Tc-99m-Labeled Red Blood Cells in the Evaluation of Hemangiomas of the Skull and Orbit: Concise Communication

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Nine patients with hemangiomas of the skull and orbit were evaluated by scintigraphy with Tc-99m-labeled red blood cells and by radiological tests. All patients showed a focally increased blood pool in the hemangiomas; radionuclide angiography, however, did not show increased perfusion. This “perfusion vs. blood-pool mismatch” appears to be typical of hemangiomas. The findings on plain radiographs, TCT, and in one of two patients undergoing contrast angiography were less specific in showing the vascular characteristics of the lesion.


Tc-99m-labeled red blood cells (Tc-99m RBC), which provide an intravascular tracer, have been used extensively in nuclear cardiology. It was suggested that they may be of value in demonstrating vascular abnormalities in various regions of the body (1), and recently their use in the diagnosis of cavernous hemangiomas of the liver was demonstrated (2). The role of Tc-99m RBC scintigraphy in the diagnosis of hemangiomas of the skull and orbit has been evaluated in the present study.

MATERIALS AND METHODS

Nine patients with hemangiomas of the skull were investigated. These included two hemangiomas of the mandible, four of the skull vault, and three in the orbit. All patients had plain radiographs of the skull. The two patients with mandibular hemangioma underwent contrast angiography of the carotid artery, and those with orbital hemangioma had a TCT examination of the head.

Scintigraphy was performed using 20 mCi of red blood cells labeled in vitro with Tc-99m using a commercial kit*. The reducing agent was 200 μg of stannous glucoheptonate. Separated red blood cells were successively incubated, first with the reducing agent and then with pertechnetate. The tagging efficiency with this kit is 95–97% (3).

All scintigrams were obtained with a gamma camera.† For the radionuclide angiography, two-second images were obtained after bolus injection of the tracer. The flow study was immediately followed by an early blood-pool study of the head. Images were taken in the anterior and posterior views, and both laterals. Delayed blood-pool studies were done 1–2 hr after the injection. In four patients bone scintigraphy was performed with Tc-99m MDP.

RESULTS

Clinical data and the results of the scintigraphic and radiologic studies are summarized in Table 1. In all nine patients the hemangioma appeared in the delayed images as a region of high activity as compared with the neighboring tissue (Figs. 1–5). None of the hemangiomas appeared on radionuclide angiography. Orbital hemangiomas showed increase in activity in the delayed static study as compared with the early study (Fig. 4). Bone scintigraphy was abnormal in three out of four patients (Table 1).

Plain radiographs were suggestive of hemangiomas of the vault but were normal in one patient with mandibular hemangioma and in all three patients with orbital
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<td>1. Hemangioma of mandible</td>
<td>Swelling, paresthesia: right mandible.</td>
<td>Plain radiographs: ill-defined radiolucency in body of right mandible. Contrast angiography of common carotid artery: somewhat increased number of tortuous and wide distal branches of right submental artery. No angiomatous formation, vascular blush, or venous drainage (Fig. 1, left).</td>
<td>Tc-99m RBC: normal flow study; increased blood pool in body of right mandible (Fig. 1, center). Tc-99m MDP: (after bone biopsy) increased uptake in body of right mandible (Fig. 1, right).</td>
<td>Biopsy.</td>
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<td>3. Hemangioma of skull</td>
<td>Massive bleeding during dental extraction</td>
<td>Plain radiographs: large vascular identations over vault of skull.</td>
<td>Tc-99m RBC: normal flow study; increased blood pool right maxilla and vault of skull (Fig. 2, left). Tc-99m MDP: normal (Fig. 2, right).</td>
<td>Skull x rays. Followup of 8 months.</td>
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<td>4. Hemangioma of vault</td>
<td>Headache, vertigo</td>
<td>Plain radiographs: two well-demarcated osteolytic lesions, honeycombed appearance, sclerotic septa, left frontal and left occipital bones suggestive for hemangioma of skull.</td>
<td>Tc-99m RBC: normal flow study; static study: localized increased blood pool in left fronto-parietal and posterior part of skull, adjacent to transverse sinus (Fig. 3, top). Tc-99m MDP: increased uptake in left frontal and occipital bones. (Fig. 3, bottom).</td>
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<td>7. Hemangioma of orbit</td>
<td>Right exophthalmus, headache, vertigo.</td>
<td>Plain radiographs: normal. TCT of orbit: round, retrobulbar, intraconal lesion in right orbit. No bone invasion. Only slight enhancement after contrast (Hounsfield units not measured).</td>
<td>Tc-99m RBC: normal flow study (Fig. 4, top). Static studies: area of increased blood pool in right orbit. Lesion becomes more evident in delayed study (Fig. 4, center and bottom).</td>
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(continued)
The skull is the second most frequent site of involvement by hemangiomas of the bone (4,5) and hemangiomas are the most frequent tumor in the orbit (6). Static scintigraphy with Tc-99m RBC enables visualization of the increased blood volume of such lesions. Whereas radionuclide angiography—the scintigraphic method commonly used for assessment of vascularity—was negative in all cases, blood-pool imaging clearly demonstrated the lesions. This “perfusion vascularity mismatch” is typical of hemangiomas, reflecting the low regional blood flow and large blood volume of the lesion. Similar findings have been reported in hepatic hemangiomas (2).

Radiological tests were found to be less helpful in establishing the vascular characteristics of the hemangiomas. In neither of the two patients with hemangioma of the mandible was the plain radiographic study typical of hemangioma, and in one of them contrast angiography was also not helpful (Case 1, Table 1, Fig. 1). Diagnosis of hemangiomas of the vault can be suggested on plain radiographs of the skull but may sometimes be difficult (4,5). Followup eventually confirms that the lesions are hemangiomas (4). The specific pattern of RBC scin-

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**TABLE 1. (Continued)**

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<th>8. Hemangioma of orbit</th>
<th>Left</th>
<th>Plain radiographs: normal. TCT of orbit: oval, retrobulbar, intraconal, well-demarcated mass in left upper orbit. Left exophthalmus. Change in enhancement after contrast (ΔH) 50 HU.</th>
<th>Tc-99m RBC: normal flow study. Static study: well-defined area of increased blood pool in left orbit (Fig. 5).</th>
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**FIG. 1.** (Case 1): Hemangioma of mandible. Contrast angiography of right common carotid artery, showing somewhat wide distal branches of right submental artery, but no typical hemangioma pattern (left). Scintigrams with Tc-99m-labeled RBC show increased blood pool in body of right mandible (center). Bone scintigrams with Tc-99m MDP (after bone biopsy) show increased uptake in body of right mandible (right).

hemangioma. Contrast angiography showed only some increase in the number of the submental vessels of one mandibular hemangioma (Fig. 1), and was diagnostic in the other. TCT of the orbital hemangiomas showed a retrobulbar intraconal lesion. Change in enhancement after injection of contrast (ΔH) was 25 and 50 units in the two tumors measured (Patients 8 and 9, Table 1).

**DISCUSSION**

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**FIG. 2.** (Case 3): Hemangioma of maxilla and vault. Scintigrams with Tc-99m-labeled RBC show extensively increased blood pool in right maxilla and vault of skull (left). Normal bone scintigrams with Tc-99m MDP (right).
FIG. 3. (Case 4): Hemangioma of vault. Tc-99m-labeled RBC show large blood pool in left fronto-parietal region and in posterior part of skull, adjacent to transverse sinus (arrows) (upper). Bone scintigraphy with Tc-99m MDP shows increased uptake in same lesions (arrows) (lower).

*1\* I I $tigraphy indicates the vascular nature of the lesion, and the patient needs only be observed. While TCT defines very accurately the form, size, and anatomic relationship of orbital hemangioma (6–8), it is less specific in indicating its vascular nature. Change in Hounsfield units ($ΔH$) after contrast injection (measured in cases 8 and 9) was 25 and 50 units respectively, but it may vary from 10 to 50 units (8). In some cases, the low degree of enhancement may falsely suggest an avascular lesion. Low enhancement is caused, probably, by the lack of mixing of contrast early after the injection in a lesion with a sluggish perfusion but large blood pool. Contrast is rapidly cleared from the blood and after 2 hr only 35%
FIG. 5. (Case 8): Hemangioma of orbit. Scintigrams with Tc-99m-labeled RBC show markedly increased blood pool of hemangioma (arrow).

of the original concentration remains in the blood (9). Labeled red blood cells, an intravascular agent, become completely mixed in the blood pool of the lesion after two hours and show its whole extent.

CONCLUSION

In the nine patients reported here, Tc-99m RBC scintigraphy, using a combination of the dynamic blood-flow phase and the delayed blood-pool phase, displayed a characteristic pattern in every case: sluggish flow with large blood pool. It indicates the vascular characteristics of hemangiomas, which may not be evident from radiological studies.

REFERENCES


Announcement of Berson–Yalow Award

The Society of Nuclear Medicine invites manuscripts for consideration for the Fifth Annual Berson–Yalow Award. The manuscript will be presented at the 30th Annual Meeting of the Society of Nuclear Medicine in St. Louis, MO, June 7–10, 1983, and a suitably engraved plaque will be awarded to the authors by the Education and Research Foundation of the Society of Nuclear Medicine.

The manuscript should be approximately ten pages in length (typed, double-spaced). A letter requesting consideration for the award, including the author’s full mailing address and telephone number, should accompany the manuscript. Original manuscript and eight copies must be received by January 17, 1983 at the Society of Nuclear Medicine office, 475 Park Avenue South, New York, NY 10016, Attn: Mr. Dennis L. Park.

Deadline for receipt of manuscripts: January 17, 1983.