Research Article

Pamukkale Medical Journal
doi:https://dx.doi.org/10.31362/patd.1457265

Received: 22.03.2024
Accepted: 14.05.2024
Area of Expertise: Clinical Sciences

Title: Evaluation of Ema, Töllner and Rodwell scores in the diagnosis of neonatal sepsis.
Short title: Comparison of newborn sepsis scores.

Abstract

Purpose: There are no specific signs, symptoms and rapid laboratory tests to definitively diagnose sepsis in the neonatal period. Therefore, in this study, we planned to investigate the clinical adequacy and reliability of EMA (European Medicines Agency), Töllner and Rodwell hematological scoring in the early diagnosis of neonatal sepsis.

Materials and methods: EMA, Töllner and Rodwell hematological scoring was performed on each patient. Complete blood count, peripheral smear, C-reactive protein, procalcitonin, blood gas and blood sugar values of newborn babies with suspected sepsis were recorded, blood culture, urine culture and cerebrospinal fluid examination and cultures taken when necessary were evaluated. Using statistical analysis, the 'Positive Expected Value and Negative Expected Values' ratios of the scores were obtained, and the performance results were examined.

Results: 95 newborns with a preliminary clinical diagnosis of sepsis were included in the study. These babies were divided into two groups: clinical (n:71) and proven sepsis (n:24) according to blood culture results. Positive and negative predictive values of scoring systems in definitive sepsis diagnosis; for EMA respectively; 21.5%, 56.3% for Töllner; It was determined as 31.3%, 77.8%, and 100%, 77.8% for Rodwell.

Conclusion: Our study showed that clinician opinion and standard laboratory tests are limited in the diagnosis of neonatal sepsis, and Rodwell hematological scoring is more prominent in recognizing proven sepsis compared to the other two scores.

Keywords: Sepsis, newborn, EMA, Töllner, Rodwell.

Makale başlığı: Yenidoğan sepsis tanısında Ema, Töllner ve Rodwell skorlarının değerlendirilmesi.

Öz

Amaç: Yenidoğan döneminde sepsis tanısını kesin olarak saptayacak özgün belirti, bulgu ve hızlı laboratuvar testleri bulunmamaktadır. Bu nedenle bu çalışmada yenidoğan sepsisinin erken tanısında EMA (European Medicines Agency), Töllner ve Rodwell hematolojik skorlamalarının klinik yeterlilik ve güvenirliğini araştırmayı planladık.

Yöntem: Her hastaya EMA, Töllner ve Rodwell hematolojik skorlaması yapıldı. Sepsis düşünülen yenidoğan bebeklerin tam kan sayımı, periferik yayma, C-reaktif protein, prokalsitonin, kan gazı ve kan şekeri değerleri kaydedildi, bebeklerden alınan kan kültürü, idrar kültürü ve gerekli hallerde alınmış beyin omurilik sıvı incelemesi ve kültürleri değerlendirildi. İstatistiksel analizler kullanılarak skorlamaların 'Pozitif Beklenen Değer ve Negatif Beklenen Değerler' oranları elde edildi, performans sonuçları incelendi.

Bulgular: Klinik sepsis ön tanısı alan 95 yenidoğan çalışmaya alındı. Bu bebekler kan kültürü sonuçlarına göre klinik (n:71) ve kanıtlanmış sepsis (n:24) olmak üzere iki gruba ayrıldı. Kesin sepsis tanısında skorlama sistemlerinin pozitif ve negatif prediktif değerleri; sırasıyla EMA için; %21,5, %56,3, Töllner için; %31,3, %77,8, Rodwell için ise %100, %77,8 saptandı.

Sonuç: Çalışmamız, yenidoğan sepsis tanısında klinisyen görüşünün ve standart laboratuvar testlerin sınırlı olduğunu, Rodwell hematolojik skorlamasının diğer iki skorlamaya göre kanıtlanmış sepsisi tanımada daha ön planda olduğunu göstermiştir.

Anahtar kelimeler: Sepsis, yenidoğan, EMA, Töllner, Rodwell.

Introduction

Neonatal sepsis is a clinical syndrome in which systemic findings and signs of infection are seen in the first month of life and a specific pathogen is grown in blood culture [1-3]. Despite advances in maternal and neonatal care, neonatal sepsis continues to be a major factor in morbidity and mortality. [4-6].

Signs and symptoms in the neonatal sepsis are generally non-specific. In early-onset neonatal sepsis, findings related to multiple organs or systems may occur, whereas in late and very late-onset neonatal sepsis, infection findings may be multisystemic or focal (such as meningitis, pneumonia, omphalitis, osteomyelitis, septic arthritis) [7]. Neonatal sepsis may affect many systems and present with many different findings such as moaning, withdrawal of auxiliary respiratory muscles, nasal wing respiration, apnea,

cyanosis, tachypnea in the respiratory system; bradycardia/tachycardia, peripheral circulatory disorder, hypotension, increased capillary filling time in the cardiovascular system; feeding intolerance, failure to suck, vomiting, diarrhoea, abdominal distension, hepato-splenomegaly, jaundice in the digestive system; sclera, cutis marmaratus, pustules, abscesses, petechiae, pupura in the skin; and lethargy, hypotonicity, tendency to sleep, poor or high pitched crying, puffy fontanelle, irritability, convulsion, hypoactivity, temperature irregularities and failure to suck in the central nervous system [7-10].

Isolation of the specific pathogenic agent from the blood, which should be absolutely sterile, is the gold standart for definitly diagnosis of the neonatal sepsis [11]. In a blood culture taken with the correct methods, the growth time of the agent is within the first 48 hours in 90% of patients. While waiting for the culture result, there is no test with high sensitivity and specificity that can help to define the diagnosis of sepsis in a shorter time. Diagnosis is aided by the use of several inflammatory markers together [8].

In addition to the lack of specific signs, symptoms, findings and rapid laboratory tests for the diagnosis of neonatal sepsis, the possibility that findings suggestive of sepsis may be related to non-infectious causes that are common in the neonatal period makes the diagnosis of neonatal sepsis difficult. This situation makes timely diagnosis and initiation of treatment difficult in babies without sepsis or leads to unnecessary treatment [2].

Various combinations of inflammatory response factors, laboratory analysis, and physical examination findings have been used in the literature to create sepsis scores. In 1982, Töllner developed the first known scoring system for neonatal sepsis to define sepsis on the basis of both clinical and basic laboratory assessment [12]. Rodwell developed hematological sepsis scoring in 1988 [13]. The Pediatric Committee (PDCO) of the European Medicines Agency (EMA) proposed the EMA sepsis criteria for the standardisation of the diagnosis of neonatal sepsis in 2010 [14]. However, a specific scoring method with high sensitivity and reliability in recognizing neonatal sepsis has not yet been developed. Also, there are no reports evaluating EMA, Töllner and Rodwell scores together in the literature. Therefore, in this study, EMA, Töllner, and Rodwell scores were compared in proven and clinical sepsis cases and their predictive values in the early diagnosis of the neonatal sepsis were evaluated.

Materials and methods

A total of 95 neonates who were admitted to the neonatal intensive care unit of Pamukkale University Hospital between July 2021 and July 2023, who were diagnosed with clinical or proven sepsis, and for whom parental consent was obtained, were enrolled in this study.

Newborns who had significant congenital abnormalities, proven intrauterine infection, metabolic disease, history of chorioamnionitis, preterm rupture of membranes (>18 hours), history of maternal antibiotic use in the last week of pregnancy (except for the last 4 hours prenatally), and antibiotic use in the last 1 week with a clinical diagnosis of sepsis were not included in the study.

Complete blood count, peripheral smear, C-reactive protein (CRP), procalcitonin, blood gas and blood glucose values routinely obtained from newborn babies with sepsis were recorded. Blood culture, urine culture and cerebrospinal fluid (CSF) examination and culture obtained when necessary were recorded.

EMA scoring, Rodwell hematological scoring, and Töllner scoring were performed in each patient included in the study.

All data were evaluated with SPSS 25.0 (IBM SPSS Statistics 25, IBM Corporation, Armonk, New York, United States). Continuous variables are expressed as mean ± standard deviation. Categorical variables are expressed as numbers and percentages.

Spearman or Pearson correlation analyses were used to analyse relationships between continuous variables. When the assumptions for parametric tests were met, the significance test for the difference between two means and one-way analysis of variance were used to analyse differences between groups; when the assumptions for parametric tests were not met, Kruskal-Wallis analysis of variance and the Mann-Whitney U test were used.

Variations between categorical parameters were assessed by Chi-square analysis. ROC analysis method was used for analysing the performance and validity of the scores.

Youden Index value was used in determining the most appropriate cut-off point as a result of ROC analysis. As a result of the examinations made with the most appropriate cut-off points obtained from Youden Index values, the performance results were analysed by obtaining the ratio of 'Positive Expected Value and Negative Expected Value' of the scoring.

This study was approved by the Pamukkale University Non-Interventional Clinical Research Ethics Committee.

Results

A total of 95 neonates with clinical or proven sepsis admitted to the neonatal intensive care unit of Pamukkale University Hospital were involved in our study. Demographic and clinical data of these infants according to clinical sepsis and proven sepsis are presented in Table 1. Table 2' EMA, Table 3' Töllner and Table 4' Rodwell scores parameters are shown. Table 5-7, show the positive and negative predictive values of EMA, Töllner and Rodwell scores in proven sepsis, respectively.

When comparing the demographic and clinical data between both groups, a statistically significant difference was found in birth weight, Apgar scores, age at onset of infection, early (<3 days), late (3-30 days), very late (>30 days) sepsis and length of hospital stay, while there was no other statistically important difference. Significant differences were observed between both groups in terms of respiratory evaluation, metabolic acidosis and apnea data in the Töllner score, and degenerative changes in neutrophils in the Rodwell score, which are among the parameters of the EMA score.

The positive and negative predictive values of the scoring methods for the definite diagnosis of sepsis were 21.5%, 56.3%; 31.3%, 77.8% and 100%, 77.8% for EMA, Töllner, and Rodwell scoring, respectively.

Discussion

In this presented study, we found the positive and negative predictive values of the scoring methods in the diagnosis of proven sepsis to be 21.5%, 56.3%, 31.3%, 77.8%, and 100%, 77.8% for EMA, Töllner, and Rodwell, respectively. As can be seen from this study, Rodwell hematological scoring appears to be the most effective scoring method in definitive sepsis detection.

To demonstrate the importance of the Rodwell hematological scoring method in the detection of neonatal sepsis, a study was conducted in India in 2009 in which 12 patients with proven sepsis, 26 patients with clinical sepsis and 12 healthy infants were included. It was found that immature/total neutrophil ratio (I:T) and immature/maturity neutrophil ratio (I:M) were the highest sensitive parameters in defining neonates with sepsis [15]. A study was conducted in India in April-July 2011 to evaluate and emphasise the importance of the Rodwell hematological scoring method in the rapid detection of neonatal sepsis. A total of 110 infants with proven sepsis (n=42), clinical sepsis (n=22) and control group (n=46) were included in the study. Immature polymorphonuclear neutrophil (PMN) count was found to be the highest sensitive (96.87%) and I:M PMN ratio the most specific (97.22%) indicator. It has been shown that hematological sepsis scoring has a much higher sensitivity and specificity in premature than in term newborns

[16]. In our study, we did not detect any differences in ratio of I:M and I:T and did not divide the groups into term and premature infants however, we noticed that the change in the direction of toxic granulation in neutrophils in the Rodwell hematological scoring method could be evaluated in favour of proven sepsis.

A multicentre prospective methodological study was conducted in Türkiye between October 2015 and November 2018 to evaluate the adequacy of EMA sepsis criteria in the definition of neonatal sepsis. A total of 245 infants over 34 weeks of age who met the EMA criteria or suspected sepsis were accepted into the trial. In 97 infants, EMA criteria were found to be positive, and 113 patients were diagnosed with proven sepsis. The sensitivity, specificity, and accuracy of the EMA criteria for proven sepsis were 44.2%, 64.4%, and 55.1%, respectively [17]. In our study, we found the positive and negative predictive values of EMA scoring method in the diagnosis of definite sepsis to be 21.5% and 56.3%.

In a study published in Indonesia in 2022, which included forty-seven newborns, the positive predictive value of Töllner score in the diagnosis of neonatal sepsis was 91.7% and the negative predictive value was 87.5% [18]. In contrast to the high positive and negative predictive value according to Indonesia study, we found a positive predictive value of 31.3% and a negative predictive value of 77.8% for the Töllner score in our study.

To our knowledge, there is no any publication included a comparison of all three sepsis scoring methods including EMA, Töllner, and Rodwell used to diagnosis for the neonatal sepsis. Therefore, our study is the first study to comperison all three sepsis scoring methods. The primary limit of this research was the restricted number of patients and the lack of a healthy control group.

In conclusion, our study showed that clinical assessment and routine laboratory tests are limited in the definition of neonatal sepsis and that the Rodwell hematological score is more accurate in detecting proven sepsis than the other two scoring methods. It is urgently needed to find more sensitive and more specific scoring methods or biological parameters for earlier recognition of neonatal sepsis, which is an important cause of morbidity and mortality. For this, additional large-scale randomised controlled trials with long-term results are needed.

Conflict of interest: No conflict of interest was declared by the authors.

Referrences

1. Satar M, Engin Arısoy A, Çelik İH. Turkish neonatal society guideline on neonatal infections-diagnosis and treatment. Turk Pediatri Ars 2018;53:88-100. https://doi.org/10.5152/TurkPediatriArs.2018.01809

2. Haslam BD. Epidemiology of infection. In: Kliegman RM, Blum NJ, Shah SS, eds. Nelson textbook of pediatrics. 21st ed. Philadelphia: Elsevier 2020:996-1005.
3. Stovall SH, Hoffman MA. Bacteremia, Sepsis, and Septic Shock. In: Kline MW, Blaney SM, Giardino Ap, eds. Rudolph's pediatrics. 23rd ed. McGraw-Hill Education 2018:3295-3304.
4. Embree JE, Alfattoh NI. Infections in the newborn. In: MacDonald MG, Seshia MMK, eds. Avery's neonatology pathophysiology and management of the newborn. 7th ed. Philadelphia: Wolters Kluwer 2016:930-982.
5. Weinberg GA. Infections of Organ Systems. In: Chess PR, ed. Avery's neonatology board review certification and clinical refresher. 1st ed. Philadelphia: Elsevier 2019:273-281.
6. Clinical features, evaluation, and diagnosis of sepsis in term and late preterm infants. Available at: https://www.uptodate.com/contents/clinical-features-evaluation-and-diagnosis-of-sepsis-in-term-and-late-preterm-neonates. Accessed March 04, 2022
7. Shane AL, Sánchez PJ, Stoll BJ. Neonatal sepsis. Lancet 2017;390:1770-1780. https://doi.org/10.1016/S0140-6736(17)31002-4
8. Satar M, Arısoy AE, Çelik İH. Türk neonatoloji derneği yenidoğan enfeksiyonları tanı ve tedavi rehberi 2023 güncellemesi. Available at: https://neonatology.org.tr/tani-tedavi-protokolleri. Accessed December 9, 2023
9. Edwards MS, Baker CJ. Sepsis in the newborn. In: Gershon AA, Hotez PJ, Katz SL, eds. Krugman's infectious diseases of children. 11th ed. Philadelphia:Mosby 2004:545-561.
10. Gerdes JS. Diagnosis and management of bacterial infections in the neonate. Pediatr Clin North Am 2004;51:939-959. https://doi.org/10.1016/j.pcl.2004.03.009
11. Embree JE, Alfattoh NI. Infections in the newborn. In: MacDonald MG, Seshia MMK, eds. Avery's neonatology pathophysiology and management of the newborn. 7th ed. Philadelphia: Wolters Kluwer 2016:930-982.
12. Saldir M, Tunc T, Cekmez F, et al. Endocan and soluble triggering receptor expressed on myeloid cells-1 as novel markers for neonatal sepsis. Pediatr Neonatol 2015;56:415-421. https://doi.org/10.1016/j.pedneo.2015.03.006
13. Rodwell RL, Leslie AL, Tudehope DI. Early diagnosis of neonatal sepsis using a hematologic scoring system. J Pediatr 1988;112:761-767. https://doi.org/10.1016/s0022-3476(88)80699-1
14. European Medicines Agency (EMA). Report on the Expert Meeting on Neonatal and Paediatric Sepsis. London: 2010. Available at:

https://www.ema.europa.eu/en/documents/report/reportexpert-meeting-neonatal-paediatric-sepsis_en.pdf. Accessed April 13, 2020
15. Narasimha A, Harendra Kumar ML. Significance of hematological scoring system (HSS) in early diagnosis of neonatal sepsis. Indian J Hematol Blood Transfus 2011;27:14-17. https://doi.org/10.1007/s12288-010-0050-2
16. Makkar M, Gupta C, Pathak R, Garg S, Mahajan NC. Performance evaluation of hematologic scoring system in early diagnosis of neonatal sepsis. J Clin Neonatol 2013;2:25-29. https://doi.org/10.4103/2249-4847.109243
17. Tuzun F, Ozkan H, Cetinkaya M, et al. Is European Medicines Agency (EMA) sepsis criteria accurate for neonatal sepsis diagnosis or do we need new criteria? PLoS One 2019;14:e0218002. https://doi.org/10.1371/journal.pone.0218002
18. Putri VR, Lubis BM, Lubis IND. Effectiveness of Tollner's score and procalcitonin for diagnosing neonatal sepsis. IJISRT 2022;7:947-950. https://doi.org/10.5281/zenodo.6974466

Ethics committee approval: Pamukkale University Non-Interventional Clinical Research Ethics Committee approval (date: 03.08.2021, no: 14 and number: E-60116787-020-83901) was obtained for the study.

Authors' contributions to the article

O.M.A.O. and B.E. constructed the main idea and hypothesis of the study. Discussion section of the article written by M.T. O.M.A.O. reviewed, corrected and approved. In addition, all authors discussed the entire study and approved the final version.

Table 1. Demographic and clinical data according to clinical sepsis and proven sepsis status

	Clinical sepsis	Proven sepsis	*p* value
Total Count (n)	71	24	
Birth weight mean ± SD, (gram)	2570.18±934.24	1395.20±774.45	**0.001**
Weight according to birth week **AGA** **SGA** **LGA**	 55 (77.5%) 10 (14.1%) 6 (8.5%)	 17 (70.8%) 5 (20.8%) 2 (8.3%)	 0.733
Mean birth week ± SD	35.08±5.58	30.02±4.73	0.063
Gender **girl (percentage)** **boy (percentage)**	 27 (38.0%) 44 (62.0%)	 7 (66.7%) 17 (70.8%)	 0.434
Birth type **C/S** **SVD**	 65 (91.5%) 6 (8.5%)	 24 (100%) -	 0.332
Apgar Score (median, min-max) **1th minute** **5th minute**	 8 (4-9) 9 (5-9)	 9 (6-10) 8 (1-10)	 **0.005**
Age at onset of infection (day)	7	17	**0.001**
Respiratory support (percentage)	48 (67.6%)	18 (75.0%)	0.496
Respiratory support type (percentage) **O_2 in newborn incubator** **nCPAP** **nIPPV** **Intubated PTV**	 4 (8.3%) 27 (56.3) 11 (22.9%) 6 (12.5)	 1 (5.6%) 4 (22.2%) 9 (50%) 4 (22.2%)	 0.062
Inotrope support	4 (5.6%)	0 (44.4%)	0.569
RDS	31 (43.7%)	15 (62.5%)	0.110
PDA	8 (28.6%)	7 (38.9%)	0.304
GM-IVH	4 (10.5%)	5 (23.8%)	0.502
Sepsis **Early** **Late**	 41 (57.7%) 29 (40.8%)	 2 (8.3%) 18 (75%)	 **0.001** **0.027**
Hospital stay ± SD, days	30.33±25.22	55.50±36.30	**0.001**

SD: standard deviation, AGA; appropriate for gestational age, SGA: small of gestational age, LGA: large of gestational age, C/S: caesarean section, SVD: spontaneous vaginal delivery, nCPAP: nasal continuous positive airway pressure, nIPPV: nasal intermittent positive pressure ventilation, PTV: patient triggered ventilation, RDS: respiratory distress syndrome, PDA: patent ductus arteriosus, GM-IVH: germinal matrix intraventricular hemorrhage

Table 2. Evaluation of EMA score parameters

	Clinical sepsis	Proven sepsis	*p* value
Total Count (n)	71	24	
Body temperature **normal** **>38.5** **<36.0**	 58 12 1	 22 2 0	0.486
Cardiovascular system **normal** **arrhythmia** **urine <1 ml/kg/h** **hypotension** **impaired peripheral perfusion**	 50 16 3 2 0	 13 10 0 0 1	0.101
Skin and subcutaneous lesions **none** **sclerem**	 70 1	 24 0	1.000
Respiratory **normal** **apnea** **tachypnea** **increased oxygen or ventilation support**	 21 7 29 14	 6 10 3 5	**0.002**
Gastrointestinal **no findings** **feeding intolerance** **decreased absorption** **abdominal distension**	 21 17 26 7	 6 10 4 4	0.165
Non-specific findings **none** **irritability** **lethargy** **hypotonicity**	 50 8 8 5	 16 3 1 4	0.429
Leukocyte count **normal** **<4000** **>20000**	 60 1 10	 20 1 3	0.710
Immature/Total neutrophil ratio **<0.2** **>0.2**	 18 53	 4 20	0.576

Platelet count **>100000** **<100000**	 64 7	 22 2	1.000
CRP **<15 mg/dL** **>15 mg/dL**	 48 23	 20 4	0.192
Base deficit **<10 mEq/L** **>10 mEq/L**	 69 2	 21 3	0.101
Serum lactate **<2 mMol/L** **>2 mMol/L**	 17 54	 10 14	0.119

CRP: c-reactive protein

Table 3. Evaluation of Töllner score parameters

	Clinical sepsis	**Proven sepsis**	***p* value**
Total Count (n)	71	24	
Change in skin color **none** **middle** **evident**	 64 4 2	 20 3 1	0.500
Peripheral circulatory disorder **none** **damaged**	 69 2	 23 1	1,000
Hypotonia **none** **middle** **evident**	 66 4 1	 19 5 0	0.078
Bradycardia **none**	 71	 24	-
Apnea **none** **There is**	 54 17	 10 14	**0.005**
RDS **none** **yes**	 35 36	 13 11	0.814
Hepatomegaly **none** **yes**	 71 -	 23 1	0.253
Gis finding **none** **yes**	 23 48	 6 18	0.612

Leukocyte **normal** **leukocytosis** **leukopenia**	 50 20 1	 18 5 1	 0.586
Shift left **none** **yes**	 56 15	 16 8	 0.273
Thrombocytopenia **none** **yes**	 60 11	 21 3	 1.000
Metabolic acidosis **none** **pH>7.2** **pH<7.2**	 28 42 1	 17 5 2	 **0.003**

RDS: respiratory distress syndrome

Table 4. Evaluation of Rodwell score parameters

	Clinical sepsis	**Proven sepsis**	***p* value**
Total Count (n)	71	24	
Total leukocyte count **normal** **<5000** **>25 000 at birth, 12-24** **>30000 per hour, >21000 after 2nd day**	 67 1 3	 20 1 3	 0.243
Total neutrophil count **normal** **neutrophil count increased or decreased**	 47 24	 16 8	 1.000
Immature Neutrophil count **normal** **increased**	 17 54	 4 20	 0.576
I/T **normal** **increased**	 18 53	 4 20	 0.576
I/M **<0.3** **>0.3**	 18 53	 4 20	 0.576
Degenerative changes in neutrophils **normal** **toxic granulation**	 68 3	 19 5	 **0.023**
Platelet count **<150 000** **>150 000**	 13 58	 3 21	 0.753

I/T: immature/total neutrophil ratio, I/M: immature/maturity neutrophil ratio

Table 5. Positive and negative predictive values of the EMA score

EMA Scoring	Clinical sepsis (n)	Proven sepsis (n)	Total count
Positive **count** **expected count** **% in EMA**	 62 59 78.5	 17 20 21.5	 79 79 100.0
Negative **count** **expected count** **% in EMA**	 9 12 56.3	 7 4 43.8	 16 16 100.0

Table 6. Positive and negative predictive values of Töllner score

Töllner scoring	Clinical sepsis (n)	Proven sepsis (n)	Total count
≥5 (possible sepsis) **count** **expected count** **% in Töllner**	 22 23.9 68.8	 10 8.1 31.3	 32 32 100.0
<5 (no sepsis) **count** **expected count** **% in Töllner**	 49 47.1 77.8	 14 15.9 22.2	 63 63 100.0

Table 7. Positive and negative predictive values of Rodwell score

Rodwell scoring	Clinical sepsis (n)	Proven sepsis (n)	Total count
≥5 (sepsis)			
count	0	5	5
expected count	3.6	1.4	5
% in Rodwell	00.0	100.0	100.0
<3 (no sepsis)			
count	42	12	54
expected count	38.4	15.6	54
% in Rodwell	77.8	22.2	100.0

Ozdemir OMA, Erdal B, Turgut M. Evaluation of Ema, Töllner and Rodwell scores in the diagnosis of neonatal sepsis. Pam Med J 2025;18:…-…

Özdemir ÖMA, Erdal B, Turgut M. Yenidoğan sepsis tanısında Ema, Töllner ve Rodwell skorlarının değerlendirilmesi. Pam Tıp Derg 2025;18:…-…

Özmert MA Özdemir, Prof. Pamukkale University Faculty of Medicine, Department of Child Health and Diseases, Department of Neonatology, Denizli, Türkiye, e-mail: drozmert@gmail.com (https://orcid.org/0000-0002-2499-4949)

Büşra Erdal, M.D. Pamukkale University Faculty of Medicine, Department of Child Health and Diseases, Denizli, Türkiye, e-mail: busra.erdal2@gmail.com (https://orcid.org/0000-0002-1816-8608)

Musa Turgut, M.D. Pamukkale University Faculty of Medicine, Department of Child Health and Diseases, Department of Neonatology, Denizli, Türkiye, e-mail: musaturgut1989@hotmail.com (https://orcid.org/0000-0001-6474-0161) (Corresponding Author)