Toxicological Effects Of Camphor Administration On The Histology Of The Kidney Of The Rabbit (Oryctolagus cuniculus)

B Enaibe, A Eweka, J Adjene

Citation

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Abstract

This study involved the oral administration of varying concentrations of camphor solution to the domestic rabbits (Oryctolagus cuniculus) daily for ten days. The rabbits of both sexes (n=12), average weight of 300g were randomly assigned into four groups (A, B, C, D), with the D as control group. The rabbits in group A received 0.001g of camphor in 1ml of solution daily, those in group B received 0.004g/ml of camphor solution daily, while those in group C obtained 0.007g/ml of camphor solution daily. The control animals received equal volume of the solvent without camphor added daily for the same ten days. The rabbits were fed with growers mash obtained from the Bendel Feeds and Flour Mill, Ewu, Edo State, Nigeria and given water liberally. The animals were sacrificed on day eleventh of the experiment, the kidney was carefully dissected out and quickly fixed in 10% formal saline for histological study.
Histological findings observed in the kidney of the treated groups revealed mild edema with glomerulonephritis, glomerular lobulations, tubular necrosis, and congestion of the blood cells. These results suggest that oral administration of varying concentration of camphor solution to the domestic rabbit has a cytotoxic effect on the kidney. This may have an adverse effect on the functions of the kidney. It is recommended that further studies aimed at corroborating these observations be carried out.

INTRODUCTION

Camphor, which is a bicyclic terpene, is a common organic substance with an aromatic odour and a molecular formula of $C_{10}H_{16}O$ [1] (Camphor was probably introduced into Europe by the Arabs, who called it “kafer”). Although Camphor is now known to have little therapeutic value it had been used medicinally in some rural areas in the United States and is still being used in Nigeria [2].

Camphor exists in the optically active dextro- and levo-forms and as the racemic mixture with a melting point of 178?c. The principal form of camphor is the dextro form, which occurs in the wood and leaves of the Cinnamomum camphora [3]. Most camphor used commercially is made synthetically. It is used in the manufacture of celluloid and explosives as well as in liniments and other preparations including antiseptic and anesthetic agents [2]. Camphor can also be used as plasticizer, repellant carminative, air freshener and preparation of a concoction called “Agbo” used in the management of a number of morbidities including malaria and hemorrhoids in certain parts of Nigeria. Camphor produces harmful effects in all age groups including infants if ingested [1].

Administration of as little as 3.5g of camphor could be lethal, while as much as 2.0g produce toxic effects in an adults and causes congestion of the gastrointestinal tract, kidney and brain. A small amount of camphor applied to the nostril of an infant, has been reported to have caused immediate collapse [4]. It has also been reported that the symptoms of poisoning effects of camphor include nausea, vomiting, headache, dizziness, delirium, muscle twitching and depression of the central nervous system [4]. In oxygenated mouse bone marrow cells, administration of camphor reduces radiation induced DNA damage. As in humans, the majority of drugs administered to animals are eliminated by a combination of hepatic metabolism and renal excretion [5].

Kidney is a paired organ located in the posterior abdominal wall whose functions includes the removal of waste metabolic products from the blood and regulation of water and electrolytes balance in the body. As in humans, the majority of drugs administered to animals are eliminated by a combination of hepatic metabolism and renal excretion [5].

Though that the kidney plays a major role in drug metabolism, its major importance to drugs is still its excretory function. In humans camphor is hydroxylated in the liver to yield hydroxyl camphor metabolites which are then conjugated with glucoronic acid and excreted in the urine [6].

MATERIALS AND METHODS

Animals: Twelve domestic rabbits (Oryctolagus cuniculus) of both sexes with an average weight of 300g were used. The rabbits were obtained from the Department of Biochemistry, Faculty of Sciences, University of Benin, Benin City, Edo State, Nigeria and maintained in the animal holdings of the Department of Anatomy, College of Basic Medical Sciences, University of Benin, Benin City, Edo State, Nigeria. The animals were fed with growers' mash obtained from the Bendel Feeds and Flour Mill, Ewu, Edo State, Nigeria and given water liberally. The animals were randomly divided into four groups (A, B, C, and D) of three rabbits each and gained maximum acclimatization.

Camphor Administration: Industrial camphor was obtained, weighed and kept in an airtight container. Camphor solution was prepared by dissolving three different quantities of it into 50% ethanol for animals in groups A, B, and C respectively; while animals in group D (control) received equal volume of 50% ethanol through oral administration. The concentration was calculated from comparison with the average weight of the rabbits to a physiological man [7]. In adult humans, 2g of camphor causes toxic symptoms, while more than 3.5g produces lethal effects [8]. The animals were fed daily with the camphor solution as follows.

Group A: Animals in this group received 0.001g of camphor dissolved in 1ml of 50% ethanol daily for ten days.

Group B: Animals in this group received 0.004g of camphor dissolved in 1ml of 50% ethanol daily for ten days.

Group C: Animals in this group received 0.007g of camphor dissolved in 1ml of 50% ethanol daily for ten days.

Group D: Animals in this group received 1ml of 50% ethanol daily for ten days.

All the animals in the various groups were sacrificed on day eleventh of the experiment. The kidney was quickly dissected out and fixed in 10% formal saline for routine histological techniques.

HISTOLOGICAL STUDY

The fixed kidney tissues were dehydrated in ascending grades of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 5 microns (thickness) were obtained using a rotatory microtome and the paraffin sections were stained routinely with haematoxylin and eosin staining method. Photomicrographs of the desired sections were made for further observation.

RESULTS

The kidney sections of the animals in group D (control) showed normal histological features indicating a well detailed cortical parenchyma. The renal corpuscles appeared as dense rounded structures with the glomerulus surrounded by a narrow Bowman's space. (fig.1)

The kidney sections of animals in group A treated with 0.001g of camphor solution showed a renal corpuscle (RC) with obvious signs of diffuse endocapillary proliferative glomerulonephritis. The enlargement of the glomerulus is due to edema and increase in the cellularity of the glomerulus. The Bowman's space is inconstant in the sections.

The micrograph of the animals in group B that received 0.004g of camphor solution revealed signs of tubular necrosis which is characterized by scattered tubules (T) and an increase in the interstitial tissue in the renal parenchyma. There is also the presence of glomerular edema and glomerular lobulations.

The kidney sections of animals in group C treated with 0.007g of camphor solution revealed signs of tubular necrosis, swelling of the glomerulus (G), lobulations of the glomerulus (L), congestion of blood cells (B), and increased number of nuclei (N).

Figure 1

Figure 1: Photomicrograph of the kidney of the control animals (group D) (H & E method x 400)

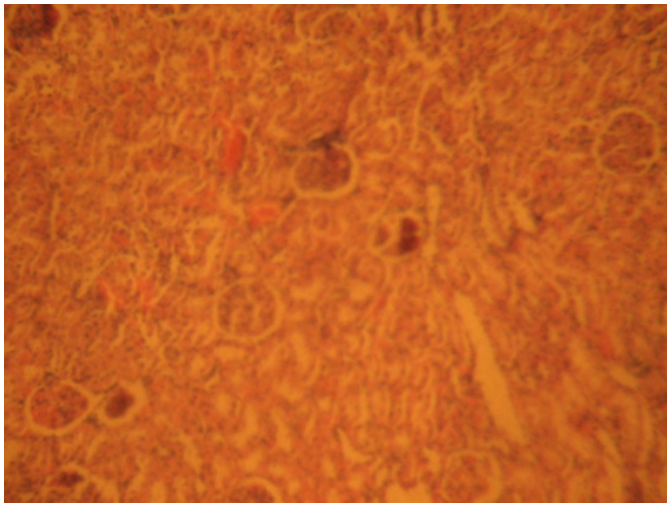


Figure 2

Figure 2: Photomicrograph of the kidney from the animals treated with 0.001g of camphor (H & E method x 400). RC= Renal Corpuscle, BS= Bowman's Space. G= Glomerulus.

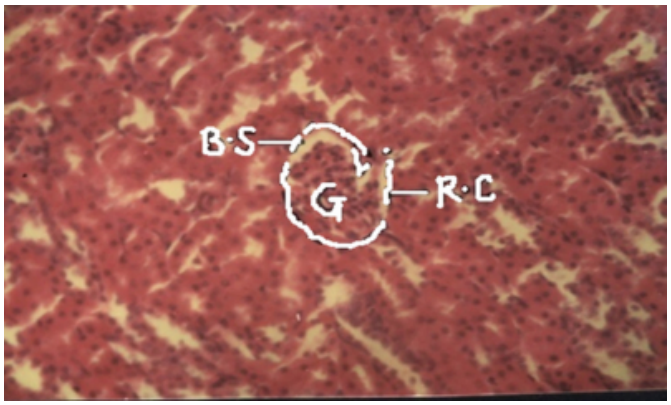


Figure 3

Figure 3: Photomicrograph of the kidney from the animals in group B treated with 0.004g of camphor. (H & E method x 400) (EG=edematous glomerulus, LG=glomerular lobulation)

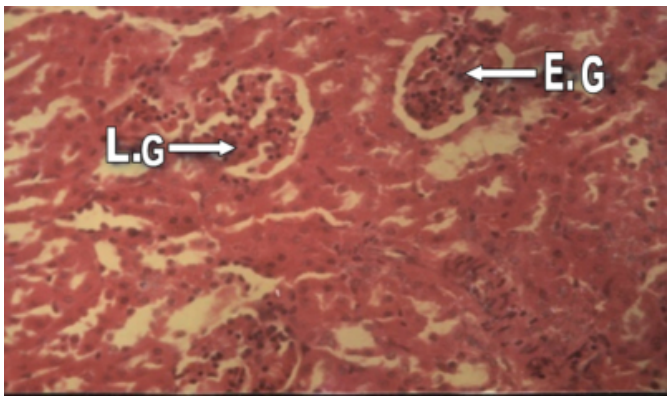
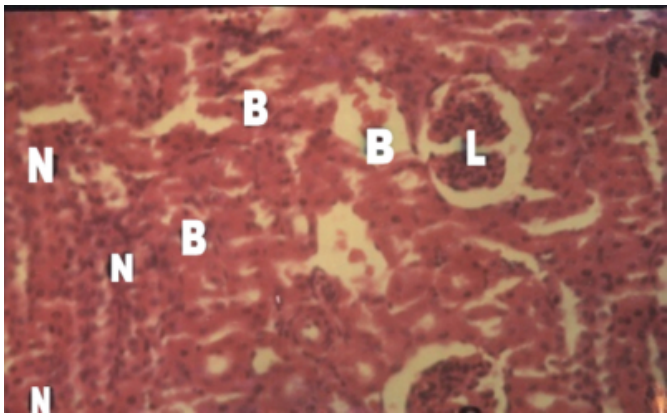


Figure 4

Figure 4: Photomicrograph of the kidney from the animals in group C treated with 0.007g of camphor) (H & E method x 400) (G= Swollen Glomerulus, L= Lobulated Glomerulus, N= Increased Numbers of Nuclei, B= Congestion of Blood Cells)



DISCUSSION

The study revealed that administration of camphor solution caused varying degree of congestion of blood cells in the renal parenchyma and tubular necrosis. The necrosis observed is probably due to the high concentration of camphor solution in the blood of the rabbit. High concentration of camphor in fetal blood, brain, liver, kidney and amniotic fluid has been previously reported, following oral administration of camphor [9] . Camphor has been reported to be poisonous and can readily be absorbed by all routes of administration [1,6] .

The experiment also revealed some histological abnormalities and cytoarchitectural distortion on the renal

cells, which may be ascribed to the camphor administration on the kidney. The obvious signs of diffuse endocapillary proliferative glomerulonephritis and enlargement of the glomerulus due to edema and increase in cellularity may have been due to the camphor concentration in the kidney. These findings implicate camphor as a precipitant of kidney disease by causing congestion and edema of the kidney. This observation is in consonance with the findings recorded in previous work, where it was noted that camphor administration has a cytoarchitectural distortion on the hepatocytes of a developing liver of the Wistar rats [10].

The kidney sections of the animals in group B and C showed severe edema with marked glomerular lobulation. There is also a densely stained cell of the Bowman's capsule and a reduced Bowman's space which is a pointer to diffuse endocapillary glomerulonephritis as reported by Giarelli [11]. It was also reported that cell death in response to neurotoxins may trigger an apoptotic death pathway within the brain cells [12]. The process of cellular necrosis involves disruption of membrane's structural and functional integrity. In cellular necrosis the rate of progression depends on the severity of the environmental insult and it holds true for logical insults to the brain and other organs [13]. In this experiment, camphor may have acted as a toxin to the cells of the kidney resulting to the tubular necrosis and glomerulonephritis observed.

CONCLUSION AND RECOMMENDATION

In conclusion, our study revealed that camphor administration distorts and disrupts the cytoarchitecture of the kidney. This resulted in tubular necrosis, glomerulonephritis, glomerular lobulations, and congestion of blood cells in the kidney. With these results, it is probable that the functions of the kidney may be adversely affected. It is recommended that further studies be carried out to examine these findings.

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Author Information

B.U. Enaibe
Department Of Anatomy, Faculty Of Health Sciences, University Of Ilorin

A.O. Eweka
Department Of Anatomy, School Of Basic Medical Sciences, University Of Benin

J.O. Adjene
Department Of Anatomy, School Of Basic Medical Sciences, University Of Benin