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STRESS FRACTURES OF THE FEMUR IN PREGNANCY - REVIEW

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Abstract

Stress fractures are caused by an unbalanced process of bone formation and resorption. During the pregnancy and postpartum periods these are typically located in the vertebral column, although in the literature one can find cases of femoral fractures. Such fractures in most cases affect the femoral neck, but there are cases of intratrochanteric or femoral head fractures. The trauma most commonly occur in the third trimester. These fractures may be connected with pregnancy associated osteoporosis or transient osteoporosis of the hip. Typical symptoms include hip area pain and mobility difficulties. The diagnostic process of fractures in pregnancy should be limited to methods which do not use ionizing radiation. The preferred treatment for a femur fracture is surgical management., preferably after delivery. Physicians need to be aware of the possibility of a femoral fracture appearance in pregnancy. An individual approach to every patient with lumbar or hip area pain is necessary.
The main aim of the study is to present the problem of femur fractures in pregnant women and to summarize it on the basis of the available literature.

Key words: stress fracture, fracture, orthopedics, pregnancy

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Introduction

Stress fractures are caused by an unbalanced process of bone formation and resorption. Femur fractures in pregnancy in most cases occur at the femoral neck, most commonly in the third trimester. The diagnostic process of fractures in pregnancy should be limited to methods which do not use ionizing radiation.

Aim

The main aim of the paper is to present the problem of femur fractures in pregnant women and to summarize it on the basis of the available literature.

Material and methods

For the purpose of this review, research of the PubMed, Web of Science, Google Scholar and NCBI databases for articles raising the topic of femoral fractures in pregnancy was conducted. We used keywords “femur fracture pregnancy”, “stress fracture pregnancy” and “fatigue fracture pregnancy". The main criteria for including the publications in the paper was if they are describing the subject of femoral fractures in pregnancy or postpartum period.

Summary

Fatigue fractures in pregnancy and postpartum periods are typically located in the vertebral column, although one can find cases of femoral fractures in the literature. In most cases the location is the femoral neck. Symptoms include hip area pain and mobility difficulties. Fractures may be connected with pregnancy associated osteoporosis or transient osteoporosis of the hip. Treatment is based on surgical methods, preferably after delivery. Physicians need to be aware of the possibility of femoral fractures in pregnancy. An individual approach to every patient with lumbar or hip area pain is necessary.

Abbreviations

PAO – Pregnancy Associated Osteoporosis
TOH – Transient Osteoporosis of the Hip
DXA - Dual-energy X-ray Absorptiometry
BMD – Bone Mineral Density
MRI – Magnetic Resonance Imaging
CT – Computed Tomography
SIF – Subchondral Insufficiency Fracture

Introduction

Stress fractures may appear as fatigue fractures, caused by increased loading on normal bone, and insufficiency fractures, where normal loading is affecting the bone of decreased mineralization [1]–[4]. The groups which are most frequently affected with this kind of fractures are athletes or military recruits [5]. Although in the literature one can find cases reporting stress fractures related to pregnancy and postpartum periods, as a result of increased load affecting the skeleton or pregnancy associated osteoporosis [5].

Pregnancy-related stress fractures most commonly occur in the third trimester [6]. The probable cause is that up to 80% of calcium which goes to the fetus is acquired from maternal resources in this period [7]. The majority of calcium is resorbed from the intestinal system, so when calcium intake is accurate, it covers the need. In cases of insufficient calcium absorption, a deficiency may appear and result in stress fractures [7]. In most cases, a fracture occurs in the sacrum or vertebral bodies, but there are case reports and studies presenting unusual locations, such as femur or tibia [8]–[10]. A study conducted by Herath et al. revealed that after evaluation of over 114,000 pregnancies, they recognized 33 fractures and the most common was located in the ankle, as a result of a fall from body height or lower [11].

Femoral fractures in pregnancy appear in approximately 1% of cases[12]. The most common location of the fracture linked with pregnancy in the postpartum period is the femoral neck, although there are cases of intertrochanteric traumas. A femoral neck fracture can appear as either one-sided or bilateral [7], [9], [10]. This kind of trauma is relatively rare in contrast to vertebral fractures [7]. A bilateral fracture is even less common. Femoral fractures in pregnancy may be linked with pregnancy associated osteoporosis or transient osteoporosis of the hip. Other potential risk factors include epileptic or hypocalcemic seizure and electric shock trauma [9].

Material and methods

For the purpose of this review, research of the PubMed, Web of Science, Google Scholar and NCBI databases for articles raising the topic of femoral fractures in pregnancy was conducted. We used keywords “femur fracture pregnancy”, “stress fracture pregnancy” and “fatigue fracture pregnancy". The main criteria for inclusion of the publications to the paper was if they described the subject of femoral fractures in pregnancy or postpartum periods. We focused on papers published between 2017 and 2023, as we wanted to focus on the most recent literature.

Pregnancy or postpartum related femoral neck fractures

Femoral fractures related to pregnancy and post-partum periods are rare. A French retrospective cohort study conducted by Laroche and colleagues revealed that among 52 patients with pregnancy-related fractures, only one had her femur bilaterally fractured. The patient was 33-years old, with celiac disease and a family history regarding osteoporosis [6].

In the majority of cases the fracture is located in the femoral neck, although Jun Jie and colleagues described a breastfeeding patient, who had her femur broken in an intertrochanteric area [13]. The fracture occurred 10 months postpartum and was probably caused by PAO. Kasahara et al. reported a case of a subchondral insufficiency fracture (SIF) of femoral head in a pregnant patient, coexisting with history of anorexia nervosa [14].

Pregnancy often involves musculoskeletal symptoms such as hip, pelvis and groin pain, however cases of non-traumatic bone fractures are relatively uncommon. It might be challenging to differentiate between patients whose symptoms require more medical evaluation and those whose pain is minor. Even generally healthy women may experience transitory osteoporosis during pregnancy, which causes bone oedema and demineralization and increases the risk of fracture without obvious damage [15]. The majority of PAO instances involve compression fractures of the vertebrae, however, there have also been case reports of femoral neck fractures. TOH is another disease that rarely causes non-traumatic fractures. In this review, selected cases describing femoral fracture in pregnant women have been collected and briefly presented in Table 1 [7], [9], [10], [12]–[18].

Tabele 1. Summary of selected cases of femoral fractures in pregnancy and postpartum periods.

Study	Patient's age	Fracture	Treatment	Comment
Al-Dourobi et al.	24	Left femoral neck fracture, displaced and unstable	- Total hip arthroplasty with ceramic bearing	Z-score and T-score results suggested osteopenia
Faraji et al.	29	Right femoral neck fracture	- Open screw fixation - Calcium and vitamin D supplementation - Alendronate therapy	Open screw fixation
Kasahara et al.	38	Femoral neck, bilateral	- Bilateral open screw fixation - Teriparatide, calcium lactate	History of anorexia nervosa, long-term low bodyweight
Kasahara et al.	40	Subchondral femoral head fracture	Hemiarthroplasty after histopathological diagnosis of subchondral insufficiency fracture, 18 months after delivery	Anorexia nervosa in history, twin pregnancy
Harold et al.	34	Right femoral neck fracture, slightly displaced	Femoral neck pin stabilization	Methadone dependance, smoking history; History of six preterm deliveries and one ectopic pregnancy; Low levels of calcium and vitamin D
Factor et al.	38	Left femoral subcapital neck fracture, displaced	Closed reduction on a traction table and screw fixation	Smoking history; Two miscarriages in history
Jun Jie et al.	33	Intertrochanteric fracture of left femur	Open reduction and internal fixation of left femur	Fracture occurred after body height fall 10 months postpartum
Sahan et al.	28	Femoral neck, bilateral	- Bilateral total hip arthroplasty - Return to valproate therapy	History of epileptic seizures
Klimko et al.	38	Right femoral neck fracture, displaced and unstable	- Hemiarthroplasty	History of thrombophilia – factor V Leiden, and anemia
Tayne et al.	32	Right femoral neck fracture with left femoral head oedema	- Total hip arthroplasty on the right side - Observation on the left side	No risk factor history Resolution of left femoral head oedema 6 months after delivery

The majority of cases were femoral neck fractures, but it is important to take under consideration that fracture may occur in femoral head or intratrochanteric area. In all cases treatment was based on surgical methods – total or hemiarthroplasty or by screw fixation. Surgery tends to be performed after delivery. In some patients risk factors, such as anorexia nervosa, smoking or long history of low body weight were present. On the other hand, in some cases there were no risk factors stated.

Discussion

In general, it is believed that stress fractures occur when the formation and resorption processes of the bone are imbalanced [5].

Most femoral fractures during pregnancy manifest with pelvic, hip, groin or lower limb pain and loss of function without any trauma history [16]. It is vital to remember that groin or pelvic pain in pregnancy is frequent, so physicians need to be aware of the possibility of transient osteoporosis of the hip or pregnancy associated osteoporosis potential development, as both conditions can result in fractures [16].

Pregnancy-associated osteoporosis (PAO) is a rare condition and its origin is unknown. Its incidence is measured as 4/1,000,000 [10], [19]. The appearance of low-energy fractures during pregnancy or early postpartum periods and painful sensations, mostly located in the lower back, pelvic and femoral area are symptoms [20], [21]. It affects previously healthy women, and the results are in most cases vertebral stress fractures, that may lead to irreversible problems with body statics and constant pain [6], [11]. The factors that may lead to higher risk of PAO are low levels of vitamin D or low molecular weight heparin therapy [20]. According to Hardcastle et al., bone mineral density tends to be decreased in women who breastfeed [20]. Another potential cause of PAO which is suggested in the literature is genetic predisposition – mutation in genes LRP5, COL1A1 and COL1A2 [10], [22].

Low body mass and BMI, anorexia nervosa, a family history for osteoporosis, vegetarian diet, severe dental problems and sedentary lifestyle since childhood may increase the risk of PAO as well [9], [10], [19].

Bone loss in pregnancy may be associated with the typical release of parathyroid hormone-related protein (PTHrP) from the placenta and breast to the circulatory system of the mother or maternal bone resorption due to fetal skeleton creation, which may be unbalanced due to decreased intestinal calcium absorption [10], [11], [20].

Femoral fractures in pregnant women can also be linked with transient osteoporosis of the hip (TOH) – a condition common among men rather than in women, but in some cases it can be connected with pregnancy [7]. Etiology is not yet stated, but multifactorial origin is taken under consideration [16]. TOH tends to appear during the third trimester or in early postpartum [16], [17], [23]. It can affect the hip and other joints of the lower limb, but less frequently. Most cases are on one-side, but bilateral TOH may also occur. Usually, TOH presents with pain in the hip area with no trauma history and a lack of inflammation symptoms [16]. The diagnostic method of choice is magnetic resonance imaging (MRI) and bone marrow oedema is typical presented [7], [24]. X-ray scans reveal regional osteopenia and radiolucency [7]. In the early stages, transient osteoporosis of the hip and avascular necrosis of the femoral head may look similar in classic radiology imaging. Also, the clinical image may appear similar [25]. TOH is considered a self-limiting condition [9], [16], [25].

The diagnostic methods for osteoporosis contain bone mineral density (BMD) measured by dual-energy X-ray absorptiometry (DXA). DXA emits insignificant radiation, and it is considered to be safe for gravidas [21].

Treatment methods include the supplementation of calcium and vitamin D or therapy using bisphosphonates, calcitonin, strontium ranelate, teriparatide or monoclonal antibodies. It is also important to remember that proteins are vital for bone strength. They shape their microstructure and determine the mineral phase of bone tissue [26]. It is vital to take under consideration that bisphosphonates tend to accumulate in bones, which may affect the skeletal development of fetuses in subsequent pregnancies [10], [27]. It is advised not to begin bisphosphonate therapy if the patient plans to be pregnant within one year [28]. Alendronate and ibandronate are preferred over risedronate, due to the minimized risk of negative effects on the fetus in future pregnancies in women who still want more children. Both medications are assigned to the drug category C in pregnant or breastfeeding women [10], [20]. Calcitonin may reduce recovery time, but similarly to bisphosphonates, it is a category C drug [17]. Strontium ranelate (SrRan) or teriparatide may be also administered [20]. SrRan affects the bone in two ways – it inhibits bone resorption and increases new bone formation, which lead to more rapid bone mineral density (BMD) growth [29]. Teriparatide, a human parathormone preparation, has an anabolic impact on bones, and it appears to have better results in PAO therapy than bisphosphonates [27], [30]. The treatment should be no longer than two years [27]. Teriparatide seems not to accumulate in the skeleton [28], [29]. Denosumab or romosozumab, human monoclonal antibodies, are other options for PAO management due to the inhibition of osteoclastic bone resorption, and their advantages have a short half-life and lack of accumulation in the skeleton [27]–[29]. Denosumab, which inhibits bone turnover due to preventing the activation of osteoclasts is effective in independent use and in sequential therapy with teriparatide [29], [30]. Romosozumab is a sclerostin inhibitor, typically used in postmenopausal osteoporosis [29]. It was first administered to breastfeeding women in their postpartum period by Kaneuchi et al. with positive result of BMD increase [29].

The diagnostic process in the case of pregnant patients has limitations connected with radiation exposure. In three cases of pregnant women reported by Harold and colleagues, X-rays were taken using a lead apron that covered the mother's abdomen [12]. In cases where the mother had an accident, radiological

imaging is indicated even with the use of a contrast agent because the benefits of these examinations outweigh the risks to the fetus. When there is a suspicion of limb injury, imaging should not be abandoned [12]. The highest fetal teratogenicity occurs during organogenesis (5-10 weeks of pregnancy). After the 15th week of pregnancy, there is a low probability that ionizing radiation will affect the fetus [31].

Ultrasound and MRI are the preferred imaging modalities during pregnancy, because they are non-ionizing methods. The Radiological Society of North America has recognized that these methods are safe for the fetus, especially in <3T MRI and in a short duration of color or power Doppler examination in the first trimester. However, ultrasonography is not widely used in case of femoral fractures. It is worth remembering that MRI contrast agent, gadolinium, is ranked as a C category drug. An MRI also raises concerns about hearing complications in the fetus due to noise during the imaging [32]. Collaborative studies have not shown a higher perinatal mortality rate for fetuses exposed to MRI during pregnancy. An MRI is not associated with increased fetal risk, according to the American College of Obstetrics and Gynecology (ACOG) [33].

The treatment of femoral fractures is mainly surgical, including internal fixation or total hip arthroplasty [9]. Total arthroplasty is preferred [15]. It is worth mentioning that such surgeries require postoperative anticoagulants administration to prevent deep vein thrombosis. However, the history of heparin intake may be considered as a risk factor of PAO [13]. Conservative management with limitation of weight-bearing and analgesia may be also taken under consideration, according to the clinical situation [9].

Summary

Femoral fractures in pregnancy and postpartum periods seem to be an important issue which needs special attention from physicians. Typical symptoms include hip area pain and mobility difficulties. Fractures may be connected with pregnancy associated osteoporosis or transient osteoporosis of the hip. In most cases the fracture is located in the femoral neck, but there are cases of intratrochanteric or femoral head fractures. The awareness of the physicians is vital to provide adequate management.

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