Introduction

Exogenous Cytokines

Domingo- Gonzalez et al. define cytokines as proteins and glycoproteins released by the immune and some different cells which remains in direct contact with microorganisms (Domingo-Gonzalez, Prince, Cooper, & Khader, 2016). The effect of cytokines primarily is autocrine and paracrine. Their primary function is to act as a messenger or to act as a mediator for the human immune system. Some other cytokines like Interleukins function as immunomodulation mediators. They stimulate and enhance the immune activities for the treating infectious, neoplastic or autoimmune diseases.

Interferon-α

They have several functions and perform a crucial role in the antivirus resistance. It also plays an important role in cell proliferation and viability by obligating the receptors at the cell surface with the virus-infected cells (Dafny & Lincoln, 2016). They also induce the transcription of crucial and precise genes. At the early stages of virus replication, the high levels of IFN control this replication. Leukocytes (like IFN-α) and fibroblasts (like IFN-α and IFN-β) are responsible for producing type I IFNs, it happens after the viral infection (Grine, Dejager, Libert, & Vandenbroucke, 2015). Cytoplasmic receptors are conditioned with viral bond of extracellular receptors and with the existence of the viral yields. The cytoplasmic receptors can also birth the expressions in type I IFNs. Different to this, the type two IFNs (IFN-γ) are created with both the NK and T cells, but it only takes place in reaction with cytokines IL- 12 and IL- 18.

The ‘antiviral state’ is promoted by both types of IFN. They interfere in the mechanism of cell delusions, their proliferation, translation and finally in the viral replication (Stifter & Feng, 2015). In addition to this, the IFNs make appear the diseased cells vulnerable to apoptosis (the commotion of procaspase). They also make them vulnerable to the acknowledgement by CD8+ the T cells with improving the physical appearance of MHC I on the diseased cells. Another important activity related to antiviral actions of IFNs is the introduction of proteins which stop explosion and maximize the obliteration of RNA molecules within the cell. This process is limited to the DsRNa- based Kinase R (PKR) protein. PKR proteins are responsible for controlling the recording and duplicating different genes with the result of antivirus like NF –κB. 2′-5′-oligoadenylate gene works to inhibit the protein synthesis by the promotion of ribonuclease (RNase) activity (Hurst & Magiorkinis, 2015). The protein Mx gets to mix with the virus polymerase and works to regulate the adenosine deaminize (ADAR). ADAR is crucial for editing and effectively constraining the multiplication of the virus (Dafny & Lincoln, 2016). Apoptosis on other hand is promoted by Caspase. Interferon is so crucial for controlling the infection and duplication of several viruses to constrain IFNs (Delaney et al., 2016).

Further, the crucial and uninterrupted antiviral properties related to IFN-α endorses cell mediation and resistance. It improves the cytotoxic belongings of the LAK cells NK. They do so by maximizing granzymes and perforins level, by producing IFN-γ, and by proliferating cells (Lasfar et al., 2016). After the IFN-γ secretion is increasing, this spur remains independent from the contact between single cells for the time being. This all takes place even in IFN-α’s absence. The interferon-gamma, on the other side, is responsible for activating and developing of APCs, which are synthesized more with means of IL- 12 and IL- 15. Interleukin 12 remains the driving force for CD 4+. In the TH1- type response, the T- cell response results in supplementary IFN-γ production. On the other hand, interleukin 15 helps in the endurance and propagation of T- cells active memory (Lasfar et al., 2016). Lastly, IFN-γ works for the development of reactive oxygen and reactive nitrogen. These are oxygen molecules, superoxide molecules, alkaline molecules, hydroxyl molecules, hydrogen peroxide, hypochlorite, nitric oxide, nitrogen dioxide and nitrous acid. Such phagocytes products work for killing effectively the microbes.

 The IFN-α which are commercially available is found in natural and recombinant forms. These forms are in multiple subtypes in vitro cleansed human IFN-α and in Escherichia coli clone which articulates human IFN-α-2a subtype DNA respectively. Its raw form provides an in-depth analysis of the wider biological purpose in comparison with the only recombinant subtype (de Brachène et al., 2018). The low- dose therapy of IFN-α is more workable in the antiviral activities when compared with high doses. The high doses stimulates extreme provocative reaction, minimizing IFN receptors, regulating, and producing neutral antibodies. The findings of IFN-α necessary for the influenza peptide in mice proved the potential benefit for the induction of CTL activity (de Brachène et al., 2018).

Interferon-α is experimented therapeutically by oral and parenteral (subcutaneous [SC], intramuscular [IM]) manner in people for testing its antiviral and non- proliferative activities. This is done in subcutaneous and intramuscular manner. The Parenteral high-dose IFN-α-2a have been tested for use in human patients with hepatitis C, the virus of West Nile (WNV) infection, for leukemia in hairy cells, for chronic myelogenous leukemia, and for acquired immunodeficiency syndrome (AIDS) which are related to Kaposi’s sarcoma. Punitive effects which are associated with parenteral high-dose IFN-α-2a treatment include fatigue, fever, and myalgia. Different results in vitro experiments increase the susceptibility of WNV to IFN-α (Touzot, Cacoub, Bodaghi, Soumelis, & Saadoun, 2015). There are proofs of both resistance and susceptibility in the virus compared to cytokine. However, human patients of WNV cured with high doses of IFN-α showed rapid recovery and less squeal. Different to this the Polyethylene glycol-conjugated IFN-α used for the treatment of mice showed increased survival, lower viremia, authorization of virus by the second day, post-infection, and prohibited worsened inflammatory reaction by macrophage and splenic CD4, CD8, and B cells in relation to non-treated and infected mice.

## Other Cytokines: Present and Future

IL-2 and IFN-α are the two most common cytokines when it comes to those human patients who are going through cancer immunotherapy. Both IL-2 and IFN-α can be taken independently in the form of high doses- completely unadulterated- or in light doses -in combination with other. This kind of treatment is mixed with the process of existing chemotherapy because of the reason that a limited number of patients are responsive to cytokine therapy as its own (Domingo-Gonzalez et al., 2016). Dose assimilation with cytokine is instrumental in generating effective response and toxicity. Hence, in order to limit systemic effect, peripheral blood or tumor-infiltrating lymphocytes are activated with cytokines-IL-2-in Vitro and moved back to the patient for potential aftereffects against tumor cells.

 When treated in vitro with IL-2, IL-15, and CD3 antibodies, hyper-responsive lymphocytes occurring from the malevolent spread of lung cancer. In treating and preventing infection with intracellular bacteria, the usage of cytokines combined with traditional antibiotic therapy or in the form of vaccine adjuvants has remained much beneficial in effects. The adjunctive properties in the induction of Th-1-type immune response with peptides in vaccinations are promising, but the application of IL-2 has restricted application in clinical health. For murine models, survival, and clearance of Mycobacterium avium, Francisella tularensis, Influenza or Cryptococci infection are done with intranasal administration of IL-2 with an antibiotic or antifungal medication (Domingo-Gonzalez et al., 2016). For asthma patients, inhibiting Th-2 type with the treatment of IL-12 and to promote Th-1 type responses have limited success in improving airway hyperactivity. Cytokine fusion protein with numerous allergens (IL-12, IL-18 OR cDNA with IL-18) redirects immune responses into Th1type and airway hyperreactivity in a mouse model. Other cytokines for inducing Th-1 type responses are less effective. IFN-γ management for preventing Pseudomonas aeruginosa infection recovered IL-12 secretion but had limited success in improving bacterial clearance or reducing mortality. Fms like tyrosine kinase treated with neonatal mice shows the hundred-fold increase in resisting herpes simplex virus type 1 and Listeria monocytogenes inherently (Hribernik, Cemazar, Sersa, Bosnjak, & Snoj, 2016). Dendritic cell induction remains independent of B and T cells and their mature cytokines.

This research is an important contribution in health sciences because it discovered implications in neonatal immune defense system because of the lack of development in the adaptive immune system.

# References:

Dafny, N., & Lincoln, J. (2016). *The Role of Interferons on the Central Nervous System in Health and Disease*.

de Brachène, A. C., Dos Santos, R. S., Marroqui, L., Colli, M. L., Marselli, L., Mirmira, R. G., … Eizirik, D. L. (2018). IFN-α induces a preferential long-lasting expression of MHC class I in human pancreatic beta cells. *Diabetologia*, *61*(3), 636–640.

Delaney, T. A., Morehouse, C., Brohawn, P. Z., Groves, C., Colonna, M., Yao, Y., Coyle, A. J. (2016). Type I IFNs regulate inflammation, vasculopathy, and fibrosis in chronic cutaneous graft-versus-host disease. *The Journal of Immunology*, *197*(1), 42–50.

Domingo-Gonzalez, R., Prince, O., Cooper, A., & Khader, S. (2016). Cytokines and chemokines in Mycobacterium tuberculosis infection. *Microbiology Spectrum*, *4*(5).

Grine, L., Dejager, L., Libert, C., & Vandenbroucke, R. E. (2015). An inflammatory triangle in psoriasis: TNF, type I IFNs and IL-17. *Cytokine & Growth Factor Reviews*, *26*(1), 25–33.

Hribernik, A., Cemazar, M., Sersa, G., Bosnjak, M., & Snoj, M. (2016). Effectiveness of electrochemotherapy after IFN-α adjuvant therapy of melanoma patients. *Radiology and Oncology*, *50*(1), 21–27.

Hurst, T. P., & Magiorkinis, G. (2015). Activation of the innate immune response by endogenous retroviruses. *Journal of General Virology*, *96*(6).

Lasfar, A., de la Torre, A., Abushahba, W., Cohen-Solal, K. A., Castaneda, I., Yuan, Y., … Laskin, D. L. (2016). Concerted action of IFN-α and IFN-λ induces local NK cell immunity and halts cancer growth. *Oncotarget*, *7*(31), 49259.

Stifter, S. A., & Feng, C. G. (2015). Interfering with immunity: Detrimental role of type I IFNs during infection. *The Journal of Immunology*, *194*(6), 2455–2465.

Touzot, M., Cacoub, P., Bodaghi, B., Soumelis, V., & Saadoun, D. (2015). IFN-α induces IL-10 production and tilts the balance between Th1 and Th17 in Behçet disease. *Autoimmunity Reviews*, *14*(5), 370–375.