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| 12 | Lecture No. |
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second part of the lecture:
the dr started talking about the two models:

1) In Vitro model:
the osteoblasts are put in petri dish and do to them whatever changes we want, and we can study the effect of a specific factor.

they studied the effect of PDGF beta on osteoblasts in two dishes:

Dish 1: a culture medium without PDGF

Dish 2: With PDGF and notice the difference on proliferation, chemotaxis and differentiation.

and according to the results we can say that PDGF when the cells presented in the dish containing PDGF is increased in number then the PDGF increases the proliferation.
but the problem here is that it contains more than one factor, in addition that it's a 2D model. we put a layer a cells on plastic surface and theses cells can't build itself; they can't become stratified.Whenever the surface is full of cells horizontally forming one layer any additional cell will die.

And because of that tehre was the 3D culture.
In which the cells forms tissue like stucture it's difficult also because it needs other functions like the movement factor.

The other model that was used is the ' Animal Model '
we take the PMP2 gene from the ovaries of the mother or we take the ovum and destruct this gene in purpose but in way that it gives a specific color to show whre is the destruction site.
they bring the genetic sequence, when it's translatedinto protien it gives the specific feature that tells taht here it was expressed either in flat bones, long bones...

some genes when changed in someway they die and no fetus is formed.
other genes like CDFA which is teh master gene of bone , when amplification is done the fetus is formed but he is born dead.
because it will have cartiligenous skeleton with no calcification.

we can't do gene amplification to more than one gene in more than one stage to know each gen's effect that's why it's still complicated.

most of our stem cells are present around boold vessels in addition to thoes in the bone marrow.
labeling for thoes in the bone marrow was done and they found that they don't stay in their place , thay rather move to athor palces.
they move and go to the place of destruction and start regeneration but the bad thing here that if they go to a precancerous place then it becomes cancer.
The study of caner is becoming better because we started understanding the mechanisms of stem cells
each cell has recetores , and there are problems in binding to these receptors.
each receptor accepts around 12 effector and this causes a problem in the regeneration technique.

growth factor is a versatile material it does it's function and die so we put it in carrier system to save it until it reaches the desired place and this is called targetting.
this way is used in cancer.
a cell cannot exercise it's activities unless it's attached to a surface.
bony cells put in a glass without adhesion will stay alive but not doing any action; it has to adhere to a surface to start an action.

3D scaffold:
we have allograft, xenograft and synthetic materials.
why we can't use the allograft and synthetic materials as a scaffold?
because it does'nt do integration with the hard tissue which is BONE in this case. and the epithelium is'nt formed.
the formed bone is not mineralized and even when mineralized some place won't, and there is a problem with resorption.
some regions of the scaffold wil not have oxygn and teh attachment is not ascceptable.
porosity also affects the vascularisation and oxygen diffusion.

Stem Cells:
they are presented in fetus , system and blood.
pluripotent stem cells can give any cell type except the supporting cells.
they give a fetus without the supporting structures of the fetus.
these supporting cells comes from the ovum.
If we take embryonic carcinoma which we can take them from testicular carcinoma cells they give everything except the supporting.

Multipotent stem cells gives : bone, skin, neurons...

 Totipotent gives everything including the supporting as if it utilizes ovum but it's dangerous.

\*Biologic death: failure to function. the heart stops or the brain is damaged.

When talking about mesenchymal cells (have high proliferation rate) are differentiated to multiple cell types by asymmetrical mitosis.
in mitosis each cell gives 2 but in asymmetrical mitosis it gives one cell undifferetiated and one differentiated to a specefic tissue type.

each type of tissue has a master gene that guide the mesenchymal cell to differentiate into the specific type of that tissue.

why is the parathyroid important in bone formatin?
because it playes a role in the genetic program of the bone factor.

we have bone marrow stem cells, neurons stem cells and basal layer stem cells.

in oral cavity we have stem cells, in addition to the previous ones we have in the dental pulp and is the shedding decideous teeth, in dental follicles and periodontal ligament.
which one is the eldest?
bone marrow and in the oral cavity it's the dental pupl stem cells.
before 15 years in the middle of 2000's.

Paul Sharpe he could seperate a whole cell from two adherent cells

"one of them epithelium and the other mesenchymal and a basement membrane in between"

the mouse has two centrals then space then molars.
They tried to inject in the edentulous area mesenchymal cells to guide the eruption of teeth in that area.

From where did the dental stem cells come from and how did they discover it ?
- they discovered it from thinking in logical way and the nature of life how everything is going. it's based on a theory present in life.

we have three types of dentine, we know them; and one of them is the tertiary dentine
from where dos it come?
from the ste cells present in the dental pulp.

And that's the waye the scientist (i don't know his name) who discovered the oral stem cells thought.
he took an extract from the dental pulp, and put them in a culture dish and he let them grow larger then he planted them on a scaffold then planted them again on the subcutaneous (in a place originally no bone or teeth would be present) of the mouse
and he had dentine like structure under the microscope.

then he restudied it and found it to be positive.

He found: Dentine Sialoproteins are the ones in charge of forming dentine in the first place.
And found osteocalcic which is the terminal differentiation marker of calcific tissues.
and when studying the mineralization he found it positive.(by staining)
 all of these are markers of stem cells.

\*\*\*And at last they made isolation of these stem cells.
2003: Shed stem cells >> teh ones from decideous teeth.

2004: stem cells of the periodontal ligament.

2008: Apical stem cells.

2005: dental follicle stem cells

\*what are the characteristics of tehse stem cells ? what makes them different from the other ones?
-they have higher proliferation rate than that of the bone marrow under same conditions.

high plasticity we can give anything out of them

tissue genin: we take cells and put signal molecules on a scaffold then we have the specific tissue in the lab and so plant it anywhere.

periodontally speaking a study in 2005 they made a sheet of stem cells and made a defect in the periodontium, they put the sheet over the defect
after a while there was complete degeneration of the defect

In conclusion:
Tissue engineering includes pathology, physiology, microbiology,biotechnology and scaffold industry.
and it's highly complicated.

tissue engineering could be ex vivo in the lab
or in vivo inside the body
how can we get benefit of it?
in dentine repair,
tooth tissue engineering.
tissue engineering of bone, cartilage, nerve and muscles.

Complexity of tissue engineering in addition to what said before:
physiochemical and mechanical factors.
stem cell extracellular matrix communication.

challenges:
Biological factors >> Signal molecules and growth factors
scaffold industry.
technical challenges>>culture conditions; until now we are using xenogeous products from pther animals.
delivery challenges
Functional integration.
Rejection.

 ...Sara Al Tally...