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Original Article

Incidence and Severity of cytopenias in Sepsis and Their Correlation with Mortality

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ABSTRACT

Introduction: Cytopenias, including anemia, thrombocytopenia, and leukopenia, are common hematological manifestations in clinical populations, particularly among the elderly and those with chronic diseases. Their presence can complicate underlying conditions, influence treatment decisions, and impact patient prognosis. This study aims to profile the prevalence and severity of major cytopenias in a cohort of adult patients.

Aims and Objectives: The primary aim was to determine the frequency and severity of anemia, thrombocytopenia, neutropenia, and lymphopenia. The objective was to correlate these findings with the demographic and comorbidity profile of the study population.

Materials and Methods: A cross-sectional analysis was conducted on 400 participants. Data on age, gender, comorbidities, and complete blood count parameters were collected. Cytopenias were defined and graded using standard laboratory reference ranges. Descriptive statistics were used for data analysis.

Results: The majority of participants (55.8%) were aged 51–70 years, with a male predominance (54.3%). Hypertension (40.3%) was the most common comorbidity. Anemia was present in 55.8% of participants, predominantly mild (65.5% of anemic cases). Thrombocytopenia was observed in 42.3%, with mild and moderate forms being most common. Lymphopenia was found in 39.5%, primarily moderate grade, while neutropenia was uncommon (6.5%).

Conclusion: A high burden of cytopenias, especially anemia and thrombocytopenia, exists in this predominantly older population with significant chronic cardiometabolic diseases. The findings underscore the importance of routine hematological screening in managing such high-risk groups.

Keywords*: Cytopenia, Anemia, Thrombocytopenia, Lymphopenia, Chronic Disease, Epidemiology.*

INTRODUCTION

Sepsis is a complex, life-threatening syndrome that arises from a dysregulated host response to infection, leading to acute organ dysfunction and significant physiological derangement [1]. Despite decades of research, sepsis continues to present a major global health burden, with high rates of morbidity, mortality, and healthcare expenditure [2]. Historically, terms such as septicemia and sepsis syndrome were used inconsistently, creating confusion in diagnosis and management [3]. The 1992 ACCP/SCCM Consensus Conference provided the first widely accepted definitions, which were later refined in the Sepsis-3 criteria [4]. According to Sepsis-3, sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection, assessed clinically by a two-point or greater increase in the Sequential Organ Failure Assessment (SOFA) score [5]. When this dysregulation progresses to circulatory failure requiring vasopressors to

maintain a mean arterial pressure above 65 mmHg, accompanied by elevated serum lactate despite adequate resuscitation, the condition qualifies as septic shock—the most severe end of the sepsis spectrum [6].The clinical manifestations of sepsis vary widely depending on the initial infection site, pathogen type, severity of the inflammatory response, and the patient's baseline health status [7]. Common early findings include fever, hypotension, tachycardia, tachypnea, and leukocytosis [8]. As the condition progresses, signs of impaired perfusion and multiorgan dysfunction—such as altered mental status, acute kidney injury, oliguria, or cyanosis—become evident . Early detection and timely administration of appropriate antibiotics remain the cornerstone of management, yet predicting which patients will deteriorate rapidly remains a challenge [9].Among the systemic effects of sepsis, hematologic abnormalities are particularly significant. Thrombocytopenia is one of the most common cytopenias observed in critically ill patients, occurring in 20–40% of individuals admitted to intensive care units [10]. In sepsis, platelet activation, endothelial binding, immunologic destruction, hemophagocytosis, and consumptive coagulopathy—including disseminated intravascular coagulation—contribute to reduced platelet counts . Both the nadir platelet count and the magnitude of decline strongly correlate with mortality risk .Similarly, leukopenia, neutropenia, and anemia frequently arise due to bone marrow suppression, cytokine-driven inhibitory mechanisms, increased peripheral destruction, impaired iron metabolism, or blood loss . These cytopenias not only reflect the severity of infection and inflammation but also exacerbate clinical deterioration by increasing susceptibility to secondary infections, bleeding, and inadequate oxygen delivery . Understanding the mechanisms underlying hematologic changes in sepsis is therefore essential, as these abnormalities provide valuable prognostic information and may guide more targeted interventions aimed at improving patient outcomes .

Sepsis is a life-threatening syndrome characterized by a dysregulated host response to infection, leading to multiorgan dysfunction and high morbidity and mortality. Hematologic abnormalities, including thrombocytopenia, leukopenia, neutropenia, and anemia, are common in sepsis and correlate with disease severity and patient outcomes. The incidence and severity of these cytopenias reflect the underlying inflammatory and immune dysregulation and are strong predictors of mortality. Early recognition and monitoring of hematologic changes can guide timely interventions and improve prognosis in septic patients.

MATERIALS AND METHODS

Study design: The study was prospective and observational study.
Place of study: This study was conducted in the Department of General Medicine,Govt. Medical College, Srinagar which receives patients from the UTs of J&K and Ladakh.
Period of study: A period of two years from June 2022 to June 2024.
Study Population: All patients admitted as sepsis under General Medicine were enrolled in the study
Sample size: The study involved a comprehensive analysis of 400 patients

Inclusion Criteria:

- All patients admitted with sepsis.

Exclusion criteria:
Patients with:

- Known chronic liver diseases.
- Hematological malignancies.
- On immunosuppressant drugs.
- On chemotherapeutic drugs.

Study Variable:

- Age
- Sex
- Anemia
- Thrombocytopenia
- Neutropenia
- Lymphopenia
- Grade of Lymphopenia
- Hypertension
- Diabetes Mellitus
- Chronic Obstructive Pulmonary Disease (COPD)
- Dementia
- NSTEMI
- Parkinson's Disease

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spreadsheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

RESULT

Table 1: Age distribution of study patients

Age (Years)	Number	Percentage
≤ 30	61	15.3
31–50	58	14.5
51–70	223	55.8
> 70	58	14.5
Total	**400**	**100**

Table 2: Gender distribution of study patients

Gender	Number	Percentage
Male	217	54.3
Female	183	45.8
Total	**400**	**100**

Table 3: Underlying comorbidity among study patients

Comorbidity	Number	Percentage
Hypertension	161	40.3
Diabetes mellitus	72	18
COPD	59	14.8
Hypothyroidism	14	3.5
Dementia	12	3
NSTEMI	9	2.3
Parkinson's disease	6	1.5

Table 4: Distribution of Anemia Status and Severity Among Study Patients

	Parameters	Number	Percentage
Anemia Status	Present	223	55.8
	Absent	177	44.3
Severity of Anemia	Mild anemia	146	65.5
	Moderate anemia	48	21.5
	Severe anemia	29	13

Table 5 : Distribution and Severity of Thrombocytopenia Among Study Patients

	Parameters	Number	Percentage
Thrombocytopenia Status	Present	169	42.3
	Absent	231	57.8
Severity of Thrombocytopenia	Mild thrombocytopenia	72	42.6
	Moderate thrombocytopenia	68	40.2
	Severe thrombocytopenia	29	17.2

Table 6: Neutropenia Status and Severity Among Study Patients

	Parameters	Number	Percentage
Neutropenia Status	Present	26	6.5
	Absent	374	93.5
Severity of Neutropenia	Mild neutropenia	9	34.6
	Moderate neutropenia	11	42.3
	Severe neutropenia	6	23.1

Table 7: Lymphopenia Status and Grading Among Study Patients

		Number	Percentage
Lymphopenia Status	Present	158	39.5
	Absent	242	60.5
Grade (ALC)	Grade 1 (800–1000)	43	27.2
	Grade 2 (500–800)	54	34.2
	Grade 3 (200–500)	52	32.9
	Grade 4 (<200)	9	5.7

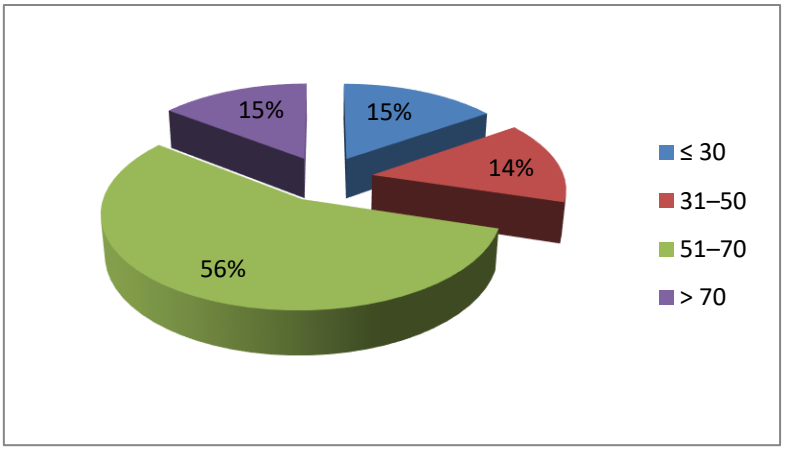

Figure 1: Age distribution of study patients

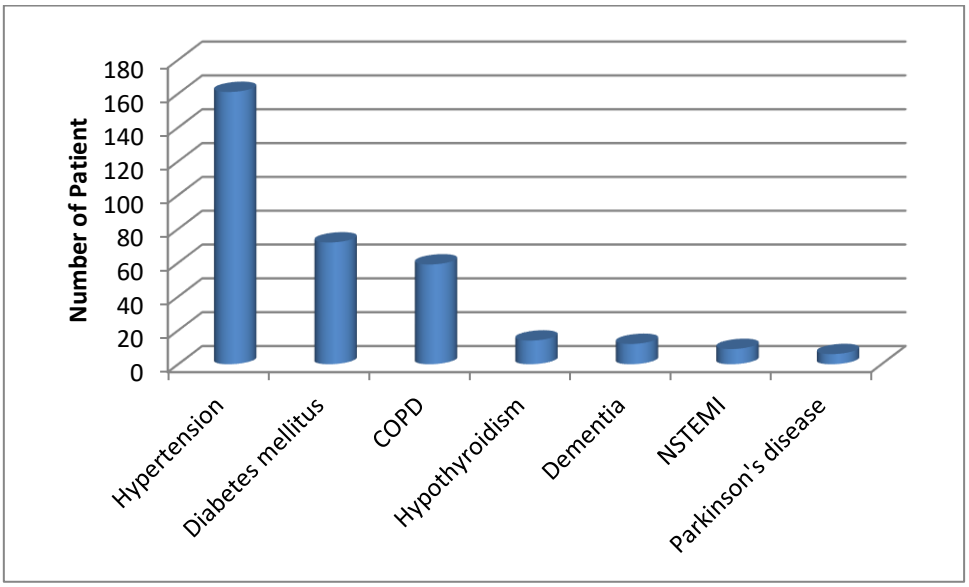

Figure 2: Underlying comorbidity among study patients

In the present study, a total of 400 participants were included. The distribution of participants according to age showed that the majority, 223 (55.8%), were in the 51–70 years age group. Participants aged ≤30 years accounted for 61 (15.3%), while those in the 31–50 years and >70 years age groups were 58 (14.5%) each. This indicates that more than half of the study population belonged to the middle to elderly age group of 51–70 years.(Table 1)

In the study population of 400 participants, 217 (54.3%) were male and 183 (45.8%) were female, indicating a slightly higher representation of males compared to females.(Table 2)

Among the study participants, the most common comorbidity was hypertension, present in 161 (40.3%) individuals, followed by diabetes mellitus in 72 (18%) and chronic obstructive pulmonary disease (COPD) in 59 (14.8%) participants. Less common comorbidities included hypothyroidism in 14 (3.5%), dementia in 12 (3%), NSTEMI in 9 (2.3%), and Parkinson's disease in 6 (1.5%) participants. This shows that cardiovascular and metabolic conditions were the predominant comorbidities in the study population.(Table 3)

In the study population, anemia was present in 223 (55.8%) participants, while 177 (44.3%) did not have anemia. Among those with anemia, the majority had mild anemia, accounting for 146 (65.5%) cases, followed by moderate anemia in 48 (21.5%) and severe anemia in 29 (13%) participants. This indicates that more than half of the study population were anemic, with mild anemia being the most common severity.(Table 4)

In the study population, thrombocytopenia was observed in 169 (42.3%) participants, whereas 231 (57.8%) did not have thrombocytopenia. Among those affected, mild thrombocytopenia was the most common, seen in 72 (42.6%) cases, followed closely by moderate thrombocytopenia in 68 (40.2%), and severe thrombocytopenia in 29 (17.2%) participants. This indicates that a significant proportion of the population had reduced platelet counts, with the majority experiencing mild to moderate severity.(Table 5)

In the study population, neutropenia was present in 26 (6.5%) participants, while the majority, 374 (93.5%), did not have neutropenia. Among those affected, moderate neutropenia was the most common, observed in 11 (42.3%) cases, followed by mild neutropenia in 9 (34.6%) and severe neutropenia in 6 (23.1%) participants. This shows that neutropenia was relatively uncommon, but when present, moderate cases predominated.(Table 6)

In the study population, lymphopenia was present in 158 (39.5%) participants, whereas 242 (60.5%) did not have lymphopenia. Among those affected, Grade 2 lymphopenia (absolute lymphocyte count 500–800) was the most common, seen in 54 (34.2%) cases, followed by Grade 3 (200–500) in 52 (32.9%), Grade 1 (800–1000) in 43 (27.2%), and Grade 4 (<200) in 9 (5.7%) participants. This indicates that moderate to severe lymphopenia was present in a substantial portion of the affected individuals.(Table 7)

DISCUSSION

The findings of this study reveal a significant burden of cytopenias within a predominantly middle-aged to elderly population characterized by a high prevalence of chronic cardiometabolic diseases. The observed prevalence of anemia (55.8%) notably exceeds rates reported in many community-based studies of older adults, such as those cited by Gaskell et al. [11], and more closely aligns with figures from cohorts with higher chronic disease burdens, suggesting anemia of chronic disease (ACD) as a predominant etiology fueled by the underlying inflammatory state associated with conditions like hypertension and COPD [12]. Similarly, the high rate of thrombocytopenia (42.3%) is substantially greater than the prevalence of incidental mild thrombocytopenia in general adult populations [14], pointing toward multifactorial origins related to chronic illness, potential myelodysplasia, or sequelae of cardiovascular disease [15]. The substantial prevalence of lymphopenia (39.5%), particularly moderate to severe grades, is a critical finding consistent with the immunological decline of "inflammaging" and is strongly supported by literature linking lymphopenia to poor outcomes in chronic conditions like heart failure and diabetes [16, 17, 18]. The relative rarity of neutropenia (6.5%) alongside frequent lymphopenia underscores a pattern of selective lymphocyte depletion over generalized marrow suppression, a hallmark of cytokine-driven immune dysregulation in chronic disease [19]. In summary, compared to general population studies, our cohort demonstrates a pronounced aggregation of cytopenias, reflecting the compounded hematological and immunological consequences of aging within a context of significant chronic inflammatory disease, a pathophysiological synergy central to the concept of inflammaging [20]. This profile highlights the importance of routine hematological screening and integrated management in such high-risk populations.

CONCLUSION

In conclusion, this study demonstrates a remarkably high concurrent burden of anemia, thrombocytopenia, and lymphopenia in a middle-aged to elderly population with significant cardiometabolic comorbidities. The prevalence of these cytopenias far exceeds that of the general aging population, underscoring that they are not merely incidental findings but likely direct hematological manifestations of the chronic inflammatory state inherent to conditions like hypertension, diabetes, and COPD. The distinct pattern—featuring prominent anemia of chronic disease, significant but often moderate cytopenias, and a selective depletion of lymphocytes—collectively paints a clinical picture consistent with advanced "inflammaging." These abnormalities likely contribute to increased morbidity, including fatigue, bleeding risk, and immunodeficiency. Therefore, our findings advocate for the proactive integration of complete blood count screening into the routine management of patients with multiple chronic diseases. Early detection and a holistic approach to managing both the underlying conditions and their hematological sequelae are essential to mitigate complications and improve patient outcomes in this vulnerable, high-risk demographic.

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