Review

The relationship between drug abuse and microbial infections

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Drugs of abuse such as cocaine, opiates, alcohol, and marijuana among others alter the neuropsychological, pathophysiological responses as well as the immune functions. Studies have shown that there are correlative observations between the use of these drugs and increased levels of microbial infections among drug users. These correlations appears to have effects on the immune system and are receptor mediated, directly or indirectly. The numerous drugs of abuse and the attendant infectious diseases are discussed.

Key words: Drug abuse, microbial infections, immune system.

INTRODUCTION

Drugs of abuse such as cocaine, heroine, and marijuana among others are widely used illegal drugs which have detrimental effects on the host's immunity. Several clinical reports on the relationship between microbial infections and the use of illegal drugs are available. The pandemic nature of AIDS prompted the urgent studies on the effects of addictive drugs on immunity. AIDS is caused by human immuno deficiency virus which leads to a total dysfunction of the immune system thereby making the host highly susceptible to opportunistic microorga-nisms (Mansel, 1984) . Drugs of abuse have been proposed as cofactors in the rapid progression of the disease (Fried-man, 1996). AIDS patients often use drugs such as marijuana, nicotine, alcohol which may be administered intravenously with contaminated needles (Donahoe, 1990). These drugs are known to exact immunosuppressive effects (Klein, 1998).

COCAINE AND MICROBIAL INFECTIONS

Cocaine is an alkaloid drug obtained from the plant *Erythroxylon coca*. It is readily absorbed through the mucous membranes of the body. The relationship between cocaine-induced modulation of immune responses and infections has been studied particularly in HIV-patients (Bagasra and Pomerantz, 1993).

Cocaine has been found to bind to sigma ( ) receptors. These receptors are found throughout the brain and the periphery of the body. Cocaine has been shown to

increase HIV Infection of human peripheral blood mononuclear cells *in vitro* (Bagasra and Pomerantz, 1993; Klein et al., 2000).

MARIJUANA AND SUSCEPTIBILITY TO MICROBIAL INFECTION

Marijuana is a plant which is known for its fiber (hemp). It is commonly called *Cannabis sativa*. It contains more than 60 cannabinoids and over 400 compounds. The cannabinoids particularly tetrahydrocannabinol (THC) exert immunomodulatory effects which interfere with the normal functions of T and B lymphocytes, NK cells and macrophages in animals and man.

The use of marijuana leads to suppression of host resistance to infections (Joy et al., 1999) . A correlation between marijuana smoking and herpes virus infection has been observed to increase the risk of mortality in HIV positive marijuana smokers (Sidney et al., 1997). Alveolar macrophages in marijuana smokers have been found to be deficient in functional properties such as phagocytosis and bactericidal activity (Baldwin et al., 1997).

Studies have shown that cannabinoid (CBR's receptors are G -protein coupled seven transmembrane receptors. There are two types, CB_1 and CB_2. CB_1 receptors are responsible for behavioral effect of tetrahydrocannabinol (THC) while CB_2 receptors are located on immune cells. The decreased host resistance to bacterial and viral infections is due to the broad spectrum action of THC on

immune functions (McAllister and Glass, 2002). Modulation of serum immunoglobulin levels has been shown to occur during marijuana use. Production of γ interferon is also inhibited (Klein et al., 2000).

ALCOHOL AND SUSCEPTIBILITY TO MICROBIAL INFECTIONS

Increased incidences of infectious diseases and decreased liver functions are some of the health problems caused by alcohol abuse (Mendenhall et al., 1990). Alcoholics are highly susceptible to infections and prone to community acquired pneumonia (Adams and Jordan, 1984; MacGregor and Louria, 1997; Ruiz et al., 1999). Alcohol has multiple effects on the host immune responsiveness. These include altered immune functions and depletion of circulating lymphocyte populations (Jerrels et al., 1992; Szabo, 1999).

Alcohol reduces the production of cytokines which are important in anti- microbial immunity. Jerrels et al. (1992) showed that immune cells from mice given alcohol and infected with pathogenic bacteria (Salmonella) had increased susceptibility (Saad et al., 1993; Jerrells, 2002).

Hepatitis C virus infection has also been linked to chronic liver disease in alcoholics (Jerrells, 2002). It also increases the risk of liver damage by activating CD8 cells (Jerrels, 2002) and enhances apoptosis (Gao, 2002)

OPIATES AND SUSCEPTIBILITY TO MICROBIAL INFECTIONS

Opium, morphine and heroine are a class of drugs called opiates and are derived from the poppy *Papaver somniferum* (Risdahl et al., 1996). The name opium is derived from the Greek word meaning "of sap" or 'juice' because the drug is obtained from the juice of the poppy plant. Over the decades, the addictive nature of opium was recognized. Morphine, codeine, and opium alkaloids were synthesized from opium (Jaffe and Martins, 1990). Serious complications of opiate addiction have been recognised (Hassey and Katz, 1950).

A relationship between opiate abuse and infectious diseases has been established (Lange et al., 1989). Pulmonary diseases caused by *Haemophilus, Streptococcus, Staphylococcus* and *Mycobacterium* are the most common diagnoses of opiate abusers (Rishdahl, 1996). They are susceptible to infections such as endocarditis, abscesses, cellulitis, hepatitis A, B, C, sexually transmitted diseases and skeletal diseases (Rishdahl, 1998).

The life-style practices and methods of injection amongst drug abusers increase their risk to microbial pathogens (Donahoe, 1990). The problem of contaminated heroin or drug paraphernalia and infections has been recently reported (Bangsberg et al., 2002). AIDS and its attendant decreased host immunity are principal actors in opportunistic infections among opiate abuses (Friedman, 1996). The outcome of HIV infection is influenced by the intravenous use of opiates (Battjes et al., 1988; Stoneburner et al., 1998). A correlation between the use of opiates, increased infection susceptibility and depressed immunity exists (Risdahl et al., 1996).

When the use of opiates is withdrawn or discontinued, the mortality rates from infections among HIV infected intravenous drug users decreases (Weber et al., 1991). Opiates appear to affect the immune response directly through opiod receptors on immune cells and indirectly via the receptors on neuronal cells (Mc Carthy et al., 2001). Opiates play important roles in increased susceptibility to infection by altering the release of hypothalamus pituitary adrenal (HPA) hormones (Allolio et al., 1987). These hormones in turn alter glucocorticoids (Boumpas et al., 1993).

NICOTINE AND SUSCEPTIBILITY TO MICROBIAL INFECTIONS

Cigarette smoke is made up of two components, the vapor and particulate phases. Nicotine (particulate) is partially responsible for the inhibitory effects on the immune responses (Sopori, 2002). The incidence of community acquired pneumonia is associated with cigarette smoking and is considered one of the risk factors for respiratory infections (Almirall et al., 1999). Nicotine is known as the addictive component of cigarettes and is a small organic alkaloid synthesised by tobacco plants.

The biological effects are receptor mediated. Nicotine is an agonist for nicotinic acetycholine receptors (nAchRs). These receptors are present on cells of the central nervous system and other cells in the body (Hienke et al., 1996). Rapid progression of nicotine in the lungs to the brain increases dopamine transmission within the brain (Tanda et al., 1997).

Nicotine inhibits the antibody forming cell response and lymphocyte proliferation. This may prevent the development of a protective immune response to microbial pathogens (Gerg et al., 1996). Studies show that *in vitro* treatments of human peripheral blood mononuclear cells with nicotine inhibit cytokine production (Onyang et al., 2000). Laboratory mice were shown to have increased susceptibility to bacterial and viral infections when exposed to cigarette smoke (Sopori and Kozak, 1998). It has been demonstrated that smoking among HIV-positive individuals increased their susceptibility to infections (Slavinsky et al., 2002).

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