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Comprehensive Management of Pelvic Trauma in Pregnant Patients

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ABSTRACT

Pelvic fractures occur frequently due to traffic accidents and high-energy. Pregnant women are susceptible to trauma, with one in 12 pregnancies complicated by such incidents, making trauma the leading cause of non-obstetric maternal deaths during pregnancy. Pelvic fractures during pregnancy pose significant risks, potentially leading to adverse pregnancy outcomes such as preterm delivery, placental abruption, fetal distress, and even maternal or fetal death. The physiological changes that occur during pregnancy, including increased blood volume and altered cardiovascular dynamics, further complicate the management of pelvic trauma in pregnant patients. Prompt and appropriate management of pelvic trauma in pregnant patients is essential to optimize outcomes for both the mother and the fetus. Initial evaluation and stabilization of the mother take precedence, with close attention to airway, breathing, and circulation. Diagnostic imaging, including pelvic X-rays and, when feasible, body CT or MRI, aids in assessing the extent of pelvic injury and identifying associated injuries. Definitive treatment of pelvic fractures may involve a combination of surgical fixation, bed rest, traction, and pelvic slings, depending on the severity of the injury. The timing and approach to delivery in pregnant patients with pelvic fractures require careful consideration, with vaginal delivery being a viable option in many cases, provided that the pelvic architecture remains intact.

Conclussions: The management of pelvic trauma in pregnant patients requires a multidisciplinary approach and careful consideration of maternal and fetal well-being. Further research is needed to establish clear treatment guidelines and preventive strategies to reduce the incidence of pelvic fractures during pregnancy and improve outcomes for both mother and fetus.

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INTRODUCTION

Fractures of the pelvis encompass a broad spectrum of injuries, from low-energy osteoporotic fractures to high-energy disruptions of the pelvic ring.[1] A pelvic fracture involves damage to the bony structures that make up the pelvic ring (hips, sacrum, or coccyx). Due to the inherent structural and mechanical integrity of this ring, the pelvis is a very stable structure. Therefore, pelvic fractures occur most frequently in the setting of high-impact trauma and are often associated with fractures or additional injuries elsewhere in the body.[2]

Traffic accidents and high-energy trauma are mainly responsible for pelvic ring fractures in the general population.[3] Pregnant women are not exempt from trauma. Trauma complicates one in 12 pregnancies and is the leading cause of non-obstetric death among pregnant women. The most common traumatic injuries in pregnant women are automobile collisions (48%).[4] Other causes of pelvic trauma are domestic violence and falls from a height. They represent

approximately 6-7% of maternal and child injuries that end in abortion, preterm birth and death.[3]

Fractures of the pelvic ring have great implications in pregnancy, they can cause multiple injuries to the fetus due to its intrapelvic position and the craniocerebral region is very vulnerable since it is susceptible to irreversible or fatal damage.[5]

EPIDEMIOLOGY

Trauma, in general:[6]

- Most frequent cause of maternal-fetal morbidity and mortality in industrialized countries.
- Main cause of non-obstetric maternal deaths during pregnancy. With a maternal mortality rate of 10-11%.
- Fetal mortality can be up to 65%.6 The most frequent causes are: Maternal shock (80%), premature abruption of normal placenta (DPNI) (30-68%), maternal death, other causes.
- Approximately 5-8% of all pregnant women suffer some trauma at some point during their pregnancy.
- The risk for both the mother and the fetus increases as pregnancy progresses, it is estimated that there is a 10-15% risk of maternal or fetal injury due to trauma in the first trimester, 32-40% in the second trimester, and 50-54% during the third.

RISK FACTORS

According to the literature, risk factors for maternal trauma include: young age (<25 years) and low socioeconomic status, domestic violence, inappropriate seat belt use, and absence of prenatal care in the first trimester. Furthermore, falls are the second leading cause of trauma during pregnancy.[7] It was reported that women under 30 years of age have a twice higher risk of falling during pregnancy.[8] Increased lordosis lumbar during pregnancy shifts the center of gravity forward and generates a higher incidence of falls.[7] Voluntary or aggressive trauma is responsible for almost 16% of traumatic injuries suffered by pregnant women.[9]

PHYSIOLOGICAL CHANGES DURING PREGNANCY

Of the causes of death from trauma during pregnancy, pelvic trauma is the most dangerous due to changes in maternal physiology.[10] During pregnancy, the body undergoes many physiological and anatomical changes. Maternal blood volume begins to increase at 10 weeks' gestation, up to an additional 45% of prepregnancy levels[11], blood volume could increase to approximately 6 L.[12] Cardiac output can increase by 1 to 1.5 L/min after the first trimester in response to increased plasma volume and decreased vascular resistance.[11] In the second trimester, blood pressure decreases by 5-10 mmHg below basal and pulse increases by 5-15 bpm.[7,12] Haemoglobin concentration during pregnancy may decrease by 5 g/L due to volume expansion, during this physiologic change, red blood cell mass expands more slowly than the total blood volume increases. This difference results in dilutional anemia.[11] Plasma, and Clotting factors and fibrinogen levels also increase. Transient osteoporosis may occur due to alterations in the physiology of pregnancy, which increases the patient's susceptibility to fractures. Uterine compression in the inferior vena cava produces a possible deterioration in cardiac output, which drops to 30% during the supine position.[7]

COMPLICATIONS

Hypertrophied pelvic vasculature creates the potential for massive retroperitoneal hemorrhage in the event of a pelvic fracture.[7] Up to 30% of blood loss may go undetected due to maternal hemodilution and lead to further delay in diagnosis. The hypervolemic maternal state allows for greater tolerance to volume depletion during a traumatic event. If the mother loses 35% or 2000 ml of circulating blood, she becomes hemodynamically unstable and unable to compensate for the blood loss, which may induce hypovolemic shock. Studies show that a shock index >1.4 may indicate the need for intensive therapy.[11] As a result of hypovolemic shock, placental blood flow to the fetus may decrease by 10% to 20%, increasing the risk of fetal hypoxemic injury or death.[13] Other concomitant injuries that may occur with pelvic fractures include concomitant abdominal injuries in 42% of cases, chest injuries in 25%, closed head trauma in 37%, and other bones in 48%.[14]

Increased coagulation factors and fibrinogen result in a hypercoagulable state that is related to a high vulnerability to thromboembolic complications.[7] Other common complications involve hemorrhagic shock, Rh isoimmunization, placental abruption, uterine rupture, preterm birth, fetal distress, intrauterine fetal death, and urethral/perineal injuries.[14]

EVALUATION AND INITIAL MANAGEMENT

Evaluation and treatment of the mother is the first priority. Pregnant women with trauma should be stabilized and be assessed based on the severity of the trauma. If the fetus is viable (≥ 23 weeks), fetal heart rate auscultation and fetal monitoring should be performed. To assess a pregnant trauma patient, a focused history should be obtained clarifying the origin of the injury. This preliminary evaluation should be done within one minute and basic life-saving measures of trauma should be started simultaneously with the initial assessment. First and foremost, basic life-support measures through rapid assessment of the initial "ABC" must be performed.[7]

- **A** Airway maintenance with cervical spine protection.[4]
- **B** Breathing and ventilation: The marked increase in basal oxygen expenditure and utmost sensitivity of the fetus to maternal hypoxia indicate that oxygen supplementation through a nasal cannula, mask, or endotracheal tube should be performed for every

pregnant trauma patient to sustain the oxygen saturation greater than 95%.[13]

- **C** Circulation with hemorrhage control: Fluid resuscitation should be pursued very aggressively. A pregnant patient can lose a significant amount of her blood volume before she demonstrates hypotension and other signs of shock. Crystalloid and early type-specific packed red blood cells are indicated to restore the physiologic hypervolemia of pregnancy. Patients with post-mid-pregnancy should be returned to the left lateral position after a thorough physical exam to prevent supine hypotension.[4]

In pregnant patients who are not hemodynamically stable, a focused assessment with sonography for trauma (FAST) examination should be performed during the primary survey to assess for possible sources of bleeding. However, FAST cannot detect retroperitoneal hemorrhage, which is more likely in pregnant women because of the increased blood flow to the uterus.[15]

Laboratory Tests

Normally, indicated laboratory tests are the same to those of non-pregnant patients. Along with conventional trauma laboratory procedures, a type and screen, coagulation profile, fibrinogen, and Kleihauer-Betke (KB) test should be obtained for all Rh-negative pregnant trauma patients due to concerns of possible alloimmunization.[4] D-dimer is often positive during pregnancy; therefore, it is not recommended to rule-out venous thromboembolism.[7]

Diagnostic Imaging

Radiographic studies are recommended when advantage to the mother overshadows probable fetal risks. The pelvic X-ray reveals a widening of the symphysis pubis and sacroiliac joints.[7]

When feasible, body CT should be done with intravenous iodinated contrast, his implementation enhances the recognition of both maternal and fetal injuries by imparting vascular contrast in organs and opacification of vascular structures, as well as the placenta. Intravenous iodinated contrast material (ICM) is designated as a category B drug by the U.S. Food and Drug Administration (FDA). This implies that it has not demonstrated any side effects in neither animal nor human studies.

MRI implementation in pregnancy may be beneficial since no fetal-related deleterious consequences have been reported following its application.[16]

Figure 1. AP Pelvis X-ray

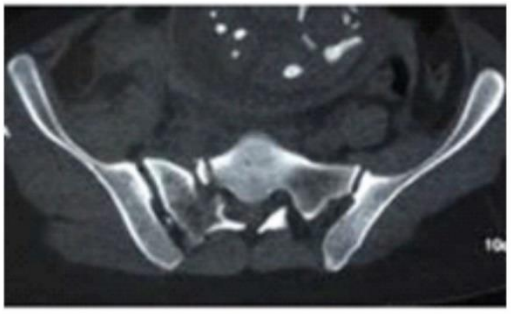


Figure 2. Axial CT cut of the pelvis

Figure 3. 3D Reconstruction. Anterior View.

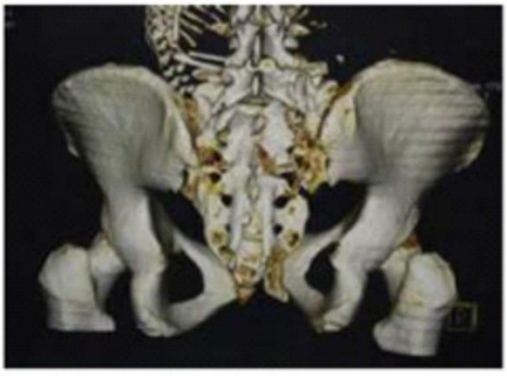


Figure 4. 3D Reconstruction. Posterior View.

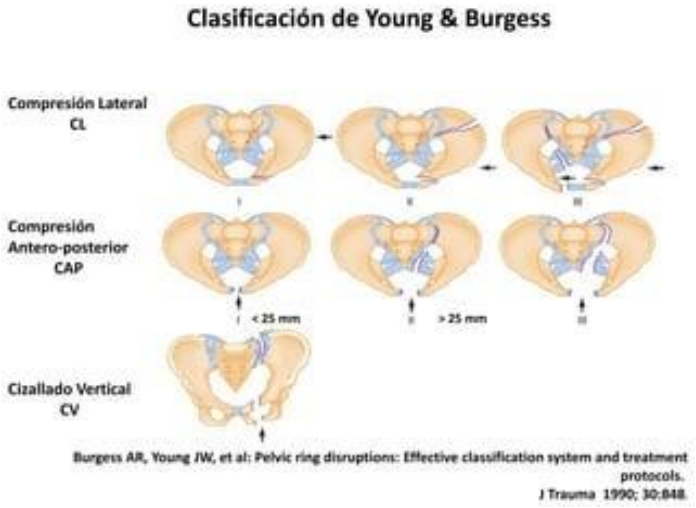
Almeida-Herdoiza C, Barros-Prieto E. Manejo de fractura pélvica en paciente gestante. A propósito de un caso. Rev Colomb Ortop Traumatol. 2015;29(1):36---40.

CLASSIFICATION OF PELVIS FRACTURE

The Young-Burgess classification system is the most commonly utilized classification system in the evaluation of pelvic ring injuries. By correctly identifying the pelvic ring injury, trauma surgeons and emergency physicians can provide adequate treatment.[2]

Fractures are divided into four categories based on the mechanism of injury.[17]

- **Anterior posterior compression.** These fractures are secondary to a direct or indirect force in an AP direction leading to diastasis of the symphysis pubis, with or without obvious diastasis of the sacroiliac joint or fracture of the iliac bone.
- **Lateral compression.** A lateral compression force, which causes rotation of the pelvis inwards, leads to fractures in the sacroiliac region and pubic rami.
- **Vertical shear.** An axial shear force causes disruption of the iliac or sacroiliac junction, combined with cephalic displacement of the fracture component from the main pelvis.
- **Combined mechanism.** A combination of two of the above vectors leads to a characteristic pattern of pelvic fracture.



PROFILAXIS TREATMENT

Anticoagulation: during pregnancy, the patient has a state of hypercoagulability and the risk of venous thromboembolism increases fivefold.[18] A pregnant patient who is immobilized Until recently, unfractionated heparin (UFH) was the preferred anticoagulant for DVT prophylaxis in pregnant patients undergoing orthopedic surgery.[18,20] Its large molecular structure prevents placental crossing. Recently, low molecular weight heparins have replaced UFH as agents of choice for pregnant patients suffering from orthopedic fractures. they do not cross the placenta, have a more convenient administration schedule, do not require monitoring of anticoagulant activity, and have a lower risk of thrombocytopenia, side effects, and heparin-induced osteoporosis.[20]

Antibiotics: The safest antibiotics during pregnancy are cephalosporins, penicillins and macrolides. Prophylactic administration is recommended before the operation and 24 hours after the surgical event. If allergy to beta-lactams is suspected, clindamycin or vancomycin can be used as an alternative.[11]

DEFINITIVE TREATMENT

After stabilization of the mother monitoring the fetus should immediately pursued.[4] All indicated emergent injuries such as open fractures, life-threatening traumas, or fissures linked to vascular injury should be treated, regardless of the pregnancy status. Elective orthopedic surgery procedures should be postponed to the postpartum period to avoid injury to the fetus.[7]

after a surgical procedure has an OR of 7.7 for the development of venous thromboembolism. In immobilized pregnant patients with a BMI >25, the risk increases to an OR of 62.[19]

When taken in isolation, pelvic fractures do not warrant emergency cesarean section, as delivery through the vagina can be performed safely, even in the third trimester. If severe bleeding from a uterine region occurs, an emergency hysterectomy should be done.[21]

In a pregnant trauma patient who does not respond to cardiopulmonary resuscitation or has a nonsurvivable injury, a perimortem cesarean section should be contemplated within 5 minutes of maternal hemodynamic instability with failure of resuscitation.[22]

Fracture management

Acute pelvic injury during pregnancy can put both mother and fetus at increased risk of mortality. If a symphyseal rupture is diagnosed clinically or radiographically and the patient is hemodynamically unstable, the most important

intervention is the control of internal pelvic hemorrhage with provisional closed reduction of the pelvic ring. If closed pelvic fusion and resuscitation of fluid do not reestablish hemodynamic stability, venous plexus bleeding can be repaired through an open laparotomy with retroperitoneal packing and external fixation. If the hemorrhage source is from the arteries, it may be more favorable to perform angiography.[23] Otherwise, management includes bed rest, traction, and a pelvic sling in most patients and early mobilization with a walker should be attempted. Surgical intervention on fractured pelvis is recommended when the patient suffers from an open tear in the pubic symphysis auxiliary to critical vaginal rupture, there is diastasis of the symphysis >4 cm, substantial malreduction of the pelvis, diastasis with the pelvic binder in place, or displacement of one or both sacroiliac joints. When prescribed, either peripheral fixation or open reduction and interior fixation should be performed within 3 weeks of injury. External fixation decreases further damage to the uterine environment and permits the fetus to reach 34 weeks' gestation.

A supraacetabular fixation approach can allow the patient to sit up and receive proper nursing care without interfering with the uterus. Although more difficult than

placing the pins in the iliac crest, the use of supra-acetabular pins allows a stable construct to be established without risk of breaching the uterine environment. Percutaneous iliosacral screws may be used after reduction of the pubic symphysis if the sacroiliac joints remain unreduced.[11] With the current evidence suggesting that fracture fixation, fluoroscopy, and general anesthesia may be safely delivered to the pregnant patient, open reduction and internal fixation of the fracture may be the treatment of choice.[24] Some authors have suggested that continuous fetal intraoperative heart monitoring leads to a timely intervention and favorable outcome.[11]

The occurrence of a pelvic fracture is not an outright indicator for avoiding vaginal delivery. If the pelvic architecture is not substantially disrupted, then a vaginal delivery can be safely performed.[25] Normal healing takes 8 to 12 weeks after an injury. Thus, if the fracture happened during the early phases of pregnancy, vaginal delivery may be an option. If a pelvic fracture has healed without substantial residual pelvic malunion, and implants are appropriately placed within the bony pelvis, vaginal delivery should be attempted after evaluating the risk-benefit ratio for both the fetus and mother.[7]

DISCUSSION

There has been an increasing rate of pelvic bone injuries in recent years. In a study by Lundin N. et al., the incidence of pelvic fractures increased from 58 to 73 per 100,000 person-years and the majority of the patients (74%) were female.[26] Due to this high incidence in the female population, it is crucial to perform an abdominal examination and laboratory tests such as B-hCG, given that early recognition of pregnancy in this type of trauma; It is important for maternal and fetal survival. [5]

The anatomical and physiological changes of pregnancy can modify the patient's response to the injury.[27] Pregnant patients who suffer major trauma require close hemodynamic monitoring; causes such as retroperitoneal hemorrhage may not be readily apparent and can cause severe hemodynamic instability before getting recognized.[28] Furthermore, due to physiological hemodilution and compression of the inferior vena cava by the pregnant uterus, the cardiovascular response to shock may be attenuated.[27] Aggressive maternal resuscitation and stabilization according to the advanced trauma life support (ATLS) protocol is recommended to save both mother and fetus.[5] Pelvic fractures, need radiographic confirmation for further management. One pelvis radiograph exposes the patient to 200 mRad radiation, and one Computed tomography scan exposes to 1.5 Rad. According to the ACOG guidelines, up to 5 Rad exposure is considered safe in pregnancy.[29] If the fetus is not affected and the mother is also hemodynamically stable, fixation of pelvic fracture can be done with an acceptable level of fetal risk.[30] The use of regional anesthesia/local anesthesia is preferred to prevent effects on the uterus and fetus.[11]

If these fractures are untreated, it may lead to malunion of unreduced fracture resulting in an unsymmetrical pelvis.[10] A severe dislocated/unstable fracture with a large healing callus precludes an attempt at vaginal delivery. Studies have shown that a pelvic fracture is not a definite contraindication for vaginal delivery. Leggon et al., in their study, showed results of 75% cases of pelvic fractures in the third trimester of pregnancy delivered by vaginal birth out of 101 cases of pelvic fractures in pregnancy.[31]

CONCLUSSIONS

Overall, pregnant women experiencing pelvic fractures face a significant increase in adverse pregnancy outcomes, such as preterm delivery, placental abruption, fetal distress at birth, fetal death, and even maternal death. For many patients, especially those with non-emergent pelvic trauma, conservative treatment may serve as an initial option, allowing for a delay in surgical intervention. It is crucial to highlight that pelvic fracture is the leading cause of mortality in trauma, particularly due to associated severe hemorrhage, necessitating immediate and comprehensive management. Optimal management of these patients involves a multidisciplinary approach and special considerations, including surgical positioning, diagnostic adjunct studies, and medication administration, all crucial for ensuring the best outcomes for both the mother and fetus. In exceptional cases, surgical treatment may be required for these injuries during pregnancy. Pelvic fractures and surgical fixation thereof are not an absolute contraindication to vaginal delivery, thus safe vaginal delivery can be achieved as long as pelvic architecture is not significantly altered.

Further research is needed to establish clear treatment guidelines and provide training for healthcare professionals. Additionally, it is essential to implement preventive strategies and educational programs to reduce the incidence of pelvic fractures during pregnancy.

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