Sternal Infarction in Sickle-Cell Anemia: Concise Communication

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Bone scintigraphy in six children with sickle-cell anemia has demonstrated infarction of bony segments of the sternum. Anterior oblique views of the thorax provided best visualization of the infarcts which were seen as areas of decreased bone tracer accumulation.

J Nucl Med 22: 322–324, 1981

Children with sickle-cell crisis may present with anterior chest pain in addition to pain at other sites, such as the extremities and/or abdomen. Bone scintigraphy in six such patients demonstrated infarction of bony segments of the sternum, which proved to be responsible for the anterior chest pain and/or tenderness that these children experienced.

The patients studied ranged in age from 4 to 19 yr. All had homozygous sickle-cell anemia. Four were males and two were females. At the time of presentation, four of the six specifically complained of anterior chest pain, and the sternum in all six was painful to palpation. All were admitted to the hospital and received intravenous fluids and supportive measures. Their symptoms resolved in 2–6 days. At no time in the clinical course of any of the patients did evidence of osteomyelitis of the sternum appear.

METHODS

Bone scintigraphy, with technetium-99m pyrophosphate or methylene disphosphonate, was performed in our routine manner on each patient within 48 hr after admission. The administered dose was calculated on the basis of weight (200 μCi/kg) and ranged from 4–8 mCi. Blood-pool imaging was performed immediately following injection in three of the six patients, using a high-sensitivity collimator. Standard scintiphotos with a high resolution collimator were obtained 2–3 hr after tracer injection in all patients. Right and left anterior oblique views of the thorax were obtained in addition to the routine anterior and posterior images. Radiographic examination of the chest was performed in frontal and lateral views.

RESULTS

All patients in this series showed absence of radionuclide uptake in one or more of their sternal segments. While the sternal defects were suspected in the anterior view (Fig. 1A), their visualization was enhanced in the oblique views (Fig. 1B). Though the size of the sternal defects varied, the proximal portion of the manubrium was never involved (Fig. 2). The midsternal segments were involved in five patients, and in two of these there was no uptake in the lower sternum as well (Fig. 2). One child had a solitary segmental defect in the lower sternum. The radiographs showed neither bony abnormality

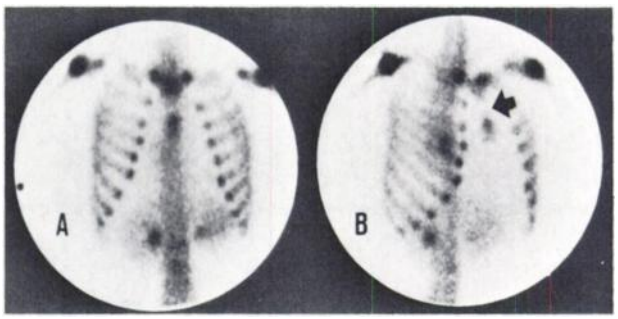

FIG 1. Female, age 8. (A) Sternal defect is masked by spinal uptake in anterior view. (B) RAO view shows midsternal defect more clearly (arrow).

Received Sept. 15, 1980; revision accepted Nov. 24, 1980.

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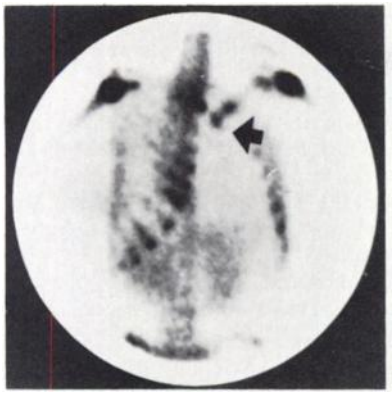

FIG. 2. Male, age 6. RAO view shows absent sternal uptake except for proximal portion of manubrium (arrow).

nor any consistent soft-tissue changes. A retrospective review of the lateral radiographs of the thorax revealed slight presternal and retrosternal soft-tissue swelling in two of the patients.

Limited follow-up studies were performed on two of the patients. Within 2–6 wk following the initial study, repeat bone scintigraphy revealed increased bone uptake at the border of the defect, and the defect had decreased in size in comparison with the initial examination (Fig. 3). In one instance a follow-up study was performed 4 mo later, and this showed the initially involved area to be almost completely filled in with tracer accumulation of normal intensity (Fig. 4).

DISCUSSION

By the sixth year of life, the sternum is composed of six segments. The first remains separate and forms the manubrium. The succeeding four segments fuse together between puberty and the 25th year to form the body of the sternum. The lowest segment, the xiphoid process, is distinct until middle life. Ossification centers appear in the six sternal segments in the interval between 6 mo and 18 yr of age. The arterial supply to all segments of the sternum is from the sternal and perforating branches of the internal thoracic artery (internal mammary artery) (*1*). Infarction of the sternum is presumed to be secondary to the sludging of sickle cells in the small vessels.

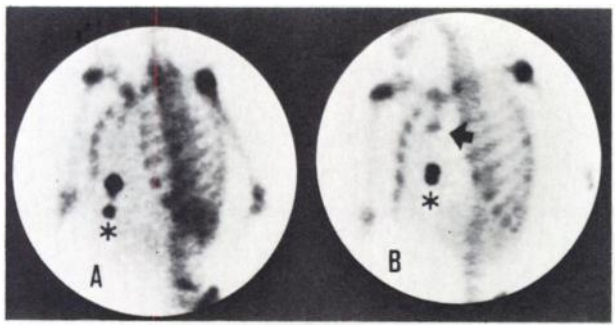

FIG. 3. Male, age 4. LAO view (A) shows absence of uptake in mid and lower sternum. Xiphoid tip is marked with external source (*). (B) after 6 wk defect has begun to fill in. Increased bone uptake is present at upper border of defect (arrow). Xiphoid tip is marked by external source (*).

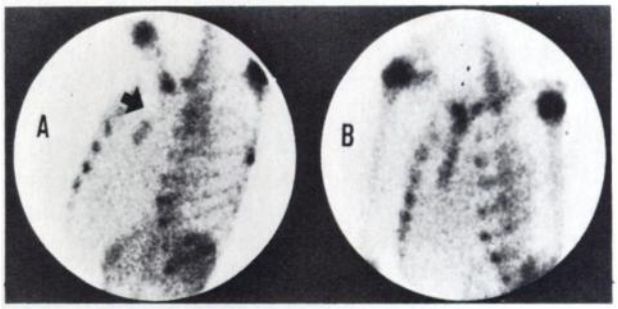

FIG. 4. Male, age 19. (A) LAO view shows defect in mid and upper sternum (arrow). (B) after 4 mo defect has almost completely filled in.

The scintigraphic detection of infarction in bone and bone-marrow in patients with sickle-cell anemia has been well established (*2–4*). Two groups of agents have been used for radionuclide imaging; the technetium-99m-labeled phosphates are used for bone imaging and technetium-99m sulfur colloid (Tc-99m SC) for marrow. The typical bone infarct appears scintigraphically as a focal area of decreased tracer accumulation. This decrease reflects the compromise of the vascular supply to the area that is responsible for the infarction. The long bones in patients with sickle-cell anemia are the most common sites of infarction. It is recognized, however, that infarction occurs in other bones, and it has been reported to occur in almost every bone of the body (*5*). Bone-marrow infarction occurs in conjunction with bone infarction and most likely occurred in our patients. The sternum is difficult to image with Tc-99m SC because of liver and splenic activity.

The identification of scintigraphic sternal defects in patients with sickle-cell anemia who complain of chest pain during crisis documents the fact that this pain is not of cardiovascular or pulmonary origin. We do not advocate the routine use of bone scintigraphy, since a careful history and physical examination will usually permit the clinician to identify the origin of the complaint.

When scintigraphic examination of the sternum is desired, right and left anterior oblique views of the thorax should be obtained with the gamma camera in order to project the sternum away from the dorsal spine. Blood-pool images are not of value, as the normal vascular activity of the heart and mediastinum obscures the blood-pool activity in the region of the sternum. Although flow studies were not obtained, we suspect that the activity of the heart and great vessels would obscure sternal perfusion in a manner similar to that noted on blood-pool images. Similarly, lateral views of the thorax have not been helpful, since the activity in the anterior ends of the ribs interferes with the evaluation of the activity in the sternum.

It is recognized that bone infarction and infection can present as photon deficiencies. Bone imaging therefore cannot distinguish between these entities with reliability. The role of scintigraphy is twofold: (a) to confirm that the chest pain in these children is due to an abnormality of the sternum, and not to cardiac or pulmonary disease; and (b) to provide guidance for other diagnostic studies such as a biopsy, etc., if these are clinically indicated for definitive diagnosis.

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