SUBDURAL HEMATOMA — WHAT IS THE ROLE OF BRAIN SCANNING IN ITS DIAGNOSIS?

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A comparison was made between brain scans and cerebral angiography in 40 patients with subdural hematomas confirmed by surgery. Lesion size was estimated as the difference in width and intensity of peripheral radioactivity between the two sides of brain scans and by maximum displacement of cerebral vessels from the skull on angiography. Scans were positive in 30 of 32 unilateral hematomas (all 12 acute and 18 of 20 chronic). The degree of scan abnormality correlated well with the x-ray findings. In 98 patients in whom the clinical course was reviewed, 87 had a prescan diagnosis of possible hematoma and 11 without clinical evidence had suspicious or positive scans. In the group surveyed, the false-negative rate was 4% and the false-positive rate was 11%, the latter usually with an obvious clinical or radiographic explanation. The likelihood of hematoma was very low in the "suspicious scan" category.

Brain scanning is frequently used as a screening procedure for detecting subdural hematomas (*1*). Chronic subdural hematomas are reputed to be more readily detected than acute ones (*1,2*), which has generally been attributed to the concept that the membrane is the main site of the abnormal activity. Unfortunately, the typical scan pattern, which is an abnormal crescentic increase in peripheral activity, primarily visible in the anterior and posterior views, is not pathognomonic of a subdural hematoma (*3*). A variety of conditions may cause this crescentic increase in activity, including scalp trauma, scalp infection, and superficial inflammatory lesions of the brain and meninges, and craniotomy defects.

As previous reports on the poor detection of acute subdural hematomas relied on historical data to determine their age, we assessed the ability of the brain scan to detect acute in comparison to chronic subdural hematomas on the basis of whether or not a membrane was present at surgery. By using the absolute criteria of surgical findings, we hoped to discover whether or not acute subdural hematomas were indeed detected less often than chronic ones. In addition, we were able to compare the brain scan findings with the angiographic results in 40 patients who had operatively proven acute or chronic subdural hematomas. In the few reported cases where the radioactivity in the membrane and fluid has been measured (*1,4*), it was approximately equal in both. Thus, the fluid that usually has a larger volume should be the more important factor in causing the scan abnormality. Therefore, we graded each scan abnormality hoping to show that with the increasing size of a subdural hematoma, the brain scan abnormality would be more apparent. To ascertain the effect of false-positive scans on the management of patients, we reviewed the clinical course of all patients with a diagnosis of subdural hematoma.

MATERIALS AND METHODS

Thirty-two patients with unilateral subdural hematomas and eight patients with bilateral subdural hematomas who had been studied by both rectilinear brain scans and cerebral angiography were reviewed. In all but three cases, the interval between the two studies was less than 48 hr. Four views of the brain were performed, usually between 30 and 60 min after the injection of 15 mCi of ^{99m}Tc-pertechnetate. All patients received potassium perchlorate before the ^{99m}Tc-pertechnetate.

Each scan was assessed as to the degree of abnormality present by determining the difference in width and the intensity of peripheral activity between the two sides on the anterior and posterior views (Fig. 1A). The difference in width was expressed in cen-

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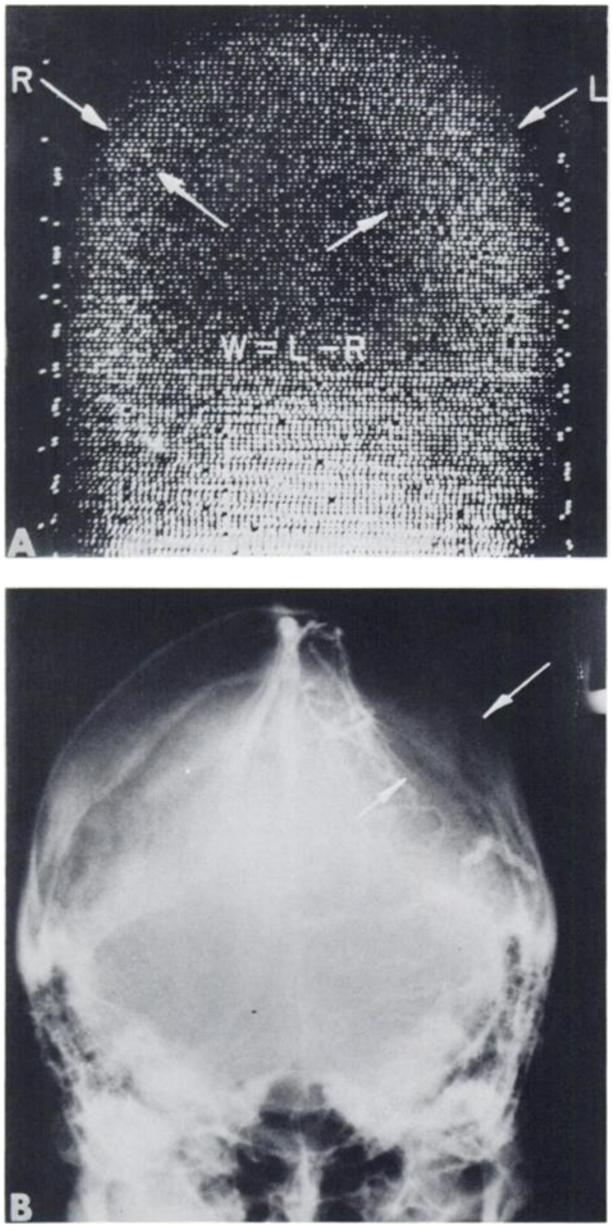

FIG. 1. (A) Anterior view of left subdural hematoma. Difference in width is determined by subtracting distance between arrows. (B) Cerebral angiogram of the same patient. Size of subdural hematoma was taken as maximum displacement of superficial vessels from inner table of skull.

timeters and the intensity on an arbitrary scale of 0–3 (0—value assigned to the normal side). Cerebral angiography was performed in the anteroposterior and lateral projections. The subdural hematoma size was the maximum displacement of the superficial cerebral vessels from the inner table of the skull as shown by the anteroposterior angiogram (Fig. 1B). This displacement was expressed in centimeters.

Retrospectively, the fate of patients who had a provisional diagnosis of subdural hematoma and who had a brain scan were analyzed. The period of this analysis was 24 months. Scans were classified as follows: positive—increase in the width or intensity of the peripheral rim of activity or both in the frontal projections; suspicious—asymmetrical increase in activity seen on either of the frontal views; and—normal. The final diagnosis was based on angiography, operation, or clinical assessment.

RESULTS

The scan was abnormal in 30 of the 32 *unilateral* subdural hematomas; the two not detected were chronic with thick collagenous membranes (Fig. 2). All 12 patients with acute unilateral subdural hematomas (no membrane present at surgery) had abnormal scans as did 18 of the 20 with chronic unilateral subdural hematomas (Fig. 3). We did not find any qualitative or quantitative difference in the scan abnormalities between acute and chronic subdural hematomas. There was no relationship between the intensity of the scan abnormality and the size of the subdural hematoma; however, as separation of the superficial cerebral vessels from the inner table of the skull increased, so did the difference in width of the peripheral activity in the frontal scans (Fig. 4).

Of the 16 individual subdural hematomas in our eight patients with bilateral subdural hematomas, four were less than 1 cm in size angiographically and only one of these had a detectable scan abnormality. Of the 12 who had displacement of the cerebral vessels from the inner table of the skull that was greater than 1 cm, 11 had a detectable scan abnormality (Table 1).

To answer the question—"What is the role of the brain scan in detecting a subdural hematoma?"—we reviewed the clinical course of 98 patients, 87 of whom had a prescan diagnosis of possible subdural hematoma and 11 patients with no clinical suspicion of subdural hematoma whose scans were categorized as "suspicious" or "positive" (Table 2).

As shown by Table 2 15 patients had positive scans suggesting subdural hematomas which were confirmed at surgery. During the 24 months that these patients were examined, however, a total of 73 patients were treated for subdural hematoma. Of these, 52 required emergency treatment and only 5 had scans. The remaining 21 were not emergency cases and 12 had scans, 2 of which were normal.

There were 11 false-positive studies, and all had pathology other than a subdural hematoma to account for the scan abnormality (Table 3).

Twenty patients had suspicious scans and none of these were found to have a subdural hematoma although 15 had other cranial or intracranial pathology.

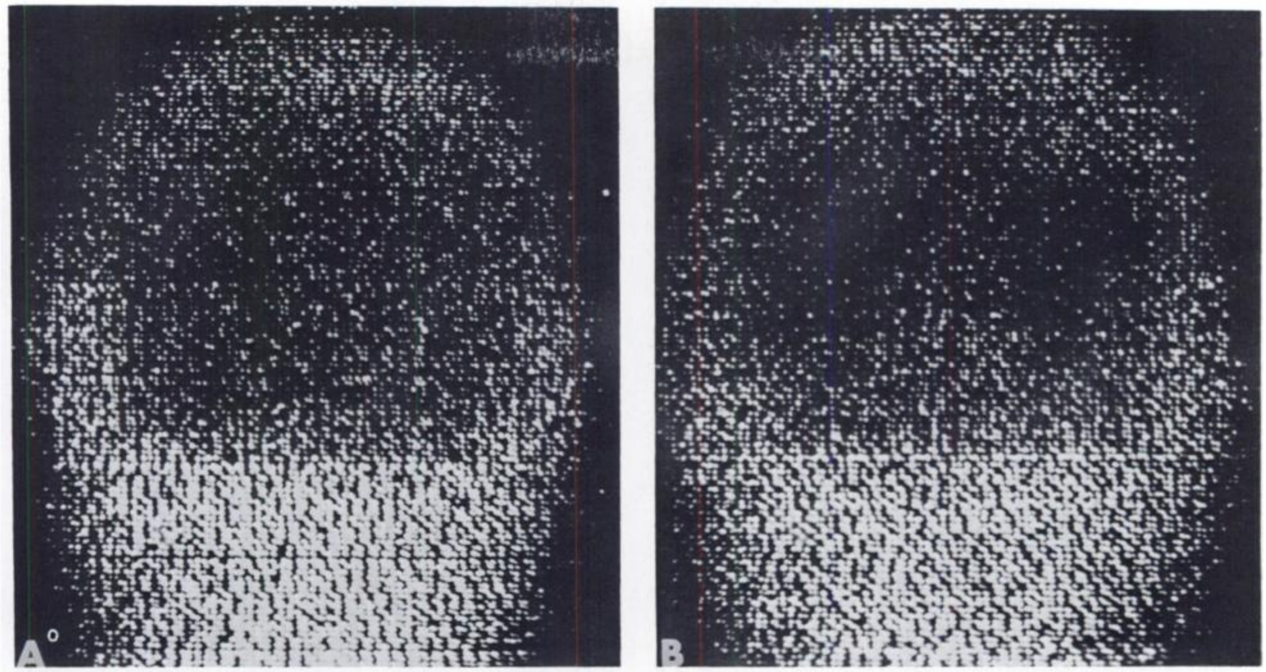

FIG. 2. One of two patients with chronic subdural hematoma who had membrane at surgery with normal scans (A, B). Angiogram (C) shows crescent-like displacement of superficial cerebral vessels.

Of the 52 patients who had normal scans but were suspected of having subdural hematomas, 2 were found to have them angiographically and subsequently had them removed surgically.

DISCUSSION

Our findings are unusual in that all 12 acute unilateral subdural hematomas resulted in abnormal scans whereas 2 of the 20 chronic unilateral subdural hematomas had normal scans. The brain scan detection of bilateral subdural hematomas has been considered difficult due to the symmetry of the increased peripheral activity resulting in a normal appearing scan. However, in eight patients with bilateral subdural hematomas, we found that if the amount of displacement of the superficial cerebral vessels from the inner table of the skull was greater than 1 cm, then a definite scan abnormality occurred on that side. This would suggest that bilateral subdural hematomas should be detectable except when they are small.

A trend exists suggesting that as the angiographically demonstrated size of the subdural hematoma increases in the frontal projection, then there will be an increase in the width of the scan abnormality. Therefore, a wide abnormality usually indicates a large subdural hematoma. As the number of cases is small in each group, ranging from 6 to 10, our results can be considered no more than indicators of a trend. If the concentration of the radioactivity in the fluid and membrane is approximately the same as has been suggested (*1,4*), as we found in two patients, then the width of the scan abnormality should increase with the increasing volume of the subdural fluid. However, as the concentration of the radioactivity is independent of the size, then the intensity of the peripheral activity should not change with the size of the subdural hematoma.

Our recommendation is that the role of the brain scan in the management of patients with subdural hematomas should be mainly that of a screening test in the clinically obscure and nonemergency situation. In a 24-month period, our false-negative

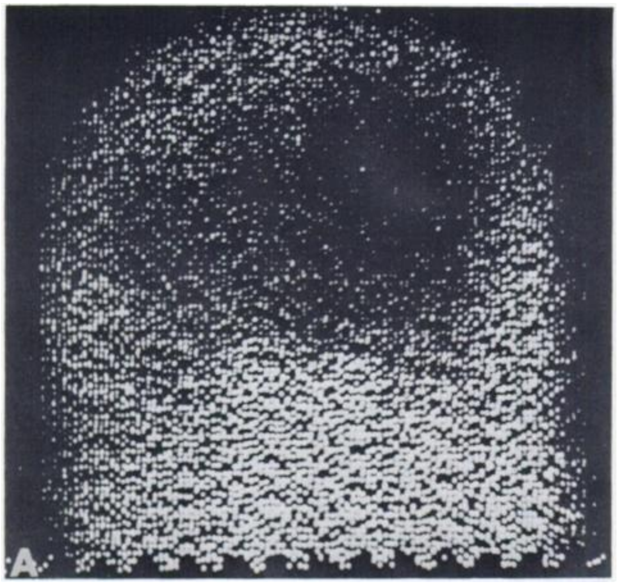

FIG. 3. (A) Chronic subdural hematoma with membrane. Scan shows typical increase in width of peripheral activity in anterior view (B). Lentiform displacement of superficial cerebral vessels is typical angiographic appearance.

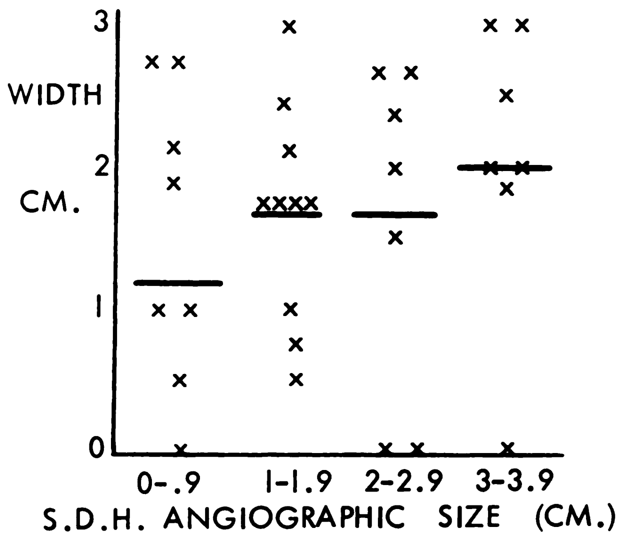

FIG. 4. As angiographic size of subdural hematoma increases, so does width of peripheral crescentic-scan abnormality.

rate was 4% and we had 11 false-positive cases in which only three patients required angiography to eliminate the possibility of a subdural hematoma whereas the other patients with a positive study had an obvious clinical or radiographic cause (such as skull fracture or scalp contusion) to account for the scan abnormality. If the scan abnormality is "just suspicious", the likelihood of a subdural hematoma is very low, as none of our patients in this category had one.

CONCLUSIONS

All 12 acute and 18 of the 20 chronic subdural hematomas had abnormal scans. In bilateral subdural hematomas, if the angiographic size of either hematoma was greater than 1 cm, it was readily detected by scanning. We found no qualitative or quantitative difference in the scan abnormalities between acute and chronic subdural hematomas. A trend was found suggesting that as the width of the scan abnormality increases, the larger will be the subdural hematoma. In our institution, brain scanning is most frequently used for detecting subdural hematomas in the clini-

TABLE 1. BILATERAL SUBDURAL HEMATOMAS

	Scan result		
Angiographic width*	No.	Pos.	Neg.
0–0.9 cm	4	1	3
1–1.9 cm	6	6	0
2–2.9 cm	6	5	1

* Width of gap between superficial cerebral vessels and inner table of skull in frontal projections.

TABLE 2. SUBDURAL HEMATOMA: OUTCOME OF BRAIN SCAN EVALUATION

Scan diagnosis	Clinical course
15 positive	15 subdural hematomas
11 positive	11 other pathology
20 suspicious	15 other pathology 5 no definite pathology
52 negative	2 subdural hematomas 50 no pathology

TABLE 3. ETIOLOGY OF POSITIVE SCANS—26 PATIENTS

Diagnosis	Assessment
15 Subdural hematomas	12 angiographic 3 operative
5 Contusions	2 angiographic 3 operative
3 Scalp hematomas	clinical
1 Subdural hygroma	angiographic
1 Wound infection	clinical
1 Cranioplasty	clinical

cally obscure nonemergency situation. False-positive scans, although frequently, usually do not require angiography to eliminate the possibility of a subdural hematoma as the cause of the abnormality is often evident clinically or radiographically.

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