

Alum as an Adjuvant in Tetanus Toxoid Vaccine

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Abstract— Aluminium hydroxide, Aluminium phosphate and calcium phosphate are used as adjuvant in (TT) vaccine. In this review mechanism, potency, benefits and limitations of alum adjuvant have been discussed.

Keyword— Aluminium hydroxide (Alum/AIOH), Aluminium phosphate (AlPO₄), Calcium phosphate (CAP/CaPO₄), Tetanus Toxoid (T.T), Vaccine.

I. INTRODUCTION

By using adjuvants, quality of vaccines can be enhanced that can selectively excite immunoregulatory responses [3]. Chemical nature of adjuvants is unpredictable [21]. Hundred of materials have been tried as adjuvant and used in realistic vaccination for more than 60 years [17,22]. In human vaccinations aluminum and calcium phosphate, oil emulsions, nanoparticles and molecular assemblies have some use [5,12]. AlPO₄ and AIOH used as an adjuvant in many vaccines licensed by the US Food and Drug Administration [16]. Alum is most commonly used chemical as adjuvant (such as tetanus toxoids) in human and veterinary vaccines also [6,15].

II. MECHANISM

Adjuvants should be selected for routine use as it may have adverse mean of action and alum mechanism is not fully understood [4, 15]. However mode of action of alum adjuvant can enhance both T helper cell 1 as well as T Helper cell 2 cellular response by NLRP3 pathway.6. Alum activates caspase-1 and induce secretion of mature Interleukin-1 β and Interleukin-18 [8].

III. POTENCY

Potency of adjuvants reliant upon the physio-chemical uniqueness and electrostatic forces between adjuvant and foreign agent [1]. One study in murine model showed CAP is more potent than alum and nano particulate adjuvant of CAP would possible to use [3]. While another research showed CAP adjuvanticity is lower or equal to alum [2]. If number of organisms (e.g; pertusis) present in vaccine is less would result in reduced potency [10].

IV. BENEFITS

Authors conclude that alum is competent to provoke a good antibody (Th2) response [6, 14]. Single dose immunization with potent alum adsorbed toxoids is possible and booster immunization with alum toxoids elicit the IgE [9,19]. In vivo purified TT and AlPO₄ adjuvant bring out vascular permeability-increasing and poisonous effects to macrophages [13,18]. CAP is natural constituent of body and enhances an insignificant IgE responses [3].

V. LIMITATIONS

Limitations of alum adjuvants consist of local response, augmentation of IgE antibody reaction, incompetence for some antigens and failure to boost cell-mediated immune (especially cytotoxic T-cell) responses [14,16]. Aluminium salts in vaccines do not cause severe or long lasting undesirable effects [7]. Investigation on adjuvants indicates that alum can be replace with other adjuvant formulations like MF59 emulsion and poly lactide co-glycolide (PLG) [20]. One study on young children showed that vaccination with alum caused significantly more local reactions than plain vaccines [7]. There is haemolytic effect by Ca-gel [18].

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