

Human Physiology
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Hello everyone, welcome to another new class on human physiology. In the last few classes, you remember we discussed male and female reproductive organs; we also discussed how the processes of spermatogenesis and oogenesis happen, as well as hormonal regulation. In this class, we will discuss what different steps of contraception and termination would be taken if any unwanted pregnancy occurs. Along with that, if any problem happens with the fertilization, then what would be the process of IVF or in vitro fertilization? So, let us stick with it. So, what different content would be covered for this class? Like we will discuss the different methods of contraception in both females and males. Also, we will discuss the termination of pregnancy.

Finally, in case of any challenges with fertilization, this can be a problem with either of the eggs or with the sperm. We will discuss how in vitro fertilization, or IVF, can be done to create a test tube baby, which can eventually be implanted in a mother. So, let us see these things one by one, and hopefully you will enjoy the class. So, what is the process of contraception? Contraception generally refers to the prevention of pregnancy.

And there are many reasons why a couple may choose to prevent pregnancy; it can be due to family planning, and it can also be due to preventing sexually transmitted diseases like AIDS. And contraceptives can also be recommended by doctors to patients, especially female patients who have issues like heart disease or diabetes. So, it can also be due to medical grounds. And generally, the process of contraception is broadly classified into two categories. The first one is the spacing method, and the second one is the terminal method.

So, what is basically like the spacing method, which is presented in cases of females? So, it is basically to increase the gap between two pregnancies. So, in the case of the spacing method, there are different classes and classifications. The first one is like the rhythm method. And what is the rhythm method? The rhythm method is also known for measuring the fertile and non-fertile days by keeping track of the periodic cycle. So, if we consider a natural periodic cycle of 28 days, generally the initial 7 to 10 days are considered infertile or mostly a safe time, but it is also debatable because sometimes the sperm can eventually stay alive for multiple days, and in cases where there is an issue with properly tracking the infertile days, there can be a high risk of fertilization or pregnancy.

So, although this process has a lot of advantages because it does not use any chemicals or drugs, it is also a non-hormonal process. This is, of course, low cost and there are almost no side effects present in this process, but as I said, if the tracking goes wrong, then there can be issues of unwanted pregnancy. The next popular barrier method, although it is not commonly used nowadays, was initially practiced as the barrier method. So, barrier methods of contraception generally prevent the meeting or the mixture of the ovum and the sperm. And you can see that different types of barrier methods or options can be used; for example, the use of cervical caps or diaphragms can be used.

And these diaphragms or cervical caps can be made of silicone or latex materials. So, they have a lot of advantages and disadvantages because these devices are generally like inexpensive. But in terms of disadvantages, sometimes the material can secrete toxic elements, especially silicon; sometimes it is not properly prepared. It can secrete toxic residues of metal or other polymeric substances, and they can eventually cause inflammation, and maybe even in the long term, it can also cause cancer. So, mostly barrier methods were previously used and employed, which was initially very common, but nowadays barrier methods are not as common.

Then there can be chemical barriers, for example, such as spermicidal agents, which can destroy the sperm when applied to the female genital tract. There can be different types of spermicidal agents, as you can see. There can also be combined methods; for example, mechanical barriers along with spermicidal agents can be used together for very effective control. So, the chemical barriers and the combined methods are still being used and are popular to prevent any type of unwanted fertilization or pregnancy. Then the third one is like a significant method that is very popular or a chemical method.

In the chemical method, there are different types; for example, the first one is the depot preparation. In the case of depot preparation, it is basically creating a slow-releasing formulation that can actually have a long-lasting effect on the body. One of the well-known depot preparations of the contraceptive is called DMPA, which is also known as medroxyprogesterone acetate. So, basically this contains this hormone called progesterone. And how do they act in terms of contraception? So, as you know, progesterone helps to prevent ovulation when your ovaries release an egg.

Eventually, it also helps in terms of thickening the cervical mucus because, if you remember, the role of progesterone after fertilization is to help thicken the cervical mucus. But if it happens before fertilization, what will happen is that sperm will find it harder to enter. So, in this way, by pre-thickening the cervical mucus even before any sperm entry, it creates a difficult situation for the sperm to enter the uterus. It also thins the lining of the uterus so that the uterus cannot prepare itself for fertilization. Also, it interferes with the signal of the brain that tells the ovaries to produce follicles and ultimately the eggs.

So, in this way, progesterone gives a negative kind of signal or negative feedback signal to the brain. Eventually, they will release secretions of hormones like follicle-stimulating hormone, and even the release of estrogen or progesterone can be negatively impacted; altogether, this will eventually stop the production or release of eggs. What are the different types of advantages? Because this report concerns the formulation of DMPA or other drugs, they are long-lasting. So, taking a single injection can be sometimes effective for a couple of months, almost like 2 to 3 months. But there are also certain disadvantages.

For example, sometimes there can be issues of sterility, or it can also change the menstruation bleeding pattern. Then vaginal rings are also another important chemical method where silicon or latex polymeric rings can be inserted inside the vagina and can contain progestin or estrogen hormones, which are similar to the hormones found in oral contraceptives. And these vaginal rings release this hormone that prevents pregnancy by inhibiting ovulation. It also helps in terms of thickening the cervical mucus, making it difficult for the sperm to enter the egg. The vaginal ring can generally be worn for a few weeks, approximately 2 to 3 weeks, and then it can be removed; otherwise, if it is not removed, there could be a significant obstacle during the bleeding.

So, for 3 weeks, it can be worn, and during the initial 7 to 10 days of bleeding, it should be removed so that the bleeding can come out. Then there are important oral contraceptives that are very popular. These are generally like steroidal drugs that are mostly used, and they are recommended for women in the younger age group up to 35 years. So, what are these oral contraceptives? Mostly, it contains a synthetic preparation of estrogen and progesterone. And when these are taken generally orally, the concentration of this hormone, which is like estrogen and progesterone, immediately arises.

That triggers a negative feedback effect because it tells our brain to stop the production of follicle-stimulating hormone and luteinizing hormone (FSH and LH), thus inhibiting the ovulation process. So, some of the very popular oral contraceptives, for example, levonorgestrel, are also a class of progestin hormones. So, how this progestin hormone actually works is that it stops the eggs from releasing by the ovary. So, basically, it will stop the ovaries from releasing the eggs; it also prevents the fertilization of the egg by the sperm. So, first, it will, of course, stop the eggs from being released, but in case the egg is released, it will also prevent the fertilization of the egg by the sperm.

And if the egg is already fertilized, it will also prevent the egg from binding to the lining of the womb or the lining of the uterus. So, it has different effects, but mostly it can either stop the eggs from being released by the ovary or, in case it is released by chance, it can prevent the fertilization step. In case it is fertilized, it will not allow the egg to be implanted in the womb. So, in this different mechanism, the progestin hormone in different classes of drugs can be used as an oral contraceptive. And what the advantages are is that it has mostly about 100 percent efficiency.

But you have to understand that until the fertilized ovum or the fertilized egg is implanted in the endometrium, it will not work. But if the fertilized egg is already implanted in the endometrium, then this process will not work. It also has other disadvantages, for example, hypertension and metabolic challenges or effects such as diabetes and obesity. It has been seen in cases that it can also promote carcinoma formation or cancer formation, especially breast carcinoma and cervical carcinoma. Then there can be a lot of intervention methods or contraceptive methods where intrauterine contraceptive devices can be used, and the copper T is one of the most popular intrauterine contraceptive devices that can be implanted inside the uterus, and as you can see, this is made of copper.

So, what basically happens is that this copper T tube secretes or releases copper ions. So, what copper tea does is secrete copper ions inside the uterus, creating a difficult environment for the sperm to stay alive. Why? Because copper tea tubes immobilize the sperm by secreting copper ions. So, once the sperm gets immobilized, it is unable to move and unable to go deep inside the fallopian tube for fertilization. So, it is very important that the copper can immobilize the sperm so that the fertilization process is stopped.

Apart from that, the copper ion can also generate inflammatory responses inside the uterus, making it difficult for the sperm to stay alive; however, there can also be disadvantages, as the copper ion can create local inflammation. So, prolonged use of a copper T can actually cause inflammatory damage to the uterus, and it can also cause cancer in the long term. So, of course, there are certain advantages to the copper T, but they may have different disadvantages that can be long-term, such as prolonged toxicity or even tumor formation. There are also different terminal methods that can be employed for permanent sterilization. For example, like tube

ectomy can be done so that the fallopian tube can be eventually like cut in order to do like a permanent method of sterilization.

So, basically, you can see that this is like a tubectomy process where the fallopian tubes are eventually cut from each other, and laparoscopic occlusion can also be done. In this case, fallopian tubes were occluded using silicone bands; you can see that silicone threads or bands can be used to tie up or create occlusion inside the fallopian tube. So, the eggs, when released from the ovaries, are unable to eventually release, and sperm, when inside the vagina, come inside the uterus; they are also unable to move inside the fallopian tube. So, this is a much more straightforward process; it does not take too long, nor does it require a long hospitalization, and this can be one of the processes for permanent sterilization. But the problem is that once it is done, the female body will not be able to conceive any further.

So, we discussed different contraceptive methods for females. Now, let us discuss some contraception methods in males. So, in the same way, there are the spacing method and the barrier method. In cases of the spacing method of contraception in males, it can be similar to natural methods. So, the natural method of contraception by males is one of the oldest methods of voluntary fertility control.

So, what basically happens in the case of the natural method? Male volunteers withdraw their penises just before ejaculation. So, in this way, male voluntary prevention prevents the release of sperm inside the vagina. But it is very risky, of course; it has a lot of advantages as there are no hormonal chemicals, other controls, or surgical controls, but it is highly risky because in the case of a wrong measurement, sperm can be released inside the vagina, causing fertilization. And sometimes during repetitive sex, there can be live sperm that can stay together inside the upper layer of the penis and can eventually go inside the vagina for possible fertilization. And sometimes there can be a risk of the slightest mistake or problem of sensitization, and even with growing age, this natural method practice becomes very difficult.

The barrier method, as you know, like condoms, is very popular in terms of its use as a barrier method, and it is very cheap; it can be made of latex, and, as you know, it prevents sperm entry from the penis to the vagina. There are a lot of advantages because it is highly cheap and safe, but there are disadvantages because there can be a risk of penetration or tear from the condom that can actually cause unwanted fertilization or pregnancy. Then there are chemical methods of male-like contraception; for example, hormonal tablets like testosterone can be given at around 400 mg, which actually produce azoospermia. That means this is like a condition where there is no sperm present. So, azoospermia is a condition where there is no sperm production or no sperm present in the male exo-coagulated fluid.

So, testosterone, like a high dose of testosterone, can stop sperm production; along with that, testosterone can also be given with another drug called denazole. This is sometimes mostly effective. So, these cases of azoospermia or oligospermia can be created with different drugs, including testosterone and progesterone. Oligospermia is also when there is a very low sperm count in the male ejaculate. So, these are some spermatogenic drugs that can be given to reduce sperm production or to destroy existing sperm.

Then calcium channel blockers can also be used; for example, these calcium channels are present in the cell membrane of the sperm, and if the calcium channel blockers are given, the sperm membrane becomes more rigid. And with the sperm membrane becoming more rigid, they get loaded with cholesterol because cholesterol then becomes unable to come out, and

eventually this rigid membrane prevents the binding of the sperm to the zona pellucida of the ovum. So, in this way, the calcium channel blockers can be used to prevent the binding of the sperm with the zona pellucida of the worm, and this is one of the popular chemical-based male contraception methods that can be used. In the same way, female terminal methods can be used; for example, vasectomy can be performed, where the vas deferens can be cut by around 1 centimeter or 2 centimeters, and even ligation or occlusion can be created to tie off this area so that the sperm, once produced, cannot eventually come out inside the scrotum or inside the penis. So, in this way this is like a permanent terminal method and there are lot of advantages because it is very simpler, no long term hospitalization is required, this is less expensive procedure and this is 100 percent effective.

But again, the challenge is that if these things are permanently cut, unless there is a reconnection made, the male will lose its complete ability for production and mainly for the release of sperm. So, this is a natural process, although there are a lot of advantages, but it can be a long-term prevention method that can be employed if the couple decides that they do not want any further babies. And then recently, some modern techniques like no-scalpel wash occlusion methods have also been developed, where an elastomer polymer type of material is injected inside the wash difference. And when it is injected, it becomes kind of like a solution phase, but after the injection, it slowly hardens inside the wash in around 20 minutes. And once it hardens, as you can understand, it will basically clog the tubes, causing no release of the sperm, and that can lead to the penis.

And what are the different advantages? Of course, this is like 100 percent efficient, and it is also a very easy procedure. But the disadvantage is that sometimes the polymer can be non-sterile during preparation. So, it can create a risk of like infection. Also, the molecules and the chemicals present in those polymers or elastomers can cause certain inflammation or other side effects. So, we discussed different procedures of contraception in both males and females.

All these contraception processes can only be employed for a few weeks of pregnancy, but mostly they are also used to prevent pregnancy. But let us consider if the pregnancy has already happened and it goes beyond those initial 2 to 3 weeks; then the couple has no choice but to decide to keep the baby, which they have every right to do. They also may decide not to take the baby or to go against the delivery of the baby. There can be different reasons for that. We are not going too much into the kind of reason, but of course, it can be due to family planning.

It can be due to different genetic sequences or the risk of other diseases to the baby. So, what are the different reasons for termination? As you can see, it can be due to unplanned pregnancy, health issues, or even fatal abnormalities. And you have to consider that, in India, abortion is legal under the Medical Termination of Pregnancy Act of 1971. So, the Medical Termination of Pregnancy Act 1971 allows the termination of pregnancy up to 20 weeks. But of course, this has to be done with the advice of the doctor, and in special cases, such as in the case of sexual abuse or a minor or certain significant disease conditions, the doctor may even allow the termination of the pregnancy up to 24 weeks.

So, in general, termination can be done up to 16 to 20 weeks, but in certain special cases, it can be done up to 24 weeks under strict supervision and recommendation from the doctor. Medical termination can be of different types; the most common type is the chemical termination, where a combination of the drugs mifepristone and misoprostol is used. So, as you can see, this is a combination of drugs where mifepristone is basically an antiprogesterone drug. And as you know, progesterone has an important role in preparing the endometrium to

thicken, preparing the uterus, and preparing the cervix. So, using an antiprogesterone type of hormone, which basically blocks the progesterone function, will cause the uterus lining to break down.

So, as you remember, I said before that progesterone helps to build the endometrium or the uterine lining. But this antiprogesterone molecule in the form of mifepristone actually breaks down this endometrial lining and degrades it. So, eventually, if there is already an implanted baby here, if the endometrium lining completely breaks down, the embryo or the baby will eventually get damaged and will not receive any nutrient supply, and that is why after a few hours it will eventually be dead. And then mifepristone can also be taken in combination with another drug, which is misoprostol. This is basically a synthetic prostaglandin, and what misoprostol does is induce uterine contractions.

So, as the mifepristone or the progesterone type of antiprogesterone drug, this endometrial lining, along with the dead embryo and the damaged uterine cells and tissues, will be collected inside the uterus. And eventually, by giving the mesoprostol, triggering the uterine contractions, the female body will be able to remove all the dead components of the embryo along with the degraded tissues and blood. And a good thing is that these are highly successful. So, it has mostly been seen that about 95 to 98 percent of success rate has been observed with mifepristone and misoprostol. But importantly, there are certain regulations you have to maintain, and with strict supervision from the doctor, you have to comply.

The doctor may also give you a specific timeline for taking these drugs. So, if the mesoprestone has been taken, there might be a time gap that you have to observe before you can take the mesoprestone. So, doctors can actually prescribe you the specific timeline in which the female, if she wants to terminate the pregnancy, can take and successfully terminate the pregnancy. Generally, up to about 70 days or 10 weeks of gestation, the pregnancy can be successfully terminated by this method of chemical abortion. In cases of more than 10 to 12 weeks of pregnancy until 24 weeks or until 20 weeks of pregnancy, the chemical-based method using mifepristone and misoprostol can be utilized.

Therefore, the chemical-based method of mifepristone and misoprostol can only terminate a pregnancy up to 10 to 12 weeks, but if it goes beyond 10 to 12 weeks, then no chemical-based method will actually work. In those cases, such as surgical-based methods, for example, dilation or evacuation, abortion must be performed by strict observance of the medical doctor or medical practitioner. In these cases, as you can see, first of all, the patient has to receive anesthesia; part of the embryo needs to be suctioned using a vacuum, and then this suctioned part of the embryo can be completely removed using a vacuum pump. So, this is like different steps of the surgical abortion process. Of course, we are not here to judge the rightness or wrongness of surgical abortion.

So, the disclaimer is that, of course, these visual images can cause momentary challenges. And then, in case of challenges with fertilization, the couple can also pursue the process of in vitro fertilization. This is an artificial way that a test tube baby can be developed. So, basically, what is IVF? IVF is an in vitro fertilization process. The process by which an egg is fertilized outside the body in vitro, where fertilization of oocytes can happen under laboratory conditions with sperm.

The first successful birth of a test tube baby happened in 1978, and the famous medical scientist Robert G. Edwards, who was the physiologist to develop this IVF or test tube baby,

was awarded the Nobel Prize in Physiology and Medicine. Very well-known doctor Subash Mukhopadhyay, who was based in Kolkata, developed the second test tube baby, who was named Durga. And as you see, South India's first test tube baby was named Kamala Rathanam. So, this is a very popular method; there was a lot of research and history behind the development of IVF, and in cases of challenges, IVF can be employed.

So, let us see what the different steps of IVF are. There are, of course, certain steps of IVF that need to be followed, such as the steps of ovarian stimulation followed by the retrieval of the egg. After the retrieval of the egg, the sperm needs to be collected simultaneously from a healthy donor. Once both the healthy eggs and the healthy sperm are collected from different donors, they can be mixed to create fertilization in the laboratory. And after the egg fertilization in the laboratory, the embryo can be cultured in a laboratory setting, and eventually, the embryo can be transferred and implanted in a healthy woman's uterus. So, in this way, the healthy egg and healthy sperm, when cultured and mixed in a laboratory setting or in a test tube setting, can form an embryo after fertilization, and the cultured embryo can be successfully implanted in a female uterus for a possible pregnancy.

So, this is like a savior for many couples who are having issues with natural fertilization and natural pregnancy. But of course, these methods are highly costly, and this does not assure a successful pregnancy. In many cases, it happens that even after the implants, due to hormonal deregulation in the female body, the embryo is eventually unable to become a healthy baby, and the mother faces severe challenges in delivering the baby. So, IVF, even though it can be successful, is a highly costly procedure, and there is no 100 percent success rate even for this procedure. So, let us think about it: name one pregnancy, name one emergency contraceptive method, and then name one risk or challenge of IVF.

So, hopefully you like the contraceptive class and IVF class where we discuss different procedures of both female contraceptives along with male contraceptives. We also discuss different ways of terminating a pregnancy in cases of unwanted pregnancy. And further, in cases of challenges with natural pregnancy, we also discuss how artificial or in vitro fertilization procedures can be employed. So, hopefully, you are enjoying different classes of human physiology. If you have any further questions, please discuss them with us during the live sessions.

You can also drop us questions in the email. So, thank you again for attending another class on human physiology. Hopefully, we will meet again soon with a new class and new lecture. Thank you.