Listeria Monocytogenes

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Abstract

Listeria monocytogenes is the organism responsible for listeriosis infection in both humans and animals. Its main mode of transmission is through contamination of contaminated foods, normally raw foods and food products that have not been properly processed. This pathogen is classified under Gram-positive bacteria, and it occurs in 13 different serotypes. Infection with *Listeria monocytogenes* leads to health problems such as miscarriages, encephalitis, gastroenteritis and arthritis. Researchers base their studies on the bacteria's pathophysiology as they strive to develop effective drugs and vaccines for *Listeria monocytogenes*. Some of the major recent advances involving this bacterium involve investigations about the significance of cell-mediated immunity in providing prolonged protection against the bacteria, and the use of *Listeria monocytogenes* as a vector for delivery of cancer vaccines. One of the major debates surrounding these advancements is the efficacy and safety of the pathogen as a recombinant drug delivery system. Further research is necessary to prove these findings and to allow for human interventions. Generally, everyone in the society has a role to play in order to prevent infections with *Listeria monocytogenes*.

Introduction

Listeria monocytogenes is a food borne bacteria that causes an often fatal infection known as listeriosis (Schuppler et al. 2). It is found in diverse environments such as various food products, water, soil, humans and animals. Most infections with *Listeria monocytogenes* pathogen occur following ingestion of contaminated food that has not been processed effectively. Examples of such foods include soft cheese, contaminated milk products, frankfurters and many others. Infection with *Listeria monocytogenes* may also occur from mother to fetus through the placenta or during birth. Infection from mother to child may result in abortion or miscarriage. Listerosis may present as encephalitis, meningitis, arthritis, osteomyelitis and at times, pneumonia in both humans and animals (Weinstein 2). Listeriosis infection has attracted the attention of many research scientists due to the nature of physiological effects associated with it. Studies that aim at effective drug development have majorly focused on the pathogen's interraction with the mucosal immune system of the gastrointestinal tract (Schuppler et al. 3). Such investigations have led to new discoveries on how infection with *Listeria monocytogenes* bacteria can be treated, as well as some of the important medical benefits of the bacteria. These discoveries have raised debates among scientists, as some have contrary opinions about them. However, significant gaps still exist that give young scientists the opportunity to conduct further research, and to provide future directions in a fight towards listeriosis-free society (Yang et al. 196).

Listeria monocytogenes is grouped under Gram-positive bacteria, meaning that its cell membrane is covered by a thick peptidoglycan layer that retains crystal violet stain that is normally used in Gram staining (Topley 260). It is also classified into thirteen different serotypes, with only three serotypes being associated with listerosis outbreak in many countries.

The three strains are 4b, which is the most dangerous, 1/2a and 1/2b (Laksanalamai et al. 1372). According to the *Center for Disease Control and Prevention*, approximately 50 million people in the United States of America get sick from *Listeria monocytogenes* pathogen. However, the incidence of *Listeria mocytogenes* is lower than that of other food borne pathogens such as *Salmonella* species. Members of the population who are at high risk of acquiring listeriosis include; immune-compromised individuals, expectant women and their newborns, adults aged 65 years and above, and those consuming foods contaminated with the bacteria.

As earlier stated, *Listeria monocytogenes* can either pass through the placenta to an unborn fetus or it can infect a child during birth through an infected birth canal. These can lead to stillbirths, miscarriages and death of newborns (Topley 261). *Listeria monocytogenes* pathogen spreads quickly in the blood stream of a person with weakened immune system. A person's immune system can get weakened by disease conditions such as diabetes, cancer, HIV/AIDS, liver failure, kidney failure, old age, and many other conditions (Laksanalamai et al. 1380). Weakened immunity enables the bacteria to get into the brain and infect the Central Nervous System thereby causing meningitis and encephalitis. Additionally, those who consume ineffectively processed and raw foods are known to be at high risk of listeriosis infection because these foods hide *Listeria monocytogenes* pathogen. Foods such as smoked seafoods, raw milk, soft cheeses, raw sprouts and hotdogs have been found to be very serious (*Center for Disease Control and Prevention*).

Since most infections with *Listeria monocytogenes* occur through ingestion, studies have been conducted to investigate how this pathogen adheres and invades the gastrointestinal epithelium (Schuppler et al. 2). Results obtained from such investigations have helped in both drug and vaccine development towards the bacteria. According to Schuppler et al., *Listeria*

monocytogenes enters the host's intestinal mucosa through two principle mechanisms (6). The first mechanism involves direct attack of the intestinal cells, leading to infection of the enterocytes. This mechanism of invasion only occurs in organisms whose intestinal mucosa contains internalins, the Listeria monocytogenes receptors. Examples of organisms include guinea pigs and humans. The second mechanism involves transverse translocation of the pathogen through the M-cells of Peyer's patches. This mode of entry occurs in organisms that do not express internalins on their intestinal mucosa such as rats and mice.

The pathogen's ability to penetrate the intestinal epithelium through attack of intestinal cells forms the center for pathophysiology of *Listeria monocytogenes* in the gastrointestinal tract (Archer et al. 660). Effectivity of the pathogen is initiated by various cytokines such as interleukin-A and interleukin-B. Different phospholipases assist the pathogen to get into the enterocyte's cytoplasm thereby causing gastroenteritis. Knowledge of these invasion steps and the phospholipases involved has enabled pharmacists to develop antibiotics that have proved highly effective against *Listeria monocytogenes* such as Ampicillin and Gentamicin (Schuppler et al. 8). Before administration of antibiotics, the body has its own protective mechanism through which it tries to eliminate the *Listeria monocytogenes* pathogen, known as cell-mediated Immunity (Archer et al. 656).

Cell-mediated immunity is a mechanism used by both humans and animals to protect themselves from intracellular pathogens. Following infection with *Listeria monocytogenes*, the instinctive immune response provides resistance and begins the development of antigen-specific lymphocytes such as cytotoxic CD 8 positive T –cells. These T-cells produce antibodies that are responsible for destruction of all cells infected with the pathogen (Archer et al. 658). For over ten years, *Listeria monocytogenes* has been used as a model organism to study about the production

of cell-mediated immunity resulting into prolonged immunity. This research acts as one the most significant advancements in the field of bacteriology (Archer et al. 902). Most scientists agree that adaptive immunity in organisms is initiated after activation of the innate immune system. However, some scientists disagree to the statement that cell mediated immunity is responsible for the prolonged immune response against *Listeria monocytogenes*. For this reason, there is always continued study to investigate the role of adaptive immune responses in offering protection against *Listeria monocytogenes* pathogen (Yang et al. 187).

Even though bacteria are always seen as pathogens that cause harm to living organisms, some of them have successfully been used as drug delivery systems in several research studies. One of the recent discoveries in the field of bacteriology is the use of *attenuated Listeria monocytogenes* pathogen as a vector for delivering cancer vaccines into body systems. According to Yang et al., weakened *Listeria monocytogenes* is a promising candidate vector for the delivery o cancer vaccines (186). In this strategy, non-replicating form of the pathogen is genetically modified to express human CD24 protein, a biomarker for hepatic cancer stem cell that is responsible for metastasis and apoptosis of hepatocellular carcinoma (Yang et al. 185). When the modified *Listeria monocytogenes* enters the human cell, it is phagocytosised by antigen-presenting cells. Subsequently, the bacterium stimulates the two Major Histocompatibility Complex (MHC) pathways, MHC-I and MHC-II. These eventually induce the increased production of antigen-specific T-lymphocytes that generate antibodies against cancer (Yang et al. 190).

Several debates however exist about the safety and efficacy of this method of cancer prevention, and this forms one significant gap in the research. While others argue that it is highly safe and convenient, others claim that it might expose a person to bacterial infection, and that it

might not effectively act a cancer vaccine (Archer et al. 810). In order to develop an efficient gene medicine, it is clear that quite a number of improvements to the current studies are required. One of the future directions therefore is that, safety and efficacy of *Listeria monocytogenes* as a drug delivery system must be proved in order to allow for further human interventions (Schuppler et al. 10).

Conclusion

Infection with *Listeria monocytogenes* can be avoided with the help of the federal government, health care providers, food industries, people at higher risks and the entire population. Federal and state governments must develop regulations and guide food industries on safer methods of producing and handling foods. In addition, health care providers should tell pregnant women and people with weakened immunity about *Listeria monocytogenes* and its dangerous effects. Again, food industries need to communicate recalls of foods at risk for contamination. People at higher risk of infection need to know which foods are the most dangerous for them in order to avoid consumption of such foods. Finally, it is everyone's responsibility to know the risks of food poisoning and avoid infection with *Listeria monocytogenes* bacteria.

Works Cited

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