Yoshinori Ohsumi: A Nobel Prize for Life and Death

Richard Béliveau

Translated from Le Journal de Montréal, October 10, 2016

The 2016 Nobel Prize for medicine was awarded last week to the biologist Yoshinori Ohsumi for his discoveries on autophagy, a form of cellular death which plays a fundamental role in the maintenance of good health. This is a good occasion to recall that understanding death often allows us to better appreciate life and to plainly see the incredible complexity of the human body.

Every day, in complete anonymity, about **10 billion** of our cells become ineffective and die, most of them (quite fortunately) being simultaneously replaced by new, effective cells. The extent of death and rebirth varies considerably according to the type of cell; a cell which lines the wall of the intestine, for example, will live only five days while lifespan is one month for a skin cell and four months for a red blood cell.

In time, however, the potential for renewal diminishes and can even produce a gradual deterioration of physiological function and, ultimately, to the death of the organism. In summary, if we are to one day die it will be because we die a little bit every day.

DEATHS A LA CARTE

Three mechanisms are principally responsible for these cellular deaths:

Necrosis: This is a form of violent death which occurs when the cells have been subjected to physical or biochemical damage. An infection, an injury or a lack of blood supply (as with a heart attack, for example) can all cause cellular death by necrosis.

Apoptosis: This refers to a programmed death, i.e. to a series of very precise events which permit the correct elimination of a cell. This process is absolutely essential for elimination of cells which have become non-functional or which present potentially dangerous anomalies (mutations in DNA).

Autophagy: As its name indicates, autophagy (from the Greek words *auto*, itself, and *phagy*, to eat) refers to processes in which the cells digest their own components. First observed during the 1960s by the celebrated Belgian scientist Christian de Duve, autophagy could thus be considered as a form of cellular cannibalism which allows the cells to eliminate damaged proteins or structures which have become dysfunctional.

DYING… BUT NOT COMPLETELY!

For a long time, autophagy was considered to be a relatively rare phenomenon, primarily observed in response to a lack of nutrition (by degrading some cell constituents, the cell buys time by utilizing the energy thus generated to survive the "famine"). When the stress persists, the cell reaches a point of no return and then dies; however, autophagy frequently does not provoke death, but rather permits the cell to perform "housekeeping" and improve its activity by removing non-functional residue which could interfere with its survival. In other words, rather than leading to death, autophagy becomes instead a rejuvenating treatment which improves the performance of the cell. As the German philosopher Friedrich Nietzche said, "That which does not kill me makes me stronger."

Thanks to the work of the Japanese scientist Yoshinori Ohsumi, Nobel laureate for medicine in 2016, we know today that autophagy plays an absolutely essential role in the maintenance of normal physiological functions and that perturbations in the mechanisms which govern this process are involved in the development of several pathologies. Insufficient autophagy is associated with excess cellular debris which can favor certain neurodegenerative diseases such as Parkinson's disease.

Inversely, autophagy can become problematic under certain conditions. For example, cancer cells can survive by cannibalizing themselves into a dormant state; when the environmental conditions improve (new blood vessels, formation of metastases) they are then able to rapidly renew their growth and can become even more dangerous. It is often said that life hangs by a thread and autophagy undoubtedly represents one of the best examples of this delicate equilibrium between life and death.

You find the content of this column useful? Make a donation at www.richardbeliveau.org to speed up our research

You find the content of this column useful? Make a donation at www.richardbeliveau.org to speed up our research

You find the content of this column useful? Make a donation at www.richardbeliveau.org to speed up our research