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Do aluminum vaccine adjuvants contribute to the rising prevalence of autism?

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ABSTRACT

Autism spectrum disorders (ASD) are serious multisystem developmental disorders and an urgent global public health concern. Dysfunctional immunity and impaired brain function are core deficits in ASD. Aluminum (Al), the most commonly used vaccine adjuvant, is a demonstrated neurotoxin and a strong immune stimulator. Hence, adjuvant Al has the potential to induce neuroimmune disorders. When assessing adjuvant toxicity in children, two key points ought to be considered: (i) children should not be viewed as "small adults" as their unique physiology makes them much more vulnerable to toxic insults; and (ii) if exposure to Al from only few vaccines can lead to cognitive impairment and autoimmunity in adults, is it unreasonable to question whether the current pediatric schedules, often containing 18 Al adjuvanted vaccines, are safe for children? By applying Hill's criteria for establishing causality between exposure and outcome we investigated whether exposure to Al from vaccines could be contributing to the rise in ASD prevalence in the Western world. Our results show that: (i) children from countries with the highest ASD prevalence appear to have the highest exposure to Al from vaccines; (ii) the increase in exposure to Al adjuvants significantly correlates with the increase in ASD prevalence in the United States observed over the last two decades (Pearson $r = 0.92$, $p < 0.0001$); and (iii) a significant correlation exists between the amounts of Al administered to preschool children and the current prevalence of ASD in seven Western countries, particularly at 3–4 months of age (Pearson $r = 0.89–0.94$, $p = 0.0018–0.0248$). The application of the Hill's criteria to these data indicates that the correlation between Al in vaccines and ASD may be causal. Because children represent a fraction of the population most at risk for complications following exposure to Al, a more rigorous evaluation of Al adjuvant safety seems warranted.

1. Introduction

During prenatal and early postnatal development the brain is extremely vulnerable to neurotoxic insults [1,2]. Not only are these highly sensitive periods of rapid brain development in general [3] but also, the blood brain barrier (BBB) is incomplete and thus more permeable to toxic substances during this time [2,4,5]. Further, immune challenges during early development, including those induced by vaccines, can lead to permanent detrimental alterations of nervous and immune system function [6–9]. Experimental evidence also shows that simultaneous administration of as little as two to three immune adjuvants, or repeated stimulation of the immune system by the same antigen, can overcome genetic resistance to autoimmunity in animals [10,11]. Moreover, in adult humans, a variety of conditions encompassed by the 'Autoimmune/inflammatory syndrome induced by adjuvants' ('ASIA') have been linked to exposure to aluminum (Al) vaccine adjuvants (Table 1).

In many Western countries, by the time children are 4–6 years old they will have received a total of 23–32 vaccines [12,13], many with Al adjuvants, through routine pediatric vaccine schedules [2,14]. According to the United States Food and Drug Administration (US FDA), safety assessments for vaccines have often not included appropriate toxicity studies because vaccines have not been viewed as inherently toxic [15]. However, if a few vaccines administered to adults can result in adverse outcomes, such as the 'ASIA' syndrome, should we *assume* without experimental evidence that the current pediatric schedules are safe for children?

Analysis of the relevant data shows that the number of vaccinations recommended prior to school entry increased from 10 in the late 1970s to 32 in 2010 (18 of which contain Al adjuvants) [16]. During this same period, the prevalence of autism spectrum disorders (ASD) in the US also increased by as much as 2000% [16]. While such observations have been of interest, the potential role of vaccines in the development of ASD remains controversial. ASD are characterized by marked impairments in social skills, verbal communication, behavior and cognitive dysfunction [17–19]. Although the etiology of 90% of ASD is still largely unknown [20,21], a growing body of scientific literature shows that neuroimmune abnormalities (i.e., abnormal cytokine profiles, neuroinflammation and presence of autoantibodies

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