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Acute Phase Reactants and Hematologic Profiles vs Blood Culture in Late Preterm Neonatal Sepsis

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Abstract. Background: Neonatal sepsis involves physical and laboratory findings due to infection within the first 30 days of life, with preterm infants being six times more at risk than term infants due to their immature immune systems and prolonged hospitalization. Sepsis is more common in males and in developing countries. The World Health Organization estimates 5 million neonatal deaths annually, mostly in developing countries. Despite advances in neonatal care, late-onset sepsis remains a significant cause of morbidity and mortality. Aim: To evaluate the significance of acute phase reactants and hematological findings versus blood culture in diagnosing sepsis in late preterm infants. Method: A cross-sectional study of 70 neonates with suspected sepsis from January 2011 to March 2012 at Babylon Teaching Hospital. Patients were classified as having early or late-onset neonatal sepsis. Tests included blood culture, c-reactive protein, erythrocyte sedimentation rate, white blood cell, platelets, and band cells. Results: Of the 70 patients, 55.7% were male and 44.3% were female. Early sepsis was observed in 40% of patients, and late sepsis in 60%. Blood culture was positive in 25.7% of cases, with 83.3% of these in early sepsis. CRP was positive in 91.4% of patients, including 100% of early sepsis cases and 85.7% of late sepsis cases. Positive band cells were found in 45.7% of cases, with 83.3% of these having positive blood cultures. Abnormal WBC counts (<5000 or >21000) were found in 64.3% of cases. Low platelet counts (<150,000) were observed in 55.7% of patients, with 67.8% in early sepsis and 47.6% in late sepsis. Elevated ESR (>6mm/h) was seen in 91.4% of cases. Conclusion: Blood culture remains the gold standard for diagnosing sepsis, though its accuracy can be affected by antibiotic use. Combining multiple diagnostic tests improves predictive values over single tests.

Highlights:

1. Late-onset sepsis remains a major cause of neonatal morbidity and mortality.
2. CRP and ESR showed high positivity, supporting their value in early detection.
3. Blood culture is essential but benefits from combined diagnostic markers.

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Keywords: ate Preterm Infant, Neonatal Sepsis, Blood Culture, Infant, CRP.

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Introduction

A preterm infant is defined as one born before 37 weeks of gestation from the first day of the last menstrual period. A late preterm infant is specifically defined as born between 34 weeks and 36 weeks + 6 days [1]. Neonatal sepsis, also known as neonatal septicemia or sepsis neonatorum [2], is a critical condition characterized by the presence of pathogenic organisms or their toxins in the blood tissues, eliciting a systemic response. Bacteremia, on the other hand, refers to the presence of viable bacteria in the bloodstream [3]. The systemic response is marked by cardinal signs such as fever or hypothermia, leukocytosis or leukopenia, tachypnea, and tachycardia, collectively termed systemic inflammatory response syndrome (SIRS). Severe sepsis occurs when organ dysfunction is present, often manifesting as hypotension or evidence of poor perfusion. When hypotension persists despite fluid resuscitation, it signifies septic shock [4]

Sepsis syndrome is defined as sepsis accompanied by evidence of altered end-organ perfusion, such as changes in mental status or oliguria [3].

Neonatal sepsis encompasses a spectrum of physical and laboratory findings resulting from invasive infection within the first 30 days of life [5]. Unique characteristics of neonatal infections include transmission of infectious agents from mother to fetus or infant, immunologic deficiencies impairing the neonate's ability to respond to infections, and various coexisting conditions complicating diagnosis and management [6].

The clinical manifestations of neonatal infections range widely, from subclinical to severe systemic or focal infections, and rarely include congenital syndromes resulting from intrauterine infections [3]. Maternal infections, often asymptomatic during pregnancy, can transmit pathogens trans placentally, contributing to neonatal infections [7].

A wide array of etiological agents, including bacteria, viruses, fungi, protozoa, and mycoplasmas, can infect newborns, with preterm infants particularly vulnerable due to prolonged hospital stays in environments conducive to nosocomial infections[8].

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The incidence of sepsis is notably higher in preterm infants, approximately 1:250 compared to 1:1500 in full-term infants, attributable to immature immune systems and prolonged hospitalizations increasing nosocomial infection risks [8]. Sepsis also exhibits a higher prevalence in males and in developing countries, with the World Health Organization reporting a significant proportion of neonatal deaths, predominantly within the first week of life [9] as seen in table (1).

Table 1. Infection in Infant according to the Age Onset [37].

CHARACTERISTICS	EARLY ONSET	LATE ONSET	VERY LATE (NOSOCOMIAL) ONSET
Age at onset	Birth to 7 days usually <72 hr	7-30 days	>30 days
Maternal obstetric complications	Common	Uncommon	Varies
Prematurity	Frequent	Varies	Usual
Organism source	Maternal genital tract	Maternal genital tract/environment	Environment/community
Manifestation	Multisystem	Multisystem or focal	Multisystem or focal
Site	Normal nursery, NICU, community	NICU, community	NICU, community

Mortality related to sepsis in neonates can be mitigated with appropriate antimicrobial therapy and intensive supportive care [10]. Infections, including septicemia, meningitis, pneumonia, and others, constitute a leading cause of neonatal mortality, underscoring the importance of effective management strategies [11].

Advances in neonatal intensive care have improved survival rates among very low birth weight infants, yet late-onset sepsis remains a substantial contributor to morbidity and mortality [12].

1. Classification

The causes of neonatal sepsis are categorized into three periods based on the timing of onset, as depicted in Figure [13]:

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a. Congenital infection: Infections acquired trans placentally during gestation, encompassing bacterial, fungal, viral, and parasitic etiologies [14].
b. Early-onset sepsis (EOS): Occurs within the first 7 days of life and is associated with maternal obstetric complications, often presenting with pneumonia or septicemia shortly after birth [15]. Risk factors include low birth weight, maternal febrile illness, and prolonged rupture of membranes.
c. Late-onset sepsis (LOS): Manifests on or after 7 days of life, often in hospital settings, and commonly presents with bacteremia or meningitis. Unlike EOS, maternal complications are not typically associated with late-onset GBS disease [16]. Risk factors include prematurity, NICU admission, and invasive procedures.
d. Nosocomial infection: Acquired during hospitalization, particularly in neonatal intensive care units (NICUs), contributing significantly to morbidity and mortality in critically ill neonates [17].

Neonatal sepsis can be caused by a spectrum of bacterial and non-bacterial pathogens, as summarized in Tables 2 and 3.

Table 2. Bacterial Causes of Systemic Neonatal Infections [37].

BACTERIA	**EARLY ONSET**	**LATE ONSET, MATERNAL ORIGIN**	**LATE ONSET, NOSOCOMIAL**	**LATE ONSET, COMMUNITY**
GRAM POSITIVE				
Clostridia	+		+	[*]
Enterococci	+		++	
Group B streptococcus	+++	+	+	+
Listeria monocytogenes	+	+		
Other streptococci	++			+
Staphylococcus aureus	+		++	+
Staphylococcus, coagulase negative	+		+++	

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Streptococcus pneumoniae	+			++
Viridans streptococcus	+		++	
GRAM NEGATIVE				
Bacteroides	+		+	
Campylobacter	+			
Citrobacter			+	+
Enterobacter			+	
Escherichia coli	+++		+	++
Haemophilus influenzae	+			+
Klebsiella			+	
Neisseria gonorrhoeae	+			
Neisseria meningitidis	+		+	
Proteus			+	
Pseudomonas			+	
Salmonella		+		+
Serratia			+	
OTHERS				
Treponema pallidum	+	+		
Mycobacterium tuberculosis		+		

+, relative frequency.

Table 3. Nonbacterial Causes of Systemic Neonatal Infections [37]**.**

VIRUSES	MYCOPLASMA	FUNGI	PROTOZA

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Adenovirus Cytomegalovirus Enteroviruses Herpes simplex virus HIV Parvovirus Rubella virus Varicella-zoster virus	*M. hominis* *Ureaplasma urealyticum*	*Candida* species *Malassezia* species	Plasmodia *Toxoplasma gondii* *Trypanosoma cruzi*

Neonates have impaired immune responses to infectious agents, partly due to the immature immune system and the physiological barriers provided by the placenta [18]. Neonatal neutrophils, critical for bacterial killing, exhibit defects in chemotaxis and decreased adherence, contributing to their diminished efficacy in combating infections. Additionally, neonates lack mature T cells and have limited cytokine production, further compromising their ability to mount effective immune responses [18].

Despite advancements in neonatal care, mortality from neonatal sepsis remains high due to deficiencies in host defense mechanisms, delayed diagnosis, and limited therapeutic options [19].

Neonates with sepsis present with subtle clinical signs such as respiratory changes (apnea or tachypnea), cardiovascular manifestations (bradycardia or tachycardia), and alterations in temperature regulation (fever or hypothermia). These signs, along with feeding intolerance and changes in skin perfusion, collectively raise suspicion of sepsis [20]. Advanced stages may manifest with petechiae, evidence of poor tissue perfusion, and respiratory distress syndrome, leading to tissue hypoxia and increased morbidity [21]

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Diagnosis of bacterial sepsis requires comprehensive laboratory evaluation, including blood culture as the cornerstone. Other diagnostic tools include total white blood cell count, neutrophil ratio, and inflammatory markers such as C-reactive protein. Lumbar puncture is crucial for diagnosing meningitis, especially when blood cultures are negative [22].

Treatment of neonatal sepsis involves antimicrobial therapy targeting suspected pathogens and supportive care. Early-onset sepsis is typically treated with ampicillin and an aminoglycoside, whereas nosocomial infections may necessitate broader-spectrum antibiotics like vancomycin [23]. Supportive measures include ensuring airway patency, providing supplemental oxygen, and managing hemodynamic stability with inotropic agents as needed [24].

Complications of neonatal sepsis range from inflammatory sequelae to exacerbation of underlying conditions like respiratory distress or electrolyte imbalances. Mortality rates are notably high in cases of neonatal bacterial meningitis, with survivors at risk for neurodevelopmental deficits [21].

The study objective is to evaluate the significance of acute phase reactants and hematological findings versus blood culture in the diagnosis of sepsis in late preterm neonatal infants.

In summary, neonatal sepsis poses significant challenges in diagnosis and management, emphasizing the need for early recognition, prompt treatment, and vigilant supportive care to improve outcomes in this vulnerable population.

Patients and Methods

This prospective study was conducted on 70 neonates exhibiting clinical signs and symptoms suggestive of sepsis in late preterm infants, from January 1, 2011, to March 31, 2012. Patients were gathered from the pediatric wards and neonatal care units of Babylon Teaching Hospital for Gynecology and Pediatrics. Neonates with congenital anomalies and metabolic abnormalities were excluded from the study.

Patients were classified based on the onset of symptoms relative to age into:

a. Early Onset Neonatal Sepsis (EONS): Symptoms from birth to 7 days.

b. Late Onset Neonatal Sepsis (LONS): Symptoms from 7 days up to 28 days.

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Demographic data included sex, gestational age, neonatal age at admission, history of antibiotic use before admission, and maternal history of prophylactic antibiotics during delivery or prior to cesarean section. The sepsis evaluation included various lab tests:

1. Blood Culture

Blood samples were taken aseptically to prevent contamination, all blood cultures have been observed for at least 72 hours before they are reported as sterile.

Primary culture was performed after withdrawal of blood and cultivated into one bottle which contained brain heart infusion broth, vitamin K1 and anticoagulant (The media for growth of bacteria). The media is prepare from 35 gm of brain heart infusion broth diluted with 1000ml of distilled boiled water at 100 C° and placed in the autoclave under 121 pressures was for half hour, after that added vitamin k1 2ml and anticoagulant. After 2-3 days, the sample was taken from the media which contained 1ml of patient's blood streaked in Blood Agar. The primary media that showed negative culture result were not discarded before 5days of inoculation.

The identification of causative micro-organisms are based on colonial morphology and any change exhibited on the media like hemolysis, pigmentative lactose fermentation or non lactose fermentation then staining reaction using Grams stain which classify micro-organism into Gram-positive and Gram-negative. All the procedures were performed by expert bacteriologist. If there was growth we did subculture to identify specific micro-organism and doing sensitivity tests to know the sensitive and resistant antibiotics.

2. C-Reactive Protein (CRP):

The CRP-latex slide agglutination test was used for detecting CRP in serum, was performed using kit from Chromatest (Spain). Results were interpreted qualitatively as positive or negative.

3. Erythrocyte Sedimentation Rate (ESR):

ESR was measured using a mixture of sodium citrate and blood in a Westergren tube, with normal neonatal values being 2-6 mm/h.

4. Band Cell Count:

Blood smears were stained with Leishman stain and analyzed for band cells.

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5. White Blood Cell (WBC) and Platelet Count:

Results were obtained using an auto hematological analyzer. WBC counts below 5000 or above 21000, and platelet counts below 150,000 were considered significant.

Statistical Analysis

The Chi-square test compared acute phase reactants and hematological findings against blood culture results for diagnosing sepsis in late preterm infants. A p-value of <0.05 was considered statistically significant.

Result and Discussion

A. Result

This study enrolled 70 preterm infants, there are 39 (55.7%) males and 31(44.3%) females admitted to the pediatric wards and the aseptic and nursery care units who have sign and symptoms suggesting neonatal sepsis. Those patients divided in to early and late neonatal sepsis according to the time of presentation. 28 (40%) have early sepsis and 42 (60%) late sepsis, the p-value >0. 05 as in table 4.

Table 4. Distribution of Patients according to the Onset of Sepsis.

Onset of sepsis	**Patients: No. (%)**	**P-value**
Early	28 (40%)	>0. 05
late	42 (60%)	
Total	70 (100%)	

Blood culture results shows 18(25.71%) have positive culture and 49(70%) have negative culture and 3(4.82%) contaminated as in table 5.

Table 5. Distribution of Patients according to the Result of Blood Culture.

Blood culture	No. (%)
+ve	18 (25. 71%)
-ve	49 (70%)
contaminated	3 (4.29)
Total	70 (100%)

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Infants with +ve culture, there are 15 (83.33%) with early sepsis and 3 (16. 66%) late sepsis, while infants with -ve culture, there are 11(22. 44%) early sepsis and 38 (77.55%) late sepsis. Contaminated culture, 2(66. 66%) have early sepsis and 1(33.33%) late sepsis. Table 6 shows these results. P-value <0.05.

Table 6. Blood Culture & Onset of Sepsis Results.

Onset of sepsis	Results of B- culture: No. (%)			P-value
	+ve	**-ve**	**Contaminated**	
Early 28	15 (83. 33%)	11 (22. 44%)	2 (66. 66%)	**<0. 05**
Late 42	3 (16. 66%)	38 (77. 55%)	1 (33.33%)	
Total 70	18 (100%)	49 (100%)	3 (100%)	

*P-value <0. 05 significant association

Study of CRP shows 64 (91. 42%) patients have +ve result and 6 (8. 58%) patients have –ve result as in table 7.

Table 7. Distribution of Patients according to the Result of CRP.

CRP	No. (%)
+ve	64(91. 42%)
-ve	6(8. 58%)
Total	70 (100%)

CRP is positive in 28 (100%) patients with early sepsis and 36 (85. 71%) with late sepsis, while negative CRP in 6 (8. 57%) patients with late sepsis. Tabe 8 shows these results.

Table 8. CRP & Onset of Sepsis Results.

Onset of sepsis	CRP: No. (%)		P-value
	+ve	**-ve**	**<0. 05**
Early 28	28 (100%)	Zero	
Late 42	36 (85. 71%)	6 (14. 29%)	
Total 70	64 (91. 42%)	6 (8.57%)	

Table 9 shows all patients with positive culture have positive CRP while 44 (89. 79%) with negative culture and 2 (66.66%) with contaminated culture have positive CRP.

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Table 9. Blood Culture & CRP Results.

Blood culture	CRP: No. (%)
+ve (18)	18 (100%)
-ve (49)	44 (89. 79%)
Contaminated (3)	2 (66. 66%)
Total (70)	64 (91. 42%)

Study of band cells shows that 32 (45. 71%) newborn with sepsis have +ve band cells and 38 (54. 28%) patients have –ve result as in table 10:

Table 10. Distribution of Patients according to the Result of Band Cell.

Band cell	No. (%)
+ve	32 (45. 71%)
-ve	38 (54. 29%)
Total	70 (100%)

There are 14 (43.75%) patients with early sepsis have positive band cell and 18 (56.25%) of late sepsis with positive band cell and the p-value >0. 05 as shown in table 11.

Table 11. Onset of Sepsis & Band Cell Results.

Onset of sepsis	+ve Band cell: No. (%)	P-value
Early (28)	14 (43.75%)	**>0. 05**
Late (42)	18 (56.25%)	
Total (70)	32 (45.71)	

Study of WBC and its relation with onset of sepsis, table 12 shows WBC<5000 in 6 (21. 42%) with early sepsis and 10 (23. 80%) with late sepsis, while WBC>21000 in 12 (42. 85%) with early sepsis &17 (40.47%) with late sepsis. The p-value >0.05.

Table 12. Onset of Sepsis & WBC Count Results.

Onset of sepsis	WBC count**:** No. (%)		P-value
	<5000	**>21000**	**>0.05**
Early (28)	6 (21. 42%)	12 (42. 85%)	
Late (42)	10 (23. 80%)	17 (40.47%)	
Total (70)	16 (22. 85%)	29 (41.42%)	

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Table 13 denotes WBC<5000 in 6 (33.33%) with positive culture &10 (20.40%) with negative culture. WBC >21000 in 9 (50%) with positive culture& 19 (38.77%) with negative culture and 1 (33.33%) with contaminated culture.

Table 13. Blood Culture & WBC Count Results.

Blood culture	WBC count: No. (%)	
	<5000	**>21000**
+ve (18)	6 (33. 33%)	9 (50%)
-ve (49)	10 (20. 40%)	19 (38.77%)
Contaminated (3)	Zero (0%)	1 (33.33%)
Total (70)	16 (22. 85%)	29 (41.42%)

The result of platelets shows 39(55.71%) patients have platelets <150.000. In 19 (67.85%) patients with early sepsis and 20(47.61%) with late sepsis. The p-value>0. 05 as in table 14.

Table 14. Onset of Sepsis and Platelets Count Results.

Onset of sepsis	platelet count<150,000**: No. (%)**	P-value
early (28)	19 (67. 85%)	**> 0.05**
late (42)	20 (47. 61%)	
Total (70)	39 (55. 71%)	

Platelets count<150,000 in 13 (72. 22%) patients with +ve blood culture and 24 (48. 97%) with –ve blood culture and 2 cases (66.66%) with contaminated culture as in the table 15.

Table 15. Blood Culture and Platelet Count Results.

Blood culture	platelet <150,000; No. (%)
+ve (18)	13 (72.22%)
-ve (49)	24 (48. 97%)
Contaminated (3)	2 (66. 66%)
Total (70)	39 (55.71%)

Results of ESR shows that ESR >6mm/h in 25 (89.28%) patients with early sepsis and 39 (92.8%) with late sepsis. The p-value >0.05 as in table 16.

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Table 16. Onset of Sepsis and ESR Results.

Sepsis	Result of ESR in mm/h >6 No. (%)	P-value
		>0. 05
early (28)	25 (89. 28%)	
late (42)	39 (92.8%)	
Total (70)	64 (91. 4%)	

Table 17 displays those 16 (88.88%) patients with ESR>6 in those with +ve culture while 45(91.83%) in those with –ve culture and 3 (100%) with contaminated culture.

Table 17. Blood Culture and ESR Results**.**

Blood culture	**Result of ESR in mm/h >6 No. (%)**
+ve (18)	16 (88. 88%)
-ve (49)	45 (91. 83%)
Contaminated (3)	3 (100%)
Total (70)	64 (91. 42%)

Table 18 shows the significance of different variables (acute phase reactant &hematological finding and the +ve blood culture) in related to clinical neonatal sepsis.

Table 18. Shows the Significance of Different Variables (Acute Phase Reactant & Hematological Finding and the +ve Blood Culture) in Related to Clinical Neonatal Sepsis.

Variables (Tests)	Clinical sepsis (70) No. (%)	p-value
Blood culture	18 (25.71%)	>0.05
CRP	64 (91.42%)	<0.01
ESR	64 (91.42%)	<0.01
Band cell	32 (45.71%)	>0.05

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Plt count	39 (55.71%)	<0.01
WBC	45 (64.28%)	<0.01

Table 19 shows the significance of acute phase reactant &hematological finding in related to the +ve blood culture in those with clinical sepsis patients.

Table 19. Shows the Significance of Acute Phase Reactant & Hematological Finding in Related to the +ve Blood Culture in Those with Clinical Sepsis Patients.

Acute phase reactant& hematological tests	+ve B. Culture 18 (25.71%)	p-value
CRP	18 (100%)	<0.01
ESR	16 (88.88%)	<0.01
Band	15 (83.33%)	<0.05
Plt count	13 (72. 22%)	<0.01
WBC	15 (83.33%)	<0.01

B. Discussion

Neonatal sepsis remains an important cause of mortality and morbidity despite the progress in hygiene, new effective antimicrobial agents and advances in early diagnosis and treatment. This study enrolled 70 preterm infants with sign and symptoms suggesting sepsis. It was found that 28 (40%) have early sepsis and 42 (60%) are presented with late sepsis which considered statistically not significant (p-value >0.05) as table -1. Such result may be due to poor hygiene that led to the newborn getting infection later on or low socioeconomic status that makes the parents late presenting their infant to the hospital. This result is comparable to data reported by other study done in Canada [25].

The current study showed that 18 (25.71%) patients from total 70 patients have +ve blood culture and 49 (70%) patients have –ve blood culture, this result nearly similar to the study done by Delfina R. Msanga et. al. [26] which showed 14 (26.4%) of 53 neonatal positive blood culture, but it differs to other studies done in Portugal [27], which showed 52 (71.2%) out of 73 patients have +ve culture and

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there is no contaminated culture and other study done in Indonesia [28], showed 88 (86.4%) out of 125 patients have +ve culture and no contaminated culture . The difference in the results may be due to the use of antibiotics prior to admission or using of antibiotics prior to labor and to the technique or skills of the lab staff.

Table 6 shows those with +ve blood culture have 15 (83.33%) patients presented with early sepsis and 3 (16. 66%) with late sepsis, while those with –ve blood culture 11 (22. 44%) patients presented with early sepsis and 38 (77. 55%) presented with late sepsis. The p-value <0.05 which considered statistically significant. This result may be related to the use of antibiotics later in newborn and repeated admission to the hospital before blood culture was taken with late presented sepsis.

Regarding CRP, 64 (91. 42%) of newborn evaluated for sepsis have +ve CRP while 6 (8. 58%) have –ve CRP as in table 7. In relation to the onset of sepsis, table 8 shows those with early sepsis have 28 (100%) were +ve for CRP, while those with late sepsis 36 (85.71%) patients were +ve for CRP, This result statistically significant (p-value <0.05). In patients with +ve culture, all patients were +ve CRP 18 (100%) and 44 (89.79%) in those with -ve blood culture as in table 9. This result may be due to the highly sensitivity of CRP against any inflammatory process affecting the body. These findings comparable with other study done in Egypt [29], which detected a significant association ($p \leq 0.001$) of CRP in the proved sepsis group than the suspected neonatal sepsis cases.

For the presence of band cell in those newborns with sign and symptoms of sepsis, it was found that 32 (45.71%) have +ve band cell and 38 (54. 28%) with -ve result as in table 10. In relation to the onset of sepsis 14 (43.75%) of patients with early sepsis have +ve band cell and 18 (56.25%) with late sepsis as in table 11. This is not statistically significant (p-value >0.05).

In Patients with +ve blood culture, there are 15 (83.33%) patients have +ve band cell and 15 (30. 62%) patients with –ve blood culture have +ve band cell as in table 20. This Study compared with other study done in India [30] showed that 166 (44.6%) +ve for band cells from the total number (372 patients) and 115 (89.84%) band cell in those +ve culture and 193 (79.09%) -ve band cell in those

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with -ve blood culture. This difference between the results may be related to the experience of the staff in the lab unit or due to the use of antibiotics.

Table 20. Blood Culture & Band Cell Results.

Blood culture result	+ve Band cell: No. (%)
+ve (18)	15 (83. 33%)
-ve (49)	15 (30. 61%)
Contaminated (3)	2 (66. 66%)
Total (70)	32 (45. 71%)

Table 12 shows that 6 (21.42%) with early sepsis have WBC<5000 and 12 (42.85%) with WBC >21,000. In late sepsis, there are 10 (23.80%) patients with WBC <5000 and 17 (40.47%) with WBC >21.000. This result not significant statistically (p-value >0.05).

Relation of WBC and results of blood culture, table 13 shows that 6 (33. 33%) patients with +ve blood culture have WBC count <5000, and 9 (50%) their WBC >21.000. In those with –ve culture, there are 10 (20.40%) patients with WBC <5,000, and 19 (38.77%) with WBC >21,000. This Study comparable with other study done in Pakistan [31]& similar study which nearly have same result done in Pakistan [32] which shows (23.5%) with WBC <5000 with +ve culture and (29.4%) with-ve culture. This difference in the results may be affected by irrational use of antibiotics or to the experience of lab staff in the counting of WBC.

For platelets number, our study shows that 39 (55. 71%) patients have platelets count <150,000, 19 (67.85%) patients with early sepsis and 20 (47.61%) with late sepsis as in table 14. In relation with the results of blood culture, the study shows 13 (72. 22%) patients have +ve blood culture and 24 (48. 97%) patients with –ve blood culture as in table 15. These findings in comprise with study done in India [33] which showed (35.71%) with plt <100,000 and (85.50%) with those +ve blood culture and (73.17%) in those with-ve blood culture. This difference in the result could be due to the low level of platelets count taken (<100,000).

Results of ESR shows 25 (89.28%) patients have ESR >6mm/h with early sepsis and 37 (88.09%) patients with late sepsis. This result not significant statistically (p-value>0. 05), as in table 16. ESR >6mm/h in 16 (88.88%) patients with +ve culture and 45 (91.83%) patients with -ve culture as in table 17. This result

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might be due to the highly sensitivity of ESR against any inflammatory process affecting the body. I cannot find other study show this relation, but Study done in Navi Mumbai[34]. show Micro-ESR demonstrated high sensitivity (87.5%) but low specificity (28.80%) for detecting neonatal sepsis.

Table 18 shows values of different tests used for sepsis evaluation and their relation to the clinical sepsis, it was found that blood culture +ve in 18 (26.8%) out of 67 patients and the results statistically not significant. This result differs to other study in India [35] which showed (54.5%) of patients have +ve blood culture and in Egypt [36] which showed 140 (40.7) out of 344 patients have +ve culture. The results of other tests were statistically significant except for band cell. This mean that there is a need for combination of other diagnostic tests to improve the predictive values rather than use single test, especially in our society as there is widely using of antibiotics.

Barbara J. Stoll [37] mentioned that It is important to note, however, that some patients with bacterial infection may have negative blood cultures ("clinical infection"), and other approaches to identification of infection are needed &If the mother has been treated with antibiotics for chorioamnionitis, the newborn's blood culture result may be negative, the clinician must rely on clinical observation and other laboratory tests. So, this table recommend to use acute phase reactant and other hematological study in diagnose patient with clinical sepsis other than blood culture only because of irrational use of antibiotic during labor or prior to cesarian section and to all patients with clinical sepsis.

Regarding the positive results using in screening for sepsis in comprise to the +ve blood culture, table 19 which shows all the results are statistically significant. This support the idea that no single test helpful in clearly identifying which infant are infected and we should take combination of tests effective in predicting of sepsis.

Conclusions

Blood culture remains the gold standard for diagnosis of sepsis, but its positivity affected by using of antibiotics to neonate or the mother.

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Combination of other diagnostic tests improves the predictive values in relating to the use of single test.

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