"STUDY OF IMMATURE GRANULOCYTE COUNT AS EARLY DIAGNOSTIC MARKER TO DIFFERENTIATE BETWEEN SIRS AND SEPSIS PATIENTS"

BY

REG NO: BG0122016

Dissertation

Submitted to the KLE Academy of Higher Education and Research, Belagavi, Karnataka

In Partial Fulfilment
of the Requirements for the Degree of

M.D.
IN
GENERAL MEDICINE

DEPARTMENT OF GENERAL MEDICINE
J. N. MEDICAL COLLEGE
BELAGAVI - 590010. KARNATAKA

SEPTEMBER /OCTOBER 2025

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH,

BELAGAVI, KARNATAKA.

Endorsement by the HOD/ Principal/ Head of the Institution

This is to certify that the dissertation entitled **"STUDY OF IMMATURE GRANULOCYTE COUNT AS EARLY DIAGNOSTIC MARKER TO DIFFERENTIATE BETWEEN SIRS AND SEPSIS PATIENTS"** is a bonafide research work done by **REG NO: BG0122016.**

Dr. REKHA S PATIL
MD (GENERAL MEDICINE)
Professor and Head,
Department of General Medicine,
J. N. Medical College,
Nehru Nagar, Belagavi – 10
Date : 26/03/25
Place : Belagavi

Professor & HOD
Dept. of Medicine
J. N. Medical College Belgaum

Dr.(Mrs.) N.S. MAHANTSHETTI
MD (PAEDIATRICS)
Principal,
J. N. Medical College,
Nehru Nagar, Belagavi – 10
Date : 26/03/25
Place : Belagavi

PRINCIPAL
Jawaharlal Nehru Medical College
BELAGAVI

UNDERTAKING

I, **REG NO: BG0122016**, hereby declare that the information and data mentioned in my dissertation entitled **"STUDY OF IMMATURE GRANULOCYTE COUNT AS EARLY DIAGNOSTIC MARKER TO DIFFERENTIATE BETWEEN SIRS AND SEPSIS PATIENTS** belongs to me and is original. I am aware of the definition of plagiarism as detailed below:

- An act or instance of using or closely imitating the language and thoughts of another author without authorization and the representation of that author's work as one's own, as by not crediting the original author.
- A piece of writing or other work reflecting such unauthorized use or imitation.
- The deliberate or reckless representation of another's words, thoughts or ideas as one's own without attribution in connection with submission of academic work whether graded or otherwise.

I hereby declare that the dissertation prepared by me is original one and does not involve plagiarism anywhere. In case at a later stage, it is found that I have indulged in plagiarism, then I am solely responsible for the same and the institution is at liberty to take any disciplinary action against me including cancellation of dissertation or any other penalties imposed by the University.

Date: 26-03-2025

Place: Belagavi **REG NO: BG0122016**

PLAGIRISM CLERANCE

KLE ACADEMY OF HIGHER EDUCATION AND RESEARCH

JAWAHARLAL NEHRU MEDICAL COLLEGE

(A constituent unit of KLE Academy of Higher Education & Research Deemed-to-be-University)

(Recognized by National Medical Commission, New Delhi)

Accredited 'A+' Grade by NAAC (3rd Cycle) Placed in Category 'A' by MoE (GoI)

Nehru Nagar, Belagavi- 590 010, Karnataka, INDIA

0831 - 2471350 0831 - 2470759 www.jnmc.edu principal@jnmc.edu

Ref No: MDC/PG/ Date: 24-03-2025

"ACCEPTANCE LETTER"

The softcopy of thesis entitled: **"STUDY OF IMMATURE GRANULOCYTE COUNT AS EARLY DIAGNOSTIC MARKER TO DIFFERENTIATE BETWEEN SIRS AND SEPSIS PATIENTS"** has been submitted for anti-plagiarism check through Turnitin software. The scan has been carried out and the scanned output reveals a match percentage of **02%** which is within the acceptable limits of **10%** as per the guidelines given by UGC.

KAHER BELAGAVI J.N. MEDICAL COLLEGE

Guide
28/03/2025.

Dr. (Mrs.) N.S. Mahantashetti.
Chairperson-Antiplagiarism Committee &
Principal,
J. N. Medical College, Belagavi.

To,
Reg. No. BG0122016
Postgraduate Student,
2022-23 Batch,
Department of General Medicine
J. N. Medical College, Belagavi.

ETHICAL CLERANCE

K.L.E. ACADEMY OF HIGHER EDUCATION AND RESEARCH
(Deemed – to- be- University)
Accredited 'A+' Grade by NAAC in (3rd Cycle) Placed in Category 'A' by MHRD (GoI)
JNMC INSTITUTIONAL ETHICS COMMITTEE
JAWAHARLAL NEHRU MEDICAL COLLEGE,
NEHRU NAGAR, BELAGAVI-590010 (KARNATAKA-INDIA)
Website: http//www.jnmc.edu
E-Mail : dome@jnmc.edu
Phone: (+ 91-(0)831 Office : 2472550
Principal: 2471701
Fax No. +91 (0)831 – 2470759

Ref No.MDC/JNMCIEC/ 79 Date: 18/03/2023

To,
REG NO: BG0122016
PG Student in General Medicine
J. N. Medical College,
BELAGAVI.

Sub: Institutional Ethical Clearance for the study.

With reference to the above, we wish to inform you that your proposed research project titled **"STUDY OF IMMATURE GRANULOCYTE COUNT AS EARLY DIAGNOSTIC MARKER TO DIFFERENTIATE BETWEEN SIRS AND SEPSIS PATIENTS"**, is ethical and justifiable. The proposed research project has been cleared by the JNMC Institutional Ethics Committee.

(Dr. Smita Sonoli)
Member Secretary
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi.

(Dr. Harsha Hegde)
Chairman,
JNMC Institutional Ethics Committee
J.N.Medical College, Belagavi

ABBREVATIONS

SIRS	Systemic inflammatory response syndrome
IG	Immature granulocyte
MODS	Multiorgan dysfunction syndrome
PIRO	Predisposition, insult or infection, response, and organ dysfunction
ICU	Intensive care unit
CARS	Compensatory anti-inflammatory response syndrome
IVC	Inferior vena cava
TPN	Total parenteral nutrition
ARDS	Acute respiratory distress syndrome
CNS	Central nervous system
PaO2	Partial pressure of oxygen
CT	Computed tomography
MRI	Magnetic resonance imaging
ECG	Electrocardiogram
MI	Myocardial infarction
MAP	Mean arterial pressure
BUN	Blood urea nitrogen
HR	Heart rate
RR	Respiratory rate
SBP	Systolic blood pressure

ABSTRACT

Introduction: Differentiation between Systemic Inflammatory Response Syndrome (SIRS) and sepsis at earliest remains challenging but crucial for optimal patient outcomes. Traditional markers like serum Pro-calcitonin, blood cultures etc lack the necessary sensitivity and specificity for early diagnosis. This study investigated the utility of immature granulocyte (IG) count.

Methodology: A prospective study was conducted on 65 patients presenting with SIRS criteria. According to established criteria patients were categorized into SIRS and sepsis groups. Demographic data, clinical parameters, and laboratory values including IG count, total leucocyte count, bilirubin, and creatinine were analyzed. The diagnostic performance of IG count was evaluated using various cut-off values.

Results: The study population (mean age 62.12±14.3 years, 73.8% males) comprised 29 SIRS and 36 sepsis patients. In IG counts between groups, significant differences were observed ($p<0.001$), with 58.4% of sepsis patients showing counts >3% compared to 17.3% in SIRS patients. Sepsis patients demonstrated significantly higher rates of organ dysfunction and greater requirements for clinical support ($p<0.001$). IG counts showed significant correlation with both ionotropic ($p=0.020$) and ventilatory support requirements ($p=0.028$).

Conclusion: Immature granulocyte count appears to be a promising early marker for differentiating between SIRS and sepsis, showing significant correlation with disease severity and support requirements. Its integration into routine screening protocols could potentially enhance early sepsis detection and improve patient outcomes

CONTENTS

SR. NO.	TOPIC	PAGE NO.
1.	INTRODUCTION	1-3
2.	OBJECTIVES	4
3.	REVIEW OF LITERATURE	5-25
4.	MATERIALS AND METHODS	26-29
5.	RESULTS	30-54
6.	DISCUSSION	56-64
7.	CONCLUSION	65-66
8.	SUMMARY	67
9.	BIBLIOGRAPHY	68-76
10.	ANNEXURES	77-86
	ANNEXURE I – CONSENT FORM	77-79
	ANNEXURE II – PROFORMA	80-83
	ANNEXURE: III- KEY TO MASTER CAHRT	84
	ANNEXURE IV – MASTER CHART	85-86

LIST OF TABLES

SR. NO.		DESCRIPTION	PAGE NO
1		Distribution of patients according to age	30
2		Distribution of patients gender wise	31
3		Distribution of patients according to co-morbidities	32
4		Distribution of patients in SIRS and sepsis	33
5		Distribution of patients according to source of infection	34
6	6A	Distribution of patients according to Heart rate	35
	6B	Distribution of patients according to Respiratory rate	36
	6C	Distribution of patients according to Temperature	37
7		Distribution of patients according to blood pressure (Systolic blood pressure)	38
8	8A	Distribution of patients according to Leucocytosis	39
	8B	Distribution of patients according to Leucopenia:	40
9		Distribution of patients according serum creatinine	41
10		Distribution of patients according to total bilirubin	42
11		Distribution of patients according to Immature Granulocytes (IG) count	43

12	Comparison of age in SIRS and sepsis patients	**44**
13	Comparison SIRS and sepsis with gender	**45**
14	Comparison of co-morbidities in SIRS and sepsis	**46**
15	Comparison of patients with different source of infection in SIRS and sepsis	**47**
16	Comparison of patients with clinical parameters in SIRS and sepsis	**48**
17	Comparison of patients with systolic blood pressure in SIRS and Sepsis	**49**
18	Comparison of total leucocyte count in SIRS and Sepsis	**50**
19	Comparison of patients with serum creatinine in SIRS and Sepsis	**51**
20	Comparison of patients with Total Bilirubin in SIRS and Sepsis	**52**
21	Comparison of patients with Immature granulocyte count in SIRS and Sepsis	**53**
22	Comparison of Immature granulocyte count with inotrope support and ventilatory support	**54**
23	Comparison of patients requiring ventilatory and inotrope support in SIRS and Sepsis	**55**
24	Diagnostic performance of IG count	**56**

LIST OF GRAPHS

SR. NO.		DESCRIPTION	PAGE NO
1		Distribution of age among study participants	**30**
2		Distribution of patients gender wise	**31**
3		Distribution of co-morbidities among study participants	**32**
4		Distribution of patients in SIRS and sepsis	**33**
5		Distribution of patients according to source of infection	**34**
6	**6A**	Distribution of patients according to Heart rate	**35**
	6B	Distribution of patients according to Respiratory rate	**36**
	6C	Distribution of patients according to Temperature	**37**
7		Distribution of patients according to blood pressure (Systolic blood pressure)	**38**
8	**8A**	Distribution of patients according to Leucocytosis	**39**
	8B	Distribution of patients according to Leucopenia:	**40**
9		Distribution of patients according serum creatinine	**41**
10		Distribution of patients according to total bilirubin	**42**
11		Distribution of patients according to Immature Granulocytes (IG) count	**43**

INTRODUCTION

Approximately 48.9 million cases and 11 million deaths were observed globally related to sepsis thus it remains a major cause of mortality among critically ill patients. Patient's outcomes depend upon early identification and prompt treatment. However, there is clinical challenge in distinguishing between Systemic Inflammatory Response Syndrome (SIRS) and sepsis. Infection is the sole cause for sepsis that leads to organ dysfunction while SIRS is characterized by a generalized inflammatory response that can result from both infectious and non-infectious conditions.

Current diagnostic approaches primarily rely on traditional biomarkers, including C-reactive protein (CRP), procalcitonin, and blood culture analysis. However, these methods have certain limitations, particularly in terms of turnaround time and specificity. Blood cultures typically require 24 to 72 hours to give results and may yield false-negative results especially in patients who have received prior antibiotic treatment yet they are considered as gold standard. These delays can lead to either postponed treatment initiation or unnecessary antibiotic administration, contributing to antimicrobial resistance and escalating healthcare costs.

Recent advancements in automated hematology analyzers have enabled the rapid measurement of immature granulocytes (IGs) in peripheral blood. Immature granulocytes, including metamyelocytes, myelocytes, promyelocytes, are released into circulation during severe inflammatory responses or infections. The presence of elevated IGs, commonly referred to as a "left shift", has historically been assessed through manual differential counts. However, automated IG counting provides greater accuracy and faster turnaround times, making it a potentially valuable tool for early sepsis detection.

Several studies have reported a correlation between elevated IG counts and various inflammatory conditions. For example, research exhibited by Martinez et al. proved that IG percentage had sensitivity of 86.2% and specificity of 91.5% in predicting bacteremia in emergency department patients. Similarly, findings by" Ansari-Lari et al. indicated that IG counts were significantly higher in culture-positive sepsis cases compared to culture-negative SIRS patients". Automated IG counting has key advantages of cost-effectiveness. It does not require additional blood samples or specialized testing procedures as it can be included in routine complete blood count (CBC) analysis. This practical advantage, combined with its quick result availability, suggests that IG count may serve as a useful early biomarker for distinguishing between SIRS and sepsis.

Inspite of being readily available tool, further research is necessary to establish diagnostic utility of IG count for differentiating SIRS from sepsis. Some studies have shown encouraging results, but inconsistencies in cutoff values, measurement techniques, and reporting formats across different hematology analyzers highlight the need for standardization.

The investigation will evaluate its sensitivity, specificity, and predictive value in comparison to conventional biomarkers. Additionally, the study will explore the association between IG count, disease severity, clinical outcomes, and other established inflammatory markers.

A better understanding of the clinical relevance of IG count may facilitate early sepsis detection, allowing for timely intervention and improved patient management. Accurate and early diagnosis is essential for promoting optimal

antibiotic stewardship for the global burden of sepsis and the increasing challenge of antimicrobial resistance,

This research has the potential to enhance diagnostic algorithms for sepsis, ultimately reducing treatment delays and optimizing healthcare resource utilization. Furthermore, validating IG count as a reliable early biomarker could provide clinicians with an additional tool for risk stratification and informed decision-making in patients with systemic inflammatory responses.

AIMS AND OBJECTIVES

Objective:

1. To study immature granulocyte count as earliest diagnostic marker to differentiate systemic inflammatory syndrome from sepsis.

REVIEW OF LITERATURE

Historical Perspective on Sepsis

Year	**Major Contributor**	**Developments**	**Impact on Sepsis Understanding**
5th Century BCE	Hippocrates	Introduced the concept of sepsis, describing it in relation to rotting flesh and infected wounds.	First recorded description of sepsis as a disease process.
19th Century	Ignaz Semmelweis	Proposed handwashing to reduce infection transmission in hospitals, linking hygiene to infection control.	Revolutionized hospital hygiene practices, reducing maternal and surgical mortality.
19th Century	Louis Pasteur	Developed the germ theory, establishing microorganisms as the cause of infections, including sepsis.	Provided the foundation for modern microbiology and infection control.
19th Century	Robert Koch	Identified specific pathogens responsible for sepsis and introduced bacteriological techniques for diagnosis.	Enabled pathogen-specific diagnosis and laid the groundwork for antibiotic use.

20th Century	Surviving Sepsis Campaign	Emphasized early recognition and immediate antibiotic administration within the first hour to reduce mortality.	Standardized sepsis management protocols worldwide.
21st Century	Global Health Organizations	WHO and other global health organizations recognized sepsis as a major health burden and emphasized improved diagnostic strategies.	Sepsis identified as a global health priority, prompting policy changes.
Present Era	Modern Researchers	Ongoing research into biomarkers for early sepsis detection, with a focus on improving sensitivity and specificity.	Advancements in precision medicine and sepsis biomarkers

Systemic Inflammatory Response Syndrome (SIRS)

Various stressors like infection, surgery, trauma, ischemia-reperfusion injury, and malignancy triggers Systemic inflammatory response syndrome. The primary objective of SIRS is elimination of endogenous or exogenous threats. However, despite its defensive nature, an uncontrolled cytokine storm may lead to severe inflammation, culminating in either reversible or irreversible organ damage and, in severe cases, death.[24]

Sepsis and SIRS: A Continuum of Disease

Sepsis is termed as, SIRS accompanied by suspected or confirmed infection. At the early stages, infection confirmation via culture is not necessary for diagnosis. When this condition worsens it leads to organ dysfunction thus leads to severe sepsis. These conditions collectively represent a physiological continuum in which the balance between pro-inflammatory and anti-inflammatory responses progressively deteriorates[24]

According to the American College of Chest Physicians (ACCP) and the Society of Critical Care Medicine (SCCM), multiple organ dysfunction syndrome (MODS) is characterized by altered organ function in critically ill septic patients to the extent that homeostasis cannot be maintained without medical intervention[24]

Diagnostic Criteria for SIRS

Criteria	Diagnostic Threshold
Body Temperature	>38°C or <36°C
Heart Rate	>90 beats per minute
Respiratory Rate	>20 breaths per minute or $PaCO_2$ <32 mmHg
Leukocyte Count	>12,000/μL, <4,000/μL, or >10% immature forms (bands)
Pediatric Consideration	In pediatric patients, abnormal leukocyte count or temperature is required for diagnosis due to frequent variations in heart and respiratory rates.

"SIRS is present in almost all septic patients, but not all patients with SIRS have sepsis". Kaukonen et al. identified subgroups of hospitalized patients who initially did not meet SIRS criteria but later developed severe infections, organ dysfunction, and

increased mortality, suggesting that SIRS criteria alone may not be sufficient for early identification of sepsis[24]

To enhance early recognition, laboratory-based indices and clinical scoring systems, such as the Sequential Organ Failure Assessment (SOFA), Acute Physiology and Chronic Health Evaluation (APACHE), and Logistic Organ Dysfunction (LOD) Score, have been developed.

Evolution of SIRS Definition

Year	Key Developments	Limitations of Previous Model	Clinical Implications
1980s	Systemic inflammation and multi-organ dysfunction termed as sepsis was earlier concept.	No standardized criteria for sepsis, leading to variability in diagnosis and treatment.	Paucity of consensus led to delays in recognition and treatment, increasing mortality.
1991	ACCP and SCCM established SIRS criteria to standardize sepsis recognition.	SIRS criteria lacked specificity, leading to overdiagnosis and unnecessary antibiotic use.	Standardization improved sepsis identification but led to excessive antibiotic administration and misclassification.
2001	Predisposition, Insult, Response, and Organ Dysfunction (PIRO model) introduced to classify sepsis.	PIRO model was complex and difficult to implement in routine clinical practice.	Structured framework encouraged better risk stratification but lacked widespread clinical adoption.
2016	Sepsis-3 redefined sepsis as life-threatening organ dysfunction due to dysregulated host response to infection. Introduced SOFA and qSOFA scores.	SOFA requires laboratory testing, limiting real-time bedside utility. qSOFA has limited sensitivity.	Enhanced focus on organ dysfunction improved mortality prediction but required additional validation.
2021	Ongoing refinement of sepsis definitions and AI-driven prediction models integrated into clinical practice for early detection.	Challenges remain in integrating AI models into routine care and ensuring equitable application across healthcare settings.	AI-driven models show promise in early sepsis detection, potentially reducing diagnostic delays and improving outcomes.

qSOFA Criteria

Criteria	Diagnostic Threshold	Clinical Significance	Predictive Value
Respiratory Rate	≥22 breaths per minute	Indicates respiratory distress and potential for worsening sepsis.	Associated with increased risk of ICU admission and mortality.
Systolic Blood Pressure	≤100 mmHg	Suggests hypotension and risk of circulatory failure.	Linked to progression to septic shock and organ failure.
Glasgow Coma Scale (GCS)	<15 (indicating altered mental status)	Lower scores indicate altered mental status, a key predictor of poor outcomes.	Correlates with higher risk of prolonged hospital stay and mortality.

Studies indicate that qSOFA outperforms SIRS in predicting organ dysfunction in emergency and non-ICU settings, although its applicability is limited in ICU environments due to the frequent use of mechanical ventilation, vasopressors.

Pathophysiology of SIRS and Sepsis[15]

Pathophysiological Aspect	Description	Associated Conditions	Potential Therapeutic Targets
Triggering Pathways	1. Damage-Associated Molecular Patterns (DAMPs) – Non-infectious triggers such as burns, trauma, ischemia, and autoimmune diseases. 2. Pathogen-Associated Molecular Patterns (PAMPs) – Initiated by bacterial, viral, or fungal infections.	Burns, trauma, ischemia, autoimmune diseases, bacterial/viral infections.	DAMP and PAMP inhibitors, early antimicrobial therapy.
Key Cellular Components	"Neutrophils, macrophages, mast cells, platelets, and endothelial cells" release inflammatory mediators.	"Sepsis, septic shock, multiple organ dysfunction syndrome (MODS)".	Anti-inflammatory drugs, cytokine blockers, immune modulators.
Pro-Inflammatory Cytokines	"Tumor Necrosis Factor-alpha (TNF-α), Interleukin-1 (IL-1), Interleukin-6 (IL-6), Interleukin-8 (IL-8)".	Systemic inflammatory response, disseminated intravascular coagulation (DIC).	TNF-α inhibitors, IL-1 receptor antagonists, IL-6 pathway inhibitors.
Major Effects of Inflammatory Cascade	1. Coagulation abnormalities → Microvascular thrombosis. 2. Endothelial dysfunction → Increased capillary permeability → Tissue hypoxia. 3. Stress hormone activation → Catecholamines and glucocorticoids → Metabolic dysregulation.	Organ failure (lungs, kidneys, heart), increased risk of death.	Anticoagulants, endothelial protectants, oxygen therapy.
Compensatory Anti-Inflammatory Response Syndrome (CARS)	Mediated by IL-4 and IL-10, suppressing pro-inflammatory cytokine production.	Post-sepsis immunosuppression, secondary infections, delayed recovery.	IL-4 and IL-10 modulators, immune-boosting therapies.

Clinical Consequences of Imbalance	Persistent imbalance between SIRS and CARS leads to immunosuppression, increasing susceptibility to secondary infections and worsening clinical outcomes.	High mortality rates, increased hospital stay, recurrent infections.	Sepsis vaccines, targeted immunomodulation, precision medicine approaches.

Biomarkers for Sepsis Diagnosis

Biomarker	Significance in Sepsis Diagnosis	Sensitivity (%)	Specificity (%)	Clinical Utility
Procalcitonin (PCT)	Increases within 2-4 hours of inflammation; better specificity than CRP.	75-85	80-90	Useful in differentiating bacterial from non-bacterial infections; guides antibiotic therapy.
C-Reactive Protein (CRP)	General marker of inflammation; elevated in both infectious and non-infectious conditions.	60-70	50-60	Broad marker; elevated in multiple conditions, reducing specificity.
Lactate	Indicator of tissue hypoxia and severity of sepsis.	80-90	85-95	Used for risk stratification and monitoring treatment response.
Interleukin-6 (IL-6)	Elevated levels (>300 pg/ml) correlate with multiple organ dysfunction and increased mortality.	85-95	80-90	Potential for early sepsis detection; associated with disease severity.
Leptin	Levels >38 mcg/L have 91.2% sensitivity in distinguishing infectious from non-infectious SIRS.	91	90	Potential biomarker for distinguishing infectious from non-infectious inflammatory responses.
Endothelial Markers (Angiopoietin-2, P-selectin, E-selectin)	Angiopoietin-2 is linked to 28-day mortality; P-selectin and E-selectin help differentiate septic from non-septic SIRS.	Varies	Varies	Aids in prognosis and risk stratification in sepsis cases.
New Biomarkers (suPAR, DcR3, TREM-1)	Emerging biomarkers showing promise in early and more accurate sepsis detection.	Varies	Varies	Requires further validation; potential to enhance early diagnosis.

Epidemiology of Sepsis

Estimating the global epidemiological burden of sepsis remains challenging due to variations in definitions, diagnostic criteria, and reporting systems. The incidence of sepsis has doubled over the past decade, it as one of the leading causes of death in intensive care units (ICUs).[26]

The frequency of sepsis and septic shock has shown a steady increase since first consensus definition (Sepsis-1) established in 1991. Approximately 49 million cases of sepsis and nearly 11 million deaths were reported worldwide in 2017. These alarming statistics prompted the World Health Organization (WHO) to recognize sepsis as a global health priority[27,28]

Several factors contribute to the rising incidence of sepsis, including:

- **In western countries increased aging population**
- **Invasive medical procedure overuse**
- **Widespread administration of immunosuppressive therapies**
- **Growing prevalence of antibiotic resistance**.

Sepsis accounts for **20% of all global deaths** and leading to one of the deadliest conditions encountered in emergency departments (EDs)[29,30] despite of medical advancement.

Sepsis in Developing Nations

In resource-limited settings, such as India, sepsis poses a substantial healthcare challenge. It is estimated that 60–80% of annual sepsis-related deaths occur in developing countries. Approximately 40% of infections were because of Gram-negative bacteria. The prevalence of severe sepsis or septic shock is reported to be 28.3%, while a recent prospective study found that 56.4% of ICU patients suffer from sepsis[31]

Pathophysiology of Sepsis

Risk Factor	Impact on Sepsis Risk	Clinical Significance
ICU Admission	Nearly 50% of ICU patients develop hospital-acquired infections, significantly increasing the risk of sepsis.	ICU-acquired infections require stringent infection control measures.
Bacteremia	95% of positive blood cultures are associated with sepsis or septic shock, highlighting its strong correlation.	Early identification and treatment of bloodstream infections are critical.
Advanced Age (>65 years)	Age is an independent predictor of sepsis-related mortality due to reduced immune response and comorbidities.	Older adults require closer monitoring and early intervention.
Immunosuppression	Conditions such as renal failure, liver failure, HIV, and immunosuppressive therapy compromise immune defenses.	Immunocompromised patients need targeted infection prevention strategies.
Diabetes and Cancer	Diabetes and cancer weaken immune function, making patients more prone to infections and sepsis.	Diabetic and cancer patients should be screened regularly for infections.
Prior Hospitalizations	Previous hospital stays and antibiotic exposure increase the risk of multidrug-resistant infections, raising sepsis susceptibility.	Antibiotic stewardship programs can help reduce the risk of resistant infections.
Genetic Factors	Although some single nucleotide polymorphisms (SNPs) have been studied, no definitive genetic predisposition to sepsis has been established.	Further research is needed to determine potential genetic markers for sepsis susceptibility.

Microbiology of Sepsis

The prevalence of microorganisms implicated in sepsis has evolved over time. Presently, **Gram-positive bacteria** are more frequently identified than Gram-negative pathogens, and **fungal sepsis** is gaining clinical significance.

Microbiology of Sepsis

Category	Representative Pathogens	Infection Type	Risk Factors	Clinical Significance
Common Gram-Positive Pathogens	Staphylococcus aureus, Streptococcus pneumoniae	Bloodstream infections, pneumonia, skin and soft tissue infections	Hospitalization, invasive devices (catheters, ventilators), immunosuppression	Frequent cause of bloodstream infections; associated with high morbidity and mortality.
Common Gram-Negative Pathogens	Escherichia coli, Klebsiella spp., Pseudomonas spp.	Urinary tract infections, pneumonia, bloodstream infections	Prolonged hospitalization, prior antibiotic use, immunocompromised state	Major contributors to sepsis, often associated with healthcare-associated infections.
Fungal Pathogens	Candida species (notably in immunocompromised or oncologic patients)	Invasive candidiasis, bloodstream infections, disseminated fungal infections	Prolonged antibiotic therapy, neutropenia, malignancy, ICU stay	Increasing prevalence in immunocompromised and critically ill patients; difficult to treat due to antifungal resistance.

The primary sites of sepsis-related infections include:

- **Respiratory tract** (43%)
- **Urinary system** (16%)
- **Abdomen** (14%)

- **Unidentified fever source (FUO)** (14%)
- **Other causes** (13%)

Sepsis 1 (1991)[33]	Sepsis 2 (2001)[34]	Sepsis 3 (2016)[58]
Systemic Inflammatory Response Syndrome (SIRS): Defined as a systemic inflammatory reaction triggered by various severe clinical insults. The diagnostic criteria include: - Body temperature >38℃ or <36^{0}C - Heart rate exceeding 90 beats per minute - Respiratory rate > 20 breaths per minute or PaC02 < 32 mmHg - White blood cell count > 12,000/µL -4000/µL or >10% immature (band) forms	Definition of Infection and Sepsis: Suspected or confirmed infection accompanied by: General Parameters: - Fever (>38.3℃) or hypothermia (<36℃) -Heart rate >90 bpm or >2 SD above normal for age -Respiratory rate >30 breaths per minute -Altered mental status -Significant edema or positive fluid balance (>20 mL/kg over 24 hours) - Hyperglycemia (>110 mg/dL) in non-diabetic individuals	Updated Definition of Sepsis: Sepsis is characterized as a life-threatening organ dysfunction caused by an imbalanced host response to infection. Clinical Criteria: -Suspected or confirmed infection -An acute increase of ≥2 SOFA (Sequential Organ Failure Assessment) points
S evere Sepsis: Sepsis with associated dysfunction, hypoperfusion, or hypotension. Indicators of hypoperfusion lactic acidosis, oliguria, or acute status changes.	Inflammatory and Hemodynamic Parameters: Inflammatory Markers: Elevated wbc count >12,000/µL) or leucopenia (<4000/µL) CRP and procalcitonin > 2 SD above normal Hemodynamic Markers: Systolic BP <90 mmHg MAP<70 mmHg, or BP drop >40mmHg Organ Dysfunction Markers: Hypoxia(Pa02/Fi02 < 300), oliguria(0.5 mL/kg/h), creatinine elevation ≥ 0.5mg/dl, thrombocytopenia (platelet count <100,000/µL), hyperbilirubinemia (>4 mg/dL)	qSOFA Criteria: Designed to identify high-risk patients outside the ICU. A positive qSOFA score includes: -Altered mental status (GCS -Systolic BP <100 mmHg -Respiratory rate breaths per minute

Septic Shock: Defined as sepsis induced hypotension that persists despite adequate fluid resuscitation, often accompanied by perfusion abnormalities like lactic acidosis, oliguria, or altered mental state. Patients requiring vasopressors may not be hypotensive at the time of assessment.	Tissue Perfusion Indicators: - Hyperlactatemia (s 3 mmol/L) - Capillary refill delay or mottled skin	Septic Shock (Revised Definition): A severe subset of sepsis where circulatory and metabolic abnormalities significantly increase mortality risk. Diagnostic criteria include - Persistent hypotension requiring vasopressors to maintain MAP >65 mmHg - Serum lactate >2 mmol/L despite adequate fluid resuscitation

Immunopathophysiology of Sepsis[34]

Sepsis is not just hyperimmune reaction now it became complex interplay between infectious agents and host body

Innate Immunity and Inflammatory Mediators[34]

Innate immune cells, primarily neutrophils, monocytes, macrophages, and natural killer (NK) cells produces initial immune response to infection. These immune cells recognize "pathogen-associated molecular patterns (PAMPs) and damage-associated molecular patterns (DAMPs)" through receptors such as:

- NOD-like receptors (NLRs)
- RIG-1-like receptors (RLRs)
- Toll-like receptors (TLRs)

Pro-inflammatory markers will be released after activation of above pathways including:

- Interleukin-1 (IL-1)
- Interleukin-6 (IL-6)
- Tumor Necrosis Factor-alpha (TNF-α)

These mediators enhance leukocyte migration, complement activation, acute-phase reactant production, and endothelial adhesion, but in sepsis, the widespread cell death and collateral tissue damage is due to dysregulated immune response.

Dysregulation of Hemostasis[35-37]

Sepsis leads to simultaneous activation of coagulation pathways and inflammatory , contributing to microvascular thrombosis and disseminated intravascular coagulation (DIC) .

- **Hypercoagulation:**
    - Coagulation cascade is activated by endothelial cells release tissue factor
    - Widespread platelet-fibrin clots impair tissue perfusion, leading to organ failure.
- **Anticoagulant Dysfunction:**
    - Protein C and Antithrombin levels decrease, promoting unregulated clot formation.
    - Clot resolution is prevented by loss of fibrinolysis due to plasminogen activator inhibitor-1 (PAI-1)

Sepsis-Induced Immunosuppression

Following the initial pro-inflammatory phase, a prolonged immunosuppressive state develops in many septic patients.

- Immune surveillance is reduced by apoptosis of CD4+ and CD8+ T-cells.

- Reduced cytokine responsiveness weakens immune activation.

- Neutrophil dysfunction impairs pathogen clearance.

Low lymphocyte counts could serve as a biomarker for immunosuppression because studies show that early lymphopenia in sepsis correlates with higher 28-day and 1-year mortality.

Affected organs[40-41]

Affected Organ System	Pathophysiology	Clinical Consequences
Lungs	Acute Respiratory Distress Syndrome (ARDS) occurs in up to 40% of sepsis patients due to increased capillary permeability and alveolar damage, leading to hypoxia and respiratory failure.	Progressive respiratory failure requiring mechanical ventilation; increased risk of secondary infections.
Kidneys	Acute Kidney Injury (AKI) is common in sepsis, primarily resulting from hypoperfusion and inflammatory damage, leading to impaired filtration and electrolyte imbalances.	Fluid and electrolyte imbalances, increased risk of dialysis dependency, prolonged ICU stay.
Gastrointestinal Tract	Increased intestinal permeability in sepsis promotes bacterial translocation, exacerbating systemic inflammation and increasing the risk of secondary infections.	Septic ileus, impaired gut function, increased systemic inflammatory response.
Central Nervous System (CNS)	Sepsis-associated encephalopathy (SAE) leads to altered sensorium and neurotransmitter disruption. Blood-brain barrier (BBB) dysfunction increases susceptibility to secondary infections and neurological deterioration.	Cognitive impairment, delirium, increased long-term neurological deficits.
Metabolic System	Hyperglycemia and insulin resistance occur due to heightened catabolic responses in sepsis, resulting in muscle wasting and impaired cellular metabolism.	Severe metabolic derangements, impaired immune function, muscle loss, and delayed recovery.

Diagnosis of Sepsis[42]

In individuals recovering from surgery, sepsis may present with mild symptoms that can be confused with other conditions (such as delirium, pulmonary embolism, or intrinsic cardiac failure). Common clinical signs of sepsis include tachypnea, diaphoresis, tachycardia, and fever, often with normal blood pressure in the early stages. Additional clues may indicate the underlying infection. In elderly or very young patients, reduction in awareness or confusion may serve as an early sign of sepsis or septic shock. Although hypotension eventually develops, the skin may paradoxically become warm initially, later progressing to peripheral cyanosis, mottling, and cool, pale extremities. Organ-specific dysfunction also produces further symptoms (for example, oliguria in renal failure or dyspnea in respiratory failure).

Diagnostic Workup

- **Clinical Assessment:** Monitoring of vital signs and evaluation of organ function.
- **Laboratory Investigations:** A complete blood count (CBC) with differential, electrolyte panel, creatinine, and lactate levels are essential. Additional tests include central venous oxygen saturation ($ScvO_2$), arterial oxygen partial pressure (PaO_2), and invasive central venous pressure (CVP) measurements when indicated.
- **Microbiological Cultures:** Blood, urine, and samples from potential infection sites (e.g., surgical wounds) should be collected.
- **Imaging Studies:** Ultrasonography (e.g. CT or MRI and the RUSH [Rapid Ultrasound for Shock and Hypotension] Examination) may be necessary in cases where a surgical or occult source of sepsis is suspected.

When a patient with a known illness presents with organ dysfunction or systemic inflammatory signs, sepsis should be suspected. Similarly, patients exhibiting unexplained systemic inflammation should undergo a thorough evaluation that includes history, physical examination, blood cultures, additional fluid cultures, and urinalysis (especially in those with indwelling catheters). Biomarkers such as procalcitonin and C-reactive protein (CRP) are often elevated in severe sepsis, although these findings are nonspecific. Ultimately, the diagnosis of sepsis is clinical.

Based on history, physical examination, we should consider hypovolemia or myocardial infarction (MI) as causes of shock ,electrocardiography, and cardiac biomarkers. Sepsis-induced hypoperfusion can produce ECG changes in absence of MI (including various arrhythmias, nonspecific ST-T wave abnormalities, T-wave inversions,)

Early identification of organ failure is critical. Although several grading systems have been developed, the "quick Sequential Organ Failure Assessment (qSOFA) score "and SOFA score have proven useful in predicting mortality. The qSOFA score, based on the respiratory rate, blood pressure, Glasgow Coma Scale and, is particularly practical as it does not require laboratory results. It is generally a better predictor of in-hospital mortality for patients than the full SOFA score or the systemic inflammatory response syndrome (SIRS) criteria. In the ICU setting, however, full SOFA score is more robust.

Patients who meet at least two of the following SIRS criteria should be further evaluated:

- Heart rate >90 beats per minute
- Respiratory rate >20 breaths per minute or $PaCO_2$ <32 mm Hg
- Temperature >38°C (100.4°F) or <36°C (96.8°F)
- White blood cell count >12,000/µL, <4,000/µL, or >10% immature (band) forms

Additional laboratory monitoring includes creatinine, serum electrolytes, Serum lactate levels ,blood urea nitrogen (BUN), and chest x-rays. and central venous oxygen saturation ($ScvO_2$) ,arterial blood gases (ABGs) may guide treatment decisions. Variations in white blood cell (WBC) counts can occur during sepsis, influenced by the severity of the condition, concurrent corticosteroid therapy, and other factors.

Early in sepsis, hyperventilation leads to respiratory alkalosis as a compensatory response to lactic acidemia. As shock progresses, metabolic acidosis ensues, with blood pH decreasing and serum bicarbonate levels falling. Hypoxemia and a reduced PaO_2:FIO_2 ratio may signal acute respiratory distress syndrome (ARDS) and early respiratory failure, may be evident on chest imaging. Progressive renal insufficiency, marked by rising BUN and creatinine, and hepatic dysfunction with increased bilirubin and transaminases, may also develop. Invasive hemodynamic monitoring (e.g., using central venous or pulmonary artery catheters) will be necessary when large volumes of fluids are required and the type of shock is unclear.Bedside echocardiography serves as a useful noninvasive alternative for monitoring in the ICU.

Immature Granulocyte as an Early Diagnostic Marker

"Sepsis is a leading cause of mortality worldwide, with mortality rates in India reaching up to 65.2% in severe cases. Early detection is crucial for initiating appropriate treatment, yet the lack of a definitive diagnostic test for sepsis remains problematic. Traditional microbiological blood cultures are time-consuming and have low sensitivity, with 40% of sepsis cases yielding negative results. In addition, distinguishing sepsis from noninfectious inflammatory conditions is essential, as treatment approaches differ markedly".

"The recommendation by **Surviving Sepsis Campaign** is antibiotic administration within one hour of sepsis onset, such that mortality will increase by 7.6% by each hour of delay in treating septic shock. Consequently, rapid and accurate diagnostic methods are imperative. In light of the limitations of microbiological cultures, researchers have turned to biomarkers that offer high sensitivity, specificity, and rapid turnaround."

The immature granulocyte (IG) count has emerged as a promising early biomarker. Under normal conditions, the IG count ranges from 1.5 to 8.5 × 10^9/L, with IG% typically less than 1%. Inflammatory or infectious conditions trigger the premature release of granulocytes from the bone marrow into the peripheral blood. Although these immature forms are normally absent from peripheral circulation in adults, their presence—often referred to as a "left shift"—can indicate increased myeloid cell production in response to stress, infection, or other pathological processes.

In clinical practice, early differentiation of sepsis from SIRS is crucial. Conventional biomarkers such as procalcitonin and CRP have shown variable effectiveness. In contrast, an elevated IG% has demonstrated a strong correlation with infection, offering a rapid, accessible, and cost-effective diagnostic tool when measured by modern automated hematology analyzers.

Review of Related Studies

- **"Bhansaly et al. (2022):** A prospective observational study conducted at Sawai Man Singh Hospital in Jaipur found that immature granulocyte count and percentage were significant early biomarkers for sepsis, with area under the curve (AUC) values of 0.81 and 0.82, respectively, 24 hours before clinical sepsis diagnosis using Sepsis-3 criteria. The limitation for this study was absence of gold standard diagnosis of sepsis"
- **"Nierhaus et al. (2013):** This study demonstrated that the IG count distinguished between sepsis and SIRS with a sensitivity of 89.2% and specificity of 76.4%, particularly within 48 hours of SIRS onset. However, the IG count did not reliably predict sepsis prognosis."
- **Karon et al. (2017):** Conducted at the Mayo Clinic, this prospective study evaluated lactate, WBC, neutrophil counts, procalcitonin, and IG counts in emergency department patients. The study found that conventional biomarkers had limited utility in sepsis prediction, partially due to its retrospective design.
- **Ayres et al. (2019):** This study indicated that an IG percentage of less than 2.0% could rule out sepsis with 90.0% specificity, suggesting that early therapy initiation based on IG% may improve recovery. However, the delayed

reporting of blood culture results compared to IG% limited its role as an early marker.

- **Ünal et al. (2018):** In a retrospective analysis, IG% demonstrated high sensitivity (94.4%) and specificity (97.9%) in diagnosing complex appendicitis, underscoring its potential utility in differentiating between uncomplicated and complicated inflammatory conditions.
- **"Geest et al. (Study):** Among 46 patients, IG% and CRP levels increased in parallel with infection severity. While WBC and CRP were less predictive when used alone, the inclusion of IG% provided additional early diagnostic value".
- **"Georgakopoulou et al.:** Found that higher IG counts were associated with greater disease severity, longer hospital stays, and increased rates of intubation and mortality, particularly in COVID-19 patients".
- **Bernstein et al.:** Validated the Sysmex IG parameter (excluding band neutrophils) and proposed an optimal IG cut-off value of 3.2 for sepsis detection.
- **"Senthilnayagam et al.:** Demonstrated that an absolute IG count (IGC) of 0.03 × 10^2/cu mm and an IG% of 0.5% could predict bacteremia with sensitivities of 86.3% and 92.2%, respectively, while higher thresholds (>0.3 IGC and >3% IG) yielded specificities above 90%".
- **"Jeon et al.:** Reported a median IG% -2.6% (95% CI: 1.4–3.1) in sepsis patients, with a receiver operating characteristic AUC of 0.77 and an optimal cut-off value of 3%, noting that sepsis probability increased significantly at an IG% of 6% alongside elevated CRP levels."

MATERIALS AND METHODS

- **Study design:** A cross-sectional study.
- **Study area:** Medical Intensive Care Unit, Department of General Medicine, Kaher's Jawaharlal Nehru Medical College, Belagavi, Karnataka, India.
- **Study period:** Research study was conducted from June 2023 to May 2024. Below is the work plan.
- **Sample size**: Calculated as per previous 3 years admission in medicine ICU

Formula used for sample size calculation is,

$$n = \frac{\widehat{Se}\left(1 - \widehat{Se}\right)Z_{\frac{\propto}{2}}{}^2}{Prev * d^2}$$

Where,

- n is the sample size required
- $\widehat{Se}$ is the pre-determined values of sensitivity
- d is the maximum marginal error required
- $Z_{\frac{\propto}{2}}$ is the value corresponding to level of confidence required and
- Prev is the prevalence.

IG count significantly discriminated between infected and non-infected patients with a sensitivity of 89.2%. Considering similar result with 60% prevalence, at 95% confidence level and 10% maximum error, the sample size is given by,

$$n = \frac{0.892 \text{ x } (1 - 0.892) \text{ x } 1.96^2}{0.6 \text{ x } 0.1^2}$$

$$n = 61.68073 \approx 62$$

Hence, minimum sample size required is 62. As sample size increases, accuracy of result also increases.

Sample size as per calculation is 62 but for sake of convenience of study taken as 65 by using Convenient sampling method.

- **Sampling method**: Convenient sampling method

- **Inclusion criteria:**

1. Age > 18 years

2. All those patients come to medicine ICU selected by using any 2 variables of SIRS criteria i.e. (heart rate and total leucocyte count etc)

- **Exclusion criteria:**

1. Patients known case of Malignancy
2. Patients who are on Immunosuppressive or immunostimulatory therapy
3. Patient who are having H/O Recent organ transplantation
4. Pregnancy/Lactating women
5. Patients who are known case of chronic liver disease and chronic kidney disease

METHODOLOGY:

This hospital-based cross-sectional study was conducted at a tertiary care centre in Belagavi from January 2023 to December 2023. Prior institutional ethical committee approval was obtained. Written informed consent was obtained from all participants or their legally authorized representatives.

Study Population and Sample Selection:

The study included patients aged 18 years and above admitted to the Medicine Intensive Care Unit (MICU). Patients were screened within 24 hours of admission for SIRS criteria. Those fulfilling at least two SIRS variables (heart rate >90 beats/minute and total leukocyte count >12,000/µL or <4,000/µL) were enrolled. The Sequential Organ Failure Assessment (SOFA) score was calculated for all enrolled patients.

Sample Collection and Laboratory Analysis:

Blood samples were collected from enrolled patients following standard aseptic precautions. The following investigations were performed:

Arterial Blood Gas Analysis was conducted using a point-of-care analyzer within 15 minutes of sample collection. Complete blood count with automated immature granulocyte count and percentage was performed using a Sysmex XN-series analyzer. The analyzer was calibrated daily according to manufacturer specifications.

Renal function tests including blood urea nitrogen, serum creatinine, and electrolytes were analyzed using automated biochemistry analyzers. Liver function tests comprising total bilirubin, direct bilirubin, SGOT, SGPT, and serum albumin were performed.

Serum procalcitonin levels were measured using electrochemiluminescence immunoassay when clinically indicated, particularly in cases where infection was suspected but not clearly evident.

Patient Classification:

Based on clinical presentation, laboratory findings, and SOFA scores, patients were categorized into two groups:

1. SIRS group: Patients fulfilling SIRS criteria without evidence of infection
2. Sepsis group: Patients meeting SIRS with documented or suspected infection.

All laboratory investigations were performed in the hospital's central laboratory under standard operating procedures and quality control protocols. Results were recorded in a structured data collection form along with relevant clinical information.

STATISTICAL ANALYSIS

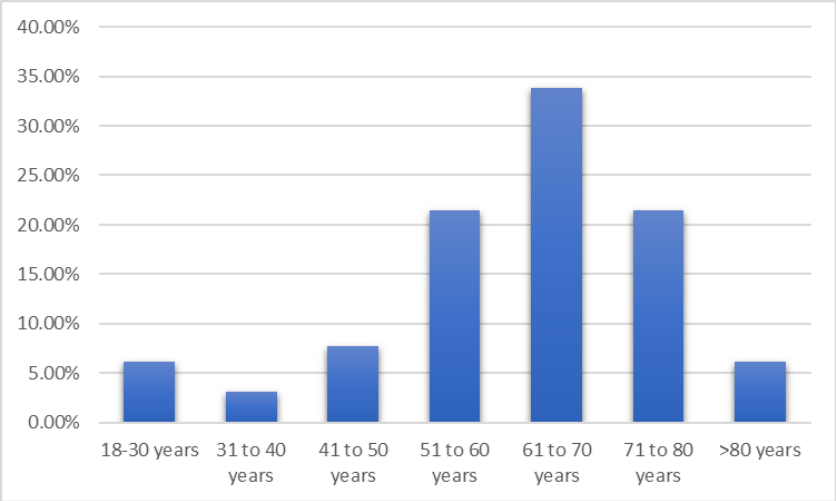
Data was entered in excel sheet and analyzed using SPSS version 21. Results were presented in tabular and graphical forms Mean, median, standard deviation and ranges were calculated for quantitative data. Qualitative data were expressed in terms of frequency and percentages. Student t test (Two Tailed) was used to test the significance of mean and P value <0.05 was considered significant.

RESULTS

Table 1: Distribution of patients according to age:

Age in years	Number of patients	Percentage
18-30 years	4	6.2%
31 to 40 years	2	3.1%
41 to 50 years	5	7.7%
51 to 60 years	14	21.5%
61 to 70 years	22	33.8%
71 to 80 years	14	21.5%
>80 years	4	6.2%
Total	**65**	**100%**

Graph 1: Distribution of age among study participants

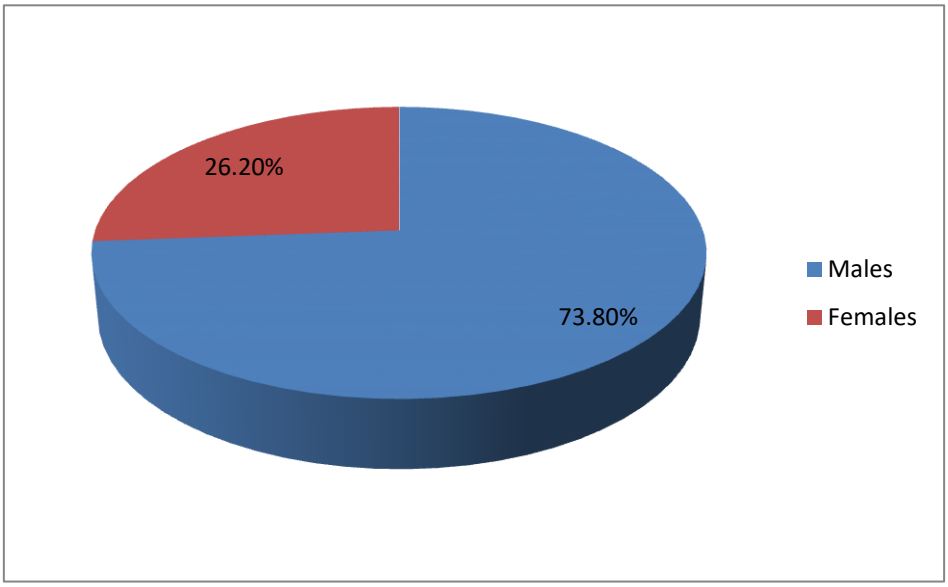


In our present study of 65 patients, maximum patients were in the age group of 61-70 years i.e. 22(33.8%),71-80 years and 51-60 years there were 14 (21.5%) in each group,5 (7.7%) patients were in 41-50 years ,4(6.2%) in 18-30 years as well in more than 80 years age group while only 2(3.1%) patients were in age group of 31-40 years. The mean age of patients was 62.12±14.3 years.

Table 2: Distribution of patients gender wise:

Gender	Number of patients	Percentage
Males	48	73.8%
Females	17	26.2%
Total	**65**	**100%**

Graph 2: Distribution of patients gender wise:

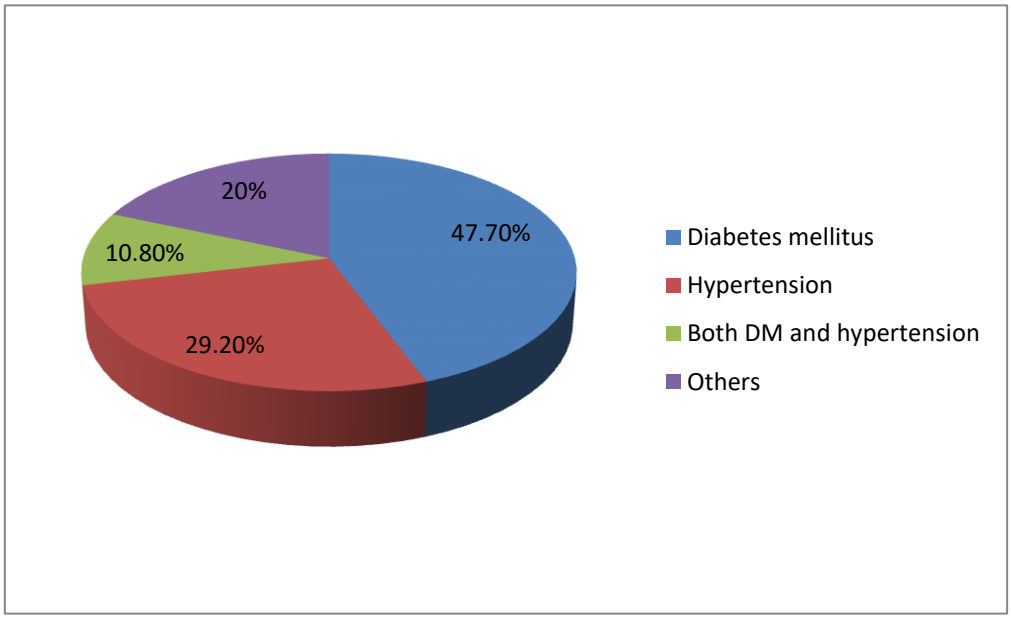


In our present study, maximum patients were male i.e. 48(73.8%) and remaining 17 (26.2%) were female. There was male preponderance observed ratio is 2.823 i.e. male to female ratio: 2.8:1.

Table 3: Distribution of patients according to co-morbidities:

Co-morbidities	Number of patients	Percentage
Diabetes mellitus	31	47.7%
Hypertension	19	29.2%
Both DM and hypertension	7	10.8%
Others (CVA, IHD, asthma)	13	20%
Total	**65**	**100%**

Graph 3: Distribution of co-morbidities among study participants

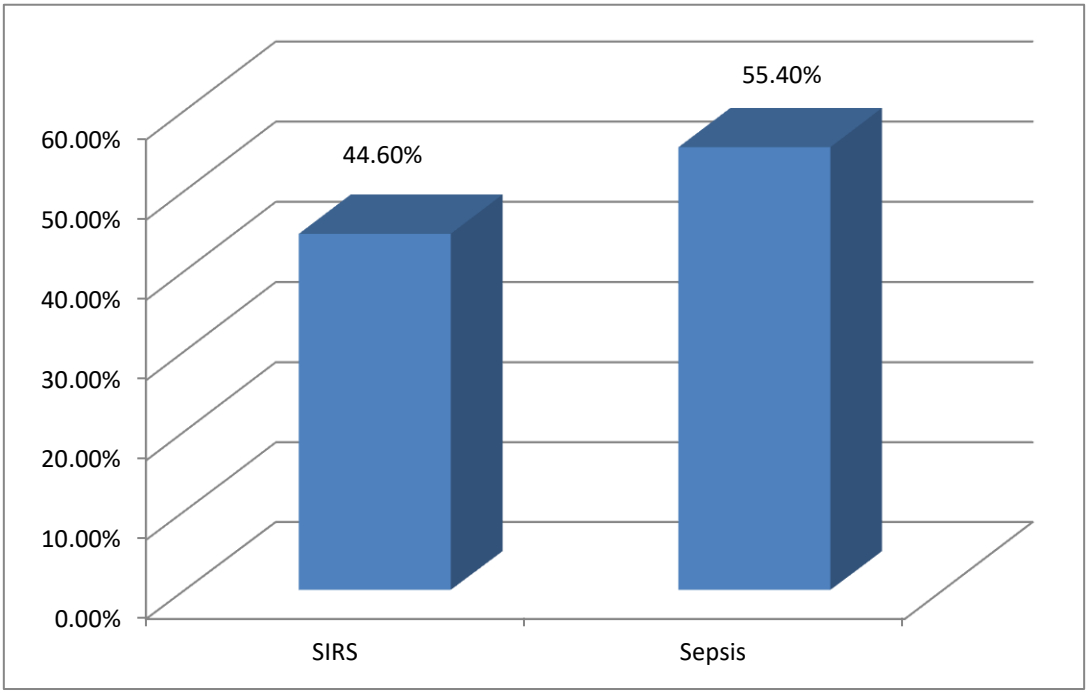


Majority of patients had type2 diabetes mellitus as comorbidity i.e. 31(47.7%) patients followed by hypertension 19(29.2%), both Type2 diabetes mellitus and Hypertension were 7(10.8%) and others like Cerebrovascular accidents, IHD and asthma as co-morbidities 13 (20%).

Table 4: Distribution of patients in SIRS and sepsis

Outcome parameters	Number of patients	Percentage
SIRS	29	44.6%
Sepsis	36	55.4%
Total	**65**	**100%**

Graph 4: Distribution of patients in SIRS and sepsis

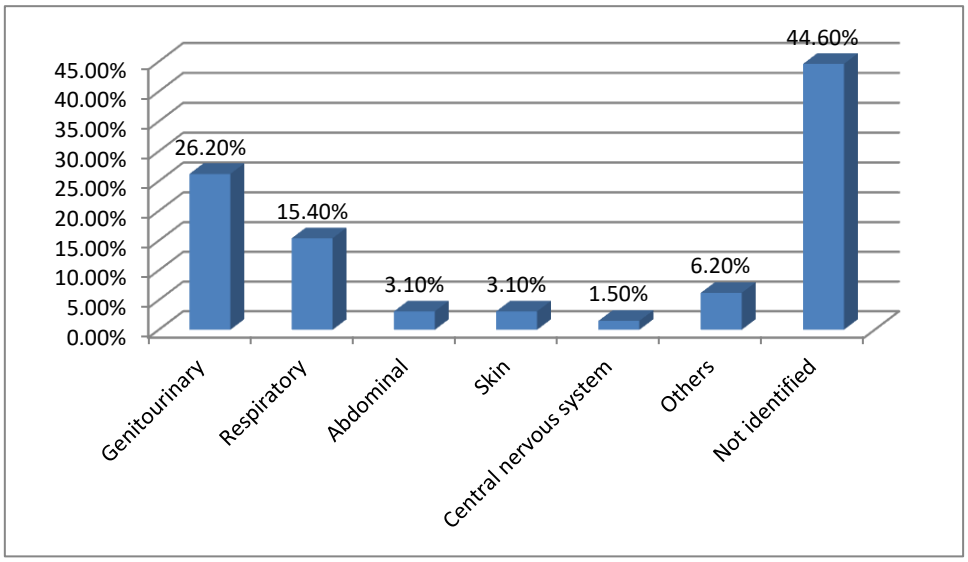


Among 65 patients,29(44.6%) patients were in SIRS group and remaining 36(55.4%) in sepsis group as depicted above (Table- 4)

Table 5: Distribution of patients according to source of infection

Source		Number of patients	Percentage
Known (N=36)	**Genitourinary**	17	26.2%
	Respiratory	10	15.4%
	Abdominal	2	3.1%
	Skin	2	3.1%
	Central nervous system	1	1.5%
	Others	4	6.2%
Unknown (N=29)	**Not identified**	29	44.6%
Total		**65**	**100%**

Graph 5: Distribution of patients according to source of infection



More than 36(55.4%) patients had known different source of infection for their problem of either SIRS or sepsis, however remaining 29(44.6%) patients, we could not find source of infection for SIRS and sepsis.

Table 6: Distribution of patients according to clinical parameters:(Heart rate, Respiratory rate, Temperature)

6A: Heart rate:

Heart rate (beats per min)	Number of patients	Percentage
90-100	3	4.6%
100-110	18	27.7%
110-120	35	53.8%
>121	9	13.8%
Total	**65**	**100%**

Graph 6A: Distribution of patients according to heart rate

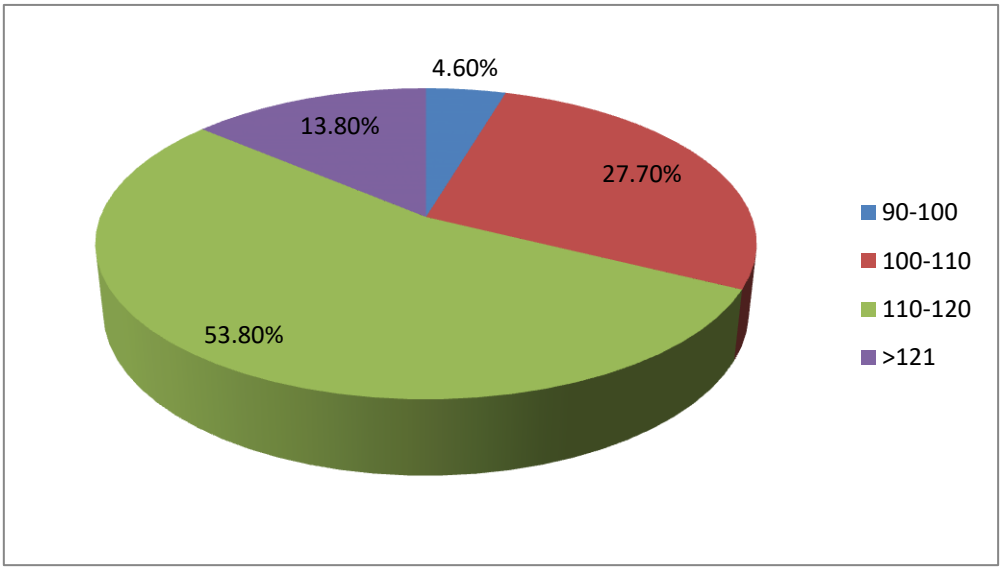
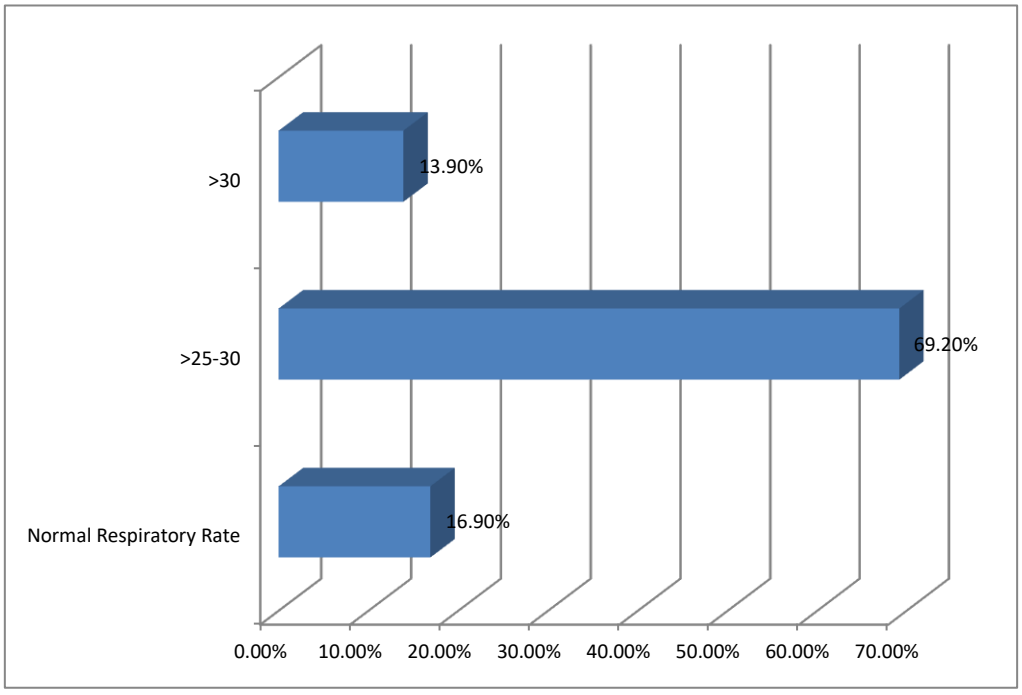


Table no 6A depicts varying heart rate in our patients, majority of our patients had heart rate between 111-120bpm i.e. 35(53.8%) patients followed by between 101-110 bpm were 18(27.7%),9 (13.8%) had more than 120 bpm and only 3(4.6%) patients had heart rate between 90-100 bpm

Table 6B: Respiratory rate

Respiratory rate(cycles per min)	Number of patients	Percentage
Normal Respiratory Rate	11	16.9%
>25-30	45	69.2%
>30	9	13.9%
Total	**65**	**100%**

Graph 6B: Distribution of patients according to respiratory rate

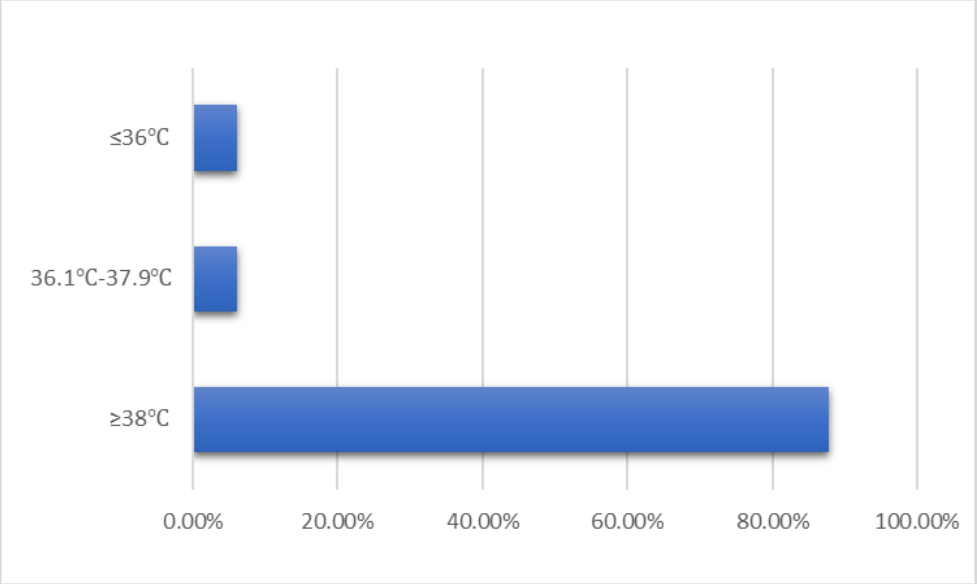


Majority of patients i.e. 45(69.2%) were having respiratory rate >25-30 cpm,11 (16.9%) patients had normal respiratory rate while 9(13.9%) patients had more than 30cpm

Table 6C: Temperature:

Temperature (℃)	Number of patients	Percentage
≥38℃	57	87.8%
36.1℃-37.9℃	4	6.1%
≤36℃	4	6.1%
Total	**65**	**100%**

Graph 6C: Distribution of patients according to temperature:

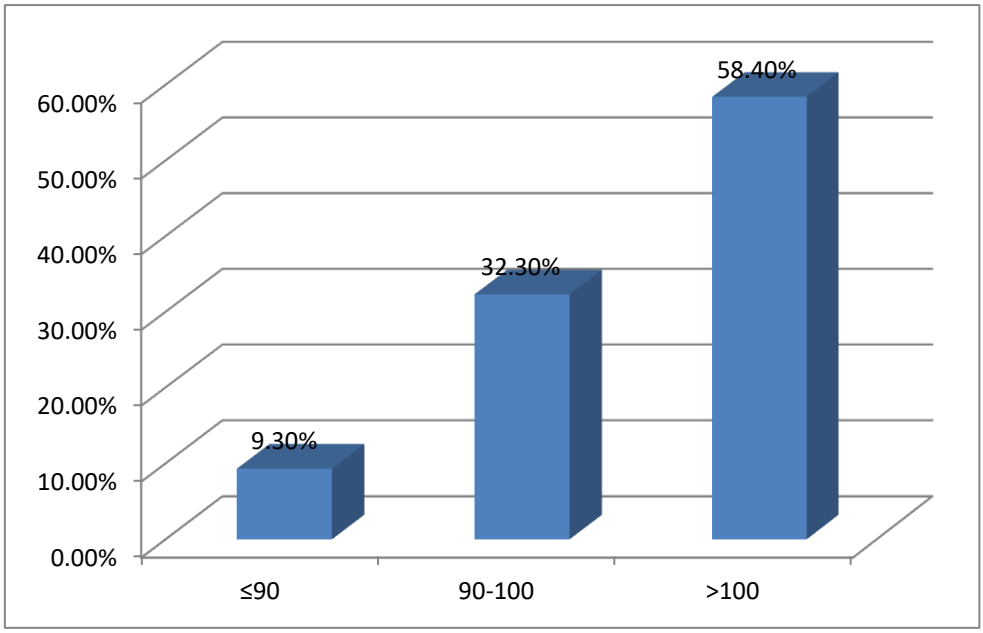


Majority of our patients had temperature more than or equal to 38℃ i.e 57(87.8%) and there were 4(6.1%) patients in each group whose temperature were 36.1-37.9℃ and ≤ 36℃

Table 7: Distribution of patients according to blood pressure (Systolic blood pressure)

Systolic blood pressure (mmHG)	Number of patients	Percentage
≤90	6	9.3%
90-100	21	32.3%
>100	38	58.4%
Total	**65**	**100%**

Graph 7: Distribution of patients according to blood pressure (Systolic blood pressure)



In present study of 65 patients systolic blood pressure varied between 90-100mmHG,38 (58.4%)patients had normal systolic blood pressure i.e. more than 100mmHG,21(32.3%) had SBP of 90-100 mmHG while only 6(9.3%) had less than or equal to 90mmHG

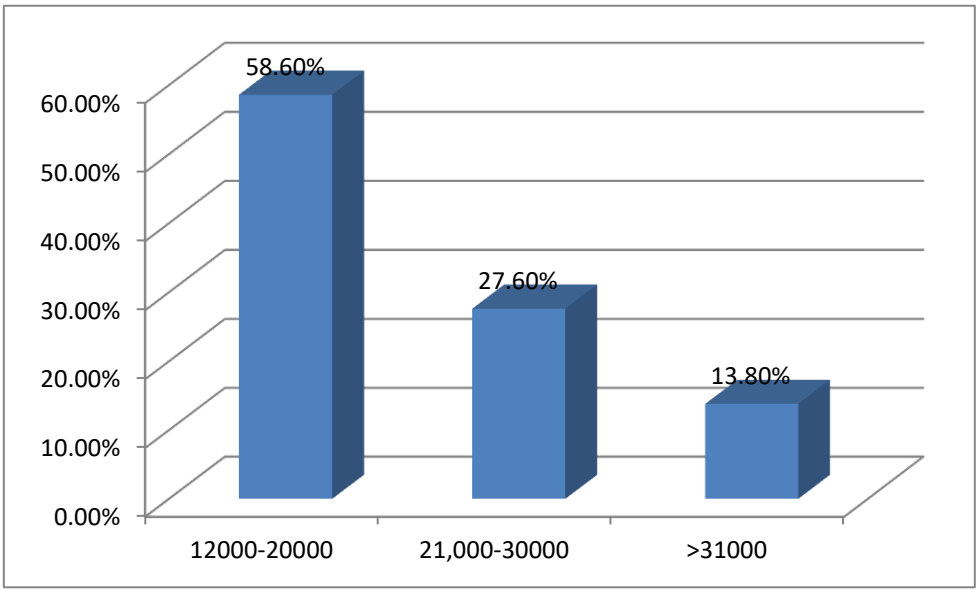
LAB PARAMETERS

Table 8: Distribution of patients according to total leucocyte count (TLC):

Table 8A: Leucocytosis:

TLC (cells/mm^3)	Number of patients	Percentage
12000-20000	34	58.6%
21,000-30000	16	27.6%
>31000	8	13.8%
Total Leukocytosis	**58**	**100%**

Graph 8: Distribution of patients according leucocytosis:

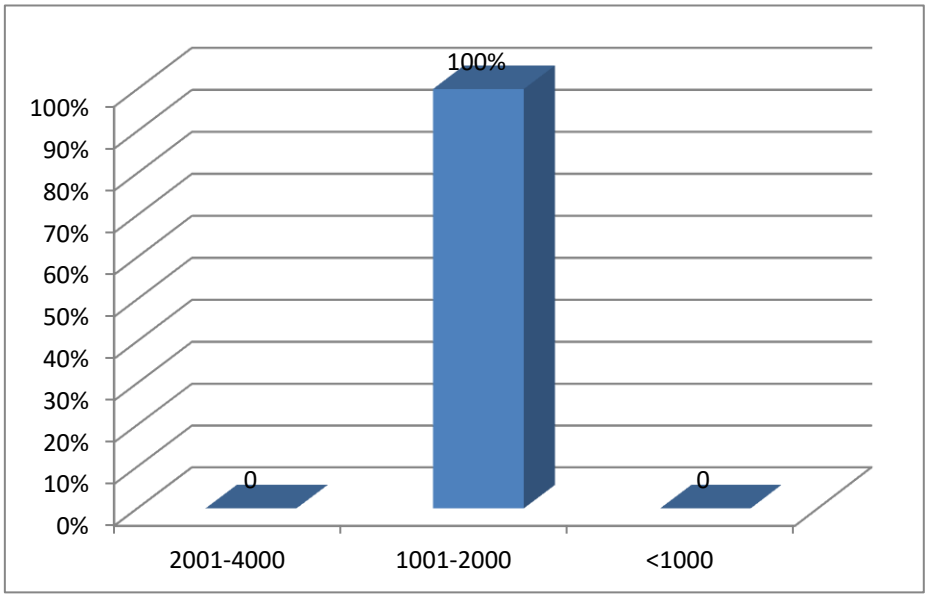


34(58.6%) patients were having leukocytosis ranging between 12000-20000 cell/mm^3,16(27.6%) had 21000-30000 cell/mm^3, while only 8 (13.8%) patients had leucocyte count more than 31000cells/mm^3

Table 8B- Leucopenia:

TLC(cell/mm^3)	Number of patients	Percentage
2001-4000	0	0
1001-2000	2	100%
<1000	0	0
Total Leukopenia	**2**	**100%**

Graph 8B: Distribution of patients according leukopenia:



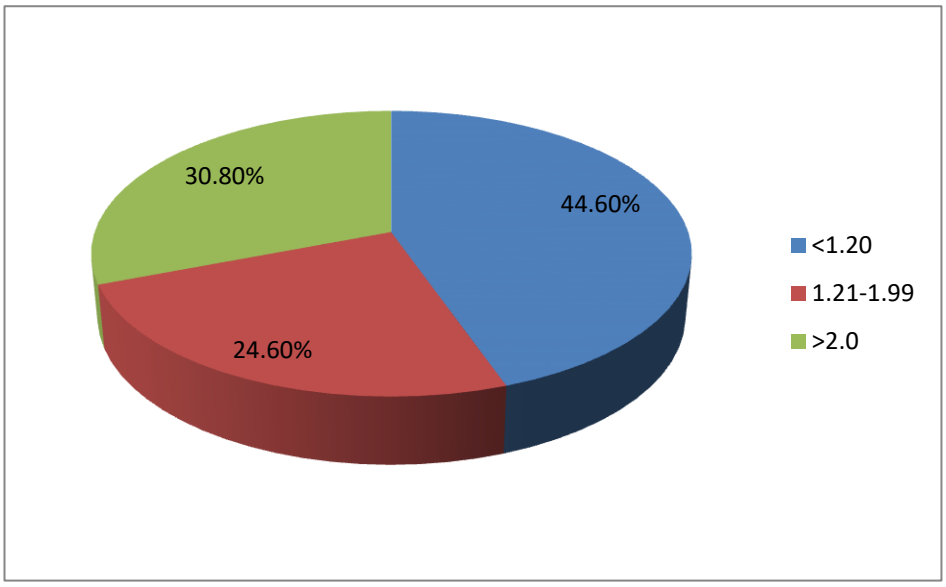
In our present study only 2(100%) patients had leucopenia whose leucocyte count was ranging between 1001-2000 cells/mm^3. Remaining 58 patients had varying degree of leukocytosis. 5 patients had normal total leucocyte count.

Table 9: Distribution of patients according serum creatinine:

(cut off value:≤1.20mg/dl)

S. Creatinine (mg/dl)	Number of patients	Percentage
<1.20	29	44.6%
1.21-1.99	16	24.6%
>2.0	20	30.8%
Total	**65**	**100%**

Graph 9: Distribution of patients according serum creatinine



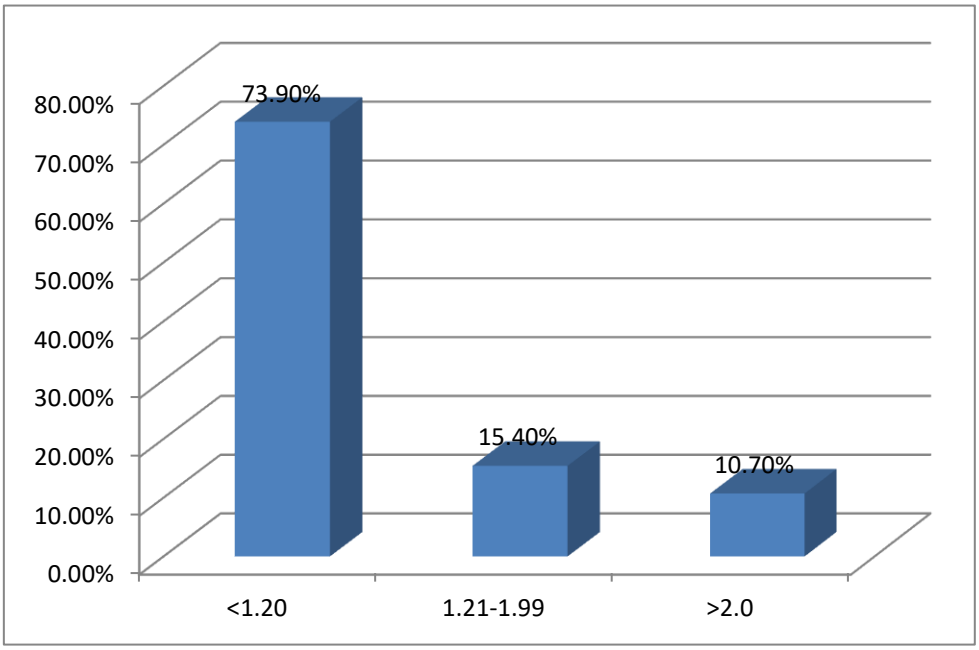
In our present study,29(44.6%) patients had serum creatinine of less than or equal to 1.20mg/dl, 16(24.6%) patients had serum creatinine ranging between 1.21-1.99mg/dl and remaining 20(30.8%) patients had serum creatinine more than 2.0mg/dl.

Table 10: Distribution of patients according to total bilirubin:

(cut off value:≤1.20 mg/dl)

Total Bilirubin (mg/dl)	Number of patients	Percentage
<1.20	48	73.9%
1.21-1.99	10	15.4%
>2.0	7	10.7%
Total	**65**	**100%**

Graph 10: Distribution of patients according to total bilirubin

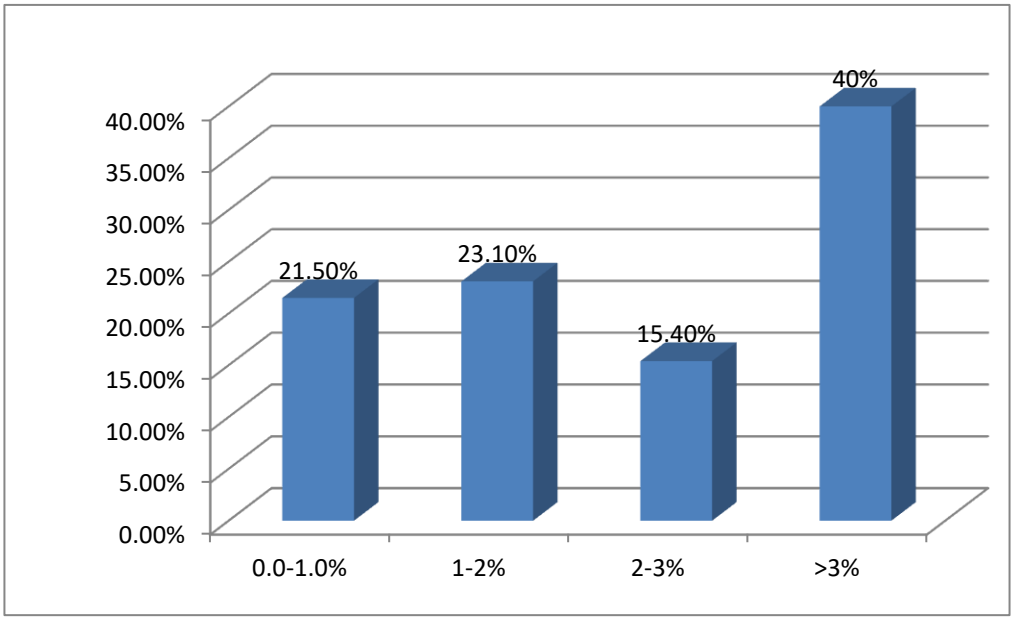


In our present study,48(73.9%) patients had serum bilirubin level less than or equal to 1.20mg/dl,10(15.4%) patients had total bilirubin ranging between 1.20-1.99mg/dl,7(10.7%) patients were having total bilirubin level more than 2.0mg/dl.

Table 11: Distribution of patients according to Immature Granulocytes (IG) count :(cut off value: 0-1%)

IG count (%of total WBC count)	Number of patients	Percentage
0.0-1.0%	14	21.5%
1-2%	15	23.1%
2-3%	10	15.4%
>3%	26	40%
Total	**65**	**100%**

Graph 11: Distribution of patients according to Immature Granulocytes (IG) count:



All our 65 patients were subjected for Immature granulocyte count which was calculated based on percentage of total WBC count and results observed are shown in above table no-11.

Table 12: Comparison of age in SIRS and sepsis patients:

Age in years	SIRS	Sepsis	P value
18-30	1 (3.4%)	3 (8.3%)	0.412
31 to 40	2(6.9%)	0	
41 to 50	3 (10.3%)	2 (5.5%)	
51 to 60	8(27.9%)	6 (16.7%)	
61 to 70	9 (31%)	13 (36.1%)	
71 to 80	4(13.8%)	10 (27.8%)	
>80	2 (0.7%)	2 (5.6%)	
Total	29 (100%)	36(100%)	-

We categorized our patients age wise as SIRS or sepsis patients, and our observation was both SIRS and sepsis was more observed in age group of >50years of age, there were 23(79.3%) patients in SIRS and 31(86.1%) patients in sepsis. The other split up of patients is shown in table no-12.

P-value:0.412 was not statistically significant

Table 13: Comparison SIRS and sepsis with gender:

Gender	SIRS	Sepsis	P value
Males	21(72.4%)	27 (75%)	0.813
Females	8 (37.6%)	9 (25%)	
Total	29(100%)	36(100%)	-

Gender wise comparison of SIRS and sepsis, we observed both SIRS and sepsis were more in males as compared to females as shown in table no-13.

P-value:0.813 was not statistically significant

Table14: Comparison of co-morbidities in SIRS and sepsis

Co-morbidities	SIRS	Sepsis	P value
Diabetes mellitus	14 (48%)	17 (47.2%)	0.933
Hypertension	8(27%)	11 (30.5%)	0.794
Both DM and hypertension	5 (17%)	2 (5.5%)	0.131
Others	3 (8%)	10 (16.8%)	0.071

Both SIRS and Sepsis was more observed in patients with Type2 Diabetes mellitus followed by hypertension. Both Type2 Diabetes Mellitus and Hypertension together 5(17%) patients in SIRS and 2(5.5%) patients in sepsis. Patients with other comorbidities like Cerebrovascular accidents, IHD and asthma 3(8%) in SIRS and 10(16.8%) in sepsis

P-value for all comorbidities was not statistically significant.

Table 15: Comparison of patients with different source of infection in SIRS and sepsis:

Source	SIRS	Sepsis	P value
Genitourinary	0	17 (47.2%)	**<0.001**
Respiratory	0	10 (27.7%)	
Abdominal	0	2 (5.5%)	
Skin	0	2 (5.5%)	
Central nervous system	0	1 (2.7%)	
Others	0	4 (11.4%)	
Not identified	29 (100%)	0	
Total	29(100%)	36(100%)	-

When we attempted to categorize the patients based on source of infection as SIRS or Sepsis, to our observation patients with different source of infection all were in sepsis group, however 29 patients of SIRS were found in unknown source of infection group. No patient of sepsis in group of unknown sources of infection was present.

P-value:<0.001 statistically significant for all sources of infection and in all unknown sources of infection.

Table no 16: Comparison of patients with clinical parameters in SIRS and sepsis:

Variable		SIRS	Sepsis	P-value
Heart rate (beats per min)	90-100	3(10.3%)	0	0.07
	101-110	6(20.6%)	12(33.3%)	
	111-120	18(62%)	17(47.2%)	
	>121	2(7.1%)	7(19.5%)	
Total		29(100%)	36(100%)	
Respiratory rate (cycles per min)	Normal	5(17.4%)	6(16.6%)	0.998
	>25-30	20(69%)	25(69.4%)	
	>30	4(13.6%)	5(14%)	
Total		29	36(100%)	
Temperature (℃)	≥ 38℃	27(93.2%)	30(83.4%)	0.491
	36.1℃-37.9℃	1(3.4%)	3(8.3%)	
	≤ 36℃	1(3.4%)	3(8.3%)	
Total		29(100%)	36(100%)	

Table no 16 depicts comparison of various clinical parameters like heart rate, respiratory rate and temperature.

P-value was not statistically significant for all clinical parameters

Table no 17: Comparison of patients with systolic blood pressure in SIRS and Sepsis:

Systolic blood pressure(mmHG)	SIRS	Sepsis	P-value
≤ 90	1(3.4%)	5(13.9%)	0.002
90-100	4(13.8%)	17(47.2%)	
>100	24(82.8%)	14(38.9%)	
Total	29(100%)	36(100%)	

Table no 17 shows comparison of 65 patients with systolic blood pressure.

P-value:0.002 statistically significant

Table no 18: Comparison of total leucocyte count in SIRS and Sepsis:

Total leucocyte count cell/mm^3	SIRS	Sepsis	P-value
Leucocytosis (>12,000)	25(88%)	33(90%)	0.122
Normal (4000-12,000)	4(12%)	1(5%)	
Leukopenia (<4000)	0	2(5%)	
Total	29(100%)	36(100%)	

In our present study of 65 patients, majority of our patients had leucocytosis in both i.e. SIRS 25(88%), Sepsis 33(90%), only 2 patients of sepsis were in leukopenia group.

5 patients were having normal Total leucocyte count 4(12%) in SIRS and 1(5%) in Sepsis

P-value:0.122 not statistically significant

Table no:19 Comparison of patients with serum creatinine in SIRS and Sepsis: (cut-off value:1.20mg/dl)

Serum creatinine(mg/dl)	SIRS	Sepsis	P-value
1.20	25(86.2%)	4(11.1%)	<0.001
1.21-1.99	3(10.3%)	13(36.1%)	
>2.0	1(3.5%)	19(52.8%)	
Total	29(100%)	36(100%)	

Majority of patients in SIRS group i.e. 25(86.2%) were having serum creatinine of 1.20mg/dl, in sepsis group only4(11.1%) patients were having serum creatinine of 1.20mg/dl, in between 1.21-1.99mg/dl there were 3(10.3%) patients in SIRS group and 13(36.1%) in sepsis group. More than 2.0mg/dl of serum creatinine 1(3.5%) in SIRS and 19(52.8%) in sepsis group was observed.

P-value:<0.001 which was statistically significant

Table no 20: Comparison of patients with Total Bilirubin in SIRS and Sepsis: (cut off value:≤1.20mg/dl)

Total Bilirubin(mg/dl)	SIRS	Sepsis	P-value
1.20	27(93.2%)	21(58.3%)	0.006
1.21-1.99	1(3.4%)	9(25%)	
>2.0	1(3.4%)	6(16.7%)	
Total	29(100%)	36(100%)	

Table no 20 depicts ,27(93.2%) patients had normal level of total bilirubin in SIRS and 21(58.3%) patients in sepsis. Total bilirubin of 1.21-1.99 mg/dl 1(3.4%) patient in SIRS and 9(25%) in sepsis while 1(3.4%) in SIRS and 6(16.7%) in sepsis patient had more than 2.0mg/dl of total bilirubin

P-value:0.006 was statistically significant.

Table no 21-Comparison of patients with Immature granulocyte count in SIRS and Sepsis: (Cut-off value:0-1%)

Immature granulocyte count (%of total WBC count)	SIRS	Sepsis	P-value
0-1%	10(34.4%)	4(11.1%)	<0.001
>1-2%	11(38%)	4(11.1%)	
>2-3%	3(10.3%)	7(19.4%)	
>3%	5(17.3%)	21(58.4%)	
Total	29(100%)	36(100%)	

Comparison of patients with Immature granulocyte count in SIRS and sepsis we found varying percentage of Immature granulocyte count in SIRS and Sepsis group as shown in table no 21

P-value:<0.001 was statistically significant

Table no 22: Comparison of Immature granulocyte count with inotrope support and ventilatory support:

Immature granulocyte count (%of total WBC count)	Inotropic support		Ventilatory support		
	With support	Without support	Invasive	Non-invasive	Without support
0-1%	3(10.7%)	11(29.7%)	1 (11.1%)	11 (28.9%)	2 (11.1%)
>1-2%	4(14.3%)	11(29.7%)	1 (11.1%)	12 (31.6%)	2 (11.1%)
>2-3%	4(14.3%)	6(16.2%)	0	6 (15.8%)	4 (22.2%)
>3%	17(60.7%)	9(24.3%)	7 (77.8%)	9 (23.7%)	10 (55.6%)
Total	**28(100%)**	**37(100%)**	**9 (100%)**	**38 (100%)**	**18 (100%)**
P-Value	**0.020**		**0.028**		

Similarly, we compared Immature granulocyte counts to see the correlation between Inotrope and ventilatory support required we observed both inotrope and ventilatory support needed in increasing Immature granulocyte counts. There was statistical significance observed.

Table No.23: Comparison of patients requiring ventilatory and inotrope support in SIRS and Sepsis:

		SIRS	Sepsis	P-Value
Ventilatory support	Invasive	0	9(25%)	<0.001
	Non-invasive	1(3.4%)	17(47.2%)	
	Without support	28(96.6%)	10(27.8%)	
Total		29(100%)	36(100%)	
Inotrope support	With support	0	28(77.8%)	<0.001
	Without support	29(100%)	8(22.2%)	
Total		29(100%)	36(100%)	

Comparison of patients requiring ventilatory and inotrope support in SIRS and Sepsis we found in patients of sepsis both ventilatory as well as inotrope support was more required compared to SIRS patients.

P-value:<0.001 was statistically significant.

Table 24: Diagnostic performance of IG count

IG Count Result	Sepsis present	Sepsis absent	Total
>1.2% (Positive)	30 (TP)	18 (FP)	48
≤1.2% (Negative)	6 (FN)	11 (TN)	17
Total	36	29	65

Where:

- TP = True Positive
- TN = True Negative
- FP = False Positive
- FN = False Negative

Table 25: Diagnostic Performance of IG Count

Performance Metric	Value	95% CI
Sensitivity	83%	67.19% to 93.63%
Specificity	37.9%	20.69% to 57.74%
Positive Predictive Value	57.3%	49.37% to 64.90%
Negative Predictive Value	69.5%	48.90% to 84.40%
Accuracy	60.6%	47.73% to 72.53%
Optimal Cut-off Value	>1.2%	

Table no 24 and Table no 25 depicts diagnostic performance of Immature granulocyte count. IG count has sensitivity of 83% and specificity of 37.9% with optimal cut-off value of >1.2%.

DISCUSSION

In present study of 65 patients, to study the Immature granulocyte count as early diagnostic marker to differentiate between SIRS and sepsis patient was carried out in KLE's Dr. Prabhakar Kore hospital and medical research centre and same was compared with various factors. Study period was between June 2023 to May 2024(1 year).

All our 65 patients fulfilling two out of four SIRS criteria or SIRS plus identified source of infection were included.

All our 65 patients presented with different source of infections as a cause of either SIRS and sepsis their age ranged between 18-90 years with mean age of 62.12±14.3 years. Maximum patients were in the age group of 61-70 years i.e. 22(33.8%),71-80 years and 51-60 years there were 14 (21.5%) in each group,5 (7.7%) patients were in 41-50 years ,4(6.2%) in 18-30 years as well in more than 80 years age group while only 2(3.1%) patients were in age group of 31-40 years in present study.

Youngest was 28years old and oldest was 86years old.

Study by Axel Nierhaus et al.[52] in their study population of 70 patients is almost comparable to our study as far as distribution as well criteria deployed for SIRS/sepsis.

In sharp contrast to a study by Prabhav Bhansaly et al.[43] who have studied 150 patients youngest was 15 years and oldest was 85 years the median age group in their study was 45 years

This sharp contrast could be because of their sample size of 150 as compared to our study of 65 patients.

Study by Cihan Bedel et al.[68] they did not find any statistically significant difference in gender in their study population (p value is 0.779). In our present study we observed male preponderance.

Study by Akshay Kriplani et al.[65] though their sample size 517 as compared to our sample size of 65 patients yet they found male preponderance like our study.

Study by Cihan Bedel et al.[68] is almost comparable as far as comorbidities are considered except 27 patients of malignancy as associated comorbidity in their study population was observed which was statistically significant (p value-0.012). The probable explanation for the increased mortality in these patients of malignancy explained on the basis of increased risk of sepsis secondary to infection. This could be because of reduced immunity in malignancy and prone for various infection as a cause of sepsis. As well the release of pro-inflammatory markers like interleukins and other cytokines could be the reason for release of immature granulocytes in the circulation as a result of sepsis.

In study by Nirmal Joshi et al.[55] they found in their study population diabetes as major comorbidity with respiratory infection (pneumococcal pneumoniae) as major risk factor for sepsis.

We also attempted to segregate our 65 patients as SIRS or sepsis to best of our knowledge most of the author have not done this segregation as patients of SIRS or sepsis.

Similarly, we tried to find the source of infection as a cause of SIRS or sepsis in our patients, in 36 patients we had different source of infection remaining 29 patients we could not ascertain the source of infection (Table no.5)

Study by Jason Phua et al.[57] in their series of 1285 patients majority of their patients had different source of infection as a cause of sepsis. Only a small percentage of their patients (5.1%) did not have known source of infection.

We similarly attempted to look for clinical parameter like Heart rate (Table no.6A), Respiratory rate (Table no.6B), Temperature (Table no.6C). We observed 62 patients had increased HR >100bpm,54 patients had RR more than 25 cpm, in 57 patients the temperature recorded was more than 38℃ and 8 patients had temperature ranging between ≤36℃-37.9℃. Various authors coated in our study have not taken into consideration these clinical parameters (HR, RR and Temperature) in their study.

Systolic blood pressure was considered as a next clinical parameter, only 6 patients had systolic blood pressure of ≤90 mmHg, remaining 59 patients had systolic blood pressure ranging between 90 to >100 mmHg.

Study by Mervyn Singer et al.[58] and Shankar Hari et al.[58] have taken various factors into consideration to define septic shock as a result of sepsis, these patients requiring fluid challenge, inotrope support and other measures deployed to maintain blood pressure.

All our patients were subjected to total leucocyte count estimation;58 patients had leucocytosis in varying degrees (Table no.8A). Table 8B depicts leukopenia which was observed in only 2 patients. In 5 patients total leucocyte count was within normal limits.

A study by Tracey Anne Mare et al. [63] in their study population of 136 have observed leucocytosis and based on leucocyte count they further defined their patients as sepsis, possible sepsis, or SIRS. They also looked for no SIRS or sepsis based on

TLC and 20 patients they have taken as control group. The cause of SIRS or sepsis is due to inflammatory response of body to various infections and their severity leading on to organ failure. The exaggerated inflammatory response of body due to infectious and non-infectious causes suppresses the immune response by decreasing the cytolytic activity of lymphocytes, T-lymphocytes and Natural killer cells (NK-cells). Platelets are rich in pro-inflammatory agents and are capable of releasing active inflammatory metabolites. The other causes of non-infectious inflammatory response are trauma, stress, cardio-pulmonary by pass and pancreatitis.

Study by Kibum Jeon et al.[51] in their study population of 177, observed increased WBC count in both infectious and non-infectious patients though there was no statistical significance observed in these groups.

All our patients subjected for estimation of serum creatinine (Table no-9) only 20 patients had >2mg/dl of serum creatinine however remaining 45 patients had serum creatinine below 2 mg/dl.

A study by Akshay Kriplani et al.[65] study population of 517 patients, they also found increasing serum creatinine in patients of SIRS and sepsis The rising serum creatinine in these patients could be because of inflammation leading to acute kidney injury, could be because of hypotension or septic shock leading to hypoperfusion of kidneys leading to increase in serum creatinine.

Study by Marteen Cobussen et al.[64] had found in their study population raised serum creatinine as a result of acute kidney injury due to inflammatory process.

All our patients subjected to total bilirubin (Table no- 10), only 7 patients had total bilirubin of >2mg/dl and remaining 58 patients had total bilirubin (≤1.20- 1.99 mg/dl).

Study by Richard S. Hotchkiss et al.[60] have also found rise in total bilirubin as a result of sepsis, none of their patients had liver failure as a result of sepsis. The inflammatory injury of the liver is indicated by increased concentration of total bilirubin and serum alanine transferase. In our study we found hepatic dysfunction is more common in sepsis patients.

We observed in our 65 patients varying degree of immature granulocyte count in the circulation, 14 patients had normal immature granulocyte count, remaining 51 had varying degree of immature granulocyte count. Out of 51, 26 patients had count of >3% (Table no-11).

Study by Prabhav Bhansaly et al.[43] have found in their study population varying degree of increased immature granulocyte count in patients of sepsis. They did not observe increased IG count in non-sepsis patients. The explanation of increased IG count is due to inflammatory response because of infection.

When we compared the age of our patients who are more prone for SIRS and sepsis and to see whether age has any influence on these two components of infections, we did not find any relation of age with SIRS or sepsis.

A study by Hsien-Ling Chou et al.[67] have shown with advancing age in elderly patients i.e. over the age of 65 years, patients are more prone for non-specific insult of either infectious or non-infectious cause resulting in either SIRS or sepsis with tachycardia, tachypnoea, sub-normal temperature could be because of the blunted

response of the body with aging. Reason for sub-normal temperature could be because of blunted response of endogenous pyrogens with aging.

In our study, there were more males in SIRS as well as in sepsis group as compared to females.

A study by Ines Lakbar et al.[66] there is increasing evidence to suggest that gender has an effect on host response to sepsis, sex hormones have got an effect on immune system cells, Textoris et al. have shown 86% of genes involved in Coxiella burnetiid infection they are associated with sex(gender). This is because of sex polarization in host response to infection. Another explanation why males are more affected than females could be because of reduced inflammatory response in female as compared to males. oestrogen is known to induce a protective cell mediated and humoral response whereas androgen is known to suppress this cell mediated and humoral response.

In our small sample size of 65 patients, patients of diabetes having SIRS or sepsis were more as compared to hypertension alone or both Type2 DM and hypertension and other comorbidities like CVA, IHD and asthma (Table no-14)

A study by Nirmal Joshi et al.[55] have proposed the altered immunity in patients of Type 2 DM is well known factor. The polymorphonuclear cell function is reduced more so associated with acidosis in diabetes. The leukocyte adherence, chemotaxis and phagocytosis are also affected. The anti-oxidant system responsible for bactericidal action is also affected. The humoral immunity in these patients there is limited data available. Diabetes there is increased risk of bacteraemia as compared to non-diabetes.

We looked for different source of infections for SIRS and sepsis (Table no-15). Unknown source of infection was responsible for SIRS(N-29,100%) whereas other sources of infections were having sepsis not a single patient of unknown source infection was found in sepsis. P-value was statistically significant

(P-value:<0.001).

In our present study the studies by different authors coated have not compared the source of infection whether more prone for SIRS or sepsis.

When we attempted to compare clinical parameters like HR, RR and temperature all three clinical variables were affected in patients of sepsis than SIRS though p-value was not statistically significant.

Many authors coated in our study have not done comparison of clinical parameters with SIRS and sepsis in their study groups.

It is well known fact that variation in HR, RR and temperature varies with presence of infection.

In our present study, 1 patient in SIRS and 5 patients in sepsis had SBP ≤90 mmHg, remaining patients their SBP varied between 90 to >100 mmHg. P value was statistically significant.

A study by Delphi et al. have used SBP as a qSOFA score criteria and proposed the reason for alteration in SBP could be because of various factors like cellular dysfunction others such as reduced tissue oxygenation, alteration in aerobic respiration, increased aerobic glycolysis and reduced hepatic clearance may all contribute to systolic blood pressure.

A study by Richard S. Hotchkiss et al.[60] feels the alteration in SBP could be because of loss of intravascular volume, leaky capillaries and vasodilatation in these patients of sepsis.

In present study of 65 patients all our patients except 4 in SIRS and 1 in sepsis had normal total leucocyte count (TLC). 2 patients there was leukopenia noted in sepsis patients, though p-value was not statistically significant.

A study by Tracey Anne Mare et al.[63] proposed identifying elevated levels of immature neutrophils is more helpful than total white blood cell count in these patients of sepsis. They proposed that immature neutrophils are not fully efficient functionally in clearing the bacterias during infection i.e. sepsis.

A study by Kibum Jeon et al.[51] they have proposed mechanism in their burn patients that skin is the first barrier to infection as skin forms first barrier to infection and thereafter to inflammatory response. There is also possibility of dysregulation of host response to infection.

All our patients were subjected to serum creatinine estimation and found that 19 patients in sepsis group and 1 in SIRS group had serum creatinine ≥2mg/dl. 25 patients in SIRS and 4 in sepsis had serum creatinine of 1.2 mg/dl (cut off value-1.20mg/dl). Between 1.21-1.99 mg/dl there were 3 in SIRS and 13 in sepsis group. P value was statistically significant.

A study by Richard S. Hotchkiss et al. acute kidney injury and renal dysfunction in these patients of sepsis could be reason for raised serum creatinine level but the exact mechanism of sepsis induced renal function derangement is not clear. They proposed this can be overcome by measures like meticulous volume resuscitation.

All our patients subjected for total bilirubin estimation (Table no- 20, p-value was statistically significant).

A study by Richard S. Hotchkiss et al. found derangement of liver function is well known factor in these patients however they did not find acute liver failure in their sepsis patients. The liver injury due to inflammation incited by process of infection is reason for this.

In all our patients Immature granulocyte count (IG) was compared with SIRS and sepsis patients and found to have significant p value of 0.001

(Table no- 21). 10 patients in SIRS and 4 patients in sepsis had normal IG count. Rest of the patient had increased IG count that is 19 in SIRS and 32 in sepsis.

A study by Kibum Jeon et al.[51] proposed IG count estimation in patients of infection leading to SIRD or spies is an easy, readily available and reliable investigation as compared to total white blood cell count which could be either normal, low or elevated.

A study by Tracey Anne Mare et al.[63] suggested the estimation of IG count in these patients helps in prediction of whether patients are having SIRS or sepsis as a result of infection. Some authors feel that it has limited diagnostic value.

A study by Axel Nierhaus et al.[52] proposed that healthy individual do not have immature granulocytes in peripheral blood. The polymorphonuclear leucocytes (PMNL) forms first line of defence in bacterial infections. This increase in PMNL count is induced by granulocyte colony stimulating factor(G-CSF), PMNL develops from pro-genitor cells and matures in bone marrow over period of 7-10 days and migrate to

peripheral blood. Because of need for situation i.e. infection they get into circulation prematurely, thus immature granulocytes increase during infection.

We also compared IG count in patients requiring inotrope and ventilatory support found to have significant p value

Best of our knowledge in the studies we have coated have not compared IG value with inotrope and ventilatory support

In our study we found that increased IG count requires both inotrope support and ventilatory support more suggesting severe degree of infection(sepsis).

We compared all our patients requiring inotrope or ventilatory support in SIRS and sepsis group (Table no- 23)

We noted both inotrope and ventilatory support required in sepsis patients than in SIRS patients.

No authors gave coated this particular comparison to best of our knowledge. As it is self-explanatory that patients in sepsis are more serious and requires either inotrope or ventilatory support or both.

We feel it is worthwhile taking more number of patients and subjecting them for simple tool (IG count) which is done in all laboratories and when extrapolated to find the outcome of these patients. There are not enough studies done in India if this simple tool i.e. estimation of IG count is applied to large population it will become easy to predict outcome and mortality in these patients

CONCLUSION

In our present study, evaluation of 65 patients for immature granulocyte count in patients of SIRS/sepsis admitted in medical intensive care unit of KLE's Dr Prabhakar Kore Hospital and research Centre, Belagavi. We conclude the study with following observations-

- In our present study of 65 patients either with SIRS or sepsis most of our patients were in age group of 61-70 years followed by 71-80 and 51-60years.
- There was male preponderance observed in our study with male to female ratio of 2.8:1.
- Type 2 diabetes mellitus followed by hypertension were the most observed comorbidities.
- The genitourinary tract infection was the commonest known source of infection followed by respiratory infection. In 29 patients the source of infection was not known.
- Most of our patients required either inotrope support or ventilatory support or both in patients of sepsis. In patients if SIRS there was no requirement of inotrope support though they required ventilatory support.
- Patient with increased immature granulocyte count were more in sepsis group.
- All clinical parameters like HR, RR and temperature were altered in either SIRS or sepsis group. Though p-value was not statistically significant.
- Lab parameters like total leucocyte count, serum creatinine and total bilirubin were altered in patients with SIRS as well as sepsis.
- All our patients of SIRS were in non-identified group of infection and all sepsis patients were in known source of infection.

- Immature granulocyte count was increased i.e. >3% in both SIRS and sepsis. P-value was statistically significant.
- The immature granulocyte count estimation is an easy, readily available laboratory tool for identification of patients with SIRS or sepsis.

Though present study includes only 65 patients if we applied to large population, it may have valuable importance in these patients.

SUMMARY

In our present study, evaluation of 65 patients for immature granulocyte count in patients of SIRS/sepsis admitted in medical intensive care unit of KLE's Dr Prabhakar Kore Hospital and research Centre, Belagavi.

- Type 2 Diabetes mellitus was more associated with SIRS or sepsis followed by hypertension.

- When we compared various factors like age, gender, comorbidities there was no significant correlation observed except for various sources of infections as well unknown source of infection which had significant correlation.

- IG count is the simplest and easily available laboratory tool to assess the patient due to infections for complications like SIRS or sepsis. There is varied consensus by different authors, some authors consider IG count has limited role in assessing these patients for evidence of SIRS or sepsis reason for this could be IG count shows promise as an early diagnostic marker for differentiating between SIRS and sepsis, particularly as a screening tool due to its high sensitivity. However, its low specificity suggests it should be used in conjunction with other clinical and laboratory parameters rather than as a standalone marker.

BIBLIOGRAPHY

1. Rudd KE, Johnson SC, Agesa KM, Shackelford KA, Tsoi D, Kievlan DR, Colombara DV, Ikuta KS, Kissoon N, Finfer S, Fleischmann-Struzek C. Global, regional, and national sepsis incidence and mortality, 1990–2017: analysis for the Global Burden of Disease Study. The Lancet. 2020 Jan 18;395(10219):200-11.
2. Briggs CJ, Linssen J, Longair I, Machin SJ. Improved flagging rates on the Sysmex XE-5000 compared with the XE-2100 reduce the number of manual film reviews and increase laboratory productivity. American journal of clinical pathology. 2011 Aug 1;136(2):309-16.
3. Martinez EC, Omron EM, Kaplan J, et al. Immature granulocyte percentage: A novel predictor of bacteraemia in the emergency department. J Emerg Med. 2018;55(1):17-25.
4. van der Geest PJ, Mohseni M, Brouwer R, van der Hoven B, Steyerberg EW, Groeneveld AJ. Immature granulocytes predict microbial infection and its adverse sequelae in the intensive care unit. Journal of critical care. 2014 Aug 1;29(4):523-7.
5. Kaukonen KM, Bailey M, Pilcher D, Cooper DJ, Bellomo R. Systemic inflammatory response syndrome criteria in defining severe sepsis. New England Journal of Medicine. 2015 Apr 23;372(17):1629-38.
6. Vincent JL, Opal SM, Marshall JC, Tracey KJ. Sepsis definitions: time for change. Lancet. 2013;381(9868):774-5.
7. Fernando SM, Rochwerg B, Seely AJE. Clinical implications of the Third International Consensus Definitions for Sepsis and Septic Shock (Sepsis-3). CMAJ. 2018;190(36): E1058-E1059.

8. Finkelsztein EJ, Jones DS, Ma KC, Pabón MA, Delgado T, Nakahira K, et al. Comparison of qSOFA and SIRS for predicting adverse outcomes of patients with suspicion of sepsis outside the intensive care unit. Crit Care. 2017 Mar 26;21(1):73.

9. Churpek MM, Zadravecz FJ, Winslow C, Howell MD, Edelson DP. Incidence and Prognostic Value of the Systemic Inflammatory Response Syndrome and Organ Dysfunctions in Ward Patients. Am J Respir Crit Care Med. 2015 Oct 15;192(8):958-64.

10. Pittet D, Rangel-Frausto S, Li N, Tarara D, Costigan M, Rempe L, et al. Systemic inflammatory response syndrome, sepsis, severe sepsis and septic shock: incidence, morbidities and outcomes in surgical ICU patients. Intensive Care Med. 1995;21(4):302-9.

    Comstedt P, Storgaard M, Lassen AT. The Systemic Inflammatory Response Syndrome (SIRS) in acutely hospitalised medical patients: a cohort study. Scandinavian journal of trauma, resuscitation and emergency medicine. 2009 Dec; 17:1-6.

11. Dremsizov T, Clermont G, Kellum JA, Kalassian KG, Fine MJ, Angus DC. Severe sepsis in community-acquired pneumonia: when does it happen, and do systemic inflammatory response syndrome criteria help predict course? Chest. 2006;129(4):968-78.

12. NeSmith EG, Weinrich SP, Andrews JO, Medeiros RS, Hawkins ML, Weinrich MC. Demographic differences in systemic inflammatory response syndrome score after trauma. American Journal of Critical Care. 2012 Jan 1;21(1):35-41.

13. Choudhry MA, Bland KI, Chaudry IH. Trauma and immune response--effect of gender differences. Injury. 2007 Dec;38(12):1382-91.

14. Chakraborty RK, Burns B. Systemic Inflammatory Response Syndrome. [Updated 2023 May 29]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK547669/
15. Bellomo R. Acute glycaemic control in diabetics. How sweet is optimal? Pro: Sweeter is better in diabetes. Journal of intensive care. 2018 Dec;6:1-3.
16. Hernandez Botero JS, Florian Perez MC. The History of Sepsis from Ancient Egypt to the XIX Century [Internet]. Sepsis - An Ongoing and Significant Challenge. InTech; 2012.
17. Funk DJ, Parrillo JE, Kumar A. Sepsis and septic shock: a history. Critical care clinics. 2009 Jan 1;25(1):83-101.
18. Gül F, Arslantaş MK, Cinel İ, Kumar A. Changing definitions of sepsis. Turkish journal of anaesthesiology and reanimation. 2017 Jun;45(3):129.
19. Gyawali B, Ramakrishna K, Dhamoon AS. Sepsis: The evolution in definition, pathophysiology, and management. SAGE Open Med. 2019 Mar 21;7:2050312119835043.
20. Dellinger RP, Schorr CA, Levy MM. A users' guide to the 2016 Surviving Sepsis Guidelines. Intensive Care Med 2017; 43: 299:303
21. Evans, L.; Rhodes, A.; Alhazzani, W.; Antonelli, M.; Coopersmith, C.M.; French, C.; Machado, F.R.; Mcintyre, L.; Ostermann, M.; Prescott, H.C.; et al. Surviving sepsis campaign: International guidelines for management of sepsis and septic shock 2021. Intensive Care Med. 2021, 47, 1181–1247.
22. Gauer R, Forbes D, Boyer N. Sepsis: diagnosis and management. American family physician. 2020 Apr 1;101(7):409-18.

23. Bone RC, Balk RA, Cerra FB, et al. Definitions for sepsis and organ failure and guidelines for the use of innovative therapies in sepsis: the ACCP/SCCM consensus conference committee. American College of Chest Physicians/Society of Critical Care Medicine. Chest 1992; 101(6): 1644–1655.

24. Levy MM, Fink MP, Marshall JC, et al. 2001 SCCM/ESICM/ACCP/ATS/SIS international sepsis definitions conference. Crit Care Med 2003; 31: 1250–1256.

25. Gul, F. et al. (2017) 'Changing definitions of sepsis', Turkish Journal of Anesthesia and Reanimation, 45(3), pp. 129–138. doi:10.5152/tjar.2017.93753.

26. Chiu C, Legrand M. Epidemiology of sepsis and septic shock. Current Opinion in Anaesthesiology. 2021 Apr 1;34(2):71-6.

27. WHO. Global Report on the Epidemiology and Burden of Sepsis: Current Evidence, Identifying Gaps and Future Directions; World Health Organization: Geneva, Switzerland, 2020.

28. Vakkalanka, J.P.; Harland, K.K.; Swanson, M.B.; Mohr, N.M. Clinical and epidemiological variability in severe sepsis: An ecological study. J. Epidemiol. Community Health 2018, 72, 741–745.

    Yealy, D.M.; Mohr, N.M.; Shapiro, N.I.; Venkatesh, A.; Jones, A.E.; Self, W.H. Early care of adults with suspected sepsis in the Emergency Department and Out-of-Hospital Environment: A Consensus-Based Task Force Report. Ann. Emerg. Med. 2021, 78, 1–19.

29. Edathadathil F, Alex S, Prasanna P, Sudhir S, Balachandran S, Moni M, Menon V, Sathyapalan DT, Singh S. Epidemiology of Community-Acquired Sepsis: Data from an E-Sepsis Registry of a Tertiary Care Centre in South India. Pathogens. 2022 Oct 24;11(11):1226.

30. MacFie, J. (2013). Surgical sepsis. British Journal of Surgery, 100(9), 1119–1122. doi:10.1002/bjs.9155_1

31. Álvarez, J. a. P., & Zuñiga, C. C. (2023). Overview of Sepsis in Surgery. International Journal of Medical Science and Clinical Research Studies, 03(05). https://doi.org/10.47191/ijmscrs/v3-i5-37

32. Vincent JL, Moreno R, Takala J, et al. Working group on sepsis-related problems of the European society of intensive care medicine: the SOFA (Sepsis-related Organ Failure Assessment) score to describe organ dysfunction/failure. Intensive Care Med 1996; 22: 707–710.

33. Remick DG. Pathophysiology of sepsis. The American journal of pathology. 2007 May 1;170(5):1435-44.

34. van der Poll T, Opal SM. Host–pathogen interactions in sepsis. Lancet Infect Dis 2008; 8: 32–43.

35. Esmon CT. The interactions between inflammation and coagulation. British journal of haematology. 2005 Nov;131(4):417-30.

36. Taylor Jr FB, Chang A, Ruf W, Morrissey 6, Hinshaw L, Catlett R, Blick K, Edgington TS. Lethal E. coli septic shock is prevented by blocking tissue factor with monoclonal antibody. Circulatory shock. 1991 Mar 1;33(3):127-34.

37. Heagy W, Nieman K, Hansen C, Cohen M, Danielson D, West MA. Lower levels of whole blood LPS-stimulated cytokine release are associated with poorer clinical outcomes in surgical ICU patients. Surgical infections. 2003 Jul 1;4(2):171-80.

38. Luce JM. Pathogenesis and management of septic shock. Chest. 1987 Jun 1;91(6):883-8.

39. Doig CJ, Sutherland LR, Dean Sandham J, Fick GH, Verhoef M, Meddings JB. Increased intestinal permeability is associated with the development of multiple organ dysfunction syndrome in critically ill ICU patients. American journal of respiratory and critical care medicine. 1998 Aug 1;158(2):444-51.

40. Seymour CW, Liu VX, Iwashyna TJ, et al. Assessment of clinical criteria for sepsis: For the third international consensus definitions for sepsis and septic shock (sepsis-3). JAMA 215:762–774, 2016.

41. Bhansaly P, Mehta S, Sharma N, Gupta E, Mehta S, Gupta S. Evaluation of immature granulocyte count as the earliest biomarker for sepsis. Indian Journal of Critical Care Medicine: Peer-reviewed, Official Publication of Indian Society of Critical Care Medicine. 2022 Feb;26(2):216.

42. Karon BS, Tolan NV, Wockenfus AM, Block DR, Baumann NA, Bryant SC et al. Evaluation of lactate, white blood cell count, neutrophil count, procalcitonin and immature granulocyte count as biomarkers for sepsis in emergency department patients. Clinical biochemistry. 2017 Nov 1;50(16-17):956-8.

43. Ayres LS, Sgnaolin V, Munhoz TP. Immature granulocytes index as early marker of sepsis. International journal of laboratory hematology. 2019 Jun;41(3):392-6.

44. Ünal Y. A new and early marker in the diagnosis of acute complicated appendicitis: immature granulocytes. Ulus Travma Acil Cerrahi Derg. 2018 Sep 1;24(5):434-9.

45. Geest PJ, Mohseni M, Brouwer R, Hoven B, Steyerberg EW. Immature granulocytes predict microbial infection and its adverse sequelae in the intensive care unit. J Crit Care 2014;29(4):523-7.

46. Georgakopoulou VE, Makrodimitri S, Triantafyllou M, Samara S, Voutsinas PM, Anastasopoulou A et al. Immature granulocytes: Innovative biomarker for SARS CoV 2 infection. Molecular Medicine Reports 2022;26(1):12733.

47. Bernstein LH, Rucinski J. Measurement of granulocyte maturation may improve the early diagnosis of the septic state. J Clinical Chem Lab Med 2011;49(12):2089-95.

48. Senthilnayagam B, Kumar T, Sukumaran J, Rao K R. Automated measurement of immature granulocytes: performance characteristics and utility in routine clinical practice. Pathology research international. 2012;2012(1):483670.

49. Jeon, K, Lee N, Jeong S, Parl MJ, Song W. Immature granulocyte percentage for prediction of sepsis in severe burn patients: a machine leaning-based approach. BMC Infect Dis 2021;21:1258.

50. Nierhaus A, Klatte S, Linssen J, Eismann NM, Wichmann D, Hedke J, Braune SA, Kluge S. Revisiting the white blood cell count: immature granulocytes count as a diagnostic marker to discriminate between SIRS and sepsis-a prospective, observational study. BMC immunology. 2013 Dec;14:1-8.

51. Angus DC, Van der Poll T. Severe sepsis and septic shock. New England journal of medicine. 2013 Aug 29;369(9):840-51.

52. Ansari-Lari MA, Kickler TS, Borowitz MJ. Immature granulocyte measurement using the Sysmex XE-2100: relationship to infection and sepsis. American journal of clinical pathology. 2003 Nov 1;120(5):795-9.

53. Joshi N, Caputo GM, Weitekamp MR, et al. Infections in patients with diabetes mellitus. N Engl J Med. 1999;341(25):1906-12.

54. Kumar A, Roberts D, Wood KE, Light B, Parrillo JE, Sharma S, Suppes R, Feinstein D, Zanotti S, Taiberg L, Gurka D. Duration of hypotension before initiation of effective antimicrobial therapy is the critical determinant of survival in human septic shock. Critical care medicine. 2006 Jun 1;34(6):1589-96.

55. Phua J, Koh Y, Du B, et al. Management of severe sepsis in patients admitted to Asian intensive care units. BMJ. 2011;342:d3245.

56. Singer M, Deutschman CS, Seymour CW, Shankar-Hari M, Annane D, Bauer M, Bellomo R, Bernard GR, Chiche JD, Coopersmith CM, Hotchkiss RS. The

third international consensus definitions for sepsis and septic shock (Sepsis-3). Jama. 2016 Feb 23;315(8):801-10.

57. Mayr FB, Yende S, Angus DC. Epidemiology of severe sepsis. Virulence. 2014;5(1):4-11.

58. Hotchkiss RS, Moldawer LL, Opal SM, Reinhart K, Turnbull IR, Vincent JL. Sepsis and septic shock. Nature reviews Disease primers. 2016 Jun 30;2(1):1-21.

59. Marcos V, Nussbaum C, Vitkov L, et al. Delayed but functional neutrophil extracellular trap formation in neonates. Blood. 2009;114(23):4908-11.

60. Park SH, Park CJ, Lee BR, Nam KS, Kim MJ, Han MY, Kim YJ, Cho YU, Jang S. Sepsis affects most routine and cell population data (CPD) obtained using the Sysmex XN-2000 blood cell analyzer: neutrophil-related CPD NE-SFL and NE-WY provide useful information for detecting sepsis. International journal of laboratory haematology. 2015 Apr;37(2):190-8.

61. Mare TA, Treacher DF, Shankar-Hari M, et al. The diagnostic and prognostic significance of monitoring blood levels of immature neutrophils in patients with systemic inflammation. Crit Care. 2015;19:57.

62. Cobussen M, Verhave JC, Buijs J, Stassen PM. The incidence and outcome of AKI in patients with sepsis in the emergency department applying different definitions of AKI and sepsis. International Urology and Nephrology. 2023 Jan;55(1):183-90.

63. Kriplani A, Pandit S, Chawla A, de la Rosette JJ, Laguna P, Jayadeva Reddy S, Somani BK. Neutrophil–lymphocyte ratio (NLR), platelet–lymphocyte ratio (PLR) and lymphocyte–monocyte ratio (LMR) in predicting systemic inflammatory response syndrome (SIRS) and sepsis after percutaneous nephrolithotomy (PNL). Urolithiasis. 2022 Jun;50(3):341-8.

64. Lakbar I, Einav S, Lalevée N, Martin-Loeches I, Pastene B, Leone M. Interactions between gender and sepsis—implications for the future. Microorganisms. 2023 Mar 14;11(3):746.

65. Chou HL, Han ST, Yeh CF, Tzeng IS, Hsieh TH, Wu CC, Kuan JT, Chen KF. Systemic inflammatory response syndrome is more associated with bacteraemia in elderly patients with suspected sepsis in emergency departments. Medicine. 2016 Dec 1;95(49):e5634.

ANNEXURES

ANNEXURE – I - INFORMED CONSENT FORM

Title of Research study- "**Study of Immature granulocyte count as early diagnostic marker to distinguish between SIRS and Sepsis patients".**

Introduction and purpose: It is important to know about immature granulocyte count or IG percentage to get early diagnosis of SIRS or sepsis as it is simplest, readily available and very cost-effective marker than other available markers of infection.

Explanation of procedure: Patient will be selected according to SIRS variables and blood sample will be drawn for determination of immature granulocyte count/percentage within first 24 hours of admission in medicine ICU. This blood investigation will be done in routine complete blood count. If IG percentage is more than 3% then it will be considered as patient is in critical hours after initial SIRS alert.

Withdrawal from participation in the study: Participation in this study in voluntary. You will be free to decide whether to participate in this study or continue participation once enrolled. In case you decide to withdraw your participation, you are free to do so. However, please convey the decision to the principal investigator.

Possible benefits from participating in the study: You will get any benefits by participating in this study. As early diagnosis will be helpful to determine further course of treatment**.** The data gathered will help population at large.

Possible risks from participating in the study: There are no risks involved in participating in this study.

Privacy and confidentiality: The information collected from you will be coded, to prevent any person to identify you. Your identity will never be revealed. The data collected from you will be kept confidential and only processed or aggregated data will be used for publication.

Financial incentives: You will not receive any payment for participating in this study.

Cost of investigations done during the course of study will be paid by the principal investigator**.** (Strike out which is not applicable)

Authorization for publication of aggregated data: Results obtained after processing of the aggregated data will be published for scientific purpose and or presented to scientific groups. However, your identity will never be revealed.

Questions: In case of any questions with regard to this study, you are free to contact: BG0122016.

If you have any question or complaints with regard to your right as study participant you may contact Dr Harsha Hegde, Chairperson, Ethical committee of JNMC, 0831-2473777 Extension 4052.

Legal rights: By signing this consent form, we are not waving any of your legal rights

CONSENT STATEMENT

I am making a voluntary decision to participate in the study **"Study of Immature granulocyte count as early diagnostic marker to distinguish between SIRS and Sepsis patients"** My signature below indicates that I have decided to participate and I have read the information provided above or the information provided above has been read to me in the language that I understand best. I was given the opportunity to ask questions and that they have been answered to my satisfaction.

Name of the participant:

Signature or left thumb impression of the participant:

Name of the witness:

Signature or left thumb impression of the witness:

Name of the investigator: BG0122016

Signature of the investigator:BG0122016

ANNEXURE: II- PROFORMA

CASE NO	
NAME	
IP NO	
AGE	**YEARS**
SEX	**MALE FEMALE**
ADDRESS	
OCCUPATION	

Complaints at presentation	
Past history	
Family history	
Personal history	
Treatment history	

VITALS

Temperature	
Pulse	
Respiratory rate	
Blood pressure	
Ionotropic support	
GCS score	
Ventilatory support	

PHYSICAL EXAMINATION

	Yes	**No**
Pallor		
Icterus		
Lymphadenopathy		
Cyanosis		
Clubbing		
Edema		

SYSTEMIC EXAMINATION

C.V.S	
R.S.	
C.N.S	
PER ABDOMEN	

INVESTIGATIONS

Hemoglobin		Total Bilirubin		Na+	
Total Count		Direct Bilirubin		K+	
Neutrophils		Total protein		S. creatinine	
Lymphocytes		Albumin		IG%	
Eosinophils		A/G ratio		IG#	
Monocytes		SGOT		Pao2/FiO2	
Basophils		SGPT			
RBS		Serum Procalcitonin			

FOCI OF SEPSIS

Respiratory	
Genitourinary	
Abdominal	
C.N.S	
Skin	
Others	
Non identified	

ANNEXURE: III- KEY TO MASTER CAHRT

TYPE2 DM	Type 2 diabetes mellitus
BPM	Beats per minutes
CPM	Cycles per minutes
SBP	Systolic blood pressure
IG	Immature granulocyte count
SIRS	Systemic inflammatory response syndrome

ANNEXURE: IV- MASTER CAHRT

NUMBER	IP NO	AGE()YRS)	SEX	TYPE2DM	HYPERTENSION	TYPE2DM/HYPERTE	OTHER COMORBIDITIES	HEART RATE(BPM)	ORY RATE(CP	TURE(DEGREE	SBP(mmHG)	TLC(cells/mm^3)	TOTAL BILIRUBIN (mg/dl)	SERUM CREATININE(mg/dl)	IG COUNT(%)	SIRS	SEPSIS	SOURCE	VENTILATORY SUPPORT	IONOTROPIC SUPPORT
1	10035081	84	F	YES	YES	YES		118	32	38.8	90	17500	0.36	1.01	0.1	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
2	10035166	67	M	YES				102	30	37.2	90	11400	3.63	2.51	5.8		YES	CENTRAL NERVOUS SYSTEM	WITHOUT SUPPORT	WITH SUPPORT
3	10034947	75	M	YES				105	28	36.6	90	12600	1.63	0.7	2.4		YES	SKIN	WITHOUT SUPPORT	WITH SUPPORT
4	10035069	62	M	YES				120	30	38.3	110	14800	0.53	0.83	0.6	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
5	10009313	86	M	YES				112	28	38.8	110	20700	0.87	0.59	1.8	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
6	10013364	56	F		YES			118	40	38.8	80	28100	0.26	3.79	6.2		YES	GENITOURINARY	INVASIVE	WITH SUPPORT
7	10014016	72	M	YES				116	28	38.8	100	16700	0.59	6.26	4.7		YES	GENITOURINARY	INVASIVE	WITH SUPPORT
8	10032993	43	M					112	28	38.8	120	19200	0.98	0.8	1.2	YES		NOT IDENTIFIED	NON-INVASIVE	WITHOUT SUPPORT
9	10035039	68	M		YES			118	30	38.8	100	46100	0.62	1.95	4.1		YES	GENITOURINARY	NON-INVASIVE	WITH SUPPORT
10	10034677	82	F	YES				118	30	38.3	100	13000	0.2	1.93	3.2		YES	GENITOURINARY	NON-INVASIVE	WITH SUPPORT
11	10029252	68	F		YES			120	28	38.8	100	26800	0.34	11.8	4.2		YES	GENITOURINARY	INVASIVE	WITH SUPPORT
12	10024392	71	M	YES				102	22	38.3	110	12600	0.34	1.88	2.6		YES	GENITOURINARY	NON-INVASIVE	WITH SUPPORT
13	10027953	56	M					102	20	38.3	110	20800	0.85	0.75	2.9	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
14	10025500	54	M				YES	118	28	38.3	100	12000	0.69	0.65	4.2		YES	GENITOURINARY	NON-INVASIVE	WITH SUPPORT
15	10020232	66	M	YES				118	32	38.8	100	28600	1.92	3.32	1.1		YES	GENITOURINARY	INVASIVE	WITH SUPPORT
16	10019872	75	M				YES	108	22	38.8	100	16300	1.72	2.74	0.9		YES	RESPIARTORY	NON-INVASIVE	WITH SUPPORT
17	10018303	53	M	YES				120	28	38.8	120	22400	0.35	1.08	1.5	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
18	10035084	75	M	YES				120	28	38.3	100	14000	2.85	3.18	14.8		YES	GENITOURINARY	NON-INVASIVE	WITHOUT SUPPORT
19	10032371	45	F		YES			130	28	38.8	90	12700	1.07	2.58	2.1		YES	SKIN	NON-INVASIVE	WITH SUPPORT
20	10031341	45	M	YES			YES	112	32	38.3	110	17100	0.44	1.07	0.4	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
21	10027983	37	M					119	28	38.3	120	15600	0.82	0.72	1.4	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
22	10026036	28	F					118	28	38.3	110	20600	0.31	11.1	2.6		YES	GENITOURINARY	NON-INVASIVE	WITHOUT SUPPORT
23	10025928	65	M	YES				118	28	38.8	100	13700	0.64	6.07	3.7		YES	OTHERS	WITHOUT SUPPORT	WITH SUPPORT
24	10024534	71	M					118	38	38.8	100	50900	0.55	4.67	14.7		YES	RESPIARTORY	NON-INVASIVE	WITH SUPPORT
25	10022436	69	M	YES			YES	120	22	39.4	110	28600	0.63	1.9	3.6		YES	GENITOURINARY	NON-INVASIVE	WITH SUPPORT
26	10018660	66	F	YES				126	30	38.8	110	37500	0.68	1.15	5.9	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
27	10017040	70	M					130	30	36.6	160	17600	1.48	2.16	12		YES	RESPIARTORY	INVASIVE	WITH SUPPORT
28	10014958	66	F	YES				112	28	38.8	140	14800	0.68	0.26	2	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
29	10050193	80	M		YES			120	30	38.3	100	54500	0.64	2.08	3.1		YES	RESPIARTORY	INVASIVE	WITH SUPPORT
30	10055057	79	M	YES				128	30	38.8	90	25600	0.66	1.53	2.2		YES	ABDOMINAL	WITHOUT SUPPORT	WITHOUT SUPPORT
31	10009429	68	F	YES				102	30	38.3	130	12000	0.96	0.65	3.4	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
32	10000541	50	M					103	28	38.3	100	12000	0.58	1.89	0.3		YES	RESPIARTORY	NON-INVASIVE	WITH SUPPORT
33	10004644	66	M		YES			128	28	38.8	130	14100	4.36	3.47	2.6		YES	GENITOURINARY	WITHOUT SUPPORT	WITHOUT SUPPORT

34	10004769	70	F	YES				120	28	38.8	130	13000	0.59	0.35	1.4	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
35	10038037	55	M	YES				130	28	38.3	120	22400	0.26	0.41	1.5	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
36	10037260	75	M					110	32	38.8	120	27100	0.88	0.67	1.4	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
37	10036992	42	M					102	30	39.4	140	4000	0.8	0.71	1.9	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
38	10036566	64	M					110	30	38.3	120	4000	0.71	1.03	0.7	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
39	10036344	55	F	YES	YES	YES		118	20	37.7	110	12000	0.52	1	0.3	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
40	10035155	70	M		YES			120	32	38.8	110	1800	2.96	1.19	62.9		YES	OTHERS	NON-INVASIVE	WITH SUPPORT
41	10033768	25	M					110	20	38.8	120	12000	0.52	0.57	0.2	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
42	10033805	75	M					100	20	38.3	130	4000	0.59	0.91	1	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
43	10033013	55	F					118	28	39.4	100	12000	0.51	0.83	0.5	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
44	10032525	68	M		YES		YES	120	32	38.8	120	14700	1.4	1.55	2.7	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
45	10032333	83	M		YES		YES	108	30	38.8	130	21400	1.1	1.46	4.4		YES	RESPIARTORY	NON-INVASIVE	WITHOUT SUPPORT
46	10033269	62	M	YES	YES	YES		100	30	38.3	110	12000	0.99	0.68	6.3	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
47	10031894	51	M	YES				118	28	38.3	110	14300	1.92	1.87	1.1		YES	ABDOMINAL	NON-INVASIVE	WITH SUPPORT
48	10038664	57	M	YES			YES	130	28	35.5	130	40100	0.43	5.15	4.1		YES	GENITOURINARY	WITHOUT SUPPORT	WITH SUPPORT
49	10041823	68	F					128	28	38.8	110	20400	1.32	1.57	2.3		YES	RESPIARTORY	NON-INVASIVE	WITH SUPPORT
50	10043931	74	M		YES		YES	118	20	38.8	100	12000	1.14	1.83	0.5	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
51	10045811	55	M		YES			118	28	38.3	140	23400	0.32	3.49	4.8	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
52	10046372	61	F	YES	YES	YES		120	30	38.3	140	18800	1.18	0.98	2.6	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
53	10047722	55	M	YES	YES	YES		100	28	38.8	100	12100	0.36	0.75	1.3	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
54	10049486	55	M	YES	YES	YES	YES	108	28	38.3	100	4000	0.88	1.28	0.5		YES	OTHERS	WITHOUT SUPPORT	WITHOUT SUPPORT
55	10049825	78	M	YES				118	20	38.8	110	53100	1.14	5.92	1.7		YES	GENITOURINARY	WITHOUT SUPPORT	WITH SUPPORT
56	10040672	70	M		YES		YES	102	30	38.3	130	12900	2.34	1.81	5.6		YES	RESPIARTORY	NON-INVASIVE	WITHOUT SUPPORT
57	10041504	30	F					140	36	38.8	100	35800	1.65	1.28	3.2		YES	GENITOURINARY	WITHOUT SUPPORT	WITH SUPPORT
58	10041441	78	F					110	28	38.3	110	12100	0.94	1.32	4.8		YES	RESPIARTORY	NON-INVASIVE	WITHOUT SUPPORT
59	10046343	69	M	YES	YES	YES	YES	118	20	35	100	21500	0.24	4.73	1.4		YES	OTHERS	WITHOUT SUPPORT	WITH SUPPORT
60	10047743	51	M	YES				110	30	38.8	100	1900	1.63	0.76	50.5		YES	RESPIARTORY	INVASIVE	WITH SUPPORT
61	10048599	60	M					120	28	38.8	160	25600	1.19	1.17	6.3	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
62	10051091	70	M	YES			YES	110	20	35.5	100	18100	1.47	3.52	0.9		YES	GENITOURINARY	INVASIVE	WITH SUPPORT
63	10055840	28	F					102	28	38.8	130	37700	2.03	2.11	12.4		YES	GENITOURINARY	INVASIVE	WITH SUPPORT
64	10053980	40	M				YES	118	30	38.3	110	16600	5.02	0.69	0.7	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT
65	10054970	71	M					118	30	35	100	12200	0.3	1.6	1.6	YES		NOT IDENTIFIED	WITHOUT SUPPORT	WITHOUT SUPPORT