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Determination of Glomerular Filtration Rate by Use of Single Injection of Iodine-131 Labelled Sodium Diatrizoate[1]

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During the last few years, the use of radioactive materials for measurement of renal function has become more frequent. Techniques were devised for measurement of renal plasma flow using ^{131}I labelled Hippuran (Smith *et al*) (1). Recently, Morris *et al* (2) using ^{131}I labelled meglumine diatrizoate (Renografin) and Sigman *et al* (3) using ^{131}I labelled sodium iothalamate (Conray) have measured glomerular filtration rate in a manner comparable to inulin. However, their techniques require the use of constant infusions. Meschan *et al* (4) found that a single intravenous dose of ^{131}I Renografin gave clearance levels comparable to inulin.

In our studies with ^{131}I Hippuran using a single intradermal injection with epinephrine (1), it was observed that a constant plasma level could be maintained because of the presence of the epinephrine. Since sodium diatrizoate (Hypaque) is handled by filtration in the same fashion as inulin, ^{131}I Hypaque[4] was used as a vehicle to see if this technique of single injection with epinephrine could be utilized in the measurement of glomerular filtration rate.

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[4]Courtesy of Abbott Laboratories.

MATERIALS AND METHODS

A series of 34 simultaneous inulin and ^{131}I Hypaque clearances were performed on ten mongrel dogs. The animals were given an infusion of four per cent urea in saline to produce an adequate urine output. They were then given 30 μC of ^{131}I labelled Hypaque intradermally with a drop of epinephrine. The specific activity of the isotope was approximately 200 μC/mg. The inulin determinations were performed as described by Smith (5) using a 50 mg/kg primer and 32.5 mg/min sustaining infusion throughout the study. After allowing one hour for equilibration, clearance studies were performed in a series of 15 minute periods. Preliminary studies had shown that the dosage of 30 μC gave an adequate plasma level of counts per minute per cc above background. The count rate stabilized in one hour utilizing the ^{131}I Hypaque. Also in a series of dogs studied for a period of four hours, the plasma level remained adequate to measure clearances throughout this period. The samples of urine and plasma were collected in the usual manner and were counted in a Nuclear Chicago well counter. The chemical analysis of inulin was performed as described by Smith (5).

RESULTS

The results are presented in graphic form in Figure 1. The results of the inulin determination are plotted against those with Hypaque. The straight line represents the line of absolute correlation. The individual points are given for each of 34 determinations.

Table I gives the average of the clearances obtained on the dog in one set of observations. The percentage difference between the two clearances is given and the average percentage difference is found to be 5.44 per cent. The standard deviation is $\pm$ 2.8. A t test for statistical significance for the variation between the means indicates that the difference between the two observations is not significant.

DISCUSSION

Results seem to indicate that at least in dogs, ^{131}I Hypaque can be used as the substitute for inulin in the determination of glomerular filtration rate. The use of the single injection with epinephrine enables one to maintain relatively constant plasma levels for a period of at least four hours utilizing only 30 μC of ^{131}I Hypaque. Caution must be used in the volume of epinephrine utilized to prevent reabsorption from being too slow. The volume of ^{131}I Hypaque must be controlled and kept small, preferably below 0.2 cc. If the volume is large, the amount to be reabsorbed becomes prohibitive.

The advantage of this method aside from reducing the difficulty of analysis after the material is obtained is the fact that only one single injection of the required substance is needed. The necessity for using the constant infusion technique is eliminated. This factor becomes particularly important in studies where constant infusions are difficult to maintain, as in the unanesthetized animal. It might be noted here also that in three of the dogs, probenecid sodium (Benemid,

100 mg/kg)[1] was given during the clearance studies and both the clearance of inulin and ^{131}I Hypaque were undisturbed. This evidence lends further support to the fact that the ^{131}I Hypaque is only handled by filtration and is not involved in an active reabsorption or secretion system at least one that is inhibited by probenecid. The technique has not been attempted in patients.

SUMMARY

Thirty-four individual clearance determinations on a series of ten dogs showed that ^{131}I Hypaque with a single injection technique gave the same values for clearance as inulin. The clearance values were over a wide range and showed no increasing discrepancy at the lower or higher clearance values. The technique may be useful also in a clinical situation in which one wishes to determine glomerular filtration rate without the use of constant infusion and give a more accurate determination than is available with the 24 hour creatinine clearance.

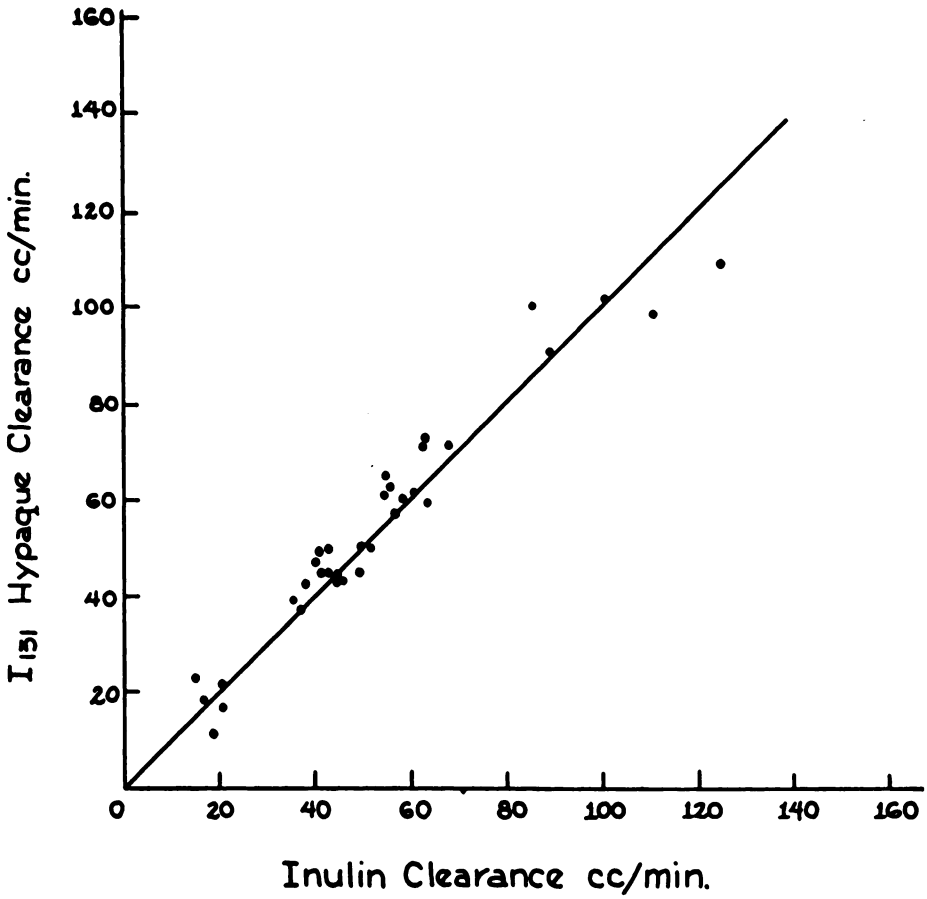

Fig. 1. The graph represents a plot of the 34 simultaneous inulin and ^{131}I Hypaque clearances. The solid line represents the line of perfect correlation.

[1]Courtesy of Merck, Sharp & Dohme Laboratories.

TABLE I

COMPARISON OF SIMULTANEOUS INULIN AND ^{131}I HYPAQUE CLEARANCES

^{131}I Hypaque cc/min	*Inulin cc/min*	*Per Cent Difference*
15.0	18.6	4.2
17.6	18.6	5.7
46.3	42.7	8.4
47.2	48.5	2.7
48.7	49.1	0.08
49.8	47.2	5.5
50.1	49.4	1.4
55.6	60.6	9.0
59.0	54.2	9.0
66.3	62.1	6.7
113.2	105.6	7.2
	Average	5.44
	Standard Deviation ±	2.8

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