Incidental Diagnosis of Pregnancy on Bone and Gallium Scintigraphy

Christopher J. Palestro, Jan Malat, Carl J. Collica, and Alan H. Richman

Section of Nuclear Medicine, Section of Radiologic Physics, and Department of Radiology, Norwalk Hospital, Norwalk, Connecticut

Bone and gallium scintigraphy were performed as part of the diagnostic workup of a 21-yr-old woman who presented at our institution with a history of progressively worsening low back pain over a 1-wk period of time. The angiographic phase of the bone scan demonstrated a well-defined radionuclide blush within the pelvis just cephalad to the urinary bladder with persistent hyperemia noted in the blood-pool image. We attribute these findings to a uterine blush secondary to the pronounced uterine muscular hyperplasia, hyperemia, and edema that accompany pregnancy. Gallium scintigraphy demonstrated intense bilateral breast accumulation of the imaging agent in a typical doughnut pattern which is commonly found in the prelactating and lactating breast. Also demonstrated was apparent gallium accumulation in the placenta. This case is presented to emphasize the radionuclide findings that occur during pregnancy, particularly the incidental finding of radionuclide blush during the angiographic phase of a radionuclide scintigraphy which should alert the nuclear physician to the possibility of pregnancy in a woman of childbearing age.

J Nucl Med 27:370–372, 1986

Bone and gallium scans were inadvertently performed on a pregnant woman with undiagnosed complaints. The scans illustrate several important deviations from normal.

CASE REPORT

A 21-yr-old woman presented at our institution with a history of progressively worsening low back pain over a 1-wk period of time accompanied by intermittent low grade fever. Radiographs of the lumbar spine and pelvis were interpreted as normal. Bone and gallium scintigraphy were performed as part of the diagnostic workup.

The three-phase bone scan was performed following the injection of 20 mCi of technetium-99m methylene diphosphonate ([^{99m}Tc]MDP). A large field-of-view gamma camera equipped with a 3/8 in. NaI (Tl) crystal, and a high resolution parallel hole, low-energy collimator were employed. The angiographic phase of the study demonstrated a well-defined radionuclide blush within the pelvis just cephalad to the urinary bladder (Fig. 1). Persistent hyperemia in this region was noted on the blood-pool image (Fig. 2). Delayed osseous images were interpreted as normal, with the exception of some extrinsic compression upon the dome of the bladder. The significance of the bone scan findings was only appreciated retrospectively.

Following completion of the bone scintigraphy, because of the patient's persistent discomfort and fever, gallium scintigraphy was performed 48 hr after i.v. injection of 4.0 mCi of gallium-67 (^{67}Ga) citrate. Whole-body scans were performed on a large field-of-view scanning camera equipped with a medium-energy, parallel hole collimator, and a 3/8 in. NaI (Tl) crystal. Intense, symmetric bilateral breast accumulation of radiogallium was noted; the distribution was characteristic of the so-called doughnut pattern. Increased radionuclide accumulation in the anterior aspect of the pelvis (confirmed by a lateral pelvic image) was also noted and this probably represented accumulation of the imaging agent in the placenta and perhaps even the fetus (Fig. 3).

Upon completion of the gallium study, an ultrasound examination was performed and an intrauterine gestation of ~16 wk was confirmed. The placenta was located anteriorly.

The calculated radiation dose to the fetus, based upon dosimetry models and physiologic parameters as formulated by the MIRD Committee from 4.0 mCi of [^{67}Ga]citrate, 20.0 mCi of [^{99m}Tc]MDP, and radiographs of the spine and pelvis were 3.78, 3.27 and 0.85 rad, respectively (*1,2*).

DISCUSSION

The mechanisms responsible for changes in blood flow to the uterus are not thoroughly understood. There

Received May 14, 1985; revision accepted Nov. 7, 1985.

For reprints contact: Christopher J. Palestro, MD, Section of Nuclear Medicine, Dept. of Radiology, Norwalk Hospital, Norwalk, CT 06856.

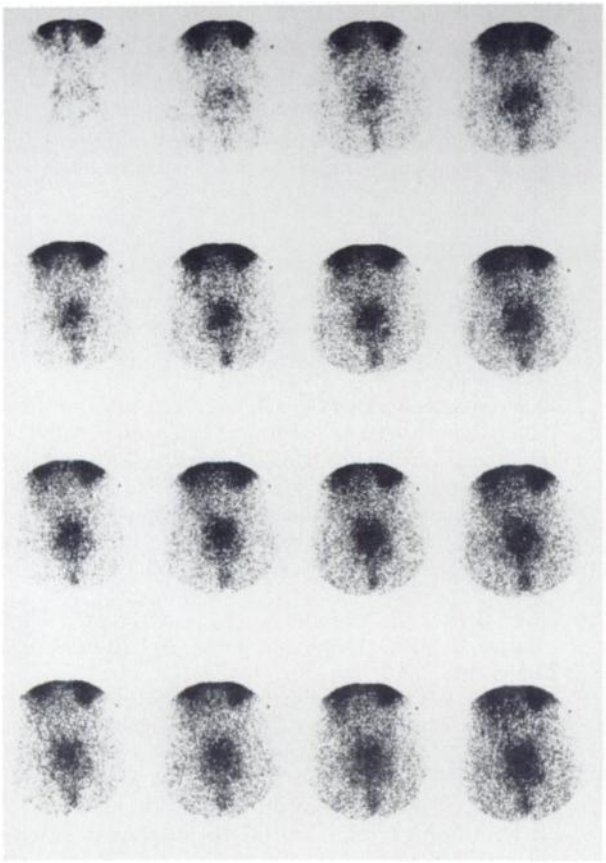

FIGURE 1
Radionuclide angiogram (4 sec per image) of posterior pelvis. Note intense uterine blush cephalad to urinary bladder

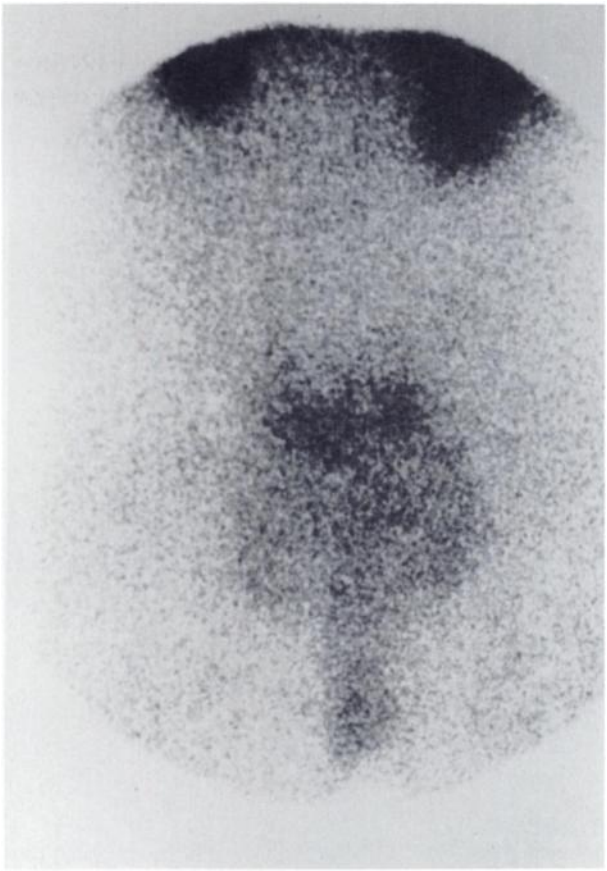

FIGURE 2
Blood-pool image (~5 min postinjection) demonstrating persistent uterine hyperemia

is considerable evidence to suggest that blood flow to the nonpregnant uterus is under hormonal control and that uterine blood flow may increase as much as tenfold at the time of ovulation. Progressive increase in uterine blood flow during gestation is derived from an increase in cardiac output combined with a decrease in uterine vascular resistance (*3*).

The uterine blush, occurring during radionuclide angiography, has been described previously by Fink-Bennett in women in the menstrual or secretory phase of their menses (*4*). The increased accumulation of the imaging agent was attributed to either a combination of edema and hyperemia of the secretory phase of the menses or perhaps sequestration of free pertechnetate within areas of necrosis and hemorrhage that occur during the menses itself.

In our own case, we attribute the angiographic blush to the pronounced uterine muscular hyperplasia, hyperemia, and edema that occur as a direct result of the hormonal changes of pregnancy; these changes undoubtedly also explain the hyperemia noted on the blood-pool image which has been reported previously in a 1-mo gestation (*5*). The relatively advanced stage of the pregnancy, the large size of the uterus, and, hence, the increased blood flow, account for the more intense and larger angiographic blush demonstrated in our own patient than that demonstrated by Fink-Bennett in nongravid females.

In addition to other hormonal alterations, the gestational state is characterized by a progressive rise in prolactin, which together with growth hormone, are the most important pituitary hormones affecting mammary growth (*6*). The hyperprolactinemic state results in pronounced peripheral lobular and acinar development which presumably accounts for the doughnut pattern of gallium uptake in the prelactating and lactating breast (*7*). The exact mechanism of gallium accumulation in these states is not completely understood, although gallium activity in the milk of lactating women has been demonstrated previously (*8*). Gallium is also known to have an affinity for lactoferrin which constitutes ~15% of the total human milk protein (*9*).

Accumulation of ^{67}Ga in the human placenta is known to occur (*10*). Radioactive gallium citrate is largely bound to plasma proteins in the blood stream. The placenta is a vascular organ with blood comprising

FIGURE 3
Anterior 48-hr image demonstrating classic doughnut pattern of gallium accumulation in prelactating breast. Note also gallium accumulation within pelvis, probably in placenta

~18% of the placental weight; this may explain, at least in part, the increased placental accumulation of gallium relative to the surrounding viscera (*11*,*12*).

The inadvertent administration of radionuclide to a pregnant woman is a relatively uncommon event. In this particular case, the patient repeatedly denied any possibility of pregnancy or even recent sexual relations. We present this interesting, though unfortunate, case, to emphasize the radionuclide findings that occur during pregnancy, particularly the incidental finding of the radionuclide blush during the angiographic phase of the bone scintigraphy which should at least alert the nuclear physician to the possibility of pregnancy in a woman of childbearing age.

REFERENCES

1. Leovinger R, Berman M: A schema for absorbed-dose calculations in biologically distributed radionuclides, MIRD Pamphlet No 1, *J Nucl Med* 9:Suppl. No 1, 7-14, 1968
2. Leovinger R, Berman M: *A Revised Schema for Calculating the Absorbed Dose from Biologically Distributed Radionuclides, MIRD Pamphlet No 1*, New York, The Society of Nuclear Medicine, March 1976
3. Resnik R: Gestational changes of the reproductive tract and breast. In *Maternal Fetal Medicine: Principles and Practice*. Philadelphia, W.B. Saunders, 1984, pp 141-145
4. Fink-Bennett D: The uterine blush: A potential false-positive in Meckel's scan interpretation. *Clin Nucl Med* 7:444-446, 1982
5. McAfee JG, Silberstein EB: *Differential Diagnosis in Nuclear Medicine*, New York, McGraw-Hill, Inc., 1984, p 304
6. Reyniak JV: Physiology of the breast. In *The Breast*, St. Louis, C. V. Mosby Company, 1978, pp 23-32
7. Kim YC, Brown ML, Thrall JH: Scintigraphic patterns of gallium-67 uptake in the breast. *Radiology* 124:169-175, 1977
8. Larson SM, Schall GL: Gallium-67 concentration in human breast milk. *JAMA* 218:257, 1971
9. Hoffer PB, Huberty J, Boshia HK: The association of Ga-67 and lactoferrin. *J Nucl Med* 18:713-717, 1977
10. Newman RA, Gallagher JG, Clements JP, et al: Demonstration of Ga-67 localization in human placenta. *J Nucl Med* 19:504-506, 1978
11. Mahon DF, Subramanian S, McAfee JG: Experimental comparison of radioactive agents for studies of the placenta. *J Nucl Med* 14:651-659, 1973
12. Salhanick HA, Neal LM, Mahoney JP: Blood content of the human placenta. *J Clin Endocrinol Metab* 16:1120-1122, 1956