CELL CYCLE AND ITS REGULATION

Q.How cell cycle is being regulated by extracellular signals? Give suitable example

AN example of cell cycle regulation by extracellular signals is provided by the effect of growth factors on animal cell proliferation. Different cellular processes (e.g.; cell growth, DNA replication and mitosis) must be coordinated during cell cycle progression. This accomplished by a series of control points that regulate progression through various phases of the cell cycle.

Q.What is START?

A major cell cycle regulatory point in many types of cells occurs late in G_1 and controls progression from G_1 to S. This regulatory point was first defined by studies of budding yeast (*Saccharomyces cerevisiae)*, where it is known as START (**Figure1**). Once cells passed START, they are committed to entering S phase and undergoing one cell division cycle. However, passage through START is a highly regulated event in the yeast cell cycle where it is controlled by external signals, such as availability of nutrients, as well as cell size.

If Yeasts are faced with a shortage of nutrients, they arrest their cell cycle at START and enter a resting state than proceeding to S phase.

Start is the point at which cell growth is coordinated with DNA replication and cell division.

Q.How restriction point in animal cells differs from START point of yeast.

The proliferation of most animal cells is similarly regulated in the G_1 phase of the cell cycle. In particular, a decision point in late G_1, called the **restriction point** in animal cells, functions analogously to START in yeasts.

The passage of animal cells through the cell cycle is regulated primarily by the extracellular growth factors that signal cell proliferation, rather than by the availability of nutrients. In the presence of the appropriate growth factors, cells pass the restriction point and enter S phase. Once it has passed through the **restriction point**, the cell is committed to proceed through S phase and the rest of the cell cycle, even in the absence of further growth factor stimulation.

Q.Check points

In most cells corordination between different phases of the cell cycle dependent on a series of **cell cycle checkpoints** that prevent entry into the next phase of the cell cycle until the events of the preceding phase have been completed (**Figure2**).

These checkpoints sense unreplicated or damaged DNA and coordinate further cell cycle progression with the completion of DNA replication repair.

Q.How ATM and ATR related to checkpoints?

Cell cycle arrest at stage G_1, S and G_2 checkpoints is mediated by two related protein kinases, designated ATM and ATR, that recognize damaged or unreplicated DNA and are activated in response to DNA damage. ATM and ATR then activate a signalling pathway that leads not only to cell cycle arrest, but also to the activation of DNA repair and in some cases, **programmed cell death**.

Key:ATR-(Serine/threonine-protein kinase-Ataxia telangiectasia and Rad 3 related proteins);
ATM(Ataxia telangiectasia mutated)

Q.What is spindle assembly checkpoints?

This checkpoint maintains the integrity of the genome occurs toward the end of mitosis (**Figure3**). This check point is called **spindle assembly checkpoints,** monitors the alignment of the chromosomes on the mitotic spindle, thus ensuring that a complete set of chromosomes is distributed accurately to the daughter cells.

Failure of one or more chromosomes to align properly on the spindle causes mitosis to arrest at metaphase, prior to the segregation of the newly causes replicated chromosomes to daughter nuclei.