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Anti-Pneumococcal Antibody and COVID 19 - A Review

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ABSTRACT

Aim: To study and learn the role of anti-pneumococcal antibody and the development of vaccines for COVID 19.

Materials and Methods: Review of Literature by collecting and retrieving information from a minimum of articles.

Discussion: The antibody-polysaccharide antigens, such as the pneumococcal vaccine. Polysaccharide pneumococcal vaccines have evolved over the past 20 years, using both unconjugated polysaccharides and polysaccharides conjugated to toxins to elicit a protective immune response in groups at risk for pneumococcal infection. Current CDC immunization guidelines for these vaccines have reduced the rates of pneumococcal infections within immunized communities. Vaccines against pneumonia, such as a pneumococcal vaccine, do protect against the COVID 19.

Conclusion: We acknowledge that the development of pneumococcal vaccine may not protect against the coronavirus. More affordable and accessible vaccines for pneumonia are needed to protect from vaccines to kill the coronavirus in one shot. As the virus is new and different as it needs its vaccine.

Key Words: Anti-pneumococcal antibody, Pneumonia, SARS, COVID-19, Vaccine, Pneumococcal infection

INTRODUCTION

Severe acute respiratory syndrome coronavirus 2 that is SARS-CoV-2 has become a pandemic and people are confronting it. It appears that the coronavirus has been in multiple countries and billions of people. There is wide variability in the anti-pneumococcal antibody response of normal subjects as shown in one study ¹. Anti-capsular polysaccharide antibodies are believed to represent the single most important protective mechanism against invasive disease. The basis of serum therapy was antibodies to pneumococcal polysaccharides in which passively transferred, serotype-specific anti-pneumococcal serum has reduced mortality from pneumococcal pneumonia by making it into half ². The example of antibody-polysaccharide antigens includes pneumococcal vaccine.

Streptococcus pneumoniae has capsular polysaccharide and shows a diverse group of polymers. A previous study demonstrated the virulence of bacterium and its essential role with 90 serologically distinct capsules ³. Vaccination of infants

and young children with the pneumococcal conjugate vaccine has decreased in nasal carriage rates and pneumococcal disease in all age groups. Antibodies to capsular polysaccharide antigens provide serotype-specific protection against serious infections such as pneumonia, and the pneumococcal vaccines are designed to cover the serotypes most commonly associated with severe pneumococcal disease. Currently, a pneumococcal polysaccharide vaccine has a total of 23 serotypes that are 23-valent and a 7-valent polysaccharide-protein conjugate vaccine has been marketed internationally. Both vaccines are considered very safe. Respiratory secretions from the patient and direct contact with the healthy person pneumococci are getting transmitted. There are serious pneumococcal infections such as pneumonia, meningitis, and febrile bacteremia, and other respiratory disorders that are more common but have less serious manifestations.

The previous study demonstrated that pneumonia is a leading cause of community-acquired pneumonia irrespective of comorbidity, individuals with chronic lung diseases, particu-

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larly those with COPD, are at increased risk of pneumococcal community-acquired pneumonia and invasive pneumococcal disease, are prone to higher rates of complications and mortality and suffer prolonged recovery after such illnesses⁴. One study shows acute pulmonary embolism and Chest CT plays an important role in the management of patients with COVID 19⁵. The symptoms of coronavirus are similar to influenza that is fever, cough, sore throat, and also major respiratory problems that are a problem in breathing and highly prevalent shown in one study⁶. COVID 19 does not cause Nocturia⁷. Diabetic people can be a risk factor of COVID 19⁸. Generally, coronaviruses were not considered to be highly pathogenic to humans until the outbreak of Severe Acute Respiratory Syndrome (SARS) in 2002 and 2003⁹. Hysterectomy can be risky during COVID 19¹⁰. It alters the hemoglobin level¹¹. Lung cancer patients have higher chances of SARS¹². To understand how vaccination can stop a disease spreading through an otherwise susceptible population it can be done by game-based learning methods¹³. Vitamins help in fighting COVID 19¹⁴. This review of the literature has been done by collecting and retrieving information for a minimum of 30 articles. Articles were selected from Pubmed, google scholar, etc.

COVID-19 AND ANTI-PNEUMOCOCCAL ANTIBODY

COVID-19 Pneumonia

COVID-19 pneumonia is a specific disease with hypoxemia and is also associated with normal respiratory compliance¹⁵. Hypoxemic patients have the same single etiology (SARS-CoV-2) but show different symptoms from others like normal breathing (“silent” hypoxemia) or remarkably dyspneic; quite responsive to nitric oxide or not.

A previous study demonstrated the beginning of COVID 19 Pneumonia having characteristics of Low elastance which estimates that the amount of gas in the lung is nearly normal¹⁶. Low ventilation -to-perfusion, low lung weight, and low lung recruit ability, the amount of non-aerated tissue are very low; consequently, the recruiting ability is low¹⁷ these are L-type COVID-19 Pneumonia. H-type COVID-19 Pneumonia has characteristics of High elastance that is the decrease in gas volume due to increased edema accounts for the increased lung elastance, High right-to-left shunt. Due to increased edema and superimposed pressure in the dependent lung regions, it will be developed by the fraction of cardiac output perfusing the non-aerated tissue. High lung weight that is quantitative analysis of the CT scan shows a remarkable increase in lung weight (> 1.5 kg), on the order of magnitude of severe ARDS¹⁸. High lung recruit ability that is an increased amount of non-aerated tissue is associated, as in severe ARDS, with increased recruit ability.

The Type H pattern, 20–30% of patients in our series, fully fit the severe ARDS criteria: hypoxemia, bilateral infiltrates, decreased respiratory system compliance, increased lung weight, and potential for recruitment. Type L and Type H patients are best identified by CT scan and are affected by different pathophysiological mechanisms¹⁹. COVID 19 can alter hemoglobin level²⁰. Ankylosing spondylitis patients on biologics should take extra precautions to minimize the risk of contracting a COVID-19 infection²¹. Cancer people should be more careful²².

Anti- Pneumococcal Antibody

Streptococcus pneumonia is an important human pathogen causing asymptomatic carriage as well as important mucosal and systemic infections. Anti-capsular antibodies are thought to represent the single most important protective mechanism against invasive disease²³. Antibodies to pneumococcal capsular polysaccharides were the basis of serum therapy in which passively transferred, serotype-specific anti-pneumococcal serum was shown to reduce mortality from pneumococcal pneumonia by half. Resistance to pneumococcal colonization is determined by the antibodies to the pathogen. Anti capsular antibodies reduce the pneumococcal colonization and protect nasopharyngeal carriage²⁴. The WHO has anticipated new modifications in antibody assays for pneumococcal anti-capsular antibodies which can be useful for the people. There is an outlined principle to determine to change the protective concentration of such assay modification. For improvement of ELISA for anti-capsular antibodies this principle was applied, i.e. absorption with 22F pneumococcal polysaccharide, that increases the specificity of the assay for vaccine serotype anti-capsular antibodies by removing non-specific antibodies²⁵. Liquid Paraffin on Antibody Responses and Local Adverse Reactions of Bivalent Oil Adjuvanted Vaccines Containing Newcastle Disease Virus and Infectious Bronchitis Virus²⁶.

Detection of Specific Antibodies to SARS

One study reported the evaluation of recombinant severe acute respiratory syndrome (SARS) coronavirus (SARS-CoV) nucleocapsid protein enzyme-linked immunosorbent assay (ELISA)-based antibody tests for serodiagnosis of SARS-CoV pneumonia and compare the sensitivities and specificities of this ELISA for detection of immunoglobulin G (IgG), IgM, IgA, and their combinations with serum samples from healthy blood donors²⁷. The specificities of the ELISA for IgG, IgM, and IgA detection were higher respectively. The test for diagnosis of SARS-CoV pneumonia is sensitive which is done by ELISA and does not require the cultivation of SARS-CoV²⁸. Isolation of coronavirus is insensitive in clinical laboratories for diagnosis of SARS-CoV, while the detection of viral RNA by reverse transcription-PCR can achieve a sensitivity of only 50 to 79%, depending

on the type and number of clinical specimens collected and the protocol used^{29,30}. During the SARS epidemic, using the ELISA test will be useful for the diagnosis of SARS-CoV pneumonia. It is well known that in the presence of possible cross-reactions, the positive predictive value of serological tests depends on the prevalence of the infection in a particular location at a particular moment. On the other hand, the positive predictive value of the serological test would be increased if the prevalence of the infection is high, such as during an epidemic and when applied in clinically compatible cases³¹.

Vaccine Development

One study reported that the Polysaccharides that were identified coursing along the exterior of the bacterium could be targeted for vaccine development. British physician Sir Almroth Wright conducted the first large clinical trial of a whole-cell pneumococcal vaccine.

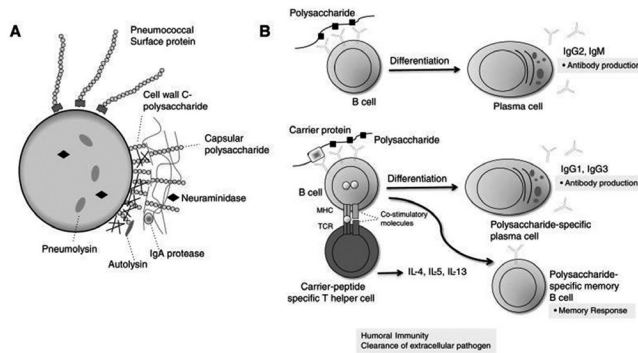


Figure 1: (A): Pneumococcus bacteria and virulence factors including capsular polysaccharide, (B): Immune response to polysaccharide and protein-polysaccharide conjugate vaccines.³²

For the next three decades, the trial for vaccine development was largely unsuccessful. Streptococcus pneumonia is a bacterium with 93 different polysaccharide capsular serotypes as shown in Figure 1A, the most important determinant of pneumococcal virulence is an antiphagocytic bacterial capsule. Immune response to polysaccharide and protein-polysaccharide conjugate vaccines in Figure 1B.

Polysaccharide pneumococcal vaccines have evolved over the past 20 years, using both unconjugated polysaccharides and polysaccharides conjugated to toxins to elicit a protective immune response in groups at risk for pneumococcal infection. Current CDC immunization guidelines for these vaccines have reduced the rates of pneumococcal infections within immunized communities³³. Vaccines against pneumonia, such as a pneumococcal vaccine, do protect against the COVID 19. The virus is new so it will take some time for the production of the vaccine against it. A pneumococcal vaccine is not enough for this virus. Scientists are trying to

develop a vaccine against coronavirus as the pneumococcal vaccine is not enough.

One study reported that stem cells are unspecialized cells that have a property of differentiating into specific specialized cell types³⁴. Using umbilical cord mesenchymal stem cells, protection against coronavirus can be done in the future. As vaccination is important for everyone³⁵.

Table 1: Advantages and disadvantages of 23-valent PS vaccine

Pros	Cons
<ul style="list-style-type: none"> The vaccine covers a large number of serotypes Serotypes covered account for 85-90% of invasive pneumococcal diseases in the US (ACIP, 1997) It is cost effective and widely used in developing countries 	<ul style="list-style-type: none"> Cannot be used on children <2 years Cannot be used on immunodeficient patients Time period of protection is limited because of no T-cell response (Bogaert, 2004). Does not affect carrier rate due to no mucosal immunity (Pletz et al. 2008)

Table 2: Advantages and disadvantages of PCV-7 conjugate vaccine³⁶

Pros	Cons
<ul style="list-style-type: none"> More immunogenic than 23-valent PS vaccine Can be used on infants under 2 years of age Provides both, systemic and mucosal immunity 	<ul style="list-style-type: none"> Limit to the amount of polysaccharide-protein linkages that can be formed Not cost effective

CONCLUSION

COVID-19 pneumonia is a specific disease with hypoxemia and is also associated with normal respiratory compliance. Hypoxemic patients have the same single etiology (SARS-CoV-2) but show different symptoms from others like normal breathing ("silent" hypoxemia) or remarkably dyspneic; quite responsive to nitric oxide or not. Polysaccharide pneumococcal vaccines have evolved over the past 20 years, using both unconjugated polysaccharides and polysaccharides conjugated to toxins to elicit a protective immune response in groups at risk for pneumococcal infection. Current CDC immunization guidelines for these vaccines have reduced the rates of pneumococcal infections within immunized communities. Vaccines against pneumonia, such as a pneumococcal vaccine, do protect against the COVID 19. The coronavirus infection has recently arisen as a pandemic and found to affect the organ systems especially, the lungs severely. So, the

researchers started the production of the vaccine against it to prevent the infection. The vaccination which is currently used to protect older people from pneumonia targets a type of bacteria called *Streptococcus pneumoniae* is suspected to be useful for coronavirus infection also but has no clinical evidence³⁷. This review thus highlights the urge for further experimental validation on the cross-protection of the same for COVID disease.

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