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Tc-99m labeled red blood cells scintigraphy: a diagnostic method for orbital cavernous hemangioma

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ABSTRACT: Purpose. *To evaluate Tc-99m labeled red blood cells scintigraphy (Tc-99m RBC scintigraphy) as a diagnostic method for orbital cavernous hemangioma.*
Patients and Methods. *Retrospective analysis of the medical records of all patients who were diagnosed as suffering from orbital cavernous hemangioma over the last 16 years.*
Results. *Medical records of 12 patients with orbital cavernous hemangioma were identified. In all twelve patients, the tentative diagnosis of orbital cavernous hemangioma was made by CT scan. In all of them, the diagnosis was established by Tc-99m RBC scintigraphy, demonstrating a typical picture of "perfusion blood- pool mismatch" (This is normal radionuclide angiography, followed by a variable radionuclide uptake during the early blood-pool study and an intensive radionuclide uptake during the delayed blood-pool study). The tumor was surgically removed in all 12 patients. This diagnostic method was found to be reliable as no single case was recorded in which the preoperative diagnosis was not confirmed pathologically after surgical removal of the tumor.*
Conclusions. *Tc-99m RBC scintigraphy is a reliable method for diagnosing orbital cavernous hemangioma. It should be included in our arsenal of diagnostic techniques, particularly for cases which are otherwise difficult to diagnose. (Eur J Ophthalmol 1999; 9: 125-9)*

KEY WORDS: Cavernous hemangioma, Orbital tumor, Exophthalmus

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INTRODUCTION

Tc-99m labeled red blood cells (Tc-99m RBC) is an intravascular tracer which has been used extensively in nuclear medicine (1). The main applications of the tracer are: the evaluation of the cardiovascular system (2), and the detection of gastrointestinal bleeding (3). It has also been found to be specific for diagnosing cavernous hemangioma of the liver (4). Encouraged by this high specificity of Tc-99m RBC for diagnosing cavernous hemangioma of the liver, as early as 1982 we attempted to use this intravascular tracer for diagnosing orbital cavernous hemangioma (5). We used Tc-99m RBC scintigraphy to establish the preoperative diagnosis of orbital cavernous hemangioma in 3 patients with orbital masses, in whom the diagnosis of orbital cavernous hemangioma was suspected on CT scan. The preoperative diagnosis of all 3 patients was later confirmed pathologically. From then onwards, over the past 16 years, we have used Tc-99m RBC scintigraphy routinely to confirm the diagnosis of orbital cavernous hemangioma whenever it was suspected on CT scan. Following our initial work, 3 cases of orbital cavernous hemangioma which were diagnosed by nuclear medicine techniques using red blood cells were recently published (6,7).

The purpose of this retrospective case series was to evaluate Tc-99m RBC scintigraphy as a diagnostic method for orbital cavernous hemangioma.

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PATIENTS AND METHODS

The medical records of all patients who were diagnosed as suffering from orbital cavernous hemangioma from the beginning of 1982 to date were reviewed. Data regarding the clinical presentation, pathological ocular findings, CT scan, Tc-99m RBC scintigraphy, operative reports and pathological reports were collected.

We used three-phase Tc-99m RBC scintigraphy routinely on all patients in whom the presumptive diagnosis of orbital cavernous hemangioma was suspected based on CT scan.

Scintigraphy was performed after an intravenous injection of 20mCi of red blood cells (separated from 10 ml blood) labeled *in vitro* with Tc-99m using a commercial kit suitable for routine clinical use (8), (Soreq Nuclear Plants, Israel). This labeling procedure is short and simple, involving the incubation of the blood with a reducing agent and with Tc-99m pertechnate solution in a sterile kit.

All scintigrams were obtained with a digital gamma camera (SP-6, Elscint, Israel) with a parallel hole low energy all purpose collimator. Radionuclide angiography was performed after a bolus injection of the tracer and images were obtained at two-second intervals for the first minute in the anterior view. This was followed by an early blood-pool study of the head in the anterior, posterior and both lateral views. A total of 600 Kcounts were acquired for each view. A delayed blood-pool study of the head was performed 2 hours after the injection using the same acquisition parameters.

RESULTS

Twelve patients were diagnosed as suffering from orbital cavernous hemangioma. There were 8 male and 4 female patients, aged from 20 to 58 years (average 44 years). In all of the patients but one (patient No. 3), the tumor was intraconal and confined mainly to the middle third of the orbital space. No tumor was located in the orbital apex. All of the patients presented with a good preoperative visual acuity of 20/40 or better (8 of them with 20/20 vision). In all 12 patients, the tumor was surgically removed and the diagnosis was confirmed pathologically. Patients' clinical data are summarized in Table I, and examples of a typical CT scan and scintigraphic pictures are shown in Figures 1 and 2.

Radionuclide angiography was normal in all patients. A mild increased uptake was seen in 5 patients in the early blood-pool study. An area of high activity was noted in all patients in the delayed blood-pool study of the Tc-99m RBC scintigraphy. Perfusion blood-pool mismatch with an increase in uptake over time was seen in all patients.

DISCUSSION

Orbital cavernous hemangioma is a benign vascular tumor which occurs most commonly in middle-aged women (in contrast to our series, which was dominated by males), and accounts for 3 to 7 percent of all orbital mass lesions (9-11). The tumor is composed of large, well-formed vascular spaces which are lined

TABLE I - PATIENTS' DATA AND MAIN FINDINGS

Patient No.	Sex	Age (yr)	CT localization of lesion	Tumor size (two largest diameters in cm)
1	M	20	Intraconal	2.0 x 2.5
2	M	46	Intraconal	2.0 x 2.5
3	M	50	Extraconal (inferonasal)	2.5 x 3.5
4	F	55	Intraconal	2.0 x 3.0
5	M	42	Intraconal	3.5 x 2.0
6	M	40	Intraconal	2.5 x 2.5
7	F	46	Intraconal	2.0 x 1.5
8	F	44	Intraconal	1.6 x 1.6
9	M	58	Intraconal	2.5 x 2.5
10	F	46	Intraconal	1.7 x 1.5
11	M	52	Intraconal	2.1 x 1.8
12	M	49	Intraconal	2.5 x 2.7

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with flattened endothelial cells and surrounded by a fibrous capsule (12,13). The tumor does not have an increased blood flow, and is relatively isolated from the systemic blood circulation. All cavernous hemangiomas share some common characteristics on CT or MRI scans, appearing as rounded, homogeneous, encapsulated lesions (Fig. 1) (14). Standardized echography, which is based on standardized A-scan supplemented by contact B-scan and Doppler sonography, is a good method to achieve a specific diagnosis by way of tissue differentiation (15).

We find the three-phase Tc-99m RBC scintigraphy a very useful method to substantiate the diagnosis of orbital cavernous hemangioma. There are three stages during the test (Fig.2). The first stage is a one-minute dynamic study, radionuclide angiography, with images obtained at two-second intervals after an intravenous bolus injection of the tracer. Radionuclide angiography is an index of tumor perfusion. As mentioned above, orbital cavernous hemangioma is relatively isolated from the systemic blood circulation, and as a result, tumor blood flow is low. This explains why no abnormal accumulation of the tracer is noted within the hemangioma at this time (Fig.2a). As the blood recirculates, the intravascular tracer slowly accumulates in the small blood-pool of the hemangioma. This may explain some variable degree of radionuclide uptake in the tumor during the early blood-pool study (Fig.2b). A larger amount of the tracer is taken up by the increased blood-pool within the hemangioma 2 hours after the intravenous injection, and this is clearly shown during the late blood pool study, in which the amount of the radionuclide tracer is much higher than in the early part of the test (Fig.2c).

The scintigraphic picture described above is called “perfusion blood-pool mismatch” and is typical of cavernous hemangioma due to its unique vascular structure. Although CT and MRI scans are the important tests for diagnosing orbital cavernous hemangioma, a number of lesions that can mimick the clinical and the radiologic appearance on CT or MRI scans have been described (14). These include lesions such as traumatic conjunctival inclusion cyst, lymphangioma, neurolinoma, extradural meningioma, metastatic melanoma and malignant fibrous histiocytoma, all of which can be excluded from being orbital cavernous hemangioma using Tc-99m RBC scintigraphy, as they do not share its unique vascular structure. In 16 years

Fig. 1 - *Axial CT scan showing the typical appearance of an intraconal cavernous hemangioma in the right orbit.*

of experience, we used Tc-99m RBC scintigraphy whenever orbital cavernous hemangioma was suspected or included in the differential diagnosis on CT scans. In all 12 patients with orbital cavernous hemangioma treated by us, the preoperative diagnosis was confirmed by Tc-99m RBC scintigraphy, demonstrating the typical picture of “perfusion blood-pool mismatch”. In all 12 patients, the diagnosis was later confirmed pathologically. We performed Tc-99m RBC scintigraphy on numerous occasions and found it to be negative in orbital masses of various histology. As orbital masses are not encountered frequently, it is obvious that our list of orbital tumors in which Tc-99m RBC scintigraphy is negative (not demonstrating the typical picture of “perfusion blood-pool mismatch”) is far from being complete. In spite of this, based on our experience and the understanding of the unique vascular structure of orbital cavernous hemangioma, we find it unlikely that the typical scintigraphic picture of

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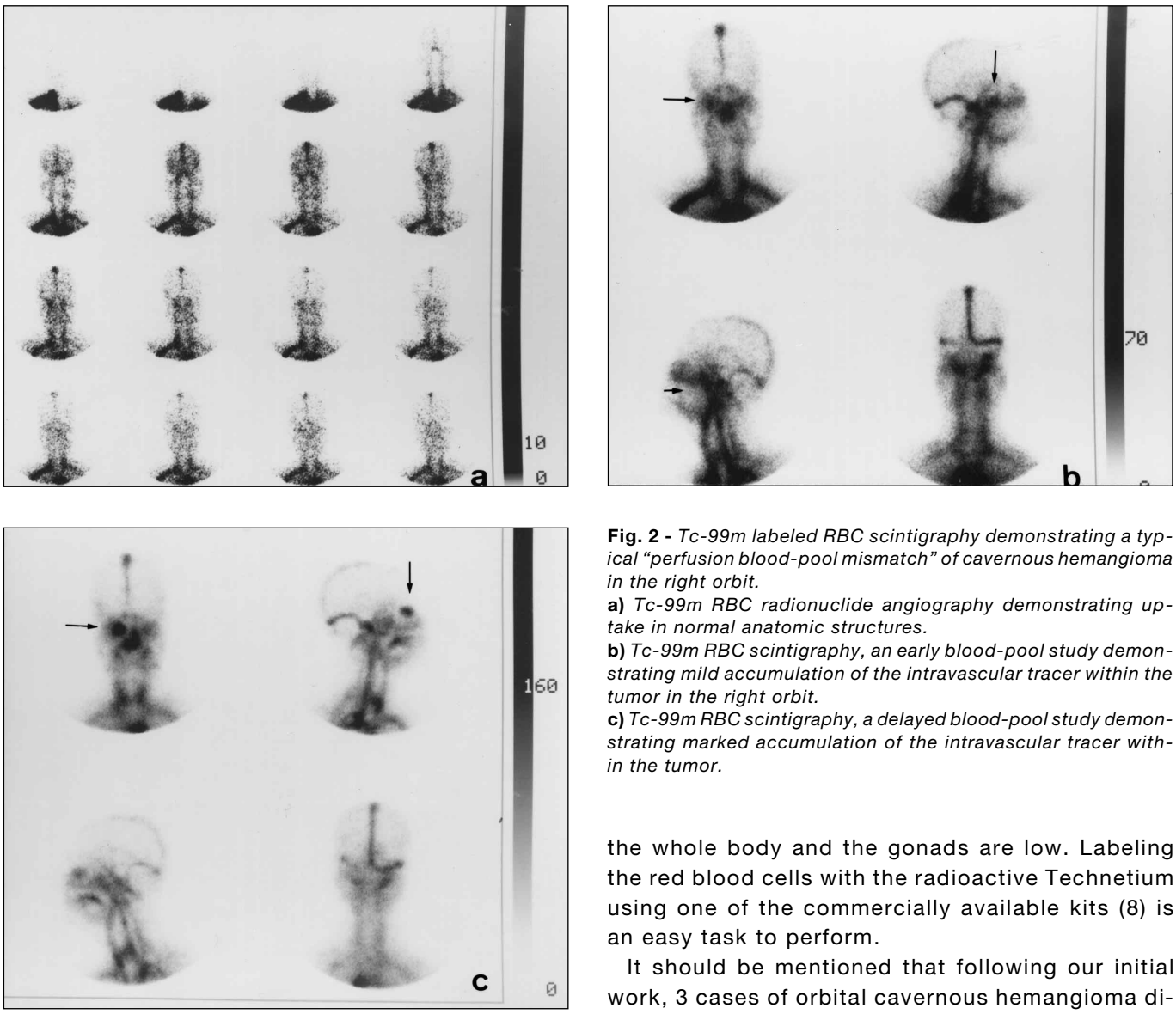

Fig. 2 - *Tc-99m labeled RBC scintigraphy demonstrating a typical "perfusion blood-pool mismatch" of cavernous hemangioma in the right orbit.*
a) *Tc-99m RBC radionuclide angiography demonstrating uptake in normal anatomic structures.*
b) *Tc-99m RBC scintigraphy, an early blood-pool study demonstrating mild accumulation of the intravascular tracer within the tumor in the right orbit.*
c) *Tc-99m RBC scintigraphy, a delayed blood-pool study demonstrating marked accumulation of the intravascular tracer within the tumor.*

the tumor will occur in any other orbital mass except hemangiopericytoma, which has a similar vascular structure and at present cannot be diagnosed preoperatively by any other diagnostic method.

Although Tc-99m RBC scintigraphy is a reliable method for diagnosing orbital cavernous hemangioma, the precise location of the tumor in the orbit, its size and its shape cannot be determined by this method.

The diagnostic test described in this article is a non-invasive one. Tc-99m RBC is an intravascular tracer which has been used extensively in nuclear medicine. It is a very safe tracer as no adverse reactions have been reported and radiation doses to the whole body and the gonads are low. Labeling the red blood cells with the radioactive Technetium using one of the commercially available kits (8) is an easy task to perform.

It should be mentioned that following our initial work, 3 cases of orbital cavernous hemangioma diagnosed by nuclear medicine techniques using red blood cells were recently published, two of them by Ki et al (6), and 1 by Murata et al (7). The latter one was the only case of orbital cavernous hemangioma in a series of 48 patients with head and neck hemangiomas.

In this series, we described 12 cases of orbital cavernous hemangioma treated by us over the past 16 years. In all 12 cases, the presumptive diagnosis was established by Tc-99m RBC scintigraphy and was confirmed later pathologically. Tc-99m RBC scintigraphy was found to be a safe, reliable and easy to perform method for diagnosing orbital cavernous hemangioma, and as such, should be included

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in our arsenal of diagnostic methods whenever this tumor is suspected, and particularly when difficulties in diagnosis are encountered with other diagnostic methods.

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