

Role Of Serum Activin A In Diagnosis Of Neonatal Sepsis

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Abstract:

Background: Neonatal sepsis remains a leading cause of morbidity and mortality worldwide. Early diagnosis is challenging due to nonspecific clinical signs and limitations of current biomarkers. Activin A, a cytokine belonging to the TGF- β superfamily, has emerged as a potential early indicator of inflammatory processes.

Aim: to assess serum level of Activin A as a diagnostic tool for sepsis once target neonate admitted to NICU.

Methods: This case–control study included 90 neonates admitted to the NICU at El-Obour Insurance Hospital, Kafr El-Sheikh, from April 2025 to November 2025. They were divided into: Group I: 45 neonates with sepsis and Group II: 45 apparently healthy neonates as controls. All underwent full history, clinical examination, hematological scoring, routine laboratory investigations, blood culture, and measurement of serum Activin A levels using ELISA.

Results: Serum Activin A levels were significantly higher in septic neonates compared to controls. Activin A showed a strong correlation with hematological scores and the Tollner sepsis score. Receiver operating characteristic (ROC) analysis demonstrated excellent diagnostic performance, with an area under the curve (AUC) of 0.962, sensitivity of 93.33%, and specificity of 88.89%.

Conclusion: Serum Activin A is a promising biomarker for early diagnosis of neonatal sepsis, demonstrating high sensitivity and specificity and correlating well with sepsis severity scores.

Keywords: Neonatal sepsis, Activin A, Biomarker, ELISA, Tollner score, Hematological score.

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Introduction:

Neonatal sepsis, defined as a bloodstream infection occurring in newborns within the first 28 days of life, continues to be a major contributor to neonatal morbidity and mortality, particularly in low- and middle-income countries [1]. Its incidence ranges from one to five cases per 1,000 live births [2]. In addition to prolonging hospital stays, neonatal sepsis increases the risk of complications such as necrotizing enterocolitis, bronchopulmonary dysplasia, patent ductus arteriosus, and adverse neurodevelopmental outcomes due to inflammatory damage or direct central nervous system infection [3].

Blood culture remains the gold standard for diagnosis; however, several challenges hinder its reliability in neonates. These include the small blood volumes obtainable, low or intermittent bacteremia, and prior maternal intrapartum antibiotic exposure [4]. Due to the nonspecific presentation of sepsis and the high risk of mortality and morbidity without prompt treatment, many asymptomatic neonates undergo sepsis workups based on risk factors or clinical suspicion. Despite this, only 3–8%

of cultured samples yield positive results, even though 7–13% of all neonates are evaluated for sepsis [1].

Activin A, a pleiotropic cytokine and member of the TGF- β superfamily, plays essential roles in fundamental biological processes such as tissue repair and stem cell pluripotency [5]. Emerging evidence indicates that Activin A is also produced in response to infections and other inflammatory conditions. Serum Activin A levels rise early in the inflammatory cascade, often preceding elevations in tumor necrosis factor- α and interleukin-6, and increase significantly following *in vitro* stimulation with bacterial, viral, or pro-inflammatory toll-like receptor ligands [5]. This positions Activin A as a potential early biomarker for neonatal sepsis.

Methods:

This case control study was conducted from April 2025 to November 2025, in the newborn critical care unit of El Obour Insurance Hospital in Kafr El-Sheikh. For the study, ninety babies were divided into two groups: Group I (patient group): 45 neonates with

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sepsis based on follow-up observations that suggested sepsis or the presence of sepsis risk markers in the infant, ages 2–23 days, and Group II (Control Group): forty-five apparently healthy neonates. The ethics committee at Suez University's Faculty of Medicine authorized the study design, which adhered to the principles of the Declaration of Helsinki and was approved by the relevant ethics review board (IRB number: 3/2025 PED10).

Exclusion criteria included any syndromes or congenital defects, birth hypoxia, cerebral hemorrhages, and abnormalities of the central nervous system, as these conditions may raise the amount of Activin A (6), infants suffering from respiratory distress syndrome.

Methods

All participants were subjected to the full history taking including antenatal, natal and postnatal history including risk factors for sepsis, physical clinical examination and hematological Score of Sepsis that is consisted of WBC count overall $\geq 5000/\text{mm}^3$ or $\geq 25000/\text{mm}^3$ 12–24 hours or $\geq 21000/\text{mm}^3$ on the second day, neutrophil count overall $< 1750/\text{mm}^3$, band of immature neutrophils: $400/\text{mm}^3$, the I/T ratio is greater than 0.16 at birth, > 0.3 after 72 hours, or > 0.2 at the maximum normal ratio, I/M ratio ≥ 0.3 and platelets $\leq 150,000/\text{mm}^3$; degenerative alterations (toxic granules/Döhle bodies) (7). Total score is equal 7. Score > 3 is considered positive.

Routine laboratory tests included complete blood count (CBC), C-reactive protein (CRP) and blood culture. The human Activin A ELISA kit (Shanghai Sunred Biological Technology Co., China) was used to quantify serum Activin A following the manufacturer's instructions. Two milliliters of venous blood were collected under complete aseptic conditions and distributed into three tubes: 1 mL in EDTA tube for CBC, 1 mL in plain tube for CRP and the serum was stored at -20°C for Activin A measurement.

Statistical Analysis: The data that was entered into the computer was examined using the IBM SPSS software package, version 20.0. (Armonk, NY: IBM Corp., 2003) (Kirkpatrick LA et al. Fisher's Exact, the Pearson coefficient, the Student t-test, the Mann Whitney test, the Receiver operating characteristic curve (ROC), and the Chi-square test were all employed.

Results:

Table (1): Demographic data of the two studied groups:

Demographic data	Group I (n = 45)		Group II (n = 45)		Test of Sig.
	No.	%	No.	%	
Gender	29	64.4	27	60.0	$\chi^2=0.189$
Male	16	35.6	18	40.0	
Female					
Age (days)	2.0 – 23.0 (4.0)		2.0 – 21.0 (4.0)		U=972.50
Min	10.0		7.0		
Max			11.0		
Median (IQR)					
Gestational age (weeks)		55.6		60.0	$\chi^2=0.182$
Preterm (≤ 37)		44.4		40.0	
Full term (> 37)					
Min	33.0 – 39.0		33.0 – 39.0		U=988.0
Max					
Median	37.0(33.0 – 39.0)		37.0(33.0 – 39.0)		

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(IQR)					
Consanguinity	88.9	39	86.7	$\chi^2=$	
Negative	11.1	6	13.3	0.104	
Positive					

Group I: neonates with sepsis Group II: control
 IQR: Inter quartile range, SD: Standard deviation
 t: Student t-test, U: Mann Whitney test, χ^2 : Chi square test, p: p value for comparing between the two studied groups, *: Statistically significant at $p \leq 0.05$
 There was non-significant statistical difference between the two studied groups regarding consanguinity, age in days, gender and gestational age in weeks (Table 1).

Table (2): Maternal and neonatal data of the two studied groups:

Maternal data	Group I (n=45)		Group II (n=45)		Test of Sig.	
	No.	%	No.	%		
Maternal age (years)						0.646
Min.	20.0	44.0	21.0	40.0		
Max.	29.47		30.02	5.15		
Mean \pm SD	6.25					
Gravidity	9	20.0	9	20.0		
1	17	37.8	16	35.6	$\chi^2=$	0.972
2	19	42.2	20	44.4	0.056	
≥ 3						
Min. - Max.	1.0 - 5.0		1.0 - 5.0		U=	0.820
					985.50	

x.						
Parity						
Primipara	12	26.7	9	20.0	$\chi^2=$	0.455
Multipara	33	73.3	36	80.0	0.559	
Min. - Max.	1.0 - 5.0		1.0 - 5.0		U=929.0	0.477
Median (IQR)	2.0 (1.0 - 3.0)		2.0 (2.0 - 3.0)			
Abortion						
No. of Abortion	35	77.8		86.7	$\chi^2=$	0.270
	10	22.2		13.3	1.216	
Maternal risk factors						
CS	42	93.3	37	82.2	$\chi^2=2.589$	0.108
DM	3	6.7	4	8.9	0.155	Fep=1.000
HTN	7	15.6	8	17.8	0.080	0.777
UTI	6	13.3	4	8.9	0.450	0.502
ROM	15	33.3	12	26.7	0.476	0.490
Neonatal risk factors						

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Prema- turity	15	33.3	12	26.7	$\chi^2=0.476$	0.490
IUGR	4	8.9	0	0.0	4.186	FEp=0.117

Group I: neonates with sepsis Group II: control
 IQR: Inter quartile range, SD: Standard deviation U: Mann Whitney test, χ^2 : Chi square test, FE: Fisher Exact, p: p value for comparing between the two studied groups, *: Statistically significant at $p \leq 0.05$. Cs: caesarean section. DM: diabetes mellitus. HTN: hypertension, UTI : urinary tract infection, PROM: premature rupture of membrane IUGR: intrauterine growth retardation.

There was non-significant statistical difference between the two studied groups regarding maternal age, gravidity, parity and abortion. There was non-significant statistical difference regarding IUGR, prematurity, CS, DM, HTN, UTI and PROM (Table 2).

Table (3): Vital signs of the two studied groups:

Vital Signs	Group I (n = 45)		Group II (n = 45)		Test of Sig.	p
	No.	%	No.	%		
Respiratory rate (Breaths / min)						
Min.	37.0		37.0		U=	0.061
Max.	75.0		60		781.0	
Median (IQR)	48.0 (44.0-54.0)		45 (43.0-50.0)			
Heart rate (Beats / min)						
Min.	119.0		106.0		t=9.272	<0.001
Max.	183.0		142.0		*	*
Mean \pm SD.	$\pm 147.4 \pm 13.85$		$\pm 124.6 \pm 8.93$			
MBP						

Min.	32.0	32.0		
Max.	96.0	77.0	t=2.621	0.011*
Mean \pm SD.	$\pm 71.07 \pm 16.17$	$\pm 63.62 \pm 10.08$	*	
Temperature				
Min.	36.10	36.50	t=2.138	0.037*
Max.	39.0	37.50		
Mean \pm SD.	$\pm 37.34 \pm 0.60$	$\pm 37.13 \pm 0.27$	*	

Group I: neonates with sepsis Group II: control
 U.O.P: urine output, IQR: Inter quartile range, SD: Standard deviation t: Student t-test, U: Mann Whitney test p: p value for comparing between the two studied groups, *: Statistically significant at $p \leq 0.05$
 MBP: mean blood pressure

There was significant statistical difference between the two studied groups regarding heart rate, MBP and temperature ($p < 0.001, 0.011, 0.037$ respectively) but there was non-significant statistical difference regarding respiratory rate (Table 3).

Table (4): Clinical signs and blood culture of group 1 (cases):

	Group I (n = 45)	
	No.	%
Clinical signs		
Clinical Signs	15	33.3
Poor suckling		
Decreased U.O.P.	15	33.3
Mottling	14	31.1
Impaired perfusion	34	75.6
Petechial Rash	8	17.8
Sclerema	11	24.4
Jaundice	3	6.7
Fever		

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Negative	29	64.4
Positive (≥37.6)	16	35.6
Blood culture		
Klebsiella	14	31.1
Staph. aureus	14	31.1
Enterobacter	10	22.2
No growth	7	15.6

Group I: neonates with sepsis, U. O.P: urine output

33.3% of the cases showed poor suckling ,33.3% of the cases showed decreased urine output, 31.1% showed mottling, 75.6% showed impaired perfusion, 17.8% showed peticheal rash, 24.4 % showed sclerema, 6.7% showed neonatal jaundice and 35.6 % showed fever. 31.1 % of the cases showed klebsiella growth ,31.1% showed Staph. aureus, 22.2% showed enterobacter growth and 15.6% showed no growth (Table 4).

Table (5): laboratory data of the two studied groups:

Variable	Group I (n = 45)		Group II (n = 45)		Test of Sig.	
	No.	%	No.	%		
Glucose intolerance	27	60.0	45	100.0	$\chi^2=22.50$	<0.001*
Negative	18	40.0	0	0.0		
Positive						
CRP	40	88.9	45	100.0	$\chi^2=72.0$	<0.001*
Negative	5	11.1	0	0.0		
Positive						
Min.	11.04		6.0	6.0	U=0.000	<0.001*
Max.	149.3		6.0	6.0		
Median	34.0 (24.0)		6.0	6.0		
Mean						
SD	48.0					

Variable	Group I (n = 45)	Group II (n = 45)	U=	p-value
WB				
Cs	1.90	4.50 – 14.0	390.5	<0.001*
Min	36.50	7.30(5.60 – 9.0)	0*	
Max.	25.10(9.80 – 27.40)			
Median				
Plat	11.0	128.0 – 490.0	737.5	0.026*
Min	741.0	299.0 (214.0 – 325.0)	0*	
Max.	227.0(120.0 – 324.0)			
Median				
Bas	-13.0	-13.0 – -1.0	728.5	0.021*
exc	1.0	-8.0 (-10.0 – -5.0)	0*	
Min	-5.0	(-9.0 – -3.0)		
Max.				
Median				
Serum Activin A	147.0	107.09 – 195.32	10.897	<0.001*
Min. – Max.	390.3	195.32	7*	
Mean ± SD.	265.9 ± 58.69	± 161.50 ± 26.21		

Group I: neonates with sepsis Group II: control, IQR: Inter quartile range, SD: Standard deviation, t:Student t-test U: Mann Whitney test p: p value for comparing between the two studied groups, *:Statistically significant at $p \leq 0.05$

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There was significant statistical difference between the two studied groups regarding glucose intolerance ($p < 0.001$), CRP ($p < 0.001$), WBCs ($p < 0.001$) decrease in platelet ($p = 0.026$) and base excess ($p = 0.021$) in neonates with sepsis group when compared to control group. There was significant statistical increase of Activin A level in neonates with sepsis group when compared to control group (Table 5).

Table (6): Distribution of the studied cases according to hematological score of sepsis, hematological score of sepsis and onset of sepsis in group I (n = 45):

Variable	Min. – Max.	Mean ± SD.	Median (IQR)
Hematological score of sepsis	5.0 – 7.0	5.89 ± 0.83	6.0 (5.0 – 7.0)
Tollner sepsis scoring	6.0 – 11.0	7.69 ± 1.39	7.0 (7.0 – 8.0)
Onset of disease		No.	%
<3 (early)		24	53.3
>3 (late)		21	46.7

IQR: Inter quartile range, SD: Standard deviation

The mean of hematological score of sepsis was 5.89 ± 0.83 , Regarding Tollner sepsis scoring in neonates with sepsis, the Mean \pm SD was 7.69 ± 1.39 and the median was 7. Regarding distribution of the studied cases according to onset of sepsis, there was 53.3% less than 3 days versus 46.7% more than 3 days (Table 6).

Table (7): Correlation between serum Activin A level, hematological score of sepsis and Tollner sepsis scoring in group I (n = 45):

	serum Activin A level	
	r	p
Hematological score of sepsis	0.853	<0.001*
Tollner sepsis scoring	0.562*	<0.001*

r: Pearson coefficient, *: Statistically

significant at $p \leq 0.05$

In neonates with sepsis group, there was significant statistical association between increased serum Activin A levels and hematological score of sepsis. There was significant statistical association between increased serum Activin A level and Tollner sepsis scoring in neonates with sepsis (Table 7).

Table (8): Relation between Serum Activin A level with Onset of disease and Gestational age (weeks) in Group I (n = 45)

		Serum Activin A level			
		Mean ± SD.	Median (Min. – Max.)		
Gestational age (weeks)	Preterm (≤ 37)	246.38 ± 7.01	233.93 (146.13 – 290.33)	2.663*	0.011*
	Full-term (> 37)	290.33 ± 6.83	276.14 (204.58 – 375.64)		
Onset of disease	≤ 3 (early)	306.62 ± 46.14	291.51 (250.06 – 390.34)	7.652*	<0.001*
	> 3 (late)	219.39 ± 29.45	221.66 (147.01 – 254.84)		

t: Student t-test, p: p value for comparing between the two studied groups, *: Statistically significant at $p \leq 0.05$

There was significant difference in serum activin A level regarding onset of disease (lower than 3 days versus higher than 3 days) and gestational age (preterm versus full-term) in neonates with sepsis (Table 8).

Table (9): Prognostic performance for serum

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Activin A level to discriminate group I (n = 45) from control (n = 45):

	AUC	P	95% C.I	Cut off	Sensitivity	Specificity	PPV	NPV
Serum Activin A level	0.962	<0.001*	0.915 – 1.0	>190.89	93.33	88.89	89.4	93.0

AUC: Area Under a Curve, p value: Probability value, CI: Confidence Intervals, NPV: Negative predictive value, PPV: Positive predictive value, *: Statistically significant at $p \leq 0.05$

At AUC 0.962 (95% CI: 0.915 – 1.0) and cut off point of > (190.89), the sensitivity of Activin A level to differentiate between neonates with sepsis and controls is (93.33%), the specificity is (88.89%), the positive predictive value is (89.4%) and the negative predictive value is (93%) (Table 9, Figure 1).

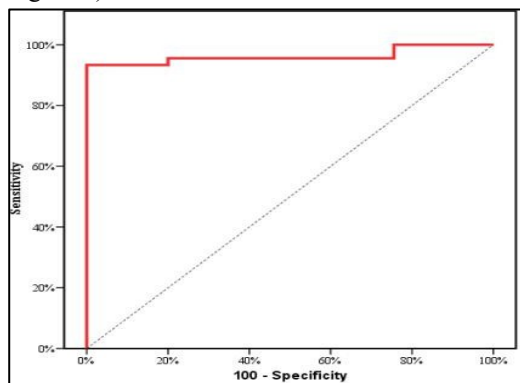


Figure (1): ROC curve for serum Activin A

level to discriminate sepsis (n= 45) from control (n = 45).

Discussion

Neonatal sepsis remains a critical health burden, especially in resource-limited settings. Clinicians face difficulties in making an early diagnosis since sepsis symptoms are nonspecific. One frequent and conventional method for detecting sepsis is blood culture (8).

Blood cultures are time-consuming, though, and it takes at least two to five days for the organism in the blood to be identified. Furthermore, when fastidious or slow-growing organisms are cultured, or if antibiotic therapy has been started, Blood cultures' sensitivity sharply declines (9).

Activin A is a pleiotropic cytokine that belongs to the growth factor- β 1 class and converts (5). In both acute and chronic inflammatory conditions, serum and tissue activin levels rise (10). Serum activin-A concentration has been proposed as a potential predictor of disease severity in a number of investigations utilizing clinical and animal models (11).

Finding a new biomarker and diagnosing neonatal septicemia are important because they help identify sepsis early on and start the right treatment to reduce death and long-term morbidity. In order to prevent neonatal infection-related fatalities in that susceptible group, we evaluated the sensitivity and accuracy of utilizing Activin A as a biomarker for prompt detection of neonatal sepsis and to initiate treatment early (5).

The findings of our study, which involved 45 newborns with mean ages ranging from 2 to 23 days (15 preterm and 30 full-term). The percentage of men was 64.4%, while the percentage of women was 35.6%. The 45 seemingly healthy neonates (12 preterm and 33 full term) were chosen as neonates with suspected sepsis because they had sepsis risk factors or showed signs of sepsis during follow-up. There was no discernible difference between the two groups, and their fundamental demographic and maternal data matched. To eliminate the influence of these variables on the study's overall findings, this result was essential.

CS, DM, HTN, UTI, PROM, neonatal jaundice, IUGR, and preterm did not significantly differ between the two groups in our study.

In contrast to our research, Rameshwarnath et al. (12) examined the risk variables for sepsis and neonatal

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infections and found that low birth weight is a risk factor for nosocomial infections. Studies have shown that birth weight is a valid and independent predictor of nosocomial infection. Low birth weight neonates are susceptible to infections due to their lack of developed immune systems, protective endogenous microbial flora, and adequate structural barriers, as was most likely the case in this study.

Our results showed that hemodynamic parameters such as temperature, heart rate, and MBP increased considerably more in the sepsis group than in the control group ($p < 0.001$, $p = 0.011$, and $p = 0.037$, respectively).

Li et al.'s (13) analysis of neonatal sepsis clinical data revealed that sepsis-affected neonates had elevated body temperature, respiration rate, and heart rate, which is consistent with our findings.

According to our study's findings, laboratory tests revealed that 18 cases ($p < 0.001$) had glucose intolerance, 54 cases ($p < 0.001$) had positive CRP, the platelet count ($p = 0.026$) was substantially lower in the sepsis group than in the control group, and WBCs ($p < 0.001$) were significantly greater and more positive in the sepsis group than in the control group.

In line with our findings on glucosuria as an early indicator of newborn sepsis, Bekhof et al. (14) shown that sepsis neonates had a markedly higher level of glucose intolerance than the control group.

According to Zea-Vera et al.'s (15) article, Challenges in the diagnosis and management of neonatal sepsis, a single C-reactive protein (CRP) measurement has intolerably poor sensitivities, especially in the early stages of infection. A sensitivity of 74–89% and specificity of 74–95% are obtained by taking serial determinations 24–48 hours following the beginning of symptoms. The most widely used threshold is 10 mg/l, while other cutoff points ranging from 0.2 to 95 mg/l have also been employed.

Of the patients suspected of having NNS, 38 (29.5%) had positive CRP results. Hisamuddin et al. (16) found an accuracy of 70.07% for CRP in 72 hours of life, which is in contrast to our study.

The sensitivity of CRP tests was reported to be 40%. The low percentage of sensitivity for CRP tests could be due to the newborn's undeveloped immune system. As the baby grows larger, the CRP tests become more precise and sensitive. The low positive CRP reading could be the result of blood samples being taken for sepsis screening within a few hours of birth. However,

another study found adequate sensitivity and specificity (17).

The platelet count and WBCs are considerably lower in cases of sepsis, according to KC et al.'s (18) analysis of the parameters of complete blood counts and neonatal sepsis. Because bacteria and their products harm the endothelium, which leads to platelet aggregation, or because they bind directly to platelets, which leads to their aggregation and removal from circulation, this could be the result of enhanced platelet destruction during disseminated intravascular coagulation.

According to the results of our blood culture study, *Klebsiella* (31.1%) and *Staph aureus* (31.1%) were found in the majority of cases.

Similar findings were made by Hisamuddin et al. (16), who discovered that 30% of their sepsis cases had culture-positive *Klebsiella*. Furthermore, it can be challenging to identify pathogenic organisms in neonates with sepsis syndrome, according to Edmond and Zaidi (19). Because only tiny volumes of blood can frequently be extracted from neonates and because mothers are frequently given antepartum or intrapartum antibiotics, the bacterial burden may be modest. The technical challenges of sterile venipuncture in little infants can also result in extremely high contamination rates.

Additionally, because coagulase-negative staphylococci (such as *S. epidermidis*) are both pathogenic organisms and typical skin flora in babies with indwelling blood vessel catheters and premature newborns, and their involvement could be misunderstood. (16, 19).

Our study's serum activin A level results indicate that the sepsis group had a significantly higher serum activin A level than the control group ($p < 0.001$).

In line with our findings, Saleeh et al. (5) 55 neonates were split into two groups for an analytical cross-sectional comparison study: 25 healthy neonates served as the control group and 30 neonates with sepsis served as the study group. The results of the investigation showed that the septic and healthy neonates had significantly different levels of Activin A (4.89 ± 2.85 and 1.61 ± 0.92 pg/ml, $P < 0.05$).

Analysis of the receiver operating characteristic curve of the ideal cutoff point of serum Activin A in the diagnosis of sepsis among neonates was ≥ 2.49 with 96.7% sensitivity and 86% specificity, demonstrating the great significance of Activin A as a novel

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biomarker for early sepsis diagnosis (20).

According to the results of the Saleeh study, Activin A is a novel biomarker that can effectively aid in the prompt detection of neonatal sepsis. Although prior research has demonstrated the effectiveness of activin A in treating infections in both adults and animal models, as well as in diagnosing hypoxic ischemic encephalopathy in neonates, there is currently no conclusive prior research on its use in diagnosing infections in neonates (5).

This variation in Activin A expression in the serum of septic newborns may be explained by the activation of an endogenous defensive mechanism to organize inflammatory processes seen during the early days of neonatal sepsis. The amount of tissue injury and inflammation determines the production of activin A by neonatal peripheral blood mononuclear cells, not the type of organism producing the harm. (21).

Other research has demonstrated that Activin A is increased in the bloodstream during adult septicemia and is correlated with the degree of inflammation, which agrees with what we found. Additionally, elevated levels of Activin A are found in the cerebral fluid of both humans and animal models of meningitis. (22).

Serum activin-A may be a more accurate indicator of the current state of sepsis than other biomarkers that only reflect proinflammatory conditions because of the similarities between the net immunological response pattern in sepsis and the ambiguous role of activin-A in inflammation and immunity. (23).

In neonates with sepsis group, we identified substantial statistical connection between higher serum Activin A levels and hematological score of sepsis ($p < 0.001$). According to Elsayed et al., (24), the higher the score the greater the certainty of sepsis was present.

According to the current study's findings, full-term septic neonates had a considerably greater serum level of activin A than preterm newborns, and there was a significant difference in the time it took for the disease to manifest (less than three days versus more than three days). Saleeh study indicated substantial difference in their study between Activin A in preterm and full-term neonates (5). Additionally, Saleeh et al. (5) demonstrated that 1-2 days of life had higher levels of Activin A than 3-5 days and 6-8 days; however, there was no statistically significant difference between 3-5 days and 6-8 days.

The current study's findings indicated a significant statistical correlation ($p < 0.001$) between elevated serum Activin A levels and Tollner sepsis scores in sepsis-affected infants.

Tollner developed a score system for early newborn sepsis diagnosis based on laboratory testing and clinical assessment. Putri et al. (25) declared that the Tollner's score cut-off was 11.8, with a sensitivity of 91.7% and a specificity of 87.5. Tollner's score can be used in restricted healthcare facilities since it has strong sensitivity and specificity for diagnosing infant sepsis.

Conclusion:

With its high sensitivity and specificity and strong correlation with sepsis severity levels, One promising biomarker for the early identification of neonatal sepsis is serum activin A.

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