The Influence of Age and Plasma Glucagon on Renal Clearance of $^{99m}$Tc-DTPA (Sn)

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Abstract. Using an external arm counting technique and $^{99m}$Tc-DTPA(Sn), as previously described (Macleod, Sampson & Houston, 1977), the glomerular filtration rate (GFR) of 120 subjects with normal renal function was measured and found to correlate significantly with age ($r = 0.91$). Using the same technique in the investigation of 260 patients with a variety of diagnoses but who had normal renal function (GFR greater than 86 mls/min), 42 (16%) were found to clear the $^{99m}$Tc-DTPA significantly faster. Twelve of these were subsequently found to be diabetic and to have significantly raised plasma glucagon levels. The remaining 30 also had significantly high plasma glucagon levels.

Key words: Glomerular filtration rate, Age, Hyperclearance, Glucagon.

INTRODUCTION

Age related changes have been described in the glomerular structure of the kidney and its vasculature (10) and in the renal glomerular basement membrane in rats (4). These findings suggest that there is a relationship between renal function and age but, to date, there has been no attempt to demonstrate this. Using an arm counting technique already described (6) this paper describes the relationship found between the glomerular filtration rate (GFR) and the age of the individual.

Observations by Levy and Starr (5), Miyazaki et al. (7) and Parving et al. (8) showed that an increase in GFR could be induced by raised plasma pancreatic glucagon levels and in a preliminary study we were able to confirm this (9). The present paper is an extension of this work and is one part of an ongoing study into several metabolic diseases which appear to have as a common factor a disorder of glucagon metabolism.

MATERIALS AND METHODS

During routine measurement of renal dynamic profiles, using a gamma camera and computer to generate activity/time curves of the clearance of $^{99m}$Tc-DTPA(Sn), 120 subjects were found to have normal renal function and no clinical evidence of renal disease or metabolic disorder. This was confirmed by conventional clinical, radiological and biochemical examinations. Following the gamma camera studies, the GFR of these 120 subjects was determined by external arm counting using the biological $t_{1/2}$ to measure the renal clearance of the chelate since this is directly related to the glomerular filtration rate and can be simply converted to mls/min if required (6) (Fig. 1).

In the course of measuring the renal dynamic profiles of a series of patients suffering from a variety of diseases including proteinuria, haematuria, urinary infection, urolithiasis and hypertension, 260 were found to have normal dynamic renal function (3). The GFR of these patients was additionally measured using the technique already described.

Free Tc$^{99m}$ and protein bound Tc$^{99m}$DTPA were estimated by using a Sephadex G-25 medium gel chromatograph with Blue Dextran used as a marker and the column longitudinally scanned with a 2" sodium iodide (T1) crystal and 1 cm slit collimator. Protein binding was found to be between 3% and 4%. Free Tc$^{99m}$ was less than 4%.
Fig. 1. Relationship of biological $t_{1/2}$ to glomerular filtration rate (6)

Fig. 2. Regression of $t_{1/2}$ biol. on age with control limits placed at 2 standard errors of estimate on either side of regression line