Chapter 14

Amyotrophic Lateral Sclerosis Disease and Environmental Risk Factors: Role of Heavy Metals and Pesticides

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ABSTRACT

Amyotrophic lateral sclerosis (ALS) is a progressive neurodegenerative disorder that affects central and peripheral motor neuron cells leading to a severe muscle weakness. Until now, no efficient cures exist and those existing are limited. The ALS etiology remains obscure, although the relationship between genetic background and environmental insults including pesticides and heavy metals is well documented. These latter may play a major role in the onset of the ALS neurodegenerative process. Pesticides are known to have many benefits to mankind in the agricultural and industrial areas, but their toxicities in humans have always been a debatable issue. The pathophysiological mechanisms involve, among others, inflammation processes, oxidative stress, and mitochondrial function impairments. The aim of this chapter was to examine the association between the risk of amyotrophic lateral sclerosis (ALS) and exposure to pesticides and heavy metals.

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INTRODUCTION

Amyotrophic lateral sclerosis (ALS) is a fast progressive degenerative brain disease. About 90% of patients diagnosed with ALS have been classified as having sporadic sickness (Kiernan et al., 2011), only 10% of ALS is classified familial. Even though numerous environmental risk factors have been considered, the real and direct causes of ALS still unknown. Therefore, the association between ALS and exposure to many neurotoxic substances, including pesticides, solvents and heavy metals, has been studied in several epidemiologic studies (Ahmed & Wicklund, 2011; Weisskopf et al., 2009).

Several studies suggest that pesticides are proven to be significant risk factors for the onset of ALS and other neurodegenerative brain diseases, such as Parkinson’s and Alzheimer’s (Parrón, Requena, Hernández & Alarcón, 2011). While the pathophysiological mechanisms contributing to risk of ALS related with pesticides exposure are unidentified. Several pesticides are considered as potential neurotoxins, which affect the brain functioning in various ways (Keifer & Firestone, 2007).

Epidemiology of Amyotrophic Lateral Sclerosis

Recent studies showed that the crude incidence of ALS in Europe and North America countries, especially among white people, is quite stable, about 2-3 patients/100,000 people/year (Cronin, Hardiman & Traynor, 2007; Alonso, Logroscino, Jick & Hernan, 2009). Even though the incidence of ALS in Asia continent is generally reduced, it has been shown that the highest incidences (50-100 times more than the world average) have been reported in Asia, especially in Guam and the surrounding Pacific islands between 1940 and 1960 (Plato et al., 2003; Okamoto et al., 2009b; Spencer, Palmer & Ludolph, 2005; Waring et al., 2004; Steele, 2005; Yoshida et al., 1998). Moreover, populations of Hispanic or African root exhibit lower incidences of ALS (Cronin, Hardiman & Traynor, 2007). Based on the relatively short life span of the ALS patients, the incidence of the disease is almost similar to the mortality rate. (Marin, Couratier, Preux & Logroscino, 2011a).

According to new ALS epidemiological studies, both the incidence and prevalence are higher in men compared to women, the ratio being approximately 1.5:1 (McCombe & Henderson, 2010). Concerning the age of the ALS onset, data showed that it’s positively correlated with the male sex (Gordon et al., 2011a). A large amount of ALS in male’s sex has been assigned to respiratory, arms flailing, classic and pure lower motor neuron phenotypes (Chio, Calvo, Moglia, Mazzini & Mora, 2011). Recently, this male preponderance which suggests that changing the exposure to environmental risk factors for ALS, may partly explain this gender difference. (Gordon et al., 2011a).

ALS is an age-related neurodegenerative disease, sharing some similarities with Alzheimer’s disease; however, unlike Alzheimer’s disease, ALS is not strictly an aging associated condition (Brody & Grant, 2001). It has been shown that the incidence of ALS rises with age, and peaks are reached at about seventy years of age, and then declines quickly thereafter (Logroscino et al., 2008). Despite the fact that ALS is a rare neurodegenerative disease, it has been reported that the proportion of global mortality related to ALS has increased in recent years, so, women suffer more than men (Gordon et al., 2011a).
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