An Electron Microscopic Study on the Effects of Prostaglandin $F_2\alpha$ (PG $F_2\alpha$) and Fenugreek Extract on Thymocytes in Thymus Gland

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Abstract

This study was done to clarify the effects of $PGF_2\alpha$ on thymocytes in rat thymus gland, and the possibility of minimizing its effects by using fenugreek extract. The results have shown that $PGF_2\alpha$ can cause a considerable degenerative changes in thymocytes. On the other hand،the fenugreek extract enhances the thymocyte proliferation and at least minimizes the effects of $PGF_2\alpha$ on thymocytes.

Introduction

The prostonoids (prostaglandins (PGs), thromboxanes, and prostacylins) mediate a wide variety of physiological processes including ovulation, hemostasis, platelet aggregation, kidney water balances, and immune responses (1). They exert their effects by binding to specific receptors on cells in the immediate vicinity of their production. $PGF_2\alpha$ has diverse physiological actions in vitro. For instance, it causes vascular smooth muscle contraction (2), hypertrophy of cardiac myocytes (3, 4), and is critical to the induction of labor and parturition in vivo (5). The actions of $PGF_2\alpha$ are mediated via a membrane receptor, which belongs to the G protein-coupled receptor (6, 7, 8). Since PGs have not only cytoprotective but

also independent immunosuppressive effects (9) and the role of thymus gland is well established in the maturation and differentiation of T-lymphocytes, yet to our knowledge no study was devoted to the still poorly exploited aspect of the possibilities of overcome or at least minimize the effects of PG on thymocytes of thymus gland by using fenugreek (aqueous extract) which is the aim of the present study.

Materials and Methods

Fenugreek Schedules: Fenugreek (Trigonella foneum - graecum) seeds were cleaned, and standardized in the "Iraqi National Herbarium". Fenugreek seeds were ground, in a coffee grinder. The seeds powder was suspended in distilled water, mixed by a glass rod, and given through an oro-gastric tube.

Laboratory Animals: Two major groups of Albino rats were used in this study:

A. Control Rats: Controls received 0.2 ml distilled water daily for 28 days through oro-gastric tube.

B. Experimental Rats: These animals were subdivided into 3 subgroups as in the following:

First Group: Animals were given twice daily, via oro-gastric tube 106 mg/kg fenugreek extract.

Second Group: Animals were injected subcutaneously with. (1.5 mg/kg $PGF_2\alpha$ (Sanofi: Santa Nutrition animal) twice daily for 28 days).(10)

The Third Group: Animals were injected subcutaneously with 1.5 mg/kg $PGF_2\alpha$ twice daily and after 1 hour were given via oro-gastric tube 106 mg/kg fenugreek extract for 28 days.

At the end of the treatment, all animals were sacrificed by spinal dislocation and dissected. The thymus glands were removed, cut into small pieces (2 × 2 × 2 mm) and prefixed in 2.5% gluteraldehyde in phosphate buffer pH (7.4). The specimens were post fixed in 1% osmium tetroxide for 1 hour, dehydrated through a series of ethanol dilutions (30%, 50%, 70%, 80%, 90%, 100%), then cleared in propylene oxide and embedded in araldite (11). Ultra-thin sections were prepared and examined by Philips CM10 electron microscope.

Results and Discussion

Electron microscope examination of the thymus in the control animals showed that lymphocytes in the cortex are mainly of large size (immature thymocytes) and medium size (partially differentiated) with rather afew number of small size (completely differentiated) Fig. (1). The present investigation observed a marked increase in the mitotic division in the thymocytes in animals treated with fenugreek extract (Fig. 2). This enhancement in the mitotic division may be related to the fenugreek component since it contains nutritive and restorative properties (12). On the other hand, fenugreek is a rich source of calcium, iron, β-carotene and other vitamins which play an essential role in lymphoid proliferation (13, 14). While animals treated with $PGF_2\alpha$ have shown considerable changes in thymocytes in both cytoplasmic contents and nuclear material. Some of the thymocytes were appeared with irreversable changes, since nuclear material exerts high electron density Fig.(3 ,4,5) showed reversable degenerated thymocytes with fatty infiltration. Their cytoplasm stains relatively light and shows characteristic vacuoles.

These changes might be related to the presence of specific $PGF_2\alpha$ binding site on the thymocyte, since PGs exert their effects via a membrane receptor, which belongs to the G-protein-coupled receptor (1, 6, 7, 8). These changes have no doubt effect the thymic microenvironment and thymic function, including lymphocyte maturation and differentiation.

Although animals treated with fenugreek after $PGF_2\alpha$ treatment exert normal thymocytes appearance in various regions (Fig. 6) but some of thymocytes show vacolated cytoplasm with fat droplets (Fig. 7). These changes exert the essential role of fenugreek in the thymocyte proliferation (13, 14).

From this study , it is concluded that fenugreek extract could at least minimize the effects of $PGF_2\alpha$ on thymocyte. These findings emphasize the conception that fenugreek may be useful for restoration of some immune functions in mature individuals.

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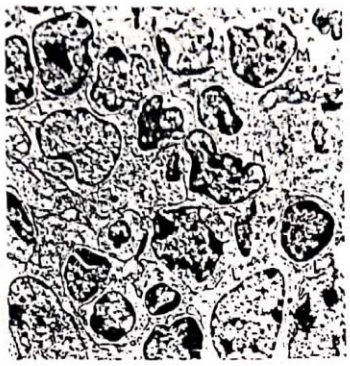

Fig. (1) Cortex of thymus gland in control animal. Uranyl acetate and lead citrate (4400 x).
L: Large size thymocyte, M: Medium size lymphocyte, S: Small size lymphocyte.

Fig. (2) Cortex of thymus gland in animal treated with fenugreek extract. Uranyl acetate and lead citrate (5800 x).
M: Mitotic division, Ly: Lymphocyte.

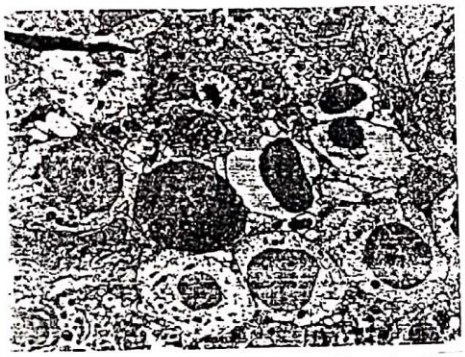

Fig. (3) Cortex of thymus gland in animal treated with $PGF_2\alpha$. Uranyl acetate and lead citrate (4400 x).
V: Irreversible degenerative thymocyte.

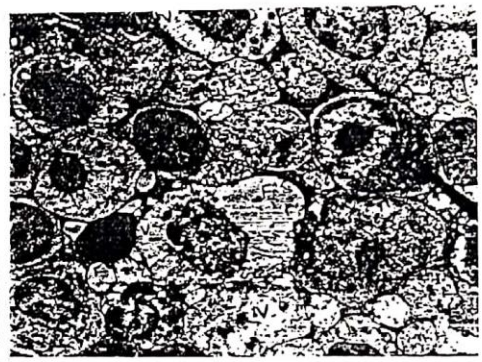

Fig. (4) Cortex of thymus gland in animal treated with $PGF_2\alpha$. Uranyl acetate and lead citrate (3400 x).
V: Vacuole, F: Fatty droplet.

Fig. (5) Fatty infiltration in the cortex of thymus gland in animal treated with $PGF_2\alpha$. Uranyl acetate and lead citrate (3400 x). F: Fat droplet.

Fig. (6) Cortex of thymus gland in animal treated with fenugreek after $PGF_2\alpha$ treatment. Uranyl acetate and lead citrate (3400 x). Note the normal appearance of thymocyte.

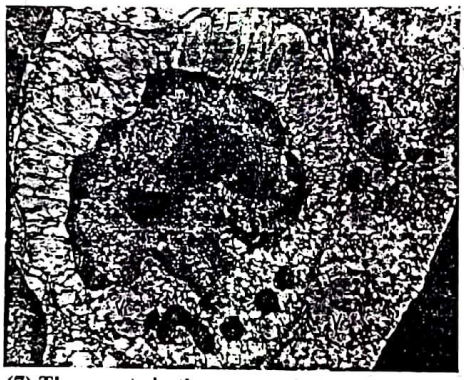

Fig. (7) Thymocyte in the cortex of thymus gland in animal treated with fenugreek after $PGF_2\alpha$ treatment. Uranyl acetate and lead citrate (8700 x). M: Mitochondria, N: Nucleus, V: Vacuole, F: Fat droplet.

مجلة ابن الهيثم للعلوم الصرفة والتطبيقية المجلد 18 (2) 2005

دراسة في المجهر الإلكتروني على تأثير الموثين$F_2\alpha$ ومستخلص الحلبة على الخلايا التوتية في غدة التوتة

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الخلاصة

أجريت هذه الدراسة لإلقاء الضوء على تأثيرات الموثين $F_2\alpha$ في الخلايا التوتية في غدة االتوتة للجرذ. وتضمنت دراسة إمكانية تقليل تأثيرات الموثين باستخدام مستخلص الحلبة. أظهرت النتائج أن الموثين@F2 تؤدي إلى تنكس ملحوظ في الخلايا التوتية. ومن جهة أخرى فإن مستخلص الحلبة يزيد من تكاثر الخلايا التوتية مما يؤدي على الأقل إلى التقليل من تأثيرات فعل الموثين في الخلايا التوتية.

ومستخلص الحلبة على الخلايا التوتية $F_2\alpha$دراسة بالمجهر الإلكتروني على تأثير الموثين في غدة التوتة