



Fighting our Own Battles: the Role of our Immune System in Health and Disease

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Introduction

The human body during its life span goes through numerous stresses including physical (trauma), chemical (metabolic and other toxic materials), biological (viruses, bacteria, fungi, parasites) and psychological (job, family and others) insults. In order to maintain homeostasis our immune system plays a vitally important role. With dedicated effort in improving our health, we are able to enhance our immune system's efficacy with little adjustment to our dietary choices and life style. If we could maintain the optimal immune system, we would not have to revert to centuries past when we used to place a blame on ambiguous "bad luck factors" for our health problems.

Citizens all over the world stand in high respect and admiration for the discipline and sacrifice of their nation's soldiers. A soldier constitutes the ideals of machine-like work in harrowing circumstances, fiercely determined in the pursuit of defense. Similarly, the army in our body's immune system: an invisible and unrelenting system of cells and biochemical reactions. Much like an army, the immune system depends on its own attack mechanisms and defense strategies in order to be effective. An army depends on weapons to harm their enemies, fortified compounds for defense and for the soldiers' sanctuary, and secret communications that can be disclosed only within its ranks. Within our bodies, there are equally impressive mechanisms in place: Our inner army has several purposes: bring the body back to normal condition from any trauma (physical or psychological), eliminate any toxins including food metabolites (a type of chemical assault), and eliminates pathogens, an agent that causes disease, with minimal collateral damage to the host. Furthermore, this army must be carefully calibrated for optimal efficacy: a deficiency in any aspect of the immune response leads to an immune deficient individual. On the other hand, an overactive immune system that indiscriminately launches attacks leads to autoimmune disorders such as multiple sclerosis or lupus, wherein the body's natural immune responses attacks its own tissues, mistaking the host body as the foreign invader. This balance between effective, intimidating wartime execution and ineffective, self-harming deployment is a tricky and constant compromise for our immune system, much like two ballet dancers who must learn the proper give-and-take of each other's body in a difficult duet. Let us start understanding and appreciating this challenge that silently occurs every millisecond in our private battlefield.

We begin with the most natural and instinctive habit of our body. With each breath in and out, our body encounters a host of pathogens ranging from environmental toxins to infectious agents. Indeed, the interface between the air and our body is the battlefield "most frequently targeted by pathogens." Just like an army advancing towards its opponents and breaching the first wave of enemy soldiers, there will inevitably be casualties on both sides. Visualize this action inside the lungs: any damage incurred as the immune system attacks the lung

pathogens also sheds away its own physical barrier, weakening its own defense structures one cell layer at a time, exposing its own soldiers to the volatile elements of the battle. (Nature Immunology, December 2014). Think of how many times each year we cough, notice the green-yellow sputum in our tissues, and call our doctor: that number represents how many total battles were fought in our respiratory system and how our lungs suffered and were weakened a bit at a time during the attack.

Now at this point consider an individual, who had an episode of the common cold in the winter and after he recovered, habitually reached for a pack of cigarettes. Each inhale of smoke is an advancing enemy, slowly breaching the mouth, the trachea, until it reaches the bronchioles of the lungs that house the alveoli, the basic lung units that exchange carbon dioxide for oxygen. Does this individual, chained to his habit of cigarette smoking, realize he has personally delivered 7,000 chemicals, 69 of which are directly known to cause cancer, to his lungs that now are becoming more burdened in their quest to deliver oxygen? These toxic chemicals specifically damage the cilia, the microscopic hair-like projections in the lungs that sweep away any mucus or unwelcome particle. With each inhalation, more cilia are paralyzed and destroyed until there is no way for the lungs to protect themselves against basic invaders. This damage occurs with each cigarette until the individual, who now has emphysema, now depends on an oxygen tank to supply him what his lungs cannot do anymore. Even more frightening, the soldiers that protect those lungs from all that seek to injure them now lie defeated, the battle forever lost and the individual forever compromised [1].

Much like the lungs, another organ system that is constantly being inundated with pathogens as part of a vital life requirement is our gastrointestinal system in its quest to obtain nutrition. The gastrointestinal system's goal is to extract the nutrients from our diet, along with the corresponding pathogens like Salmonella and E. coli that make their home in our eggs and beef and cause the unwelcome symptoms of diarrhoea and dehydration. When the healthy nutrients and infectious invaders enter our digestive tract, our stomach, pancreas, and gallbladder are stimulated to secrete their potent digestive enzymes that break down the nutrients into the basic building blocks that provide energy, such as amino acids from protein, fatty acids from oils and fat, and simple sugar glucose from carbohydrates. While this occurs, our gut flora, the community of 100 trillion beneficial microorganisms in our intestines, utilizes the fatty acids and carbohydrates from our diet into a source of energy so that they may continue to enhance our overall immunity. In this way, our gut flora is like a miniature army under the umbrella of our body's armed services, providing another layer of defense and attack to its enemies from the deepest bowels of warfare. Fortunately, there is a way to enhance our gastrointestinal army and gut flora through our diet. When you go into the supermarket, you may notice a shelf of yogurt boasting the term "probiotics," referring to live microorganisms that have a health benefit

when ingested. Depending on the specific type of microorganism added to the yogurt, the benefits range from relief from irritable bowel syndrome symptoms like abdominal bloating and pain to mitigating diarrhoea. As you continue making your way through the aisles, deciding whether to purchase a loaf of your favourite white bread to make sandwiches or another stack of sliced whole wheat bread that has been advertised so frequently for its health benefits, consider that this choice could affect whether or not you develop Type II Diabetes Mellitus. This condition, one of the most prevalent diseases in our increasingly unhealthy society, is due to a failure of the pancreas to secrete insulin, the key hormone that lowers blood glucose (sugar) levels after we eat. When there is an excess of sugar in our blood, the basic chemical reactions that seek to utilize the sugar creates unstable oxygen-containing molecules that are toxic to our insulin-producing cells. Thus, the higher our blood sugar remains, the more cell death occurs from the oxidative stress mechanism as the body attempts to reduce the blood sugar. As the cells of the pancreas that secrete insulin slowly exhaust themselves attempting to lower the blood sugar, the less insulin is secreted and the body is unable to regulate its blood sugar level and must depend on an prescription for insulin along with an increased risk of kidney disease, eye disease, stroke, and heart attack. Hopefully, the whole wheat bread, which raises your blood sugar level more slowly than white bread, is looking more appealing now. While many diseases are characterized by the introduction of the foreign invader to our host environment, one disease in particular stands out since the invader is not from foreign lands, but rather a host cell that has defected from the ranks. Cancer is a vague term encompassing many different diseases with varying prognoses, outcomes, and treatments, but the basic principles of its terrifying methods of invasion remain the same. Any type of cancer is dependent on the host's cells ability to proliferate unstopably without controlled cell death, manipulate the host's blood vessels and growth signals in order to sustain its development, and eventually be able to escape the limited environment of one organ to distant areas of the body. Unfortunately, it is the fact that a cancerous cell originates from us that makes it so difficult for the immune system to enact its merciless defense mechanisms and eradicate this enemy. After all, it is immeasurably more challenging to detect one's rogue cancer cell among the trillions of cells still abiding by the body's natural mechanisms of regulation.

Even with all of the sophisticated machinery that both foreign invading agents and aberrant host cells use to circumvent our immune system, it remains remarkable that our own body silently and effectively is able to defend us against the multitude of pathogens encountered in every conceivable environment. Moreover, we are living in an exciting time where the advances in biotechnology will inevitably lead to progress in using our natural immunity to more successfully defeat the pathogens that remain defiant. Imagine an era where scientists identified the exact agent that targets the insulating myelin sheath in our nervous system and were able to finally design a therapy against that agent to assist those suffering from Multiple

Sclerosis. Speculate a future where Type I Diabetes Mellitus was a disease of the past ever since investigators were able to prevent the destruction of insulin producing pancreatic cells by the immune system. Think of a time where a cancer diagnosis leads to a personalized treatment protocol based on one individual's genetic profile and the specific mutation that precipitated the development of their cancer. Recent articles have discussed the mechanisms of cancer and attributed roughly 2/3 of all cancers to random DNA mutations, otherwise projected as genetic "bad luck". If we think properly we will realize that in reality there is no such entity called a 'bad luck factor', instead we create that "factor" with our cumulated bad decisions over the years in our lifetime. The tiny little fruit fly (*Drosophila melanogaster*) has 13,700 active genes compared to a human's 25,000 active genes. The question is what all those millions of genes are doing in our body! The portion of the DNA's inactive genes, at times, come to rescue of the active genes to make several isoforms (or inappropriate form) of the protein known as workhorse of our body. Our active genes are continuously adapting with the changes, stresses, food habit and lifestyle, whether sedentary or over active. These dynamic genes adapt to maintain homeostasis (the system of balance) in our body, which means that the genes must conform to by cell division and mutation. However, while observing the natural process of cell division and mutation, we must also acknowledge the remaining chances of adding cancer, as an enemy, albeit an enemy we have the power and resources in our immune system to fight, if we could maintain the optimal immune system [2].

We can choose not to smoke and prevent the damage the physical barrier of our lungs to nicotine. We can apply sunblock to lessen the exposure of our skin cells to the sun's DNA-damaging ultraviolet radiation. Until we can count biotechnology as another weapon in our arsenal, we can take our own small, effective steps towards protecting our immune system soldiers in the war against disease. We must take pride in our body's personal source of strength as we take pride in those who defend us abroad. We would not deprive our troops of basic resources like food, water, and a safe place to sleep and expect them to defend us in battle effectively. Why should we deprive ourselves of the supplies our immune system's needs in order to fight their constant battles? Why would we weaken our indefatigable army, our immune system, through our choices and actions? We must remember that though the battle is fought between two armies, vying for the territory of health or disease, ultimately, we are the generals [3].

References

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