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Concentration of anti-pneumococcal capsular polysaccharide IgM, IgG and IgA specific antibodies in adult blood donors

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ABSTRACT

Objectives: Anti-pneumococcal capsular polysaccharide (PCP) IgM, IgG and IgA ELISAs have been developed to aid assessment of the adaptive immune system. The relationship between the concentrations of PCP IgM, IgG, and IgA was investigated.
Design and methods: The concentrations of PCP IgM, IgG, and IgA were measured in sera obtained from 231 adult blood donors.
Results: Concentrations of each isotype were not normally distributed. The median concentration for PCP IgM was 54 U/mL (range 37–75 U/mL), IgG 40 mg/L (range 26–79 mg/L) and IgA 21 U/mL (range 13–44 U/mL). The median PCP IgM titres decreased with age and were significantly lower in patients aged 81–90 years compared to those aged 18–80 years. By contrast, there was a significantly higher median serum PCP IgG titre in the 61–90 years group compared to those aged 18–60 years and a significantly higher median serum PCP IgA titre in the 51–90 years group compared to those aged 18–50 years. The correlation between PCP IgG and IgA was more significant than between IgM and IgA and between IgM and IgG. Correlation of PCP IgA and IgM concentrations identified four phenotypes: high PCP IgM and IgA; high PCP IgM only; high PCP IgA only; and low PCP IgM and IgA. A significant number of individuals with a PCP IgG concentration $>$ 50 mg/L had low PCP IgA and IgM concentrations.
Conclusion: The additional measurement of PCP IgA and PCP IgM, alongside PCP IgG, in individuals investigated for a compromised immune system may provide a more detailed antibody profile.

1. Introduction

Serum antibody measurements are used to assess immune system competence and recovery, and are included in guidelines for the assessment of antibody deficiencies [1,5,7]. Commonly measured antibodies include those raised in response to tetanus, haemophilus and pneumococcal capsular polysaccharide (PCP). Recently, the measurement of PCP IgM and IgA has been reported in patients with common variable immunodeficiency (CVID) [3]. Cavaliere et al. identified four PCP IgM and IgA phenotypes and assessed their concentrations retrospectively to stratify the risk of pneumonia and bronchiectasis. At present, the measurement of antigen-specific IgA and IgM is not routinely performed for the assessment of immunocompetence or risk of infection.

In this study we report the concentration of, and correlation between, PCP IgM, IgG, and IgA antibodies in a large cohort of blood donor samples. We hypothesise that the simultaneous measurement IgA and IgM in addition to PCP IgG may give the clinician a more detailed antibody profile for the assessment of immunocompetence.

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Table 1
Age stratified median PCP IgM, IgG and IgA antibody titres and interquartile ranges.

	Age stratified median antibody titre (interquartile range)							
	18–20 yrs	**21–30 yrs**	**31–40 yrs**	**41–50 yrs**	**51–60 yrs**	**61–70 yrs**	**71–80 yrs**	**81–90 yrs**
PCP IgM (U/mL)	65 (47–156)	57 (45–81)	54 (36–94)	46 (32–72)	56 (34–73)[a]	50 (29–77)	44 (28–83)[a]	27 (14–52)[a]
Number of samples	12	78	18	37	25	29	21	11
PCP IgG (mg/L)	32 (17–49)[a]	32 (22–54)	34 (30–49)	46 (27–76)	37 (26–69)	98 (28–168)	110 (58–270)	67 (48–117)
Number of samples	12	78	18	37	23	28	21	11
PCP IgA (U/mL)	20 (11–27)[a]	19 (12–29)	21 (12–27)	24 (13–51)	28 (15–67)	35 (14–116)	43 (43–96)	55 (21–96)[a]
Number of samples	13	77	18	36	25	29	21	11

[a] These samples were determined to be normally distributed by Shapiro Wilk analysis.

2. Materials and methods

2.1. Samples

Serum samples were obtained from 231 blood donors (125 males and 106 females) aged 18–90 years. Only subjects who were free of recurrent infections or inflammation at the time of donation (assessed by questionnaire) and whose C-reactive protein concentrations were < 10 mg/L were included in the analysis. Samples were stored at -80 °C. The samples were collected in donor centres by Biomex Solutions (Heidelberg, Germany) and purchased from Quest Biomedical (Solihull, UK). Sample collection was approved by the Institution Ethics Review Board (#05142), with all donors providing written informed consent.

2.2. Measurement of antigen-specific antibodies

Commercially available test kits (VaccZyme™ PCP Enzyme-Linked Immunosorbent Assays [ELISAs], The Binding Site Group Limited, Birmingham, UK) were used to measure PCP IgM, IgG and IgA according to the manufacturer's instructions. All three ELISAs employ the use of capsular polysaccharide (CPS) absorption to improve the specificity of pneumococcal antibody detection. The data obtained was stratified by age (Table 1) and median values and interquartile ranges (IQR) were established for each age group. Median values were used to establish cut-offs for anti-PCP IgA and IgM, which were compared to previously published cut-offs (20 U/mL and 150 U/mL respectively) for defining four phenotypic groups [3]. For PCP IgG, the cut-off concentration of 50 mg/L was applied [4].

2.3. Statistical analysis

Shapiro–Wilk, Chi squared, Fisher's exact and Mann Witney *U* tests were performed using Graphpad Prism software (GraphPad Software, La Jolla, CA, USA). $p < 0.05$ was considered statistically significant.

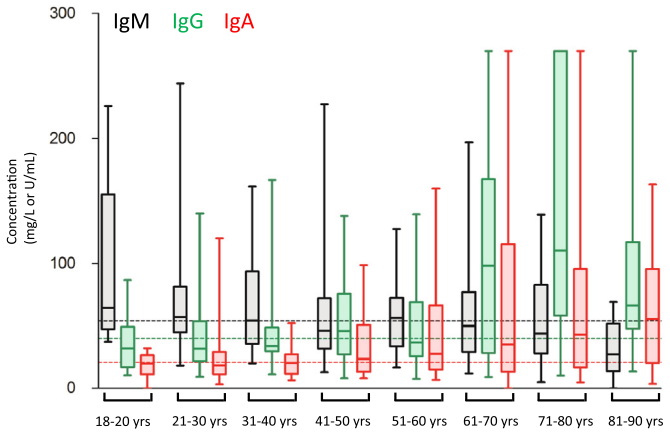

Fig. 1. Age-stratified concentrations of PCP IgM (U/mL), IgG (mg/L) and IgA (U/mL) in adult blood donors. Dotted lines represent median concentrations for IgM (54 U/mL; black), IgG (40 mg/L; green) and IgA (21 U/mL; red). Box and Whisker plots show interquartile ranges, median, minimum and maximum concentrations.