Histopathological and reproductive effect of tamsulosin and finasteride on induced Benign prostate hyperplasia in mice

Shukur Mahmood Yaseen
Medical Biology and Anatomy Department, Faculty of Medicine, Diyala University, Iraq.

Firas R. Al-Samarai
Department of Veterinary Public Health, College of Veterinary Medicine, University of Baghdad, Iraq.

Huda F. Hasan
Department of Physiology and Pharmacology, College of Veterinary Medicine, University of Baghdad, Iraq.

Abstract---The prostate hyperplasia (BPH) was induced in male mice by subcutaneous injection of testosterone propionate (20 mg/kg) for 30 days. Fifty mice were divided equally into five groups, the first group (G1) was (negative control group), and the second group (G2) was (positive Control group) induced BPH previously and inoculated orally distilled water. The third group (G3) was induced BPH and treated orally with tamsulosin (0.156mg /kg), the fourth group (G4) was induced BPH and treated orally with Finasteride (1.495 mg /kg) and finally, the fifth (G5) was induced BPH and treated orally with a combination of tamsulosin and finasteride (0.0825, 0.7475) mg/kg respectively. The histopathological results showed prostate hyperplasia and abnormal proliferation of the epithelial and stromal cells with inflammation cells accompanying stenosis of acini in G2. Whereas showed a decrease in hyperplasia, and epithelial layer thickness in G3 and G4. Furthermore, prostate shrinkage and the glandular cavities trended towards the normal approach of the prostate in G5. The testosterone levels in G2 showed a significant increase (P<0.05) as compared to other treated groups with a more significant decrease in G4 compared to other treated groups. the sperm motility% and countx10⁶ showed a significant decrease (P<0.05), with a significant increase in the sperm dead% and abnormality% in G2 as compared with all other treated groups, whilst showing a significant increase in motility% and countx10⁶ and a decrease in the dead%, abnormality% in G5 when compared with all other treated groups. Concluded that the Combination dose was
highly competent and more effective in BPH treatment by minimizing the side effect of each drug by decreasing the dose of each one. Besides, the beneficial activity was due to the synergistic interaction drugs that promoted effects to decreasing symptoms of BPH.

**Keywords**—BPH, tamsulosin, finasteride, their Combination, Histopathological Changes, testosterone, and Sperm Count %.

**Introduction**

Benign prostatic hyperplasia (BPH) is a common andrological disease among elderly males. characterized by histological proliferation of the epithelial cells in the transitional zone of the prostate which leads to lower urinary tract symptoms (LUTS), and constriction of the urethra [Fano et al., 2017]. Commonly, testicular hormones and aging are important elements leading to the genesis and development of BPH [Atawia et al., 2013]. BPH was attributed to a highly prevalent and costly condition that mostly affects older animals worldwide. (Hollingsworth and Wilt, 2014).

Alpha-blockers such as Tamsulosin and 5α-reductase inhibitors such as finasteride are currently used for the medical management of BPH. The effect of alpha-blocker treatment initiates more rapidly than finasteride [Ishizuka et al., 2002]. However, these drugs had several systemic side effects such as dizziness, drowsiness, weakness, nausea, nasal congestion, rhinitis, allergies, diarrhea, and reduce fertility rate [Dahm et al., 2017]. Furthermore, finasteride was confirmed to reduce prostate cancer risk and decrease the prostate size by inhibiting the formation of the active androgen DHT metabolite [Gravas and Oelke, 2010]. Combination therapies are commonly applied to treat prostate size and symptoms simultaneously [Strand et al., 2017]. However, the combination between tamsulosin and finasteride effectively reduces symptoms of irritation and obstruction in BPH than is monotherapy. [Wang et al., 2019]. The aim of the current study was to investigate the role of Combination tamsulosin and finasteride in treating BPH by minimizing the side effect of each drug by decreasing prostate hyperplasia and infertility.

**Methods and Materials**

**Experiment design**

Fifty adult males of Swiss albino mice (Balb/c) strain, the ages were (7-8) weeks old and the weight was ranged (24 – 25 gm), mice were provided by the Iraqi Center of the Cancer Research in Baghdad at a period of 21 October 2020. Where they were bred and housed under the standard animal house in Lab Animals house from Medical College – Diyala University, they have been reared under an appropriate environment the temperature was ranged from 22- 26°C, with air-condition and a humidity-controlled between 45% - 55%, in light: dark cycle 12: 12-hour. the mice had food standards (pellets) and water (ad libitum). After the end of induction of BPH, the mice were divided into five groups and the period of treatment was 30 days, the treatment was given orally by stomach tube: (G1): ten
mice without induced BPH and without any treatment. (Negative control group). 
(G2): ten mice will be induced with BPH previously and inoculated with distilled 
water only. (Positive Control group). (G3): ten mice were induced with BPH and 
treated with a tamsulosin dose (0.156 mg /kg). (G4): ten mice were induced BPH 
and treated with Finasteride dose (1.495 mg /kg). (G5): ten mice were induced 
BPH and treated with a Combination of Tamsulosin and Finasteride dose (0.0825, 
0.7475) mg /kg respectively.

**Prostate Histopathological Preparation**

After the end of the period of treatment, the histopathological examination of the 
mice prostate was conducted. The prostate histopathological examination 
procedure was made according to the standard operation procedure of Lab Iraqi 
Ministry of Health, 2013, mice were anesthetized with Diethyl ether inhalation 
and then sacrificed, the prostate samples were taken through anatomical process 
then placed in formalin solution 10% fixation, immediately for 24 hours prior 
steps of the examination, The histopathological examination of the mice prostate 
was done in Al-Secor laboratories in Diyala –Iraq.

**Measurement of testosterone concentration in the serum:**

The determination of the levels of testosterone in mice serum was using an 
Enzyme-Linked Immune Sorbent Assay (ELISA) kit according to the 
manufacturer’s instructions (Calbiotech, TE187S. 1935 Cordell Ct., CA92020), 
The absorbance was measured at 450 nm / 15 minutes, The concentration of 
testosterone in ng/ml was demonstrated by using a microplate ELISA reader (Bio-
Rad Laboratories, Inc.), to obtain concentration Values expressed per mL.

**Determination of the Sperms Function Count:**

The total Sperm count in seminal specimens, dependent on the collection of 
semen for the epididymis was isolated and placed in a Petri dish containing 1ml of 
PBS, which was measured by using a hemocytometer (Neuberger Type) chamber. 
The hemocytometer was filled with 50 µl of a sperm suspension by micropipette 
and covered by a cover slide. The sperms were counted in squares of red blood 
cells by using a light microscope x40. Estimation of sperm was made according to 
the following formula (Silverberg and Turner, 2012).

**Statistical analysis:**

The data were analyzed using one-way ANOVA and the least significant 
differences post hoc test were used to assess the significant differences among 
groups (SAS 2010).

**Results**

**Histopathological changes**

After ending the period of induction and treatment, the histopathological sections 
were taken in the current study, the sectioned tissue of induced BPH in mice after 
30 days, showed prostate hyperplasia and abnormal proliferation of the epithelial
and stromal cells with inflammation cells. as well as, in after a period of treatment of 30 days was revealed severe hyperplasia of epithelial lining acini led to stenosis of acini, noticed the attached pappli project to another side as in figure (1,2). While G3 showed a decrease in hyperplasia, epithelial layer thickness, and proliferation of epithelial, stromal cells. as well, as less hyperplastic changes with few inflammatory cells close to normal as in figure (3). In addition, G4, showed a mild decrease in hyperplasia and the epithelial layer thickness, proliferation of epithelial and stromal cells, with a slight decrease in inflammatory cells, as in figure (4). Finally, G5, showed shrinkage of prostate size with a marked increase in density of the fibromuscular matrix and the glandular cavities trended towards the normal approach of prostate and were varying degrees of relief on prostatic epithelium hyperplasia and thickness of the epithelium and stromal cells, close to normal with less hyperplastic changes. as in figure (5).

Figure (1): The sectioned tissue of induced BPH, showed changes in the lumen of prostate cells by growth (hyperplasia) and abnormal proliferation of the epithelial and stromal cells with inflammation cell, E &H (100X).

Figure (2): The sectioned tissue of induced BPH and treatment, showed severe ever hyperplasia of epithelial lining acini leading to stenosis of acini, and noticed the attached pappli project to another side. (H and E X100).
Figure (3): After treatment with tamsulosin, showed a decrease in hyperplasia, epithelial layer thickness, and proliferation of epithelial, stromal cells, E &H (100X).

Figure (4): After treatment with finasteride, showed mildly decreased in hyperplasia and the epithelial layer thickness, proliferation of epithelial and stromal cells, with a slight decrease in inflammatory cells, E &H (100X).

Figure (5): After treatment tamsulosin with finasteride, showed shrinkage of prostate size with a marked increase in density of the fibromuscular matrix, E &H (100X).
Serum Testosterone (ng/ml) level:

Testosterone (ng/ml) were shown in table (1). The testosterone level of G2 was a significant increase (P<0.05) in mean values (15.14±1.03) as compared with all other treated groups, the testosterone levels in G3 showed a significant increase (11.54±0.86) as compared with G1, G4, and G5. Whereas the testosterone levels in the G4 showed a more significant decrease (4.80±0.88) as compared with the other treated groups, as well as the G5 showed no significant difference (6.30±0.46) when compared with a G1.

Table 1:
Effect of Tamsulosin, Finasteride, and their Combination on Serum Testosterone (ng/ml) of mice-induced BHP

<table>
<thead>
<tr>
<th>Groups</th>
<th>Testosterone (ng/ml)</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>6.20±0.41c</td>
</tr>
<tr>
<td>G2</td>
<td>15.14±1.03a</td>
</tr>
<tr>
<td>G3</td>
<td>11.54±0.86b</td>
</tr>
<tr>
<td>G4</td>
<td>4.80±0.88d</td>
</tr>
<tr>
<td>G5</td>
<td>6.30±0.46c</td>
</tr>
<tr>
<td>LSD</td>
<td>1.40</td>
</tr>
</tbody>
</table>

*Means with a different small letter in the same column are significantly different (P<0.05),

Sperm function count (Motility %, Dead %, Sperm Abnormality % and Sperm Concentration x10^6)

The Sperm Motility % and Countx10^6 of the G2 showed a significant decrease (P<0.05) and revealed a significant increase of the Sperm Dead % and Abnormality % as compared with all other treated groups, whereas, Motility % and Countx10^6 of G3 showed a significant increase (P<0.05) as compared with G4 with a significant decrease as compared with G1 and G5, while Dead %, Abnormality % of G3 showed a significant decrease as compared with G2 with a significant increase as compared with G1, and G5. Motility % and Countx10^6 of the G5 showed a significant increase (P<0.05) when compared with all other treated groups, while the Dead %, Abnormality % of G5 showed a significant decrease when compared with G2, G3 and no significant with G1. were shown in table (2).

Table 2
Effect of Tamsulosin, Finasteride and their combination on Sperm function count of mice induced BHP

<table>
<thead>
<tr>
<th>Group</th>
<th>Motility %</th>
<th>Dead %</th>
<th>Abnormality %</th>
<th>Countx10^6</th>
</tr>
</thead>
<tbody>
<tr>
<td>G1</td>
<td>77.60±2.35a</td>
<td>12.00±1.00c</td>
<td>11.00±0.83c</td>
<td>20.00±0.83a</td>
</tr>
<tr>
<td>G2</td>
<td>28.80±1.85c</td>
<td>47.60±1.07a</td>
<td>26.40±2.35a</td>
<td>11.40±0.81c</td>
</tr>
<tr>
<td>G3</td>
<td>62.60±2.50b</td>
<td>20.20±1.15b</td>
<td>19.20±0.66b</td>
<td>15.00±0.83bc</td>
</tr>
</tbody>
</table>
Discussion

After the end period of treatment, the positive group revealed severe hyperplasia of epithelial lining leading to stenosis of acini, with extensive stroma and unremarkable fibro-muscular matrix, this finding agreed with {Mbaka et al., 2017}, the increases in cells numbers may be regarded to proliferation epithelial and stromal cells {Cunha et al., 2019}. Tamsulosin treated exhibited marked changes in prostate histopathology, such as decreased hyperplasia, and epithelial layer thickness with few inflammatory cells close to normal {Roehrborn, and Rosen 2008}. Finasteride exhibited marked an improvement in histo-architecture of prostatic tissue, which may be attributed to the stromal cell associated with the ability to inhibition of the 5a-reductase type 2 expression {Hwangbo et al., 2018}. In addition to constituting the DHT secretion when enzyme within the stromal cell was the key androgenic amplification step {Roehrborn, and Rosen 2008}. Furthermore, the increased serum testosterone in the positive group may be regarded as the effect BPH had on the ability the stimulation of prostate gland and stimulation of cholesterol which is considered the precursor for the pregnenolone pathway leading to stimulation production of progesterone from testes and then converted to 17- hydroxyl progesterone that played an important role in the synthesis of androgens, especially testosterone, as well as, increase secretion of 5 alpha-reductase lead to increase testosterone hormone {Carson and Rittmaster, 2003}. Besides, the induction of BPH by testosterone promotes the stimulation of 5a-reductase found mainly within the stromal and epithelial cells which converted testosterone into a potent androgen {Mbaka, et al., 2019}. The slight decrease of testosterone in the tamsulosin referred to the effects of a drug on reduced serum testosterone and gonadotrophic concentrations by affecting steroid-forming enzymes in the testes or its inhibitory properties on the adrenergic {Kohistani et al., 2020}. the ability of finasteride in decreasing the levels of steroid hormones, by inhibition of 5a-reductase activity led to reducing testosterone {Traish et al., 2015}. The combination of tamsulosin with finasteride showed a significant decrease in testosterone levels, because of the efficiency of Combination drugs in inhibiting the proliferation of prostatic cells by the synergistic effect of a combination { Odusanya, et al., 2017}.

The sperm function counts of the induced BPH resulted in a significant decrease in motility and sperms concentration, as well as a significantly increased in the dead sperms and sperms abnormality {Dzulsuhaimi et al., 2017}. This result can be attributed to BPH being increased prostatic oxidative stress, hormonal imbalance, and then sperms damage {Flores et al., 2017}. Tamsulosin caused an increase in motility, and sperm concentration, with a significant decrease in dead sperm, and sperm abnormality, these results may be regarded as to leading improved nearly normal levels of testosterone {Mokhtari and Shariati, 2007}. Whereas Finasteride caused a significant decrease in motility, and sperm concentration with an increase significantly in dead and sperm abnormality,
these findings agreed with {Chiba et al., 2011; Askar, 2017}. Moreover, finasteride was a synthetic inhibitor of 5α-reductase and acted by blocking its enzymatic action resulting in erectile dysfunction, loss of libido, and poor sperm quality, such as oligospermia {Angrimani et al., 2020}. Combination treatment caused a more significant increase in motility, and sperm concentration, and a decrease significantly in dead, sperm abnormality, by providing a powerful and preferable therapeutic effect in treating BPH with less incidence of sexual side effects {Zhou et al., 2019}.

**Conclusion**

In combination of tamsulosin with finasteride was more effective and competent in the treatment of BPH than only tamsulosin or finasteride alone due to the synergistic action by using the new formula of combination to minimize the side effects of each drug by decreasing the dose of each one.

**References**


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