Lp-PLA2: An Emerging Risk Factor for Cardiovascular Heart Disease  
— Tina Binesh Marvasti —

Until recently, traditional cardiovascular heart disease risk factors, such as high cholesterol and blood pressure levels, were considered to be the potential and predictor risk factors of heart disease. However, recent studies show that not all patients suffering from myocardial infarction have had such predicting signs. Studies on blood samples of patients with a cardiac event show that high levels of an enzyme called lipoprotein associated phospholipase A2 (Lp-PLA2) in blood plasma can be associated with future cardiac events. Hence researchers have hypothesized that among patients with no traditional risk factors, abnormal activities of Lp-PLA2, an emerging coronary disease risk factor, can increase the risk of future coronary complications independent of other factors.

This hypothesis was tested in an epidemiological study conducted by the West of Scotland Coronary Prevention Study Group [1]. In this study, patients with hypercholesterolemia were monitored for the levels of Lp-PLA2 activity. The result of the research, which was published in The New England Journal of Medicine, showed that in a sample of 580 patients, high levels of Lp-PLA2 activity have a positive association with the development of arterial plaque and can independently increase the risk of myocardial infarction.

Furthermore, an article published in Nature Medicine in 2008 reported a study done on hypercholesterolemic pig models, which demonstrated that abnormal activities of Lp-PLA2 produce deleterious effects by oxidizing cholesterol and producing coronary atherosclerotic lesions on the arterial walls [2]. This was shown using darapladib, a drug that inhibits the activity of Lp-PLA2 in blood plasma, which lowered the rate of plaque formation by preventing the oxidation process.

As a newly emerging risk factor, Lp-PLA2 must be investigated further for better understanding of its activity in cardiovascular diseases. Hopefully, genetic and environmental factors that play a role in the over expression of this enzyme can be identified, studied, and controlled. By better understanding the factors causing Lp-PLA2’s abnormal expression in the blood plasma, more can be learned about the potential risk factors associated with coronary disease - a leading cause of death and disability in Canada and throughout the world.


Mechanism of swearing as a response to pain  
— Nancy Dong —

Given how common swearing is as a response to pain, Richard Stephens and colleagues at Keele University were surprised to find that no neurological mechanism has been established to explain exactly why that is. To investigate, they recruited a group of undergraduate students who were subjected to the cold pressor test while repeating a swear word of their choice, and later as a control underwent the test again repeating a neutral word. It was found that under the swearing condition there was significantly lower pain perception than in the non-swearing condition [1].

In recent years, there has been a growing body of research on the role that emotions play in pain regulation, to allow a better understanding of the brain and its application in a clinical setting. Is it the sensation of pain that is unpleasant or the emotions that accompany it? It was found in a 2006 study by INSERM that under the same conditions, individuals who were shown scenes of human pain had higher pain perception than individuals who were shown equally unpleasant pictures that do not contain references to pain [2]. More recently, a Chinese study done this year showed that contrary to common view, both happy and sad music that are equally emotionally arousing can significantly reduce pain ratings to the same painful stimuli [3].

The regulating effect that emotions have on pain can be explained by the fact that the body’s own mechanism for pain modulation is closely tied to the parts of the brain that process emotions [4], such as the hypothalamus and the amygdala (which have been shown to activate when one swears) [5]. Activation of these brain parts in turn activate the periaqueductal gray area in the brain stem, resulting in the release of the neurotransmitter enkephalin that inhibit the release of substance P by binding to the pain transmitting neurons in the spinal cord [6]. Previous research has shown that rats lacking in substance P cannot detect increasing intensities of pain, thus possibly explaining why an individual has a higher pain tolerance when emotionally aroused [7].

The findings made by Stephens’ team add to the body of evidence that can be used to answer the mind-brain problem by explaining how the physical actions of the brain can produce our mental experiences. The next step is to gain further understanding of exactly which emotions reduce pain and how it might be applied to emotion-provoking psychotherapy for patients suffering from chronic pain.

New Research on NK Cells blurs the line between the innate and adaptive immune systems

— Ana Komparic —

Prevention remains one of the sustaining pillars of modern medicine, with vaccination lying at its foundation. Understanding the intricacies of the immune system is essential for the continued development and amelioration of preventive medicine. Traditionally, a clear distinction has been drawn between the innate and adaptive immune systems. The innate immune system is an organism’s first line of defense against non-self antigens, requiring no prior exposure to initiate an immunological response. The adaptive immune system, which is believed to have developed after the innate immune system, requires exposure to a particular antigen prior to initiating an effective response and developing ‘memory’ cells which maintain long-term immunity to the antigen in question [1].

The adaptive immune response has been described as a set of four phases: expansion, contraction, memory maintenance and a recall or secondary response phase. The last two phases were believed to be unique to the adaptive immune system and to be responsible for the principle of long-term immunity, which vaccination relies on. In 2009, Sun et al documented the first memory maintenance and secondary response phases ever to be observed in natural killer (NK) cells [2]. This suggests that NK cells, which are the effector cells of the innate immune system, may in fact share some key characteristics with cytotoxic T lymphocytes and other cells of the adaptive immune system.

Sun et al exposed infected mice with mouse cytomegalovirus (MCMV) and monitored NK cells which display the MCMV-specific Ly49H receptor (Ly49H+). They noticed that the Ly49H+ NK cells proliferated vigorously, and produced ‘memory’ cells, which were detected in both lymphoid and non-lymphoid organs several months after infection. These ‘memory’ cells produced IFN-γ ex vivo upon reactivation. Furthermore, following adoptive transfer of MCMV-primed Ly49H+ NK cells into naïve immunodeficient mice, the experienced NK cells were found to be ten times more protective against MCMV than NK cells transferred from naïve mice [2].

These findings add to the growing body of research which proposes that innate and adaptive immune systems share more similarities than previously believed, leading to new understanding of NK cell redundancy and the evolution of the immune system [1,3]. Further research is required to investigate whether a similar NK response persists in vivo or to other pathogens and models. If further studies confirm immunological memory in NK cells, novel approaches in preventive medicine, particularly vaccination, will surely be investigated.

Neuroscience: the key to effective education?

— Sarah Sidky —

Recent technological advances in neuroscience have allowed scientists to gain a stronger understanding of how the human brain actually learns. But why, despite this, do neuroscience and education continue to be kept separate? At Harvard University, Dr. Kurt Fischer and his team strive to bridge the gap between neuroscience and education. He explains that “the relationship between neuroscience and education should be a reciprocal one in which scientific research and educational practice inform and learn from one another, as medicine and biology act symbiotically [1].”

Previous research suggests that an increased performance level in memory-involved activities is associated with physical activity. Usha Goswami, director of Cambridge University’s Center for Neuroscience, believes that we can use scientific research such as this to modify our teaching methods. She explains that “learning comprises changes in neural activity, either via changes in potentiation at the synapse or the strengthening of connections [2].” Since successful teaching directly affects brain function by changing connectivity, it is up to us to discover and employ the most effective teaching methods – teaching methods that will allow students to reach their full academic potential.

Sarah Shaw, an advanced skills teacher at Lakeside Primary School of Cheltenham, England, leads one of the few classes in the world taught according to the principles of neuroeducation. She believes that incorporating movement and dance into her curriculum has the ability to intentionally trigger the brain’s biological ability to take in and store information, thus strengthening connections in the brain. Shaw’s work brings up a principal question in our mission to bridge the gap between neuroscience and education: to what extent does physical movement in the classroom induce or enhance long-term potentiation in the hippocampus? We can now at least attempt to answer this question thanks to recent technological advances such as functional magnetic resonance imaging (fMRI), which allows us to study the brain in vivo.

Results obtained from these experiments can offer quite valuable possibilities to education, including early diagnosis of special educational needs, comparison of the effects of different kinds of educational input, and an increased understanding of individual differences in learning. As Trisha Gura explains in her paper titled Big Plans for Little Brains, “we are going to see an explosion of interdisciplinary findings that we had not had before in learning science [3].”
