Biological robustness and fragility

Biological systems must be able to resist external stimuli to be able to preserve their integrity and pass on their information to their offspring. Those traits of robustness are specifically seen through evolutionary preserved mechanisms of DNA replication and gene expression, protein folding and metabolism (Koonin *et al.*, 2020) which are an integral part of survival, flow of information and continuation of life. The robustness is usually preserved through extra checkpoint steps or extra scaffolding molecules which are able to assist the process and minimise potential mistakes, meaning they have internal capability to self-maintain the process and avoid perturbations (Barnum and O'Connell, 2014). However, there is a trade-off in these between robustness, fragility, cell and performance, which makes these mechanisms robust-yest-fragile (Kitano, 2007).

The process I want specifically focus on in this case is cell cycle and cancer. The core information flow occurs at a cellular level, with the process of DNA replication. The replication of genetic information is the core of cell cycle process. Cell cycle is one of the most underestimated controls of continuation of life and transfer of information. Each cell in the body divides in parallel and destruction of one cell does not destroy the growth and division of an organism, whether the cell is in the brain or the heart. The cell cycle has 4 stages, M- mitosis, G1 - growth, S - DNA synthesis and G2 growth and preparation for mitosis (Barnum and O'Connell, 2014). These steps are sequential, and between each step the cell must monitor the order and integrity of the steps taken, otherwise the DNA replication process will be corrupted, and the information flow will be halted. This is why surveillance system of 3 checkpoint exists: G2/M checkpoint, M/G1 checkpoint and G1/S checkpoint. Each phase has a specific purpose, for example, G2/M phase supervises cells entry into mitosis, where the cell must be committed to align DNA, complete DNA replication, resolve any present DNA damage and make sure the cell is prepared for the cell cycle by checking its size and the quantity of synthesised molecules (Barnum and O'Connell, 2014). How does this surveillance system work? The checking occurs through signalling pathways and special molecules called cyclins, which are names after the step when they are signalling and cyclin dependant kinases of CDKs. However, the system has its limits.

Cell cycle can undergo replication stress, is a process by which may be caused by a variety of factors, such is DNA lesions and gaps, restart of replication, external factors such as UV light and more (Zeman and Cimprich, 2014). Replication of cells is an important process in growth of an organism, and it is important that the growth is controlled, and any faulty by products of the growth, such as mutated cells, are illuminated from the system through the process of apoptosis. Even in the case of accumulation of mutations, which is the initial cause of cancer tumour formation, the organism still functions and only when the tumour becomes spread and disturbs the work of all human systems through metastasis (Dillekås *et al.*, 2019).

All in all, this short essay has discussed some of the aspects of biological robustness and fragility, with the emphasis on one of the critic processes in biological systems – cell cycle.

**Reference list**

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