Original Article

Role of Sesame Oil in Ameliorating Testicular Damage in a Rat Model of Acute Kidney Injury: A Histological and Immunohistochemical Study

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ABSTRACT

Introduction: Acute kidney injury (AKI) is characterized by rapid deterioration of renal functions causing many distant organ injuries. Testicular dysfunction was reported upon chronic renal failure, yet little is known about the underlying mechanism of the damaging effect of AKI on testicular structure and function. Sesame oil was proved to have antioxidant effects.

Aim of the Work: To assess the effects of AKI on the rat testis and the possible protective role of sesame oil.

Material and Methods: Twenty-four adult male albino rats were allocated into 4 groups; control, sesame oil-treated (0.5ml/kg orally for 1week), AKI-induced (10mL/kg of 50% glycerol), and AKI-pretreated with sesame oil. Serum testosterone was assayed. Sperms were analyzed. Biochemical assay of tissue malondialdehyde (MDA), reduced glutathione (GSH), and superoxide dismutase (SOD) were performed. Testes specimens were processed for histological staining and immunohistochemical detection of Bcl2, Ki67, and Androgen receptor (AR).

Results: AKI group showed a significant decline in serum testosterone, tissue GSH, and SOD with a significant rise in tissue MDA. Sperms revealed a significant rise in abnormal sperm morphology percentage with a significant decline in sperm count. Histological examination depicted various nuclear and cytoplasmic alterations in the testicular histoarchitecture with a significant rise in the collagen fiber deposition. A significant decline in Bcl2, Ki67, and AR immunohistochemical expression were recorded. Sesame oil pretreatment significantly ameliorated all studied parameters.

Conclusions: AKI significantly impacted the testicular structure and function through different mechanisms. Sesame oil efficiently ameliorated this adverse effect through its antioxidant, antiapoptotic, antiproliferative, anti-inflammatory, and antifibrotic activities.

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Key Words: Acute kidney injury; sesame oil; testis.

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INTRODUCTION

Acute kidney injury (AKI) is a serious clinical condition of acute loss of renal function that lately replaced the expression of acute renal failure (ARF)[1]. The incidence of AKI has dramatically increased over the few past decades affecting around 13.3 million of the general population with prolonged hospital stay and increased mortality rate reaching over 50% of the patients[2,3].

The main causes of AKI include rhabdomyolysis, surgical ischemic renal injury, infections, sepsis, dehydration, and toxic drugs including nonsteroidal anti-inflammatory drugs and radiocontrast agents[2,4]. Several studies provided a great body of evidence that AKI could cause many distant organ injuries including respiratory, cardiac, and central nervous system dysfunctions[5]. Up till now, there have been no satisfactory therapies either to prevent or treat AKI[1].

Rhabdomyolysis, a common cause of AKI, is a clinical syndrome defined by the breakdown of the skeletal muscles with the release of large amounts of intercellular muscular proteins (including myoglobin) into the circulation[6]. Rhabdomyolysis is usually traumatic in nature caused by muscle crush, severe physical exercise, and prolonged muscle compression. Non-traumatic causes include extreme changes in body temperature and exposure to infections, drugs, and toxic agents[7]. It was reported that up to 50% of patients with rhabdomyolysis develop AKI[8].

Experimentally, a single intramuscular injection of glycerol is the most commonly used model to induce AKI through mimicking rhabdomyolysis.[3] Glycerol-induced AKI is conducted by renal vasoconstriction and ischemia together with acute cortical tubular necrosis, obstruction, and cast formation besides myoglobin-induced direct cytotoxicity and lipid peroxidation[6,9]. Previous studies have also implicated oxidative stress, apoptosis, and inflammation in the process of glycerol-induced renal injury[10]. Some studies reported testicular dysfunction and impairment of spermatogenesis upon chronic renal failure,[11] yet little is known about the mechanism underlying the damaging effect of AKI on testicular structure and function.

Sesame oil is extracted from seeds of the sesamum Indicum L. plant[12]. Sesame seeds are traditionally used as a health booster food in Asian countries and also in

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the treatment of dental and gum diseases, constipation, atherosclerosis, and skin allergy[13]. Sesame seeds are composed of oil, carbohydrates, proteins, water, ash, and crude fibers. They contain phenols, flavonoids, minerals (such as calcium and phosphorus) and vitamins (such as vitamin E, B1, and B2). Sesame oil is considered a rich source of lignans (phytoestrogens) and fatty acids (such as linoleic, oleic, palmitic, and stearic acids)[12,14].

Sesame lignans were documented to have many beneficial properties including antioxidant, anti-inflammatory, and anti-mutagenic effects. They also prevent DNA oxidative damage and reduce lipid peroxidation[15]. Moreover, sesame oil was also proved to enhance the antioxidant body defense system[16] and to protect against multiple organ failure, hepatic injury, renal injury and sepsis[17]. Besides, sesame was reported to ameliorate the adverse effects of streptozotocin-induced diabetes and ketoconazole on testes and sperm parameters[15,18].

Taken together, this study aimed to explore the potential adverse effects of AKI on the rat testis and sperm parameters and to assess the possible protective effect of sesame oil.

MATERIALS AND METHODS

Experimental design

Twenty-four adult male Wistar albino rats, weighing 160-180 grams each, were kept in well-ventilated cages with free access to standard diet and water. The daily animal procedures were carried out between 8:00 and 10:00 am. The experimental procedures were performed in accordance with the guidelines for the care and use of laboratory animals, declared by the National Institutes of Health Guide and Laboratory Animals Use, under the permission of the Tanta Faculty of Medicine's Research Ethics Committee. The rats were equally divided into 4 groups at random:

Group I (Control group) (n=6): Rats were orally administered 1 ml distilled water daily for 1 week before getting a single intramuscular injection of 1 ml saline in the hind limbs; half ml in each limb.

Group II (Sesame oil-treated group) (n=6): Rats were orally administered 0.5 ml/kg body weight of sesame oil for 1 week[19] before getting a single intramuscular injection of 1 ml saline in the hind limbs; half ml in each limb. Sesame oil (cat # S3547, Sigma Aldrich Chemical Co, St. Louis, MO, USA).

Group III (Acute kidney injury (AKI)-induced group) (n=6): Rats were orally administered 1 ml distilled water daily for 1 week, thereafter, they were fasted from both food and water for 24h before getting a single intramuscular injection of 10 mL/kg body weight of glycerol (50%) dissolved in saline solution 1:1 (v/v) into their both hind limbs, where each hind limb received half the dose to induce acute kidney injury[10]. Glycerol (cat # G5516, Sigma Aldrich Chemical Co, St. Louis, MO, USA).

Group IV (AKI pretreated with sesame oil group) (n=6): Rats were orally administered sesame oil for 1 week followed by glycerol injection[19] as shown in groups II and III respectively.

After 48 h of glycerol injection, blood samples were obtained for biochemical assay, where the serum was separated by centrifugation then frozen and stored at -20°C until assayed. Rats were euthanized with pentobarbital (40mg/kg)[20]. The testes were instantly dissected out to be processed for biochemical study and histological examination.

Sperm analysis

Both right and left cauda epididymides were rapidly dissected. Sperms were released through a small incision to be collected in a vial containing 5ml bovine serum albumin (BSA)-Hank's balanced salt solution (HBSS). The mixture was filtered through a nylon mesh sieve and diluted with formalinized saline. Epididymal sperm count was done using Neubauer® hemocytometer[21]. Sperm analysis was performed using the Eosin-Nigrosin staining technique to examine for abnormal forms.

Biochemical study

Serum testosterone was assayed by radioimmunoassay (Diagnostic Products Co., Los Angeles, CA, USA). The pro-oxidative marker; tissue level of malondialdehyde (MDA) was measured with spectrophotometry[22] The antioxidant markers; reduced glutathione (GSH) concentration,[23] and superoxide dismutase (SOD) activity[24] were both assayed.

Histological staining

Testicular specimens were immersed in Bouin's solution, washed, dehydrated, cleared, and paraffinized. Five µm thick sections were stained with hematoxylin and eosin (H&E),[25] Periodic Acid Schiff reagent (PAS),[26] and Masson's trichrome stain[27].

Assessment of Acute kidney injury model

Kidney specimens from AKI group III were prepared for histological examination and blood samples were examined for serum creatinine and blood urea nitrogen to ensure the induction of AKI

Immunohistochemical staining

Testicular sections of 5 µm thickness were deparaffinized, rehydrated, washed, incubated with 10% normal goat serum, rinsed, and incubated overnight at 4°C with the primary antibodies; rabbit polyclonal antibodies against Bcl2 (B-cell lymphoma 2; as an antiapoptotic marker), Ki67 (as a proliferation marker), and androgen receptor (AR) (ab59348, ab15580 and ab3510 respectively, Abcam, Cambridge, Massachusetts, USA). Thereafter, the sections were incubated with goat anti-rabbit IgG horseradish peroxidase-conjugate antibody for 60 min at room temperature. Finally, the immunohistochemical reaction was detected using 3,3′-diaminobenzidine (DAB)

hydrogen peroxide chromogen followed by counterstaining with Mayer's hematoxylin[28].

Morphometric analysis

A Leica DM500 optical microscope with an attached Leica ICC50 digital camera (Switzerland) were used for image acquisition followed by image analysis with the "ImageJ" software (version 1.48v National Institute of Health, Bethesda, Maryland, USA). Ten non-overlapping randomly chosen fields per section at 400x magnification were quantified for:

1. The mean diameter of the seminiferous tubules, seminiferous epithelial height, and mean number of Sertoli cells.
2. The mean color intensity of PAS histochemical reaction and mean thickness of basal lamina.
3. The mean area percentage of collagen fiber content.
4. The mean color intensity of Bcl2-positive immunoreaction.
5. The mean percentage of Ki67-immunopositive cells.
6. The mean percentage and color intensity of androgen receptor-positive immunoreaction.

Statistical analysis

The data were analyzed by one-way analysis of variance (ANOVA) followed by Tukey's test using statistical package for social sciences statistical analysis software (IBM SPSS Statistics for Windows, IBM Corp, Version 22.0. Armonk, NY, USA). Values were demonstrated as mean ± standard deviation. Probability value $p < 0.05$ indicated significant differences.

RESULTS

No deaths among animals were recorded during this study.

Biochemical findings

Mean serum testosterone from group III demonstrated a significant drop ($p<0.001$) regarding both groups I and II. However, group IV exhibited a significant rise with respect to group III ($p<0.001$), yet it was non-significantly different from the control group (p=0.1001) (Table 1).

Additionally, group III expressed a significant increase ($p<0.001$) in mean tissue MDA that associated with a significant decrease ($p<0.001$) in both mean tissue SOD and reduced GSH with regard to both groups I and II. However, group IV demonstrated a significant decrease ($p<0.001$) in mean tissue MDA that coupled with a significant increase ($p<0.001$) in both mean tissue SOD and reduced GSH with respect to group III, but all three parameters were non-significantly different from those of the control group (p=0.2729, 0.1735, 0.2716 respectively) (Table 1).

Moreover, serum creatinine and blood urea nitrogen levels of group III were significantly higher than control group ($p<0.001$) indicating a successful induction of AKI model (Table 1).

Sperm study

Examination of sperms from the control group showed that most sperms had the normal characteristic hook-like head with a regular long tail (Figure 1A). Whereas group III depicted sperms with many head abnormalities in the form of pin-shaped (Figure 1B), amorphous (Figure 1C), deformed (Figure 1D), or bent heads (Figure 1E). The sperms also revealed tail abnormalities in the form of angulated (Figs. 1B, 1F) or coiled tails (Figures 1D,E) with focal or total thinning (Figures 1C,E,F), in addition to numerous sperms with tails missing their heads or heads missing their tails (Figure 1F). On the other hand, sperms from group IV depicted some head abnormalities in the form of amorphous (Figure 1G) or deformed heads (Figure 1H), in addition to few sperms with heads missing their tails (Figure 1H) and few tail abnormalities in the form of coiled tails (Figure 1I).

Morphometrical analysis of mean sperm cell count and abnormal sperm morphology percentage demonstrated a significant drop ($p<0.001$) in sperm cell count in group III together with a significant rise ($p<0.001$) in the abnormal sperm morphology percentage with respect to both groups I and II, while group IV showed a significant rise ($p<0.001$) in sperm cell count associating with a significant drop ($p<0.001$) in the abnormal sperm morphology percentage regarding group III, yet both parameters were non-significantly different from the control group (p=0.1535, 0.2355 respectively) (Table 1).

H&E staining

Groups I&II (Control and Sesame oil-treated groups)

H&E stained testicular sections from both groups I and II showed closely packed seminiferous tubules with little interstitium in between. The seminiferous tubules were bounded by a thin regular basal lamina and flattened myoid cells. The tubules were lined with stratified germinal epithelium composed of spermatogonia, primary spermatocytes, and spermatids with sperms observed in the lumina. Sertoli cells were detected among the spermatogenic cells harboring the spermatids. Groups of Leydig cells were detected in the interstitium (Figure 2).

Group III (AKI-induced group)

H&E stained Kidney specimens from group III revealed the characteristic signs of acute kidney injury in the form of tubular dilatation with thinning of their walls as well as tubular epithelial cellular vacuolation, necrosis, and desquamation together with cast formation in the tubular lumina. Widened glomerular capsular space was also observed (Figure 3).

H&E stained testicular sections from group III depicted many distorted seminiferous tubules with diminished germinal epithelium. Scanty sperms and sloughed cells were detected in the lumina. Some seminiferous tubules revealed distorted spermatogenic and Sertoli cells with cytoplasmic vacuolation and pyknotic, hyperchromatic, karyorrhectic, and karyolitic nuclei. Some seminiferous tubules depicted intercellular vacuoles, widened intercellular spaces, and areas of loss of intercellular boundaries. Nuclear pyknosis and cytoplasmic vacuolation of Leydig cells were detected as well (Figures 4,5). Other seminiferous tubules were either lined with a single layer of germinal epithelium with intercellular vacuoles or focally depleted of germinal epithelium (Figure 6), whereas few seminiferous tubules were even replaced by necrotic cells (Figure 7). Eosinophilic hyaline material and dilated congested blood vessels were observed in the widened interstitium (Figures 5,6,7).

Group IV (AKI pretreated with sesame oil group)

H&E stained testicular sections from group IV showed a near normal cytoarchitecture of the seminiferous tubules with mostly intact germinal epithelium with some widened intercellular spaces and some vacuolated cells. Abundant sperms were observed in the lumina. Apparently normal Leydig cells and some hyaline material were detected within the interstitium (Figure 8).

Morphometrical analysis of the mean diameter and epithelial height of the seminiferous tubules and mean number of Sertoli cells in group III demonstrated a significant depression (p<0.001) in all three parameters regarding both groups I and II. Meanwhile, group IV parameters exhibited a significant elevation with respect to those of group III (p<0.001), yet they were non-significantly different from the control group (p=0.1771, 0.1900, 0.2582 respectively) (Table 2).

PAS histochemical staining

PAS stained testicular sections from both groups I and II showed regular intact basal lamina of the seminiferous tubules with a strong PAS-positive histochemical reaction (Figure 9). Whereas group III sections depicted a weak PAS-positive reaction in apparently thickened basal lamina with focal distortion, irregularity, and detachment of the basal lamina (Figure 10). However, group IV sections revealed normal basal lamina of most tubules with a moderate PAS-positive reaction, however, scarce focal areas of thickened basal lamina were detected (Figure 11).

Morphometric analysis of the mean thickness of the basal lamina in group III exhibited a significant thickening (p<0.001) with respect to both groups I and II, while group IV expressed a significant thinning with respect to group III (p<0.001), yet its thickness was non-significantly different from the control group (p=0.2137) (Table 2). On the contrary, the mean color intensity of PAS histochemical reaction in group III recorded a significant weakening (p<0.001) regarding both groups I and II. Whereas group IV demonstrated a significant reinforcing with respect to group III (p<0.001) but it was also non-significantly different from the control group (p=0.5709) (Table 2).

Masson's trichrome staining

Masson's trichrome stained testicular sections from both groups I and II demonstrated a minimal amount of bluish-green stained collagen fibers in the basal lamina of the seminiferous tubules and around the blood vessels (Figure 12). While group III sections showed an excessive accumulation of collagen fibers in the interstitium, basal lamina, and around the blood vessels (Figure 13). Meanwhile, group IV sections depicted a moderate accumulation of collagen fibers in the interstitium, basal lamina of some tubules, and around the blood vessels (Figure 14).

Morphometric analysis of the mean area percentage of collagen fiber content in group III demonstrated a significant building up (p<0.001) with respect to both groups I and II, while group IV exhibited a significant reduction in relation to group III (p<0.001) but was non-significantly different from the control group (p=0.2778) (Table 2).

Bcl2 immunohistochemical staining

Bcl2 immunohistochemically stained testicular sections from both groups I and II demonstrated a strong Bcl2-positive cytoplasmic immunoexpression in both the spermatogenic and Leydig cells (Figure 15). Whereas group III exhibited a weak Bcl2-positive immunoexpression in the spermatogenic cells together with a moderate immunoreaction in the Leydig cells (Figure 16). However, group IV showed a moderate Bcl2-positive immunoexpression in the spermatogenic cells, while a strong immunoreaction was observed in the Leydig cells (Figure 17).

Morphometric analysis of the mean color intensity of Bcl2-positive immunoreaction in group III expressed a significant weakening (p<0.001) with respect to both groups I and II. Conversely, group IV demonstrated a significant reinforcing regarding group III (p<0.001), which was not significantly different from the control group (p=0.2157) (Table 2).

Ki67 immunohistochemical staining

Ki67 immunohistochemically testicular stained sections from both groups I and II showed a nuclear Ki67-positive immunoreaction in most spermatogonia and primary spermatocytes (Figure 18). Whereas group III sections revealed a few spermatogonia and primary spermatocytes with Ki67-positive immunoreaction (Figure 19). However, group IV sections demonstrated Ki67-positive immunoreaction in many spermatogonia and primary spermatocytes (Figure 20).

Morphometric analysis of the mean number of Ki67 positive cells (proliferation index) in group III expressed a significant reduction (p<0.001) regarding both groups

I and II. Meanwhile, group IV exhibited a significant elevation with respect to group III (p<0.001) but was non-significantly different from the control group (p=0.4674) (Table 2).

AR immunohistochemical staining

AR immunohistochemically stained testicular sections from groups I and II demonstrated a strong nuclear AR-positive immunoreaction in most Sertoli, myoid, and Leydig cells (Figure 21). However, group III sections revealed a weak AR-positive immunoreaction only in a few of those cells (Figure 22). Whereas group IV sections showed a moderate AR-positive immunoreaction in numerous Sertoli, myoid, and Leydig cells (Figure 23).

Morphometric analysis of both the mean percentage and color intensity of AR-positive immunoreaction of group III demonstrated a significant reduction (p<0.001) regarding both groups I and II. Meanwhile, both parameters from group IV exhibited a significant elevation with respect to group III (p<0.001), yet they were non-significantly different from the control group (p=0.4264, 0.5710 respectively) (Table 2).

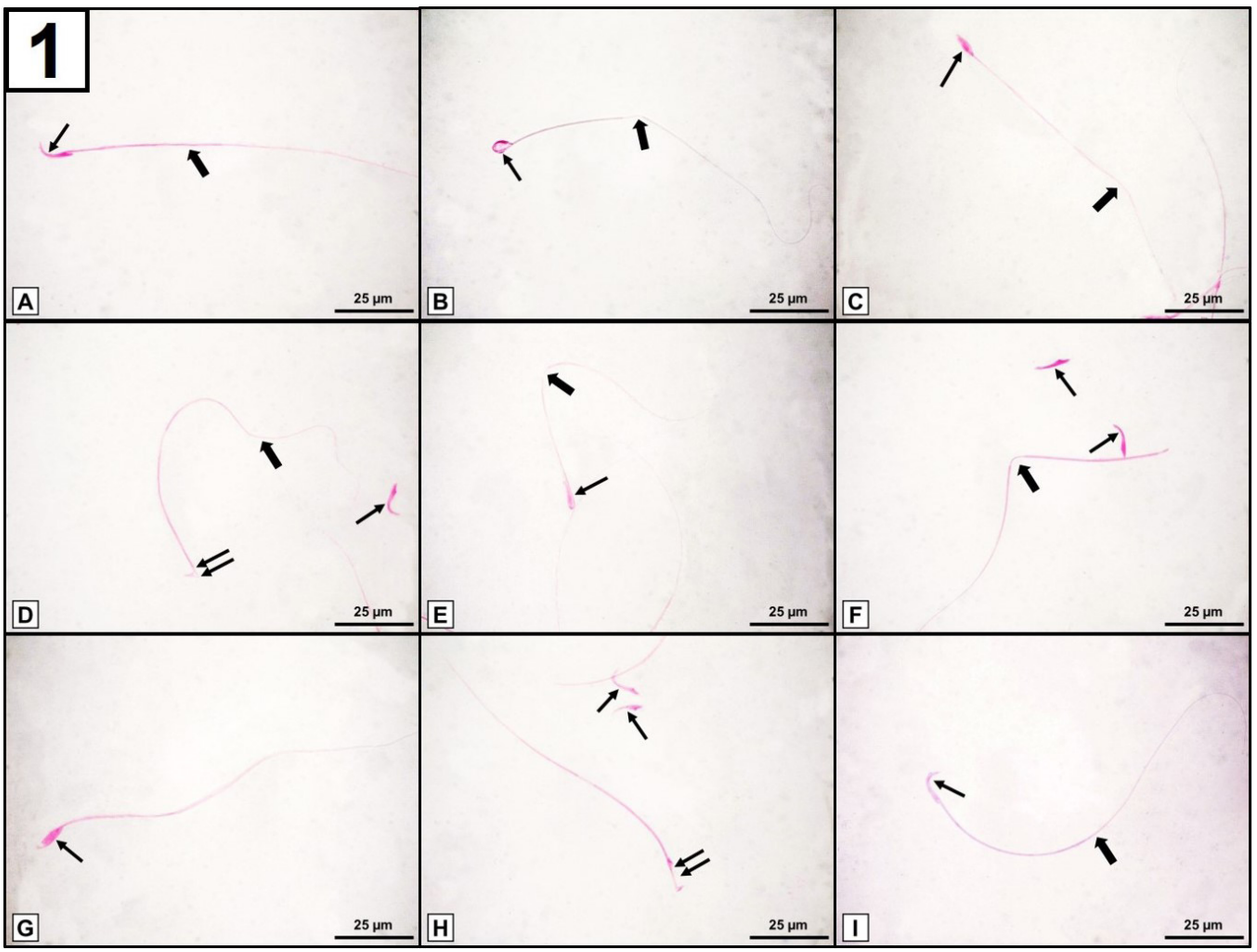

Fig. 1: Sperm morphology: **A)** Control group; Most sperms show the normal characteristic hook-like head (thin arrow) with a regular long tail (thick arrow). B-F) AKI group; **B)** sperm shows pin-shaped head (thin arrow) and angulated tail (thick arrow) with peripheral coiling, **C)** sperm shows amorphous head (thin arrow) and thin tail (thick arrow), **D)** sperms show head without a tail (thin arrow), deformed head (double thin arrows) and coiled tail (thick arrow), **E)** sperm shows bent head (thin arrow) and coiled tail with focal thinning (thick arrow), **F)** sperms show heads without tails (thin arrows) or headless angulated tail with focal thinning (thick arrow), G-I) Sesame oil-pretreated group; **G)** sperm shows amorphous head (thin arrow), **H)** sperms show heads without tails (thin arrows) or deformed head (double thin arrows), **I)** apparently normal sperm shows hook-like head (thin arrow) with a regular long tail (thick arrow). (Magnifications; A-I x1000, scale bar=25 µm)

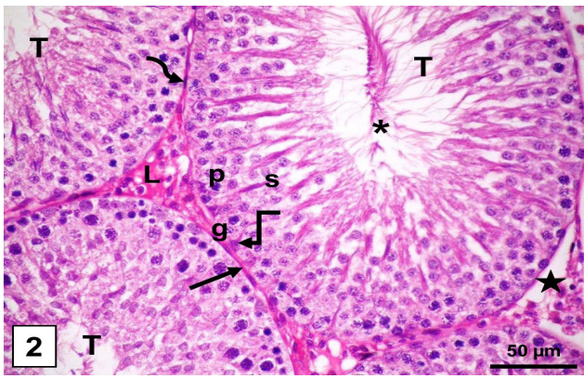

Fig. 2: Testicular section from control group shows closely packed seminiferous tubules (T) with little interstitium in between (star). The seminiferous tubules are surrounded by a thin regular basal lamina (thin arrow) and flattened myoid cells (wavy arrow). The tubules are lined with stratified germinal epithelium composed of spermatogonia (g), primary spermatocytes (p), and spermatids (s) with sperms (asterisk) detected in the lumina. Sertoli cells (angular arrow) are observed among the spermatogenic cells. Groups of Leydig cells (L) are detected in the interstitium. (H&E x400, scale bar=50 µm)

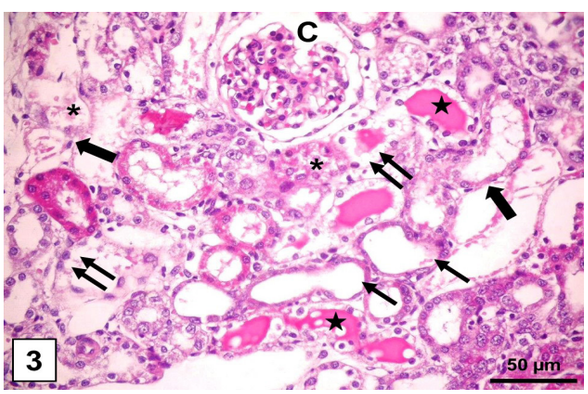

Fig. 3: Kidney section from AKI group shows signs of acute kidney injury in the form of tubular dilatation with thinning of their walls (thin arrows), tubular epithelial cellular vacuolation (double thin arrows), necrosis (thick arrows), and desquamation (asterisks) with cast formation (stars) in the tubular lumina. Widened glomerular capsular space (C) is observed. (H&E x400, scale bar=50 µm)

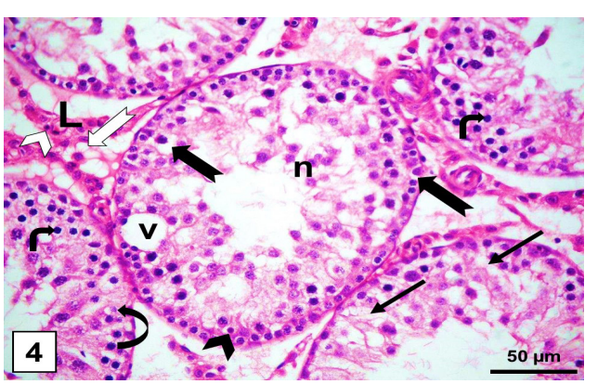

Fig. 4: Testicular section from AKI group shows some seminiferous tubules with distorted spermatogenic and Sertoli cells with cytoplasmic vacuolation (black notched arrows), pyknotic (black arrowhead), hyperchromatic (bent arrow), and karyolytic (curved arrow) nuclei. Some intercellular vacuoles (v) and widened intercellular spaces (thin arrows) are observed. Notice some completely separated cells into the lumen (n). Nuclear pyknosis (white arrowhead) and cytoplasmic vacuolation (white notched arrow) of Leydig cells (L) are detected. (H&E x400, scale bar=50 µm)

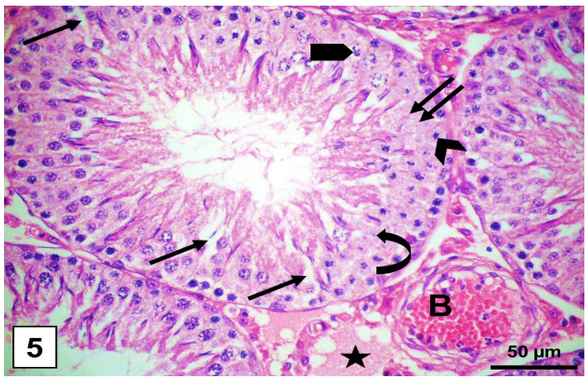

Fig. 5: Testicular section from AKI group shows a seminiferous tubule with nuclear pyknosis (arrowhead), karyorrhexis (bullet arrow), and karyolysis (curved arrow). Widened intercellular spaces (thin arrow) and areas of loss of intercellular boundaries (double thin arrow) are observed. Eosinophilic hyaline material (star) and dilated congested blood vessels (B) are detected in the interstitium. (H&E x400, scale bar=50 µm)

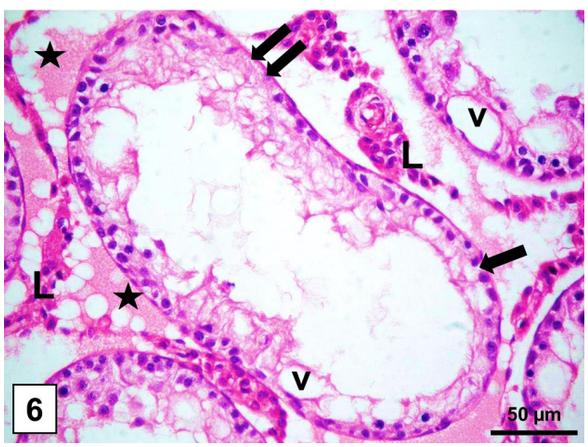

Fig. 6: Testicular section from AKI group shows some seminiferous tubules lined with a single layer of germinal epithelium (thick arrow) with intercellular vacuoles (v). Some areas are completely depleted of germinal epithelium (double thick arrows). Widened interstitium filled with eosinophilic hyaline material (stars) is observed. Some degenerated Leydig cells (L) are also observed. (H&E x400, scale bar=50 µm)

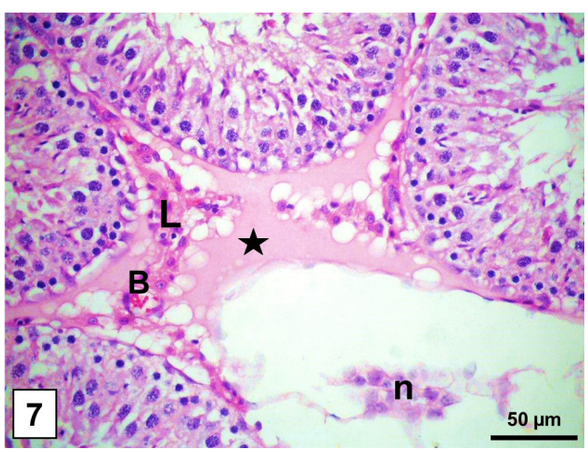

Fig. 7: Testicular section from AKI group shows necrotic cells (n) replacing a seminiferous tubule. Eosinophilic hyaline material (star) and congested blood vessels (B) are observed in the widened interstitium (star). Some degenerated Leydig cells (L) are also observed. (H&E x400, scale bar=50 µm)

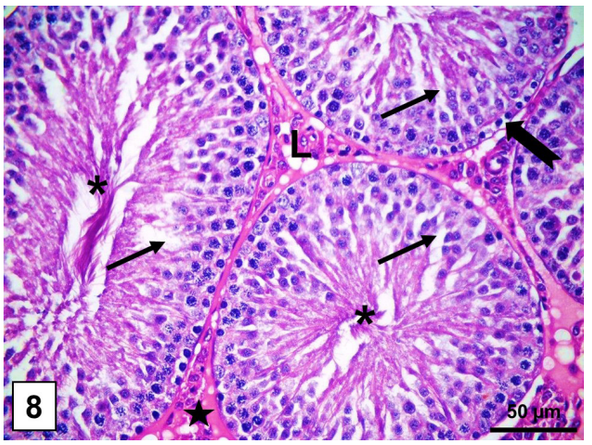

Fig. 8: Testicular section from sesame oil-pretreated group shows apparently normal seminiferous tubules with mostly intact germinal epithelium with some widened intercellular spaces (thin arrows) and some vacuolated cells (notched arrow). Abundant sperms are detected in the lumina (asterisks). Notice little interstitium in between the tubules with some eosinophilic hyaline material (star) and apparently normal Leydig cells (L). (H&E x400, scale bar=50 µm)

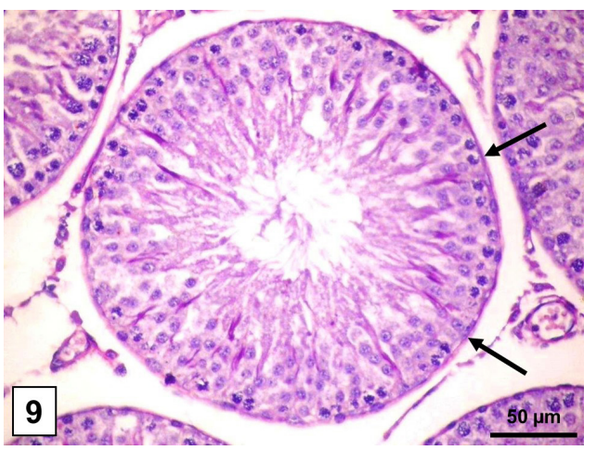

Fig. 9: Testicular section from control group shows regular intact basal lamina of seminiferous tubules (arrows) with a strong PAS-positive reaction. (PASx400, scale bar=50 µm)

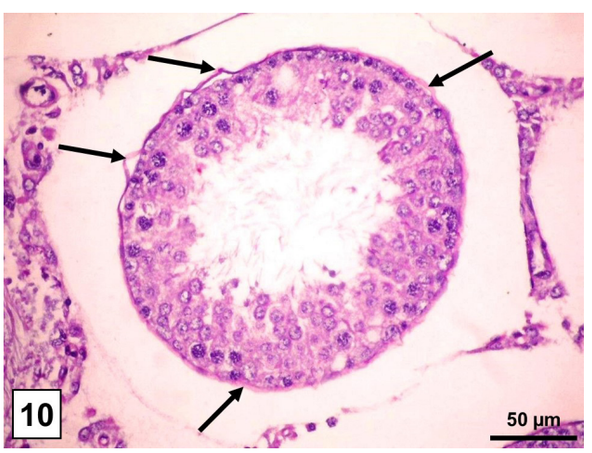

Fig. 10: Testicular section from AKI group shows a weak PAS-positive reaction in apparently thickened basal lamina (arrows) with focal distortion, irregularity, and detachment of the basal lamina. (PASx400, scale bar=50 µm)

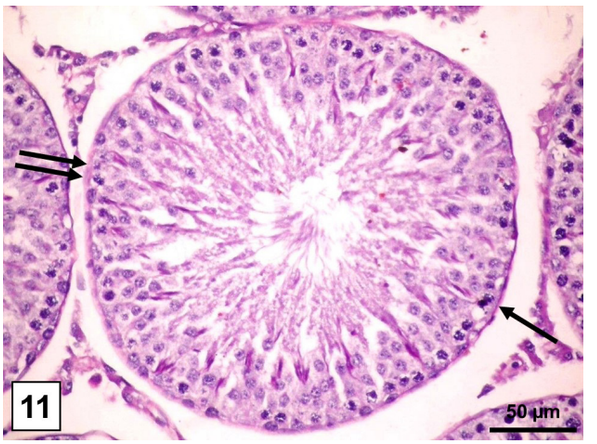

Fig. 11: Testicular section from sesame oil-pretreated group shows normal basal lamina (arrow) of most tubules with a moderate PAS-positive reaction with focal thickening of the basal lamina (double arrows). (PASx400, scale bar=50 µm)

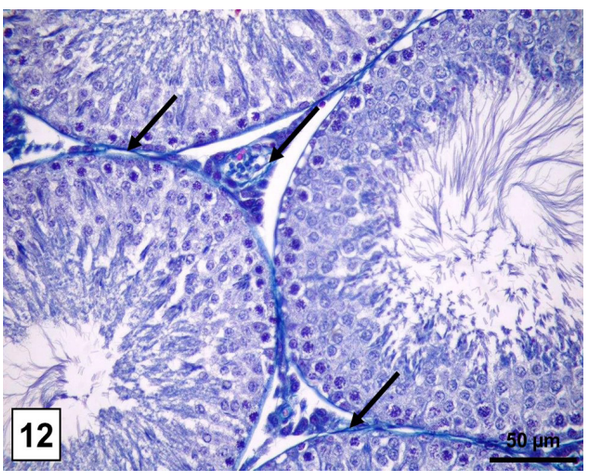

Fig. 12: Testicular section from control shows a minimal amount of bluish-green stained collagen fibers (arrows) in the basal lamina of seminiferous tubules and around the blood vessels. (Masson's trichrome stain x400, scale bar=50 µm)

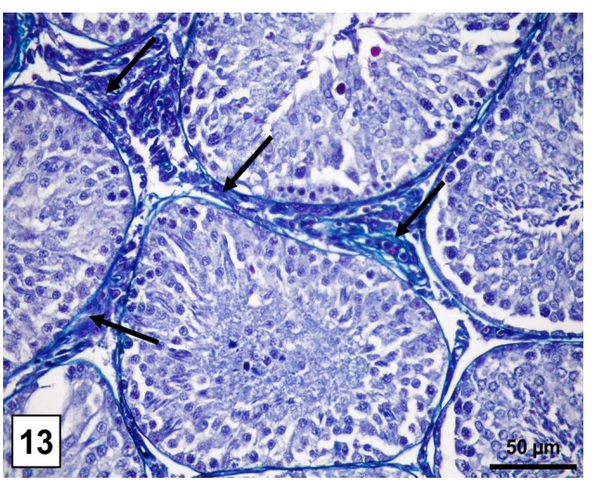

Fig. 13: Testicular section from AKI group shows excessive collagen fibers (arrows) in the basal lamina, interstitium, and around the blood vessels. (Masson's trichrome stain x400, scale bar=50 µm)

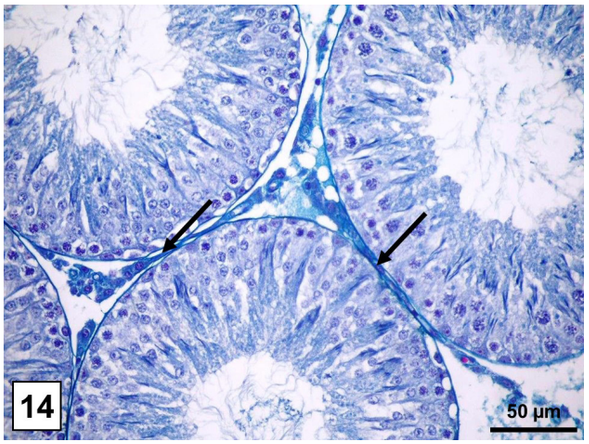

Fig. 14: Testicular section from sesame oil-pretreated group shows a moderate amount of collagen fibers (arrows) in in the basal lamina, interstitium, and around the blood vessels. (Masson's trichrome stain x400, scale bar=50 µm)

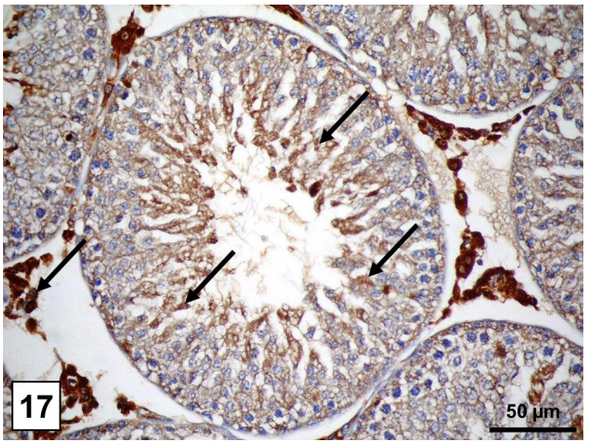

Fig. 17: Testicular section from sesame oil-pretreated group shows a moderate Bcl2-positive immunoreaction (arrows) in the spermatogenic cells, whereas a strong reaction is detected in Leydig cells. (Bcl2x400, scale bar=50 µm)

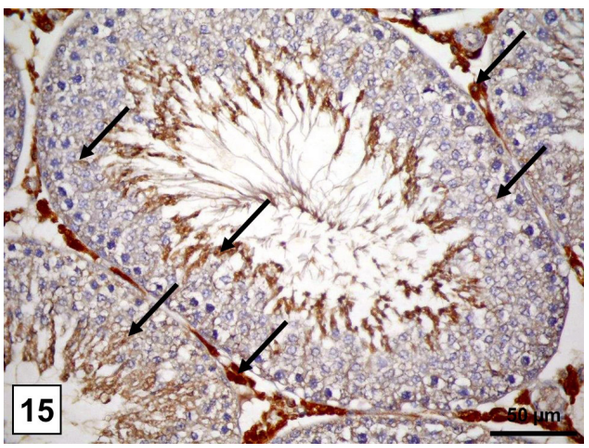

Fig. 15: Testicular section from control group shows a strong positive cytoplasmic Bcl2- immunoreaction (arrows) in the spermatogenic and Leydig cells. (Bcl2x400, scale bar=50 µm)

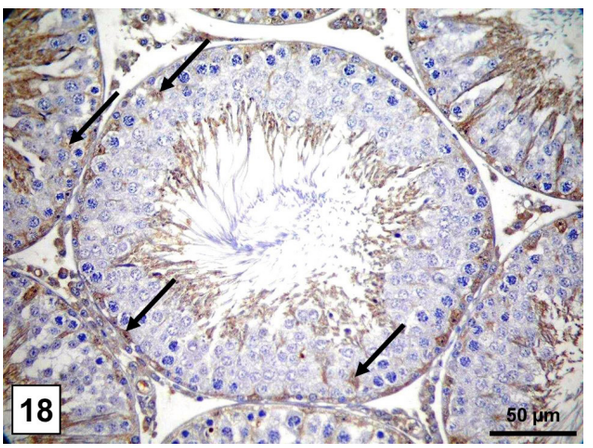

Fig. 18: Testicular section from control group shows a nuclear Ki67-positive immunoreaction (arrows) in most spermatogonia and primary spermatocytes. (Ki67x400, scale bar=50 µm)

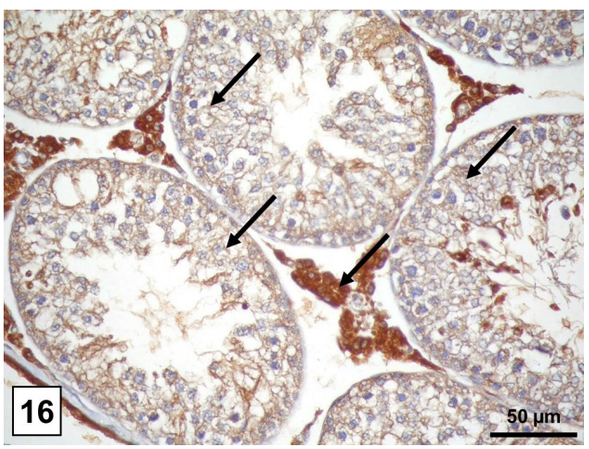

Fig. 16: Testicular section from AKI group shows a weak Bcl2-positive immunoreaction (arrows) in the spermatogenic cells, whereas a moderate reaction is detected in Leydig cells. (Bcl2x400, scale bar=50 µm)

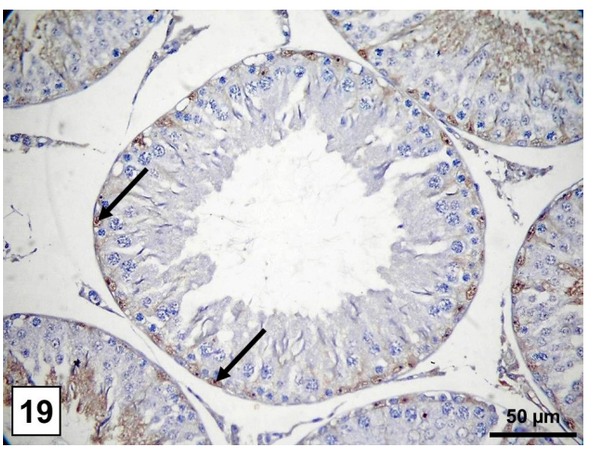

Fig. 19: Testicular section from AKI group shows a few spermatogonia and primary spermatocytes with Ki67-positive immunoreaction (arrows). (Ki67x400, scale bar=50 µm)

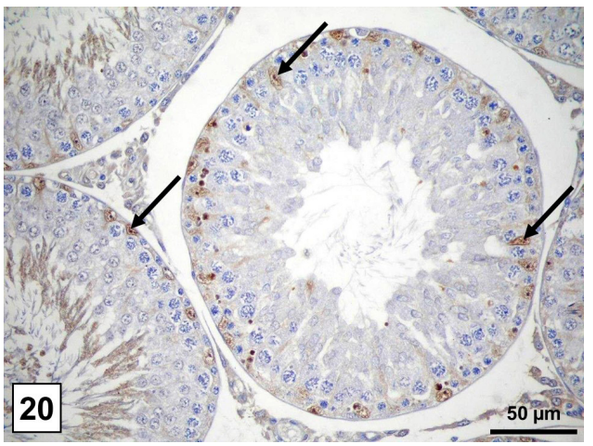

Fig. 20: Testicular section from sesame oil-pretreated group shows many spermatogonia and primary spermatocytes with Ki67-positive immunoreaction (arrows). (Ki67x400, scale bar=50 µm)

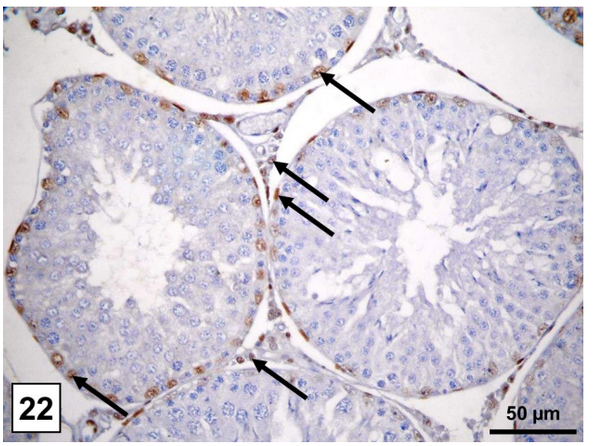

Fig. 22: Testicular section from AKI group shows a weak AR-positive immunoreaction (arrows) in few Sertoli, myoid, and Leydig cells. (ARx400, scale bar=50 µm)

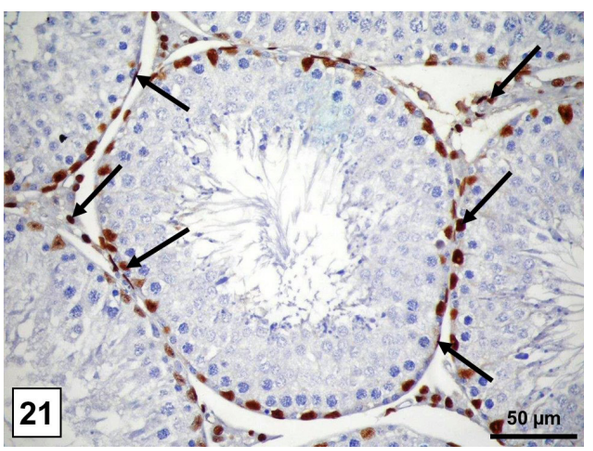

Fig. 21: Testicular section from control group shows a strong nuclear AR-positive immunoreaction (arrows) in most Sertoli, myoid, and Leydig cells. (ARx400, scale bar=50 µm)

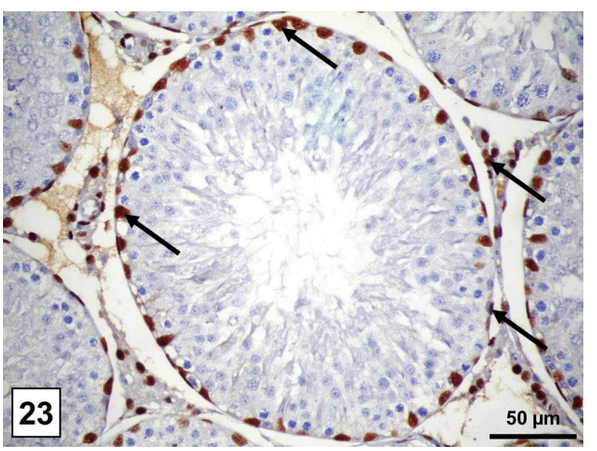

Fig. 23: Testicular section from sesame oil-pretreated group shows a moderate AR-positive immunoreaction (arrows) in numerous Sertoli, myoid, and Leydig cells. (ARx400, scale bar=50 µm)

Table 1: Biochemical and sperm analysis of different study groups

Parameters	Group I	Group II	Group III	Group IV
Serum creatinine (mg/dl)	0.68±0.11	0.65±0.27	6.06±1.92^{a,b}	2.51±0.83^{a,b,c}
Blood urea nitrogen (mg/dl)	37.02±4.32	37.15±3.66	128.37±14.39^{a,b}	53.07±9.13^{a,b,c}
Serum testosterone (ng/ml)	1.69±0.06	1.68±0.05	0.85±0.09^{a,b}	1.61±0.09^{c}
MDA nmol/g tissue protein	91.05±6.13	90.82±6.07	166.51±9.55^{a,b}	95.93±8.28^{c}
Reduced GSH mol/g tissue protein	39.89±3.11	39.21±3.91	25.91±2.06^{a,b}	35.67±6.33^{c}
SOD U/g of tissue protein	29.09±2.03	28.94±2.85	18.08±2.09^{a,b}	26.61±4.81^{c}
Sperm count (106/ml)	89.23±6.39	88.28±6.91	42.12±9.57^{a,b}	82.02±9.49^{c}
Abnormal sperm morphology percentage (%)	8.69±0.83	8.77±0.99	58.39±4.82^{a,b}	11.73±5.84^{c}

Superscript letters ^{a,b,c}denote $p<0.05$ versus groups I, II, and III respectively

Table 2: Morphometrical analysis of different study groups

Parameters	Group I	Group II	Group III	Group IV
Mean diameter of seminiferous tubules (µm)	111.39±9.69	112.66±9.51	77.09±8.08^{a,b}	103.13±10.01^{c}
Mean epithelial height of seminiferous tubules (µm)	36.85±2.37	36.68±3.01	14.39±3.84^{a,b}	32.97±6.33^{c}
Mean number of Sertoli cells	18.64±2.09	19.02±2.69	9.95±1.01^{a,b}	16.37±4.14^{c}
Mean thickness of basal lamina (µm)	0.358±0.057	0.378±0.064	1.158±0.08^{a,b}	0.431±0.122^{c}
Mean color intensity of PAS positive reaction	18.29±2.57	18.65±2.66	9.27±1.09^{a,b}	17.04±4.55^{c}
Mean area percentage of collagen fiber content	8.91±1.06	8.67±1.20	21.45±3.55^{a,b}	10.37±2.93^{c}
Mean color intensity of Bcl2-positive immunoreaction	30.13±2.15	30.01±2.70	16.62±3.12^{a,b}	27.56±4.25^{c}
Mean percentage of Ki67-positive cells	68.29±4.66	68.97±4.50	38.64±3.77^{a,b}	65.91±6.15^{c}
Mean percentage of AR-positive cells	87.65±5.06	87.09±5.97	44.09±6.14^{a,b}	84.50±7.81^{c}
Mean color intensity of AR-positive immunoreaction	42.26±3.18	42.86±3.26	25.85±2.66^{a,b}	40.72±5.60^{c}

Superscript letters ^{a,b,c} denote $p<0.05$ versus groups I, II, and III respectively

DISCUSSION

In the present work, AKI group revealed a significant elevation of tissue MDA levels associating with a significant reduction of GSH and SOD levels. AKI was documented to cause distant organ injuries through induction of systemic oxidative stress, inflammatory cascades, apoptosis, molecular expression, and trafficking of the leukocytes[5,29].

In this study, sperm count was significantly decreased in the AKI group. This reduced sperm production was previously suggested to be secondary to direct injury to the germ cells causing their apoptosis[30]. Meanwhile, our reported abnormal morphology of the sperms in this study was proposed to be induced by ROS thus causing lipid peroxidation of their membranes and damage of their mitochondria[31].

In the current study, a significant drop in testosterone serum level was recorded in AKI group as was similarly recorded in a previous work upon studying the effect of ischemia/reperfusion (I/R)-induced AKI on testicular function and structure[32]. This dropped serum testosterone level was also reported in male patients with chronic renal failure[11]. Besides, the seminiferous tubules of the AKI group revealed reduced height, number of layers, and number of spermatogenic cells of their germinal lining epithelium together with a significant drop in the mean number of Ki67-immunopositive spermatogonia and primary spermatocytes. Researchers attributed the decreased number of spermatogenic cells to the reduction of testosterone serum level together with the inhibition of spermatogenesis that occurs secondary to oxidative stress and the direct effect of the free radicals on the testes[32]. Whereas the thinning of the germinal epithelium and the decline in the number of its layers were argued to be related to the inhibition of mitosis of B-spermatogonia secondary to prolongation of G1 phase of the cell cycle[33].

In this study, cytoplasmic vacuolation in both Sertoli and Leydig cells were reported in the AKI group. Sertoli cells' vacuoles were suggested to be phagocytic vacuoles that develop as a part of the process of engulfing the apoptotic germinal cells[33]. Besides, another work attributed these vacuoles to the metabolic disturbance within the cells resulting in a secondary change in their structure[30]. Moreover, AKI group depicted intercellular vacuoles in some seminiferous tubules. Previous studies related these vacuoles to the reduction or even loss of the molecules responsible for cell adhesion such as cadherin and was proposed to be a sign of apoptosis[34].

Similarly, widened intercellular spaces and sloughed necrotic cells detected in AKI group. These findings were previously attributed to either disruption of the cell junctions with the subsequent loss of cohesiveness of the adjacent cells or due to destruction of Sertoli cells' processes resulting in exfoliation of the germinal cells into the lumen[30,35]. Moreover, the thickened basal lamina of some seminiferous tubules detected in AKI group were argued to be related to the increased production of collagen by the myoid cells and/or its decreased proteolysis[36]. Cells with pyknotic, hyperchromatic, karyorrhectic, and karyolitic nuclei were reported as well in AKI group together with a significant drop in the immunohistochemical expression of Bcl2, thus indicating that those cells were apoptotic, where researchers previously illustrated that spermatogonia and primary spermatocytes are the most sensitive and the most susceptible cells to undergo apoptosis[37].

Additionally, the interstitial vacuolation detected in AKI group were suggested to be linked to the elevated activity of the Leydig cells with a subsequent increase in their steroidal content,[30] which was proposed as a compensatory process to the reduced testosterone serum levels[32]. Moreover, AKI group recorded some signs of inflammation in the form of dilated congested blood vessels and interstitial eosinophilic hyaline exudate. Researches related these findings to either lymphatic exudation from the damaged lymphatic vessels or increased permeability of the blood vessels[35]. This came in association with a significant rise in collagen fiber content. Previous studies related this change to either an increased collagen production[38] or decreased collagen breakdown and metabolism[39]. Both studies related this finding to oxidative stress and increased production of ROS.

In the present study, AKI group revealed a significant drop in testicular ARs immunohistochemical expression. ARs are nuclear ligand-activated receptors that are

normally expressed within the cytoplasm and nuclei of Sertoli cells as well as nuclei of myoid and Leydig cells. The intense expression of ARs in Sertoli cells together with the absence of their expression in the germ cells are essential for proper development, survival, proliferation, division, and differentiation of the germ cells. As testosterone affects Sertoli cells' maturation and normal expression of their androgen receptors, therefore, low serum levels of testosterone cause decreased expression of Sertoli cells' ARs resulting in the arrest of spermatogenesis before the first meiotic division at the phase of the transformation of round spermatids into elongated spermatids with subsequent loss of fertility[40].

On the other hand, the pretreatment with sesame oil in group IV significantly improved biochemical parameters, sperms count, and morphology in addition to the testicular histological structure and immunohistochemical findings compared to the AKI group. A significant rise in serum testosterone levels reported in group IV compared to AKI group came in accordance with previous studies[13,15]. Studies attributed these alterations to the potential androgenic effect of the unsaturated fatty acids content (oleic and linoleic acids) of sesame oil on the synthesis of both steroidal and peptidal hormones causing an increase in luteinizing hormone production with subsequent increased production of testosterone hormone by the Leydig cells[13].

A significant rise in both mean tissue SOD and reduced GSH associating with a significant drop in mean tissue MDA were reported in the sesame oil-pretreated group IV compared to AKI group. Sesame oil pretreatment was previously proved to inhibit the development of oxidative, where it acted as an effective scavenger of free radicals that played an important role in metal chelation and inhibition of lipid peroxidation[41].

In the current study, group IV demonstrated a significant rise of the sperm count together with a significant decrease in the abnormal sperm cell morphology percentage compared to AKI group. These results came in agreement with a previous study that reported an improvement in the fertility parameters; including increased sperm count, viability, and motility in sesame seed oil (SSO)-pretreated group compared to the penconazole-treated group[42]. He linked this to the effect of SSO on the normalization of the testicular levels of vitamins A, C, and E which are essential for the stabilization of testicular cell membranes through reduction of the condition of lipid peroxidation. He added that the lignans content of sesame inhibited CYP450-dependent N-hydroxylase enzyme resulting in increased tissue levels of tocopherol which is responsible for improving sperms quality and morphology. Other researchers illustrated that sesame lignans could also inhibit carnitine oxidase and dismutase enzymes which have inhibitory effects on both sperms maturation and motility in the epididymis resulting in their improvement[43]. On the other hand, vitamin E content of sesame is considered the main antioxidant of the spermatozoa that play a major role in protecting their membranes against harmful effects of ROS and lipid peroxidation[44].

Collagen fibers deposition were significantly dropped in group IV compared to AKI group. Other studies attributed the antifibrotic activity of sesame oil to the inhibition of fibroblasts proliferation and blockage of the signaling pathway of transforming growth factor β1 which is considered the main profibrotic factor responsible for fibroblasts proliferation and differentiation as well as collagen production[45,46].

Additionally in this work, sesame oil efficiently exerted an anti-inflammatory effect which was argued to be primarily mediated through reduction of neutrophils infiltration and suppression of production of inducible nitric oxide synthase enzyme (iNOS) and inflammatory cytokines causing a reduction of NO levels[46,47]. Sesame oil was previously proved to reduce the incidence of lipopolysaccharide-induced multiple organ failure and decrease the rats' mortality due to its suppressive effect on the xanthine oxidase enzyme which is considered the main source of superoxides and their reactive oxidants[48].

CONCLUSIONS

Taken together, this study illustrates that the acute kidney injury exerted its deleterious effect on the testes through inducing testicular oxidative stress, altering testosterone level, enhancing apoptosis, suppressing androgen receptors expression, and inducing interstitial inflammation and fibrosis. It also reports the significant antioxidant, antiapoptotic, anti-inflammatory, and antifibrotic effect of sesame oil pretreatment against these adverse effects.

CONFLICT OF INTERESTS

There are no conflicts of interest.

REFERENCES

1. Wu J, Pan X, Fu H, Zheng Y, Dai Y, Yin Y, Chen Q, Hao Q, Bao D, Hou D. Effect of curcumin on glycerol-induced acute kidney injury in rats. Sci Rep 2017;7:10114.

2. Zuk A, Bonventre J V. Acute Kidney Injury. Annu Rev Med 2016;67:293–307.

3. Al Asmari AK, Al Sadoon KT, Obaid AA, Yesunayagam D, Tariq M. Protective effect of quinacrine against glycerol-induced acute kidney injury in rats. BMC Nephrol 2017;18:41.

4. Lima-Posada I, Fontana F, Pérez-Villalva R, Berman-Parks N, Bobadilla NA. Pirfenidone prevents acute kidney injury in the rat. BMC Nephrol 2019;20:158.

5. Grams ME, Rabb H. The distant organ effects of acute kidney injury. Kidney Int 2012;81:942–8.

6. Ustundag S, Sen S, Yalcin O, Ciftci S, Demirkan B, Ture M. L-Carnitine Ameliorates Glycerol-Induced Myoglobinuric Acute Renal Failure in Rats. Ren Fail 2009;31:124–33.

7. Reis NG, Francescato HDC, de Almeida LF, Silva CGA da, Costa RS, Coimbra TM. Protective effect of calcitriol on rhabdomyolysis-induced acute kidney injury in rats. Sci Rep 2019;9:7090.
8. Kim JH, Lee SS, Jung MH, Yeo HD, Kim HJ, Yang JI, Roh GS, Chang SH, Park DJ. N-acetylcysteine attenuates glycerol-induced acute kidney injury by regulating MAPKs and Bcl-2 family proteins. Nephrol Dial Transplant 2009;25:1435–43.
9. Liu Y, Fu X, Gou L, Li S, Lan N, Zheng Y, Yin X. L-Citrulline Protects Against Glycerol-Induced Acute Renal Failure in Rats. Ren Fail 2013;35:367–73.
10. Li Y-F, Xu B-Y, An R, Du X-F, Yu K, Sun J-H, Zhang G-H, Wang W, An L-P, Wu G-L. Protective effect of anisodamine in rats with glycerol-induced acute kidney injury. BMC Nephrol 2019;20:223.
11. Adachi Y, Sasagawa I, Tateno T, Tomaru M, Kubota Y, Nakada T. Influence of adenine-induced chronic renal failure on testicular function in the rat. Andrologia 2009;30:115–8.
12. Borai IH, Atef AA, El-Kashoury AA, Mohamed RA, Said MM. Ameliorative Effects of Sesame Seed Oil Against Penconazole-Induced Testicular Toxicity and Endocrine Disruption in Male Rats. Biomed J Sci Tech Res 2019;14:10365–75.
13. AL-Sallam JaSM. Effect of Sesame Oil on Male Rats Treated with Acrylamide in some Physiological and Hormonal Blood Criteria. Int J Curr Pharm Rev Res 2017;8:134–40.
14. Mahabadi J, Bafrani H, Nikzad H, Taherian A, Salehi M. Effect of Diet Contains Sesame Seed on Adult Wistar Rat Testis. Int J Morphol 2013;31:197–202.
15. Khaneshi F, Nasrolahi O, Azizi S, Nejati V. Sesame effects on testicular damage in streptozotocin-induced diabetes rats. Avicenna J phytomedicine 2013;3:347–55.
16. Saleem TSM, Chetty CM, Kavimani S. Sesame oil enhances endogenous antioxidants in ischemic myocardium of rat. Rev Bras Farmacogn 2012;22:669–75.
17. Srinivasan P, Liu M-Y. Comparative Potential Therapeutic Effect of Sesame Oil and Peanut Oil against Acute Monocrotaline (Crotalaria) Poisoning in a Rat Model. J Vet Intern Med 2012;26:491–9.
18. Yusuf M, Ibegbu A, Alawa J, Ilyas M, Evang A. Effects of Ethanolic Extract of Sesamum Indicum Seeds on the Histology and Sperm Concentration in Ketoconazole-Induced Testicular Damage in Male Wistar Rats. Clin Res Open Access 2018;4:1–5.
19. Hsu D-Z, Li Y-H, Chu P-Y, Periasamy S, Liu M-Y, Liu C-T, Li Y-H, Chu P-Y, Liu M-Y. Sesame oil prevents acute kidney injury induced by the synergistic action of aminoglycoside and iodinated contrast in rats. Antimicrob Agents Chemother 2011;55:2532–6.
20. Gaertner DJ, Hallman TM, Hankenson FC, Batchelder MA. Anesthesia and analgesia for laboratory rodents. In: Fish, R.E., Danneman, P.J., Brown, M., Karas AZ, editor. Anesthesia and Analgesia in Laboratory Animals. 2nd ed. Elsevier Academic Press, London (UK); 2008:239–97.
21. Mailankot M, Kunnath AP, Jayalekshmi H, Koduru B, Valsalan R. Radio frequency electromagnetic radiation (RF-EMR) from GSM (0.9/1.8GHz) mobile phones induces oxidative stress and reduces sperm motility in rats. Clinics (Sao Paulo) 2009;64:561–5.
22. Kurokawa T, Itagaki S, Yamaji T, Nakata C, Noda T, Hirano T, Iseki K. Antioxidant Activity of a Novel Extract from Bamboo Grass (AHSS) against Ischemia-Reperfusion Injury in Rat Small Intestine. Biol Pharm Bull 2006;29:2301–3.
23. Vardi N, Parlakpinar H, Ozturk F, Ates B, Gul M, Cetin A, Erdogan A, Otlu A. Potent protective effect of apricot and β-carotene on methotrexate-induced intestinal oxidative damage in rats. Food Chem Toxicol 2008;46:3015–22.
24. Winterbourn C, Hawkins R, Brian M, Carrell R. The estimation of red cell superoxide dismutase activity. J Lab Clin Med 1975;85:337–41.
25. Gamble M. The Hematoxylins and Eosin. In: Bancroft, JD and Gamble M, editor. Theory and Practice of Histological Techniques. 6th ed. Philadelphia: Churchill Livingstone Elsevier; 2008:121–34.
26. Myers R, Fredenburgh J, Grizzle W. Carbohydrates. In: Bancroft J and GM, editor. Theory and Practice of Histological Techniques. 6th editio. Churchill Livingstone Elsevier; 2008:161–86.
27. Jones ML, Bancroft JD, Gamble M. Connective Tissues and Stains. In: Bancroft, JD and Gamble M, editor. Theory and Practice of Histological Techniques. 6th ed. Philadelphia: Churchill Livingstone Elsevier; 2008:135–60.
28. Buchwalow IB, Böcker W. Working with Antibodies. In: Immunohistochemistry: Basics and Methods. Springer Berlin Heidelberg; 2010:31–9.
29. Gyurászová M, Kovalčíková AG, Renczés E, Kmeťová K, Celec P, Bábíčková J, Tóthová Ľ. Oxidative Stress in Animal Models of Acute and Chronic Renal Failure. Dis Markers 2019;2019.
30. ElSherif N, ElMehi A. Effect of Semicarbazide on the Testis of Juvenile Male Albino Rat. J Interdiscip Histopathol 2015;3:9–18.
31. Hasanin N, Sayed N, Ghoneim F, Al-Sherief S. Histological and ultrastructure study of the testes of acrylamide exposed adult male albino rat and evaluation of the possible protective effect of Vitamin E intake. J Microsc Ultrastruct 2018;6:23–34.

32. Gholampour F, Mansourkhani SM, Owji SM. Amelioration of testicular damages in renal ischemia/ reperfusion by berberine: An experimental study. Int J Reprod Biomed 2019;17:799–806.
33. Anan HH, Wahba NS, Abdallah MA, Mohamed DA. Histological and immunohistochemical study of cyclophosphamide effect on adult rat testis. Int J Sci Reports 2017;3:39–48.
34. Bagheri S, Yadegari M, Porentezari M, Mirjalili A, Hasanpor A, Dashti RMH, Anvari M. Effect of Ferula assa-foetida oleo gum resin on spermatic parameters and testicular histopathology in male wistar rats. J Ayurveda Integr Med 2015;6:175–80.
35. El-Beltagi E, Elwan W, Mohsen El-Bakry N, Salah E. Histological and immunohistochemical study on the effect of gibberellic acid on the seminiferous tubules of testis of adult albino rat and the possible protective role of grape seeds proanthocyanidin extract. Tanta Med J 2017;45:79–91.
36. Abou Elnaga A, Kassab A, Soliman G, El Shal A. Histological and immunohistochemical study of the effect of tramadol on the seminiferous tubules of adult albino rat and the effect of its withdrawal. Tanta Med J 2018;46:38–53.
37. Yamazaki M, Muguruma M, Takahashi M, Moto M, Kashida Y, Mitsumori K. Molecular pathological analysis of apoptosis induced in testicular germ cells after a single administration of mono-(2-ethylhexyl) phthalate to F344 rats. J Toxicol Pathol 2006;19:185–90.
38. Hegazy AA, Morsy MM, Moawad RS, Elsayed GM. Histological study on the effect of experimentally induced hyperthyroidism on testes of adult albino rats and possible ameliorating role of l-carnitine. Egypt J Histol 2020;43:63–74.
39. Soliman AHM, Ibrahim IA, Shehata MA, Mohammed HO. Histopathological and genetic study on the protective role of B-Carotene on testicular tissue of adult male albino rats treated with titanium dioxide nanoparticles. African J Pharm Pharmacol 2020;14:9–19.
40. Ismail OO, Isaac JA, Ugochukwu O, Oluwatosin OO, Aniekan PI, Edwin NCS, Onyemaechi AO. Impaired expression of testicular androgen receptor and collagen fibers in the testis of diabetic rats under HAART: The role of hypoxis hemerocallidea. Folia Histochem Cytobiol 2017;55:149–58.
41. Al-Attar AM, Elnaggar MHR, Almalki EA. Physiological study on the influence of some plant oils in rats exposed to a sublethal concentration of diazinon. Saudi J Biol Sci 2018;25:786–96.
42. M Said M. Ameliorative Effects of Sesame Seed Oil Against Penconazole-Induced Testicular Toxicity and Endocrine Disruption in Male Rats. Biomed J Sci Tech Res 2019;14:10365–75.
43. Shittu LAJ, Shittu RK, Adesite SO, Ajala MO, Bankole MA, Benebo AS, Tayo AO, Ogundipe OA, Ashiru OA. Sesame radiatum Phytoestrogens Stimulate Spermatogenic Activity and Improve Sperm Quality in Adult Male Sprague Dawley Rat Testis. Int J Morphol 2008;26:643–52.
44. Mahabadi JA, Bafrani HH, Nikzad H. Effect of Sesame-Supplemented Diet on Prostate and Seminal Vesicle Histology of Adult Rat. Int J Morphol 2016;34:604–9.
45. Zhao M, Zheng S, Yang J, Wu Y, Ren Y, Kong X, Li W, Xuan J. Suppression of TGF-β1/Smad signaling pathway by sesamin contributes to the attenuation of myocardial fibrosis in spontaneously hypertensive rats. PLoS One 2015;10:1–15.
46. Ali F, Abdellah N, Hafez LO, El-Ghoneimy AA. Sesame oil ameliorates gentamicin-induced cardiotoxicity in wistar albino rats. J Adv Vet Res 2020;10:81–7.
47. Ismail M, Hasan H, El-Orfali Y, Ismail H, Khawaja G. Anti-inflammatory, antioxidative, and hepatoprotective effects of trans Δ 9-Tetrahydrocannabinol/Sesame Oil on Adjuvant-Induced Arthritis in Rats. Evidence-based Complement Altern Med 2018;2018.
48. Hsu DZ, Liu MY. Sesame oil attenuates multiple organ failure and increases survival rate during endotoxemia in rats. Crit Care Med 2002;30:1859–62.

الملخص العربى

دور زيت السمسم في تخفيف تضرر الخصية في نموذج لإصابة الكلى الحادة في الجرذان: دراسة هستولوجية وهستوكيميائية مناعية

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مقدمة: تتميز إصابة الكلى الحادة بالتدهور السريع لوظائف الكلى مما يسبب العديد من إصابات الأعضاء البعيدة. تم تسجيل تضرر الخصية في حالات الفشل الكلوي المزمن ومع ذلك لا يُعرف الكثير عن الآلية الكامنة للتأثير الضار لإصابة الكلى الحادة على بنية الخصية ووظيفتها. و قد ثبت أن زيت السمسم له تأثيرات مضادة للأكسدة.

الهدف من العمل: هو تقييم آثار إصابة الكلى الحادة على خصية الجرذان والدور الوقائي المحتمل لزيت السمسم.

مواد و طرق البحث: تم تقسيم أربعة وعشرين من ذكور الجرذان البيضاء البالغة إلى 4 مجموعات: المجموعة الضابطة، والمعالجة بزيت السمسم (0.5 مل / كجم عن طريق الفم لمدة أسبوع واحد)، مجموعة إصابة الكلى الحادة (10 مل / كجم من الجلسرين 50 ٪)، و مجموعة إصابة الكلى الحادة المعالجة بزيت السمسم. تم فحص هرمون التستوستيرون في الدم و تحليل الحيوانات المنوية و إجراء الفحص الكيميائي الحيوي للمالوندهايد و الجلوتاثيون وديسموتاز الفائق في الأنسجة. و تمت معالجة العينات بالصبغات الهستولوجية و الهستوكيميائية المناعية لمستقبلات Bcl2 و Ki67 و مستقبلات الأندروجين.(AR)

النتائج: أظهرت مجموعة إصابة الكلى الحادة انخفاضًا ذا دلالة إحصائية في هرمون التستوستيرون في الدم مع ارتفاع ذي دلالة إحصائية في المالوندهايد و الجلوتاثيون وديسموتاز الفائق في الأنسجة. كشف فحص الحيوانات المنوية عن ارتفاع ذي دلالة إحصائية في نسبة التشكل غير الطبيعي للحيوانات المنوية مع انخفاض ذي دلالة إحصائية في عدد الحيوانات المنوية. أظهر الفحص النسيجي العديد من التغيرات النووية و الستوبلازمية في نسيج الخصية مع ارتفاع ذي دلالة إحصائية في ترسب ألياف الكولاجين. تم تسجيل انخفاض ذي دلالة إحصائية في التعبير الهستوكيميائي المناعي لكل من Bcl2 و Ki67 و .AR بينما أدت المعالجة المسبقة بزيت السمسم إلى تحسن ذي دلالة إحصائية لجميع المتغيرات المدروسة.

الاستنتاجات: أثر إصابة الكلى الحادة بشكل كبير على بنية و وظيفة الخصية من خلال آليات مختلفة. بينما يخفف زيت السمسم بكفاءة من هذا التأثير الضار من خلال أنشطته المضادة للأكسدة و لموت الخلايا المبرمج و لتكاثر الخلايا و للالتهابات وللتليف.