Cell Culture Technologies

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Lecture – 15
Interaction of cell and glass/poly-carbonate surface – II

Welcome back to the lecture series in Animal Cell Culture. So, today we are into the fifth lecture of week 3. So, if you recollect in the last lecture where I ended was a very interesting point that, every cell secretes an unique extracellular matrix think logically for a minute that will make more sense to you.

So, in our body or this heart there are heart cardiac cells growing in that location, we have the brain the brain cells are growing in that location, we have the muscle skeletal muscle or the skeletal muscles are growing in the region and each one of these have certain different mechanical properties right. See for example, if I talk about the mechanical property of the heart they are entirely different than the skeletal muscle then the mechanical property of these cells in the brain. I am just taking the simple or then you could have many more you, can think of the cells which are lining the gut where the food is moving through the smooth muscle. What is meant by the mechanical property? Your heart is beating, so it means cells are moving like this right.

Now, having seed this think for a minute just this something really have to, say for example, these are your heart cells ok.

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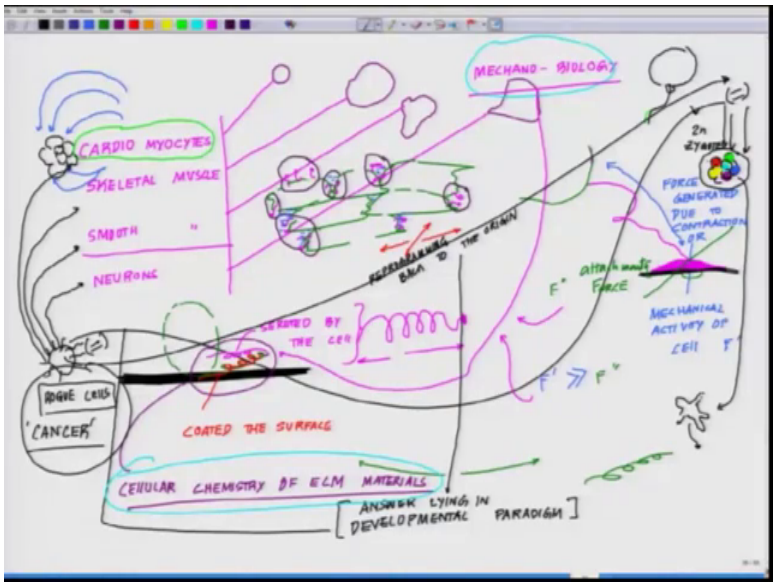

Now, just for simplicity sake I am just putting it like and these cells are suspended the blue is some kind of extracellular fluid which is there and these cells are anchored to each other by extracellular matrix as well as to the surrounding tissue by certain degree of a matrix ok.

Now, while this cell is moving. So, there are different kind of movement with this cells is undergoing. So, it has movement like this, it has contraction like this, it has contraction like this, so every time while it is doing so there are movement in these attachment points, you see these attachment points it is like these attachment springs or attachment points are getting stretched and strained all the time.

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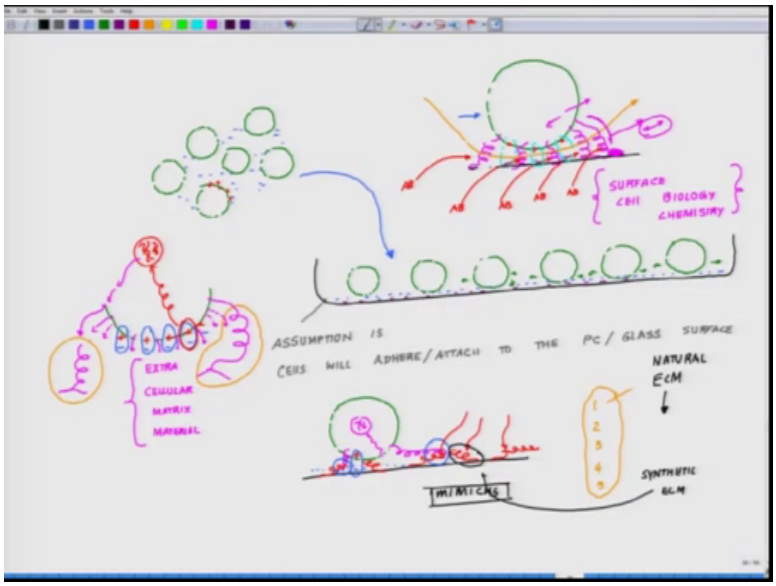

So, coming back to the drawing what I was trying to tell you see for example, this stuff is kind of have a flexible arm to move around, now imagine for a minute the force generated by this attachment point is higher than the force with which it is attached, because of this contraction lotion out here the force generated by this attachment peg is higher than the adhering force.

So, there are 2 forces here one is the force generated due to the movement of this part, let us draw it simple much more ok. This is how it is attached and this is the cell n, so this is the point of attachment out here on a substrate and this the substrate. So, there is one force which is helping it to attach attachment force, there is an attachment force whereas, there is another force which is functioning here which is force generated due to contraction or mechanical activity of cell.

Now, if I denote this force with F prime and I denote the attachment force as F double prime and if F prime in terms of the newton is greater than F double prime then what will happen? this cell will get detached from this surface so in order for this cell to remain there, either it has to be inducted in such a way that it kind of adhere there or its mobility has to be flexed in such a way that you give it a linear window to you know flex like this.

So, it means this attachment point has to be equally a flexible surface, you see my point? So, instead of so here what we are I am telling you that you have a glass substrate right which does not have any additional molecules or anything, now on top of the glass

substrate you decorate this glass surface with something like this and once your cells come and sit there, cells are coming and sitting there now these cells are secreting something which kind of bind like this. So, this let me change the color that now confuse you let me use it as red that will make life more easier.

So, this is the red which you have quoted the surface and the pink one what you observe is secreted by the cell. So, now, these 2 interact with each other now so that is something like this, this is the molecule I have quoted the surface. So, it is dangling like this, here is a cell coming and it is secreting this this arm which is now I am waving this arm this is the arm which has been secreted by the cell.

So, these 2 come and you know form a bond like this, now you see they can move better like this. So, this is precisely what I am trying to tell you is whenever we talk about the substrate vessel and modifications and all this is surface modification this is precisely what can be done. But then having said this I will ask a different question before I get into this, so I told you. So, different cells at different places, so I took example of 4 cells, 1 I told you about cardio myocytes, one I told you about skeletal muscle, the third I told you about smooth muscle and the forth was about neurons in the brain right, because the smooth we added.

Now, all these different muscle type and the cell type the neurons this neuron also so I cannot call are muscle type. Even within this muscle type has different mechanobiology, they are mechanical interaction with the surface is different with its surrounding cells is different and it generates different kind of forces out there, which is governed by this force generation is governed by the cellular chemistry of extracellular matrix materials. So, there are 2 things, one its mechanical properties varies second the mechanical property is the function of cellular chemistry of the ECM material.

So, it seems if we look at it very carefully it seems these cells preferred to remain in different kind of colonies of their own with a different kind of surface interaction. So, if you have to culture a specific cell type in a dish, you have to have a idea about the extracellular matrix what or which will help that cell type to mimic or to feel much of the same environment where it is growing in vivo or in real life, this is one aspect.

So, if you know that extracellular matrix nature then what you can do you have you take the substrate so here you have the substrate. So, you wanted to say grow cell 1 cell,

whatever you know then you (Refer Time: 11:52) that substrate with that choice of your extracellular matrix protein or material does it has carbohydrates to like this. Now modified situation here is your cell coming, first of all start that to roll it has its medium out there a little bit first it looks for its electrostatic interaction, positive negative interaction which it will do it will fall in a substrate and then, this possibly this is something which is believed to be this extracellular coating what you have done may sends it a signal through its surface receptors to its dna telling it, dude I need some of those proteins to be secreted by you which are going to form bond or will start dating with this other protein which is on the substrate.

Now, you see so now they are kind of cross talking with each other and this is how a cell initiates it live outside the system, what you are essentially doing you are taking the cell from its home you are marrying the cell getting it married to another environment another substrate, another house and your house is that vessel where you are getting them married. But now, if you want them to succeed there you have to create a conducive environment for them to feel at home. So, this conducive environment for them to feel at home is out here.

Yet there is there are some cells who, why they do we do not know, they prefer to lose their extracellular harmony and can grow anywhere any community and can start to proliferate anywhere, they are kind of rogue cells. You have seen this movie called rogue nations something like that rogue cells, these cells absolutely can go anywhere it means they can either adapt to their extracellular environment of anything and everything or they do not even need one specific one and these rogue cells are or is the beginning of what we call this word cancer.

So, those cells this is another we can define cancerous cells, those cells whose extracellular matrix harmony is compromised they travel along wherever they can and develop the rogue colonies there and what they do from that surrounding they pull out the resources for their own benefit and pretty much cripple that community and make them devoid of their necessary requirements and eventually ensure that they succeed till mankind succeed to understand their own problem inside them that, they have such rogue nations or rogue cells within them, they can do wonders.

Now, that brings us to a very different paradigm all together, the paradigm is this, this has been there for a long time and the plot contemplating over it the paradigm is this that if we accept for a minute that this is how it is working. So, it means when the sperm and the ovum fertilized when a man and women had sex and you know they have a baby conceived. So, the first cell which was formed was a zygote right.

So, you have this is sperm oh one second let me take this, this is sperm and this egg fertilize with each other and what we call as a 2 n or a zygote right. This all of you had up to class 10 somewhere or other you must have studied. This zygote then form a mass of cell and this mass of cell eventually forms an embryo and this embryo eventually becomes a baby. Now think of these phase as well they are going through, these cells there is no colony because they are still with very early phase. So, these cells were adapting to different extracellular matrix at the initially they are all clustered together it means the cells from where we are originating they cluster together with that unique extracellular matrix and then eventually the extracellular matrix differentially, like you know cell community of cells like 10 cells will become will secrete different kinds of extracellular matrix.

Another 10 is going to secrete different extracellular matrix, but earlier to that if you think of this situation where they could attain any kind of extracellular matrix feet on the similar all these cells similar to these cells. So, that brings us to a very different way of looking at cancer, is it a developmental disorder or maybe a not by the right word because developmental disorder is used for a different conditions that it is something, something the answer may be lying in developmental paradigm let us put it like this, instead of borrowing any word from anybody let us put it like this.

Because those cells try to just visualize, a single cell become a mass of cell these mass of cells eventually you know pick up their colonies, some become red some become green I mean just here I am putting it symbolically to some becomes violet, some becomes yellow likewise. So, so these colonies while they are formed earlier to that it was they can do anything and everything, are they similar? The questions which future is going to answer, but at this stage what is very important for you to understand this these are some of the very emerging areas which are coming up these mechanobiology and a great understanding is happening in the cellular chemistry of ECM materials.

So, the question where now you are landing up with, what are those extracellular ECM natural ECM, there is a reason why I use this word natural ECM in which ECM which can be used to coop the vessels to grow the cells of your choice one and what are those synthetic ECMs, what we mean by synthetic ECM is? If these are your natural ECMs you can always develop analogue or something which mimics these natural ECM.

So, those which mimics these natural ECM those items or coin it as synthetic ECM, we will talk about this synthetic ECM from very unique bio organic kind of things to very inorganic kind of things we would talk about it. So, at this stage what is important the take home message for you people is, yes we have these different kinds of vessels where I started with.

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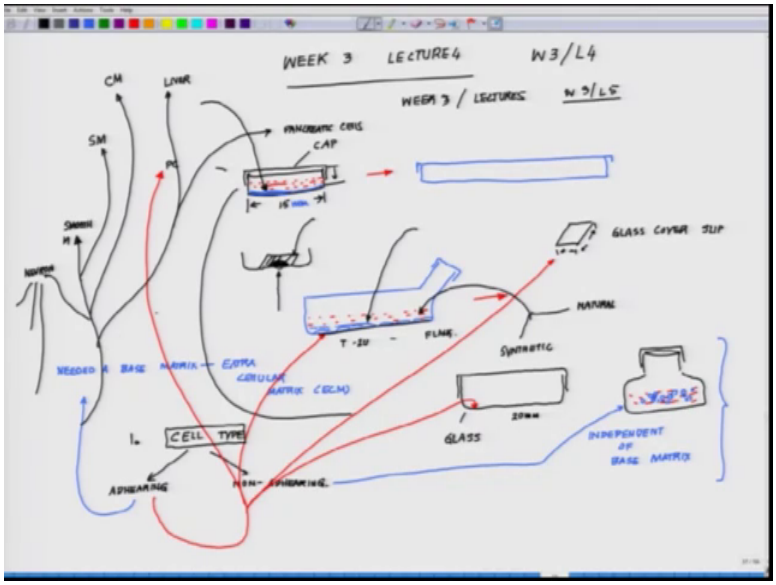

So, we are in the fifth lecture just let me put it like you know week 3 and this is our lecture 5 where we are almost to the phase of concluding it.

So, we have these different kind of vessels and then on top of that we can do a lot of modifications on them, depending on what cell type we wanted to grow and we can either go by synthetic route or we can go by natural route and what kind of interaction they will do and having said this about the cell type in a very subtle manner I told you within the adhering cell type, what cell type are we talking about? Means is it cardiac cell, is it cardiac muscle or is it skeletal muscle or is it smooth muscle, is it neuron and what neuron within them you know, different neurons have different requirements will

come in the specialized section or is it liver cells is it pancreatic cells. So, this list can go on and on.

What is important for you to understand is individual cell types have individual ECM bearing aside those which becomes rogue you can call them rogue or you can call them some reprogram themselves back to the origin, reprogramming back to the origin. So, that is why we came up with this thing, does the answer for cancer lies in the developmental paradigm, but that also tell us something that could we create a matrix to trap the cancer cells say for example, we know here you have the cancer cells and they may have the competitive binding for a substrate. And as soon as they hit on that substrate, you can program the substrate like that it will induce death in them, could we have such things, could we think little louder much ahead of our time that could make whole lot of difference on looking at cancer from a surface chemistry point of view.

So, with this thinking I will closing this lecture next week we will continue this story.

Thanks a lot.