International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s,2025
https://theaspd.com/index.php

The Effect Of PRP (Platelet Rich Plasma) Administration On The Histomorphometric Profile Of The Rabbit Ovarian Follicles

Duaa S. Hasson[1], Thaer M. Farhan[2]
[1]Msc. Candidate Histology and Embryology, College of Medicine, Al-Nahrain University, Baghdad, Iraq
https://orcid.org/0009-0003-6946-8461
[2]Human Anatomy, College of Medicine, Al-Nahrain University, Baghdad, Iraq
https://orcid.org/0000-0003-1638-8620
*Corresponding email: duaa.sami0094@gmail.com

ABSTRACT
The ovaries of Oryctolagus cuniculus rabbit are small, ovoid organs situated laterally in the pelvic cavity, comprising an outer cortex and inner medulla containing follicles and stromal tissue, giving their essential role in oocyte production and hormonal regulation, enhancing ovarian function. Platelet-rich plasma (PRP), has clinical significance increasingly utilized across medical disciplines, has emerged as a potential therapy to improve reproductive outcomes. This quantitative analysis study, conducted at the Department of Human Anatomy, College of Medicine, Al-Nahrain University started in (Oct 2024), to evaluate PRP's anatomical and histological effects on rabbit ovaries. Sixty female rabbits were divided into three groups: Group A (control), Group B (intraperitoneal PRP), and Group C (intravenous PRP). Histological analysis revealed significant increase number of primordial and mature follicles, as well as thicker granulosa and thecal layers in both PRP-treated groups compared to controls ($p < 0.001$). Notably, the intraperitoneal group showed superior improvements in folliculogenesis and vascularization relative to the intravenous group. Differences in theca interna thickness between PRP groups were also significantly different ($p < 0.001$). These findings underscore PRP's efficacy—particularly via the intraperitoneal route—in enhancing ovarian structure and function, suggesting its potential as a therapeutic approach for fertility preservation and ovarian rejuvenation
Keywords: *Platelet rich plasma, Ovarian, rabbit, follicle, theca, Granulosa*

1. INTRODUCTION

Rabbit ovaries are tiny, flattened ovoid structures that are located on the left and right lateraly in the pelvic cavity. A single layer of epithelium covers the surface of the rabbit ovary. The underlying ovarian tissue, which is divided into the inner medulla and outer cortex and is made up of follicles and stroma, is separated from the surface cells by a thick the membrane, (tunica albuginea). There are more follicles at each stage of the entire growth phase with a greater ovulation rate, according to studies of the total follicular populations in animals of high and low ovulation rate (1).
The surfaces of the ovaries are covered by connective tissue fibers thick tunica albuginea simple cuboidal or columnar epithelium. Interstitial connective tissue is present in the cortex. The corpus luteum, atretic, mature, primordial, primary, secondary, and tertiary follicles make up the cortical parenchyma. Blood and lymphatic vessels are abundant in the loose connective tissue that makes up the medulla. The ovary serves dual roles as an internal secretory gland and a reproductive organ. (1).
The ovaries play a critical role in female reproductive health, responsible for the production of oocytes and the regulation of hormonal cycles (2).
PRP is a plasma preparation enriched with a platelet concentration above that normally contained in whole blood (3)
Platelet-rich plasma (PRP) was first described by (Marx RE, et al.)
PRP therapy has emerged as promising regenerative treatment in various medical fields, including orthopaedics , dermatology and more recently, reproductive medicine. PRP derived from expression of blood which contains a high level of platelets which release numerous growth factors and cytokines that play pivotal roles in tissue healing and regeneration. These growth factors, such as vascular endothelial growth factors (VEGF), platelet-derived growth factor (PDGF) and transformating growth factor-beta (TGF-β), are known to stimulate cellular proliferation, enhanc angiogenesis, and modulate inflammatory responses

In context of ovarian health, PRP has been proposed as a novel treatment to enhance ovarian function and roster fertility (5). Platelet-rich plasma is defined as an autologous concentration of human platelets that is three to five times greater than physiologic concentration of thrombocytes in whole blood (6)

Mesenchymal stem cells and PRP are used to the repair and regeneration of damaged tissues as regenerative medicine for the treatment of many serious diseases. The locally regenerative and angiogenic effect of PRP has clearly been demonstrated in numerous studies in the field of bone, muscle, tendon, cartilage, and skin growth (7,8)

Through the activation of platelets in PRP, cytokines and growth factors become bioactive and are secreted within ten minutes of coagulation. They can regulate cell migration, fixation, proliferation and differentiation and promote the accumulation of extracellular matrix (9)

Membrana granulosa refers to the inner layer of granulosa cells that surrounds a mature oocyte in a follicle. It is separated from the vascularized layer of theca interna cells by the basement membrane of the follicle (10). Granulosa Cells are Supporting cells for the developing female gamete in the ovary. They are derived from the coelomic epithelial cells of the gonadal ridge. Granulosa cells form a single layer around the oocyte in the primordial ovarian follicle and advance to form a multilayered cumulus oophorus surrounding the ovum in the Graafian follicle. The major functions of granulosa cells include the production of steroids and LH receptors (11).

The theca layer of ovarian follicles is critical not only for maintaining the structure of the follicle but also for delivering nutrients to the granulosa cells and oocyte that reside in an non-vascular environment within the follicle (12). Theca cells are endocrine cells located exclusively in the ovary (13)

2. MATERIALS AND METHODS

The study was approved by the Institutional Review Board (IRB) of the College of Medicine at Al-Nahrain University. All procedures followed the guidelines of the National Institutes of Health for the care and use of laboratory animals.

Animal Housing and Feeding:

The study involved 60 rabbits (Oryctolagus cuniculus) obtained from the animal house of the College of Veterinary Medicine at Baghdad University. The rabbits were aged between 20 and over 75 weeks, with body weights ranging from 1000 to 2600 grams.

The animals were housed in clean, well-ventilated cages at room temperature (25°C), with free access to clean tap water and high-quality food. Two rabbits were housed per cage.The rabbits appeared healthy and active throughout the study.

At the end of the treatment period, all rabbits from the three groups were humanly euthanized by chloroform that had been soaked in cotton swabs and kept in an airtight chamber for 3-5 minutes. Thenafter, the ovaries were carefully dissected, then weighed and measured for volume

Experimental Setting

The animal care and breeding were prepared in laboratory sites at the College of Veterinary Medicine / University of Baghdad.

The research was carried out in the Department of Human Anatomy/ College of Medicine/ AL-Nahrain University. Which lasted for the period from October 2024 through may 2025

Animal grouping and study design

The experimental study design (quantitative analysis) 60 rabbits (Oryctolagus cuniculus) were divided into three groups:

Group A: 20 female rabbits (control) to:

Each rabbit was administered with an equivalent volume of normal saline (0.9% NaCl solution) as placebo into peritoneal for two doses 10 day a part (Five rabbit injected into the animals via intra peritoneal route) and (Five rabbit via intra vascular route).

Group B: 20 female's rabbits (injection with PRP via intra-peritoneal route) to:

platelet-rich plasma (PRP) was used as the treatment. PRP was obtained by drawing 2 mL of blood from each rabbit, which was then processed using a centrifuge (4000 to 6000 revolutions per minute (RPM) for 5-10 minute) to separate the plasma. This PRP was subsequently injected into the animals via intra-peritoneal route for two successive doses (1-5ml/kg) 10 days a part.

Group C: 20 females (injection with PRP via intra-vascular route):
via intra-vascular route for two successive doses (1-5ml/kg) 10 days a part.

Tissue preparation for paraffin section procedure: -

The ovarian specimens were histologically prepared for paraffin section as follows (14):

- Fixation,
- Dehydration,
- Clearing
- Impregnation and embedding
- Sectioning de-waxing
- Staining and mounting.

Staining procedure Hematoxylin and Eosin (H&E):

The paraffin tissue sections for each group were stained with Hematoxylin (Harris Alum hematoxylin) and Eosin stain for general histological tissue examination.

Paraffin sections were stained by dewaxed (deparaffinization) into three sets of xylene (10 minutes for each), then rehydration in descending concentration of ethanol alcohol (100%, 90%, and 70%) then pass to distilled water, three minutes for each exchange, after that, slides were stained with Hematoxylin (Harris Hematoxylin) for one minute, followed by bluing with running tap water for another four minutes, Than stained with eosin for 30 seconds, after that sections were dehydrated in an ascending concentration of absolute ethanol alcohol (70%, 90%, and 100%), three minutes for each exchange, Then transferred to xylene (10) minutes, Than mounted with mounting media (DPX),after that Slides are ready for examination by light microscope

3. RESULT

General anatomical and histological characteristics of the ovarian tissue

Histologically, each ovary is composed of stroma, a dense fibrous connective tissue. It is made up of developing follicles, nerves, blood and lymph vessels. The stroma is further divided into an inner narrow medulla that contains blood and lymph vessels and an outside broad cortex. Ovarian follicles in different developmental phases, regressing follicles such as corpora lutea and corpora albicans, and interstitial cells are all found in the cortex.

Microscopic present data showed distinct structural development in the cortex and medulla of the ovaries. Development of the medium-sized and large ovarian follicles that were occupied more spaces of the cortical and medullary regions. These changes caused indistinct separation of these two regions. Arbitrary of the blood vessels were localized obviously around the large types of follicles which could play their role in subsequent stages of follicular maturation and ovulation.

General anatomical and histological description of the ovary in the study groups (A, B,C)

In Group A (control), the ovaries exhibited a normal external appearance with typical size and weight. The stromal tissue appeared clearly organized, and only a single mature follicle was observed. Additionally, the number of primordial follicles was significantly lower compared to Groups B and C, indicating limited baseline follicular activation under physiological conditions.

In contrast, Group B (intraperitoneal PRP) showed a marked increase in ovarian size and weight. Histologically, there was a significant rise in the number of mature follicles, along with an increased presence of primordial follicles. A noticeable enhancement in vascular density was also observed, along with thickening and maturation of the granulosa cell layers and both the theca interna and externa. These findings suggest a strong local stimulatory effect of PRP on folliculogenesis and stromal remodeling.

Group C (intravenous PRP) also exhibited an increase in ovarian size and weight compared to the control. There was a clear increase in the number of developing and primordial follicles, along with enhanced vascularization. Follicular layers showed signs of improved development and maturation, although slightly less pronounced than in Group B. These observations reflect the systemic effect of PRP on ovarian tissue, with a moderate but still significant stimulatory impact on follicular growth and ovarian structure.

Statistical analysis of the number of primordial follicles in different study groups (A, B and C)

1-comparison of the number of primordial follicles between Group A and Group B.

The mean of primordial follicles number in the IP group (11.48±1.82) showed highly significant differences in comparison with control group with P value <0.001 and mean (6.89±1.61) as shown in Table (1) and Figure (1)

Table (1): Comparison of number of primordial follicles between Group A and Group B

Parameter		Control (A) N=20	IP PRP (B) N=20	P value
No. of Premordial follicles	Mean±SD	6.89±1.61	11.48±1.82	<0.001*
	Median (range)	7.15 (4.4-9.2)	11 (10.2-16.6)	

* P value by Mann Whitney test

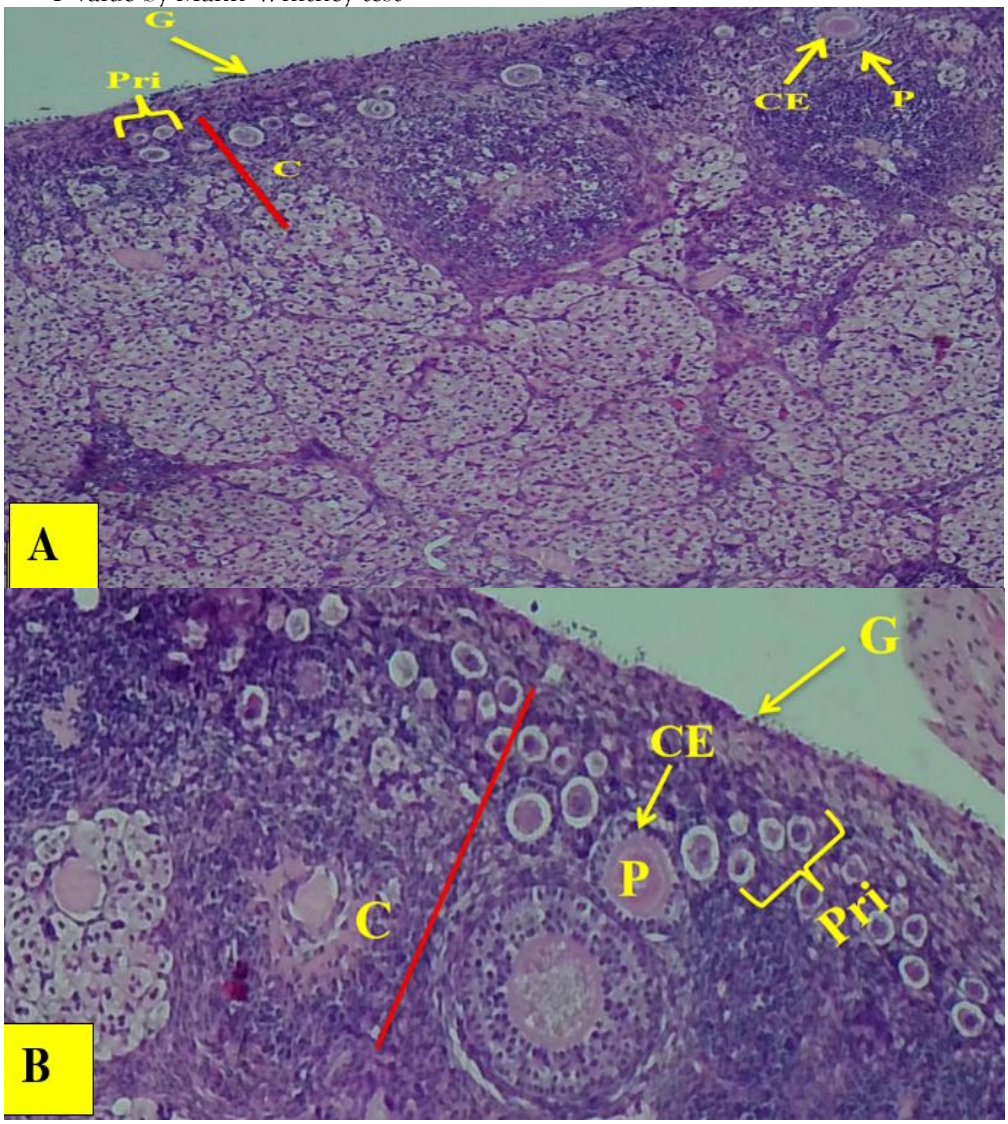


Figure (1) section in ovarian tissue of Group A&B shows the cortex layer (C) with red line covered by (G) germinal epithelium and (CE)cuboidal epithelium surrounding the no follicle (Pri) primordial (p)follicles primary follicles, (10x magnification; H&E) stain

2-comparison of the number of primordial follicles between the Group A and Group C.

The mean of primordial follicles number in the IV group (13.64±1.28) showed highly significant differences in comparison with control group with P value <0.001 and mean (6.89±1.61) as shown in Table (2)

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s,2025
https://theaspd.com/index.php

Table (2): Comparison of number of primordial follicles between Group A and Group C

Parameter		Control (A) N=20	IV PRP (C) N=20	P value
No. of Premordial follicles	Mean±SD	6.89±1.61	13.64±1.28	<0.001*
	Median (range)	7.15 (4.4-9.2)	13.5 (12-15.4)	

* P value by Mann Whitney test

3-comparison of the number of primordial follicles between the Group B and Group C.

The mean of primordial follicles number in the IV group (13.64±1.28) showed highly significant differences in comparison with IP group with P value <0.001 and mean (11.48±1.82) as shown in Table (3)

Table (3): Comparison of number of primordial follicles between Group B and Group C

Parameter		IP PRP (B) N=20	IV PRP (C) N=20	P value
No. of Premordial follicles	Mean±SD	11.48±1.82	13.64±1.28	<0.001*
	Median (range)	11 (10.2-16.6)	13.5 (12-15.4)	

* P value by Mann Whitney test

Comparison of the number of mature follicles

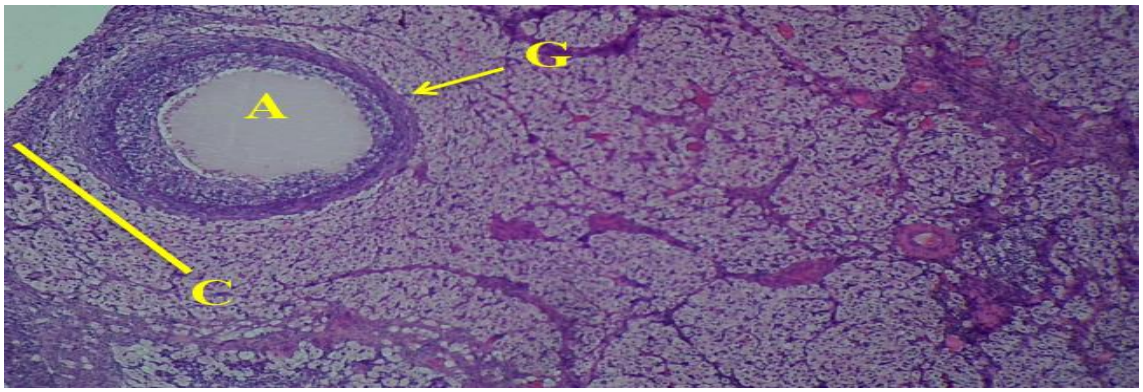
1-comparison of the number of mature follicles between the Group A and Group B.

The mean of mature follicles number in the IP group (6.7±1.84) showed highly significant differences in comparison with control group with P value <0.001 and mean (1.6±0.5) as shown in Table (4) and Figure (2)

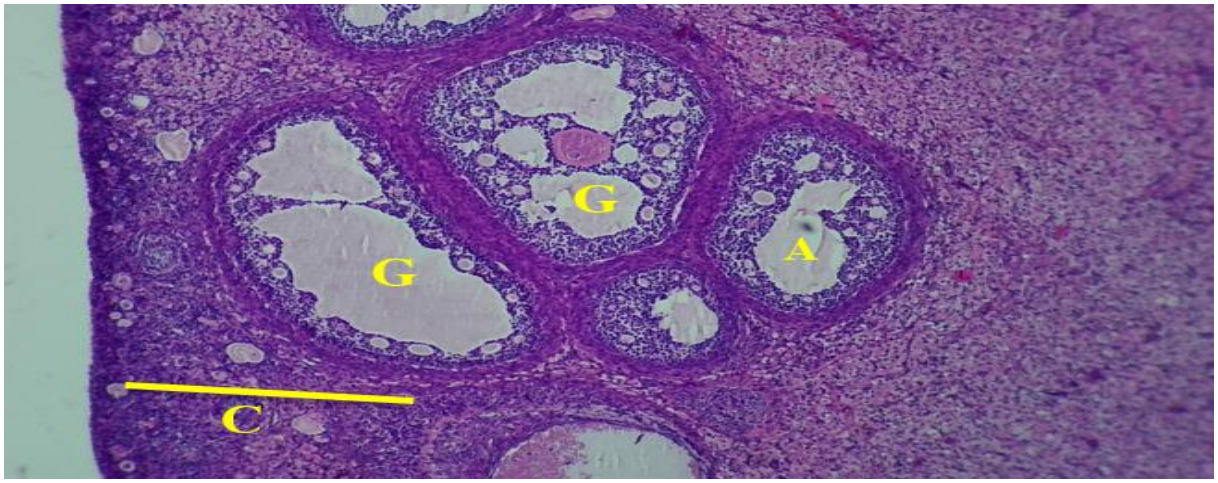
Table (4): Comparison of number of mature follicles between Group A and Group B

Parameter		Control (A) N=20	IP PRP (B) N=20	P value
No. of mature follicles	Mean±SD	1.6±0.5	6.7±1.84	<0.001*
	Median (range)	2 (1-2)	7 (4-9)	

* P value by Mann Whitney test



A



B

Figure (2) section in ovarian tissue of Group A&B shows (G) graafian follicle with and (O) oocyte within (CO) cumulus oophorous within (A) antrum (10x magnification, H&E)

2-comparison of the number of mature follicles between the Group A and Group C

The mean of mature follicles number in the IV group (7.7±2.52) showed highly significant differences in comparison with control group with P value <0.001 and mean (1.6±0.5) as shown in Table (5)

Table (5): Comparison of number of mature follicles between Group A and Group C

Parameter		Control (A) N=20	IV PRP (C) N=20	P value
No. of mature follicles	Mean±SD	1.6±0.5	7.7±2.52	<0.001*
	Median (range)	2 (1-2)	7 (5-13)	

* P value by Mann Whitney test

3-comparison of the number of mature follicles between the Group B and Group C.

The mean of mature follicles number in the IV group (7.7±2.52) showed slight differences in comparison with IP group with P value = 0.265 and mean (1.6±0.5) as shown in Table (6)

Table (6): Comparison of number of mature follicles between Group B and Group C

Parameter		IP PRP (B) N=20	IV PRP (C) N=20	P value
No. of mature follicles	Mean±SD	6.7±1.84	7.7±2.52	0.265*
	Median (range)	7 (4-9)	7 (5-13)	

* P value by Mann Whitney test

Statistical analysis of the granulosa layer thickness in different study groups (A,B and C)

1-comparison of the granulosa layer thickness between the Group A and Group B.

The mean of granulosa layer thickness in the IP group (88.83±18.65) showed highly significant differences in comparison with control group with P value <0.001 and mean (55.53±12.02) as shown in Table (7) and Figure (3)

Table (7): Measurement of granulosa layer thickness in Group A and Group B

Parameter	Control (A) N=20	IP PRP (B) N=20	P value

International Journal of Environmental Sciences
ISSN: 2229-7359
Vol. 11 No. 19s,2025
https://theaspd.com/index.php

Granulosa layer thickness (µm)	Mean±SD	55.53±12.02	88.83±18.65	<0.001*
	Median (range)	52.31 (43.36-82.84)	85.35 (66.23-137.58)	

* P value by Mann Whitney test

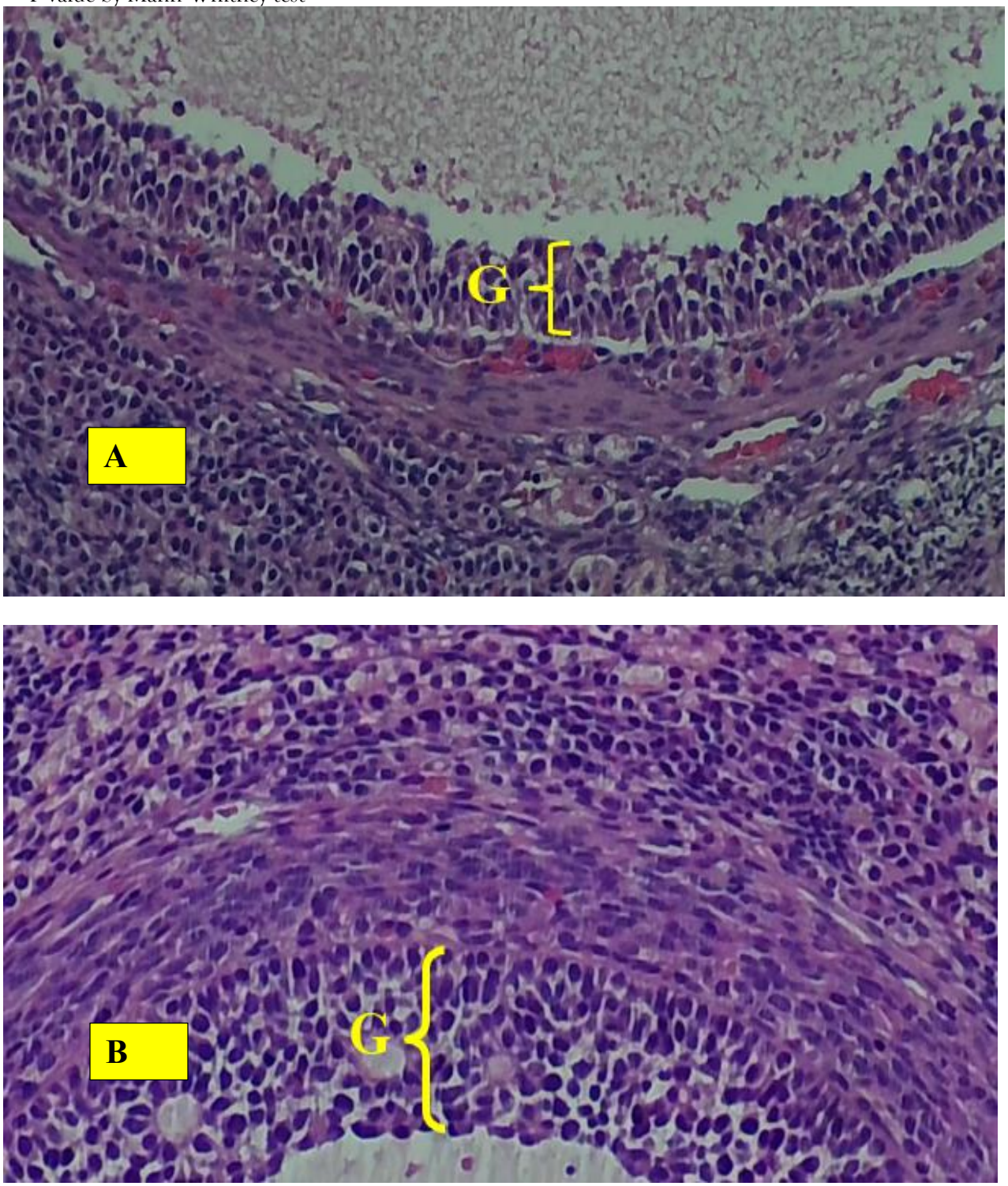


Figure (3) section in ovarian tissue of Group A&B shows, (G) granulosa layer thickness (10x magnification, H&E).

2-comparison of the granulosa layer thickness between the Group A and Group C.

The mean of granulosa layer thickness in the IV group (82.12±12.17) showed highly significant differences in comparison with control group with P value <0.001 and mean (55.53±12.02) as shown in Table (8)

Table (8): Measurement of granulosa layer thickness in Group A and Group C

Parameter		Control (A) N=20	IV PRP (C) N=20	P value
Granulosa layer thickness (µm)	Mean±SD	55.53±12.02	82.12±12.17	<0.001*
	Median (range)	52.31 (43.36-82.84)	80.95 (61.95-104.37)	

* P value by Mann Whitney test

3-comparison of the granulosa layer thickness between the Group B and Group C.

The mean of granulosa layer thickness in the IV group (82.12±12.17) showed slight differences in comparison with IP group with P value = 0.355 and mean (88.83±18.65) as shown in Table (9)

Table (9): Measurement of granulosa layer thickness in Group B and Group C

Parameter		IP PRP (B) N=20	IV PRP (C) N=20	P value
Granulosa layer thickness (µm)	Mean±SD	88.83±18.65	82.12±12.17	0.355*
	Median (range)	85.35 (66.23-137.58)	80.95 (61.95-104.37)	

* P value by Mann Whitney test

Statistical analysis of the of the theca layer thickness in different study groups

1-comparison of the theca layer thickness between the Group A and Group B.

The mean of theca interna layer thickness in the IP group (60.69±8.47) and the mean of theca externa of same group (67.82±6.61) showed highly significant differences in comparison with control group with P value <0.001 and mean (45.45±10.19) (54.33±20.68) as shown in Table (10) and Figure (4)

Table (10): Measurement of theca layer thickness in Group A and Group B

Parameter		Control (A) N=20	IP PRP (B) N=20	P value
T1 Theca Interna	Mean±SD	45.45±10.19	60.69±8.47	<0.001*
	Median (Range)	42.59 (33.85-65.24)	60.28 (46.92-80.42)	
T2 Theca Externa	Mean±SD	54.33±20.68	67.82±6.61	<0.001*
	Median (Range)	48.94 (31.77-122.96)	69.29 (51.8-80.35)	

* P value by Mann Whitney test

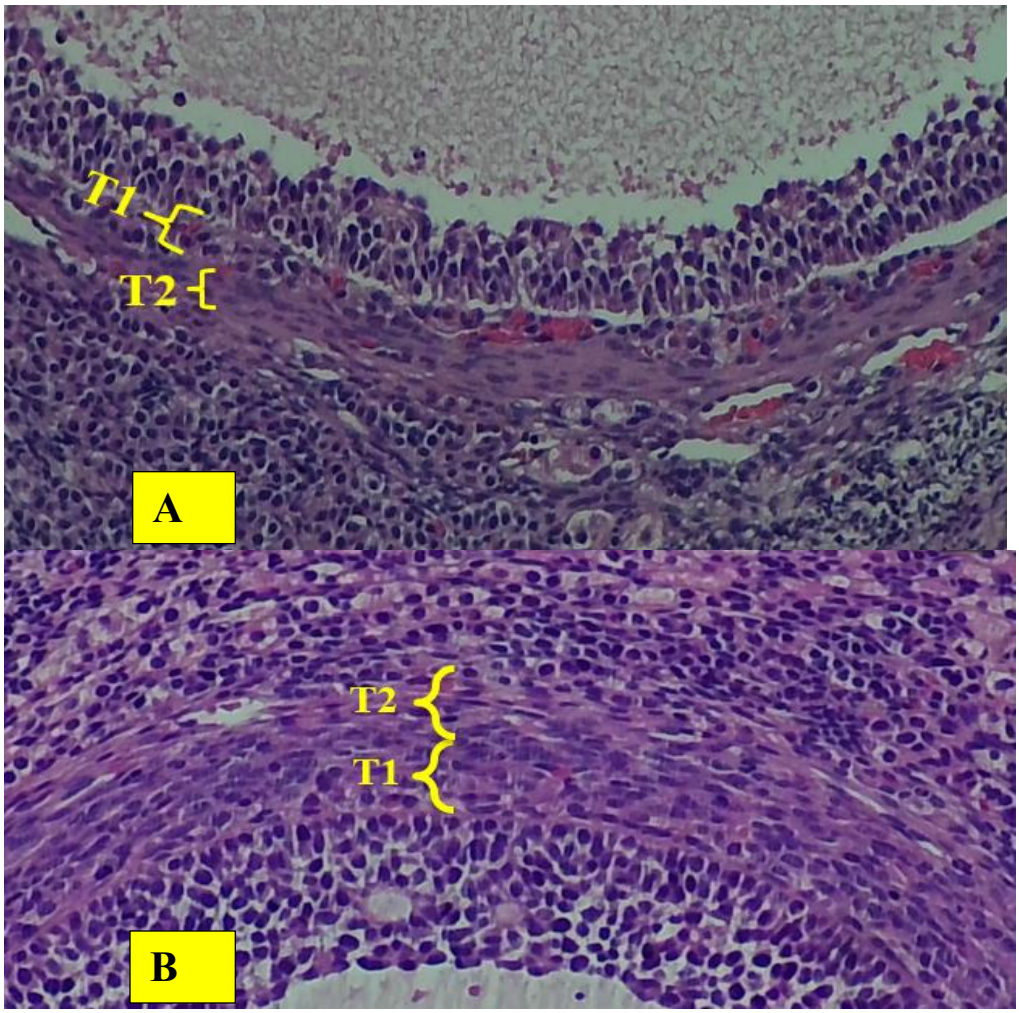


Figure (4) section in ovarian tissue shows, (TI) theca interna (T2) theca externa layer p (10x magnification, H&E).

2-comparison of the theca layer thickness between the Group A and Group C. The mean of theca interna layer thickness in the IV group (52±7.53) and the mean of theca externa of same group (65.13±12.86) showed highly significant differences in comparison with control group with P value <0.001 and mean (45.45±10.19) (54.33±20.68) as shown in Table (11)

Table (11): Measurement of theca layer thickness in Group A and Group C

Parameter		Control (A) N=20	IV PRP (C) N=20	P value
T1 Theca Interna	Mean±SD	45.45±10.19	52±7.53	<0.001*
	Median (Range)	42.59 (33.85-65.24)	52.95 (41.16-66.54)	
T2 Theca Externa	Mean±SD	54.33±20.68	65.13±12.86	<0.001*
	Median (Range)	48.94 (31.77-122.96)	63.73 (47.84-93.36)	

* P value by Mann Whitney test

3-comparison of the theca layers thickness between the Group B and Group C.

The mean of theca interna layer thickness in the IV group (52±7.53) and showed highly significant differences in comparison with IP group with P value <0.001 and mean (60.69±8.47) but the mean of theca externa of IV (65.13±12.86) slight differences in comparison with IP group with P value =0.413 and mean (67.82±6.61) as shown in Table (12)

Table (12): Measurement of theca layer thickness in Group B and Group C

Parameter		IP PRP (B) N=20	IV PRP (C) N=20	P value
T1 Theca Interna	Mean±SD	60.69±8.47	52±7.53	0.001**
	Median (Range)	60.28 (46.92-80.42)	52.95 (41.16-66.54)	
T2 Theca Externa	Mean±SD	67.82±6.61	65.13±12.86	0.413**
	Median (Range)	69.29 (51.8-80.35)	63.73 (47.84-93.36)	

* P value by Mann Whitney test, ** P value by unpaired t-test

4. DISCUSSION

-PRP administration appears to be a promising approach to enhance folliculogenesis and ovarian function. Its proliferative effects on ovarian histological structures—such as granulosa and theca layers suggest a role in tissue regeneration and follicular development.

-PRP has a positive impact on the reproductive tissue of the ovary which is evident by notifying the increased number of the primordial follicles remarkable in experimental groups (b,c) rather than the number of the primordial follicles in the control group this will suggest on a biostatistical base the stimulatory effect of the PRP to promote the folliculogenesis and push this process forward thus the ovarian reserve (number of primordial follicles / ovary) is increased, a promising therapeutic solution of many clinical cases might get benefit from PRP therapy

The microscopic data in the present study showed structural and functional development induced in both cortex and medulla of the ovaries , this maybe expressed as evident cortico-medullary definition, these changes could be due the crucial role of the PRP growth factors that induce growth and proliferative effect.

The growth factors in PRP improve tissue repair by stimulating chemotaxis Proliferation and differentiation of stem cell and angiogenesis (15)

The ovary size and weight has been measured in all groups of the current study which showed marked increase in group B (intra-peritoneal route) ,than group C (intra-vascular route) apart from the control group , these findings might suggest the dominant positive effect on the ovarian tissue (medulla and cortex) this suggestion is agreed with (Ozcan, et al.) who suggest this dominant role of PRP on ovarian cortex volume, and follicles diameter in rat (16).

Ovarian follicles are structure in the ovaries that have two major functions, the production of hormones and gametes (oocyte) . due to hyper secretion LH causing premature oocyte maturation. during folliculogenesis, the oocyte undergoes significant set of genetic, epigenetic and cytoplasmic changes to attain ability for fertilization. (17) thus any factor or treatment like prp that cause more stimulation of pituitary gland to increase secretion of LH hormone and/or increase the activity of LH receptors in ovarian tissue lead ultimately to promot folliculogenesis process step wise forward and to see more number of different ovarian follicles in the ovary, and this what happened in the current study when the number of primordial follicles was increase significantly in experimental groups. When the two

experimental group (B,C) showed a significant increment in the number of primordial follicles in compare to control group.

The method of PRP preparation can be categorized according to the preparation method, the sample content and the proposed application. Preparation vary in terms
of centrifugation speed, time and the use anticoagulants (18) . in the current study
the researchers proposed to use two ways of administration of prp to the study sample (rabbits), one was intraperitoneal and the other was intravascular route

The methodologies for PRP preparations are still under development. Roh et al
2009 demonstrated that PRP activated with mixture of thrombin and calcium that significantly increase the release of many growth factors over many days compared with non-activated PRP (19,20). The activation of prp include the fusion of the granulosa that contain many growth factors fused with the cell membrane, this will transform these secretory proteins within granulosa (like PDGF, TGF-B etc) into a bioactive state by addition of histones. The bioactive proteins are then secreted and bind to receptors of the target cells which include mesenchymal stem cells, osteoblast, fibroblast, endothelial cells, epidermal cells, in addition to other type like those encountered .in the current research work, the PRP tube, used contain calcium as activators for collected PRP. In current study , ovarian cells, like granulosa cells, myoepithelial cells which are stimulated by the PRP effect (21)

Recent research data suggests that PRP-effect on ovarian tissue can promote ovarian function, increase folliculogenesis and angiogenesis (22)

Which conclusively, increase the rate of growth and maturation of ovarian follicles, Thus the research might notice. increased number of the graafian Follicle seen per high power field of ovarian tissue. This mentioned interpretations could be the meaning behind what is seen in the Current study when there is a significant increase in the number of mature ovarian follicles saw in Group B or C in comparison to control gr.(A) with p.value (≤0.001) this indicate available role of PRP injection as a promising solution for non-responding ovary or those patient with anovulatory cycle or those with small sized ovarian follicles .

The PRP administration whether intra-peritoneal or intra-vascular will reactivate follicular growth and might promote IVF cycle Initiation if it is adopted in IVF protocols. although there is still a lack of relevant documented clinical researches on such suggestion(22).

In the current study the findings regarding the thickness of different layers of ovarian follicles leven indifferent stages, Primordial, primary, secondary, and even mature follicles suggested the significant difference study groups B and C (Experimental groups) in Comparison to the control group. when there is evident Increment in the thickness of the granulosa and theca layers. These changes might be attributed to the impact of PRP administration on the ovarian tissue as mentioned in 2024 Yahyavi, et al

Stated that PRP strongly affects granulosa cells determining a high proliferation rate and up regulation of genes that play an essential role in reproduction (23)

In concerning the role of the PRP administration on the status of granulosa cell it was found by previous study due on 2023 by yahya.y. et al that the PRP effectively. Inhibit apoptosis and enhanced cell proliferation of the granulosa cell across all incubation period in that study. Those granulosa cells treated with different doses PRP showed significantly lower levels of apoptosis indicating higher cell viability. This suggests cell survival and proliferation as result of PRP treatment which is evidently agreed with what has been shown in this current study when the number of granulosa cells around the Oocyte is increased which lead significant increase in the layer thickness which suggests that the growth factors present in the PRP have anti-apoptotic effects and promote high rate of granulosa cells proliferation (24)

The ovarian follicles are considered the functional units of the ovary and are comprised of oocyte surrounded by layers of granulosa cells different in morphology according to the maturation and growth stage of the follicle. The granulosa cells specifically work in concern with the oocyte dual action via paracrine factors as well as gap junction signalings which ultimately result in maturation of the egg (25)

The granulosa cells role in steroid-gensis is well studied and summarized, specifically, it is critical role for to process integral to steroid hormones production namely the estrogen, progesterone and androgen by the granulosa cell mitochondria (26)

On the other hand, the aging process causes reduction in the number of ovarian follicles which might lead to reduction of steroid hormones bio synthetic and decrease in granulosa cell activity with aging leads to reduced circulating level of AMH (biomarker for fertility) as wall as reduction in the suggested by the current study result to promote the functional activity of the follicular cells in particular the steroid -producing granulosa cells So conclusively, one might postulate the crucial role of PRP on preserving the fertility status organism and the viability of the ovarian follicles (27).

REFERENCES:

1. Ahmed Mahdi Saleh (2013). Histological study of ovary through last periods (Oryctolagus cuniculus) of pregnancy in domestic rabbit. Kofa journal for Veterinary Medical Sciences. Vol.4 No.1
2. Adrielli Riboldi Ferrari, Sylvia Cortrezzi, Edson Borges Junior, Daniela Braga, Maria do Carmo Borges de Souza, Roberto de Azevedo Antunes (2021). Evaluation of the Effects of Platelet-Rich Plasma on Follicular and Endometrial Growth: A Literature Review. Journal abbreviation: JBRA assisted reproduction doi:10.5935/1518-0557.20210036
3. Malanga, G.A., Goldin, M. PRP: review of the current evidence for musculoskeletal conditions. Curr Phys Med Rehabil Rep 2, 1–15 (2014). https://doi.org/10.1007/s40141-013-0039-5
4. Marx RE, Carlson ER, Eichstaedt RM, Schimmele SR, Strauss JE, Georgeff KR. (1998). Platelet-rich plasma: growth factor enhancement for bone grafts. Oral Surg Oral Med Oral Pathol Oral Radiol Endod. doi: 10.1016/s1079-2104(98)90029-4. [DOI] [PubMed]
5. Dhurat R, Sukesh M.(2014). Principles and Methods of Preparation of Platelet-Rich Plasma: A Review and Author's Per-spective. J Cutan Aesthet Surg. 7:189-97. PMID:25722595 DOI: 10.4103/0974-2077.150734
6. Nebojsa Nick Knezevic, Kenneth D Candido , Ravi Desai, Alan David Kaye (2016). Is Platelet-Rich Plasma a Future Therapy in Pain Management?. Medical Clinics of North America Vol.100 Issue 1
7. Lee KS, Wilson JJ, Rabago DP, Baer GS, Jacobson JA, Borrero CG. (2011) Musculoskeletal Applications of Platelet-Rich Plasma: Fad or Future?American Journal of Roentgenology Volume 196, Issue 3
8. Li W, Enomoto M, Ukegawa M, Hirai T, Sotome S, Wakabayashi Y, Shinomiya K, Okawa A. (2012). Subcutaneous Injections of Platelet-Rich Plasma into Skin Flaps Modulate Proangiogenic Gene Expression and Improve Survival Rates. Plastic and Reconstructive Surgery 129(4):p 858-866, DOI: 10.1097/PRS.0b013e3182450ac9
9. Chang Y, Li J, Chen Y, Wei L, Yang X, Shi Y, Liang X. Autologous platelet-rich plasma promotes endometrial growth and improves pregnancy outcome during in vitro fertilization. Int J Clin Exp Med. 2015;8:1286-90. PMID: 25785127
10. Paul V. Malven (1993). Mammalian Neuroendocrinology. CRC Press(Taylor & Francis)
11. Hoyer, P. B., & Sipes, I. G. (2019). Ovarian Toxicology. In Mammalian Neuroendocrinology. Academic Press
12. J M Young, A S McNeilly. (2010) Theca: the forgotten cell of the ovarian follicle. society for Reproduction and Fertility DOI: 10.1530/REP-10-0094 ISSN 1470–1626 (paper) 1741–7899
13. G F Erickson, D A Magoffin, C A Dyer, C Hofeditz.(1985). The ovarian androgen producing cells: a review of structure/function relationships. National library of medicine
14. Suvarna, K .S., Layton, C. & Bancroft J. D.(2018): Bancroft's Theory & Practice of Histological Techniques E-Book, academic press, Oxford.
15. Julien Pintat, Alain Silvestre, Guy Magalon, Alain Pierre Gadeau, Lionel Pesquer, Anne Perozziello, Alain Peuchant, Charbel Mounayer, Benjamin Dallaudière. (2017). Intra-articular Injection of Mesenchymal Stem Cells and Platelet-Rich Plasma to Treat Patellofemoral Osteoarthritis: Preliminary Results of a Long-Term Pilot Study. National library of medicine
16. Pinar Ozcan, Taha Takmaz, Olgu Enis Tok, Sevde Islek, Esra Nur Yigit, Cem Ficicioglu. (2020). The protective effect of platelet-rich plasma administrated on ovarian function in female rats with Cy-induced ovarian damage. Journal of Assisted Reproduction and Genetics
17. Adrielli Riboldi Ferrari, Sylvia Cortrezzi, Edson Borges Junior, Daniela Braga, Maria do Carmo Borges de Souza, Roberto de Azevedo Antunes (2021). Evaluation of the Effects of Platelet-Rich Plasma on Follicular and Endometrial Growth: A Literature Review. National library of medicine
18. Federica Facchin, Edgardo Somigliana, Andrea Busnelli, Anita Catavorello, Giussy Barbara, Paolo Vercellini (2019). Infertility-related distress and female sexual function during assisted reproduction. Oxford University Press on behalf of the European Society of Human Reproduction and Embryology
19. Y. h. Roh, W. Kim, K. U. Park, J. h. Oh (2016). cytokine-release kinetics of platelet-rich plasma according to various activation protocols. Bone & Joint Research (BJR) vol. 5, No. 2,
20. Sandra S Scherer, Mickael Tobalem, Enrico Vigato, Yvonne Heit, Ali Modarressi, Boris Hinz, Brigitte Pittet, Giorgio Pietramaggiori(2012). Nonactivated versus thrombin-activated platelets on wound healing and fibroblast-to-myofibroblast differentiation in vivo and in vitro. National library of medicine
21. Rachita Dhurat, MS Sukesh (2014). Principles and Methods of Preparation of Platelet-Rich Plasma: A Review and Author's Perspective. Journal of Cutaneous and Aesthetic Surgery, Volume 7, Issue 4
22. Xuanling Li, Huicong Liu, Guangyao Lin and Lianwei Xu (2023).The effect of ovarian injection of autologous platelet rich plasma in patients with poor ovarian responder: a systematic review and meta-analysis. Frontiers in Endocrinology
23. Yahyavi Yahya ; Karimi, Abbas ; Ebrahimi-Kalan, Abbas ; Ramezani, Fatemeh ; Hasanzadeh, Mahdi ; Yousefi, Soudabe ; Sadrekarimi, Hourieh ; Abouasoltani, Neda ; Nouri, Mohammad ; Edalati, Mahdi (2024). Assessment of Platelet-Rich Plasma (PRP) Effects on the Proliferation and Apoptosis of Cyclophosphamide-Induced Damage in Human Granulosa Cells. Pharmaceutical Sciences Vol.30

24. Yahya Yahyavi, Abbas Karimi, Abbas Ebrahimi-Kalan, Fatemeh Ramezani, Mahdi Hasanzadeh, Soudabe Youseif, Hourieh Sadrekarimi, Neda Abouasoltani, Mohammad Nouri, Mahdi Edalati (2024). Damage in Human Granulosa Cells. Pharmaceutical Sciences.
25. Hannah C. Alberico, Dori C. Woods (2022). Role of Granulosa Cells in the Aging Ovarian Landscape: A Focus on Mitochondrial and Metabolic Function. Frontiers in Physiology. Volume 12, Article800739
26. Walter L. Miller (2013). Steroid hormone synthesis in mitochondria. Molecular and Cellular Endocrinology. Volume 379, Issues 1–2.
27. Yifan Liu, Ming Han, Xiaoshuang Li, Hui Wang, Minyue Ma, Shihui Zhang, Yifan Guo, Shuling Wang, Yuanfen Wang, Na Duan, Bing Xu, Jingwen Yin, and Yuanqing Yao (2017). Age-related changes in the mitochondria of human mural granulosa cells. Human Reproduction, Vol.32, No.12 pp