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Diagnostic Value of RIHSA and Chlormerodrin ^{197}Hg Brain Scanning in Intracranial Arteriovenous Malformations[1]

Murray Budabin, M.D.[2]

New York, New York

INTRODUCTION

There are wide variations in the reported accuracy of brain scanning in cases of intracranial arteriovenous malformations. Although experience in scanning arteriovenous malformations is somewhat limited, no doubt due to the relative rarity of these lesions[3], current reports indicate that both the type of tracer agent employed for scanning and the time at which scanning is performed may be critical factors in determining whether these vascular lesions can be detected (1-6).

This report reviews the experience gained with arteriovenous malformations in 13 patients in whom both immediate and delayed scans were performed following the administration of radio-iodinated human serum albumin (RIHSA). In six of these cases, Chlormerodrin ^{197}Hg scans were also performed at varying intervals following injection prior to the RIHSA scans. Comparison of the RIHSA and the Chlormerodrin ^{197}Hg scans obtained in these cases forms the basis of this communication.

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[1]From the Department of Neurology and the Andre Meyer Department of Physics, The Mount Sinai Hospital, New York.

[2]Read by title at the 18th Annual Meeting of the American Academy of Neurology, Philadelphia, April 25-30, 1966.

[3]In Zulch's clinic the incidence of arteriovenous malformations was 1.5 per cent of intracranial tumors (K. J. Zulch: Brain Tumors, New York, Springer, 1957, p. 233.

METHODS AND MATERIALS

Thirteen of 750 patients on whom brain scans were performed between December, 1963, and November, 1965, proved to have angiographically verified intracranial arteriovenous malformations. All 13 of these patients were scanned both immediately following the administration of 5 μc/Kg of RIHSA and 48 hours later when possible. Six of the 13 patients had already been scanned previously with Chlormerodrin ^{197}Hg 10 μc/Kg up to a dose of 700 μc (one patient inadvertently received a dose of 930 μc of Chlormerodrin ^{197}Hg). The mercury scans were performed at varying intervals from immediately following administration of the radioisotope to three hours afterward. All scans were made with a commercially available scanning instrument equipped with a three inch crystal and a photorecorder. Further technical details are as described in a prior publication (7).

RESULTS

The results of this study are summarized in Table I.

Immediate Scans: 12 of 13 RIHSA scans performed immediately following administration of this tracer agent were positive. The negative scan occurred in a case with an arteriovenous malformation situated in the posterior fossa. All five cases scanned immediately following the administration of Chlormerodrin ^{197}Hg proved to have positive scans.

Delayed Scans (a few hours after tracer dose): In the six cases scanned with Chlormerodrin ^{197}Hg (one in addition to the five mentioned above) one to three hours following administration of this substance there were only two positive scans. The abnormalities were less marked than in the scans made immediately after injection.

Delayed Scans (48 hours after administration): Such scans were performed in 11 of the 13 cases which were studied immediately following injection of RIHSA. It is obvious that scans could be obtained with this delay only with a material which has a relatively long effective half-life such as RIHSA. All 11 of these cases had positive immediate scans. Only six of the delayed studies were positive and the abnormalities were much less marked than on the immediate studies.

Comparison of RIHSA and Chlormerodrin ^{197}Hg scans: RIHSA scans, whether delayed or immediate, were always diagnostically superior to Chlormerodrin ^{197}Hg scans (Figures 1 & 2). It is to be emphasized that in the six patients on whom both mercury scans were done, after a few hours and RIHSA scans done after a 48 hour delay, the superiority of the RIHSA scans was particularly striking.

DISCUSSION

The findings of this study concerning the superiority of RIHSA to Chlormerodrin scanning in cases of arteriovenous malformations are in agreement with reports of other authors.

TABLE I

RESULTS OF IMMEDIATE AND DELAYED SCANS OF INTRACRANIAL ARTERIO-VENOUS MALFORMATIONS WITH RIHSA AND CHLORMERODRIN-^{197}HG

Location of AVM	*Number of cases*	*RIHSA*				*Chlormerodrin-^{197}Hg*			
		Immediate		*Delayed (48 hrs.)*		*Immediate*		*Delayed (1-3 hrs.)*	
		Positive	*Negative*	*Positive*	*Negative*	*Positive*	*Negative*	*Positive*	*Negative*
Deep posterior frontal and/or anterior parietal	4	4	0	3	1	3	0	1	3
Superficial posterior frontal and/or anterior parietal	4	4	0	1	2	–	–	–	–
Deep posterior parietal	2	2	0	1	1	1	0	1	0
Inferior temporal	2	2	0	1	1	1	0	0	1
Posterior fossa	1	0	1	–	–	–	–	–	–
Total	13	12	1	6	5	5	0	2	4

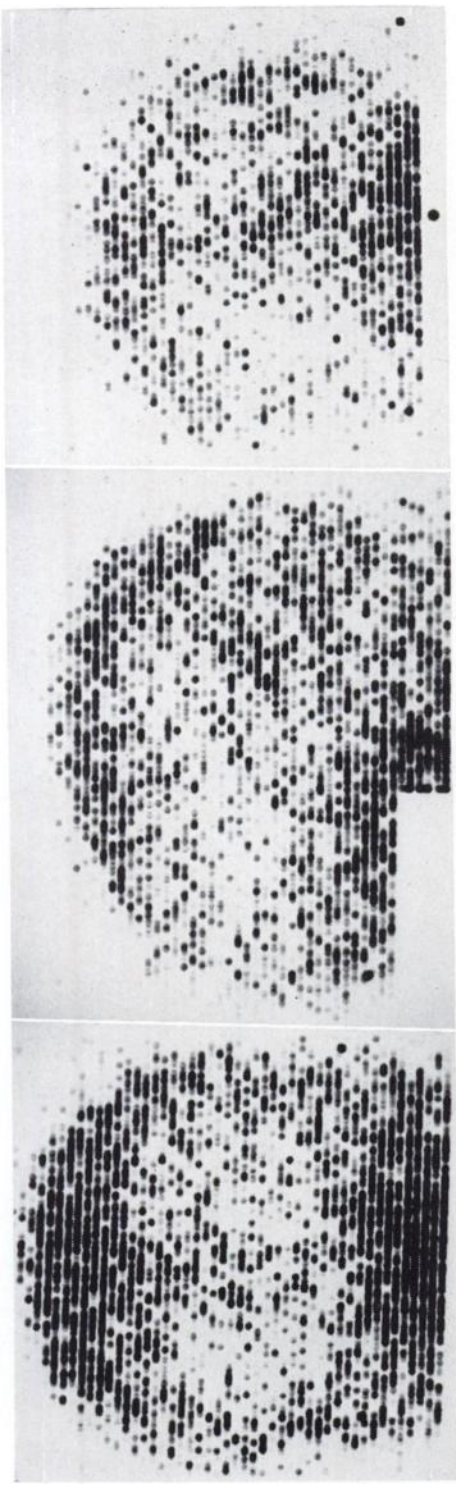

Fig. 1A Fig. 1B Fig. 1C

Fig. 1. (A) Anterior and (B) left lateral Chlormerodrin ^{197}Hg scan performed immediately after administration demonstrating a fronto-parietal arteriovenous malformation. (C) and (D) Immediate and (E) and (F) delayed (48 hour) RIHSA studies in the same case. Corresponding angiographic views (G) and (H).

(See pages 883, 884, 885)

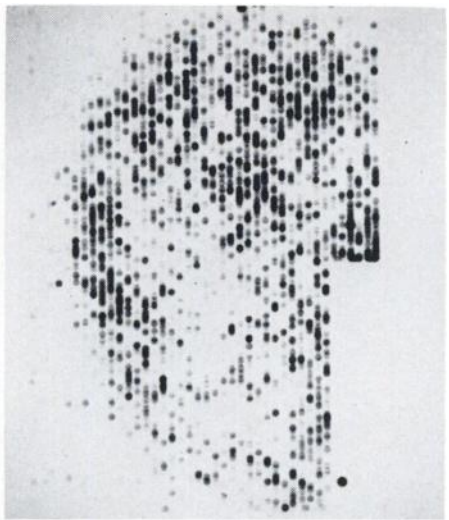

Fig. 1F

Fig. 1E

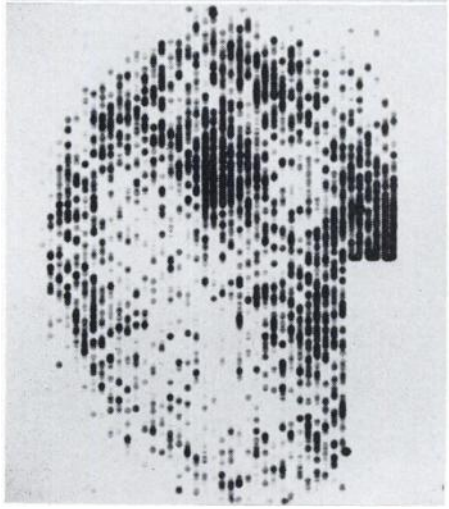

Fig. 1D

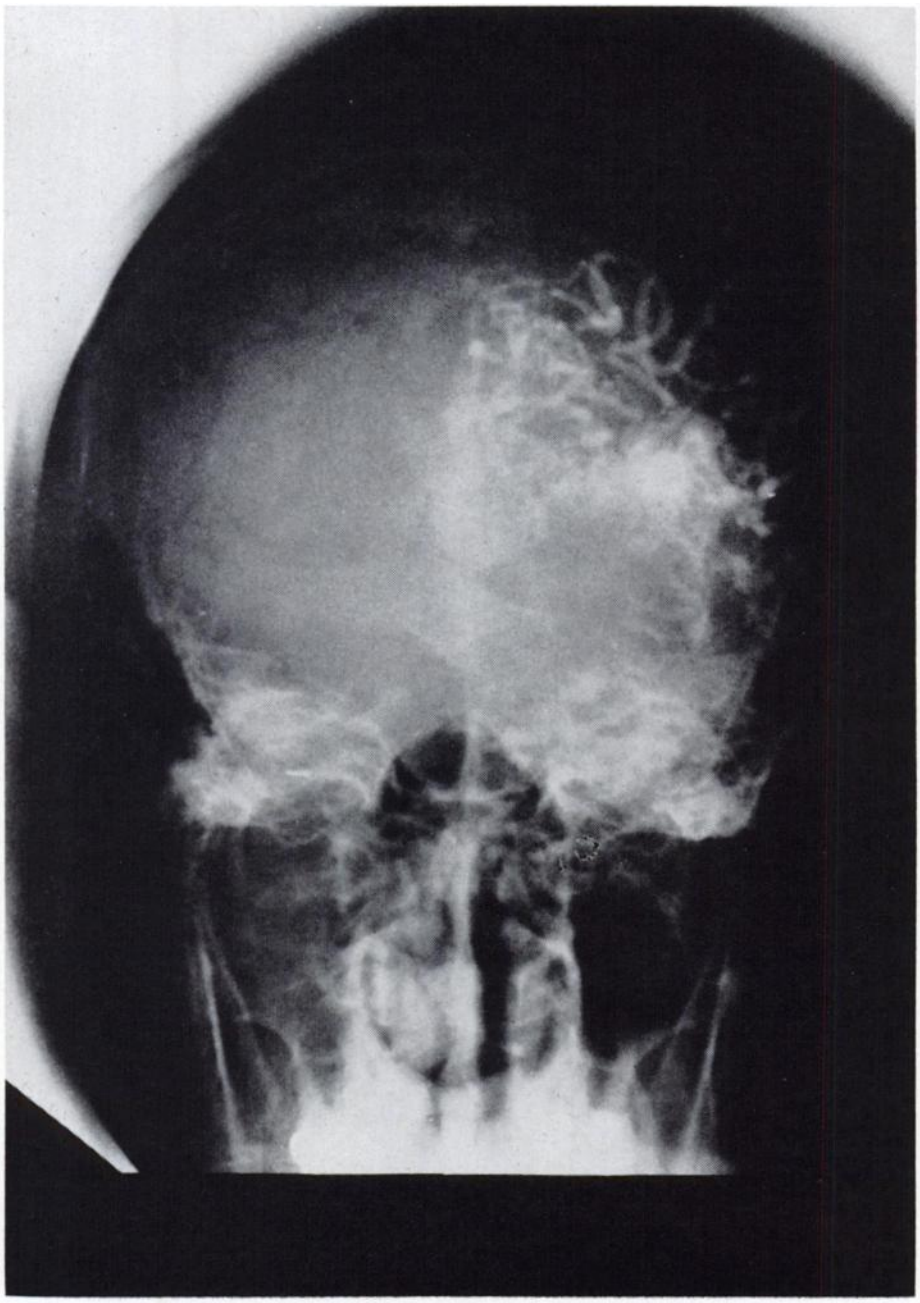

Fig. 1G

Schlesinger *et al* (4), detected nine of a total of 10 AVMs by performing serial RIHSA scans. They reported that these lesions were best seen immediately after injection. Similar experience with RIHSA was reported by Planiol and Akerman (5), who detected 49 of 54 arteriovenous malformations. McFee and Fueger (6) commented on the dilated vascular channels associated with and characteristic of AVMs as could be visualized with RIHSA.

Based on their experience with three arteriovenous malformations (AVMs) detected with Chlormerodrin ^{197}Hg, Dugger and Pepper (1) originally suggested that scanning be performed from 15 to 45 minutes following administration of this radioisotope, rather than at one to three hours, as is usually the case. They also reported that these lesions appeared more diffuse and were visualized in less striking fashion than in the case of intracranial tumors.

Afifi *et al* (2), concluded that earlier scans were not a prerequisite for the demonstration of arteriovenous malformations, since they reported good localization of AVMs four hours after injection of Chlormerodrin ^{203}Hg in five out of six cases. Overton *et al* (3), working with both Chlormerodrin ^{197}Hg and Chlormerodrin ^{203}Hg, detected only six of a total of 11 AVMs. They noted that small malformations which were situated in or very close to the midline were most liable to elude detection.

Recently, Witcofski *et al* (8), reported adequate visualization of 4 AVMs in scans performed with ^{99m}Technetium.

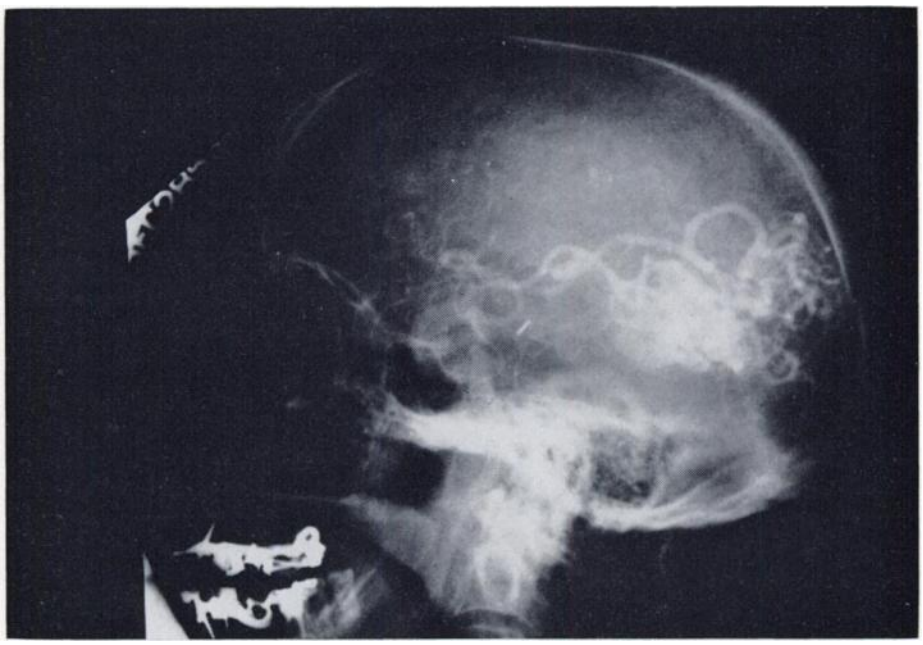

Fig. 1H

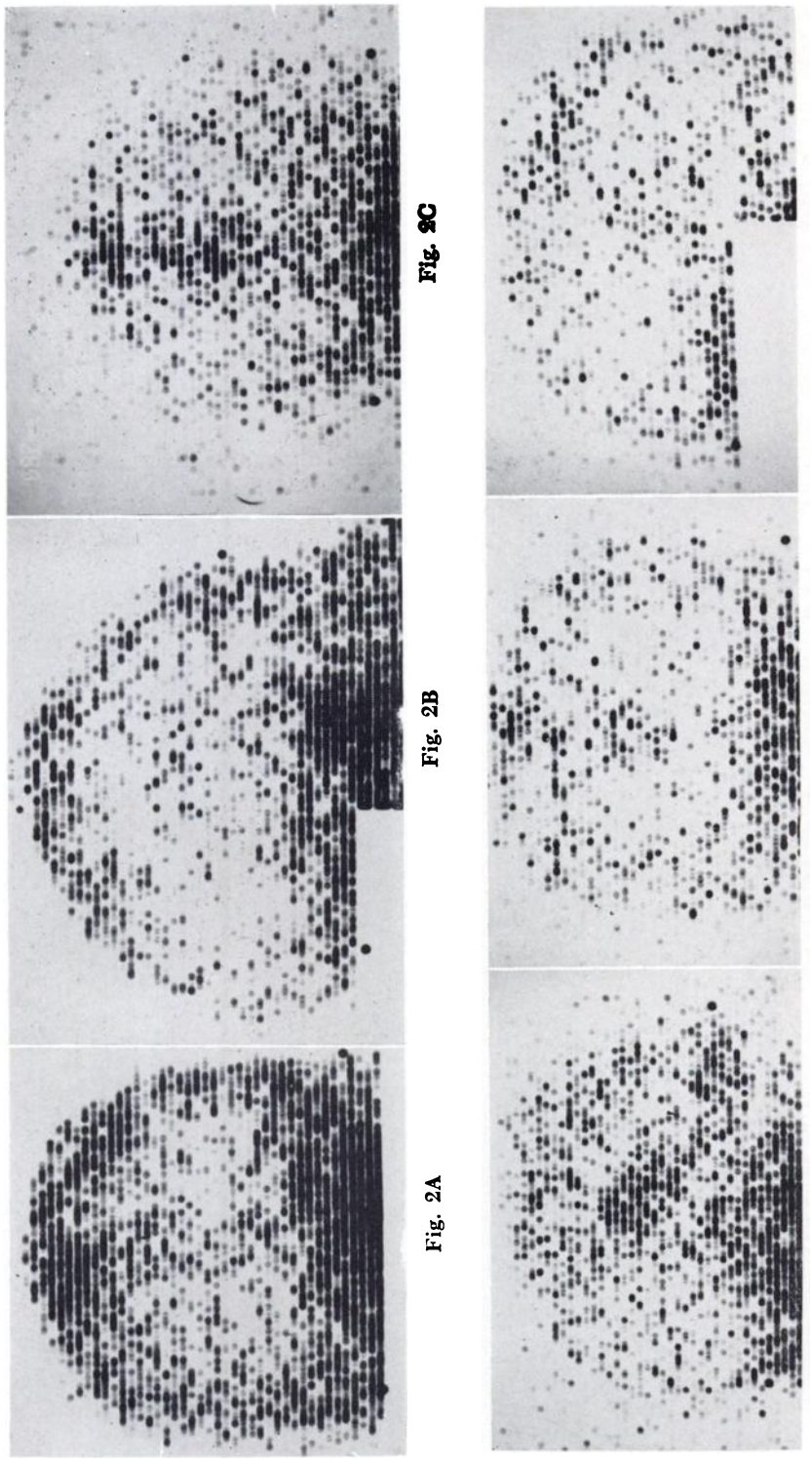

Fig. 2A Fig. 2B Fig. 2C

Fig. 2D Fig. 2E Fig. 2F

Fig. 2. (A) Anterior and (B) right lateral Chlormerodrin ^{197}Hg scans performed one hour after administration in a patient with a large midline arteriovenous malformation. (C) and (D) Immediate and (E) and (F) delayed (48 hour) RIHSA studies in the same case. Corresponding angiographic views (G) and (H). (See Fig. 2 on page 886.)

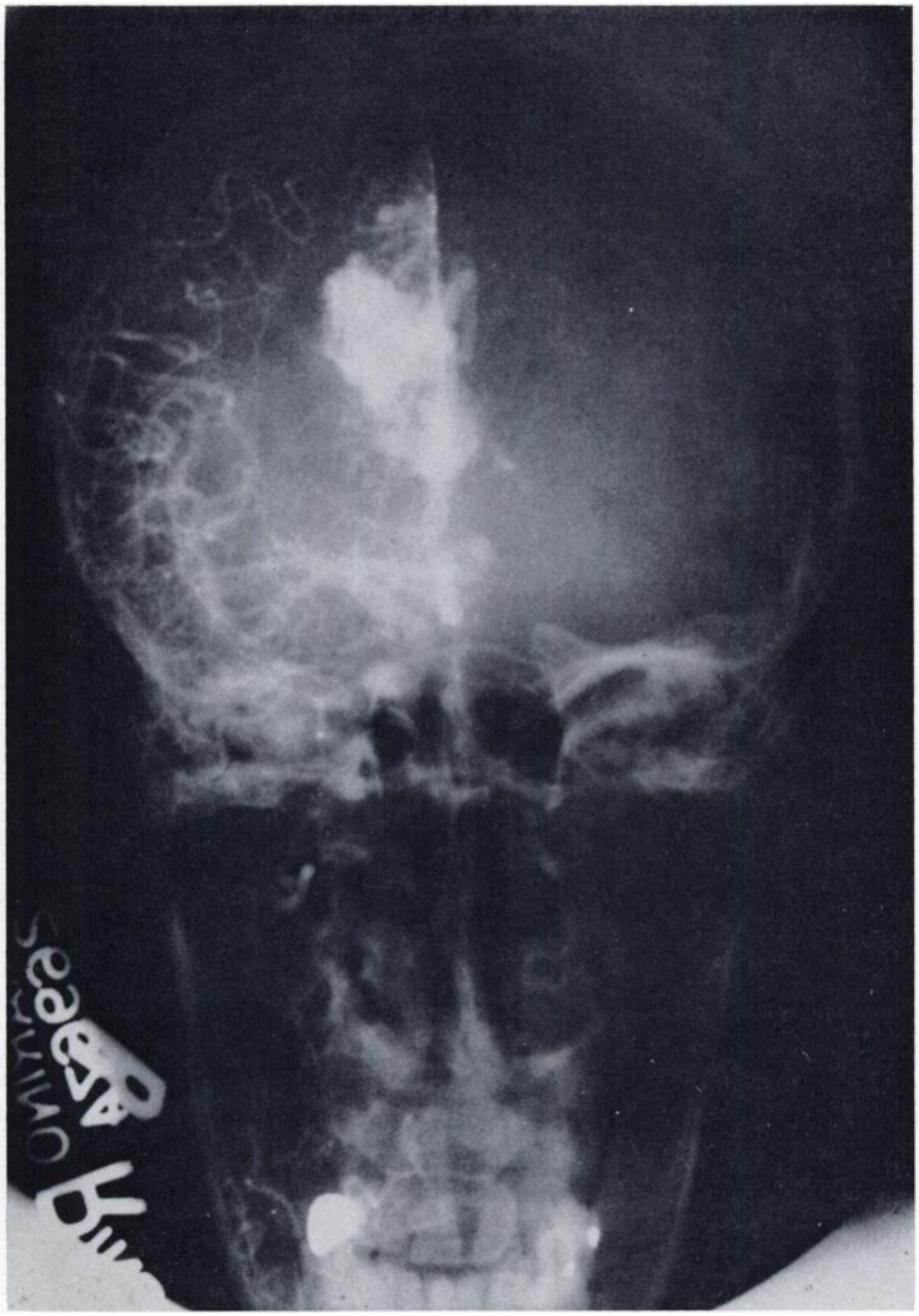

Fig. 2G

Although classified as neoplasms, intracranial arteriovenous malformations are essentially abnormally developed arteries and veins of increased calibre and length which result in a tortuous vascular mass (9). The results of the study here presented indicate that optimum visualization of these lesions with either RIHSA or Chlormerodrin ^{197}Hg is dependent on early scanning. The finding that delayed RIHSA scans are diagnostically superior to delayed Chlormerodrin scans is no doubt a function of the respective clearance rates of these substances from the blood.

It has been shown that Chlormerodrin is cleared from the blood in very rapid fashion. More than 90 per cent of this substance is eliminated from the blood stream within five hours. Within this time, because of different dynamics, approximately 10 per cent of the administered dose of RIHSA has been lost from the intravascular compartment. Clearance of RIHSA, as opposed to Chlormerodrin, is so gradual that even 48 hours after administration 40 to 50 per cent is still present in the bloodstream (10) (Figure 5).

Vascularized lesions such as meningiomas and gliomas may also be visualized by early scanning; however, neoplastic lesions tend to become progressively more distinct as time elapses contrary to the case with intracranial arteriovenous malformations (7). This finding may be of aid in differential diagnosis between neoplasms and arteriovenous malformations.

SUMMARY

Comparison of the results of immediate and delayed RIHSA and Chlormerodrin ^{197}Hg brain scans performed in 13 patients with intracranial arteriovenous

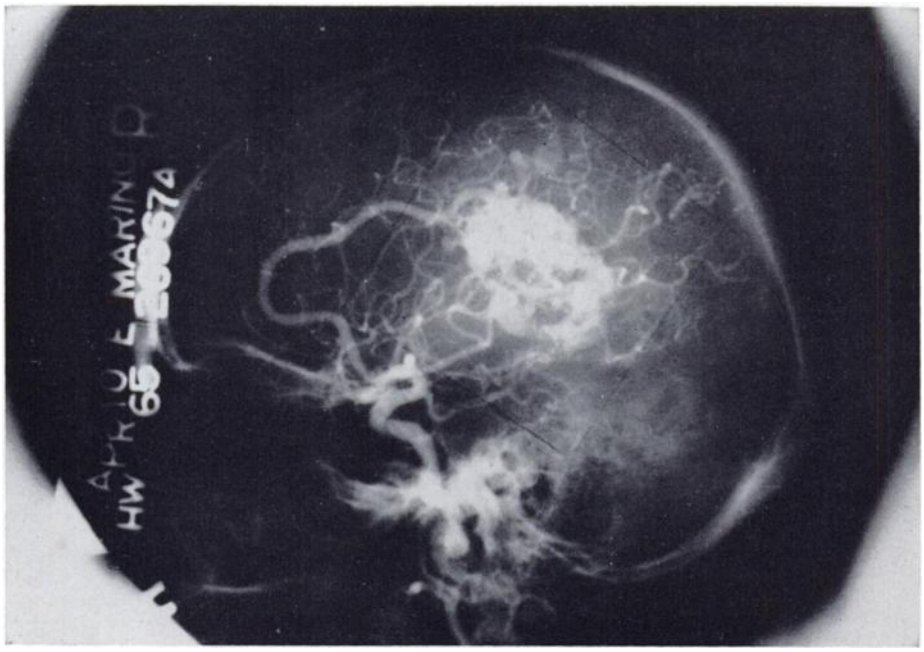

Fig. 2H

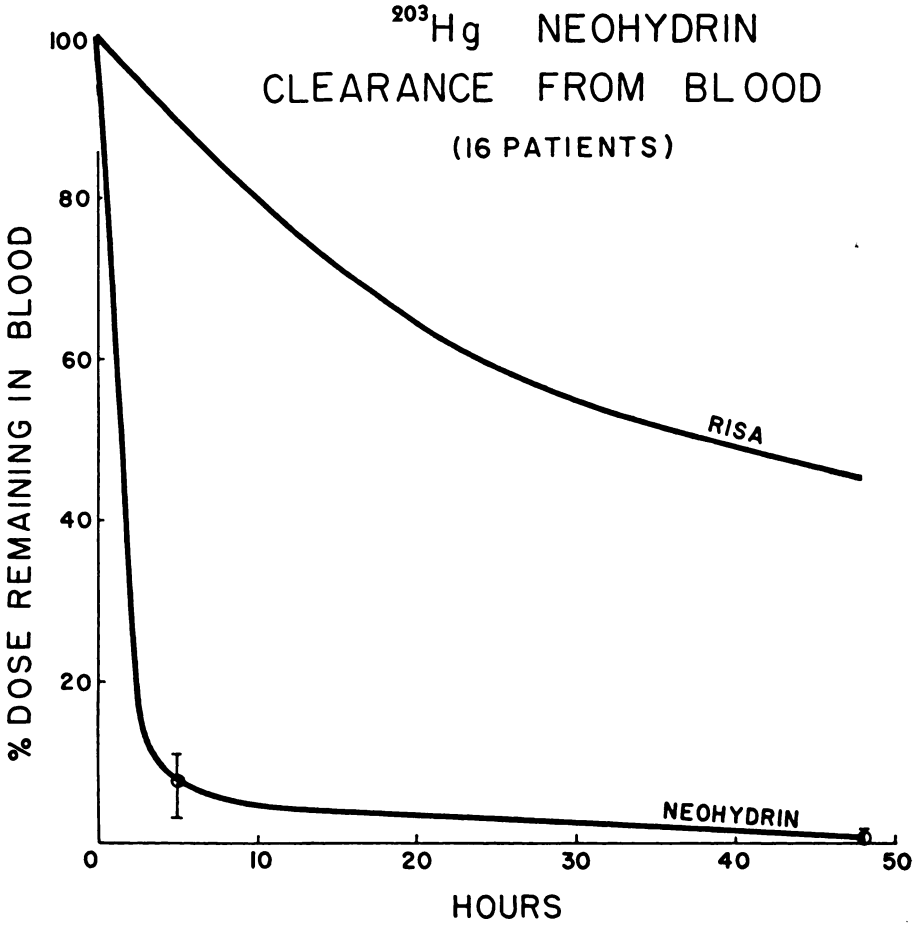

Fig. 3

Fig. 3. Blood clearance of ^{203}Hg Neohydrin and ^{131}I human serum albumin (RIHSA).

malformations indicates that these lesions are best visualized when scanning is performed immediately following administration of either substance. RIHSA was found to give scans that were technically superior to those obtained with Chlormerodrin ^{197}Hg.

Note: Fig. 3 is reproduced with permission from Blau and Bender (10).

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The following Letter to the Editor is herewith repeated from the August, 1967 issue of The Journal of Nuclear Medicine incorporating several changes requested by the author, Dr. C. M. E. Matthews:

LETTER TO THE EDITOR

I am writing to correct the impression given in an article by Mrs. M. B. Glos in Nucleonics, February, 1967, about ^{123}I labeled albumin for brain scanning. In fact, I have not actually used this radioactive substance in patients and do not claim that it is definitely "superior to almost any other isotope." What I have done, is to calculate a Figure of Merit for a number of different possible substances and also, the probable minimum size of brain tumor which could be detected with each of them (*J. Nucl. Med.* 6:155, 1965. *Acta Radiologica,* In press).

Using this criterion, ^{99m}Tc pertechnetate came at the top of the list of those substances which have been actually used and for low energy gamma ray emitters ^{123}I albumin was the next on the list. Highest values of Figure of Merit were obtained for short lived positron emitters, but the use of these would depend on finding a suitable labeled compound which could be made quickly enough.

Dr. D. J. Silvester has prepared ^{123}I on the Medical Research Council cyclotron, here, but it has not been used for brain scanning, because the proportion of other iodine isotopes produced at the same time is too high.

C. M. E. Matthews, Ph.D.
Medical Research Council
Cyclotron Unit
Hammersmith Hospital
Ducane Road
London, W.12, England