

Cite as: Archiv EuroMedica. 2024. 14; 3. DOI [10.35630/2024/14/3.343](https://doi.org/10.35630/2024/14/3.343)

Received 18 April 2024;
Accepted 4 June 2024;
Published 14 June 2024

POST-TRAUMATIC HEMORRHAGE IN A PREGNANT WOMAN IN THE PRACTICE OF PRIMARY EMERGENCY MEDICAL TEAMS

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ABSTRACT

Pregnancy is a unique period in a woman's life. It involves physiological changes, as well as mental and emotional ones for the mother-to-be. Pregnant women are at a higher risk of death from trauma compared to the rest of the female population. Medical activities aimed at treating pregnant trauma patients are issues that pose serious challenges for members of emergency medical teams. They require interdisciplinary medical knowledge, that of anatomy, physiology, trauma, but also obstetric and possibly neonatal care. In the pre-hospital setting, diagnosis and assistance is severely limited, so it is crucial that the pregnant woman be brought as quickly as possible to a hospital with appropriate diagnostic and specialty facilities. The aim of this study was to discuss the problem of uncontrolled internal hemorrhage in a pregnant woman, its consequences and the pre-hospital management of primary emergency medical teams. The research method was a review of the literature and recommendations of specialists of international organizations established to develop guidelines for emergency medicine. Based on the analysis, the following conclusions were drawn: 1. A traumatized pregnant woman should be given priority and special treatment in prehospital care due to measures that affect at least two lives - that of the mother and that of the child/children. 2. Due to the changes taking place in the body of the mother-to-be, injuries in pregnant women occur more frequently than in women who are not pregnant. 3. In pregnant women, the forces acting during the trauma, lead to different injuries than in non-pregnant women. 4. The effects of injuries sustained during pregnancy depend on the mechanism of injury, the severity of the injury and the stage of pregnancy. 5. Hypovolemia associated with decompensation of traumatic shock in a pregnant woman indicates an inauspicious prognosis for the health and life of the mother and baby. 6. Medical emergency procedures in pregnant trauma patients are similar to those used for other patients, but require some modifications related to the anatomical and physiological changes that occur during pregnancy. 7. Examining a pregnant patient may be difficult due to the anatomical and physiological changes occurring during this period.

Increased heart rate and decreased blood pressure should not be considered a consequence of pregnancy if other causes are not ruled out. 8. It seems reasonable to introduce TXA acid into the regimens of basic emergency teams for victims with symptoms of hemorrhagic shock.

Keywords: emergency medical teams; pregnant; trauma; uncontrolled internal hemorrhage

INTRODUCTION

Pregnancy is a unique period in a woman's life. It involves physiological changes, as well as mental and emotional changes for the mother-to-be. According to Article 68 (3) of the Polish Constitution, public authorities have a duty to provide special care to women expecting a child. *"Regardless of the rules of financing health services, pregnant women are in a distinguished group to whom the state guarantees the realization of the right to health care"* [1]. Maintaining the well-being of the pregnant woman is a component of perinatal care, the purpose of which is to provide care, health promotion and activities during the planning of pregnancy, its duration, delivery and postpartum [2].

A particular challenge in maternity care is trauma and related injuries. According to Petrone and co-authors [3], trauma during pregnancy is the leading unrelated cause of maternal and child death. Data indicate that 6 - 8% of women suffer trauma during pregnancy [4], and 1 in 12 mothers succumb to complications due to it [5].

The main observed symptom of trauma in pregnant women is blood loss. The severity of bleeding can be extremely variable, ranging from minor bleeding to life-threatening hemorrhages [6]. In view of the above, the purpose of this paper is to discuss the problem of uncontrolled internal hemorrhage in a pregnant woman, its consequences and the prehospital management of primary emergency teams.

THE AIM OF STUDY

The aim of this study was to discuss the problem of uncontrolled internal hemorrhage in a pregnant woman, its consequences and the pre-hospital management of primary emergency medical teams.

METHODS

To achieve the goal, the following research problems were formulated:

1. Are pregnant women at greater risk of injury, and are the consequences more dangerous than those of non-pregnant women?
2. Are pregnant women with uncontrolled internal hemorrhage allowed to be treated analogously to other adult patient?

In view of the above questions, the following research hypotheses were formulated:

1. Pregnant women are at higher risk of complications of trauma, which is closely related to the physiological changes that occur during pregnancy.
2. Prehospital management of uncontrolled traumatic hemorrhage in a pregnant woman differs from recommendations for other groups of injured.

The research method through which information was obtained to enable the hypotheses to be considered true or false was document analysis. The research technique for the chosen method was qualitative analysis, based on the following research tools: medical literature, peer-reviewed scientific articles, guidelines and works of other authors. A literature searches were conducted using the search terms 'pregnant and physiology', 'trauma during pregnancy' and 'pregnancy and hemorrhage'. The University of Warmia and Mazury Library's online access database and the Internet were used.

PHYSIOLOGICAL CHANGES

Numerous adaptive changes take place in a woman's body during pregnancy to ensure optimal conditions for the development and growth of the fetus. We are talking about transformations related to both the reproductive organs and other organs and systems [7].

The most characteristic, at the same time quickly noticeable symptom of pregnancy is the weight gain of the future mother. With the end of a single normal pregnancy, body weight increases by an average of 10-12 kg (weight of the baby, placenta, fluid, uterus and fat mass) [8].

Cardiovascular changes are caused by placental synthesis of progesterone and estrogen. They exhibit a short vasodilatory effect and a long-lasting effect, probably preventing arteriosclerosis. As a result of estrogen's action, there is a decrease in tension and an increase in susceptibility of the vascular walls of

arteries and veins [9]. Between 6 and 8 weeks of pregnancy, there is an increase in blood volume, which reaches a maximum at 32 to 34 weeks of pregnancy. The increase in blood volume facilitates the exchange of oxygen between mother and child, and reduces the consequences of blood loss during labor. Plasma volume increases by up to 1200-1300 ml (40-50%) compared to the state before pregnancy, the erythrocyte mass also increases (20-30%). Since the increase in plasma volume is greater than the increase in the number of red blood cells, the hematocrit value decreases [7, 9]. The increase in blood volume increases cardiac stroke volume, and so in the first three months of pregnancy, stroke volume is 30-40% higher compared to non-pregnant women, and reaches its maximum value around the 20th week of pregnancy. An increase in ejection volume and heart rate by 10 - 15/min (80-90/min at rest), results in an approximately 50% increase in minute volume [7]. Blood pressure is influenced by both minute cardiac volume and peripheral vascular resistance. Despite the increase in minute ejection capacity, the pregnant woman's arterial blood pressure decreases due to a reduction in peripheral vascular resistance. Reductions in systolic and diastolic fractions range from 5 to 15 mmHg. The lowest blood pressure values are determined around the 28th week of pregnancy, and later in the perinatal period they return to pre-pregnancy values [7, 10]. The uterus, which is steadily increasing in weight, leads to compression of the inferior vena cava after the 28th week of pregnancy. In 90% of women, at the end of pregnancy, in the supine position, its lumen is almost completely closed, resulting in a decrease in venous return and decreased cardiac output. Compensatory mechanisms in most pregnant women lead to an increase in peripheral vascular resistance, which allows the blood pressure to remain normal, but this is followed by a decrease in visceral flow, including uteroplacental flow. In about 12% of pregnant women, this compensation is inadequate. In this case, a decrease in blood pressure values is observed. The enlarged uterus also causes pressure on the abdominal segment of the aorta. The hemodynamic consequences of this condition primarily affect the fetus - even in the case of complete closure of the abdominal aortic lumen, the results of blood pressure measurements in the pregnant arm may remain normal. The syndrome of the symptoms indicated above is referred to as aorto-venous syndrome (ACS - Acute Coronary Syndrome), previously referred to as "inferior vena cava syndrome" according to Kruszynski [8]. Due to the hemodynamic consequences of the pregnant woman's supine position, the enlarged uterus compresses both the vena cava and the aorta (Figure 1).

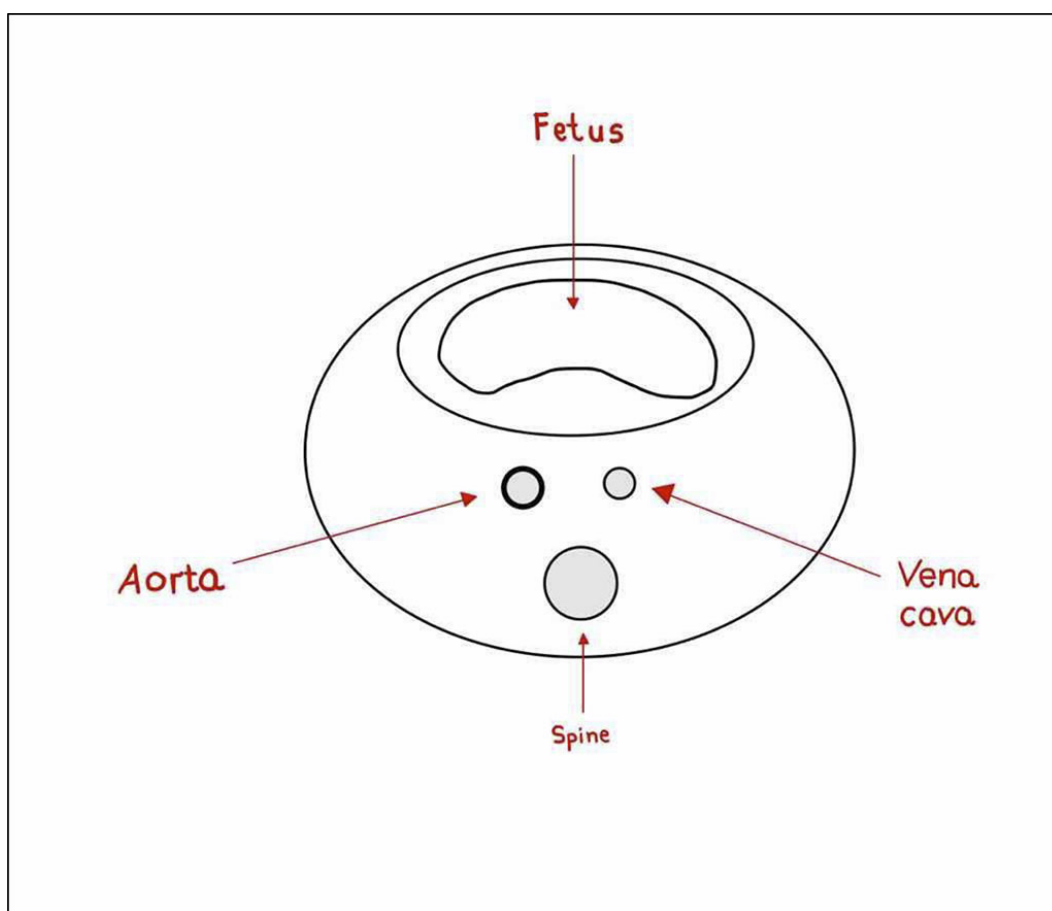


Figure 1. Aorto-venous syndrome [Authors' own figure].

As the fetus grows, the uterus lifts the diaphragm, and this in turn leads to cardiac displacement and its left rotation relative to the long axis. The dimensions of the heart, as a result of the hypertrophy of the fibers, as well as the increase in heart volume, increase by about 12%. Widening of the tricuspid valve lumen can lead to the occurrence of a backward wave, clinically manifested by the presence of a systolic murmur [9].

On electrocardiography with the end of pregnancy, a shift of the electrical axis to the left can be seen, sometimes premature atrial contractions and sinus tachycardia. Paroxysmal supraventricular tachycardia is rather rare [7, 8].

The coagulation system also undergoes physiological changes. There is an increase in the concentration of fibrinogen and factors: VII, IX and X. The number of platelets and their adhesion capacity, the level of antithrombin or protein C remain unchanged. The resulting condition creates, on the one hand, a protective mechanism against excessive bleeding during labor, and on the other, increases the risk of deep vein thrombosis during pregnancy [8]. During the last period of pregnancy, the diaphragm rises by about 4 cm, resulting in a decrease in the volume of the chest. The pregnant woman's body compensates for this condition by increasing the anterior-posterior and transverse dimensions of the chest. There is also an increase in the number of breaths and about 40% increase in tidal volume. In the perinatal period, alveolar ventilation exceeds the pre-pregnancy value by 70%. There is a decrease of about 20% in functional retention volume, which in 1/3 of pregnant women positioned on their backs leads to bronchial closure at the end of inspiration. This process intensifies in women who do not stop smoking tobacco products despite pregnancy, as well as pregnant women with obesity and scoliosis [8]. The digestive system is another system that is affected by pregnancy. The increasing volume of the uterus causes elevation and rotation of the stomach. Probably under the influence of progesterone, intestinal peristalsis slows down, resulting in constipation in about 38% of pregnant women. This condition affects a marked prolongation of gastric emptying, especially in the final stage of pregnancy [7, 8].

HEMORRHAGIC SHOCK

Hemodynamic changes occurring in pregnant women are designed to prepare the body for the expected labor bleeding. The physiological response to various degrees of blood loss makes it possible to classify hemorrhages into 4 different groups [11, 12].

To illustrate, assuming that a woman's weight at the 30th week of pregnancy is 60 kg and her blood volume is close to 6,000 ml, a first-degree hemorrhage occurs with a blood loss of about 1,000 ml (about 15% of the volume). Associated symptoms in this case are dizziness, or palpitations [11]. Grade two hemorrhage is a loss of about 1,500 ml of blood (20-25% of volume). In this case, the symptoms are accompanied by tachycardia and accelerated breathing of the pregnant woman. Tachycardia is a compensatory mechanism to increase the heart's minute capacity. In grade II hemorrhage, stimulation of the adrenergic sympathetic nervous system determines the centralization of the circulation. The final effect of the above changes is vasoconstriction and an associated increase in diastolic blood pressure and maintenance of systolic blood pressure values. The final effect of the body's response to grade II bleeding is orthostatic hypotonia. In practice, the indicated condition can be assessed by examining capillary recurrence - a significant delay in reperfusion [11].

Third-degree hemorrhage occurs with a loss of 30 - 35% of blood, or about 2000 ml. In this case, intensification of compensatory mechanisms from stage II can be observed - tachycardia 120-160/min, acceleration of respiration 30-50/min, hypotension, change in color and warmth of the skin coats, as well as anxiety [11].

Loss of more than 2,500 ml (40% of blood) results in a grade IV hemorrhage. Clinical signs, in addition to those observed in earlier stages, include the absence of a palpable peripheral pulse, oxygen starvation, and oliguria or anuria [11].

Significant loss of circulating blood leads to hemorrhagic shock (absolute hypovolemia). This results in hemodynamic instability, increasing metabolic acidosis, cellular dysoxia, which obviously negatively affects tissues, organs and systems, and in the long run leads to multi-organ failure. This process, in the absence of proper treatment, inevitably leads to death [13]. It is clear that hypovolemia during pregnancy poses a risk to both the pregnant woman and the baby [14].

The literature indicates the division of shock into three phases - initial, compensated and irreversible, or decompensated. These depend on the amount and rate of blood loss. The early phase often proceeds in a latent manner, despite the distribution disorders already occurring and the reduction of oxygen in the tissues. In the compensated phase, the key is to maintain blood pressure at a level sufficient to ensure tissue perfusion. Hypotension is an early sign of decompensated shock - it indicates that defense mechanisms have been exhausted and cardiac arrest is imminent [12, 13, 15].

In pregnant women, blood flow to the uterus is strongly dependent on perfusion pressure. Situations that reduce blood supply, including the shock in question, severely disrupt fetal oxygenation. A reduction in the diameter of the uterine vessels reduces, by about 20 - 30%, uterine blood flow. The fetal response to the situation is a decrease in fetal arterial pressure and a decrease in heart rate. The decrease in the oxygen pressure in the mother's blood is a huge threat to the baby [16].

Many situations can lead to significant blood loss and the development of shock. Most often, however, hypovolemic shock is caused by perinatal and intraoperative hemorrhages, gastrointestinal bleeding and

trauma. Noteworthy, the symptoms of severe trauma can overlap with the picture of shock [13].

MECHANISMS OF INJURY FOR TRAUMA IN PREGNANCY

Hemorrhage is considered one of the most common causes of death. It is estimated that 1.9 million people lose their lives each year due to blood loss – analysis of the material indicates that of this number, as many as 1.5 million deaths are closely related to trauma [13]. According to the data obtained, injuries in pregnant women occur more often than in non-pregnant women. This may be influenced by changes in the pregnant woman's body - modifications of vital signs, impaired motor coordination, increased fatigability and possible, especially in the first trimester, syncope [17]. Global cultural differences and different health care systems affect the incidence as well as the consequences of injuries during pregnancy [4]. According to Deshpande [18] pregnant women are 1.6 times more likely to die as a result of injury compared to the rest of the female population. An analogous result is presented by the results of a 10-year study conducted by Maxwell [19] in one of two Level I trauma centers in the state of Oregon (USA). Here, the mortality rate for pregnant women was determined to be 2.1%, while in the group of other ladies it was 0.2%. A considerable amount of data to understand the nature of the problem and the dangers of injuries in the pregnant population comes from North America [4].

In Canada and the United States of America, the most common causes of injury to pregnant women are traffic accidents, falls, thermal injuries and aggression from partners [20]. Similar results are indicated by studies in the United Kingdom [21] and Japan, where traffic accidents are considered the leading cause of injury to pregnant women - 64.6% [22]. In Africa, about 4% of pregnant women suffer injuries, but in this region the majority, 46 - 52%, of cases are related to aggression and physical violence [4]. The overall statistics indicated are affected by many factors. In Poland, these include, for example, limited use of seat belts (allowed by law) and failure to adjust speed to road conditions [17, 20, 23]. Also worth mentioning here are the previously discussed physiological changes that can potentially affect driving errors, (especially in women in the second trimester of pregnancy) [24]. Studies show that up to 71% of women may experience physical violence from family members, with pregnancy being a particularly high-risk period - about 30% of acts of aggression involve this time. The risk of partner violence is particularly high in underdeveloped countries with low education rates and poor socioeconomic conditions [20].

The presented causes of injury in pregnant women lead to two types of injuries - blunt and penetrating. The first are the result of the application of force to the body. Two mechanisms of this type of injury can be distinguished. The first is crushing, leading to rupture of the parenchymal organs or rupture of the cavernous organs. The second is deceleration, resulting in rupture of organs and blood vessels [25, 26]. Blunt abdominal injuries in pregnant women are usually responsible for traffic accidents and falls, resulting mainly from a shift in the center of gravity [17]. In pregnancy up to the 12th week, direct injury to the fetus is rare. It is surrounded by the amniotic sac, which contains fluid that limits the effects of force. The mother's pelvis also provides some protective barrier. The death of the baby can be a consequence of abdominal bleeding or extraperitoneal hematomas of the pregnant woman [6, 27]. Later in pregnancy, i.e. in the second and third trimesters, the risk of direct harm to the baby from blunt trauma increases. The ratio of amniotic fluid volume to fetal size is unfavorable. In addition, the baby's head is directed toward the pelvis during this period, and the trunk is positioned above it [27]. It should be noted that blunt abdominal trauma significantly increases the risk of premature separation of the placenta (66% of cases). The uterus undergoes acceleration and deceleration, acting oppositely on the uterus and placenta. The uterine muscle stretches and changes shape, adapting to the forces at work. The placenta, unfortunately, lacks such abilities. The result is a separating force that can lead to the separation of the placenta from the uterine muscle [28], resulting in intrauterine bleeding, the initiation of the function of the uterine contraction and the development of hypovolemic shock [6, 29]. Another, admittedly rare, but extremely serious in its consequences, blunt trauma in a pregnant woman can be uterine rupture. This does not always involve a complete rupture of the muscle wall; it can be partial. Moreover, it can be asymptomatic and happen even a few days after the injury. Hence, post-traumatic observation of the pregnant woman in the hospital setting is very important [6,17,29]. High-energy blunt trauma carries the risk of fractures in the pelvic rim. This results in a number of serious complications, accompanied by injuries to the organs of the pelvis minor and concurrent other multiple injuries [6]. Increased vascular filling in the pelvic area puts a woman at greater risk of retroperitoneal hemorrhage as a result of the injury [10]. Severe blunt trauma can result not only in damage within the uterus, but also in rupture of the spleen or liver [27, 28]. According to Łyziński [27], the risk of these injuries in pregnant women is higher than in non-pregnant women. Penetrating injuries are usually associated with acts of aggression. In pregnant women, the most common injuries of this type are stab wounds and gunshot wounds [17, 27] and usually affect the third trimester of pregnancy [6]. Penetrating abdominal injuries are extremely dangerous to both mother and child, with a lower maternal mortality rate. The enlarged uterus provides a barrier to protect the organs laid deeper, thus the likelihood of death for the pregnant woman is less than the risk of death for the fetus exposed to the direct action of the causative agent [28]. In a study conducted by Petrone [3] in a group of pregnant women after penetrating injuries, death was reported in 7% of mothers and as many as 73% of fetuses. Because of the risk of extensive intestinal damage, injuries located in the epigastric region are a serious threat to the

pregnant woman. As the uterus enlarges, they are displaced upward [3, 17].

Comparing the dangers of gunshot and stab wounds, the former pose a greater risk to pregnant women. Bullets, which have high kinetic energy and generate a shock wave, contribute to more serious injuries than knife wounds [10]. The results of analyses show that gunshot wounds to the abdomen are associated with maternal mortality in about 4-10% of cases. Damage to the fetus as a result of gunshot wounds is 60-70% with a mortality rate in the 40-71% range. In the case of stab wounds, the risk of maternal death is similar to that of gunshot injuries. Fetal mortality reaches 40-42% [3, 16, 28, 30].

EMERGENCY MEDICAL ACTIVITIES IN THE PRACTICE OF THE PRIMARY TEAM

During pregnancy, almost every organ in a woman's body undergoes specific adaptive processes. Emergency measures taken after trauma must be based on knowledge of the most significant anatomical and physiological changes occurring during this period. These differences can directly affect the response of the mother-to-be's body to the applied treatment and condition the need to modify the procedure [6, 28]. A key element that determines therapeutic decisions, and at the same time a highly stressful factor for members of the emergency team, is the fact that the actions taken affect both mother and child, or children if we are talking about a multiple pregnancy [27]. It should be noted that in the first period of pregnancy is not visible, the patient herself may not be aware that she is expecting a child or her condition will prevent the collection of a reliable history. In view of the above, Jain [5], in his recommendations for the management of a traumatized pregnant patient, points out the rationale for treating any woman of childbearing age as pregnant until pregnancy is ruled out. Care of the pregnant woman after trauma is based on her examination and stabilization of her general condition. The initial procedure does not deviate from the ITLS (International Trauma Life Support) scheme. The undertaking of rescue operations should be preceded by an assessment of the circumstances, the scene, the number of victims, the mechanism of injury and the safety of those present. When approaching the pregnant woman (optimally from the front), attention should be paid to the age, weight and general appearance and position in which the victim is located. While making contact, it is possible to make an initial assessment of consciousness according to the AVPU scheme - whether contact is preserved, she responds only to verbal or pain stimuli, or whether she is unconscious. In the next step, it is worthwhile to take care of manual stabilization of the cervical spine and verify whether there are serious wounds, hemorrhages. In case of unconsciousness or unresponsiveness, it is necessary to assess the patency of the airway (A) and, if necessary, decongest it, initially by using the mandibular advancement maneuver. The next step is to assess the capacity of the respiratory system (B). The basic question is, is the victim breathing? If so, is the breathing efficient? Frequency, depth, as well as respiratory effort should be assessed. Cardiovascular fitness is further verified. In a quick examination, this is based on the presence, frequency and quality of the pulse on the central and peripheral arteries (C). The examination of the skin should not be omitted, the color, moisture content, or its temperature and capillary return are worthy of attention [26, 31]. The final element of the initial evaluation is to confirm the protection of massive hemorrhages.

After the initial assessment, it is necessary to proceed to a rapid trauma examination (in certain circumstances, where the mechanism indicates it, and the victim remains in full contact - local examination). The examination is conducted from the head and in search of wounds, deformities, swelling and other features of trauma is directed downward. When assessing the neck, it is worth noting the filling of the jugular veins and the location of the trachea (this can help in the diagnosis of emphysema, pleural hematoma, or pericardial tamponade). Once the chest is exposed, the symmetry of the chest should be visually confirmed and then examined by palpation. At a later stage, auscultation of the lung fields is necessary to determine whether there is asymmetry of respiratory murmurs. If there are auscultatory changes, the chest should be tapped - an eardrum sound raises the suspicion of emphysema, a muffled one - the presence of a hematoma. The concluding element of the chest evaluation is auscultation of heart tones [31]. Examination of the abdomen in pregnant women, for obvious reasons, requires certain modifications. In addition to the standard search for bruising, lacerations, in addition, uterine muscle tone, gestational period and, if possible, evaluation of fetal movements should be assessed. Determination of gestational age in the pre-hospital stage is not very accurate (in the absence of documentation and/or reliable history), and is based on palpation of the fundus of the uterus (Figure 2). It is estimated that at 20 weeks of gestation the uterine fundus is halfway between the pubic conjunctiva and the umbilicus, at 24 weeks it reaches the height of the umbilicus, and at 32 weeks it should be probable at halfway between the umbilicus and the gladius process of the sternum [29, 31].

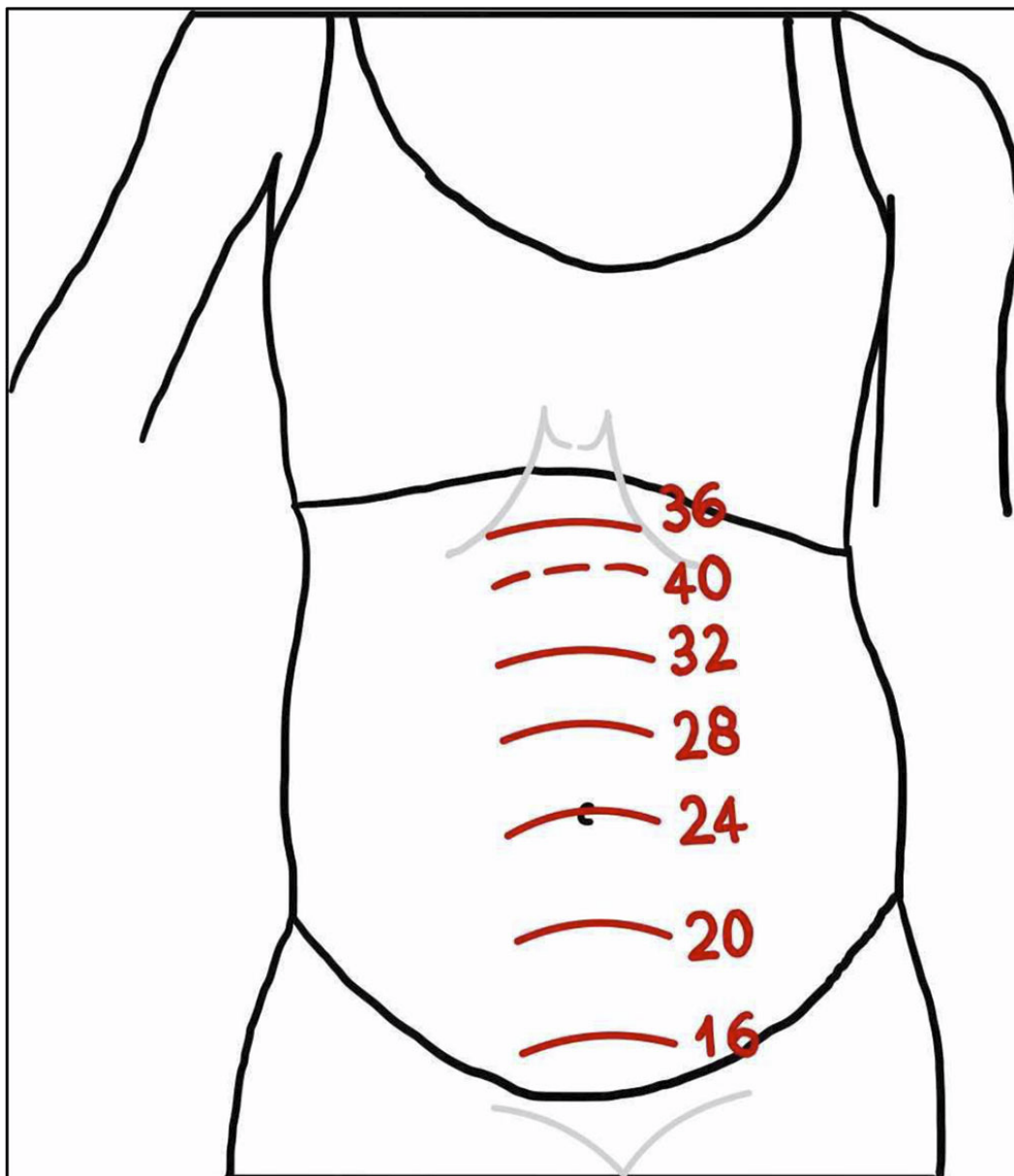


Figure 2. Height of the pregnant woman's fundus in relation to the duration of pregnancy [Authors' own figure].

The pelvic girdle stability test involves gently squeezing the iliac plates inward at the anterior aspect of the iliac crests to identify signs of instability. If pathology is found, the pelvis should not be re-examined. In pregnant women, especially after the first trimester of pregnancy, perineal examination is extremely important during the evaluation. It is aimed at detecting possible hemorrhage, amniotic fluid and even parts of the baby's body. In a further stage of the examination, the lower and upper limbs are evaluated for bleeding, deformities, or swelling. The back and buttocks are examined last, usually during body rotation allowing efficient use of central stabilization equipment [16, 31]. Once the pregnant woman is fully secured, she should be immediately transferred to an ambulance, bearing in mind that, except for extremely short transports, transporting the victim on an orthopedic board is an unadvisable procedure. Taking advantage of the transit time, while adhering to safety rules, it is worth using the available medical apparatus to continuously monitor basic vital signs (BP, HR, respiratory count) and complete the medical history, for example, according to the SAMPLE scheme. To detail the trauma examination, it is worthwhile to weave elements of the abbreviated neurological examination into the evaluation: assessment of pupil symmetry and reactivity, motor and sensorimotor skills, Glasgow scale, and glycemic levels [31]. Further action is to continue monitoring the patient and treating her. It is carried out several times depending on the duration of transport. When the victim is in a serious condition, the follow-up examination is carried out at least every 5 minutes, with a stable condition - once every 15 minutes. A change in position, the implementation of therapeutic intervention or an observed change in the condition of the pregnant woman, requires a repeat examination [31].

The re-examination is a structured head-to-toe examination (with a back examination, of course), being the basis for identifying injuries that may have been overlooked in the initial examination. It is important to

note every change and abnormality on examination [31].

While external hemorrhage is visible and easy to diagnose, internal hemorrhage can be difficult to confirm in the prehospital setting. The use of portable ultrasound equipment and the FAST protocol can serve as a sort of screening test for blood in the abdominal and thoracic regions. Internal bleeding is difficult to diagnose, and difficult or impossible to control in the prehospital stage. Definitive protection can only take place in the operating room area. Therefore, the task of rescuers is to recognize the features of hemorrhage early, take rescue measures and rapid transport to the hospital [16, 32]. In the case of pregnant women, identification of the risk, due to the physiological and anatomical changes that occur during pregnancy, can be difficult [16,27]. According to Gaszyński [33], it is relatively common for pregnant women to experience simultaneous detachment of the placenta and rupture of the amniotic bladder. In this case, the intensity of bleeding from the genital tract may be inadequate to the actual blood loss. A high risk of bleeding into the uterus and retroperitoneal space arises. With premature detachment of the placenta, blood accumulates in the abdominal cavity as an irritant, causing tenderness and tension in the abdominal muscles [32]. The natural stretching of the abdominal wall during pregnancy and additional hormonal changes, reduce the activity of the muscles and peritoneum to stimuli. Consequently, in pregnant women with peritoneal bleeding, characteristic symptoms such as Blumberg sign, defense or muscle tension may be reduced. In addition, as a result of uterine enlargement, the internal organs rise - this can alter the localization of pain [16, 27, 33]. Symptoms of shock may be the first to manifest the onset of internal bleeding [32]. It is worth remembering that the normal vital parameters of the pregnant woman, are often confused with the values observed in shock. As a reminder, the amount of the pregnant woman's heart rate at rest is 10-15/min higher, and the systolic blood pressure is 10-15 mmHg lower than in a non-pregnant woman. In addition, an important fact is that due to the increased blood volume, a pregnant woman can lose up to 1500 ml before observable changes in blood pressure develop [16].

At every stage of the measures, it is important to remember that the end result is as important for the mother as for the baby. Effective treatment of the mother positively affects the fetal condition. All critical treatments should be implemented immediately, and the patient should be placed under specialized care in the hospital as soon as possible [27, 34]. In victims in imminent danger, the goal should be to limit the examination to 2 minutes, and on-site activities should be completed before 5 minutes [31]. The mainstay of treatment of hemorrhagic shock in the prehospital stage remains the provision of an adequate supply of oxygen to maintain normal cell metabolism [12]. Airway patency should be secured and optimal ventilation ensured. Hypoxemia of the mother and especially the fetus may go unnoticed, so early implementation of oxygen therapy with 100% O₂ is necessary. Reduced gastric sphincter and gullet tone and increased intra-abdominal pressure contribute to an increased risk of regurgitation in the unconscious pregnant woman [35]. Early intubation is indicated in these circumstances (available only in specialized teams that include a physician). Paramedics in Poland are able to clear the airway instrumentally relying only on supraglottic techniques (unless sudden cardiac arrest has occurred). Half of pregnant women have edema, which makes it difficult to maintain spontaneous airflow, thus the airway should be considered "difficult" [8]. Both passive and active ventilation should always be accompanied by capnometry (EtCO₂) monitoring [27]. An extremely important element during the management of hemorrhagic shock is to obtain vascular access and initiate fluid therapy with warm crystalloids to compensate for fluid deficiency [17]. Intravenous fluid supply should be given in amounts appropriate to the situation and to preserve peripheral perfusion. The desired effect is the return of pulse on peripheral arteries or an increase in systolic blood pressure to 80-90 mmHg. The use of excessive fluid therapy increases the dynamics of bleeding, results in acidosis and dilutes plasma clotting factors, leading to coagulopathy. Finally, crystalloids do not replace erythrocytes in any way and, as a result, do not participate in oxygen transport [15].

Current ITLS (International Trauma Life Support) recommendations [15] indicate that the horizontal position should be used when treating shock with internal bleeding. For pregnant women, the position requires discrete modification depending on the stage of pregnancy. Up to the 20th week, the positioning is analogous to nonpregnant patients, but beyond this point, the supine position causes the uterus to place significant pressure on the inferior vena cava and aorta, leading to the aorto-venous syndrome discussed above [8, 16]. It results in reduced venous blood return and a decrease in cardiac output. As a consequence, hypotension and impaired consciousness occur in the mother and bradyarrhythmia in the fetus. Therefore, in order to reduce the adverse symptoms in the victim, the uterus should be moved manually to the left side (Figure 3).

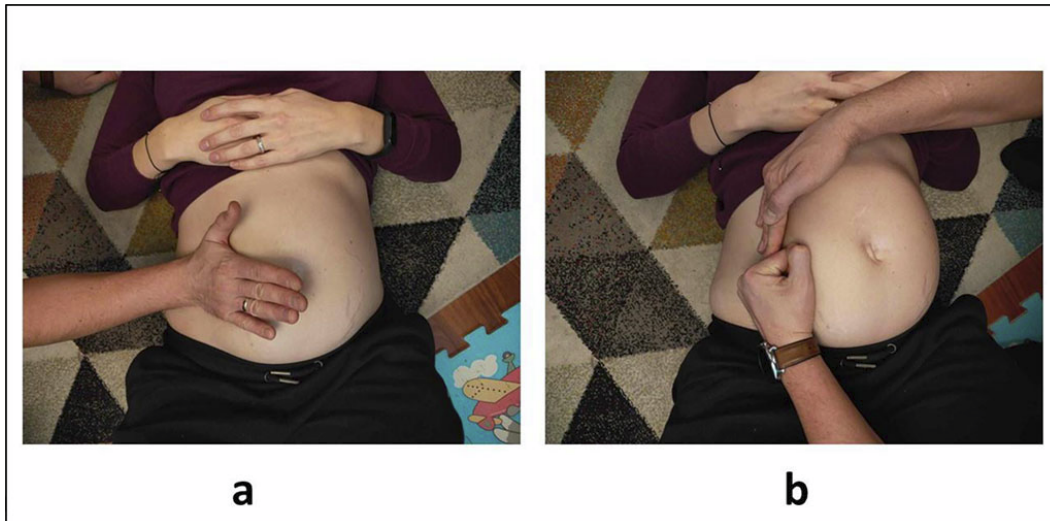


Figure 3. Maneuver to move the uterus to the left side - (a) with one hand, (b) with both hands [Authors' own figure].

In addition to manual displacement of the uterus, transportation of a woman in advanced pregnancy should be done with the elevation of the right side of the body (especially the hip) by 10-15 cm. This can be achieved by placing a rolled up blanket or other object. Similar positioning is used for pregnant women transported on a vacuum mattress and an orthopedic board. After applying stabilization with straps, the board/mattress should be raised from the right side by 15-30°. As already noted, the victim should not remain on the board longer than absolutely necessary [16, 17].

In any trauma patient, pregnant women are no exception, care should be taken for proper pain management. It is associated with the process of releasing hormones that constrict blood vessels. The effect is to restrict blood flow through the uterus and reduce blood supply to the fetus. According to Łyziński [27], opioids and benzodiazepines should not be abandoned for fear of their adverse effects on the baby. These drugs can be used relatively safely in pregnant women, as long as they are dosed thoughtfully and judiciously, and the patient's vital signs are constantly monitored. Hypovolemia associated with blood loss is the most common cause of cardiac arrest in pregnant women [18]. When assessing the cardiovascular capacity of a victim, the presence of a pulse on the central and peripheral arteries should be monitored especially carefully. Hypotension in a pregnant woman is a harbinger of cardiac arrest that may soon occur [27]. Medical emergency procedures for treating cardiac arrest in a pregnant woman are analogous to those conducted for other adults. When observing defibrillation rhythms, the energy of the discharge and the dosage of drugs are also identical. The difference is noticeable in the recommendations for the treatment of hypovolemia. Here the indicated volume of administered crystalloids is increased, up to 4,000 ml in a rapid infusion [16, 36]. After 20 weeks of pregnancy, during resuscitation, it is important to remember to manually move the uterus and maintain elevation of the right side of the victim (as in cases of stabilization after trauma) - tilting the patient to the left side is better than lying on the back. The elevation used must allow high quality chest compression to be conducted [36].

Going beyond the current authority of primary team paramedics, it should be noted that tranexamic acid (TXA) could be an additional opportunity in the pre-hospital management of pregnant victims with internal bleeding. Recently, there have been intensified efforts to introduce this drug into the current inventory of preparations available without physician supervision. Current IITLS [15] as well as ERC [36] guidelines indicate the validity of tranexamic acid in prehospital care for patients with post-traumatic hypovolemia. It is an antifibrinolytic agent. Its action is to inhibit the fibrinolytic activity of plasmin, and therefore does not promote clot formation, but stabilizes the naturally formed clot as the body's response to bleeding. Tranexamic acid is considered the primary pharmacological strategy for treating internal bleeding. Its administration in both in-hospital and pre-hospital operations has an impact on reducing mortality among patients with traumatic hemorrhagic shock. The recommended dose of TXA acid is 1 g/10 minutes, followed by a maintenance infusion of 1g/8 hours. The results of the study indicate that the greatest effect of tranexamic acid, is observed when it is given within 1 - 3 hours after injury. The drug should not be used after this time, as it can adversely affect the intensity of bleeding [15, 37]. Studies using TXA acid in pregnant women have so far been conducted on a rather limited basis. They have mainly focused on its use in the treatment of postpartum hemorrhage. The results indicate that a significant decrease in mortality in this group of patients has been achieved [36, 38]. It has also been proven that the drug does not significantly increase thromboembolic events. Despite, the small amount of data on the use of TXA acid in pregnant women after trauma, Liggett [38] recommends its use regardless of whether the woman is or is not pregnant. Tranexamic acid is estimated to be safe for the fetus [39].

CONCLUSIONS

Medical activities aimed at treating pregnant trauma patients are issues that pose serious challenges for members of emergency medical teams. They require interdisciplinary medical knowledge, that of anatomy, physiology, trauma, but also obstetric and possibly neonatal care. In the pre-hospital setting, diagnosis and assistance is severely limited, so it is crucial that the pregnant woman be brought as quickly as possible to a hospital with appropriate diagnostic and specialty facilities.

The presented review of the literature and the recommendations of specialists of international organizations established to develop guidelines for emergency medicine, led to the following conclusions:

1. A traumatized pregnant woman should be given priority and special treatment in prehospital care due to measures that affect at least two lives - that of the mother and that of the child/children.
2. Due to the changes taking place in the body of the mother-to-be, injuries in pregnant women occur more frequently than in women who are not pregnant.
3. In pregnant women, the forces acting during the trauma, lead to different injuries than in non-pregnant women.
4. The effects of injuries sustained during pregnancy depend on the mechanism of injury, the severity of the injury and the stage of pregnancy.
5. Hypovolemia associated with decompensation of traumatic shock in a pregnant woman indicates an inauspicious prognosis for the health and life of the mother and baby.
6. Medical emergency procedures in pregnant trauma patients are similar to those used for other patients, but require some modifications related to the anatomical and physiological changes that occur during pregnancy.
7. Examining a pregnant patient may be difficult due to the anatomical and physiological changes occurring during this period. Increased heart rate and decreased blood pressure should not be considered a consequence of pregnancy if other causes are not ruled out.
8. It seems reasonable to introduce TXA acid into the regimens of basic emergency teams for victims with symptoms of hemorrhagic shock.

AUTHORS' CONTRIBUTIONS

All authors have read and approved the published version of the manuscript.

FUNDING

This research did not receive external funding.

STATEMENT OF INSTITUTIONAL REVIEW BOARD

Not applicable.

STATEMENT OF INFORMED CONSENT

Not applicable.

STATEMENT OF DATA AVAILABILITY

Not applicable.

CONFLICT OF INTEREST

The authors report no conflicts of interest.

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