Circled Delta Sign or Reversed Circled Delta Sign: A Clue of a Fetus on Abdominal Radiography

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Patient: Female, 41-year-old
Final Diagnosis: Incidental pregnancy
Symptoms: Postprandial abdominal pain and fullness for months
Clinical Procedure: —
Specialty: Gastroenterology and Hepatology • Obstetrics and Gynecology • Radiology

Objective: Mistake in diagnosis
Background: Ionizing radiation poses potential health risk to fetuses, including growth retardation, organ malformations, neurological effects, fetal death, and cancer. Therefore, pregnant women rarely undergo X-ray imaging, unless absolutely necessary. However, they can be inadvertently exposed to X-rays while undergoing an examination without being aware of their pregnancy. Given that the likelihood of a fetus appearing on an abdominal radiograph is low, physicians can be unfamiliar with the appearance of a fetus on such images. If a fetus incidentally appears on an abdominal radiograph, the clinician can encounter difficulties in identifying the fetus, potentially leading to unexpected harm during subsequent imaging procedures.

Case Report: A 41-year-old woman presented with symptoms of postprandial abdominal pain, abdominal fullness, and urinary frequency. Abdominal radiography revealed a large mass with calcifications in the pelvis and lower abdomen, raising suspicion of a large pelvic tumor, such as a teratoma. However, subsequent ultrasound unexpectedly revealed that the woman was actually 6 months pregnant. The presumed tumor was an enlarged uterus, and the presumed calcifications were the fetus’s bones. Before X-ray, the woman had denied being pregnant, mistakenly attributing her condition to excess weight and irregular menstrual cycles. Fortunately, the use of ultrasound instead of computed tomography prevented radiation exposure to the fetus, and the baby was delivered in a healthy state at full term.

Conclusions: To avoid unintended harm to fetuses, clinicians should consider the possibility of pregnancy when evaluating a pelvic mass in women of childbearing age. To aid clinicians in accurately identifying fetuses on abdominal radiography and thereby reduce the likelihood of misdiagnosis, we propose the “circled delta sign” and the “reversed circled delta sign”.

Keywords: Fetus • Pregnancy, Unplanned • Radiography, Abdominal • Radiation Effects

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Background

In pregnant women, ionizing radiation can harm the fetus, resulting in both deterministic and stochastic effects. Deterministic effects occur when the radiation dose exceeds a specific threshold, leading to consequences such as growth retardation, organ malformations, neurological effects, and even fetal death. The damage from deterministic effects is short-term, although the resulting sequelae can have long-lasting effects. Stochastic effects have long-term implications and influence the probability of cancer development later in life. The higher the radiation dose received is, the greater the likelihood of developing cancer in the future is [1-7]. Therefore, clinicians and radiographers should avoid subjecting pregnant women and their fetuses to X-rays. Although no globally standardized guidelines exist [8], most healthcare institutions have specific guidelines [2,8]. These guidelines typically recommend obtaining a detailed medical history and, if necessary, conducting a pregnancy test to confirm pregnancy in women of childbearing age. This approach is implemented to prevent radiation exposure to the fetus. Hence, the likelihood of fetuses appearing on X-ray images is rare.

In women of childbearing age seeking medical care, unrecognized pregnancy can be encountered. In a study on menstruating women undergoing ambulatory and nonobstetric surgery, Manley et al [9] reported that the incidence of a previously unrecognized pregnancy was 0.3% in 7 of 2056 cases. Bochicchio et al [10] reported a comparable rate of incidental pregnancy in 13 (0.3%) of 3976 patients with trauma. However, many studies have indicated that relying solely on history taking to determine whether a patient is pregnant is unreliable [8,11-13]. Therefore, despite the low likelihood of an unrecognized pregnancy, pregnant women can inadvertently be exposed to X-rays while undergoing an examination, without being aware of their pregnancy.

Because the likelihood of a fetus appearing on an abdominal X-ray image is rather low, physicians can be unfamiliar with the appearance of a fetus on such images. In case a fetus incidentally appears on an abdominal radiograph, it may not be readily identified by the clinician because of the overlap between its bones and maternal bones or bowel gas, which can be mistakenly identified as an abdominal or pelvic tumor. This scenario can lead to unexpected harm to the fetus during subsequent imaging procedures, such as computed tomography (CT).

Case Report

A 41-year-old woman presented as an outpatient with symptoms of postprandial abdominal pain and fullness for several months and urinary frequency for 1 month. Initially, instead of seeking formal medical treatment, she chose to undergo several massage sessions, but her symptoms did not improve. During one of the sessions, the massage therapist made a remark regarding the presence of an object in the woman’s lower abdomen, although the woman expressed skepticism regarding this claim. Upon consultation with a gastroenterologist, physical examination revealed mild tenderness in the lower abdominal region. Blood tests also revealed borderline leukocytosis and mild anemia. Abdominal radiography revealed a large mass with calcifications in the pelvis and lower abdomen (Figure 1), raising suspicion of a large pelvic tumor, such as a teratoma. Further examination with contrast-enhanced CT of the abdomen and pelvis was therefore recommended in the radiological report. However, abdominal ultrasound was performed first, which unexpectedly revealed that the woman was actually pregnant (Figure 2). According to ultrasound measurements, the gestational age was estimated to be approximately 26 weeks and 4 days, and the estimated fetal weight was 960.87 g. The presumed tumor was actually an enlarged uterus, and the calcifications were the fetus’s bones. Because the X-ray examination was conducted 11 days before ultrasound, the estimated gestational age of the fetus seen in the initial abdominal radiograph was 25 weeks. In this case, X-ray was performed before ultrasound, presumably because X-ray examinations at our hospital are available on the same day of the outpatient visit, whereas ultrasound examinations require scheduling.

Figure 1. Abdominal radiography revealing a large mass (white arrows) with calcifications (black arrows) in the pelvis and lower abdomen. Each unit on the scale represents 1 cm.
easily recognized because of their small size and the overlap between their bones and maternal bones or bowel gas. In fact, our case has been presented to several radiologists and non-radiologist clinicians, and the majority of them were unable to recognize this as a case of pregnancy at first glance. If the probability of pregnancy is not considered, an enlarged uterus can be mistaken for an abdominal or pelvic tumor, and fetal bones can be mistaken for calcifications within the tumor, thus requiring further examinations, such as CT.

In an optimal scenario, the clinical physician should consider excluding the possibility of pregnancy, even if the patient’s age is close to the upper limit of reproductive age [18,19]. Patient history alone is not a reliable marker for determining pregnancy [8,11-13]. When a patient denies being pregnant, it is important to confirm whether there is truly no possibility of pregnancy or if the patient simply does not believe that she could be pregnant. If it is the latter, a pregnancy test should still be conducted. This approach can avoid unnecessary radiation exposure when a pregnant woman undergoes an abdominal X-ray examination. However, in this article, we discuss how to identify clues of the presence of a fetus on abdominal radiographs when both the physician and the patient are unaware of an unrecognized pregnancy, aiming to prevent the situation from worsening.

A single abdominal radiography exposes the fetus to a radiation dose of approximately 0.1 to 3.0 mGy, which has a negligible effect on fetal health [1,2]. By contrast, the radiation dose received by the fetus in an abdominal or pelvic CT scan is approximately 20 to 50 mGy [2,3]. According to the literature, fetal radiation exposure at such doses is unlikely to have deterministic effects, which can lead to malformations, growth retardation, mental retardation, and even death, unless the radiation dose exceeds a certain threshold [2]. However, such exposure can have stochastic effects, doubling the probability of carcinogenesis to approximately 1 in 250 compared with the value of approximately 1 in 500 among the general population [2,3]. Nevertheless, even with this probability, the overall risk remains extremely low. According to a statement made by the National Council on Radiation Protection and Measurements in 1977, the risk of abnormalities is negligible at radiation doses of 50 mGy or lower when compared with other risks during pregnancy [1]. Therefore, even if a pregnant woman undergoes a CT scan, the damage may not be substantial and may actually be deemed acceptable. However, in accordance with the “as low as reasonably achievable” principle, unnecessary radiation exposure to fetuses should be avoided [1].

In the early 20th century, when the understanding of the effects of X-rays on fetuses was limited, some articles discussed fetal X-ray examinations [4,20-22]. However, as awareness increased regarding the harmful effects of radiation on fetuses, the number of such articles decreased [4]. Because of the

**Discussion**

Clinical physicians and radiologic technologists avoid subjecting pregnant women to X-rays. Thus, fetuses rarely appear on abdominal radiographs. However, in case a pregnant woman must undergo an X-ray examination, the clinical physician or radiologic technologist usually consults with a radiologist beforehand. Therefore, when a radiologist interprets an abdominal radiograph, the possibility of pregnancy has already been ruled out, thereby affecting the patient’s differential diagnosis. Because fetuses rarely appear on abdominal radiographs, radiologists do not readily recognize them. In some cases in the literature or on the internet [1,4,14-17], fetuses were easily recognized. However, occasionally, they were not

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**Figure 2.** Abdominal ultrasound revealing a fetus inside the uterus. According to ultrasound measurements, the gestational age was estimated to be approximately 26 weeks and 4 days, and the estimated fetal weight was 960.87 g.
large time gap, most physicians do not currently have access to these articles. In recent decades, articles describing the appearance of a fetus on an abdominal radiograph have been typically limited to mentioning which fetal bones are visible and identifying the fetal position or even the presence of a fetus [1,4-8]. To the best of our knowledge, no specific radiological sign has been identified to describe the appearance of a fetus on an abdominal radiograph.

In our case and other cases of fetuses appearing on abdominal radiographs in the literature [1,4,14] and on the internet [15-17], we discovered that the most easily recognizable features of pregnancy on an abdominal radiograph are an enlarged uterus and its resulting mass effect and the fetal skull and spine, which appear as a circular or oval shape and a curve, respectively. Although fetal limbs are also often visible on these images, they exhibit great variations, depending on the posture, and are difficult to identify. Therefore, in this article, we propose a “circled delta sign” to describe the appearance of a fetus on an abdominal radiograph (Figure 3A). In this sign, the outermost circle represents the outline of an enlarged uterus or its resulting mass effect. The Greek lowercase delta represents the fetal bones, with the circular part representing the fetal skull and the curved part representing the fetal spine. The circled delta sign is a vertex presentation. In the case of a breech presentation, as in our case, the sign can be inverted into a reversed circled delta sign (Figure 3B). Other letters or numbers, such as 6, 9, P, and 3P, have similar shapes, but their “spine” points to the side of the “skull” rather than the center, as it should be in reality. Therefore, we chose lowercase delta to represent the fetal spine. Although this sign is merely a descriptive term and requires further research for validation, we hope that it can help radiologists and non-radiologist clinicians identify fetuses on abdominal radiographs to avoid unintentional harm to fetuses.

Conclusions

Clinicians should consider the possibility of pregnancy when evaluating pelvic masses in women of childbearing age, particularly when a circled delta sign or reversed circled delta sign is observed on an abdominal radiograph, in order to avoid unintentional harm to the fetus.

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References:


