Complications in Cell Reproduction Causing Cell Death

**Introduction**

The processes of Mitosis and Meiosis, or the duplication and splitting of cells to reproduce, are often taught in a generic cycle, as their performance insists. However, information of the cell’s back-up system is often omitted from the presence of learning this cycle(s). If cells are incorrectly replicated or are no longer useful, they follow instruction to naturally expunge themselves, scientifically named *Apoptosis*, as there is no use for old, inactive cells due to the cells dependably replicating. In healthy humans, billions of cells die in bone marrow and intestines alone every hour, let alone every other organ, which constantly replaces cell to ensure healthy conservation and upkeep. Death can be caused due to a lack of purpose for the cell, or merely for balance in the number of cells within the host. The natural cell death, Apoptosis, occurs in every living thing, and is extremely vital in embryonic development. In humans as adults, cells utilize apoptosis to maintain organ size as new cells are created for upkeep and maintenance, old cells are rid of that are unused. Just as there are essential enzymes to catalyze cell production, there are correspondingly vital enzymes to initiate cell death.

**Accuracy of Mitosis**

Cells utilize Mitosis to accurately duplicate and split into the specific daughter cells, including the correct replication of DNA for that cell so it may complete its designated task or purpose. Molecular machinery and proteins guarantee precision in this process. For example, the mitotic spindle, which organizes, regulates, and segregates the chromosomes to the respective daughter cells during mitosis. This process occurs due to its polar and dynamic properties, which are introduced during specific reproductive phases. Additionally, Kinetochores are an inputted macromolecular system securing precise movement of chromosomes during Mitosis. These multi-purpose organelles link to the microtubules, which drive the movement of chromosomes to one pole or the other prior to the splitting of the cell. The microtubules are extremely responsive to tension from the Kinetochores. If the attachment of the organelles is incorrect, there would be a lack or excess of tension on the connection between the two. The sensitive microtubule would then detach from the kinetochore, if the tension was incorrect, allowing a replacement Kinetochore to properly fasten and move the microtubule to its accurate area within the cell. Although most cells accurately reproduce, there are instances in which cells incorrectly replicate, instigating cell death or inappropriate purpose.

**Cell Division**

Cells, throughout their life-span and cell cycle, are consistently growing, duplicating DNA, transferring the replicated proteins and information, and then dividing to create new cells. These stages, throughout the cycle of Mitosis, are unfailingly executed to create healthy cells. Taught in the previous chapter, Mitosis occurs through four phases: Prophase, Metaphase, Anaphase, and Telophase. Errors in Mitosis most often occur during Metaphase. This is due to the duplicate chromosome improperly pairing at the metaphase plate, therefore unable to separate to their retrospective poles, occurring during Anaphase. Due to the improper transfer, one daughter cell has two chromosomes while the other cell has none. The cell with no chromosomes is deleted, while the cell with two chromosomes has other options. If the chromosomes slow development, the cell can be deleted naturally, yet if growth is exponential, cancer may occur.

**Cell Death**

Although cells have interdependent systems to ensure accurate reproduction and furthermore death, there are cases in which outside sources influence the cells, causing enough damage for them to die. Cells that perish because of injury, entitled *cell necrosis,* hindering the other cells around them. The cell swells and then burst, discharging its cellular components onto its neighboring cells. This may cause inflammation or damage to the cells around it; The unnatural and sudden death causes an after-effect on a multitude of cells surrounding it. In contrast, Apoptosis is a neat and purposeful clearance of the cell and its contents. According to Alberts et. Al, primarily, the cell separates itself from the cells close to it. The cytoskeleton then falls which shrinks the cell, the nuclear envelope disassembles, and then the nuclear DNA disperses into fragments and is engulfed by the other cells which encounter the remains. Apoptosis, nicknamed cellular suicide, is natural and ordinary, as well as completed for a purpose.

**Uses of Apoptosis**

Although there seems to only be internal use for Apoptosis, or programmed cell death, there are also external effects. For example, Mouse paws are an external observation of Apoptosis. The original shape of a mouse paw is that of a club or spade. The cells then begin to die in the webbing of the digits, thus the “fingers” are created due to the cell bereavement. A supplementary example is a tadpole’s tail, which falls off during growth into a frog due to cell death. The tadpole has no use for the tail after growth of legs, as the legs become multi-purposeful for motility on land and in water; The cells that make up the tail are shut-off, and the tail is slowly expunged as the cells disperse into other areas of its body. Plants, animals, as well as humans utilize Apoptosis as well. During embryonic development, the webbing between extremities are excised, alike mouse paws. Furthermore, in adult life, organs are consistently updating the cells that make them up by reproducing new, healthy cells to replace the old, which are additionally purged by programmed cell death.

**Apoptosis Gone Wrong**

Although natural cell death, alike the systems of reproduction of a cell seem infallible, there are multiple cases in which these systems are interrupted which causes a malfunction in the procedure or life-cycle of a cell. Many cases of illness and cancer are because of a surplus or insufficiency of cells in the body. For example, an effect of uncontrollable growth of cells is cancer, as the cells could become a tumorous mass or metastasize in the body. In contrast, a lack of growth Alzheimer’s or Parkinson’s, both life-threatening and physically damaging diseases. Furthermore, as investigation has progressed and diseases have evolved, researchers have found that the AIDS virus may utilize cell apoptosis for its own benefit, persuading immune cells to kill themselves while they are still active and useful to the human body.

**Conclusion**

The evolution of cells, through humans, animals, and plants, have developed to encourage a working system for each cell. Through the macromolecular systems placed to ensure accuracy of cell duplication and division of Mitosis and Meiosis, there are unavoidable circumstances and obscure conditions which inhibit the accuracy of these systems. Procedures are enacted to displace these inaccuracies due to the often-fatal outcome, whether it is natural, like Apoptosis, or unnatural and spontaneous cell death.

**References**

Asbury, Charles L. “How Kinetochores Promote Accuracy in Mitosis.” *BioPhysical Journal*, www.cell.com/biophysj/abstract/S0006-3495(11)02567-7.

“How do genes control the growth and division of cells? - Genetics Home Reference.” *U.S. National Library of Medicine*, National Institutes of Health, ghr.nlm.nih.gov/primer/howgeneswork/genesanddivision.

museum, Science. “Who am I?” *What happens when apoptosis goes wrong?*, NMSI / Science Museum, 19 Apr. 2010, whoami.sciencemuseum.org.uk/whoami/findoutmore/yourbody/whatdoyourcellsdo/howdocellsdie/whathappenswhenapoptosisgoeswrong.

Walczak, C E, and R Heald. “Mechanisms of mitotic spindle assembly and function.” *International review of cytology.*, U.S. National Library of Medicine, www.ncbi.nlm.nih.gov/pubmed/18275887.

“What makes cell division accurate?” *ScienceDaily*, ScienceDaily, 23 Jan. 2014, www.sciencedaily.com/releases/2014/01/140123125532.htm.

“When Happens When Mitosis Goes Wrong and in Which Phase Will It Go Wrong?” *Sciencing*, sciencing.com/happens-mitosis-goes-wrong-phase-wrong-8723.html.