Original Article

Pharmacology

The Effects of Monosodium Glutamate on the Histology of Fallopian Tube in Female Rats

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ABSTRACT

Objective: To investigate the effects of orally administered monosodium glutamate (MSG) on the fallopian tube histology in adult female Wistar rat model.

Study Design: Experimental/Analytical study

Place and Duration of Study: Animal House, Isra University Hyderabad from May to November 2013.

Materials and Methods: Forty adult male Wistar rats were divided into three groups; Group A. controls received 0.9% isotonic saline, Group B. received MSG orally (1.5 mg/kg), and Group C. received MSG orally (3 mg/kg). The animals were sacrificed after six weeks. Fallopian tubes were fixed in 4% formaldehyde, and were embedded in paraffin. Tissue sections of 5µ thicknesses were subjected to haematoxylin and eosin staining and were assessed by light microscopy.

Results: The fallopian tubes (FT) of the control group A showed normal histological features. The fallopian tubes of the treated groups showed some cellular hypertrophy of the columnar epithelium, distortion of the basement membrane separating the endosalpinx from the myosalpinx. There were degenerative and atrophic changes observed in some parts; these were more pronounced in those that received 3 mg/kg body weight of MSG. There were marked vacuolations and lysed red blood cells, (3 mg/kg body weight treated rats) appearing in the stroma cells

Conclusion: The monosodium glutamate may have deleterious effects on the fallopian tube histology in adult female Wistar rats particularly in high dose. Therefore caution must be taken for its frequent use in female because of possibility of female infertility.

Key words: Histology, Fallopian Tube, Monosodium Glutamate, Female Rat.

INTRODUCTION

The Fallopian tubes are paired, tubular, seromuscular organs which run medially from the cornua of the uterus toward the ovary laterally at the upper margins of the broad ligaments between the round and utero ovarian ligaments.[1] Millions of tiny hair-like cilia line the fimbria and interior of the fallopian tubes. The cilia beat in waves hundreds of times a second catching the egg at ovulation and moving it through the tube to the uterine cavity, Other cells in the tube's inner lining or endothelium nourish the egg and lubricate its path during its stay inside the fallopian tube.[2] The tubal wall consists of three layers: the internal mucosa (endosalpinx), the intermediate muscular layer (myosalpinx), and the outer serosa, which is continuous with the peritoneum of the broad ligament and uterus, the upper margin of which is the mesosalpinx. The endosalpinx is thrown into longitudinal folds, called primary folds, increasing in number toward the fimbria and lined by columnar epithelium of three types: ciliated, secretory, and peg cells. In the ampullary and infundibular sections, secondary folds of the tubal mucosa also exist, markedly increasing the surface areas of these segments of the tube. The myosalpinx actually consists of an inner circular and an outer longitudinal layer to which a third layer is added in the interstitial portion of the tube. The serosa of the tube is composed of an epithelial layer histological indistinguishable from peritoneum elsewhere in the abdominal cavity. [2,3]

Currently many studies have reported deleterious effects of Monosodium glutamate (MSG) on the histology of fallopian tubes in female rats.[3,4] The MSG is commonly known as AJINOMOTO.[5] MSG is the sodium salt of a naturally occurring amino acid; the glutamic acid. MSG is commonly marketed as a flavour enhancer and is used as a food additive particularly in West African and Asian dishes.[6,7] Generally, monosodium glutamate is accepted as a safe food additive that needs no specificied average daily intake or an upper limit intake.[8] An experimental study demonstrated that both subcutaneous injection and oral administration of MSG to immature rats and mice resulted in neuronal losses in the hypothalamus.[9] The ability of monosodium glutamate to damage nerve cells

of the hypothalamus is a pointer to the fact that it may alter the neural control of reproductive hormone secretion via the hypothalamic-pituitary-gonadal regulatory axis. The effects of such toxicants on male reproduction may be anatomical or only functional, depending on whether they produce structural changes in the reproductive system, or merely affect the functions of the reproductive organs.[10]

In the last few years, fear had increased due to the adverse reactions and toxicity of MSG, with few and limited literature regarding the histological studies of the damage in fallopian tubes of animals treated with MSG. Therefore, the present study aimed to investigate some probable histological effects of MSG on the fallopian tube histology in adult female Wistar rats.

MATERIALS AND METHODS

The present experimental study included forty young adult male Wistar rats at animal house of Isra University from May to November 2013. Adult female Wistar rats of 250-300 grams were included, while male rats weighing <250 grams or >300 grams were excluded from the study.

- **Animals:** The Animals were housed in animal house at an optimal room temperature with 55-60% humidity and exposed to 12 hour light-dark cycles. The chaw like fresh alfalfa and clean water are provided freely. The rats were divided into three groups;
  - **Group A. Control Group** (n=10) Rats received 0.9% isotonic saline orally on alternate day for three successive weeks and served as control group,
  - **Group B.** (n=10) Experimental Rats were given 1 mg/kg of monosodium glutamate orally.
  - **Group C.** (n=10) Experimental Rats were given 3mg/kg of monosodium glutamate orally.
- **Chemical:** The chemical used was monosodium glutamate (C5H9NO4-Na+). The MSG was purchased from the open market of Hyderabad under the license of Ajinomoto co.INC. Tokyo, Japan. A stock solution was prepared by dissolving 30 and 60 g of MSG crystals in 100 ml of distilled water. The dose schedule was so adjusted that the amount of MSG administration per animal was as per their respective weight. The MSG doses were given for six weeks. The applied doses were selected according to as referenced.[11]
- **Fallopian tube histology:** At the end of the experimental period, the animals were sacrificed by cervical dislocation and the abdominal cavity was opened up to expose the fallopian tube which were quickly dissected out, and fixed in 10% formal saline for routine histological techniques. The tissues were dehydrated in an ascending grade of alcohol (ethanol), cleared in xylene and embedded in paraffin wax. Serial sections of 3–4 lm thick were obtained using a rotator microtome. The deparaffinized sections were stained routinely with hematoxylin and eosin. Sections of fallopian tube were examined by light microscope. Photomicrographs of the desired sections were obtained for microscopic details..

RESULTS

The present study was conducted to evaluate the effects of monosodium glutamate (MSG) on the histology of testis in rat model. The MSG was given in different doses in the experimental group animals as mentioned in methodology. The control group revealed normal histology. The fallopian tubes (FT) of the control group A showed normal histological features, illustrating a well defined tubal wall which consists of three layers: the internal mucosa (endosalpinx), the intermediate muscular layer (myosalpinx), and the outer serosa (Fig. 1).

The experimental groups (Groups B and C) were studied separately for the microscopic structure of fallopian tubes. The major derangements were observed in the fallopian tubes of high dose MSG treated rats (3 mg/kg body weight). The histological details of experimental rats are shown in figure 2-3.

The fallopian tubes of the treated groups showed some cellular hypertrophy of the columnar epithelium, distortion of the basement membrane separating the endosalpinx from the myosalpinx. There were degenerative and atrophic changes observed in some parts; these were more pronounced in those that received 3 mg/kg body weight of MSG. There were marked vacuolations and lysed red blood cells, (3 mg/kg body weight treated rats) appearing in the stroma cells (Figs. 2 and 3).

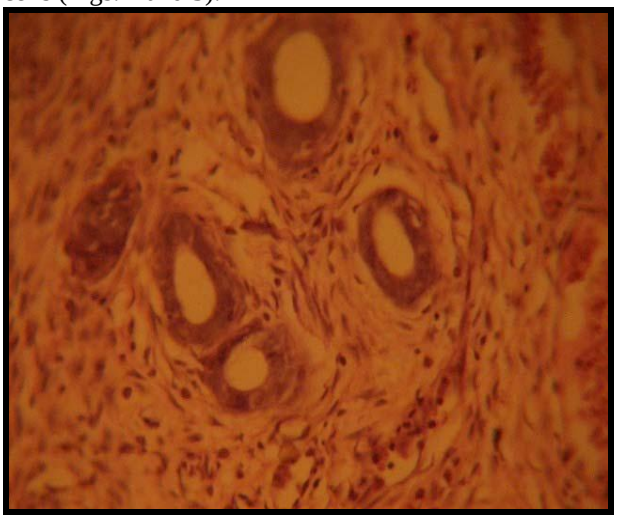

Figure No. 1: Section of testis from rats of control group (Group A) rat showing semniferous tubules (T) and interstitial spaces (N) showing normal Leydig cells (H & E stains, × 400).

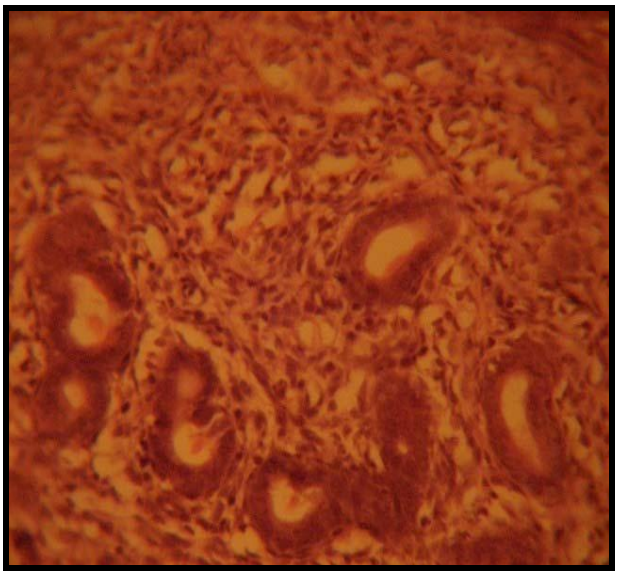

Figure No.2: Section of testis from rats (experimental group B) treated with monosodium glutamate (1mg/kg body weight) showing seminiferous tubule (T) with lots of spermatids, and oedematous interstitial space (N). (H & E stains, × 400).

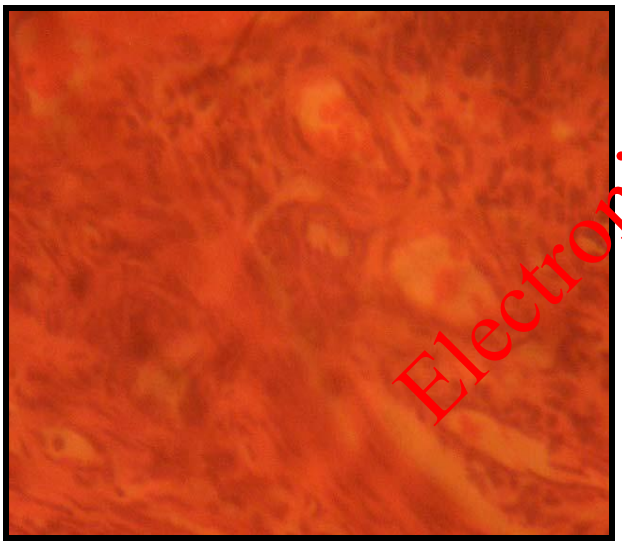

Figure No.3: Section of testis from rats (experimental group B) treated with monosodium glutamate (2mg/kg body weight) showing seminiferous tubule (T) with only few spermatids and interstitial space (N) with inflammatory exudates. H&E stains, ×400

DISCUSSION

The results of the hematoxylin and eosin staining (H & E) reactions showed some cellular hypertrophy of the columnar epithelium, distortion of the basement membrane separating the endosalpinx from the myosalpinx. Degenerative and atrophic changes were observed in some parts; these were more pronounced in those that received 3 mg/kg of MSG. There were marked vacuolations and lysed red blood cells (3 mg/kg treated rats) appearing in the stroma cells.

The increase in cellular hypertrophy of the columnar epithelium in the treatment groups as reported in this study may have been as a result of cellular proliferation caused by the improved intake of food which MSG influences.[12,13,14] The vacuolations observed in the stroma of the fallopian tubes in this experiment may be due to MSG interference. Degenerative and atrophic changes and lysed red blood cell which were observed were more pronounced in the groups treated with higher dose (3 mg/kg) of MSG.

As a result of the distortion and disruption in the lumen of the fallopian tubes, the ciliary action and other functions of the fallopian tubes may have been highly affected as a result of probable toxic effect of MSG. It may be inferred from the present results that higher dose and prolonged administration of MSG resulted in degenerative and atrophic changes observed in the fallopian tubes. The actual mechanism by which MSG induced cellular degeneration observed in this experiment needs further investigation.

Degenerative changes have been reported to result in cell death, which is of two types, namely apoptotic and necrotic cell death. These two types differ morphologically and biochemically.[15] Pathological or accidental cell death is regarded as necrotic and could result from extrinsic insults to the cell such as osmotic, thermal, toxic and traumatic effects.[16] In this experiment MSG could have acted as toxins to the epithelial cells of the fallopian tubes. The process of cellular necrosis involves disruption of membrane's structural and functional integrity which was also a landmark of this experiment.

Cell death in response to toxins occurs as a controlled event involving a genetic programme in which caspase enzymes are activated.[17].

CONCLUSION

The monosodium glutamate may have deleterious effects on the fallopian tube histology in adult female Wistar rats particularly in high dose. Therefore caution must be taken for its frequent use in female because of possibility of female infertility.

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