The connection between chemotherapy and infection

November 16 2016, by Flora Teoh

Most people's ideas of bacteria and fungi tend to be negative, since we often think of them only as the cause of many human diseases. Yet we must not forget that the average human body is colonized by trillions of microbes belonging to these microbial groups. In fact, it has been estimated that the number of bacterial and fungal cells colonizing a human far exceeds that of the number of cells actually belonging to the human!

In a healthy person, these microbes do not cause disease—many of them perform important functions, for example during the production of enzymes that break down food, the development of the immune system and even preventing disease from other microbes. This seemingly neutral relationship with the human host can take a nasty turn if the person's immune system stops working properly, which is often the case for cancer patients who are undergoing chemotherapy treatment. Cancer cells proliferate uncontrollably and rapidly, which is a double-edged sword, as uninhibited cell division enables their growth and invasion but makes them highly vulnerable to chemotherapy drugs that work by interfering with cell division and growth processes.

However there are many healthy, non-cancerous cells such as those of the epithelial surfaces—which line our gastrointestinal and respiratory tract, among other things—and immune system which also need to undergo rapid cell division in order to maintain their function. As chemotherapy drugs do not distinguish between healthy and cancerous cells, these healthy cells become collateral damage in the war between

cancer cells and chemotherapy drugs.

Ironically, a patient could die from side effects resulting from the cancer treatment rather than from the cancer itself. This is because the immune system and epithelial surfaces are important defenses against microbial invasion and infection, and weakening them via chemotherapy treatment makes it more likely for cancer patients to develop infections, even from microbes that normally peaceably reside in the human body.

Little is known about whether chemotherapy drugs have any effect on microbes themselves, and whether these effects contribute to the development of disease. Why should this be of interest? Because the targets of chemotherapy drugs present in humans, are often also present in microbes.

As the processes governing cell division and growth are so crucial to life itself, variations within these processes are not well-tolerated or optimal for life, making them highly conserved in an evolutionary sense: simply put, there are very strong commonalities in these processes from the simplest microbe to the most complex mammal.

Thus, a chemotherapy drug that affects a component in a human cell can also do so in a fungal cell. Moreover, the manner in which chemotherapy drugs act on cells also tend to produce mutations. What then, might these mutations do? Might the microbial population harbored by a cancer patient treated with chemotherapy drugs be more likely to mutate due to exposure to the drug? Might these mutations make them more likely to cause disease or be more resistant to antibiotic treatment: in short, to transform from Dr Jekyll to Mr Hyde? This is one of the main research questions I am studying in Candida albicans, a fungus which is a major resident of the human skin and gastrointestinal tract, yet is also a common cause of dangerous blood infections in cancer patients.

A note before we end: This post is not meant to demonize chemotherapy drugs, or discourage people from seeking cancer treatment. That chemotherapy is a painful and arduous course to endure cannot be disputed, but we must also acknowledge that it was for many years, the only form of treatment physicians could offer to cancer patients, and before its advent, a cancer diagnosis was effectively a death sentence. Chemotherapy has prolonged the life expectancy of cancer patients, and together with modern medical interventions, can even produce cancer remission. We therefore should endeavor to avoid throwing the baby out with the bathwater. By learning more about how chemotherapy interacts with microbes and the consequences of such interactions, we may eventually be able to prevent such opportunistic infections in cancer patients, anticipate drug resistance and assist physicians in selection of therapy, ultimately improving the outcome of cancer treatments and the life expectancy of cancer patients.

Provided by Agency for Science, Technology and Research (A*STAR), Singapore