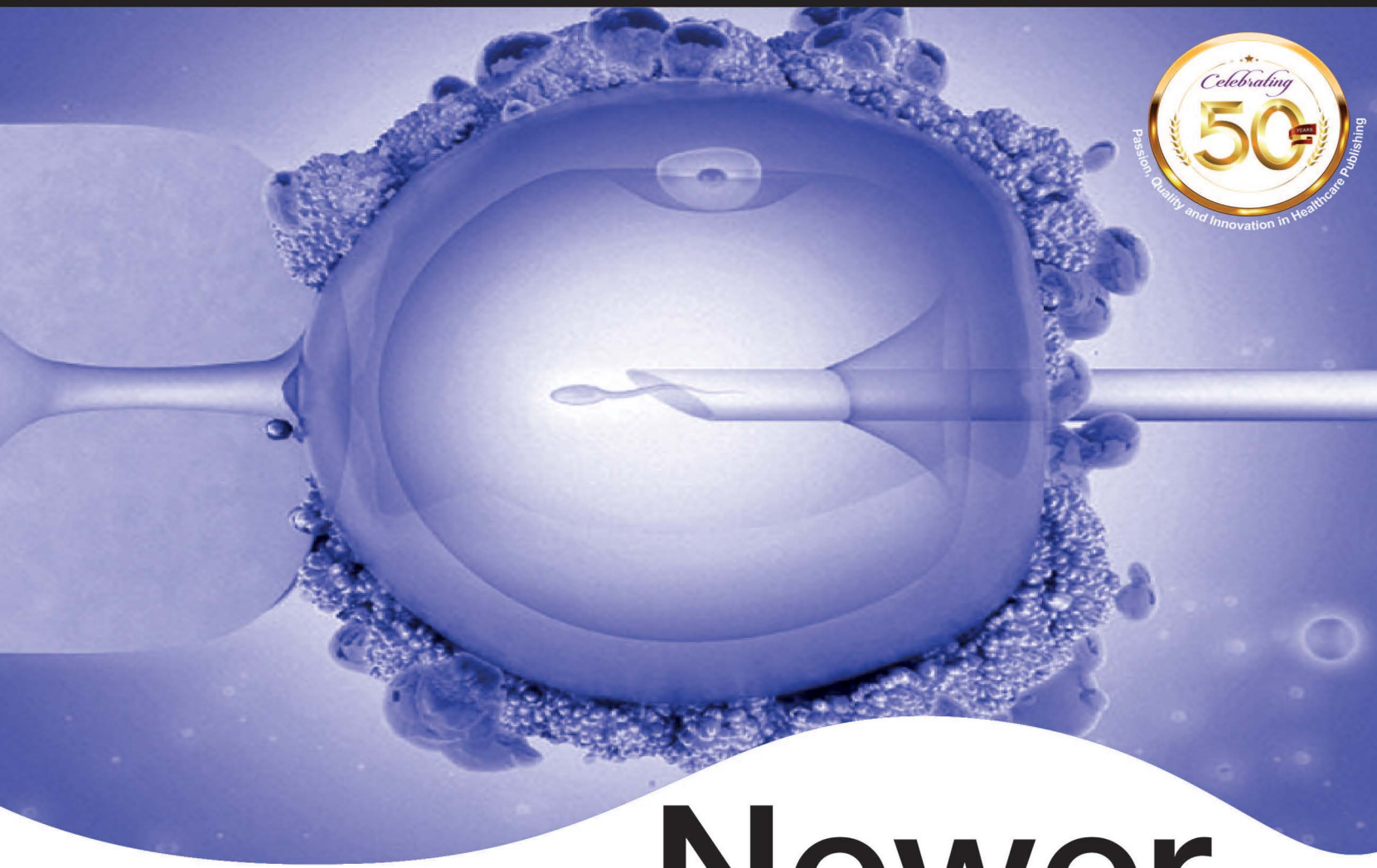
w.jaypeebrothers.com, for detailed information of obstetrics & gynecology books, visit our website www.jaypeebrothers.com, for detailed information of obstetrics & gynecology books, visit our website www.jaypeebrothers.com



Celebrating 50 YEARS
Passion, Quality and Innovation in Healthcare Publishing

Newer Trends in ART

Editors
Nandita Palshetkar
Hrishikesh D Pai
Rishma Dhillon Pai
Sunita Tandulwadkar
Kinjal R Shah
Manisha T Kundnani

JAYPEE

Contents

SECTION 1: Historical Aspects of ART

1. **The Development of In Vitro Fertilization in India** 1
   Rina Agrawal, Elizabeth Burt

SECTION 2: General Principles in Managing Infertile Couples

2. **Understanding Reproductive Physiology in ART** 5
   Pratap Kumar
3. **Evaluation of Female in ART** 9
   Varsha Baste, Shobhana Patted, Shamim Khandaker
4. **Evaluation of the Infertile Male** 16
   Vasan SS, Shashidhar B, Pragya Mishra, Shanti Roy
5. **Thyroid and Infertility** 25
   Jayamangala Gogate, Shashank Joshi, Dhanashri Natu
6. **Prolactin and Infertility** 35
   Manisha Takhtani Kundnani, Vanie Thapar
7. **Obesity and Infertility** 40
   Sanjay Makwana, Renu Makwana

SECTION 3: Common Gynecological Disorders and Infertility

8. **Female Genital Tuberculosis** 45
   JB Sharma, Sona Dharmendra, Shefali Agarwal, Poonam Loomba, Jyoti Gupta
9. **Pelvic Inflammatory Disease** 54
   Sudha Prasad
10. **Endometriosis: Infertility and ART** 58
    Prakash Trivedi, S Krishnakumar, Soumil Trivedi, Rohan Krishnakumar
11. **Adenomyosis: Newer Trends in Assisted Reproductive Technology** 66
    KD Nayar, Kuldeep Jain, Amiti Agrawal, Nupur Agarwal
12. **New Trends in Fibroids and Infertility** 75
    Parul Kotdawala, Mala Raj, Ishwaran, Parzan Mistry

13. **Polycystic Ovary Syndrome** 80
Shivanand Sakhare, Manisha Bhagat, Kundan Ingale

14. **Tubal Factor in Infertility** 88
Muralidhar V Pai

15. **ART in Seropositive Couples** 91
Nandita Palshetkar, Hrishikesh D Pai, Deepa Talreja, Nikita Lad, Shamim Khandaker

16. **Isthmocele: An Under Diagnosed Cause of Infertility** 96
Singh VP, Walker P

SECTION 4: Fertility Enhancing Endoscopic Surgeries

17. **Hysteroscopy: Instrumentation** 101
S Krishnakumar, Aditi Joshi, Rachana Kaveri

18. **Fertility Enhancing Hysteroscopic Surgery** 108
Asha Baxi, Apoorva Pallam Reddy

19. **Fertility Enhancing Laparoscopic Surgeries** 113
Alka Kriplani, Bharti Dhorepatil, Reeta Mahey

20. **Medicolegal Aspects of Endoscopy** 121
Nikhil Datar

SECTION 5: Current Concepts in Male Infertility

21. **Genetic, Lifestyle, and Environmental Factors in Male Infertility** 125
Skand Shekhar, Anne Martini, Alan DeCherney

22. **Medical Management of Male Infertility** 130
Kedar Ganla, Rana Choudhary

23. **Azoospermia** 136
Mohit Saraogi, HD Pai

24. **Oligozoospermia** 140
Vineet Mishra, Pawan Dhir

25. **Sperm DNA Fragmentation: Methods to Determine, Clinical Implications and Approaches of its Reduction** 145
Himanshu Patel, Vidisha Bhatt, Madhuri Patel

SECTION 6: Radiology in Infertility

26. **Ultrasound and Color Doppler in Infertility** 154
Narendra Malhotra, Diksha Goswami, Jaideep Malhotra

27. **Ultrasound Mapping of Fibroids** 164
Mamata Deenadayal, Aarti Deenadayal Tolani, Anupama Deenadayal Mettler

SECTION 7: Ovarian Stimulation

28. **Ovulation Induction and Superovulation** 173
Rishma Dhillon Pai, Madhoo Loomba, Rutvij Dalal

29. **Ultrasonography in Follicular Monitoring** 185
Sonal Panchal, CB Nagori

30. **Intrauterine Insemination** 197
Ameet Patki, Kedar Ganla, Rana Choudhary

31. **Individualization of Controlled Ovarian Stimulation** 204
Damodar R Rao, Abarajda V, Asha R Rao

32. **Mild Ovarian Stimulation Protocol** 211
Korula George, Abha Khurana

33. **Stimulation Protocols in Cancer Patients** 216
N Sanjeeva Reddy, Kamala Selvaraj, Erika Desai

34. **Management of Poor Responders in ART** 221
Nimish R Shelat

SECTION 8: The Endometrium

35. **Endometrium and ART** 229
Korsak Vladislav Stanislavovich, Samoylovich Yanina Andreevna

36. **Thin Endometrium** 234
Sathy M Pillai, KK Gopinath, Fessy Louis, KU Kunjumoideen

37. **Endometrial Receptivity Analysis** 243
Manish Banker, Poornima Nadkarni

38. **Recurrent Implantation Failure** 248
Sulbha Arora, Mirudhubashini Govindarajan, Laxmi Shrikhande

SECTION 9: The IVF Lab: Establishing and Maintenance; and Technical Aspects

39. **Setting of an ART Laboratory** 261
Rajul Tyagi, Meenu Handa, Sunita Arora, Kalyani Bade

40. **Quality Control and Quality Assurance** 264
Alex C Varghese, Julia Szeptycki

41. **Accreditation of the Assisted Reproductive Technique Laboratory** 277
Surendra Pal Singh Virk, Arya Salaskar, Nilam Ghamne

42. **Culture Media** 283
Prashant Patil, Jignasha Chauhan

43. **Gamete and Embryo Morphology** 291
Pinky Shah, Hima Shah

44. Sperm Preparation Techniques 304
Virendra Shah, Randhir Singh, Monica Singh, Anagha Deshpande

45. General Principles of Micromanipulation 311
Steven D Fleming

46. IVF/ICSI/IMSI/PICSI 315
Sudesh A Kamat, Vrunda Kuchekar, Akanksha Mishra

47. Assisted Hatching 330
Kanthi Bansal, Sugandha Goel, Hetal Patolia, Shilpa Damodar

48. Day 3 versus Day 5 Embryo Transfer 337
Biswanath Ghosh Dastidar, Sudarsan Ghosh Dastidar, Geetha Haripriya

49. Time-lapse Monitoring 345
Hrishikesh D Pai, Nandita Palshetkar, Rushika Mistry, Rohan Palshetkar

50. Newer Technologies in the IVF Laboratory 351
RB Agrawal, A Suresh Kumar, Madhuprita Agrawal

51. Troubleshooting in the IVF Laboratory 360
Keshav Malhotra, Gaurav Majumdar

52. Preventing Mix Up in In Vitro Fertilization Laboratory 368
PM Gopinath, Parzan Mistry

SECTION 10: Clinical Procedures and Protocols

53. Oocyte Retrieval 372
Shailendra Mahimkar, Suresh Kumar, Trupti Nagaria

54. Embryo Transfer 377
Sadhana Patwardhan, Mangala Ketkar

55. Frozen Embryo Transfer 388
Jatin P Shah

56. Elective Single Embryo Transfer 394
Gautam Khastgir

57. Luteal Phase Support 402
BN Chakravarty, Sunita Sharma

58. Ovarian Hyperstimulation Syndrome 409
Anupam Gupta, Pooja Mehta

59. Adjuvant Therapies in ART 416
Surekha Kadam, Kinjal R Shah

60. Optimize Oocyte Yield to Maximize Live Birth in Assisted Reproductive Technology 422
Sandros C Estevas

SECTION 11: Beyond ART

61. **Pregnancy after Assisted Reproductive Technology** 428
Vijay Nahata, Arun Baruah

62. **First and Second Trimester Screening** 431
Selvapriya Saravanan

63. **Recurrent Miscarriage** 438
Mala Arora

64. **Ectopic Pregnancy** 444
Suneeta Mittal, Sarita Sukhija, Laxmi Goel

65. **Fetal Reduction** 453
Devika Gunasheela, Ashwini M

SECTION 12: Cryopreservation

66. **Cryopreservation in ART** 459
Hrishikesh D Pai, Nandita Palshetkar, Kinjal R Shah, Arnav Pai

67. **Semen Banking** 470
Milind Shah, Jayshree Pattnaik, Unnati Mamtora, Charumati Pekhale

68. **Oocyte Banking** 476
Nandita Palshetkar, Hrishikesh D Pai, Rohan Palshetkar, Jiteeka Thakkar

69. **Ovarian Tissue Freezing** 481
Pankaj Talwar, Pooja Awasthi

SECTION 13: Third Party Reproduction

70. **Oocyte and Embryo Donation** 490
Maninder Ahuja, Jyoti Malik, Pritimala Gangnurde

71. **Surrogacy** 496
Nayana H Patel, Shivani Sachdev, Gajendrakant Tripathi

72. **Uterus Transplantation** 501
Taswin Kaur, Kamini A Rao

SECTION 14: Preimplantation Genetic Testing

73. **Preimplantation Genetic Testing: A Pivotal Component of ART** 513
Joe Leigh Simpson, Svetlana Rechitsky, Anver Kuliev

74. **Preimplantation Genetic Testing** 520
Ritu Hari, C Mohamed Ashraf, Shailaja Gada Saxena, Dhiraj Gada, Alexia Chatziparasidou

75. PGT: Technical Aspects, Biopsy, and Analysis **530**
Ritu Hari, C Mohamed Ashraf

76. Genetic Analysis: FISH/CGH/Microarray/NGS **535**
Alexia Chatziparasidou

SECTION 15: Regulations of ART in India

77. Guidelines of Assisted Reproductive Technologies and Surrogacy **540**
Roya Rozati, RS Sharma

78. PCPNDT Act versus IVF/ART: Medicolegal Problems in ART **549**
Rajnikant Contractor

SECTION 16: Miscellaneous and Future Directions

79. Application of Stem Cells in Infertility **554**
Sunita Tandulwadkar, Sejal Naik

80. CatSper Channel **559**
Indira Hinduja, Amruta DS Pathare, Kusum Zaveri

81. What is new in Assisted Reproductive Technology? **566**
Reeta Mahey, Hrishikesh D Pai, Arnav Pai

82. Robotics in Infertility: Technical Aspects and its Present Day Relevance **570**
Reem Sabouni, Laurel Stadtmauer

Index *575*

Understanding Reproductive Physiology in ART

2

Pratap Kumar

JAYPEE BROTHERS

OVARIAN CYCLE

The main roles of ovary are gametogenesis and hormonogenesis. The fetal gonads have 6–7 million oogonia, which is reduced to 1–2 million at birth and later 300,000–500,000 at puberty. However, only about 500 will ultimately ovulate in a woman's reproductive years.

During the reproductive years, there is a continuous atresia of oocytes. The follicles are either in resting, growing, atretic, or ready to ovulate. It takes nearly 85 days for a primordial follicle to grow to preantral stage and another 14 days for mature folliculogenesis. The first part of development before antral follicles is hormone independent, whereas the next part from antral to maturity is hormone dependent.

This hormonogenesis has two parts, and it is called "two cell gonadotropin system" **(Fig. 1)**. The theca cells have luteinizing hormone (LH) receptor and granulosa cells follicle-stimulating hormone (FSH) receptors. Stimulation of theca cells produces androgen. FSH induces aromatization in the granulosa cells, which converts androgens into estrogen.

Thus, androgen production influences estrogen production. If androgen is high, it inhibits aromatization and produces follicular atresia. The ideal situation for the initial stage of follicular development is low LH level and high FSH level, as seen in the early menstrual phase.

Follicular phase: Follicular phase is an orderly sequence, which results in development of a mature follicle. This usually takes 10–14 days. It involves four phases **(Fig. 2)**:

1. Recruitment
2. Selection
3. Dominance
4. Ovulation.

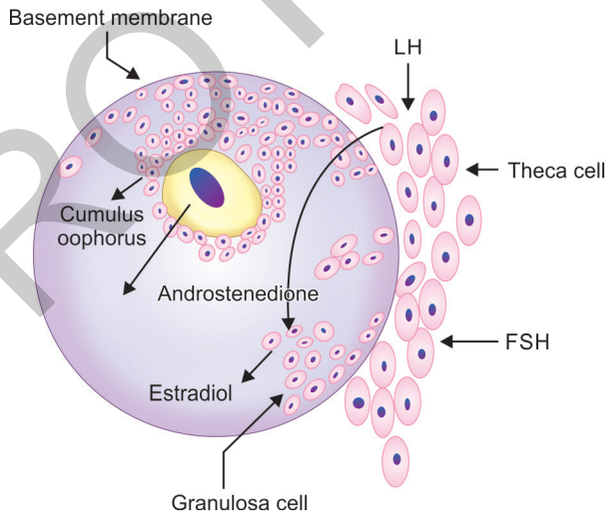


Fig. 1: Two cell gonadotropin system.

1. *Recruitment:* The process of recruitment begins at the end of corpus luteal development of the cycle preceding. During recruitment, follicles in both ovaries actively grow and secrete estrogen.
2. *Selection:* Between day 5 and 7 of the current cycle, a single follicle becomes destined to mature and ovulate. This process is termed as selection, wherein the dominant follicle is formed.
3. *Dominance:* The interval of growth preceding ovulation but following selection is called dominance. The dominant follicle controls the endocrine milieu as it prepares itself, the reproductive tract, and hypothalamic-pituitary axis for ovulation.
4. *Ovulation:* One of the paramount events at the mid cycle is the LH surge, which stimulates three major events.
   i. Resumption of meiosis.

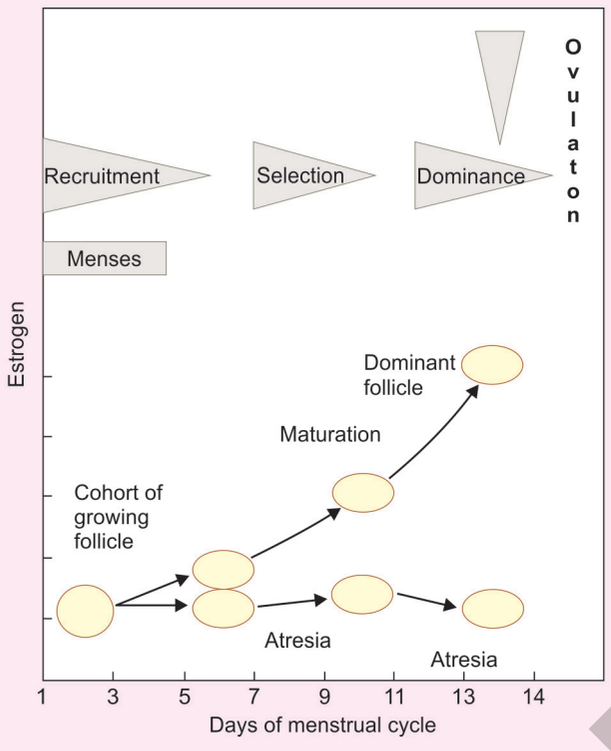


Fig. 2: Four phases of follicular phase.

ii. Granulosa cells and theca cells get luteinized. This is followed by increased production of progesterone.
iii. Extrusion of the mature oocyte, which happens usually 36 hours after the beginning of LH surge.

Mechanism of ovulation: This involves proteolytic digestion of follicular wall (mediated by prostaglandins) leading to rupture of the follicle and oocyte release. The ovum survives only 12–24 hours and then disintegrates.[1,2]

FSH Threshold and Window

Due to the increased pulsatility frequency of gonadotropin-releasing hormone (GnRH) secretion, there is an increased perimenstrual FSH secretion. The other reasons for increase in FSH are declining estrogen, inhibin A, and progesterone in the late luteal phase as the corpus luteum deteriorates.

After this perimenstrual rise, FSH remains at the same level for several days. Subsequently, its level declines under the negative feedback of inhibin B and E2 is produced by the growing pool of recruited follicles. During this decline in FSH, the most mature follicle is rescued from atresia and continues to grow. This follicle then becomes the dominant Graafian follicle. This grows faster than the others and produces higher amounts of E2 and inhibins. Hence, in the human species decremental follicular phase, FSH concentrations are fundamental for single dominant follicle selection.

Luteal Phase

After the expulsion of oocyte, granulosa and theca cells within the follicle shift from production of estrogen and follicular peptides to the production of estrogen and progesterone. This process termed as "luteinization", actually begins prior to ovulation, but requires LH surge for completion. The luteal function depends both qualitatively and quantitatively on normal development of the granulosa and theca cells during the preceding follicular phase. Inadequate proliferation of gonadal stromal cells in the follicular phase results in decreased secretion of estrogen and progesterone. This in turn may cause altered function of the fallopian tube and endometrium, possibly resulting in abnormal gamete or embryo transport and decreased opportunities for implantation. It is interesting to note that the lifespan of corpus luteum is fixed being around 14 days, irrespective of the follicular stage duration. Toward the end of luteal phase, the corpus luteum regresses unless rescued by human chorionic gonadotropin (hCG) from the implanting embryo. This is known as luteolysis.

ENDOMETRIAL CYCLE

Every month, the uterus prepares for a pregnancy by generating a thick bed of secretory endometrium for implantation. Due to failure of fertilization of the oocyte or implantation, menstruation starts. The endometrium has two principle components: (1) the glandular epithelium and (2) supporting stromal cells.

During the menstrual cycle, the epithelium differentiates to form three functional zones. The basalis, spongiosum, and stratum compactum. The endometrial events can be divided into three phases **(Fig. 3):**

1. Menstrual phase
2. Proliferative phase
3. Secretory phase.

Menstrual Phase

The beginning of each endometrial cycle is characterized by complete shedding of the spongiosum and stratum compactum layers during menstruation, which lasts for 3–5 days. The fall in plasma progesterone and estrogen levels due to degeneration of corpus luteum leads to withdrawal of hormonal support of the endometrium, which causes the withdrawal bleed.

JAYPEE BROTHERS

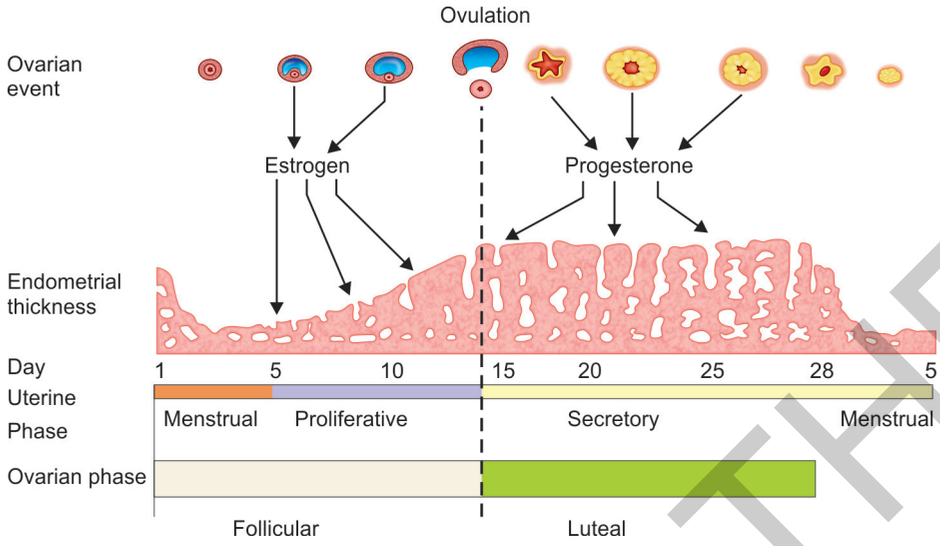


Fig. 3: Phases of endometrial events.

Due to profound vasoconstriction of uterine vessels, oxygen and nutrition are less to the endometrium and hence except the basalis layer of endometrium, rest of it is shed. After initial vasoconstriction, there is dilatation resulting in hemorrhage.

Proliferative Phase

When menstrual flow ceases, endometrium begins to thicken. It regenerates from the basalis layer. This takes 10 days or so. The ovarian follicular phase corresponds to menstrual proliferative phase of endometrial cycle. Changes in plasma concentration of estrogen and progesterone cause proliferative phase and growth of endometrium. The growth of the endometrium during this phase increases from approximately 0.5 mm to 3.5 mm in height.

Secretory Phase

Progesterone, which is secreted by the corpus luteum after ovulation will act upon the estrogen primed endometrium. This converts the endometrium to actively secreting tissue. The glands have more glycogen with numerous and densely coiled blood vessels. These changes are essential to make the endometrium helps in implantation.

FEEDBACK OSCILLATION OF THE HYPOTHALAMOPITUITARY OVARIAN SYSTEM

Hypothalamus produces intermittent pulsatile secretion of GnRH and is transported to the pituitary gland. Release of the pituitary gonadotropin (FSH and LH) secretion.

PREOVULATORY SURGE OF LH AND FSH CAUSES OVULATION

High level of estrogen around the time of ovulation causes positive feedback stimulatory effect on the anterior pituitary, which leads to big surge of secretion of LH and to a lesser extent of FSH surge. This excess LH surge leads to ovulation and subsequent development of corpus luteum. Hence in assisted reproductive technology (ART) cycle, there is need to suppress the LH surge (which will be discussed in other chapters).

MALE REPRODUCTIVE SYSTEM

Each testis has about 1,000 seminiferous tubules, which produces spermatogenesis. Testosterone is produced by specialized glandular cells called interstitial cells (or Leydig's cells) between the tubules. Sertoli cells support and nourish the sperm.

Spermatogenesis

Spermatogonia, which contains 46 chromosomes. Deoxyribonucleic acid (DNA) replication occurs to produce primary spermatocytes. By undergo meiosis, secondary spermatocytes II produce spermatids (with 23 unique chromosomes). These later change to the mature spermatozoa (also containing 23 unique chromosomes). This is the final event called spermatogenesis.

Each spermatozoa has a head (which contains the 23 chromosomes), a mid piece (where mitochondria is present for energy production), and a tail. The head is enclosed by an acrosome having enzyme acrosin. This is needed for

JAYPEE BROTHERS

breaking down the outer layer and entering the oocyte during fertilization.

Fertilization

Following sexual intercourse, sperms travels from the vaginal toward the mature oocyte in the fallopian tube. During this process, acrosome on the head of spermatozoa would be removed, releasing acrosin enzyme. About 50 spermatozoa are attached to the zona pellucida, and later allow its cell membrane to fuse with the cell membrane of ovum.

The process of meiosis II is reactivated in the cytoplasm of ovum, dividing the 46 chromosomes in the nucleus getting 23 chromosomes for fertilization (unites with another 23 chromosomes from sperm). The other 23 chromosomes are eliminated along with the second polar body.

Once sperm penetration occurs, its head gets detached from its mid piece and tail. Later there is union of chromosomes from sperm and ovum to form a complete set of genetic makeup for the offspring—two haploid cells (sperm and ovum) will become a single diploid-celled zygote.

To understand the basics we need to understand the summary of the physiology in reproduction as discussed below.

HYPOTHALAMUS–PITUITARY–OVARY AXIS

The basics endocrine principles of functional hypothalamus–pituitary–ovary (HPO) axis are:

- Hypothalamus produces GnRH
- The GnRH stimulates pituitary to secrete FSH and LH
- The LH acts:
  - On theca cells in follicular phase and produce androgens and
  - On theca and granulosa cells in luteal phase producing androgens, estrogens and progesterone.
- The FSH acts on granulosa cells producing estrogens in the follicular and luteal phases
- Increasing estrogen and progesterone levels can suppress the hypothalamus and pituitary hormone production
- Sustained high levels of estrogen can result in a gonadotropin predominantly LH surge from the pituitary.

OVARIAN CYCLE PHYSIOLOGY

- In late luteal phase of previous cycle, because of the increasing FSH (due to CL regression and fall in estrogen and progesterone levels), recruit a cohort of antral ovarian follicles.[3,4]
- When there is a rise of the estradiol levels from the developing follicles—cause long feedback inhibition of GnRH and FSH production—fall in FSH levels—allowing dominant follicle selection (FSH selection window) by day 5–6 of the menstrual cycle.
- The dominant follicle develops further as it has more sensitivity and more receptors to FSH even though the FSH levels have started to fall and become the preovulatory follicle.
- The other follicles with lesser responding and fewer FSH receptor regress due the falling FSH levels.
- The sustained high levels of estradiol produced by the preovulatory follicle cause a positive feedback on highly purified (HP) resulting in LH and small FSH surge.
- The surge brings about final oocyte maturation, and triggers the cascade leading to ovulation.
- Following ovulation, progesterone and estrogen production from corpus luteum decreases.
- In the absence of rescue of corpus luteum by hCG from an implanting embryo, it starts regressing by the 8th postovulatory day.
- The consequently falling progesterone and estradiol levels remove the HP negative feedback allowing the GnRH to preferentially cause FSH increase. This allows the next cohort of FSH sensitive antral follicles to recruit.
- Activins, inhibins, and follistatin are hormones that aid and abet the above physiological sequence where GnRH, FSH, LH, estradiol, and progesterone are the major role players.

REFERENCES

1. Irianni F, Hodgen GD. Mechanism of ovulation. Endocrinol Metabol Clin North Am. 1992;21:19-38.
2. Speroff L, Glass RH, Kase NG. Clinical gynecologic endocrinology and infertility, 6th edition. Philadelphia: Lippincott Williams and Wilkins; 1999. pp. 201-46.
3. McGee EA, Hsueh AJ. Initial and cyclic recruitment of ovarian follicles. Endocr Rev. 2000;21:200-14.
4. Adhikari D, Liu K. Molecular mechanisms underlying the activation of mammalian primordial follicles. Endocr Rev. 2009;30:438-64.

JAYPEE BROTHERS

etailed information of obstetrics & gynecology books, visit our website www.jaypeebrothers.com, for detailed information of obstetrics & gynecology books, visit our website www.jaypeebrothers.com, for detailed information of o

Newer Trends in ART



Nandita Palshetkar MD FCPS FICOG is a Professor of Gynecology, DY Patil Medical College, Navi Mumbai, Maharashtra, India. She is the Head of IVF Unit, Lilavati Hospital, Mumbai; DY Patil Medical College, Navi Mumbai; Fortis Hospitals, New Delhi, Gurugram, Chandigarh; Sakra World Hospital, Bengaluru. She is the present President of FOGSI and has been Senior Vice President, FOGSI (2011). She has been Past President, Mumbai Obstetric and Gynecological Society (MOGS); President Elect of Association of Maharashtra Obstetric and Gynecological Society (AMOGS); and Past President of Indian Association of Gynaecological Endoscopists (IAGE) and Vice President of Indian Society of Assisted Reproduction (ISAR). She has been practicing IVF since the last 25 years.



Hrishikesh D Pai MD FCPS FICOG MSc (USA) is Gynecologist and Head of IVF Unit, Lilavati Hospital, Mumbai; DY Patil Medical College, Navi Mumbai; Fortis Hospitals in New Delhi, Gurugram, Chandigarh; Sakra World Hospital Bengaluru. He is the Past Secretary General of FOGSI; Past President of Indian Society of Assisted Reproduction; Director of International Affairs of International Federation of Fertility Societies (IFFS); past Senior Vice President of FOGSI; Past President; Indian Association of Gynaecological Endoscopists (IAGE); and Mumbai Obstetric and Gynecological Society (MOGS). He has been practicing IVF since the last 30 years.



Rishma Dhillon Pai MD DNB FCPS DGO FICOG FRCOG is a Consultant Gynecologist at the Jaslok and Lilavati Hospitals, Mumbai, Maharashtra, India. She is the Director of the Everywoman Clinics with clinics in Bandra and Kemps Corner, Mumbai. She is the Past President of Federation of Obstetric and Gynaecological Societies of India (FOGSI) for the year 2017. She is the President, Indian Society for Assisted Reproduction; President, Indian Association of Gynaecological Endoscopists (IAGE); and Board Member, World Endometriosis Society. She has been practicing IVF since the last 25 years.



Sunita Tandulwadkar MD FICS FICOG is the Head, Department of Obstetrics and Gynecology; and the Chief, Department of IVF and Endoscopy, Ruby Hall Clinic, Pune, Maharashtra, India, for the last 19 years. She is the pioneer of laparoscopy in Pune. She was on Board of International Society of Gynaecological Endoscopist (2013–2017). She is also the Founder of Solo StemCells—A Stem Cell Research and Application Center. She is the Chairperson, Maharashtra State Chapter ISAR; Vice President, IAGE and also the Joint General Secretary of ISAR.



Kinjal R Shah DFP DNB FNB has done her DNB (Diplomate in National Board) in Obstetrics and Gynecology from Central Railway Hospital, Mumbai, Maharashtra, India. She has received two gold medals in DFP (Diploma in Family Planning). She has done her national board Fellowship in Infertility from Lilavati Hospital, Mumbai.



Manisha T Kundnani MD FNB FNUS is the Scientific Director and Consultant Fertility and Reproductive Medicine Specialist, Fertility Square, the IVF Clinic, Mumbai, Maharashtra, India. She has done her MD from the esteemed Postgraduate Institute of Medical Education and Research, Chandigarh, and was one of the first national board fellows in Infertility and Reproductive Medicine. She is practicing IVF since last 10 Years.

Available at all medical bookstores
or buy online at www.jaypeebrothers.com

JAYPEE BROTHERS
Medical Publishers (P) Ltd.
www.jaypeebrothers.com

Join us on facebook.com/JaypeeMedicalPublishers

Shelving Recommendation
OBSTETRICS & GYNECOLOGY

ISBN 978-93-88958-83-7