was assigned using the International Staging System (ISS), based on serum beta-2 microglobulin and serum albumin values at enrolment.

Statistical Analysis

Data were entered into a structured database and analysed using SPSS v21.0 (IBM, Chicago). Discrete data are expressed as number (%) and analysed using the chi-square test. Statistical significance was set at $p < 0.05$ for all analyses.

RESULTS

Demographic and Baseline Characteristics

Thirty patients met the inclusion criteria. Males accounted for 60% (n = 18) of the cohort, consistent with the known male predominance of MM. The most frequently affected age group was 61–75 years (46.7%; n = 14), followed by 46–60 years (33.3%; n = 10). No patients were younger than 31 years, and only one patient was older than 76 years ($p < 0.001$).

Presenting Symptoms and Signs

Bone pain (including low back pain) was the most common presenting symptom (86.7%), followed by generalised weakness and fatigue (80%), fever (66.7%), and cough (46.6%). Burning micturition was reported in 26.6% and bleeding manifestations (epistaxis, gum bleeding, ecchymosis) in 20%. Pallor was the most prevalent clinical sign (83.3%), followed by bony tenderness (73.3%), paraparesis and oedema (20% each), and pleural effusion (10%).

Table 1. Presenting symptoms (n = 30).

Symptom	n	Percentage (%)
Bone pain / back pain	26	86.7
Generalised weakness / fatigue	24	80.0
Fever	20	66.7
Cough	14	46.6
Burning micturition	8	26.6
Bleeding manifestations	6	20.0
Constipation	4	13.3
Nausea / vomiting	3	10.0
Confusion	1	3.3

Laboratory Investigations

Key laboratory findings are summarised in Table 2. Anaemia (Hb < 10 g/dL) was present in 63.3% of patients. Leukopenia was found in 50%, and thrombocytopenia in 23.3%. Elevated ESR (>40 mm/hr) was recorded in 86.7%. Renal impairment (serum creatinine > 2 mg/dL) was documented in 53.3% and hypoalbuminaemia (<3.5 g/dL) in 76.7%. Elevated serum LDH (>285 U/L) was present in 73.3%, and hypercalcaemia in 40%. Serum ferritin exceeded 600 µg/L in 60% of patients ($p < 0.05$), and CRP exceeded 6 mg/L in 76.7% ($p < 0.01$). Serum beta-2 microglobulin was >5.5 in 46.7% of patients.

Table 2. Key laboratory abnormalities at presentation (n = 30).

Investigation	Threshold	n (%)	p-value
Haemoglobin	< 10 g/dL	19 (63.3%)	–
WBC count	< 4000/mm³	15 (50.0%)	–
ESR	> 40 mm/hr	26 (86.7%)	–
Serum creatinine	> 2.0 mg/dL	16 (53.3%)	–
Serum albumin	< 3.5 g/dL	23 (76.7%)	–
Serum LDH	> 285 U/L	22 (73.3%)	–
Corrected serum	> 10 mg/dL	12 (40.0%)	–
Serum ferritin	> 600 µg/L	18 (60.0%)	0.007
Serum CRP	> 6.0 mg/L	23 (76.7%)	0.003
Serum beta-2	> 5.5	14 (46.7%)	0.20

Radiological Findings

On skeletal survey, osteolytic lesions were identified in 80% of patients, generalised osteoporosis in 53.3%, and pathological fractures in 20%. Two patients (6.6%) had a normal skeletal survey.

Disease Staging (ISS)

Distribution by ISS: Stage I -13.3% (n = 4); Stage II- 40.0% (n = 12); Stage III- 46.7% (n = 14). Nearly half the cohort therefore presented with advanced-stage disease.

Timing of Infections

Table 3. Timing of infection occurrence (n = 30).

Timing of Infection	n	Percentage (%)
During active treatment	17	56.7
At diagnosis / within 1 month	9	30.0
Within 6 months of diagnosis	4	13.3

Spectrum and Microbiological Profile of Infections

Bacterial infections predominated (60%; n = 18). Fungal infections were documented in 6.6% (n = 2; both Candida species). No organism was isolated in 33.3% of cases despite clinical evidence of infection. Among the organisms identified, gram-negative bacteria were most common: Escherichia coli (n = 8) and Klebsiella pneumoniae (n = 5). Gram-positive isolates included MRSA (n = 2) and Staphylococcus aureus (n = 2). One case of Mycobacterium tuberculosis was identified.

Table 4. Microbiological profile of isolated organisms (n = 20 isolates).

Organism	n
Escherichia coli	8
Klebsiella pneumoniae	5
MRSA	2
Staphylococcus aureus	2
Candida species	2
Mycobacterium tuberculosis	1

Sites of Infection

The respiratory tract was the most frequently involved site (40%; n = 12), followed by the urinary tract (23.3%; n = 7) and bloodstream infection/sepsis (20%; n = 6). Pyrexia of unknown origin (PUO) was documented in 10% (n = 3) and skin/soft tissue infections in 6.7% (n = 2).

Treatment Modality at Time of Infection

The majority of infectious episodes occurred in patients receiving bortezomib-based regimens: VCd/CyBorD in 40% (n = 12) and VRd in 30% (n = 9). Six patients (20%) were receiving other regimens, and three (10%) were on supportive care only.

Outcome Analysis

Table 5. Outcome analysis (n = 30).

Outcome	n	Percentage (%)
Complete recovery	18	60.0
Recurrent infection	7	23.3
Infection-related mortality	3	10.0
Lost to follow-up	2	6.7

DISCUSSION

This study characterises the clinical and microbiological profile of infections in MM patients treated at a tertiary referral centre in Northeast India. The findings are broadly consistent with published literature while highlighting important regional differences in pathogen distribution and disease presentation stage.

Demographics

The male predominance (60%) aligns with the established

epidemiology of MM (Kyle et al., 2003; Bladé et al., 2010). The predominance of infections in patients aged 61–75 years reflects the combined effects of advanced age-related immune senescence and MM-associated immunoparesis, consistent with findings from Blimark et al. (2015) and Teh et al. (2017), who reported median ages above 60 years in infected MM cohorts.

Clinical Presentation and Laboratory Features

Bone pain (86.7%) and generalised weakness (80%) as the dominant symptoms are consistent with classical MM presentations described by Rajkumar et al. (2014). Fever in 66.7% of patients underscores the frequency of symptomatic infection in this cohort. The high prevalence of anaemia (63.3%), leukopenia (50%), and elevated inflammatory markers (ESR 86.7%, CRP 76.7%) reflects the dual contribution of disease-related bone marrow failure and active infection. Renal dysfunction (53.3%) and hypoalbuminaemia (76.7%) were hallmarks of advanced disease and were correspondingly associated with greater infection risk, as reported by Palumbo et al. (2011).

Elevated serum ferritin (>600 µg/L in 60%; $p = 0.007$) likely reflects the combined hyperinflammatory burden of MM and superimposed infection. Raised beta-2 microglobulin (>5.5 in 46.7%) and elevated LDH (73.3%) indicate that a substantial proportion of patients in this cohort had high tumour burden, consistent with greater immunosuppression and infection susceptibility (Greipp et al., 2005).

Disease Stage and Timing

The strong representation of ISS Stage III disease (46.7%) corroborates evidence that advanced-stage MM carries a disproportionate infection burden. The observation that 56.7% of infections occurred during active treatment were predominantly bortezomib-based and is consistent with Teh et al. (2017), who highlighted treatment-induced immunosuppression as the primary driver of late infection. Bortezomib depletes T cells and disrupts viral antigen presentation, promoting VZV reactivation and bacterial susceptibility. The 30% of infections occurring at diagnosis reflects the profound disease-associated immune dysfunction (hypogammaglobulinaemia, complement deficiency) present at initial presentation.

Microbiological Profile

Bacterial infections predominated (60%), with gram-negative bacilli — E. coli and Klebsiella pneumoniae accounted for the majority of isolates. This gram-negative predominance differs from Western literature, which typically reports a higher frequency of encapsulated gram-positive organisms (Streptococcus pneumoniae, Haemophilus influenzae). The Indian pattern is consistent with prior Indian studies (Ghosh & Shetty, 2010; Dash et al., 2016) and likely reflects the high endemic burden of gram-negative urinary and respiratory pathogens, differing resistance profiles, and patient-level factors including nutritional status and baseline renal disease. The identification of one case of Mycobacterium tuberculosis highlights the particular importance of tuberculosis screening in MM patients from high-endemic regions. A culture-negative rate of 33.3% may partly reflect prior antibiotic exposure, as well as diagnostic constraints in a resource-limited setting.

Infection Sites

The respiratory tract was the predominant site (40%), consistent with reports from Blimark et al. (2015) and international MM infection literature, in which pneumonia is the most common serious infection. Urinary tract infections (23.3%) and bloodstream infections (20%) were the next most frequent categories. The high rate of sepsis (20%) underscores the clinical severity of infectious complications in this population and the need for prompt, broad-spectrum antimicrobial intervention.

Outcomes

Complete recovery was achieved in 60% of patients with appropriate antimicrobial therapy and supportive care. However, 23.3% experienced recurrent infections, and infection-related mortality occurred in 10% whose figures were comparable to those reported by Augustson et al. (2005), who identified infections as a leading cause of early death in MM. These outcome data reinforce the need for systematic risk-stratification, prophylactic strategies (levofloxacin in the first 3 months; acyclovir prophylaxis during proteasome inhibitor therapy; Pneumocystis prophylaxis with high-dose steroids), and enhanced microbiological surveillance in this patient group.

CONCLUSIONS

This hospital-based observational study demonstrates that infections are frequent and clinically significant complications of multiple myeloma in the Northeast Indian setting. Several conclusions emerge:

1. Infections predominantly affect elderly males with advanced ISS stage disease, most commonly during active bortezomib-based chemotherapy.

2. Bacterial pathogens dominate; in contrast to Western cohorts, gram-negative organisms (E. coli, Klebsiella pneumoniae) are the most frequently isolated, reflecting the regional epidemiological pattern.

3. The respiratory and urinary tracts are the principal sites of infection; bloodstream infection/sepsis occurs in one-fifth of patients and warrants aggressive early management.

4. Anaemia, leukopenia, renal dysfunction, hypoalbuminaemia, elevated LDH, elevated ferritin, and advanced ISS stage are clinical parameters strongly associated with the occurrence of infections.

5. Early recognition of infection risk, prompt microbiological evaluation, and guideline-directed antimicrobial prophylaxis are essential to reduce infection-related morbidity (recurrence rate 23.3%) and mortality (10%) in this vulnerable population.

Limitations of this study include the small single-centre sample size, absence of viral serology in all patients, and the cross-sectional design that precludes causal inference. Larger prospective multicentre studies from the Indian subcontinent are warranted.

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Conflicts of Interest: The authors declare no conflict of interest.

Ethics: Approved by Institutional Ethics Committee (Human), Assam Medical College and Hospital, Dibrugarh. Informed consent obtained from all participants.

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