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Original Article

Histopathological Studies on the Effect of the Magnetized Water on the Kidney of Albino Rat

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ABSTRACT

The present study aims to know the effects of the magnetized water on experimental animals histo-pathologically. Tap water samples were collected from Faculty of Science, Zagazig University, Zagazig, Egypt. Rats were divided into 2 groups (i.e: pre-exposure (PE) and post-exposure (PO). Water was exposed to a weak static magnetic field (MF) generated from a stack of magnets (B = 18 G). After the treatment, albino rats (*Ratus Norvegicus*) were kept for a month (30 days) and then the kidney tissue samples were prepared and analyzed utilizing the light and electron microscope. In addition to that, renal functional parameters were also studied. Results showed that the magnetized water destroyed the renal functions and was not safe for drinking. Therefore, it is not recommended for daily drinking purpose.

Keywords: 18 G magnetic field, magnetized water, serum creatinine, blood urea, histopathology of rat kidney, tap water.

INTRODUCTION

The trend of water purification with the magnetic field has gained popular for many years ago and has been accounted as being effective in various cases (For example: increasing the plant growth and enzyme activity) (Balcavage *et al*., 1996). It was observed that the magnetic field has the ability to change the osmotic processes in muscle cells and, affect the permeability of the cellular membrane leading to the hydration ability malfunction in animal's tissues (Kholodov, 1974). Magnetic field can be used for improvement of blood pressure, care from diseases, tooth and hair harms, control pollution and enhance plant growth (Kotb and Abd El- Aziz, 2013).

It is known that the impact of magnetic field on water bears a complex and multifactorial character that in the final result influences the structure of water and hydrated ions as well as the physico-chemical characteristics and the behavior of dissolved inorganic salts (Mosin and Ignatov, 2014). Numerous studies claimed that magnetized water increases performance of scale reduction (Alimi *et al*., 2006), increased crop yields (Lin and Yotvat, 1990), health benefits (Yue *et al*., 1983), change in pH (Alkhazan and Sadddiq, 2010 and Shatalov, 2009), water tension reduction (Cho and Lee, 2005) and increased cement compressive and tensile strength (Nan *et al*. 2000) to name a few. Other scientific research claimed that magnetizing water has no impact and the current successes were not reproduced (Krauter *et al*., 1996). Presently, there are several peer reviewed papers and experiments done on magnetic water treatment with a substantial percentage attaining success in the water pollution treatment (McMahon, 2009).

From scientific literature, it is realized that biological systems give various bio-responses to extremely low frequency magnetic field exposure (Ibraheim and Khater, 2013). Sohaili *et al*., (2004) observed that the magnetic technology is a promising treatment process that may enhance the separation of suspended particles from the sewage. Tai *et al*. (2008) concluded that on subjecting water to magnetic field, it becomes more energetic and more able to flow which can be considered as a birth of new science called Magneto biology. Magnetic wastewater purification has been introduced to the chemical industry to remove heavy metals (Tsouris *et al*., 2001). It was found that magnetized water helps in dissolving minerals and acids by a higher rate than non-magnetized water, in addition to dissolving oxygen and increasing the speed of chemical reactions (Moon and Chung, 2000). Florenstano *et al*., (1996) observed that only total dissolved solids forms after water is subjected to magnetic fields. Magnetic methods attract a special attention due to their ecological purity, safety, simplicity and less operating costs. Alteration of physico chemical parameters of water by the magnetic field implies a specific impact on the structure of aqueous solutions and water. Previous studies made by several scientific societies has found that the magnetic field can enhance water properties of, i.e. increases solubility of salts, quickens coagulation of colloids and changes the kinetic movement of salt crystallization . Magnetic field causes the asymmetry of hydrated shells due to its impact on water molecules located around the charged particles. The magnetic field exposure causes higher electro-kinetic movement to the colloid. This will cloak the attracting particles with one another. The theory of magnetic field effect on technological processes for water purification classified into two main categories, crystallization at magnetic water preparation and impurity coagulation in water systems (Fadil *et al*., 2001).

Despite the restricted data and information concerning the magnetic preparation of wastewater, one can conclude that magnetizers may be one of the simpler and more economically justified ecological investments, having measurable impacts (Krzemieniewski *et al*., 2003).

Turker and Yel (2014) said that the ultraviolet radiation has been known to cause adverse effects on the living organisms for a long time and observed the detrimental effects of UVC radiation on kidney tissue cells in exposure periods dependent on radiation dose and exposure time.

Due to the limited information and data concerning the magnetic field effects on experimental animals, the aim of this study was to investigate the physiological and histopathological effects of the magnetized water on kidneys of rats drinking it.

MATERIALS AND METHODS

1- Sampling Site

Tap water samples were collected from the laboratory of Zoology Department, Faculty of Science, Zagazig University, Egypt.

2- Analytical Methods

Tap water samples were taken from the study site before and after subjection to the magnetic field. The magnetic apparatus (magnetic liquid modifier of professor Yuri Tkachencho, R. Sian Technology) was put in the tap of water letting the water to pass through it (Figure 1). About twenty albino rats were used, half as exposed rats and the others as a control. The kidneys (twenty samples) and the blood samples (twenty samples) were taken and prepared for physiological and histopathological studies.

Figure 1: The collected tap water after the exposure to the magnetic apparatus.

2.1- Histo-pathological Studies

2.1.1- Blood Parameters Estimation:

Blood samples (n = 20) were collected from the experimented rats after thirty days in non heparinized tubes (Weatherman tubes) for determination of serum creatinine and serum blood urea (Murry, 1984 and Tietz *et al*., 1987 and Reddy *et al*., 2012). The serum was separated from the blood cells by centrifugation for 10 minutes at 3000 rpm at room temperature. The serum was stored at -20 ℃ in stoppered metal-free polypropylene tubes (Eppendorf tubes) until used (Hegazy, 2011).

2.1.2- Electron Microscopic Studies on the Kidney of the Studied Rats

Twenty specimens of the kidneys were taken from the control and exposed rats for thirty days, undergone histological techniques then microtome slicing and prepared for electron microscopic studies (grids were examined and photographed on a Jeol- Jem 1010 transmission electron microscope belonging to Al-Azhar University, Cairo, Egypt) according to Ali (2013).

2.2- Statistical Analysis

The statistical analysis is performed with independent t-test at the significant level of 0.05 ($p < 0.05$) using SPSS program. All graphics and tables were made using Origin 8 and Microsoft word (2007).

RESULTS AND DISCUSSION

Histo-pathological Studies

1- Blood Parameters Estimation

The changes in the blood parameters such as creatinine and urea were measured for the control and exposed animals. The results indicated slight changes in all the blood parameters (Table 1). There were significantly differences ($p<0.05$) values of urea and creatinine of magnetic exposed rats compared to control.

Table 1: The serum creatinine and urea concentrations (mean ± SD) of blood samples of control and exposed rats to the magnetic field

Parameters	Magnetic field	
	Pre-exposure	post-exposure
Serum creatinine(mg/dl)	$0.515 \pm 0.01^{\#a}$	$0.775 \pm 0.01^{\#a}$
Blood urea nitrogen (mg/dl)	$17.0\ 5 \pm 0.01^{*b}$	$24.26 \pm 0.04^{*b}$

- Data are represented as mean ± SD, (n = 20).
- Means with the same letters in the same row are significant at p <0.05, using independent t-test.

2- Electron Microscopic Studies on the Kidney of Studied Rats

The electron microscopic studies indicated the dangerous effects of the magnetized water on kidneys of the studied rats drinking it (Figures 2-9). The frequency and severity of histopathological alterations in the cortical area of the kidney was increased in magnetic exposed rats compared to the control.

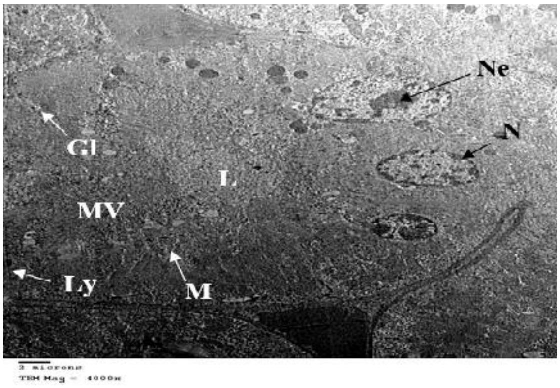

Figure 2: TEM photomicrograph of the kidney proximal convoluted tubule from a normal rat showing the central lumen (L), the microvilli (MV) and round nuclei (N) with neoclulei (Ne), peripherally placed in the cytoplasm packed with various organelles and inclusions. These organelles comprise mitochondria (M) which are numerous exhibiting round or elongated shapes and Lysosomes (Ly) which appear as rounded vesicles bounded by a single membrane. Abundant glycogen particles (Gl) are scattered in the ground cytoplasm in the form of rosette-shaped particles. (X 4000).

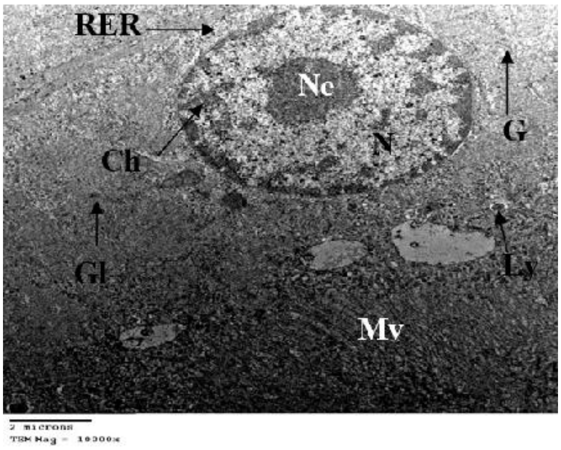

Figure 3: TEM photomicrograph of the kidney proximal convoluted tubule of a normal rat showing the general morphology of proximal convoluted tubule cells. The proximal convoluted tubule cell has long microvilli (Mv) and a round nucleus (N) with peripherally located nucleolus (Ne) and homogenous distributed chromatine (Ch), peripherally placed in a cytoplasm packed with various organelles and inclusions. These organelles comprise the rough endoplasmic reticulum (RER) and Golgi appartus (G). Mitochondria (M) are numerous exhibiting round or elongated shapes. Lysosomes (Ly) appear as small rounded vesicles bounded by a single membrane. Abundant glycogen particles (Gl) in the form of rosette-shaped particles (X 10000).

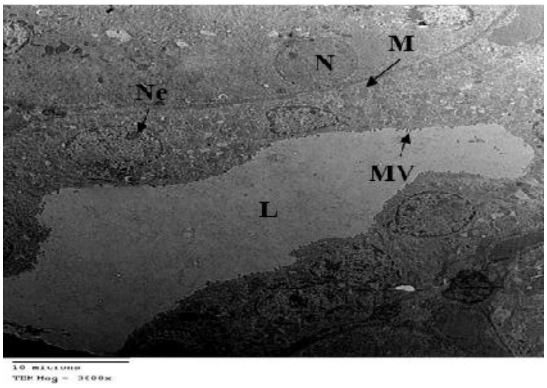

Figure 4: TEM photomicrograph of the kidney distal convoluted tubule from a normal rat showing a large central lumen (L), short microvilli (Mv) and a round nuclei (N) with nucleolei (Ne) peripherally placed in the cytoplasm packed with various organelles and inclusions as the mitochondria (M) which are numerous exhibiting round or elongated shapes (X 3000).

Figure 5: TEM photomicrograph of the kidney distal convoluted tubule of a normal rat showing the general morphology of distal convoluted tubule cells. The distal convoluted tubule cell has short microvilli (Mv), basal infoldings (IF) and a round nucleus (N) with centrally located nucleolus (Ne) and condensed chromatine (Ch), peripherally placed in a cytoplasm packed with various organelles and inclusions.These organelles comprise the rough endoplasmic reticulum (RER) and mitochondria(M) which are numerous exhibiting round or elongated shapes. Abundant glycogen (Gl) particles in the form of rosette-shaped particles (X 10000).

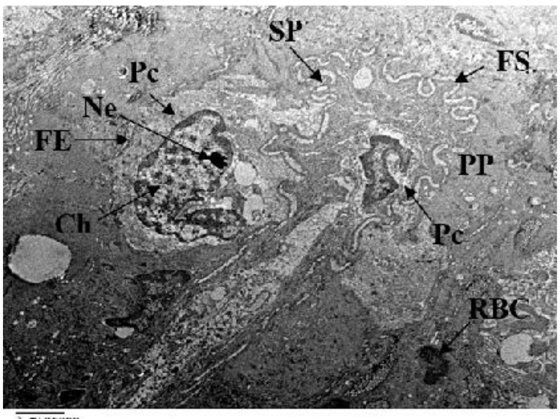

Figure 6: TEM photomicrograph of kidney Malpighian corpuscle from a normal rat showing the general morphology of podocyte and glomerular capillary. The podocyte cell body (Pc) has an irregular- shaped nucleus (N) with peripheral nucleolus (Ne) and batches of chromatine materials (Ch), centrally placed in a cytoplasm packed with various organelles and inclusions. Glomerular capillary has blood capillary, filtration slit (FS), primary process (PP) and secondary foot processes (SP) (X 6000).

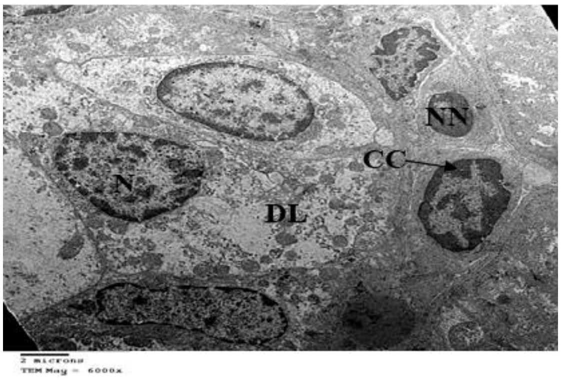

Figure 7: TEM photomicrograph of the kidney tubules of cortex from a rat treated with magnetized water for a month (30 days) showing necrosis of cytoplasmic organelles, necrotic nuclei (NN) with condensed chromatin (CC), dilation of tubule lumen (DL) and invasion of the tubule lumen with nuclei (N) (X 6000).

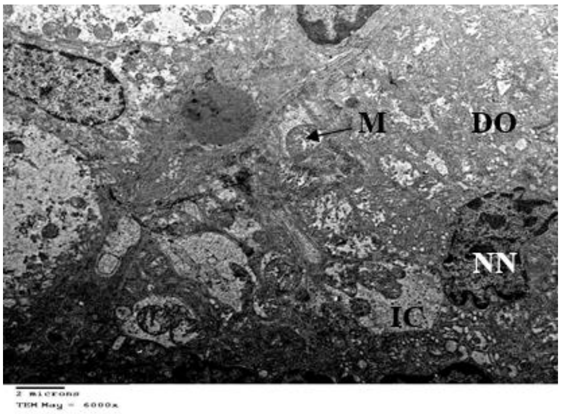

Figure 8: TEM photomicrograph of the kidney tubules from a rat treated with magnetized water for a month (30 days) showing degeneration of the cytoplasmic organelles (DO), swollen mitochondria (M), marked dilation with inflammatory cells (IC) and necrotic nuclei (NN) (X 6000).

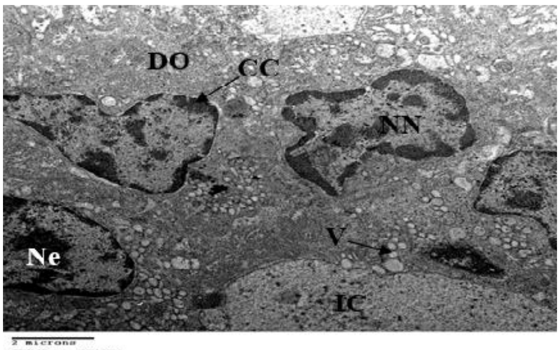

Figure 9: TEM photomicrograph of the kidney tubules of cortex of a treated rat with magnetized water for a

month (30 days) showing necrotic elongated nuclei (NN) with condensed chromatin (CC) and large nucleoli (Ne), degenaration of the cytoplasmic organelles (DO), dilated inflamatory cell (IC) and vacuolation of the cytoplasm (V) (X10000).

This data of the present study can lead to important conclusions which may be of great importance for evaluating the benefits and hazards of the exposures to low frequency or low- level magnetic field. The present data indicates the very dangerous effect of magnetized water on experimental animals as it damaged the cortical areas of kidneys of the experimental rats (Table 1 and Figures 2 -9). The present results showed that the magnetized water causes risk impacts on the examined rats kidneys as it harms the cortex tissues prompting putrefaction and kidney disappointment. This may be attributed to the role of magnetic field on hydration of ions of the exposed water which effect on molecules arrangement around charged ions in experimental animal cells causing disruption and deformation of animal tissue cells. This concurred with Mc Dwell (1974), Hummadi (2012), Reddy *et al*., (2012), Abdelhalim and Moussa (2013), Peters and Chike (2013) and Türker and Yel (2014).

CONCLUSION

The pathophysiological effect of the kidney due to magnetized water administration is rely on the magnetic field intensity and frequency. The magnetized water has harmful effects on kidney tissue cells of the exposed rats. So, using the magnetic field with an intensity of 18G for water pollution treatment is not a safe method for the living creatures. But it can be used for treating many diseases as kidney stones by subjecting it directly to the target foreign bodies. Numerous studies must be done to uncover the security of the magnetic field utilization before it was applied.

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