Cancer Cell Psychology: When People Behave Like Cancer Cells

Nzola De Magalhães, M.S., Ph.D., HTL(ASCP)[CM]
Department of Pathology, University of California San Diego
E-mail: nmmagalh@uci.edu, ndemagalhaes@ucsd.edu

Abstract
Despite continued scientific research efforts and technological advancement to find an effective cure, Cancer remains an enigma. This article aims to propose a different scientific approach to studying the biology of Cancer by offering insights into the striking similarities between the psyche of humans and the behavior of cancer cells. Without attempting to trivialize the complexity of the disease, the article will discuss the fundamental connection between humans and cells that extend beyond just signaling pathways and molecular bonds. The discussion will introduce Cancer Cell Psychology as a new area of study that should be closely considered to further our understanding of this disease.

For many years, the understanding of cancer has evaded research scientists and medical doctors. While treatments have been developed to alleviate and control the impact of human cancer, an effective cure for the most aggressive and therapy resistant ones remains elusive.

The culprits behind this disease are cells that due to alterations caused by genetic, metabolic or environmental factors cease to function and behave like healthy cells (Bertram, 2000). Healthy cells work in harmony with each other to carry out their intrinsic functions. When normal functioning cells become too damaged or too altered to effectively perform their functions, thereby compromising the performance of the entire unit (e.g. organ), they self-destruct or commit suicide, a process known as apoptosis - programmed cell death (Weinberg, 2013). In addition, if the environment becomes too toxic or when nutrients essential for survival are insufficient, normal cells dye off. The immune system recognizes these damaged cells and subsequently removes them from circulation (Baggaley, Hamilton, & Perlmutter, 2001). In contrast, cancer cells have the ability to adapt to toxic environments and survive in low oxygen and nutrient conditions. Moreover, they become deregulated and behave asynchronously from the rest of the healthy cellular unit. These unhealthy cells cease to response to intrinsic signals, they evade the apoptotic mechanism and immune system recognition, resulting in their uncontrollable growth (Weinberg, 2013). Let us think about some of these differences between healthy and cancer cell populations in a humanistic perspective.

Imagine that you are a member of a soccer team whose goal as a unit is to win the world cup. Your team has finally made it to the final match, and it is the favorite to win. All team members are in synchrony, scoring goals, making passes, and blocking the opponent's goals. As the MVP (most valuable player) of the team, you feel that this is your moment to shine and you decide that your own strategy can lead the team to victory. You implement your strategic play mid-game and as a result, you diverge from the game plan and are no longer in harmony with the rest of the team. Your divergence however is compromising the performance of the entire team, thus risking its chance of winning the world cup. For the sake of the entire team, you must self-destruct. Quitting the team or being side-benched are not available options. Would you kill yourself for your team? Perhaps some of you answered yes, but I personally would not. If you share my viewpoint, then congratulations, you are like a cancer cell.

Human and Cellular Behavior: A Communal Connection

One may argue that cells cannot think or make a decision. However, what is thought? Thought is regarded as the mental process whereby your brain registers and processes information collected by your sensory systems (olfactory, auditory, gustatory, visual, and sensation) in order to make a decision or carry out a function (Bear, Connors & Paradiso, 2006; "Brain Basics: Know your brain," 2015; Matlin, 2012; Reisberg, 2009). A cell, in order to carry out a function in the appropriate time frame, collects and processes information from its surroundings through interactions with molecules that act as "messengers" (Pollack, 2001). The information from these molecules can be collected via processes such as receptor-ligand interaction, endocytosis, and diffusion (Alberts et al., 2007). Although the process of thought may differ between the cellular and organismal level, the sequence of events is comparable in both systems. From information gathering to processing and execution, the similarities should not be surprising.

It is critical to understand that this article is not an attempt to anthropomorphize a cell to minimize the scientific scope and significance of its biology, nor is it an attempt to trivialize the complexity of a disease such as cancer. However, to conclude that humans and cells are only linked by signaling pathways and molecular bonds is dismissing the fundamental connection between the two groups (Thomas, 1974). After all, are we not a conglomeration of cells and their byproducts? Our brain is made up of cells, such as the glial cells and neurons; our heart of cardiomyocytes; our skin of keratinocytes and melanocytes among others; and our liver of hepatocytes (Baggaley, Hamilton, & Perlmutter, 2001). Is it not our own cells that generate, control, and execute our thoughts, actions, and emotions? Anthropomorphizing our cells should not be viewed as scientific taboo. Rather, it should be viewed as a tool to gain additional knowledge and understanding of our cells from a psychological perspective.

Remarkably, we have even modeled our society much like the environment in which our cells reside. Humans have migrated and settled in areas near bodies of water, such as rivers and oceans, because soil near water is more fertile, and water is essential for human survival (King & Bastable, 2007; Walker, 2010). Societies of cells (organs) tend to be highly vascularized, containing blood vessels analogous to rivers and streams, so that cells can acquire oxygen and nutrients to survive. If an area lacks blood vessels to supply the societies of cells with the necessary nutrients, the cells induce the growth of such vessels into their habitat, a process called angiogenesis (Weinberg, 2013). Likewise, humans have built dams, aqueducts, and other sophisticated water routing systems to transport and supply water to populated habitats that lack natural water sources (King & Bastable, 2007; Walker, 2010). Furthermore, our society is built such that groups of people with specific skills have a particular duty and carry out specific tasks. We have doctors to heal, police officers to patrol and enforce the law, lawyers to sue and provide justice, bakers to bake, teachers to educate, and farmers to grow and supply food (Blau, Duncan, & Tyree, 1978; Farlex, 2003). Similarly, our body is made up of specialized groups of cells that also perform specific functions. For example, the erythrocytes, or red blood cells, transport oxygen throughout the body, while leukocytes, or white blood cells, are responsible for patrolling and protecting the body against foreign and infectious threats (Alberts et al., 2007). Just like the different systems in our body where groups of cells work in harmony to carry out specific functions (e.g., the circulatory, auditory, respiratory and immune systems) (Baggaley, Hamilton, & Perlmutter, 2001), our society has systems including the health, education, and criminal justice systems designed to carry out specific societal functions (Ferris & Stein, 2012). In other words, our body is to its cells what the planet earth is to us.

Human and Cellular Behavior: Survival, Conflict, and Violence

Cancer cells that have been damaged or altered to the point where they no longer function like normal cells decide to live rather than sacrifice their life for the sake of the whole system. The interaction between these cells and normal cells can be viewed as following the realistic conflict theory (Smith & Mackie, 2007), where two groups are in conflict either due to competition for limited resources (e.g., oxygen) or due to conflicting goals (e.g., cancer cells refuse to die by bypassing or deactivating the apoptotic pathway). Cancer cells are like the rebels of *la resistance* or a guerilla regime that decided to go against the status quo. If we look at mankind's history of wars, rebels have either fought against the majority in order to gain control of their homeland, or they have fled to a distant place where they could multiply in numbers, form a new society, and plan and execute an attack from this new location (Khan & Samarina, 2007; Smith & Mackie, 2007). A few rebellious groups however, have been able to coexist with the majority by forming their own colony and living their own lives without disturbance except when threatened or provoked. Tumor cell groups follow similar behavioral patterns. Those that can coexist with the majority of normal cells are termed benign tumors. Those that cannot coexist with the majority and follow the path of war and destruction are termed malignant or cancerous (Weinberg, 2013) (**figure 1**).

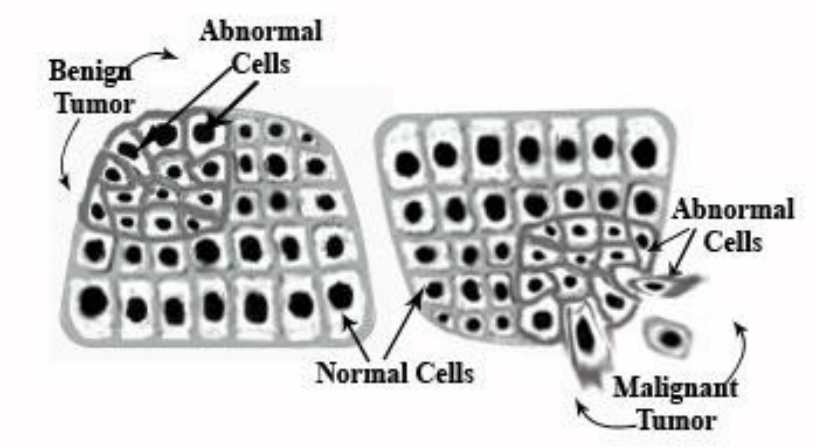

Figure 1. Illustration of benign and malignant tumors

What cancer cells do not understand, much like what humans have previously failed to understand after years of polluting this planet, is that the mayhem they create in their habitat could actually be fatal to them. In essence, the actions of humans and cancer cells alike may cause the destruction of the very world that is sustaining their existence.

Cancer is very complex; so is the human body, and even more so, our world. We do not fully understand how our body works. Likewise, we have yet to discover everything there is to know about our world. With multiple layers of activity at the genetic, molecular, cellular, and tissular levels, it is a challenge to determine exactly why cancer cells, especially metastatic cells, behave the way they do, and most importantly, how to stop them. If we compare the manifestation of disease with human behavior, in both cases there may be multiple pathways that lead to a specific outcome. While a person can be genetically pre-disposed to have a certain disease or to behave in a certain way, for example having violent tendencies towards others, the disease or behavior may never manifest itself in this person's lifetime unless it is triggered by some internal or external

stimulus (Smith & Mackie, 2007). In terms of a disease like cancer, this person may live a healthy life until the disease is induced by an external factor (e.g., carcinogen) or internal factor (e.g., mutation) (American Cancer Society, 2014). A violent person may live an otherwise peaceful life until their violent tendency is unleashed due to a traumatic stimulus (e.g., loss of a job or money, bullying, rejection). There is no set rule as to what stimulus can trigger the onset of the pre-disposed behavior and at what frequency or intensity (**figure 2**). A person can consume carcinogens for years before the pre-disposed cancer is activated. Likewise, a person can experience continuous traumatic events before the right one triggers his/her violent tendency. However, the manifestation of the disease or violent behavior can also be triggered despite no pre-disposition being present. Regardless of the presence or absence of a pre-disposition, once the disease or violent behavior has manifested, the damage done may be irreparable. In other words, with diseases such as metastatic cancer or AIDS, especially at advanced stages, finding the cause or origin may merely delay or prevent future outbreaks from happening; however, it may not be curative to a patient whose disease has already progressed.

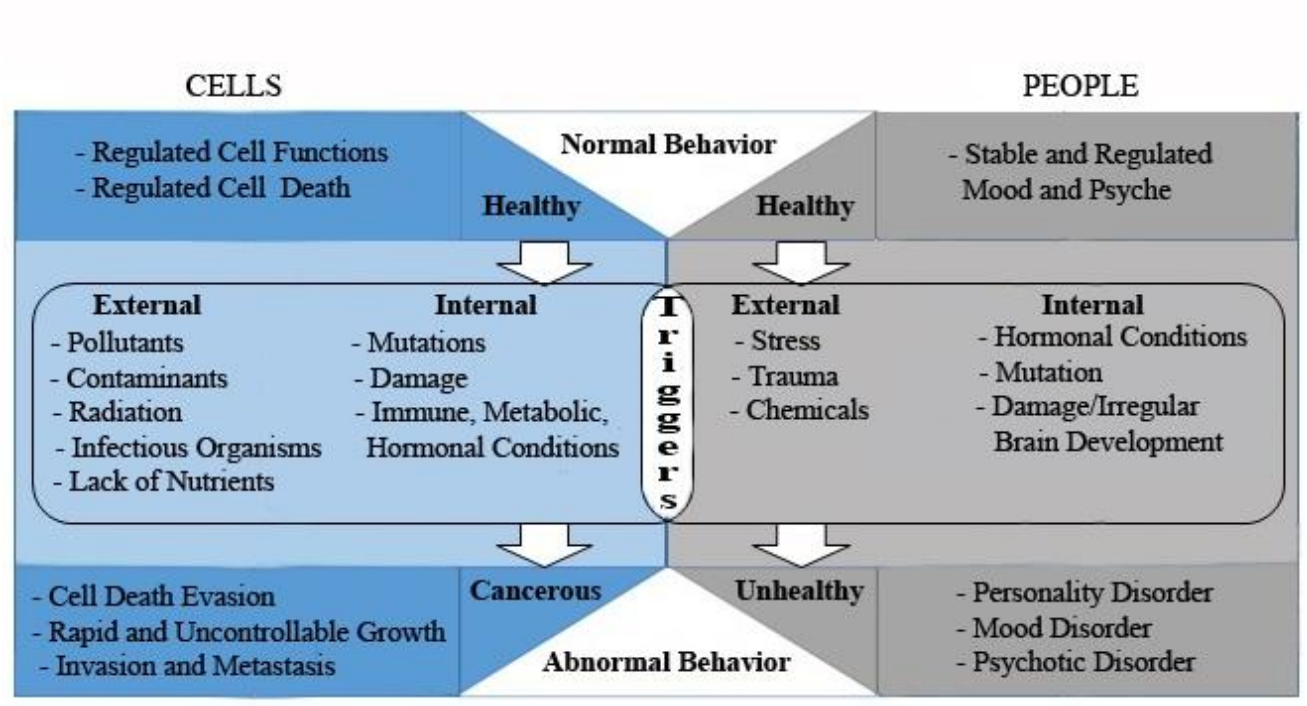

Figure 2. Illustration of similarities between human and cell Psychology. The image describes external and internal triggers that can induce abnormal behavior in cells and humans. Cells exhibiting abnormal behavior may become cancerous, and humans exhibiting abnormal behavior may become unhealthy.

Human and Cell Behavior: Cell Psychology as a New Paradigm

How, then, can one control the disease or behavior so that it is not detrimental to the person and its surroundings? More specifically, for a patient with metastatic cancer, how can one control the metastasis so that it is not fatal? While cancer research has been

predominantly focused at the biomedical level, I believe that we should also start looking at cancer at the psychological level as well.

There are a great number of people today with some form of psychological problem, some more serious than others. Yet we know that we cannot drive all of these people to "normalcy." Moreover, unlike our cells, we cannot simply eliminate them from our society for the sake of what we may consider or perceive to be normal. We have instead developed drugs, rehabilitation programs, and other methods to moderate their psyche so that their behavior is not detrimental to them or their environment (Barlow & Durand, 2011; Horwitz, 1982). Through this pathway, psychologically unstable individuals have been able to coexist with those with "normal" mental health so long as they are not provoked into unleashing an undesired behavior (Markowitz, 2011). If we can begin to view cancer cells as unstable individuals, we may be able to "rehabilitate" them as well, by investigating differences and similarities in behavioral patterns between cells and humans, and consequently identifying key markers that can be targeted to suppress their unstable behavior and violent tendencies towards normal cells. Rather than raging a war against cancer cells and sacrificing some normal cells as collateral damage, we may need to look at ways to appease these cancer cells, and create or stimulate an environment where they can coexist with the normal cells, subsequently sparing the body from fatality.

Conclusion

As mentioned previously, throughout history people have modeled their society after their own bodies. They have merely expressed the "phenotype" or the image of their cells' environment to the outside world. If we mirror our own cells and their environment, why not look at how we behave in order to better understand why some of our cells misbehave? In closing, cancer cell psychology should be an area of closer consideration to further understand and possibly treat cancer.

Acknowledgments

The author would like to acknowledge Binti Reddix, Valita Jones and BioScience Writers, LLC for providing critical review of the manuscript.

References

American Cancer Society, Cancer Facts & Figures 2014.

Alberts, B., Johnson A., Lewis J., Raff M., Roberts K., Walter P. (2007). Molecular Biology of the Cell, (5th ed.). New York, NY: Garland Science.

Baggaley, A., Hamilton, J., & Perlmutter, J. (2001). The human body (1st ed.). New York: Dorling Kindersley.

Barlow, D.H. & Durand, V.M. (2011). Abnormal Psychology: An Integrated Approach, (6th ed.). Boston, MA: Cengage Learning.

Bear, M.F., Connors, B.W. & Paradiso, M.A. (2006). Neuroscience: Exploring the Brain, (3rd ed.). Philadelphia, PA: Lippincott Williams & Wilkins.

Bertram, J. S. (2000). The molecular biology of cancer. Molecular Aspects of Medicine, 21(6), 167–223. doi:10.1016/S0098-2997(00)00007-8. https://doi.org/10.1016/S0098-2997(00)00007-8

Blau, P. M. M., Duncan, O. D. D., & Tyree, A. (1978). The American occupational structure (1st ed.). New York: Simon & Schuster Adult Publishing Group.

Brain Basics: Know your brain. (2015, April 17). Retrieved November 1, 2016, from The National Institute of Neurological Disorders and Stroke,

Farlex (2003). Occupational Structure. Collins

Dictionary of Sociology (3rd ed.). Retrieved from TheFreeDictionary.com,

Ferris, K., & Stein, J. (2012). The real world: An introduction to sociology (3rd ed.). New York: Norton, W. W. & Company.

Horwitz, A. V. (1982). The social control of mental illness (2nd ed.). New York: Academic Press.

Khan, S. & Samarina, K. (2007). Realistic group conflict theory. In Baumeister, R. & Vohs, K. (Eds.), Encyclopedia of Social Psychology. (pp. 726-727). Thousand Oaks, CA: SAGE Publications, Inc. https://doi.org/10.4135/9781412956253.n434 PMid:17315174

King, R., & Bastable, J. (2007). Atlas of human migration (1st ed.). Buffalo, NY: Firefly Books.

Markowitz, F. E. (2011). Mental illness, crime, and violence: Risk, context, and social control. Aggression and Violent Behavior, 16(1), 36–44. doi:10.1016/j.avb.2010.10.003. https://doi.org/10.1016/j.avb.2010.10.003

Matlin, M.W. (2012). Cognition, (8th ed.). Hoboken, NJ: Wiley.

Pollack, G. H. (2001). Cells, gels and the engines of life: A new, unifying approach to cell function (1st ed.). Seattle, WA: Ebner and Sons Publishers.

Reisberg, D. (2009). Cognition: Exploring the Science of the Mind, (4th ed.). New York, NY: W. W. Norton & Company.

Smith, E.R. & Mackie, D.M. (2007) Social Psychology, (3rd ed.). New York, NY: Psychology Press.

Thomas, L. (1974). The lives of a cell: Notes of a biology watcher (9th ed.). New York: New York, Viking Press.

Walker, R. (2010). Pushes & pulls: Why do people migrate? (1st ed.). New York, NY, United States: Crabtree Publishing Company.

Weinberg, R.A. (2013). The Biology of Cancer, (2nd ed.). New York, NY: Garland Science.