

Course Name :An Overview on Maternal Health Antenatal, Intranatal and Postnatal Care

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Fertilisation and Embryogenesis

Hello students. Welcome you all to yet another session for the NPTEL Certified Online course on the topic an overview on maternal health, the antenatal, intranatal and postnatal care. I am Dr. Barnali Ghosh an obstetrician and gynecologist working as an assistant professor at B.C.Roy Medical College and Research Centre IIT Kharagpur. We have already discussed the anatomy of female internal and external genitalia and also the pelvic floor and the perineal muscles. In the last class we did discuss regarding gametogenesis the process of oogenesis and spermatogenesis thereby resulting in formation of haploid gametes that is ovum and the sperm.

In today's class we are going to discuss on fertilization and embryogenesis. This forms the basis of pregnancy as a whole. The fertilization of the gametes that is the sperm and ovum will lead to the formation of diploid zygote which will ultimately form the embryo and thereby through differentiation will result in the formation of the fetus. Concepts covered are fertilization, capacitation, acrosomal reaction, cortical reaction and the detailed steps of fertilization.

Key words being sperm, ovum, fertilization and pregnancy. So, this is a picture of fertilization between the sperm and the ovum. From this picture it is clear that a single ovum is surrounded by multiple sperms. Approximately 200 to 300 sperms surround the ovum inside the fallopian tube. Out of the million sperms that get ejaculated in the vagina of the female some around 100, no 100,000 sperms will ascend up through the uterine cavity.

And approximately 200 to 300 sperms will surround the ovum in the fallopian tube. And out of these 200 to 300 sperms only one most competent sperm will gain entry into the oocyte to cause fertilization. In this picture we see that the 46 chromosomes which are in 23 pairs of chromatids in female and male they undergo meiosis or the reduction division right. So, this occurs the meiosis or the reduction division in the gametes which will result in the formation of female pronuclei or the ovum which is haploid containing 23 chromosomes and male pronuclei or the sperms which is also containing 23 chromosomes. Which the union of these two is called as the fertilization resulting in formation of zygote which is again diploid that is containing 46 number

of chromosomes in 23 pairs of chromatid.

This zygote will lead to the formation of the embryo by this will be mitosis. By the process of mitosis there will be division and it will result in formation of embryo ultimately differentiation causing the formation of the offspring. So, coming to fertilization proper what happens this is the tubes. So, we have already studied the structure of the tubes this is the interstitial part, then the isthmus, then the ampulla followed by the infundibulum. And ultimately the fimbria and here is the ovary.

So, this structure we have already discussed in the previous classes this is the vagina. So, this contains thickened muscles muscular layer all around this is the interstitial part which is 1.25 centimeter. Then comes the your this is the interstitial part then is the isthmus which is just double 2.5 centimeter.

This is the ampulla 5 centimeter then the infundibulum which is again 2.5 centimeter and this is the fimbrial end 2 centimeter. So, the length of the fallopian tube if taken from the interstitial part to the infundibulum it comes out to be 10 centimeter and when the fimbrial end is included it comes out to be 12 centimeter. Now, what happens during ovulation this is the ovary and from the ovary there will be release of the oocyte during the process of ovulation. And this oocyte is released and will be taken up by the fimbrial end of the tube and it will go inside the tube.

This will ultimately traverse from the fimbrial end towards the uterine ostiole of the tube and reach the ampulla of the tube. So, the oocyte which was released during the ovulation it reaches the ampulla of the tube. Similarly, the sperms which are ejaculated in the vagina of the female during the act of intercourse they ascend up right. So, this is the uterine cavity and these sperms will ascend up through the uterine cavity they will reach the fallopian tube and will come in contact with the ovum in the ampulla. This is the ampulla of the fallopian tube and here they will unite to form the zygote.

So, this is the zygote formed after fertilization this is diploid. So, this zygote formed in the ampulla of the fallopian tube it will then undergo division by binary fission the single cell forming double cell, double cell forming 4 cells, 4 cells to 8 cells right. So, these are the stages of division of the zygote and ultimately it will form a 16 cell structure. This is the 16 cell structure which will come to the uterine cavity. This 16 cell structure is also called as the morula right.

So, this zygote will be present in the fallopian tube for 3 days for the first 3 days or more precisely for 80 hours. It remains in the fallopian tube 90 percent of the time it remains in the ampulla of the tube and on day 4 the morula reaches the uterine cavity from where it will get implanted into the decidua. So, the endometrium of the pregnant uterus is called as the decidua.

So, this morula this is the decidua this morula gets implanted you know this morula will undergo again for the differentiation forming blastocyst and ultimately will get implanted into the decidua of the endometrial cavity. So, this is the way there is fertilization you know and as well as implantation of the fertilized zygote right.

So, coming to the steps of fertilization what happens the spermatozoa first comes in contact with the ovum in the fallopian tube that is the ampulla region and there occurs some changes in the sperms called as capacitation which enables the sperm to come in contact with the zona pellucida of the ovum leading to acrosomal reaction. And this acrosomal reaction will help in penetration of the sperm through the zona pellucida into the secondary oocyte that is into the ooplasm of the oocyte. And thus the into the ooplasm there is entry of the sperm or fusion of the sperm and the egg after the entry of the sperm into the ooplasm there is activation of the ovum which is nothing, but resumption of meiosis II of the secondary oocyte thereby leading to formation of female pronucleus and second polar body. This meiosis II is completed after fertilization there is activation of ovum female pronucleus is formed and this female and male pronuclei will fuse together to form the zygote. This from this picture we come to know about the ascent of the sperm what happens these are the testicles.

So, within the testicles the we have already read there are seminiferous tubules right. So, there are many seminiferous tubules within the testicles and within these seminiferous tubules are the production of sperms right. Within the seminiferous tubules are the production of sperms and these sperms they from the lumen of the seminiferous tubule they go to the epididymis through the rete testes. In the epididymis what occurs epididymis is actually a storehouse of sperms it stores the sperms you know starting from 2 days to 2 weeks of time. And during this period there is maturation of sperm or addition of certain proteins in the epididymis as well as motility of the sperms.

Right from the epididymis they will go to the ejaculatory duct and they will be ejaculated during the act of the coitus into the vagina of the female. These sperms they first gets deposited into the vagina of the female and then they ascend towards the cervix right. Now, another thing to note is the sperms can remain in the vagina for a maximum of 2 hours. If the sperms they remain more than 2 hours, if they remain more than 2 hours then they will be rendered immotile. If more than 2 hours then they will become immotile.

So, from the vagina they will go to the cervix. In the cervix maximum the sperm can be present or the cervix can store the sperms for a maximum of 72 hours or 3 days. Then through the cervix they ascend through the uterine cavity and reach the fallopian tube that is the ampulla of the tube where actual fertilization with the ovum occurs. In the ampulla sperm capacitation occurs. These are certain changes in the sperm which enables the sperm to you know gain hyper motility, to gain the ability to penetrate the zona pellucida of the oocyte and thereby you know

allowing the sperm to gain entry into the ooplasm which is required for the male pronuclei to fuse with the female pronuclei.

So, coming to the events that occur before fertilization starting with capacitation. Capacitation occurs in the female genital tract. After the sperms are ejaculated into the vagina they pass through the cervical mucus and ascend up to the fallopian tubes. This capacitation mostly occurs in the fallopian tube some portion may occur in the cervix. What are the 3 important accomplishments that are gained by the sperm during capacitation? Number 1 is its ability to join with the zona pellucida of the ovum.

Number 2 attainment of hypermobility and number 3 is ability you know gaining the ability to undergo acrosomal reaction right. What is the time taken for capacitation? It is 6 to 8 hours average coming out to be 7 hours from the act of ejaculation right. And I have already told cervix in the cervix the sperms can be stored for a maximum of 3 days. This in this picture we see you know this is the epidermal part. During the epidermis there are you know adhesion of certain proteins.

Mostly 2 proteins get attached beta defensin protein 1 to 6. This get attached to the sperm and also secretions from the seminal vesicle causing the seminal plasma. They will be they will adhere to the sperm and they will reach the ejaculatory duct and this will be ejaculated during the act of coitus into the vagina. And after ejaculation in the female genital tract the sperms in the female genital tract the sperms will undergo capacitation will come. So, what happens? During capacitation there is removal of certain outer coating proteins.

I have already told that the beta defensin protein 1 to 6 which gets coated on to the sperm during its transit through the epidermis. This is you know this helps in maturation of the sperm. What the epidermis serves? Epidermis serves 3 purpose. Number 1 it is a reservoir or storage of the sperms ranging from 2 days to 2 weeks before it is ejaculated into the female vagina. Number 2 it helps in maturation of sperms by addition of certain outer coating proteins.

You know and this occurs in the proximal part of the epidermis and in the distal part they gain motility. These outer proteins are essential for the passage of the sperm during its transit through the cervical mucus. After crossing the cervical mucus when it reaches the fallopian tube these outer coating proteins need to be shed off or to be removed from the sperms. In order to enable the sperms to undergo you know capacitation and attachment with the ovum. So, apart in just before capacitation the outer coating proteins need to be removed.

Now, this was the transport of the sperm right. Now, what about the egg transport coming to the egg? Egg means ovum transport of ovum. So, same this is the fallopian tube, the interstitial part with thickened muscle layer, then coming the isthmus, then the ampulla which is the longest

and the widest part followed by the infundibulum and the fimbrial end right. So, this is the uterus and here is the ovary in the lateral pelvic wall. During ovulation there is bridge in the epithelium and there is release of the ovum, release of the ovum with cumulus oophorus cells around the ovum called as the corona radiata.

This is called as the cumulus oophorus complex which is released during ovulation. What marks the ovulation? Ovulation is you know marked by LH surge. Following LH surge there is ovulation and another thing to note is this graafian follicle. The rupture of graafian follicle will release the oocyte. This last graafian follicle, this LH surge will cause the primary oocyte which was arrested in diplotene stage of prophase I of meiosis I.

This meiosis I gets resumed following LH surge and the primary oocyte which was present in the graafian follicle now just before ovulation forms the secondary oocyte. So, the primary oocyte, this was the primary oocyte which was arrested in meiosis I division, it gets converted to secondary oocyte following the LH surge and this secondary oocyte and the first polar body is released during ovulation right. So, now this after ovulation this oocyte will be taken up by the fernal end right. What happens? And it will move, it will move towards the uterine ostia of the tubes. Why? This is another important you know concept to know what happens.

So, in the tubes, in the tubes firstly the smooth muscle layer of the tubes, the contraction of the smooth muscle layer of the tubes helps to bring the ovum or the oocyte towards the uterine ostia. It helps in transport of the oocyte and number 2 is the ciliary movement, the beating of the cilia. These columnar epithelium lining the tubes they are ciliated and there is a you know synchronized ciliary movement which will cause the transport of the ovum towards the uterine. Ostia right. Another thing to note is the presence of PEG cells.

There are no glands, but there are specialized cells called as the PEG cells which secrete watery secretion and this contains you know rich amount of glucose or pyruvate which is required for the nourishment of the gametes as well as the zygote in the fallopian tube. And number 2 is this watery secretion. You know instead of the thick mucous secretion of the glands, this watery secretion from the PEG cells it helps to maintain the fluidity of the tubes and also does not block the tubes. So, all these factors helps in transport of this oocyte or the cumulus oophorus complex into the ampulla of the tubes. And we have already noted that the sperms which will ascend from the vagina, it will ascend from the vagina and will go to the tubes in the ampulla where they will fertilize with the ovum and leading to formation of zygote.

Now, the time taken for the ovum to pass to the or to reach the ampulla of the tube is 15 to 20 minutes from the time of ovulation. This is important you know within 15 minutes after ovulation the ovum will reach the fallopian tube. And these sperms after the act of ejaculation they will also reach the fallopian tube within minutes, within minutes may be within you know

20 to 30 minutes the sperms will reach the fallopian tube. So, this is the time interval required for the transport of egg and sperms. So, here the same picture the ovum this portion is the site of fertilization or the ampulla of the tubes.

So, the release of oocyte from the ovary following the elate surge and this oocyte is nothing, but the secondary oocyte which is picked up by the femoral end of the tube. And they reach the ampulla of the tubes within 15 to 20 minutes of ovulation. So, this fallopian tube serves two main purpose. Number one by keeping the zygote within the fallopian tube for the first three days of fertilization it helps or it gives the endometrium time to become receptive to this developing embryo for implantation. And also it gives the blastocyst time to mature so that it can undergo or it becomes capable of implantation.

Next coming to the fertilizable lifespan of sperm and ovum. So, fertilizable lifespan of sperm, a sperm after ejaculation it is in the vagina of the female and it can fertilize the ovum in the next 48 to 72 hours after the act of ejaculation right. So, 2 to 3 days the this for the next 2 to 3 days after the act of coitus these sperms will be you know able to fertilize the ovum if it is present in the female genital tract. For ovum the fertilizable lifespan is only 12 to 24 hours that is half a day to maximum one day from the time of ovulation. So, after ovulation the ovum will be you know is capable of fertilizing the sperm for the next 24 hours.

If that ovum is not fertilized by the sperm in the next 24 hours it will not you know it will not be fertilized any further and it will be destroyed. So, in that cycle pregnancy can only occur if there is sperm in the female genital tract within 24 hours of ovulation right. So, what is the fertile period or the period or the duration or the interval of the menstrual cycle, the interval between which if intercourse is done there is a chance of pregnancy that is the fertile period. If this is the day of ovulation. So, 6 days prior to ovulation and 3 days post ovulation this period is the fertile period if when if there is a chance of fertilization and pregnancy if intercourse occur during this age.

During this interval. So, this is what I have already discussed fertilizable lifespan, sperm is capable to fertilize ovum for 48 to 72 hours 2 to 3 days following ejaculation. Here to note the motility of the sperm is maintained motility is maintained for you know maybe for the 7 days after ejaculation. From the day of ejaculation motility of sperm is maintained in the female genital tract female genital tract for 7 days, but that does not mean that it can fertilize the ovum for 7 days only for the first 3 days the sperm can fertilize the ovum. And for ovum it is capable of fertilization for the next 12 to 24 hours following ovulation. In case of in vitro fertilization IVF here as immature oocytes are picked from the ovary artificially by ovum pickup methods then they can fertilize for the next 36 hours of incubation right.

Now, coming to the process of fertilization we have already told that the sperm comes in

contact with the oocyte right and this oocyte is this is the this is the nucleus right. So, this this is the female pronuclei or the secondary oocyte secondary oocyte which is surrounded by a plasma membrane. This plasma membrane is called as the white line membrane and outside the white line membrane is the zona pellucida, this black colored portion is the zona pellucida. And outside the zona pellucida is the cumulus oophorus cells which are also called as corona radiata. So, these sperms will pass through the corona radiata by the release of hyaluronidase they will release hyaluronidase enzyme which will cause lysis of the corona radiata cells and the sperm.

Will gain entry through the corona radiata cells and reach the zona pellucida. Coming to the zona pellucida this yellow colored thing is the zona pellucida this is the zona pellucida layer and this zona pellucida is surrounding the female oocyte it has different receptors right. So, you know there are different receptors on the zona pellucida. So, these are zona pellucida receptors there are 4 types of receptors these are zona pellucida receptors and they help in attachment of the sperms right. So, if you see that these are the sperms they are trying to gain entry to the corona radiata and one such sperm will gain access through the corona radiata and will reach the zona pellucida and binds to the ZP3 receptor.

This receptor is ZP3 receptor zona pellucida 3 receptor which helps in attachment of the sperm to the zona pellucida right. So, right zona pellucida is a layer outside the oocyte it has surface receptors or glycoproteins ZP1, 2, 3 and 4 of which sperm bind to ZP3 receptor and this ZP3 receptor is most abundant. This is the most abundant receptor present on the zona pellucida and it brings about the acrosomal reaction whereas, ZP2 receptor is responsible for the cortical reaction. What is acrosomal reaction? The outer chromosomal of so, we have discussed right. So, this is the sperm the sperm is activated in the female genital tract called as capacitation and then it passes through the cumulus layer this yellow is the cumulus layer it will release high hyaluronidase enzyme and it will ultimately pass to the zona pellucida layer and here is the ZP3 receptor which attaches the sperm right and after attachment there will be the acrosomal reaction which is nothing, but lysis of the outer chromosomal acrosomal membrane thereby release of some protease enzymes.

So, there will be release of high hyaluronidase there will be release of protease enzyme most importantly an enzyme called the acrosin which will cause lysis of the zona pellucida at the point of attachment of the sperm and thereby the sperm will gain entry into the zona pellucida in the perivitelline space. This space this pink color space is called as the perivitelline space and the sperm now resides in the perivitelline space. Ultimately the sperm plasma membrane will fuse with this white colored part is the plasma membrane or the plasma membrane of the oocyte. So, both these membranes fuse and the nucleus gains entry into the ooplasm. Lysis of the zona pellucida at the attachment of the at the site of attachment of the sperm ultimately helping in entry of the sperm into the oocyte.

So, this was the acrosomal reaction now coming to following the acrosomal reaction there occurs cortical reaction what happens after the sperm slowly the sperm will this is the zona pellucida and the sperm will penetrate through the zona pellucida and this sperm will go inside the cytoplasm of the oocyte. Immediately after this one sperm gains entry into the cytoplasm there will be release of lysosomal granules or cortical granules on the under surface this is the plasma membrane of the oocyte. So, on the under surface of the plasma membrane of the oocyte there is the release of cortical granules. These cortical granules will then extra vacate and come outside and they will be these are the extravasated cortical granules which will ultimately cause hardening of the zona pellucida layer and this will make the zona pellucida impermeable and they will not and this will not allow further attachment of sperms to the oocyte thereby preventing polyspermy or polyploidy. So, cortical reaction following entry of one sperm into the ooplasm of the oocyte there is release of lysosomal granules on the under surface of the oocyte which will extra vacate and they will there is also role of ZP2 protein this binding of the ZP2 protein of the zona pellucida will lead to the cortical reaction.

So, this will ultimately lead to the cortical reaction which is nothing, but hardening of the extracellular layer by cross linking of structural proteins and inactivation of ligands for the sperm receptors ultimately it will prevent polyspermy and thereby polyploidy formation. So, we have completed acrosomal reaction and cortical reaction. So, these are the events during the process of fertilization and another very important concept is day of ovulation in a female menstrual cycle what happens. So, this is you know maybe this one I am drawing this is one menstrual cycle ovulation day is approximately at mid cycle. So, a menstrual cycle this normally it is 28 days, but it can vary it varies female to female and in even in one single female the duration of a menstrual cycle can vary from month to month.

So, normal menstrual cycle varies between 24 to 35 days right. So, coming to a 28 day cycle the day of ovulation is you know just in the middle that is day 14. This is day 28 when there will be the next menses and here was the menses or the last menstrual period. So, this was one menstrual cycle this is day 1 right. So, change this sorry.

So, day 1 is actually the start of the last menstrual cycle. So, this was the start of the menses. So, this is the day 1 and on day 14 ovulation occurs in a case of 28 day cycle. This ovulation will divide the menstrual cycle into two parts that is into follicular phase and the luteal phase. To note is this luteal phase is constant which is of 2 weeks duration, but the follicular phase is variable right. Because in during this period there is development recruitment of follicles and development of follicles now from the follicular pool of the ovary under the action of FSH and leading to the formation of graafian follicle.

So, this graafian follicle is produced and that will ovulate on the day of ovulation. To note is this luteal phase is constant, luteal phase is also called as the secretory phase which is constant

that is 2 weeks. So, coming to you know menstrual cycle period which is say 24 days duration. So, it is less than 28 days it is 24 days, but this luteal phase will remain constant that is 2 weeks this will remain constant. So, the day of ovulation will be what when it will be 24 minus 14 that is 10th day of the cycle and this is day 1 this is the follicular phase which is short in case of short cycles, but if the cycle say is of 35 days.

So, this is 35 day cycle. So, when you will be the day of ovulation again the luteal phase is constant that is 14th day. So, the day of ovulation will be 35 minus 14 that is 21st day. So, it will be somewhere here. This is the day of ovulation this concept is very important right because the depending upon the cycle length the day of ovulation changes and thereby the day of fertilization also changes and this helps to calculate the when a fetal age or the you know age of the fetus from the day of fertilization. We calculate the expected day of date of delivery from the last day from the first day of last menstrual period, but the fetal age is not same it is to be calculated from the day of fertilization which more or less corresponds with the day of ovulation right.

So, this is what I have been talking through this lecture the ovary you know these this is the cortex of the ovary and this is the medulla in the cortex these are the you know follicles developing follicles they will develop from primordial follicles secondary follicle tertiary follicle then the graafian follicle and ultimately will lead to ovulation and these follicles have the primary oocyte right from intrauterine life before birth arrested at meiosis I stage of cell division. This meiosis I is resumed or gets completed just before ovulation and in ovulation the secondary oocyte is released this contains secondary oocyte where meiosis I is completed and meiosis II again gets arrested. This meiosis II will be resumed or completed just after fertilization more precisely 3 hours after fertilization that is 3 hours after the penetration of the sperm into the ooplasm. So, this is the antral follicle or a graafian follicle. Now, structure of a graafian follicle what I want to highlight in this picture is you know these are the theca externa you can all recapitulate because these has been already taught in the previous class theca interna then inside are the granulosa cells and the granulosa cells which surround the ovary they are the cumulus oophorus cells right.

And this is the antral antrum you know the in the cavity the antral cavity and this is the primary oocyte you know within the graafian follicle which gets converted to secondary oocyte after the LH surge just before ovulation and what comes out during ovulation is this portion, what comes out during ovulation is your this portion, this portion comes out during ovulation. So, coming to the structure of ovum now what is released during ovulation this is the primary oocyte with the nucleus. So, sorry secondary oocyte after ovulation it forms the secondary oocyte. So, the secondary oocyte which is haploid 23 x number of chromosomes right. Now, this is the ooplasm or the cytoplasm of the oocyte and this membrane is the o the cell membrane of the oocyte which is also called as the vitelline membrane and outside is the zona pellucida.

So, this is the zona pellucida and the white part in between the zona pellucida and the vitelline membrane is the perivitelline space containing the first polar body in the perivitelline space right and outer cells are nothing, but the cumulus oophorus cells which are arranged in form of ray. So, they are called as corona radiata. So, this comes out to be the structure of the oocyte and the sperm which has to pass through these layers of you know corona radiata and will pass and will get attachment with the zona pellucida, it will pass through the zona pellucida, it will attach with the plasma membrane of the oocyte and then it will go inside the nucleus will go inside into the ooplasm to fertilize the female oocyte. So, ultimately what I have told these are the steps of fertilization the sperm comes in contact with the ovum in the fallopian tube there is capacitation of the sperms it gains hypermobility it then attaches to the zona pellucida there is no this is attachment of the zona pellucida. Number 2 is acrosomal reaction causing lysis of the zona pellucida, number 3 is you know entry of the sperm into the perivitelline space, number 4 is merging of the membranes of the sperm and the oocyte and ultimately entry of the sperm nucleus inside the ooplasm and it will now this male pronucleus which is actually haploid 23 containing 23 X or 23 Y or right and it will join with the female pronucleus which is also haploid containing 23 X and their union will form the zygote which can be 46 XX signifying that the fetus is a female or it can be 46 XY signifying that the fetus is a male.

So, depending on the X or Y chromosome present in the male pronucleus the fetus becomes male or female. Coming to the MCQs number 1 question cervix acts as a reservoir of sperms for how many duration I have already told it is 72 hours or 3 days. Vagina stores sperms maximum up to 2 hours if more than 2 hours then the sperms become immobile after ovulation ovum with the cumulus oophorus are seen in the ampule of the tube within minutes precisely it is 15 to 20 minutes. Next fertilized ovum stays in the fallopian tube, the fertilized ovum meaning the zygote it stays in the fallopian tube for the first 3 days or more precisely 80 hours then it enters into the uterine cavity on day 4 as morula. Fifth most abundant zona protein on the surface of zona pellucida it is ZP3 protein which helps in the attachment of sperm and ZP2 is you know important for cortical reaction.

There is no such protein called as ZP6 it will be ZP4 1 2 3 and 4 4 types of ZP receptors. Binding of sperm to which protein leads to zona block preventing polyspermy right polyspermy prevention is by the cortical reaction and it is brought about by ZP2 receptor. Epithelium of the fallopian tube yes it is ciliated now is it pseudo satisfied no it is single columnar epithelium. So, ciliated columnar epithelium without glands without submucous layer, but containing peg cells.

First meiotic division of oogenesis gets arrested at. So, I have already mentioned repeatedly that oogenesis starts in the intrauterine life and, but it gets arrested at the first meiotic division in which stage in the prophase stage and in which stage of prophase it is the diplotene stage of prophase of meiosis 1. And this arrest will go only after the female attends puberty after now

there is release of LH from the anterior pituitary and following the LH surge the meiosis 1 is completed and it will form the secondary oocyte which is released during ovulation. So, this is B. Time taken for spermatogenesis we have seen in the previous class it is approximately 70 to 74 days.

So, we will go by 70 to 80 days. Formation of follicle, follicle means the ovary follicles the oocytes are present as follicles primordial follicles in the ovary and this is completed the oocyte formation is completed in the intra uterine life by 20 weeks following which there is no further formation of any new follicles. So, this will be the 20 to 24 weeks. Fertilization is said to be completed if very important question fertilization is said to be completed if. So, fertilization means the entry of the sperm into the oocyte. So, this oocyte is the secondary oocyte and the sperm enters into the ooplasm and this secondary oocyte will undergo this is the sperm nuclei this secondary oocyte will undergo meiosis 2 and will form the female pro nuclei right which is haploid and the second polar body.

So, the formation of second polar body is no depicts that there is fertilization if there was no fertilization the second polar body would not be formed right. So, this is the end of our class reference taken are from D.C dutta book of obstetrics, the Speroff's book of clinical gynecologic endocrinology and infertility and Williams obstetrics. Thank you all.