Recent Research on the Telemorase Enzyme
and the Concept of Immortality

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Abstract:
During DNA replication, telomeres at the tips of chromosomes maintain connections that allow orderly replication. With each division, the telomere shortens until it gradually reaches a critical length that prohibits the cell from further division, causing several diseases associated with senility. Telomerase is an enzyme found in germ cells and embryonic stem cells that helps replace the telomeres. Through processes that reactivate these telomeras, scientists hope to develop regenerative methods to significantly extend the human life span. The process of telomerase activation, on the other hand, may create cancer cells, and understanding telomerase inhibition could help in combating cancer. From an Islamic perspective, the life span of a human, which only God determines, should be spent promoting good for society and preventing what is bad. If anti-aging measures help maintain the productivity of an individual, and if that individual’s productivity is good for society, then anti-aging measures are good. Religious organizations and governments would need to promote social justice in balancing resources needed by younger and older generations.

Key words: telomere, telomerase, regenerative medicine, cancer cell, immortality, Islam, anti-aging.

Introducution

Human cells contain 23 pairs of chromosomes, which carry the genes that characterize and control the functions of the cell. The genes are coded according to nucleotide pairs, arranged on the DNA double strand in a unique way for the species (human) and for the individual (molecular fingerprinting). As the living cells replicate, the double strands separate, and each becomes a template for a new DNA strand, allowing the original double-stranded DNA to become two identical double strands, one for each of the two daughter cells. To regulate this process, the double strand of the original cell maintains connection through the tips of the chromosome so that the new double strands maintain a relationship with each other. The mechanism

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that maintains that relationship is a DNA cap at the
two terminal ends of the chromosomes. It is formed
of noncoding pairs of nucleotides (approximately
20,000 each) that share in holding the two new
daughter double strands together. Each cap is termed
a “telomere.” In the process of cell division, the
telomere loses a few hundred pairs of nucleotides, but
the major portion of the telomere remains intact and
helps in the future divisions of the cell. However, with
each cycle, the telomere becomes slightly shorter. As
life continues, the telomere gradually gets shorter
and shorter until a critical level is reached, prohibiting
the cell from any further division. Once this cell
dies, it can no longer be replaced. Depending on
the type of these cells, their functions cannot be carried
out anymore, and diseases associated with a loss in
tissue viability start to occur. In humans these
include Alzheimer’s disease, Parkinson’s disease, and
heart attacks. These are usually related to senility due
to the fact that the cells have undergone numerous
cell division cycles, causing a loss in telomeres. If
there is a way to maintain the length of the telomere,
these senility disorders could be prevented. The
function of the brain, heart, muscles, and other
organs would be maintained, resulting in a healthier,
longer life.

The enzyme that helps form or replace the telomeres is called “telomerase.” In humans, this enzyme is
only present and functioning in the germ cell (egg and sperm), the resulting embryonic stem cells of the
developing fetus, and some regenerating tissues. Certain drug companies are investing in products
that reactivate this enzyme beyond the early fetal life.

If this happens, together with the recent great
progress in health care and in the new discipline of
regenerative medicine, the average survival of
humans is expected to increase significantly well
beyond the age of 70 years (one generation ago in the
western world) and the current life expectancy of 100
years for the new generation. However, telomere
lengthening does not necessarily ensure a lifespan
extension, and telomerase activation should raise a
red flag for potential cancer development.

Normally, some cells’ DNA may acquire damage
that creates a cancerous cell. In many or most of
these cells, the telomerase enzyme that was inactive
since fetal life is reactivated. This cancer cell, with
reactivated telomerase, can make the cell rebuild the
portion of the telomere that is lost with every divi-
sion, causing the cell to continue dividing for very
long periods without aging or dying. In some cancer
cells, the telomerase level is directly related to progres-
ses. Some of these cancer cells have continued to
grow in tissue cultures and have for years outlived
the individual in whom they started. In a sense, these
cancer cells can achieve “immortality” in the labora-
tory.

If we can turn off that telomerase in the cancer
cell, the telomere cannot regenerate and will continue
to deplete with every cell division until the cell
dies; creating a situation where telomerase inhibition
is an attractive treatment for cancer therapy. On
the other hand, telomerase stimulation is attractive
for expanding the potential of cellular proliferation
with delay in senility and improving tissue regenera-
tion. A combination of both objectives, i.e. stimulating
telomerase in body cells without causing cancer,
would be optimal. This is currently a major goal for
several research and drug companies. A concern that
should be initially addressed is that the design of the
human body may not be able to cope with an extend-
ed life span. Eventually, this could be compensated
for as regenerative technology further develops.
However, current telomere technology is far from a
stage where it can be applied to actually extend the
human life span. Recently, progress has occurred in
both directions, and scientists are trying to answer
the question: Is the telomerase gene an immortality
gene or an oncogene?

Approaches of researchers to activate the telom-
erase include administering drugs and infecting the
body with viruses that carry the active gene but do
not harm the cells. The direction is promising, and
firms have already claimed some success to the
extent that California voters in 2005 approved a $3-
billion bond to start a California institute of regener-
active medicine, which includes research on aging, tis-
ue repair, stem cells, and telomerase.

**What are the Implications?**

**Religion**

From the point of view of religion, there is no
immortality for humans in this life:

كل نفس داياتة الموت

Every soul shall have a taste of death ...

Some may wish to survive 1000 years: 
... Each one of them wishes He could be given a life of a thousand years ...\(^9\)

Nūḥ (Noah) lived 950 years:

\[
\text{وَلَقَدْ أُرْسِلْتُمُ نُوحًا إِلَىٰ قَوْمٍ فَلَبِثْتُ فِيهِمْ أَلَفٌ سَنَةٌ إِلَّا خَمْسِينَ عَامًا.}
\]

We (once) sent Noah to his people, and he tarried among them a thousand years less fifty ...\(^{10}\)

The issue is not how long one lives but how much good one does.

**Society**

The impact on society would be far-reaching. Overpopulation is expected, resulting in a burden on resources. The benefit of greater productivity of longer-living experts may offset these challenges. In any event, major changes in the education system would be necessary.

**Ethics**

These developments would raise significant ethical issues. This technology would not be available to poor societies or countries, nor would it be available to the poor in affluent societies and countries, thus widening the gap between the first and third worlds and causing a new unprecedented class to emerge. More resources would be used by a smaller percentage of the population, both within nations and throughout the world.

**Discussion**

We have reviewed the topic of telomerase enzyme as an approach to immortality of the cells and probably as a future means of delaying aging. The enzyme is usually referred to as the “enzyme of immortality.” Though the issue of immortality in humans is not considered literally, research in the area has created great interest, writings, and debates in ethics and among some religious groups. New corporations have started. Among them is the Immortality Institute (ImmInst.org), which deals with the wide variety of issues regarding antiaging approaches. A Google internet search for telomerase finds about 850,000 links; a search on telomerase and immortality finds about 50,000 matches.

Antiaging medicine is important for individuals and societies. In Islam, “doing good” is an imperative. Muslims are required to promote what is good for society and prevent what is bad and to compete in doing that. If antiaging measures help maintain the productivity of an individual, and if that individual’s productivity is good for society, then the antiaging measures are good. Otherwise, antiaging measures would not, or should not, be desirable. The Qur’an mentions that someone may wish to survive for 1000 years, but that would not shelter him or her from hell fire if what they are doing is evil.\(^9\) So, longevity in itself is not beneficial if it is not associated with doing good in a society.

The length of the life of an individual cannot be predicted, and only God knows when an individual is to die. However, with improvements in healthcare over the past several decades, the average survival of Western populations increased from 40 years to 50, 60, and 70 at the present time. With the rapid pace of healthcare improvements, the survival of the new generation is expected to be 100 years, especially with the developments in regenerative medicine and in stem-cell technology. The new progress in telomerase research may push the age more towards that “relative immortality” age of 150 or more. For a Muslim, relative immortality may be realized only if God wants it to be. An interesting point to mention is that the Qur’an states that prophet Noah ﷺ lived for 950 years.\(^{10}\)

Antiaging genetic technologies would impact the relationship between individuals and society through the actions of the individual. For example, if the individual’s actions are good, carried over a longer life, the result is good. If an individual’s actions are evil, carried over longer life, it is bad for the society.

We may direct our discussion to the appropriate use of limited resources. Throughout life, those who can afford something try to get it, and those who cannot will not, especially when resources are scarce. In general, longevity leads to more resources being committed to the increasing numbers of older people. This may put pressure on resources needed for the younger growing generation, whether in food, health care, housing, transportation, etc. If there is enough
for all, there is no harm, but the expectation would be that the aging population will take away some resources from the younger and underprivileged population, and that is a problem. Even if an advanced, wealthy nation can afford to provide the extra resources for the aged, most likely that will be at the expense of resources that should help a third world nation, and there would be greater inequity within a nation and between nations. The main balancing mechanism would be promoting social justice as encouraged by religions and governments.

There is always concern that genetic technologies may lead to a new form of eugenics in which the disabled are gradually eliminated. This should never happen. We should try to eliminate the disability not the disabled. A hopeful model for that would be the direction to treat fetal disorders by fetal constructive treatments and the growing fetal stem cell technology instead of resorting to termination of pregnancy.

References
8. Glorious Qur’an, Chapter 3, Verse 185.