

SPECIAL ARTICLE

Mechanisms of aluminum adjuvant toxicity and autoimmunity in pediatric populations

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Immune challenges during early development, including those vaccine-induced, can lead to permanent detrimental alterations of the brain and immune function. Experimental evidence also shows that simultaneous administration of as little as two to three immune adjuvants can overcome genetic resistance to autoimmunity. In some developed countries, by the time children are 4 to 6 years old, they will have received a total of 126 antigenic compounds along with high amounts of aluminum (Al) adjuvants through routine vaccinations. According to the US Food and Drug Administration, safety assessments for vaccines have often not included appropriate toxicity studies because vaccines have not been viewed as inherently toxic. Taken together, these observations raise plausible concerns about the overall safety of current childhood vaccination programs. When assessing adjuvant toxicity in children, several key points ought to be considered: (i) infants and children should not be viewed as “small adults” with regard to toxicological risk as their unique physiology makes them much more vulnerable to toxic insults; (ii) in adult humans Al vaccine adjuvants have been linked to a variety of serious autoimmune and inflammatory conditions (i.e., “ASIA”), yet children are regularly exposed to much higher amounts of Al from vaccines than adults; (iii) it is often assumed that peripheral immune responses do not affect brain function. However, it is now clearly established that there is a bidirectional neuro-immune cross-talk that plays crucial roles in immunoregulation as well as brain function. In turn, perturbations of the neuro-immune axis have been demonstrated in many autoimmune diseases encompassed in “ASIA” and are thought to be driven by a hyperactive immune response; and (iv) the same components of the neuro-immune axis that play key roles in brain development and immune function are heavily targeted by Al adjuvants. In summary, research evidence shows that increasing concerns about current vaccination practices may indeed be warranted. Because children may be most at risk of vaccine-induced complications, a rigorous evaluation of the vaccine-related adverse health impacts in the pediatric population is urgently needed. *Lupus* (2012) **21**, 223–230.

Key word: adjuvants; aluminum; autoimmunity; immunotoxicity; inflammation; neurotoxicity; vaccine safety

Introduction

Aluminum (Al) is highly neurotoxic and has been shown to impair both prenatal and postnatal brain development in humans and experimental animals.^{1–2} In addition to its neurotoxic properties, Al is a potent stimulator of the immune system, which

is the very reason why it is used as an adjuvant.^{3–8} Given this, it is somewhat surprising to find that in spite of over 80 years of use, the safety of Al adjuvants continues to rest on assumptions rather than scientific evidence. For example, nothing is known about the toxicology and pharmacokinetics of Al adjuvants in infants and children.⁹ On the other hand, in adult humans long-term persistence of Al vaccine adjuvants can lead to cognitive dysfunction and autoimmunity.^{6,10} Yet, in spite of these observations children continue regularly to be exposed to much higher levels of Al adjuvants than adults, via routine childhood vaccination programmes.^{3,11}

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