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Review Article

Vaccine development for Staphylococcal Infectious Disease

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ABSTRACT

Staphylococcus aureus is common bacterial pathogen which causes illnesses ranging from minor infections to life threatening diseases. This bacterium has become major cause of hospital acquired infections. It affects patients who has already weak immune system .It is mostly spread to others by contaminated hands and Skin. Due to skin damages, *S.aureus* may gain access to tissues or the blood stream and cause infection. These bacteria can survive on dry surfaces and increasing the chance of transmission. It cannot be eradicated by antibiotics like Methicillin, Vanomycin, etc, because it is an antibiotic resistant pathogen. So there is another way to prevent this pathogen's infection by vaccination. In our lab, few experimental trials were conducted regarding identification and recommendation of various immunogens for vaccine development. The important Immunogens are inactivated cells, peptides, Nucleotides and their fragments .The natural plasmid DNA and their enzyme digested nucleotide fragments produce good immune responses.

Keywords: Staphylococcal diseases; Vaccine; Antibiotic; Resistant; Pathogen

INTRODUCTION

Bacterial infectious diseases are important causes of mortality and morbitality in developing countries. It is mainly spread through contaminated food and water [1]. The main reason for spreading diseases are poor hygiene, practice, over explosion of the population and poor environmental conditions. Nowadays, due to improper use of antibiotics pathogen develops antibiotic resistance. So it is difficult to eradicate these pathogens from people. They survival long term, gives lot of illness to people. For control these pathogens, new antibiotic discoveries are must. Our marine resources have many unexplored bioactive compounds. Now-a-days the drug industries screening new drugs from various marine and other natural resources [2,3].

STAPH INFECTIONS

Staphylococcus aureus infections range from mild to life threatening. The most common Staph infections are Skin infections, often causing abscesses. However bacteria can travel through the blood stream called bacteraemia and infect almost any site in the body, particularly heart valves endocarditic and bones called osteomylitis. The bacteria also tend to accumulate on medical devices in the body, such as artificial heart valves [4].

Joints, heart pacemakers and catheters inserted through the skin into blood vessels. Certain conditions increase the risk of getting a Staphylococcal infections, such as Influenza, Tumour, chronic lung disorder, leukaemia, burn, An open wound or sore, chronic skin disorders, surgery, diabetes mellitus, etc. There are many strains of *Staphylococcus aureus*. Some strains produce toxins that can cause staphylococcal food poisoning, toxic shock syndrome. The toxic shock syndrome is also produced by *Streptococci*. This syndrome causes rapidly progressive and severe symptoms that in clued fever, rash, dangerously low blood pressure and failure of several organs [5].

ANTIBIOTIC RESISTANCE

The Antibiotic resistance mechanism are emerging and spreading globally, threatening our ability to treat common infectious diseases, resulting in prolonged illness, disability and death. It also increases the cost of health care with longer stays in hospital and more intensive care required. Due to poor infection control, inadequate sanitary conditions and inappropriate food handling encourages the spread of antimicrobial resistance pathogens. People with MRSA (Methicillin-resistant *Staphylococcus aureus*) are estimated to be

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64% more likely to die than people with a non-resistant from the infection [6].

PREVENTION AND CONTROL

Some people always thoroughly washing their hands with soap and water or applying an alcohol based sanitizer can be protected from spread of these bacteria. People with staphylococcal skin infection should not handle food. Taking old food is not good, it may be contaminated, so better avoid old food items. Boiling drinking water help to prevent water borne infections. Staph infection also spread through wounds. So carefully maintain wound up to complete healing. Discovery of new drugs help to control these infections. If maintain good immunity by using natural immunostimulants, fruits, vegetables, etc. help to prevent these infections and also use best disinfectants to use our surrounding to destroy the pathogens. The effective tools for preventing infection in human and animals such as include immunization, safe water and sanitation, maintained of good hygiene in hospitals and animal husbandry. Appropriate use of existing and new antibiotics is also essential [7].

APPLICATIONS

Plasmids are used in genetic engineering to amplify or produce many copies of certain genes. Some plasmids help to resists various antibiotics. They make toxins to kill other bacteria. Some help resist environmental factors. They are also use unusual chemical compounds as nutrients. In pathogenic bacteria plasmid acts as antigens during infection. In cloning, a plasmid is a type of vector and uses in gene transfer to the cells of superior organisms to improve their resistance to diseases, growth rates and any other required traits. It is used to produce proteins and antibiotics at large scale. Plasmid are used to transfer genes into human cells as part as gene therapy. Plasmid cannot produces diseases. If it is combined with antigenic protein it will be induces immunity. So it is highly suitable for vaccine development. These vaccines induces to produces more antibodies, it will also useful in plasma therapy for viral infection [8].

DIAGNOSIS AND TREATMENT

Staphylococcal skin infections are usually diagnosed based on their appearance. Other infections require samples of blood or infected fluids, which are send to a laboratory to grow, identify and test the bacteria. Laboratory results confirm the diagnosis and determine which antibiotics can kill the staphylococci called Susceptibility testing .In the Bone infections, X rays, C.T scan, MRI scan, Radionuclide bone scanning or combination is also done. This test can show the damaged area and determine how severe it is. Bone biopsy is done to obtain a sample for testing. The sample may be removed with a needle or during surgery. *Staphylococcus aureus* infections are treated with antibiotics that are effective against MRSA which includes vancomycin linezolid, tedizolid, quinupristin plus dalfopristin, ceftaroline, telavancin or daptomycin. Depending of the severity of the infection antibiotics may be given for weeks. Usually, infected bone and foreign materials has to be removed surgically to cure the infection.

VITAMINS PROPHYLACTIC THERAPY

Some vitamins have immuno stimulatory function. They support the functions of immune system. Vitamins are organic compounds which is necessary very little amount for day today life activity. The immuno stimulants enhance the functions of immune system. Before infection, if add optimum range of immunostimulants in diet, leads to save us from various infections. Some vitamins induce nonspecific immunity. The optimum range of vitamins produces maximum immune response. If add more amount it may suppress the immune responses. If add low amount it is not effective. So the optimum range is best for produce maximum immune responses. In our lab trials, graded levels of various vitamins (A, D, E and C) were provided to albino rats and study immune responses against *Staphylococcus aureus*. The important result highlights are discussed here.

Vitamin A is necessary for proper immune functions, growth, wound healing, etc. It boosts up the functions of immune system. But the higher doses of vitamin A supplementation suppress the growth rate of cancer cells. It act against tumor growth. In the vitamin A trail, maximum immune responses observed in 25,000 I.U treatment after that immune response was decreased. The vitamin D is important for the functions of immune system. Vitamin D involves in calcium metabolism. If increase intake, it will prevent against cancer, rickets, hyper parathyroidism, multiple sclerosis, etc. In the current study, Vitamin D3 optimum dose 0.75 microgram produces maximum immune responses against *staphylococcus aureus*. Vitamin E act as good antioxidant and immunostimulant. It stimulate cell mediated and humoral mediated immunity. In this attempt, maximum immune responses was observed in 750 mg vitamin treatment. High level of vitamin c has been associated with improved immunity to bacterial, viral and parasitic challenges. It has protective role against environmental stress. In our study, up to optimum dose it will increase the immunity. If add more water soluble vitamins, it will excreted through urine [9].

VACCINE DEVELOPMENT

The vaccine development still going on around the world, because there are different virulence factors, and different strains are present. So still there is difficult to prepare successful vaccine. In our lab works, various types of vaccine trails going on such as Mutant strain inactivated vaccine, Plasmid DNA vaccine, Engineered Plasmid DNA vaccine, and Heat shock protein vaccine. All these vaccines produce good immunity. The plasmid DNA and their fragments produces good immune responses. The Heat shock protein induce good immunity. If plasmid DNA is combined with Heat shock protein or any antigenic protein, it will produce long term immunity. In our lab many experimental trials are carried out. The result high lights are discussed here [10].

Heat stress proteins have antigenic presentations. So it will be used as antigenic part of vaccine and also used as adjuvant for boost up the vaccine efficacy. In this vaccine trail, maximum immune response was observed in 55℃, 10 minutes treatment produced Heat stress proteins compared to other treatments. In plasmid DNA based vaccine trial, the maximum immune

response was observed in plasmid DNA treatment. In mutant strain experiment trial, the maximum immune response was observed in 6 minute U.V treated mutant strain's plasmid DNA and inactivated whole cells produces maximum immune response compared to other mutant strains. There are many methods are used for vaccine delivery in nowadays such as Intramuscular injection, Intradermal particle Bombardment, Intranasal drops, Tattooing, Oral vaccination, Skin cream, Skin Patches, etc. Based on the nature of the vaccine and the target number, the vaccination method is selected. Nowadays Needle free vaccinations are followed around the world [11].

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