Listeriosis in India: Prevalence, Risks, & Preventive Measures

Raksha Banka[1], Dr. Joyeta Ghosh[2]

[1]Research Assistant, Medical College & Hospital, Kolkata, India

[2]Assistant Professor, Amity University, Kolkata, India

Abstract: *Listeriosis, caused mainly by Listeria monocytogenes, is a serious food - borne infection affecting vulnerable populations. This review highlights the prevalence of listeriosis in India and discusses its association with various food sources. The diseases underreporting and untreated cases are also addressed. The article aims to promote better understanding of listeriosis in India and proposes preventive measures to mitigate its spread. Data from relevant published articles were used for the review, emphasizing epidemiological studies for source identification, transmission modes, and risk assessment to facilitate effective management of the infection.*

Keywords: India, infection, Listeria monocytogenes, Listeriosis, prevalence, ready - to - eat foods, food safety

1. Introduction

There has been a drastic change in the lives of people as well as in their outlook due to rapid changes in the 21st century. In this era of urbanization and globalisation, people are bound to accept these crucial changes and experience its effects. One of the leading effects is on health safety. Due to various physical, chemical and biological changes such as changes in microbial systems, decrease in the supply of freshwater, degradation of human environment, it has been estimated that there is an increasing trend of infectious diseases. With this relevance, it is expected that there will also be an increase in food - borne diseases, especially in the developing countries. It has been estimated by World Health Organisation that out of almost 57 million deaths occurring worldwide, 25% of them is caused by microbes, whereas this population is even higher in developing countries. A recent case of listeriosis outbreak has been reported from 17 states in Korea, in the month of April, 2020 in which 36 people found infected. Similarly, from 2016 to 2019, cases were found in California, Hawaii and New Jersey, in which many people were found to be seriously affected, and some were hospitalized. These were the cases caused due to food that were contaminated. Among the food - borne pathogens, *Listeria* has been found as the second deadliest pathogen next to Salmonella [1, 2].

Listeriosis is a zoonotic disease caused by the bacteria *Listeria sp.* (named after Joseph Lister) with a high mortality rate in human worldwide. There were ten species of *Listeria* until 1992. By 2019, twenty species have been identified, out of which only three are found to be pathogenic – *Listeria monocytogenes, Listeria grayii and Listeria ivanovii*. Out of these, only *Listeria monocytogenes* is found to be highly pathogenic to humans. It was first reported in 1926 by Murray, Webb and Swann as a causative agent of illness in rabbit and guineapigs in a laboratory breeding unit, due to which, in India, listeriosis was the term that was confined only to veterinary science till 1960s [3]. However, after 1980, several outbreaks of Listeria was found in food items like milk, cheese, ice - creams, meat, etc. It is responsible for almost 1600 illnesses and 260 deaths per year in United States. Today, in India, listeriosis cases among humans have emerged drastically and it is due to the primary fact that *Listeria monocytogenes* can grow on food having low temperature and low pH and high salt concentration. With the increase in mass tourism and unplanned globalisation, the spread of this food - borne pathogen may become more rampant and serious and therefore, more cases in India can be expected. Listerosis is affecting almost 20 – 30% of the population, including severe illness, hospitalization and even deaths. Till now, there have been many listeriosis outbreaks globally. Thus, listeriosis and the most fatal causative agent *Listeria monocytogenes* are being studied worldwide with intense focus. The international bodies like WHO, FAO, Codex Alimentarius, etc. called on a qualitative risk assessment process for RTE processed food to show concern towards public health, which resulted within the Intolerance Policy on L. monocytogenes in RTE (Ready - To - Eat) processed foods. This is due to remarkable increase in listeriosis which is mainly seen from the outbreaks from infectious RTE products since past years, and also because of high danger towards public health that is posed by it. Based on this policy, any *Listeria monocytogenes* that is detected in RTE foods makes it unfit for human and marked as adulterated. Still, in India there is a large population which are understudied, especially when emphasis is on listeriosis. There is very few research work published till now [4, 5, 6].

Objective:
This article aims to explore the prevalence of listeriosis in India, with a specific focus on food - borne transmission. It also emphasizes the significance of understanding the diseases impact on susceptible populations and proposes preventive measures to curtail its spread.

Study Methods:
This review article adopted a systematic approach to select relevant published articles related to listeriosis in India. Epidemiological studies were emphasized for data collection, focusing on the disease's prevalence, sources of infection, modes of transmission, and risk assessment. The gathered information helped in understanding the scope of

listeriosis cases in India and formulating preventive strategies.

2. Review of Literature

Listeriosis: A detailed study:

Listeriosis is a serious infection which is caused by *Listeria* species. It occurs due to intake of foods contaminated by *Listeria monocytogenes*, which has the capability to survive at high salt concentrations, that is 10% of sodium chloride (NaCl), a broad range of pH, that is pH 4.5 to 9, and a temperature of 30 to 37 degree Celsius (may vary from 0 to 45 degree Celsius). *Listeria monocytogenes* is small, gram - positive, facultative anaerobic, intracellular rod - shaped bacteria and non - sporulating in nature. They can be found in water, soil, foods (like vegetables, dairy products, raw meat, processed foods, unpasteurized milk and its products, etc.) and even faeces of animals or humans. The transmission is mainly through food. The symptoms of the disease include fever, diarrhoea, nausea, and muscle aches. In serious conditions, it can lead to loss of balance, confusions, stiffness of neck as well as headache. The incubation period is usually 3 to 70 days (average 21 days) after eating food that is contaminated with *Listeria*. If no appropriate antibiotic treatment is given, it can cause meningitis, septicaemia, encephalitis, abortions, still births, premature delivery during pregnancy and also death. The risk groups include pregnant women are more likely to get the disease than any other groups. Due to the effect of pregnancy, newborns can also suffer. Others include people with weak immune system, AIDS, dialysis, cancer, diabetes patients as well as elderly people [7, 8].
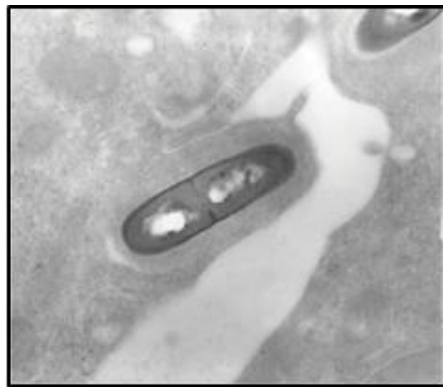

Figure 1: *Listeria monocytogenes*

[Source: Image courtesy of the Centers for Disease Control and Prevention Public Health Image Library, 2020]

Epidemiology of listeriosis:

Listeria monocytogenes is an organism that mainly affects the people with decreased cell - mediated immunity, such as the pregnant women, elderly people, patients having cancer, diabetes mellitus, dialysis patients, etc. The mortality rate is approximately 25% but may be as high as 50% in the neonatal population. Pregnant women constitute nearly 20 - 30% of all cases. There are few reports on the prevalence of *Listeria monocytogenes* in clinical sample in India, mainly due to lack of awareness or proper surveillance systems. The epidemiological data that are available till date is mainly based on the diagnostic criteria [9, 10]. Summarized views of people who are at risk and incidence rate among them are shown in the Table - 1.

Table 1: Prevalence of listeriosis in certain populations at risk:

People at risk	Prevalence rate (per 1, 00, 000 individuals per year)
Normal population	0.7
Neonates	8.6
Aged person (>70 years)	2
Alcoholics	5
Diabetic people	5
Pregnant women	12
Cancer patients	15
Kidney transplant recipients	100
Acute lymphatic leukemia	1000
Chronic lymphatic leukemia	200
AIDS	600
Steroid therapy	20

[**Source:** History and epidemiology of listeriosis, H Hof, FEMS Immunology and Medical Microbiology, 2003]

Table 2: Listeriosis cases through different food items [11, 12, 13]

Years	States	Study group	Percentage (%)	Detail report
2001	Maharashtra- Mumbai	Various	11.3 - 50	11.3% of tomatoes and 50% of coriander leaves.
2002	Maharashtra- Mumbai	Various	2.4 - 6.25	2.4% of buffalo meat samples and 6.25% of buffalo milk samples.
2007	Maharashtra- Nagpur	Farms	53.8	53.8% of farms.
2014	Bareilly	Various	1.3 - 6	6.0% of raw chicken, 4.0% of fish meat, 2.5% of beef, 2.0% of curd.
2014	Bareilly	Milk	5.1	5.1% of milk that were collected from dairy farms.
2015	Tamil Nadu	Milk	4.9	4.9% of milk and its products.
2015	Gujarat	Food	9	9% of retail foods of animal origin.
2017	Rajasthan	Milk	1.1	1.1% of raw milk samples contained *Listeria monocytogenes*.
2017	Kerala	Environmental	0.7 - 3.7	Various samples were surveyed from slaughterhouse.
2017	Jharkhand	Vegetables	3.5	Survey of raw salad vegetables.
2018	Tuticorin coast	Environmental	5.22	5.22% of seafood contact surfaces in a fishing environment.
2019	Punjab	Meat	1.8 - 6.6	Surveyed in mutton and swab samples.
2019	Kerala	Seafood	2.7	Surveyed in seafood.

[**Source:** Listeriosis: Global Status, by Gideon Informatics, Inc., Dr. Stephen Berger, Foodborne Pathogen Dis, 2017]

Many researchers have identified the presence of *Listeria monocytogenes* from different food items such as raw food, tropical seafood, milk, milk - based ready - to - eat foods. Once the bacteria get established, they are difficult to remove from processing facilities. The microbes actually make a layer of extracellular polysaccharide matrix, so as to secure themselves under that layer. When this layer meshed with cells, they are referred to as **"Biofilms"**, which basically provides protection to the microbes by increasing resistance to pressure as well as antimicrobial representatives. Therefore, this layer, when made, prevents the removal of *Listeria monocytogenes* from food - processing plants [14, 15].

So, the reports can summarize that the bacteria *Listeria monocytogenes* has already been established as habitats in the facilities of food processing, and hence they are here to stay. Thus, the need to know about this etiological agent in terms of behaviour, biology and the infection it can spread in the Indian continent is very important [16].

3. Discussion

Data management system and systematic detailing on the prevalence of clinical cases:
The inspection or monitoring systems of the infection in India, unlike developed countries, is quite inefficient due to which many clinical cases remain overlooked. Thus, there is not much data. Yet some data are found on sporadic cases of listeriosis, but they are dispersed at different corners and therefore, not acquired by the administrative bodies or the policy makers. Very less data is found on the growing risk or emerging cases. Thus, the need of a well - organised reporting system is a must that can aim to list every single individual case of occurrence. This system should tempt the reporting of the cases by a clinician, be it private or public to a common depository. By such a system, the increasing incidence can be anticipated well beforehand & prevented [17].

Prevention, diagnosis and treatment of listeriosis:
As observed by different research works, the general recommendations to prevent listeriosis are as follows [18, 19]:
a) Proper cooking of the raw animal foods, such as beef, pork or poultry
b) Proper washing of raw vegetables before cooking
c) To keep raw meat separated from vegetables, cooked foods or ready - to - eat foods
d) Keeping foods below 5 degree Celsius and consuming them as early as possible
e) Avoiding raw or unpasteurized milk and its products
f) Washing hands, knives and other utensils properly
g) Consuming RTE foods as well as perishable foods as soon as possible
h) To keep good hygienic practice such as washing off hands properly before and after food preparation

People who are at high risk for the disease are advised to avoid the following food items [20]:
a) Pre - cooked food, pre - cut fruits or salads
b) Raw seafood, smoked seafood, chilled seafood
c) Processed foods
d) Refrigerated animal food
e) Canned food
f) Soft cheese and soft serve ice - cream

Listeria monocytogenes in foods can be killed by pasteurization and cooking. There are five keys to safer food according to World Health Organisation (WHO) [21]:
a) Keeping clean
b) Separating raw and cooked ones
c) Thorough cooking
d) Keeping food at safe temperatures
e) Using safe water and raw materials.

These keys can help in better preventions of food. Not only common people, but all sectors of food chain should also start Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP). The identification or diagnosis of listeriosis mainly depends on the clinical symptoms as well as gram staining of the organism for its demonstration. Isolation of the species can be done through blood, cerebrospinal fluid (CSF), faeces, vaginal secretions, etc. For treating the infection, antibiotics are the most prevalent way. The most commonly prescribed antibiotic is intravenous ampicillin in combination with gentamicin.6g or more per day of ampicillin is recommended by most experts for treatment. This dosage provides proper intracellular penetration and thus, crosses the placenta in proper amounts. There are some other antibiotics also that are emerging for the treatment of infection [22, 23].

Current research focus and requirements:
As the above facts and epidemiology shows the increasing trends of *Listeria monocytogenes* and listeriosis in India in population as well as in food products, so it is high time for the matter to be conveyed with huge focus and priority. It has been observed that one of the programs in developed countries named Foodborne Diseases Active Surveillance Network (FoodNet) manages the observation for major food - borne infections which are identified in United States. The bacterium that is found accountable for a particular infection or disease is then sub - classified by some molecular techniques. One of such methods is PFGE (Pulse Field Gel Electrophoresis). From this method only, the word "PulseNet" is obtained. Similarly, there have been observed many other programs in the developed nations to monitor such circumstances. It has been estimated that these systems aid a lot in preventing outbreaks and lowering the frequency of the diseases. Because of such systems, it was declared by Centers for Disease Control and Prevention in its reports previously that almost 5 out of 7 infectious diseases were supervised and controlled in United States with a huge decline in the percentage of listeriosis [24, 25].

In India, as observed by different research works, the monitoring system is not so strong, still medical practitioners, researchers, clinicians and other professional workers have started working on it to improve the method. At present, many scholastic and research groups are working on *Listeria monocytogenes [26, 27]*. Some of them have been highlightedas follows:

a) Indian Veterinary Research Institute, Lucknow
b) Assam Agricultural university, Assam

c) Indian Council of Agricultural research (ICAR), Goa
d) Indian Council of Agricultural research (ICAR), New Delhi
e) Dayalbagh Educational Institute, Agra
f) Karnataka Veterinary, Animal and Fisheries Sciences University, Mangalore
g) University of Mysore, Mysore
h) Guwahati University, Guwahati
i) Nagpur Veterinary College, Maharashtra
j) Indian Veterinary Research Institute, Bareilly, Uttar Pradesh
k) ICAR Research Complex for north - east hill region, Shillong, Meghalaya

4. Conclusion

The disease incidence and prevalence in a particular region can be drained with an intense disease surveillance and data management system. Also, the sources of infection and modes of transfer of the infection can be discovered with certainty. Unlike other developed or developing nations, circumstances in India are unusual. The culture and tradition in this country changes at every 100th mile and so does the kind of food. Geographically, though not so varying, dissimilarities do exist in the climatic conditions, environment and territories within the nation. Thus, the occurrence design or pattern will be particular to a province and in the future, that is required to be studied regionally. These matters add on to the confrontation of understanding the regionalized prevalence and actions of not only *Listeria monocytogenes*, but also other food - borne pathogens. The aim, therefore, should be to expand with programs that will authorize and empower identified regional centres, which will look over, detect, monitor and document on the occurrence in food and food altering facilities. A food safety management system should also be applied based on the concepts of Hazard Analysis Critical Control Points (HACCP). Though listeriosis and *Listeria monocytogenes* may not be observed as possible clinical ultimatum in India today, with the increasing trend of intermediate expansion and emerging disease, the predictable risk that it might constitute in the years to come, cannot be neglected.

Conflict of interest
The authors declare no conflicts of interest.

References

[1] Malik S. V. S, Barbuddhe S. B, and Chaudhari S. P, (2002), Listeric infections in humans and animals in Indian subcontinent: a review, Tropical Animal Health and Production.34 (5): 359 - 381

[2] N. D. Shrinithivihahshini and M. Sheelamary, Listeriosis - an emerging food - borne disease in India, 2016, Journal of ecology and environmental science, ISSN: 2347 - 7830

[3] World Health Organization (WHO) (2007 - 2015), Estimates of the Global Burden of Food Borne Diseases; Foodborne Disease Burden Epidemiology Reference Group

[4] Centers for Disease Control and Prevention, February 2016, National enteric disease surveillance: the *Listeria* initiative

[5] Robert L. Buchanan, Leon G. M. Gorris, Melinda M. Hayman, Timothy C. Jackson and Richard C. Whiting, June 2018, A review of *Listeria monocytogenes*: An update on outbreaks, virulence, dose - response, ecology, and risk assessments, Food Control, Volume 88, Pages: 1 - 13

[6] US Centre for Disease Control, 2016

[7] Jennifer C. Hunter, DrPH, Listeriosis (2018), Rare Disease Database, National Organisation for Rare Disorders, CentersFor Disease Control and Prevention

[8] Warriner K &Namvar A.2009, What is the hysteria with Listeria? Trends Food Sci Technol 20: 245 - 254

[9] Kenneth Todar, PhD, 2020, *Listeria monocytogenes*, Todar's online textbook of bacteriology, Page: 1 - 3

[10] *Listeria monocytogenes,* Wikipedia

[11] Valimaa AL, Tilsala TA & Virtanen E, 2015, Rapid detection and identification methods for Listeria monocytogenes in the food chain - A review, Food Control 55: 103 - 114

[12] Prem Saran Tirumalai, August 2013, Listeriosis and *Listeria monocytogenes* in India, Research Gate

[13] Denver Rogalla and Paul A. Bomar, July 2020, *Listeria monocytogenes*, StatPearls Publishing, Treasure Island (FL)

[14] Listeria Fact Sheet, The Department of Health, Australian Government, 2020

[15] Almudena Hernandez - Milan and Antoni Payeras - Cifre, 2019, What is new in Listeriosis, Biomed Research International, NCBI

[16] Thejeswini Mahadevaiah, Pradeep Rangappa, Ipe Jacob, and Karthik Rao, A Rare Case of *Listeria monocytogenes* Meningitis in an Immunocompetent Adult, 2018 Dec; 22 (12): 892–893, https: //doi. org/10.4103/ijccm. IJCCM_173_18

[17] Geethavani Babu, Balamuruganvelu S, Saleel V Maulingkar, R Srikumar, Sreenivasalu Reddy V, Senthamizhan VS, 2017, Incidence Rate and Antibiotic Susceptibility Pattern of Listeria Species in High Risk Groups, https: //doi. org/ 10.7860/NJLM/2017/25461: 2224

[18] Wadhwa Desai R, Smith MA.2017, Pregnancy - related listeriosis, Birth Defects Res.15; 109 (5): 324 - 335

[19] Mylonakis E, Paliou M, Hohmann EL, et al. Listeriosis during pregnancy: a case series and review of 222 cases, Medicine (Baltimore) 2002, 81: 260–269.

[20] H. Hof, History and epidemiology of listeriosis, 2003, FEMS Immunology and Medical Microbiology, 35, 199 - 202

[21] Ali Hassan Ahmed AL - Shamary, Prevalence of *Listeria* in foods, The Iraqi Journal of Veterinary Medicine, Volume 34, Issue 2, 39 - 44, ISSN: 1609 - 5693

[22] Sangeetha MahadevaiahShantha and Shubha Gopal, 2013, Incidence of Listeria species in food and food processing environment: a review, E - ISSN: 2320 - 3528, P - ISSN: 2347 - 2286

[23] Dr. Stephen Berger, Listeriosis: global status, 2020, Gideon informatics, Inc., 70 - 71

[24] Thomas A, Listeria monocytogenes in fresh fruits and vegetables, Doctoral dissertation, Virginia Tech; 2016

[25] Neha Neha and Suresh Sutariya, November 2018, *Listeria* cross contamination levels in raw foods can serve as a predictor of their potential presence as heat - injured cells, Journal Of Dairy Science, Volume 101, Issue 11, 9659 - 9669

[26] Kalorey, D, Warke, S, Kurkure, N, Rawool, D, Barbuddhe, S, Listeria species in bovine raw milk: a large survey of Central India, Food Control, 2008; 19: 109–112.

[27] Braz J Microbiology, 2013, 44 (3): 751 - 8