DOI: 10.17986/blm.1620
Adli Tıp Bülteni 2023;28(1):41-46

Analysis of the Pregnancy Outcome in Severe Injury in Pregnant Women According to Forensic Examinations for 2008-2017 in Astana

Astana'da 2008-2017 Adli Muayenelerine Göre Gebe Kadınlarda Ağır Yaralanmanın Gebelik Sonucuna Etkisinin Analizi

Yevgeniya Shatalova[1], Tolkyn Zakupova[2], Frants Galitskiy[3], Mete Korkut Gülmen[4], Kenan Kaya[4], Tuğçe Koca Yavuz[4]

[1]Institute of Forensic Examinations in Astana of the Republican State Municipal Enterprise "Center of Forensic Examinations of the Ministry of Justice of the Republic of Kazakhstan", Astana, Kazakhstan
[2]Akmola State Medical University, Department of Forensic Medicine, Akmola, Kazakhstan
[3]The JSC "Astana Medical University" Department of Forensic Medicine, Astana, Kazakhstan,
[4]Çukurova University Faculty of Medicine, Department of Forensic Medicine and Science, Adana, Turkey

ABSTRACT

Objective: Traumatic injury during pregnancy is one of the leading causes of non-obstetric or accidental maternal mortality and disability in women. The aim of the study was to evaluate the relationship between the severity of injuries in pregnant women and termination of pregnancy, which are qualified as "serious harm to health" in accordance with the conclusions of forensic medical examination in the medical injury documentation of pregnant women.

Methods: The study examined retrospectively the records of forensic medical examinations of pregnant women where the bodily injury was qualified as "serious harm to health" between 2008 and 2017 in the Institute of Forensic Examinations in Astana. The analysis of the conditions and mechanisms of occurrence of injury, the type and area of injury, and the outcome of the pregnancy was also included in the research.

Results: Between 2008 and 2017, 12 pregnant women were found to have injuries that is qualified as serious harm to health. The traffic accidents led the causes of injury with eight cases (66.7%). In the remaining cases, one of the pregnant women had mechanical injury during the fire, the other had a sexual assault with a bottle, and two cases had penetrating stab injuries. The pregnancy outcomes were as follows: intrauterine fetal death at week 30 and 35 occurred in two cases, spontaneous miscarriage at week 20 in one case and medical abortion at 6 week in one case which amounts to 33.3%.

Conclusion: All cases of termination were accompanied by severe combined injuries in pregnant women and an unfavorable outcome is more often observed with polytrauma.

Keywords: Forensic medicine, injury, trauma, pregnancy

Address for Correspondence/Yazışma Adresi: Tuğçe Yavuz Koca, Çukurova University Faculty of Medicine, Department of Forensic Medicine and Science, Adana, Turkey
E-mail: tugcekoca02@gmail.com
ORCID ID: orcid.org/0000-0001-5936-908

Received/Geliş tarihi: 07.04.2022
Accepted/Kabul tarihi: 22.11.2022

ÖZ

Amaç: Gebelikte travmatik yaralanmalar, kadınlarda obstetrik olmayan veya kaza sonucu meydana gelen anne ölümlerinin ve morbiditenin önde gelen nedenlerindendir. Çalışmanın amacı, gebelerin tıbbi yaralanma belgelerinde adli tıbbi muayene sonuçları doğrultusunda ağır bedensel zarar olarak nitelendirilen gebelerdeki yaralanmaların şiddeti ile gebeliğin sonlandırılması arasındaki ilişkiyi değerlendirmektir.

Yöntem: Çalışmada 2008-2017 yılları arasında Astana Adli İnceleme Enstitüsü'nde bedensel yaralanması ağır bedensel zarar olarak nitelendirilen gebelerin adli tıbbi muayene kayıtları geriye dönük olarak incelendi. Yaralanmanın oluşum koşulları ve mekanizmaları, yaralanmanın türü ve lokalizasyonu ve gebelik sonucu araştırmaya dahil edildi.

Bulgular: 2008-2017 yılları arasında 12 gebe kadının ağır bedensel zarar olarak nitelendirilen yaralanmalara sahip olduğu tespit edildi. Trafik kazaları sekiz olgu ile (%66,7) yaralanma nedenlerine öncülük etti. Diğer olgulara bakıldığında gebe kadınlardan birinde yangın sırasında mekanik yaralanma, diğerinde şişe ile cinsel saldırı ve iki olguda delici alet yaralanması mevcuttu. Gebelik sonuçları şu şekildeydi: iki olguda 30 ve 35. haftalarda intrauterin fetal ölüm, bir olguda 20. haftada spontan düşük meydana geldi, bir olguda 6. haftada medikal abortus gerçekleştirildi, bu da %33,3'e tekabül ediyor.

Sonuç: Gebelik sonlandırma olgularına ciddi kombine yaralanmaların eşlik ettiği ve multipl travmalarda daha sık olumsuz sonuç meydana geldiği gözlemlenmiştir.

Anahtar Kelimeler: Adli tıp, yaralanma, travma, gebelik

INTRODUCTION

Traumatic injury during pregnancy is one of the leading causes of non-obstetric or accidental maternal mortality and disability in women (1). Its incidence is on the rise. Every year, about 7% of pregnant women get injured (2,3). According to the some authors traumas now represents the leading cause of non-obstetric causes of death in pregnancy, accounting 6-7% of all maternal deaths (4,5). For certain inner city socio-economic and ethnic groups, however, rates as high as 20-46% have been reported (1). This is due to the specific features of the female body during pregnancy and the changing conditions of life and environment due to the significant urbanisation and technological adoption of human life, stress, and frequent extreme impacts. Taking into account the fact that the potential of a pregnant woman's organism for adaptation is limited, even relatively small changes in the environment can become extremely important and lead to injuries and pathologies in pregnancy (6,7).

Special attention has to be paid to mechanical injuries in pregnant women. The complex biomechanics of modern traumas led to qualitative changes in the nature of injuries in pregnant women. Thus, injuries in pregnancy became more critical (8). As a result of injuries, 3-4 out of 1.000 injured pregnant women need resuscitation treatment. Fetal death in severely injured pregnant women occurs in 3.4-61% of cases (9).

However, there is no clear association between the severity of injury and fetal death. Some studies show a high risk of perinatal mortality even with mild injuries (10-12). At the same time, some of them believe that mechanical injuries in the termination of pregnancy should be assessed carefully since there is a number of serious injury descriptions in pregnant women, in which pregnancy was maintained and carried to full-term, despite the fact that there were often cases of miscarriage, placental rupture and serious injury to the fetus with minimal injury to the mother (7-9). A more severe outcome is observed in cases of polytrauma (13).

There are two diametrically opposed opinions of experts in the scientific community on the impact of trauma on pregnancy and childbirth. Thus, according to the study of John et al. (14) and Manoogian (15), when comparing injured pregnant women and non-pregnant women of similar age groups, pregnant women exhibited a lower mortality rate. This data suggests that hormonal and physiological differences may affect the results of trauma in pregnant women. At the same time, in a large population-based study by Cheng et al. (16), minor injuries were associated with preterm labor, while a serious injury was strongly associated with increased risks of preterm delivery, abruptio placentae, uterine rupture, and maternal death, particularly in the third trimester. It has also been reported that injuries away from the trunk may also lead to negative maternal outcomes. This controversy precludes forensic experts from clearly assessing the impact of trauma on pregnancy, and confidently justify his/her conclusions.

Thus, despite the increased urgency of the problem of injuries in pregnant women, issues related to forensic medical assessment are significantly difficult and require additional research.

According to Penal Code of the Republic of Kazakhstan, damage to human health is classified according to the degree of severity (serious harm to health, moderate harm to health and mild harm to health). "Serious harm to health" criteria are listed as: Life-threatening injury; loss of vision, speech, hearing, or any organ, or loss of organ function; abortion; mental disorder; drug addiction or substance abuse; permanent disfigurement of the face; significant permanent loss of general ability to work by at least one third; complete loss of professional ability to work (17).

The aim of the study was to evaluate the relationship between the severity of injuries in pregnant women and termination of pregnancy, which are qualified as serious harm to health in accordance with the conclusions of forensic medical examination in the medical injury documentation of pregnant women. According to figures provided by the Institute of Forensic Examinations in Astana, a branch of the Center for Forensic Examinations of the Ministry of Justice of the Republic of Kazakhstan for the last decade (2008-2017), we conducted the study.

MATERIALS and METHODS

The study material was the archival data from the Institute of Forensic Examinations Branch of the Center of Forensic Examinations of the Ministry of Justice of the Republic of Kazakhstan in Astana (hereafter referred to as "the Branch"). The study examined the records of forensic medical examinations of pregnant women where the bodily injury was qualified as "serious harm to health" between 2008 and 2017. The analysis of the conditions and mechanisms of occurrence of injury, the type and area of injury, and the outcome of the pregnancy was also included in the research. The researchers conducted the data analysis manually.

RESULTS

According to Kazakhstan Law, only a medical expert can assess the severity of harm to health. There are two types of examinations for the assessment of the severity of harm to health in living persons: Direct examination and the study of medical records in which doctors describe the injuries. Until September 2017, these types of examinations were carried out only in the branch in Astana, which allowed the complete assessment of the outcome of pregnancy in case of severe injury.

According to data from the Branch, the number of all types of examinations increased dramatically in recent years. With the growth in the total number of examinations, the number of women who applied for forensic examination to determine the severity of harm to health, as well as the number of pregnant women who associate their health problems with injuries has increased.

The analysis of medical examination records shows a tendency of increase in of both the total number of examinations of this type, and the number of examinations of this type conducted on women. The quantitative distribution of medical examinations including women and pregnant women is shown in Figure 1.

In Figure 1, there is an increase of 62.5% in the number of examinations in the period between 2009 and 2014. In addition, although there was a slight decrease of around 10% in the number of inspections in 2017 compared to 2014, it was observed that there was an increase of 23.6% compared to 2008. A similar dynamic was observed in the number of forensic examinations for women's medical records. For example, while 257 examinations were recorded in 2008, it decreased to 197 in 2009. Then there was an increase of 74.6% from 2009 to 2014. The number of examinations, which was 339 in 2015, decreased to 253 in 2017. The number of examinations conducted on pregnant women varied without any particular trend over the years studied. The highest number of examinations (11) was seen in 2010 and 2014, and the least (5) number of examinations was seen in 2013. The same number of applications (7) were registered in 2011, 2016 and 2017.

Accordingly, the number of forensic medical examinations of women varies between 28% and 40% of the total number of examinations, with an average of 35%. The number of forensic examinations performed on pregnant women constitutes 1.6% to 4.7% (average 3.0%) of female cases.

In our study, forensic medical records of pregnant cases, which were classified as serious injuries according to these criteria, were reviewed retrospectively, and between 2008 and 2017, it was shown that there were 12 cases classified as serious harm to health in the Branch in Astana.

According to the gestational age, 5 (41.7%) of the cases were below the 20th gestational week; 7 (58.3%) of them were above 20th gestational week.

The results revealed that traffic accidents led the causes of injury with eight cases and amounted to 66.7%. Five of them were pedestrian and three were passenger injuries. In the other four cases, mechanical injury was observed during the fire in one, sexual abuse with a bottle in one, and a sharp object injury in two (Figure 2).

According to the type of the injuries, the following results were obtained: Craniocerebral trauma, moderate and severe brain damage were observed in five cases. Four cases had fractures of

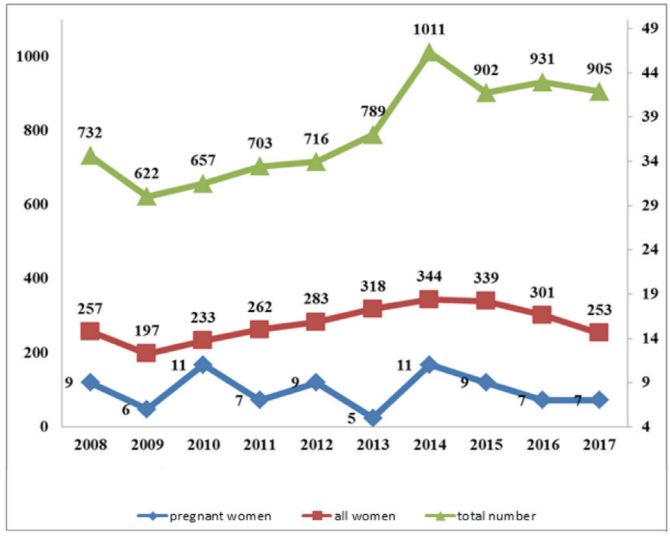

Figure 1. The quantitative allocation of examinations as follows from medical records

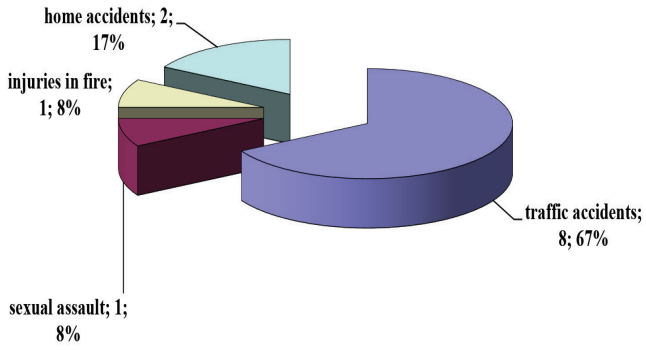

Figure 2. Conditions of injury in pregnant women with severe trauma for the period 2008-2017 in Astana

the pelvic bones, and two of them had disruption of pelvic ring continuity. In three cases with blunt abdominal trauma, one had liver rupture. Four cases had blunt chest trauma and one of them had hemothorax. Two cases had penetrating stab wounds on the abdomen with damage to the internal organs, one of them had tangential damage to the bottom of the uterus, and in the second case, stab wounds penetrating the uterine cavity. In four cases, multiple injuries were observed (Table 1).

If we consider the outcome of pregnancies of injury conditions, in two cases of three traffic accidents where pregnant women were injured inside the cabin (as passenger), there was intrauterine fetal death in weeks 30 and 35 of gestation. The injuries in these 2 cases were blunt trauma to the abdomen and chest with rib fracture and pneumothorax in one, and closed fracture of the pelvic bones with a disruption of the continuity of the pelvic ring in the other. In one case the pregnancy was preserved, but the pregnant woman had an open craniocerebral trauma, a basal skull fracture, and subarachnoid hemorrhage. In five other cases of traffic accidents pregnant women were run over by a car and injured. In two cases, injuries were in the form of an open craniocerebral trauma, in one case an open craniocerebral trauma and closed fracture of the pelvic bones, in one case a blunt trauma to the chest and abdomen with fractures of the pelvic bones with a breach in the continuity of the pelvic ring, in another case a blunt chest injury with complicated rib fractures and development of hemothorax. In these five cases, the pregnancy was preserved (at weeks 18, 26, 27, 35 and 39 of gestation) and doctors did not even record the risk of termination of pregnancy. In one case who was at the sixth gestational week, the pregnancy was terminated later for medical reasons. It should also be noted that there were two cases (case 1 and case 8) with the same injury severity in pregnant women who in late terms (weeks 35 and 39). But the pregnancy of the woman who was run over by a car (pedestrian) was not terminated but maintained, but the pregnant woman who was injured inside the cabin (passenger) experienced

Table 1. The distribution of the area and type of injury

Area and type of injury	n*
Craniocerebral trauma	5
Pelvic injury	4
Blunt trauma to the abdomen	3
Blunt trauma to the chest	4
Penetrating stab wound to the abdomen	2

* In four cases, multiple injuries were observed

intrauterine fetal death, which is probably due to the impact of the seatbelt on the abdomen (Table 2).

Pregnancy was preserved in three of the five cases who had craniocerebral trauma, while intrauterine fetal death occurred in the other two cases (case 3 and case 9). It should be noted that in cases of pregnancy termination, craniocerebral trauma was combined with fractures of the bones of the thorax, pelvis and limbs.

In one of the twelve cases, a pregnant woman was injured by an object falling from above in a fire. She got an open craniocerebral trauma in combination with rib fractures, pneumothorax, pelvic bone fractures, a blunt abdominal trauma with liver rupture. In this case, the pregnancy ended in spontaneous miscarriage at 20 weeks.

Pregnancy was preserved in a case with penetrating stab wound at 26th week of pregnancy that caused damage to internal organs and tangential injury to the lower part of the uterus. In the other case with a penetrating stab wound to the abdomen and uterine cavity, pregnancy was terminated by cesarean section at the 35th week with a live fetus.

The pregnancy outcomes were as follows: Intrauterine fetal death at weeks 30 and 35 occurred in two cases, which amounts to 16.7%. One of the twelve cases (8.3%) of pregnancy at week 20 was interrupted by spontaneous miscarriage. One pregnancy was terminated for medical reasons (8.3%). In case of penetrating injury to the uterus, the pregnancy ended with cesarean section at 35 weeks with a live fetus (8.3%).

Thus, 33.3% of the twelve cases of trauma in pregnant women ended with the termination of pregnancy, while in 66.7% of the cases, the pregnancy was not terminated.

In two cases where termination occurred, intrauterine fetal death occurred in late terms after week 30. One pregnancy at week 20 ended with a spontaneous miscarriage and one was terminated for medical reasons as early as week six. In three cases, the termination of pregnancy occurred after receiving serious injuries in an accident and in one case with polytrauma.

In this study, we observed that in cases which pregnancy was preserved in all types of injury, especially in the injury caused by a tangential stab wound to the lower part of the uterus, the risk of termination of pregnancy was not recorded by the physicians despite the severity of the injury.

Table 2. Distribution of the cases according to the cause of injury, gestational week, pregnancy outcomes and type of injury

Case number	Cause of injury	Gestational week	Pregnancy outcomes	Type of the injuries
Case 1	Traffic accidents (passenger)	35	Intrauterine fetal death	Blunt trauma to the chest and abdomen with rib fracture and pneumothorax
Case 2	Traffic accidents (passenger)	30	Intrauterine fetal death	Closed fracture of the pelvic bones with a dispruption of the continuity of the pelvic ring
Case 3	Traffic accidents (passenger)	18	Preserved	Open craniocerebral trauma, a basal skull fracture, and subarachnoid hemorrhage.
Case 4	Traffic accidents (pedestrian)	6	Termination of pregnancy with medical reasons.	Open craniocerebral trauma, closed fracture of the pelvic bones
Case 5	Traffic accidents (pedestrian)	27	Preserved	Open craniocerebral trauma
Case 6	Traffic accidents (pedestrian)	35	Preserved	Open craniocerebral trauma
Case 7	Traffic accidents (pedestrian)	26	Preserved	Blunt trauma to the chest and abdomen with fractures of the pelvic bones with a dispruption in the continuity of the pelvic ring
Case 8	Traffic accidents (pedestrian)	39	Preserved	Blunt chest injury with complicated rib fractures and hemothorax
Case 9	Blunt trauma in fire	20	Spontaneous miscarriage at week 20 of gestation	Open craniocerebral trauma, a blunt chest trauma with rib fractures and pneumothorax, pelvic bone fractures, a blunt abdominal trauma with liver rupture.
Case 10	Penetrating stab wound	26	Preserved	Damage to internal organs and tangential injury to the lower part of the uterus.
Case 11	Penetrating stab wound	35	Cesarean section at week 35 of gestation with live fetus.	Penetrating stab wound to the abdomen and uterine cavity
Case 12	Sexual assault with a bottle	No data	No data	No data

DISCUSSION

Trauma affects up to 6% to 7% of all pregnancies, and accounts for up to 46% of maternal death (18). Since this study was based on living women after trauma, the mortality rate could not be evaluated.

Unintentional trauma accounts for a large portion of major trauma during pregnancy, the most commonly encountered form of which is motor vehicle crashes (10). According to some studies motor vehicle accidents account for 50% of all traumatic injuries during pregnancy and 82% of trauma-related fetal deaths (13). Similarly, we found that the rate of motor vehicle accidents was 67%.

Incidence of trauma increases as pregnancy progresses: 8% in the first trimester, 40% in the second trimester, and 52% in the third trimester (19). In Harland et al.'s (9) study (2014), fewer women were injured in the first trimester (16.5%) as compared to the second (41.8%) and third (41.8%) trimesters. Consistently, in our study, it was found that most of the injured pregnant women were in the later period of the pregnancy.

According to Kilpatrick (6) and Pimentel (7) due to the limited adaptation potential of the pregnant organism, even relatively small changes in the environment can become extremely important during pregnancy and lead to injuries and pathologies. In similar, Cheng et al. (16) emphasized that pregnant women are particularly vulnerable to trauma and should be carefully monitored when injured, and that injuries that are insignificant for the general population can be serious for pregnant women (16).

Manoogian (15) revealed in her study that pregnant and non-pregnant women were exposed to similar accidents and that there were no major differences in injury or collision characteristics by trimester. John et al. (14) found that among pregnant and non-pregnant women of similar age groups who were equally injured, those who were pregnant exhibited a lower mortality rate and as a result of these findings, he suggested that hormonal and physiological differences during pregnancy may play a role in post-traumatic outcomes in pregnant women.

Although the data and sample in our study are not suitable for comparison with these opposing views, it is obvious that more comprehensive and comparative studies, especially autopsy studies, should be performed on this subject.

CONCLUSION

It was observed that the pregnancy termination cases in our study were accompanied by serious combined injuries. This

is a finding that will guide the forensic medicine specialist in terms of establishing a causal link between major traumas and termination of pregnancy. However, it is thought that more detailed and complete data on pregnant trauma cases should be collected in order to understand the risk of pregnant cases. In addition, the effects of minor traumas on pregnancy outcomes and their evaluation in terms of forensic medicine are still a complex issue. There is a need for comprehensive studies evaluating pregnancy outcomes in pregnant women with a history of minor trauma in future studies.

Ethics

Ethics Committee Approval: Ethics committee scientific approval was obtained.

Peer-review: İç ve dış danışmanlarca değerlendirilmiştir.

Authorship Contributions

Concept: Y.S., T.Z., F.G., K.K., T.K.Y., Design: Y.S., T.Z., F.G., K.K., T.K.Y., Data Collection or Processing: Y.S., T.Z., Analysis or Interpretation: Y.S., T.Z., F.G., M.K.G., K.K., T.K.Y., Literature Search: Y.S., T.K.Y., F.G., Writing: Y.S., T.K.Y.

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

Financial Disclosure: The authors declared that this study received no financial support.

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