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Aging: A Rectifiable Mistake?

Aging is a natural subject for biotechnology. It's hard to think of a market that would be more difficult to saturate. Although aging is already a product haven for placebos and panaceas, with billions spent on everything from molecular wrinkle cream to hair replenishing lotions, the real issues of aging—disease prevention and health promotion—receive, by some estimates, less than 4 percent of the $880 billion spent annually in the U.S. on health care.

We are already coming to terms with the consequences of living with medicines and technologies that postpone death but do not necessarily improve life. According to the U.S. Census Bureau, the number of people 65 and older has more than doubled since 1950, from 12.3 million to 31 million. Many suffer from chronic conditions ranging from diabetes to hearing loss. By the beginning of the next century, the cost of providing medical care for those over 65 in the U.S. is expected to reach $1 trillion, as the 75 million babies born between 1946 and 1964 reach the 65+ mark. The question is not only who is going to pay for this, but who wants to live like this, long and unwell?

Being elderly does not have to mean being sick. An important and inexpensive part of the solution lies with education, spreading the *fin-de-siécle* message about how individuals can reduce their risk of suffering from chronic illnesses as they age through diet, exercise, and not smoking. Another part lies with basic research into the fundamental mechanisms of aging and the disease states associated with it. Putting our resources behind this kind of work may prove more useful than the development of more and more diagnostic tools of questionable value.

One promising approach is discussed in this month's review article by Philip Barr and David Tomei, "Apoptosis and Its Role in Human Disease." Known familiarly in embryological and developmental circles as programmed cell death, apoptosis is a carefully controlled, normal cell process, or set of processes, during which a cell systematically dismantles itself (this systematic dismantling is what distinguishes it from necrotic cell death, a messy blowing up of the cell that is usually the result of severe trauma). In development, apoptosis is intrinsic to the sculpting of an organism's body plan, nervous system, and so forth. Disregulation of apoptosis—resulting in cell death (or lack of it) at the wrong times and in the wrong places—plays an essential role in diseases associated with aging. The list of disease processes in which apoptosis is implicated is long and bewilderingly diverse—everything from cancer to neurological disorders and heart disease.

The role of apoptosis in disease has clarified its importance in aging itself. The authors and others have proposed that apoptosis is the ultimate mechanism for body maintenance in multicellular organisms. When it doesn't work, errors that would ordinarily be eliminated stack up, the system is overwhelmed, and the organism ages. Aging, it seems, is one big apoptotic mistake.

Knowing this much doesn't mean the rest will come easy. It has been difficult to lay out the molecular machinery of apoptosis because apoptosis-inducing signals are diverse and include hormones, radiation, hyperthermia, calcium influx, glucocorticoids, and cytotoxic agents. This difficulty has been compounded by the fact that signals that promote apoptosis in some cells turn it off in others. In other circumstances, these same agents induce cell proliferation, reminding us once again of the extreme importance of a cell's environment in its response to the signals it receives.

Complicated as it is, Barr and Tomei believe that apoptotic processes and pathways are excellent candidates for drug therapies. Among the apoptotic targets under study are such cell surface molecules as the erythropoietin receptor and receptors belonging to the tumor necrosis and nerve growth factor receptor families, including CD40 and Fas/Apo-1.

While it is clear that there will be no quick fix, understanding aging and age-related diseases must be a priority if we are to make any significant progress in health care cost containment—and in continuing to improve the quality of life for those who endure.

—SUSAN HASSLER