# Effect of Envirnmental ultraviolet Exposure on Kidney function

Requirments of

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By

Mona Mohamed Ahmed Aly

Department of

Medical Envirnomental Sciences

~~Faculty of~~

institute of envirnomental studies & researches

Ain Sham Uni.

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# Introduction

In our life, we get exposure to several types of radiation including ultraviolet irradiation (UV) whether from natural or artificial sources.

Exposure to UV waves occurs normally to human and non human. The main natural source of this exposure is the sun rays that penetrate the earth atmosphere .

In the last decade this exposure seems to be increased as a consequence of the depletion of the ozone layer , a protective layer surrounding the earth, due to increase of the chlorofluorocarbons [CFCs] polluting our environment .

UV rays emitted by the sun is formed of 3 types according to their wave length UV-A , UVB and UV-C .

UV-C is virtually absorbed by the ozone layer so depletion of this layer might causes escape of this type of irradiation to the earth with subsequent harmful effects on the living organisms . Some chemicals were tried for protection of the animal from the harmful effect of UV irradiation exposure , para - aminobenzoic acid (PABA) was one of these chemicals (**Hansen and Ebbesen, 1991**).

# Aim of The Work

This work has been conducted in an attempt to study the effects of ultraviolet irradiation-C (UV-C) on the kidney, both biochemically and histopathologically on albino rats.

As the kidney might be the target of UV damage to living organism, this study was aimed to study the effect of UV exposure on kidney function and structure and find the efficiency of preventing this effect , if any , by protection with PABA .

# REVIEW OF LITERATURE

## *Structural and Functional Study of The Kidney*

The kidneys are located retroperitoneally, ventrolateral to the vertebral column. The kidney is covered by the renal capsule, composed of dense connective tissue with an outer cortex and an inner medulla Fig. (1) (**Junqueira *et al.*, 1977**). The renal cortex consists mainly of nephrons, the medulla consists of collecting tubules. Each kidney is composed of 1-4 million nephrons, each nephron consists of :

1. The renal corpuscle.
2. The proximal convoluted tubule.
3. The thin and thick portion of the loop of Henle.
4. The distal convoluted tubule

   **(Anderson and Edward 1976; Junqueira *et al.*, 1977 and Haschek & Rousseaux , 1991).**

### *1. The renal corpuscle*

It consists of the tuft of capillaries (the glomerulus) surrounded by double-walled epithelial capsule called Bowman's capsule. The internal of the Bowman's capsule adheres to the capillaries of the glomerulus which is called visceral layer, the visceral layer hugs the capillaries to form covering sheath. The glomerulus represents the filtering unit for blood through which the plasma filtrate is derived in the first part of uriniferous space (**Hyde & Draisey 1974; Junqueira *et al.*, 1977 and Haschek & Rousseaux , 1991**).

### *2. Proximal convoluted tubule*

It is found in the cortex, is lined by simple cuboid epithelium, it is longer and larger than the distal convoluted tubule. It have the

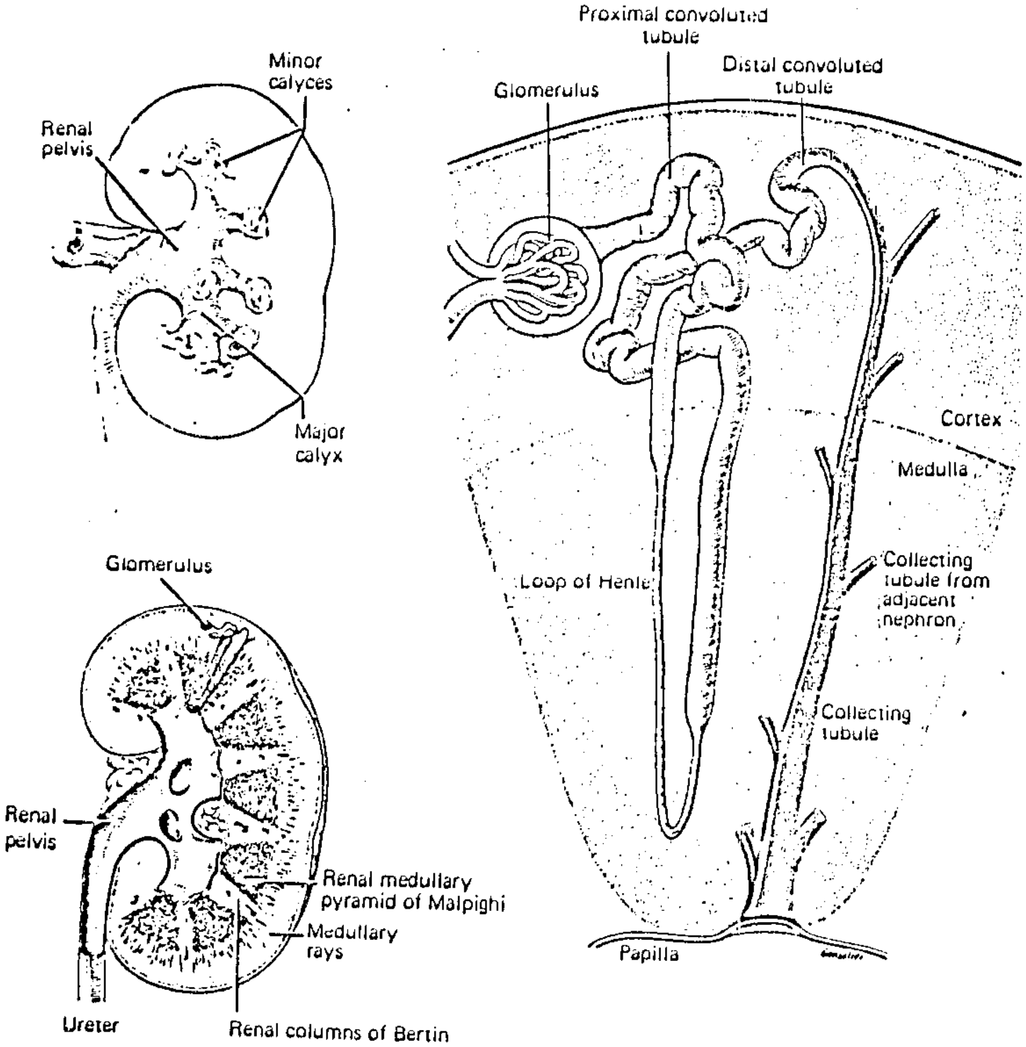


Figure 1a–1. *Left:* The general organization of the kidney. *Right:* The cortical or medullary localization of nephron segments and collecting tubules (the latter shown in black).

appearance of being highly metabolic cells. The glomerular filtrate formed in the renal corpuscle passes into the proximal convoluted tubule and the process of resorption and excretion then begins, it absorbs all of the glucose and about 85% of the sodium chloride and water contained in the filtrate (**Hyde and Draisey 1974; Junqueira *et al.*, 1977 and Guyton, 1981**).

### *3. Loop of Henle*

Each loop of Henle is U-shaped and presents thin segment (descending) followed by thick one (ascending). The cells have a minimal level of metabolic activity. The thin part (descending) which is continuation of proximal convoluted tubule has highly permeable to water and moderately permeable to urea, sodium and water. The thick ascending tubule is found in the outer zone of the medulla and in the cortex, ending near its own glomerulus. Thick ascending tubular cells are smaller than proximal convoluted tubule. Protein covers the luminal membrane surface of the cells lining the thick ascending tubule. The thick part is impermeable to urea, water and is highly active in transporting sodium to the interstitial fluid (**Junqueira *et al.*, 1977; Guyton, 1981 and Haschek & Rousseaux, 1991**).

### *4. Distal convoluted tubule*

It is the thick part of the loop of Henle penetrating the cortex but becomes tortuous. The lumina of the distal tubules are larger because the distal tubule cell is smaller than that of the proximal tubule. Protein is not found covering luminal cell membrane. In the distal tubule, sodium is reabsorbed and potassium ions are excreted, the distal tubule also secretes hydrogen ions and ammonium ion into tubular urine. The late distal tubule is almost antirely impermeable to urea, so that the urea passes on into the collecting duct to be excreted in the urine (**Junqueira** *et al.*, **1977; Guyton, 1981 and Haschek & Rousseaux, 1991**).

### *5. Collecting Tubules*

The collecting tubules are located in the medulla and follow straight path. Cells lining the collecting duct are low cuboidal in the cortex, increasing in height to a low columnar in papilla. Final dilution or concentration of urine occurs in collecting tubules. The walls of the distal tubules and the collecting tubules are permeable to water. The permeability of the tubules to water and to some extent to urea permitting the substances to be resorbed from the tubular lumen (**Hyde and Draisey 1974, Junqueira** *et al.*, **1977 and Haschek & Rousseaux, 1991**).

The kidney regulates the body's concentration of water and salt. Normally, 180 liters of fluid are filtered through the glomeruli each day, while the average daily urine volume is about one liter. Two important facts: first, that at least 88% of the filtered water is reabsorbed, even when the urine volume is 23 liters; second, that the reabsorption of the remaining of the filtered water can be varied without affecting total solute excretion (**Ganony, 1977 and Robbins, 1984**).

## Handling of some substances by the kidney

### *Absorption of Protein*

Normal kidneys excrete between 40 and 150 mg of protein per day. Approximately 10 mg/day of albumin are excreted which accounts for about 10% of the proteins.

As much as 30 g of protein filter into the glomerular filtrate each day. This would be a great metabolic drain on the body fluids. Because the protein molecule is much too large to be transported by the usual transport processes, protein is absorbed through the brush border of the proximal tubular epithelium.

Once inside the cell, the protein is digested into its constituent amino acids which are then absorbed through the base and sides of the cell into the peritubular fluids **(Brobeck, 1980 and Guyton, 1981).**

### *Creatinine*

Creatinine is the anhydride of creatine, it is found particularly in skeletal muscle. Creatine synthesis occurs in the liver and in the pancreas, then is transported in the blood stream to various tissues. In striated muscle, much is phosphorylated. The daily excretion of creatinine is, therefore, independent of diet. Creatinine is an end point of metabolism and then appears in the urine. Women usually excrete around 0.8-1.5 g/day of creatinine . In males, urine contains 20-28 mg of creatinine/kg/24 hr. Thus, a 70 kg man excretes 1.5-2.0 g/day of creatinine. Normally, creatinine concentration is less than 0.9 mg/100 ml in serum. With damage to the kidney, creatinine levels rise to as high as 10-20 mg/100 ml. Creatinine is not reabsorbed in the tubules at all indeed, small quantities of creatinine are actually secreted into the tubules by the proximal tubules so that the total quantity of creatinine increases about 20% **(Hyde and Draisey 1974; Ganony, 1977 and Guyton, 1981).**

***Urea***

Urea is the main end-product of nitrogen metabolism and constitutes about 80% of the nitrogen found in urine. It originates in the liver, being derived from amino acids and the amount produced varies with protein catabolism. The body forms an average of 25 to 30 g of urea each day, more than this in persons who eat a very high protein diet and less in persons who are on a low protein diet.

All this urea must be excreted in the urine, other wise, it will accumulate in the body fluids. Its normal concentration in plasma is approximately 26 mg/100 ml, but it has been recorded in rare abnormal states to be as high as 800 mg/100 ml, patients with renal insufficiency frequently have levels as high as 200 mg/100 ml. In general, the quantity of urea that passes on through the tubules into the urine averages about 50 to 60% of the urea load that enters the proximal tubules. When the glomerular filtration rate is very low, the filtrate remains in the tubules for a prolonged period of time before it finally becomes urine. Because all the tubules are at least slightly permeable to urea, the longer the tubular fluid remains in the tubules, the greater is the percentage of reabsorption for the urea into the blood, the proportion of the filtered urea that reaches the urine decreases considerably when the glomerular filtration rate falls too low, the blood urea concentration rises to a proportionately higher