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The relationship between isolated head trauma during pregnancy and preterm birth

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ABSTRACT

Aims: Traumatic brain injury is classified into three types. Blunt head trauma is the most common type. Studies found that after trauma high cortisol levels could cause preterm birth. In the literature, there was no study with isolated head trauma and preterm birth prediction. Our study aims to predict preterm birth in pregnancies with isolated head trauma.

Methods: In this prospective study, pregnant patients who applied to the emergency department of Şanlıurfa Training and Research Hospital with isolated head trauma between January 2018 and January 2024 were included in the study and followed up until the time of pregnancy termination (birth). All of the pregnant women with isolated head trauma (closed blunt trauma) over 18 years of age, and whose birth records are available in our hospital were included in the study. Their medical records and prognosis after blunt head trauma were followed up until birth.

Results: Out of a total of 2580 patients, 30 patients and 60 control group patients who experienced isolated head trauma during pregnancy were included. The initial mean gestational age of the patients included in the study was 26.43±6.53 in the trauma group and 24.32±6.09 gestational weeks in the control group. There was no statistical difference between groups according to the gestational age (p:0.13). Preterm birth was defined as birth before 37 gestational weeks. In the trauma group, 12 (40%) and 23 patients in the control group (38.3%) gave birth as preterm birth. No statistical difference was found (p:0.87) between the groups according to the preterm birth.

Conclusion: In mild head trauma, as all of the patient's Glasgow Coma Scale was 15, there was no risk increase in preterm birth. Studies with severe head trauma in pregnancy may be needed.

Keywords: Cervical dilatation, head trauma, preterm birth, placental abruption, vaginal bleeding

INTRODUCTION

Traumatic brain injury is one of the most common causes of disability, mortality, and morbidity at all ages all over the world.[1] As of 2005, research has shown that complications often occur after traumatic brain injury, such as neurological, psychosocial, and long-term disabilities.[2] This burdens the healthcare system and inspires the search for new treatments. The three kinds of traumatic brain injury are closed head, penetrating, and explosive trauma. Some symptoms may be observed months or even years after the injury, such as nausea, amnesia, seizures, and behavioral changes.[3]

Closed head trauma is the most common type of head trauma in the civilian population, usually resulting from blunt impact. It can damage the brain tissue and reduce blood flow due to direct neuronal damage to the area where the impact occurs or the vibrations caused by the impact. Penetrating brain trauma occurs when a penetrating object passes through the dura and damages the brain tissue. The consequences of lacerations and resulting intracranial bleeding and brain edema develop acutely and rapidly. It carries a higher risk of infection than closed-head trauma.[4] Explosive trauma, which was defined mainly after the explosions in Iraq and Afghanistan in the 2000s, occurs when an explosion near the skull creates fast and powerful shock waves that affect the brain. Results observed include damage to both gray and white matter, disruption of the blood-brain barrier, vasospasm, hyperemia, contusion, and cerebral edema; post-traumatic stress disorder is also common in survivors.[5]

Studies in both animals and humans have shown that traumatic brain injury causes the excessive release of excitatory amino acids such as glutamate and aspartate from presynaptic nerve terminals.[6] Excessive glutamate induces the failure of glutamate reuptake due to the dysfunction of glutamate transporters. Ligand-gated ion channels allow Na^+, K^+, and Ca^{2+} ionic flux upon binding to glutamate, causing membrane depolarization in neurons.[7] The NMDA receptor is also voltage-gated and is permeable to Ca^{2+} ions. Hyperactivation

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of AMPA and NMDA receptors by excessive glutamate has been shown to change ion homeostasis in postsynaptic neurons by allowing extracellular Ca^{2+} and Na^{+} ions to enter.[8] This intracellular Ca^{2+} activates various downstream signaling molecules, reactive oxygen species, and calcium-dependent mechanisms.[9]

Preterm birth is defined as live or stillbirth occurring at or above the 20th week of gestation and before the 37th week of gestation.[10] Ten percent of births are preterm. While 80% occur due to spontaneous reasons (spontaneous premature birth, premature rupture of membranes, placenta abruption, and cervical insufficiency), 20% occur due to medical reasons and termination of pregnancies due to maternal or fetal concern. Risk factors include previous premature birth, pregnancy with assisted reproductive techniques, multiple pregnancies, the threat of preterm labor in the current pregnancy, maternal or fetal life-threatening situations, Black race, cervical insufficiency, short cervix or history of conization, asymptomatic bacteriuria, periodontal disease, smoking and substance use, short pregnancy intervals, and stress.[11]

Stress can be divided into maternal and fetal stress. Fetal stress is characterized by uteroplacental insufficiency.[12] The literature shows that spontaneous preterm birth increases slightly (nearly two times) in cases of major maternal stress such as depression, post-traumatic stress disorder, or anxiety. This pathway is thought to be through the hypothalamic-pituitary-adrenal (HPA) axis. In a prospective study of pregnant women with depression, spontaneous preterm birth was twice as common as in the nondepressed control group.[13]

Stress induces the placental production and release of corticotropin-releasing hormone (CRH), released from the cause of hypothalamic stimulation for secretion of adrenocorticotropic hormone (ACTH) by the pituitary for earlier labor. Stress promotes the adrenal secretion of cortisol, inhibiting the negative feedback loop for hypothalamic CRH and pituitary ACTH.[14,15]

Our prospective cohort study focused on pregnant patients with isolated head trauma to follow up and determine whether preterm birth occurred.

METHODS

Ethics

Permission was obtained from the Harran University Clinical Researches Ethics Committee for the study (Date: 28.12.2023, Decision No: HRU/23.25.05). It conforms to the provisions of the Declaration of Helsinki. This observational prospective study had a Clinical Trial number of NCT06685549.

Pregnant patients who presented to the Emergency Department of Şanlıurfa Training and Research Hospital with isolated head trauma due between January 2018 and January 2024 were included in the study and followed up with until the time of pregnancy termination.

The Criteria for Inclusion in the Study

All of the pregnant women over 18 years of age with isolated head trauma (closed blunt trauma) who were evaluated with neurosurgical consultation or computed tomography/magnetic resonance (CT/MRI) and whose birth records are available at our hospital.

The exclusion criteria included patients with previous premature birth, pregnancies in the first trimester, pregnancies with assisted reproductive techniques, multiple pregnancies, the threat of preterm labor or abortus imminens in the current pregnancy, maternal or fetal life-threatening situations that may cause termination of the pregnancy, cervical insufficiency, short cervix or history of conization, asymptomatic bacteriuria, periodontal disease, and smoking and substance use. Patients who had trauma to the other parts of the body or placental abruption were also excluded. Additionally, the study did not include those with missing hospital records regarding birth and pregnancy follow-up.

Patient Data

We recorded the gestational week, age, parity, CT/MRI result of the patients' head trauma, whether they had surgery on the brain after the trauma, ward or intensive care hospitalizations, birth weeks, whether they had a risk of premature birth before birth, the baby's delivery method and weight, and neonatal intensive care unit admission.

Patients with a similar age and gestational age, who were not exposed to any trauma, who had no health problems, and who applied to the outpatient clinic for follow-up were randomized with a computer program and formed a control group.

Out of a total of 2,580 patients diagnosed with pregnancy and trauma, those with trauma other than isolated head trauma, first-trimester pregnancies, and those with other criteria that did not fit the study were excluded. After the exclusions, 30 patients remained.

Statistical Analysis

The data were evaluated in the SPSS 26.0 statistics program, and the percentages were calculated for the mean, standard deviations, and categorical data. The normal distribution of values was examined using visual (histogram and probability graphs) and analytical methods (Kolmogorov-Smirnov test). Student's T test was used for the variables with normal distribution to evaluate the statistical significance between the two independent groups. For the level of significance, $p<0.05$ was accepted.

RESULTS

Thirty patients and 60 patients in the control group who experienced isolated head trauma during pregnancy and met the study criteria were included in the study. The initial mean gestational age of the patients included in the study was 26.43±6.53 in the trauma group and 24.32±6.09 in the control group. There was no statistical difference between groups according to the gestational age (p=0.13). The mean age of the patients was 27.60±5.13 in the trauma group and 27.30±5.90 years in the control group. There was no statistical difference in age (p=0.81) or parity (p=0.92). The patients' demographic data are shown in Table 1.

Table 1. Patient demographics according to study group

	Trauma group	Control group	p/t values
Mean gestational age at trauma/taken into study (for control)/weeks	26.43±6.53	24.32±6.09	0.13/1.9
Mean age (years)	27.60±5.13	27.30±5.90	0.81/0.23
Mean parity	2.17±1.62	2.20±1.58	0.92/-0.09

While there was no statistical difference between groups according to the intensive care unit admission for the maternal status (p=0.85), the number of patients who were followed up in the ward for observation was statistically significantly higher in the trauma group (p=0.03). No maternal exitus was seen due to the head trauma. One out of 30 patients had a 9 mm subdural-epidural hematoma at the temporal lobe. Other patients had no intracranial bleeding. All patients' Glasgow Coma Scale (GCS) Scores were 15.

The mean gestational ages were 37.33±1.33 and 37.35±2.24 weeks at birth in the trauma and control groups, respectively (**Figure**). There was no statistically significant difference between the groups (p=0.97). The mean birth weights were 3077.83±541.35 and 3050.33±511.04 grams in the trauma and control groups, respectively, and there was no significant difference (p=0.81). In **Table 2**, the details of birth results in groups were mentioned.

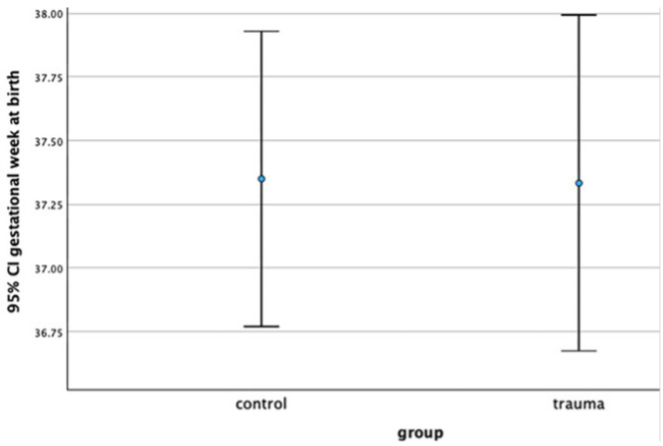

Figure. Gestational week at birth according to the groups (p: 0.97)

Table 2. The birth results in groups

	Trauma group	Control group	p/t values
Gestational week at birth	37.33±1.33	37.35±2.24	0.97/-0.03
Birth weight	3077.83±541.35	3050.33±511.04	0.81/0.23

Preterm birth was defined as birth before 37 gestational weeks. Seven patients (23.3%) in the trauma group and twelve patients in the control group (20%) gave birth preterm. No statistical difference was found (chi-square test, p=0.71, **Table 3**).

Table 3. Preterm birth among the groups (n)

	Trauma group (n=30)	Control group (n=60)	p
Preterm birth	6	12	
Preterm birth threat and preterm birth	1	0	0.71

The patient with a 9 mm subdural-epidural hematoma at the temporal lobe gave birth at the 38th gestational week and did not have a preterm birth threat.

Ten (33%) in trauma group and twenty-seven (45%) patients in control group had cesarean birth. The type of birth was not statistically different among the groups (p=0.28). There were no patients defined as placental abruption or fetal distress during the follow-up before birth. There was no correlation between the gestational week at trauma and the gestational week at birth (p=0.41).

DISCUSSION

The incidence of trauma in pregnancy is 6% and about 2-3% for severe trauma.[16] Our hospital is the center with the highest number of pregnancies and births in Turkiye, with 26,000 births per year. According to these statistics, although the expected number of pregnant women who experienced trauma should be approximately ten thousand in our six-year data, the number is less. These traumas are primarily the result of domestic violence and falling accidents,[17] so the lower number may be interpreted as domestic violence being hidden.

In the event of trauma, placental abruption and thorax or abdominal fluid are critical side effects so ultrasonographic examination is important in the evaluation of mortality. In our study, only pregnant women with head trauma were included. Obstetric ultrasound and, if necessary, cranial imaging were planned for all of them.[18]

In the literature, pregnant women with high levels of psychosocial stress have a 25%-60% increased risk for preterm birth compared with women reporting low levels of stress.[19] The pathophysiology is complex, but it is known that the HPA axis and the locus coeruleus norepinephrine systems play important roles by increasing cortisol activity. In some studies, increased cortisol levels were found to be related to preterm birth.[20]

In our study, although stress levels were high due to head trauma, there was no statistical difference or increase in preterm birth. Although these trauma patients were proven to have trauma and consulted with neurosurgeons, there was no effect on preterm birth.

The Revised Trauma Score is composed of the patient's systolic blood pressure, GCS Score, and respiratory rate.[21] Lower Scores were related to higher mortality. In our study, all of our patients Had High Scores, so our maternal and fetal results were fine, with no increase in preterm birth.

GCS is the best predictive factor for mortality and morbidity in traumatic brain injury. In our study, all patients' GCS Scores were normal, so the results were similar to the control group.

Limitations

Our study's strength is that it is the only study to focus on pregnant patients with isolated head trauma. The limitation is that our patients' GCS Scores were 15, so the results were similar to those of nontraumatic patients.

CONCLUSION

Despite our study, preterm birth is not expected from those with high GCS of pregnant women with isolated head trauma, studies with more pregnant women with isolated head trauma are needed.

ETHICAL DECLARATIONS

Ethics Committee Approval

The study was carried out with the permission of the Harran University Clinical Researches Ethics Committee (Date: 28.12.2023, Decision No: HRU/23.25.05).

Informed Consent

All patients signed and free and informed consent form.

Referee Evaluation Process

Externally peer-reviewed.

Conflict of Interest Statement

The authors have no conflicts of interest to declare.

Financial Disclosure

The authors declared that this study has received no financial support.

Author Contributions

All of the authors declare that they have all participated in the design, execution, and analysis of the paper, and that they have approved the final version.

Availability of Data and Materials

Data is deposited at doi:10.6084/m9.figshare.26096599

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