Placental Localization in Abdominal Pregnancy Using Technetium-99m-Labeled Red Blood Cells

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In a patient with third trimester abdominal pregnancy with fetal demise, technetium-99m-labeled erythrocytes (^{99m}Tc-RBCs) localized the placenta preoperatively, after nonvisualization by ultrasonography and arteriography. Extrauterine placental localization by blood-pool imaging may be useful when ultrasound fails.

J Nucl Med 1990; 31:1106–1109

With the advent of ultrasound (US) imaging, radionuclides are rarely used for placental localization. Accurate localization of the placenta in abdominal pregnancy is imperative for proper management because of the associated high intraoperative blood loss. Failure of ultrasonography to adequately localize the placenta in abdominal pregnancy may represent a unique application for radionuclide imaging. To our knowledge, only one case of placental localization in abdominal pregnancy using technetium-99m- (^{99m}Tc) human serum albumin (HSA) blood-pool visualization has been reported previously (*1*). We report the success of ^{99m}Tc-red blood cell (RBC) imaging after ultrasonographic and arteriographic failure to identify the placenta in a patient with abdominal pregnancy.

CASE REPORT

A 33-yr-old black female was referred to the Medical University at 41 wk gestation with the diagnosis of "intrauterine fetal demise." She had a previous history of two normal pregnancies and one abortion. The current pregnancy had been complicated by vaginal bleeding at ~8 wk gestation prompting an ultrasound in the emergency room which showed positive fetal cardiac activity and was interpreted as a "normal intrauterine pregnancy." At a 41 wk gestation prenatal visit, no heart tones could be auscultated and an ultrasound confirmed the fetal demise.

Upon arrival to the Medical University, a repeat ultrasound examination revealed a breech presentation with slightly decreased amniotic fluid. The patient's cervix on admission was closed, posterior, and approximately ~60%–70% effaced. Because of the fetal demise, induction of labor was initiated, however, no contractions were noted after pitocin and prostaglandin (PGE_2).

In view of the abnormal response to induction, a more detailed obstetrical ultrasound was performed which confirmed the ectopic abdominal pregnancy and fetal demise. The placenta was not definitively localized, although a low posterior position was suggested. The fetus was noted to be riding high in the abdomen with a 12×10 cm solid mass located in the right lower quadrant consistent with an empty uterus. The placenta could not be identified and to localize it preoperatively, angiography and blood-pool imaging were performed as discussed below.

The preliminary arteriography film suggested the location of the placenta by a crescent of minimally calcified soft-tissue density identified cranial and dorsal to the fetus to the left of the maternal midline (Fig. 1). Two angiographic runs, using 40 cc of contrast each, were performed through a 5 French pigtail catheter. The pigtail was positioned just above the aortic bifurcation for the pelvic arteriogram, then subsequently at the level of the twelfth thoracic vertebral body for the abdominal aortogram. Normal aorta, renal, and mesenteric arteries were identified. Although enlarged tortuous uterine arteries were demonstrated, no vascularized placenta was identified.

An emergency ^{99m}Tc-labeled RBC blood-pool imaging study was performed. Twenty minutes after the intravenous (i.v.) injection of 1 mg stannous pyrophosphate, 20 mCi of [^{99m}Tc]pertechnetate were injected as a 0.5-ml i.v. bolus (*2*). Dynamic images of the abdomen were obtained for 64 sec at a rate of 4 sec per frame on a 128×128 matrix with an Elscint 409 camera (Elscint, Boston, MA) and a low-energy all-purpose collimator. At the end of the dynamic acquisition, 1000K anterior static images were taken immediately and every 5 min for 30 min, then every 10 min for the next 30 min.

Delayed static images were obtained at 4 hr. Single-photon emission computed tomography (SPECT) was performed using the Elscint 409 digital camera and an Elscint APC 3 collimator. Data, acquired continuously through 360° at 6-

Received Nov. 31, 1989; revision accepted Dec. 26, 1989.

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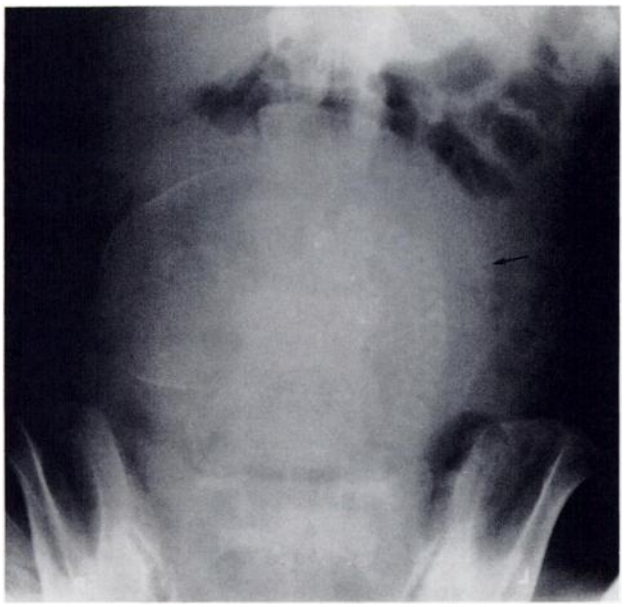

FIGURE 1
Preliminary radiograph pre-angiography. Placental location is suggested on this preliminary film of the angiographic study by the soft tissue density with minimal areas of calcification (arrow). The overlapping fetal skull bones indicate fetal death.

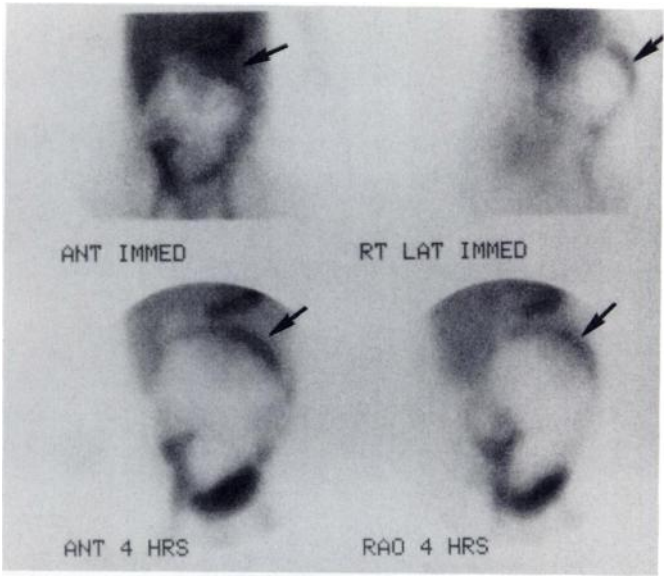

FIGURE 2
Technetium-99m-RBC blood-pool imaging, immediate and delayed planar views. The placenta is located anteriorly in the left upper quadrant (arrows). Free ^{99m}Tc is indicated by gastric and urinary bladder activity. The right pelvic activity likely represents the displaced enlarged uterus and the hypertrophied right fallopian tube. Surgery confirmed these locations. The photopenic region corresponds to the fetus.

degree intervals, were processed into coronal, sagittal, and axial images by an Elscint SP6 computer.

Radionuclide angiography was noninformative. The static images demonstrated a crescent of increased activity in the maternal left upper quadrant with extension medially and anteriorly. While these findings were present on the immediate static images taken within the first 60 min (Fig. 2), the resolution was clearly improved on the delayed planar images taken 4 hr postinjection (Fig. 2). The anterior superior location of the placenta was supported by the SPECT images taken at 4.50 hr (Fig. 3).

After the diagnostic procedures, the patient was taken to the operating room. Under general anesthesia, a midline vertical incision extending to the xyphoid was made. At the time of entry into the peritoneal cavity, a thick, opaque sack covering the fetus was noted. Because of marked vasculature at the superior left aspect of the incision (corresponding to the area of increased activity on blood-pool imaging), the decision to perform a low transverse entry into the sac was made. A stillborn female fetus weighing 4 lb, 12 oz with thick meconium was delivered. After removal of the fetus, the placenta was noted to be high in the abdomen, adjacent to the anterior abdominal wall, and adherent to small bowel and mesentery. Further exploration revealed the uterus to be ~12 wk size and located in the right pelvis.

The right fallopian tube was noted to be continuous with the sacculation which covered the pregnancy. The placenta was left in situ and the cord tied. Estimated intraoperative blood loss was 100 cc. A tubal ligation was performed. The patient was observed for an extended postoperative course with intermittent temperature elevations which gradually resolved prior to discharge.

A follow-up ^{99m}Tc-labeled RBC study performed 1 wk later failed to demonstrate the previous crescent of activity. However, ultrasound now demonstrated a small degenerating placenta anteriorly.

DISCUSSION

Abdominal pregnancy is a relatively rare obstetrical complication ranging in frequency from 1/3,372 to 1/7,931 births (*3–6*). Maternal (0%–20%) (*6–7*) and perinatal (83%) (*6*) mortality rates vary depending on delay in diagnosis and treatment. In general, surgical removal of the fetus is indicated once the diagnosis is established to avoid massive intraperitoneal hemorrhage. Accurate localization of the placenta pre-operatively could minimize blood loss during surgery by avoiding incision into the placenta (*5,6,8*). In this case, the location of the fetal sac incision was guided by the radionuclide study, resulting in only a 100-ml blood loss during surgery.

Although US has become an invaluable obstetrical diagnostic tool, in a recent study of 27 sonograms in 20 patients with abdominal pregnancy, the diagnosis of abdominal gestation was missed in 25% of the cases. Furthermore, the placenta was poorly visualized or not seen at all in 25% of the US examinations (*9*). While arteriography also can localize the placenta throughout a normal pregnancy, placental compromise may result in a nondiagnostic study. An alternative to arteriographic and ultrasonographic placental localizations is the radioisotope scan, first described in 1950 for purposes of amniocentesis (*10*). Improvements in the radionuclide techniques for placental localization using

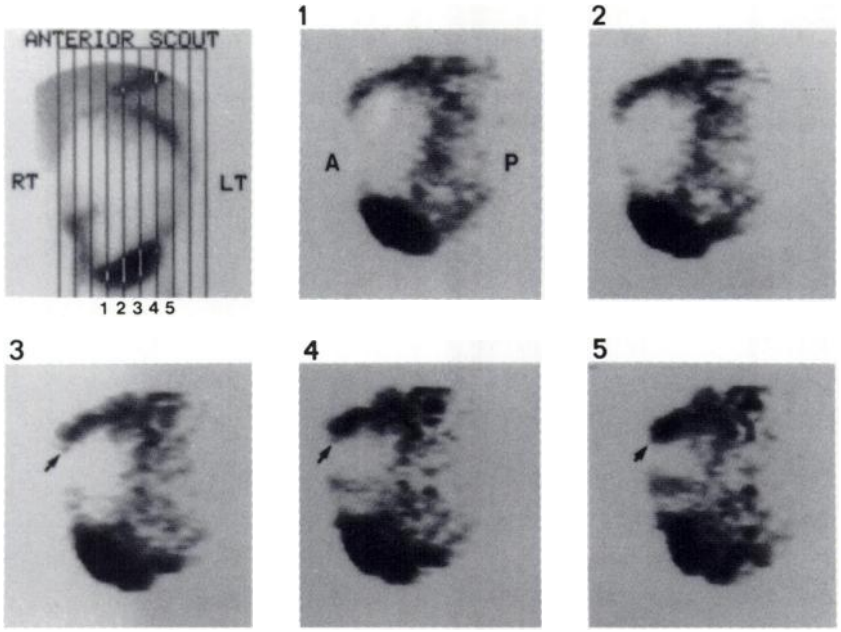

FIGURE 3
SPECT imaging at 4.5 hr postinjection. SPECT sagittal slices were the most informative, demonstrating the placenta anteriorly (arrow).

^{99m}Tc-labeled HSA increased accuracy and reduced maternal and fetal radiation doses (*11*). Intrauterine placental localization by ^{99m}Tc-HSA compared to US revealed similar results in 92% of patients; however, it was felt that US was more accurate than ^{99m}Tc-HSA scanning and avoided all irradiation during pregnancy, no matter how small (*12*).

Recently, radioisotopes (especially indium-113m (^{113m}In) which binds to transferrin) have been used for placental blood flow studies (*13*). Both ^{113m}In and ^{99m}Tc blood-pool visualization techniques take advantage of placental circulatory physiology. Maternal blood bathes the chorionic villi, resulting in blood pooling in the intervillous space. The stasis of flow probably accounts for the improved placental visualization on delayed images in the present study.

Since ^{113m}In has a short half-life (99.4 min versus 6 hr for ^{99m}Tc), radiation exposure is reduced. Preparation of the isotope, however, requires a special generator which is not readily available on an emergent basis in most nuclear medicine laboratories (*13*). The technique for ^{99m}Tc labeling of RBCs is widely used in cardiac imaging and detection of gastrointestinal bleeding. Minimizing fetal radiation dose was not an issue in our case due to the fetal demise. However, the dose to a viable extrauterine fetus could be reduced by using the in vitro method to label the red blood cells, which minimizes the circulating free ^{99m}Tc (*14*). Preadministration of an iodine preparation or perchlorate could block the transport of free ^{99m}Tc across the placenta as well as its uptake by the fetal thyroid (*11*). Since the static images were more informative than the radionuclide angiogram, the administered dose of ^{99m}Tc could be reduced. With 1 mCi of ^{99m}Tc blood-pool imaging agent, the fetal body dose has been estimated as 14 mrads (*11*). If clinically indicated, this method may be considered with a viable extrauterine pregnancy.

ACKNOWLEDGMENTS

The authors gratefully acknowledge the technical expertise provided by Patty Slay and W.A. Patterson of MUSC; Rick Olinger of Elscint; the pertinent input from Ivan Vujic, MD and E.O. Horger, MD of MUSC; and the secretarial assistance of Tracy Hackett.

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