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ORIGINAL ARTICLE

Effect of Zinc on Spermatogenesis

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ABSTRACT

Aim: To determine the effect of zinc on spermatogenesis
Methodology: the study was done at Shahida Islam Medical Complex, Lodhran. 60 albino rats were selected and divided into 4 groups each consisting of 15 albino rats each. The first control group-1 was feed with normal diet, while the group-2 and group-3 were treated with indomethacin and zinc respectively. Whereas the group-4 was treated with both zinc and indomethacin. This intervention was carried out for 12 weeks. Once the study was concluded, the rats were euthanized and histopathological analysis of the testes was carried out to determine the effect on spermatogenesis.
Results: group 4 showed favorable results in which normal spermatogenesis could be observed, in group 2 however, focal loss of germ cells series was seen as well as focal basement membrane detachment.
Conclusion: the study can safely say that zinc metal exhibits a protective role on the testes of albino rats
Keywords: Spermatogenesis, Albino rats, Zinc, Indomethacin, Sertoli cells

INTRODUCTION

In the list of many antioxidants used in medicine, Zinc is another important member. Zinc a metal, is available in the various forms including zinc acetate, zinc oxide and zinc gluconate[1]. It helps in controlling a very important enzyme called superoxide dismutase, a valuable assest for the protection of the cells from damages by free radical production. Zinc is present in copious amount in the semen[2]. Furthermore, it plays a prudent role in the process of spermatogenesis as well as sperm motility[3]. Zinc being a potent antioxidant has the ability to reduce oxidative stresses being developed in the sperm[4]. Therefore, for normal sperm functioning zinc is needed[5]. Once zinc has been administered, it leads to the formation of metallothionein[6]. In the vast list of Non-steroidal Anti-inflammatory Agents (NSAIDs), another one indomethacin is also used which is a non-selective COX-1 and COX-2 inhibitor. Although, indomethacin is widely used for its many benefical effects as a pharmacological agent, it does however have negating effects of spermatogenesis, these include azoospermia and oligospermia[7].

Considering the antixodiant effects that zinc has, a study was conducted to see if zinc can halt the toxic effects of indomethacin during spermatogenesis in albino rats

METHODOLOGY

After attaining adequate approval from the institutional review board, a longitudinal study was carried out at Shahida Islam Medical Complex, Lodhran, from 30 June 2020 to 30 December 2020. For this study, a total of 60 male albino rats were selected that weight between 200-300 grams from ISRA University. Before the study was to be initiated, all the animals were kept in room temperature (37◦C) for 7 days so that can acclimatized. Indomethacin and zinc were the pharmacological agents to be tested, both of which were to be given for a period of 12 weeks. Zinc was to be administered in syrup form in 20 mg/ 5ml orally, whereas the dose for indomethacin was to be 10mg/kg. Once the animals and the pharmacological agents were acquired, the male albino rats were divided into 4 groups of 15. The following was the parameters set in each group. Group 1 (Control Group): 15 albino rats were administered a normal daily diet. Group 2 (Indomethacin Group): 15 albino rats were treated with indomethacin 10mg/Kg for 12 weeks. Group 3 (Zinc Group): 15 albino rats were given zinc 20mg/ 5ml orally for 12 weeks. Group 4 (Combination Group): 15 albino rats were treated with a combination of Zinc and Indomethacin in their aforementioned doses administered for 12 weeks.

Figure-1: Testicular tissue with normal spermatogenesis in Control group-I. 10 x 100 H&E

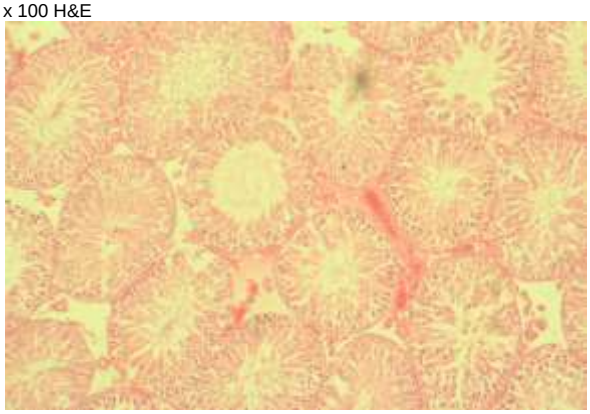

Figure-2: Testicular tissue with suppressed spermatogenesis in Indomethacin treated group-2. 10 x 100 H&E

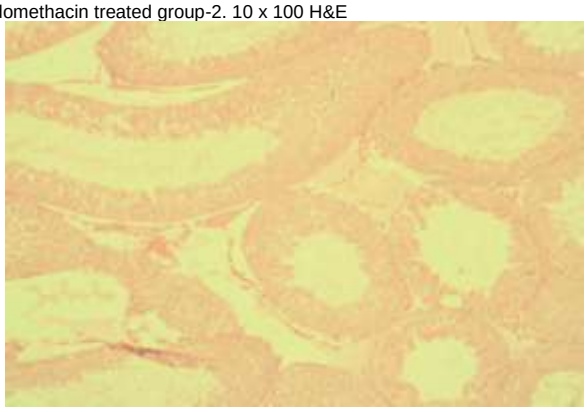

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Figure-3: Testicular tissue with normal spermatogenesis in Zinc treated group-3. 40 x 100 H&E

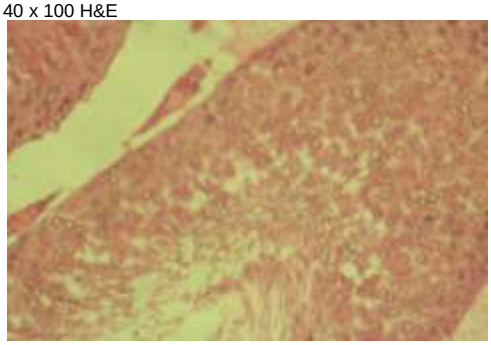

Figure-4: Testicular tissue with normal spermatogenesis in group-4 treated with both zinc and indomethacin. 10 x 100 H&E

All albino rats were observed for their daily activities and were weighted using an electronic weight machine on a weekly basis. At the end of the 12 weeks, all the animals were euthanized after which the histopathological study could be carried out. A midline incision was made up to the scrotum. The testes were excised from the animals and kept in a bouin's fluid for 2 days. The tissue sample was prepared on a slide and stained using the conventional H&E staining. Histological examination was then carried out using a light microscope.

RESULTS

Normal series of spermatogenesis was exhibited in the albino male rats of the control group with an intact basement membrane. Presence of Sertoli cells and leydig cells was also evident. Furthermore, on microscope examination multiple layers of germinal epithelieum was seen.

An overall decrease in the amount of spermatogenesis was seen in the indomethacin group with detachment of the basement membrane. Focal loss of normal distribution of germ cell was also visible on inspection. The amount of leydig cells was also diminished as compared to the control group.

The group given the combination regime showed an slight increase in spermatogenesis, and mostly had a basement membrane well intact. Spermatogenic cells were also visible on microscopy.

DISCUSSION

Our result indict the zinc is essential for spermatogenesis, and even in the presence of indomethacin which has adverse effects on spermatogenesis, it didn't have any negating action on it due to the presence of zinc. Zinc induces metallothione which has antioxidant activity thereby offering protection to the cell against any noxious agent. If there is a deficiency of zinc in rats, there can be alteration in the seminiferous tubules. Zinc suppresses the toxic effects of indomethacin on the testes. Similar finding was also seen in another previous study by Jehangir et al 2009. Atrophy of the seminiferous tubules could be observed after the provision of propoxur (PPX) by Oyewopo et al 2010. Combination therapy of zinc and indomethacin had no negative effects on the spermatogenesis in male albino rats, this finding was also reported by Falana et al 2012. Hamieda et 2002, also found similar results to our study. Babaei et al 2007 was also able to study the protective effects on zinc in the testes and conclude that zinc is a positive agent for spermatogenesis. Zinc is used to stimulate spermatogenesis even if it is disturb by some drugs. Zinc plays very important role in immune system and is protective for free radicals injury (8). Zinc is very important for human and acts as cofactor in many enzymes.(9). Zinc forms metallothione in which acts as scavenger of OH. Deficiency of zinc make human cells more susceptible to oxidative injury(10). Zinc is having good effect in growth and development; this is due to involvement of zinc in bone metabolism. Zinc is very important in synthesis of growth hormone and other hormones[11]. Reports showed that intake of zinc is helpful in the proliferation of germinal cells[5], and on the contrary diet lacking the zinc is a found as a potent risk leading to poor sperm quality and male infertility[12]. Thus the dietary supplements with antioxidants, fruits, vegetables, sea food, milk and zinc is having significant association with sperm quality[13].

Zinc is excreted from the prostate gland so it is zinc levels in seminal plasma typically represent prostatic secretory function[14]. As the human can't store the zinc in the body so zinc is essential nutrient required daily for the maintenance of healthy life style (Rink and Gabriel, 2000). The recommended daily dietary requirement for the zinc varies with sex and age of the individual and is 11mg/day for the males and 8mg/day for the females[15].

According to world Health Organization (WHO) one-third of the world's population is suffering from zinc deficiency[4], and its deficiency leads to numerous diseases. The reproductive health as well as normal fertilization of either gender is dependent on body sources of zinc. The zinc keeps the sperm cells protected from the bacterial infection as is evident from the higher zinc content of zinc in semen as compared to blood. Another role of zinc is in protection of sperms while within the female reproductive tract and also from chromosomal damage[16].

Hypogonadism is very common due to zinc deficiency[3,15,21]. Millar et al[17] in a study reported the deficient development of the accessory sex glands in the rats with deficiency of zinc. Zn concentrates in the testis at high quantity which is comparable to those in liver and kidney[1]. In human, the inhibition of spermatogenesis and sperm abnormalities have been observed in patients with Crohn's disease and nutritional disorders, both of which induce a Zn deficiency(Zinc is considered to be essential trace element for spermatogenesis[18].

Zinc collaborate in DNA repair[8]. It has very important role role in cell division and differentiation[17]. It is observed in studies that zinc promotes spermatogenesis and affects sperm motility[19]. Zn plays an important role in spermatogenesis. Zn is located primarily in the Leydig cells, and takes part in the process of spermatogenesis especially late type B spermatogonia, and the spermatids. Zinc is also necessary for the production and secretion of testosterone from the Leydig cells[20].

Zinc is essential cofactor of metaloenzyme involved in spermatogenesis and DNA transcription, expression of steroid receptors, and protein synthesis. It is not known that functional deficiencies in folate and zinc are a risk factor for male subfertility[21].

Most supplements for male fertility contain folic acid and zinc. High zinc's concentration in seminal fluid (approximately 30 times higher than in blood) shoed a link to semen quality, due to its antioxidant functions[22].

CONCLUSION

Zinc has a positive impact on spermatogenesis, even in the presence of toxic or noxious drugs or chemicals.

Conflict of interest: Nil

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