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Studying the Relationship Between Gestational Age, Sepsis, and the Occurrence of Thrombocytopenia in Newborns in Al-Marj City in Libya from January 2022 to December 2023

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دراسة العلاقة بين مدة الحمل والإصابة بتعفن الدم مع نقص الصفائح الدموية لدى حديثي الولادة في مدينة المرج في الفترة من يناير 2022 إلى ديسمبر 2023

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Abstract:
This study aimed to analyze the relationship between gestational age and the incidence of sepsis (blood infection) accompanied by thrombocytopenia in newborns in the city of Al-Marj, in addition to identifying other factors that may increase the risk of infection such as sex, birth weight, blood type, delivery method and the health status of mothers. The study included a sample of 35 newborns from Al-Marj Teaching Hospital. The small sample size is attributed to the fact that thrombocytopenia is a rare and not widely prevalent condition. Data were collected from January 2022 to December 2023. Blood samples were taken from the newborns and a questionnaire was completed at the time of sample collection. The data were then analyzed using the Statistical Package for the Social Sciences (SPSS), calculating frequencies and percentages and performing a Chi-square test. The results were considered statistically significant if the P-value was less than 0.05.
This study reveals a statistically significant relationship between gestational age and sepsis with thrombocytopenia making newborns more vulnerable. Additionally, other factors such as sex, low birth weight, cesarean delivery and blood groups (A+ ,B+ and O+) contribute to thrombocytopenia in newborns.

Keywords: gestational age, sepsis, thrombocytopenia, sex, low birth weight, cesarean delivery, blood groups and newborn.

الملخص
هدفت هذه الدراسة إلى تحليل العلاقة بين العمر الحملي والإصابة بالإنتان (تعفن الدم) المصحوب بنقص الصفائح الدموية لدى حديثي الولادة في مدينة المرج، بالإضافة إلى تحديد العوامل الأخرى التي قد تزيد من خطر الإصابة، مثل الجنس وزن الولادة وفصيلة الدم وطريقة الولادة والحالة الصحية للأمهات. شملت الدراسة عينة مكونة من 35 مولودًا جديدًا من مستشفى المرج التعليمي، ويعود صغر حجم العينة إلى أن مرض نقص الصفائح الدموية من الأمراض النادرة وغير المنتشرة بشكل كبير. تم جمع البيانات من يناير 2022 إلى ديسمبر 2023. حيث تم أخذ عينات دم من المواليد واستكمال استبيان في وقت جمع العينات. ثم تم تحليل البيانات باستخدام برنامج الحزمة الإحصائية للعلوم الاجتماعية (SPSS) مع حساب التكرارات والنسب المئوية وإجراء اختبار مربع كاي (Chi-square test) اعتُبرت النتائج ذات دلالة إحصائية إذا كانت قيمة (P-value) أقل من 0.05.

كشفت الدراسة عن وجود علاقة ذات دلالة إحصائية بين العمر الحملي والإصابة بالإنتان المصحوب بنقص الصفائح الدموية، مما يجعل المواليد أكثر عرضة لهذه الحالة لعدم اكتمال وتطور نمو الجهاز المناعي ونخاع العظم. كما أظهرت أن عوامل أخرى مثل الجنس، انخفاض وزن الولادة، الولادة القيصرية، وفصائل الدم (+A، +B، +O) تساهم في زيادة خطر الإصابة بنقص الصفائح الدموية لدى حديثي الولادة.

الكلمات المفتاحية: العمر الحملي، الإنتان، نقص الصفائح الدموية، الجنس، انخفاض وزن الولادة، الولادة القيصرية، فصائل الدم، حديثي الولادة.

Introduction

Platelets are critical components of blood and play an indispensable role in hemostasis and the prevention of bleeding through their involvement in clot formation. Neonatal thrombocytopenia (NT) is characterized by a platelet count below 150,000 per microliter of blood in newborns and represents a critical hematological condition that can significantly impact neonatal health. The condition varies in severity, ranging from mild, asymptomatic cases to severe forms that can lead to life-threatening bleeding complications. (Roberts & Murray, 2003).

The etiology of neonatal thrombocytopenia is multifactorial with contributing factors including gestational age, sex, neonatal sepsis, and low birth weight (Christensen et al., 2006). Additionally, maternal health conditions during pregnancy, such as preeclampsia or immune thrombocytopenia, as well as neonatal infections (viral or bacterial), immune system disorders and genetic predispositions have been implicated in the development of this condition (Arneth, 2020). Comprehending the root causes and risk factors is essential for timely diagnosis and proper management, as untreated thrombocytopenia may result in serious complications such as intracranial bleeding and lasting developmental impairments.

Despite advances in neonatal care neonatal thrombocytopenia remains a significant clinical challenge, particularly in preterm and low-birth-weight infants. This study aims to explore the prevalence, risk factors and clinical outcomes associated with neonatal thrombocytopenia, with the goal of informing better diagnostic and therapeutic strategies to improve neonatal health outcomes.

Research Problem:

Thrombocytopenia in newborns is a significant medical challenge due to its direct impact on neonatal health and the increased risk of bleeding. An accurate understanding of the underlying causes is crucial for enhancing diagnosis, treatment, and the prevention of related complications.

Research Objectives:

This research aims to investigate the relationship between gestational age, sepsis, and the occurrence of thrombocytopenia in newborns.as well as, Analyze the risk factors contributing to thrombocytopenia in this population and contribute to the development of strategies for prevention, early diagnosis, and appropriate management of the condition.

Research Significance:

The importance of this research stems from:

1. Minimizing the occurrence of thrombocytopenia in newborns.
2. Minimizing potential complications associated with the condition, such as severe bleeding or developmental delays.
3. Raising awareness of the risk factors for thrombocytopenia, which can aid in developing effective prevention and management strategies.
4. Improving neonatal health outcomes through early diagnosis and timely intervention.

Methodology:

Research Design:

This study was designed to investigate the relationship between gestational age, sepsis, and the occurrence of thrombocytopenia in newborns in Al-Marj City. Additionally, the study aimed to identify other potential risk factors, including sex, birth weight, blood groups, delivery mode, and maternal health conditions.

Sampling Method and Study Population:

The study included 35 newborns diagnosed with thrombocytopenia in the pediatric department of Al-Marj Teaching Hospital between January 2022 and December 2023. The birth weights of the participants ranged from 1 to 5 kg. The main goal was to determine the risk factors linked to thrombocytopenia in newborns.

Ethical Considerations:

Ethical clearance for the study was granted by the Al-Marj Educational Hospital Ethics Committee. Written informed consent was obtained from the parents or legal guardians of the newborns following a comprehensive explanation of the study's objectives, methods, and potential benefits.

Instruments of Data Collection:

The study utilized the following research instruments:

1. **Questionnaire:**
   A structured questionnaire was specifically designed to collect comprehensive data about the newborns with thrombocytopenia, including demographic information, maternal health history, and delivery details (see Appendix 1).
2. **Blood Tests:**
   - Blood samples were collected from the newborns to measure platelet counts and confirm thrombocytopenia.
   - **Blood cultures** and, in some cases urine cultures were performed to identify bacterial, viral, or fungal infections that could contribute to sepsis.
   - Additional blood tests were conducted to assess markers of infection, inflammation, or organ dysfunction associated with sepsis.
   - All samples were analyzed in the Al-Marj Educational Hospital laboratory using standardized protocols.

Data Analysis:

The data collected from the questionnaire were analyzed using the Statistical Package for the Social Sciences (SPSS) software. Frequencies and percentages were calculated and a chi-square test was performed. Correlations were deemed significant if the observed P-value was less than 0.05.

Results and discussion:

Data presented in Table (1) showed that the percentage of males in the sample recorded (68.6%**)** ,while the percentage of females which recorded **(**31.4%). Therefore, thrombocytopenia may vary depending on the biological sex of the newborn. The data is consistent with studies indicating that male newborns may be more susceptible to thrombocytopenia due to their higher inflammatory response compared to females, while females tend to have more stable platelet levels due to hormonal influences. (Chen *et al*., 2014).

Table (1): Distribution of newborns in the sample by sex .

Sex	Frequency	Percentage
Male	24	68.6%
Female	11	31.4 %
Total	35	100%

Table (2) showed high percentages of newborns with thrombocytopenia aged 1 to 12 days, recording (65.7%). This was higher than those aged 13 to 24 days, who recorded (14.3%), while those aged 25 to 42 days recorded 20%. The high incidence of thrombocytopenia in newborns aged 1 to 12 days may be due to the immaturity of the hematopoietic system, increased platelet consumption due to perinatal stress or infections, and maternal factors affecting platelet production. Our data is consistent with studies reporting that thrombocytopenia usually appears in newborns aged 1 to 10 days. This is closely aligned with the percentage observed in this study (Jones & Colleagues, 2020)."

Table (2): Distribution of the sample individuals by newborns age.

Age (day)	Frequency	Percentage
1-12	23	% 65.7
13-24	5	% 14.3
25-42	7	% 20.0
Total	35	%100

The data presented in Table (3) recorded an increase in newborns with thrombocytopenia weighing between 1 kg and 3 kg accounting for (74.3%), compared to those weighing between 3.5 kg and 5 kg who accounted for (25.7%). The date indicate that low birth weight is associated with thrombocytopenia due to the immaturity of the bone marrow, which reduces platelet production. Additionally, an increased risk of infections and inflammation can lead to higher platelet consumption. Our data is consistent with reports indicating that there is a clear relationship between thrombocytopenia and lower birth weight in newborns. (Christensen *et al*., 2006).

Table (3): Distribution of the sample individuals by newborn weight.

Weight (kg)	Frequency	Percentage
1-3	26	%74.3
3.5-5	9	%25.7
Total	35	%100

The data represented a difference in the rate of thrombocytopenia between newborns with a gestation period of 38 weeks which recorded (57.1%) and newborns with a gestation period below 38 weeks which recorded (42.9%**)** (Table 4).

The data is not consistent with previous studies indicating that newborns with a gestation period below 38 weeks experience a higher incidence of thrombocytopenia compared to those with a gestation period of 38weeks primarily due to less developed immune function and incomplete development of the bone marrow. (Kalra et al., 2016).

The variation in results may be attributed to differences in sample characteristics or environmental factors which could impact the relationship between gestational age and thrombocytopenia.

Table (4): Distribution of sample individuals according to gestational age.

Gestational Age	Frequency	Percentage
38weeks	20	%57.1
below(38weeks)	15	%42.9
Total	35	%100

Table (5) showed a difference in the rate of thrombocytopenia between newborns delivered via vaginal birth which recorded (65.7%) and newborns delivered via cesarean birth which recorded (34.3%).

Our data is not consistent with reports indicating that newborns delivered via cesarean section may be more susceptible to thrombocytopenia due to surgical stress and an elevated risk of infection which can trigger inflammatory responses that increase platelets consumption (Brown *et al*., 2013; Chang, 1996).

Table (5): Distribution of sample individuals according to the mode of delivery.

Natural Delivery	Frequency	Percentage
Cesarean Delivery	12	%34.3
Vaginal Delivery	23	%65.7
Total	35	%100

The data in Table (6) showed that a higher percentage of newborns with thrombocytopenia had blood groups A+, B+ and O+ recorded (31.4%,22.9%and 31.4%) respectively, while a very small percentage of newborns with thrombocytopenia had blood groups O-,AB+and A-which recorded(2.9%,2.9%and 8.6%)respectively. The predominance of positive blood groups (A+ and O+) among thrombocytopenic newborns may be attributed to genetic factors associated with blood group antigens that influence platelet production, function or clearance. The data is consistent with studies indicating that positive blood groups may be more associated with thrombocytopenia. Another study suggested that rare blood groups such as (AB+) have a lower risk of thrombocytopenia due to the reduced likelihood of immune reactions. (Mehta *et al*., 1990; Gupta *et al*., 2011).

Table (6): Distribution of sample individuals according to the newborn's blood group.

Blood Group	Frequency	Percentage
A-	3	%8.6
A+	11	%31.4
AB+	1	%2.9
B+	8	%22.9
O-	1	%2.9
O+	11	%31.4
Total	35	%100

The data presented in Table (7) showed that recorded (40%)of the newborns with thrombocytopenia had sepsis, while recorded (60%)of the newborns with thrombocytopenia did not have sepsis. Sepsis may lead to the destruction of platelets or reduce their production in the bone marrow. The data indicate that a significant proportion of children suffering from sepsis exhibit low platelet levels due to the effects of systemic inflammation. Our data is consistent with reports confirming that a significant proportion of newborns with sepsis suffer from severe thrombocytopenia due to systemic inflammation (Charoo *et al*., 2009).

Table (7) : Distribution of sample individuals according to the presence of sepsis.

Sepsis Infection	Frequency	Percentage
Infected	14	%40.0
Not Infected	21	%60.0
Total	35	%100

The data presented in Tables (8 & 9) revealed a statistically significant relationship between gestational age and the incidence of sepsis. The results indicate that gestational age is a significant factor influencing the risk of sepsis. The data indicate preterm infants with gestational age below 38 weeks have an underdeveloped immune system making them more vulnerable to infections like sepsis, which can subsequently lead to thrombocytopenia. Our data is consistent with reports indicating that newborns with a gestation period below 38 weeks had a twofold risk of sepsis compared to newborns with a gestation period of 38 weeks. (Al-Matary & Heena, 2023). Other previous studies have demonstrated that the full maturation of the immune system in newborns with a gestation period of 38 weeks reduces the risk of sepsis, which in turn plays a role in the development of thrombocytopenia in newborns. (Ree *et al*., 2017).

Table (8) : distribution of sample individuals according to gestational age and sepsis infection:

Classification by Gestational Age	Diagnosis of a Condition Based on Sepsis Infectio		Total
	Infected	No Infected	
Full-term	4	16	20
Preterm	10	5	15
Total	14	21	35

Table (9) : The results of the χ^2 (Chi-square) test for the relationship between gestational age and sepsis infection in newborns:

Significance Level (Sig)	χ^2 Statistic	Degrees of Freedom (df)	Sample Size (N)
0.005	7.778	1	35

From the table above, it is clear that the **significance value (Sig = 0.005)** is less than **0.05**, indicating a **statistically significant relationship** between gestational age and the incidence of sepsis in newborns. Therefore, we conclude that there is a significant association between gestational age and the risk of sepsis.

Table (10) showed that the most common blood groups among mothers were A+ , O+ and B+ which recoreded (34.3% , 25.7%and 17.1%) respectively. On the other hand, the least common blood groups among mothers were O- , AB+and A- which recoreded (5.7% , 8.6%and 8.6%) respectively. The date indicate that Maternal-fetal blood group incompatibility can trigger an immune response, leading to the production of maternal antibodies that cross the placenta and destroy fetal platelets, increasing the risk of thrombocytopenia. The data is consistent with previous studies, which demonstrated that blood group incompatibility increases the risk of thrombocytopenia in newborns. (Smith & Johnson, 2021).

Table (10) : Distribution of the sample individuals according to the mother's blood group:

Mother's Blood Group	Frequency	Percentage
A-	3	%8.6
A+	12	%34.3
AB+	3	%8.6
B+	6	%17.1
O-	2	%5.7
O+	9	%25.7
Total	35	%100

Table (11) observed that most mothers were in good health, which limits the ability to study the impact of maternal health conditions on the platelet levels of newborns. However, other unstudied factors, such as nutrition or psychological stress, could still play a role. The data is not consistent with reports that suggested poor maternal health leads to thrombocytopenia in newborns due to inflammatory factors and that healthier mothers have a lower risk of delivering newborns with thrombocytopenia. (Johnson & Smith, 2023).

Table (11) : Distribution of the sample individuals according to the mother's health status:

Mother's Health Condition	Frequency		Percentage
	No	Yes	
Mother has hypertension	32	3	%91.0
Mother has preeclampsia	35	0	%100
Mother had infections during pregnanc	35	0	%100
Mother took medications during pregnancy	33	2	%94.0
Mother has genetic diseases	35	0	%100
Mother has anemia or severe fatigue	35	0	%100

Conclusions:

The study revealed that factors such as sepsis and gestational age are significantly associated with thrombocytopenia in newborns. Newborns with a gestational age of less than 38 weeks are more susceptible to sepsis and thrombocytopenia due to the incomplete development of their immune system and bone marrow.

Other factors, such as sex, birth weight, and mode of delivery, also play a crucial role in the occurrence of thrombocytopenia in newborns. Additionally, blood group incompatibility between the mother and the newborn may increase the risk of thrombocytopenia, as it can trigger immune responses that destroy platelets.

Recommendations:

1-Improve monitoring of preterm newborns to reduce the risk of sepsis and thrombocytopenia.
2-Provide regular check-ups for at-risk newborns, especially those born before 38 weeks of gestation.
3-Strengthen infection control standards in hospitals, particularly in neonatal units.
4-Raise awareness among mothers about the importance of prenatal medical follow-ups for early detection of infections that may affect fetal health.
5-Expand the study scope to include a larger sample of newborns for more comprehensive and accurate results.
6-Investigate the impact of additional factors, such as maternal nutritional status and psychological stress during pregnancy, on neonatal health.
7-Develop appropriate treatment protocols for thrombocytopenia cases resulting from neonatal sepsis.
8-Study the effects of preventive treatments, such as maternal nutritional supplements during pregnancy, on newborn health.
9-Organize awareness campaigns on the importance of prenatal care, the risks of preterm birth, and its effects on newborn health.
10-Disseminate information on the relationship between maternal and fetal blood types and their impact on neonatal thrombocytopenia.

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Appendix (1)

Faculty of Arts and Sciences – Al-Marj

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A Questionnaire for Studying the Relationship Between Gestational Age, Sepsis, and the Occurrence of Thrombocytopenia in Newborns

This study was designed to study the relationship between gestational age, sepsis, and the occurrence of thrombocytopenia in newborns, and to determine the risk factors that lead to the development of thrombocytopenia. It is understood that this information will be used for the purposes of scientific research and will be treated with strict confidentiality. Therefore, your cooperation in completing this questionnaire will be greatly appreciated.

Serial Number: ---------- **Date:** ----------

Please tick (√) inside the box that corresponds to your situation:

Personal Data:

Sex:

☐ Male

☐ Female

Date of Birth:

Day: ---------- Month: ---------- Year: ---------

Weight at Birth: ----------

At what age did thrombocytopenia appear? ----------

What is the gestational age?

☐ 38 weeks

☐ Below 38 weeks

What is the type of birth?

☐ Vaginal birth

☐ Caesarean birth

What is the newborn's blood group?

☐ A-

☐ B+

☐ AB+

☐ A+

☐ O-

☐ O+

What is the platelet count?

☐ Less than 150

☐ 150 or higher

Did the newborn suffer from sepsis?

☐ Yes

☐ No

What is the mother's blood group?

☐ A-

☐ B+

☐ AB+

☐ A+

☐ O-

☐ O+

Did the mother suffer from other diseases?

☐ Hypertension

☐ Preeclampsia

☐ Infections during pregnancy

☐ Took medications during pregnancy

☐ Anemia or severe fatigue