



A REVIEW ON ZONOTIC SALMONELLOSIS: PREVENTION AND CONTROL THROUGH AYURVEDA

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Abstract: INTRODUCTION: Salmonellosis is a global health problem, affecting approximately 1.3 billion people annually. *Salmonella* is a gram-negative rods genus belonging to the Enterobacteriaceae family. Human salmonellosis represents 60-80 % of all reported cases of foodborne diseases. The term salmonellosis covers a complex group of foodborne infections affecting both man and animals. **METHODS:** The literature search was done from the databases like PubMed, and MEDLINE. Review of peer reviewed original research articles were done. Articles were screened by reading titles and abstracts and were initially excluded if they did not refer to zoonotic salmonellosis. **RESULT AND DISCUSSION:** . Ayurveda has an ability to cure the disease that damage our immunity and cause serious disease. The purification methods mentioned in ayurveda for water, air, and soil, following ahara upayoga vyavastha, Dhoopana, etc could curb the menace of zoonotic salmonellosis. **CONCLUSION:** Since the health sector alone cannot solve the problem of salmonellosis, responsibility for prevention and control measures may fall to agriculture, vetinary, and other ministries, outside the health sector too.

Key words - Zoonotic salmonellosis, prevention, Ayurveda, Vyadhikshamatwa.

INTRODUCTION

The term "salmonellosis" covers a complex group of foodborne infections affecting both man and animals. The disease causes illness and even death in humans, as well as economic losses in the animal and food industries. The term "food poisoning" is also commonly applied to salmonellosis.

Salmonellosis is a global problem. Human salmonellosis represents 60 to 80 per cent of all reported cases of foodborne diseases¹. While the incidence of typhoid fever has declined, the incidence of other *Salmonella* infections has increased in the developed countries. The problem is aggravated by the widespread use of animal feeds containing antimicrobial drugs that favor drug-resistant salmonellae and their potential transmission to humans. The disease can occur sporadically or in small outbreaks in the general population and usually from food contaminated at its source. The extent of the problem is not clear in developing countries where diarrhoeal diseases are widespread.

METHODS

The literature search was done from the databases like PubMed, and MEDLINE and classical texts like Charaka Samhita, Sushruta Samhita and Astangahridaya. Review of peer reviewed original research articles were done. Articles were selected using the search terms "Non typhoidal salmonellosis", "salmonella preventive measures" and "prevention through ayurveda. Articles were screened by reading titles and abstracts and were initially excluded if they did not refer to zoonotic salmonellosis.

Origin

Salmon and Smith reported the isolation of "hog cholera bacillus," later named *S. Cholerae-suis*, from pig intestine in 1885. Three years later, Gaertner reported the first foodborne outbreak of nontyphoidal salmonellosis, in which 58 persons fell ill after eating raw meat ; "Gaertner's bacillus," later named *S. Enteritidis*, was isolated from the meat, and from the spleen of a man who died in the outbreak.²

Epidemiological determinants

Agent factors

AGENT: Salmonellae comprise a large and important group of bacteria. This group is now known to comprise more than 2,500 serotypes capable of infecting humans , but in most countries only a small number of them (usually about 10) are endemic at any one time.

Compared with other gram-negative rods, salmonellae are relatively resistant to various environmental factors. They have been shown to be resistant to drying, salting, smoking and freezing even for years. This explains why these organisms survive in many kinds of food. As a result, salmonellae have been isolated from divergent foods such as chocolates, biscuits, coconuts and spices. The bacterium is sensitive to heat and will not survive temperatures above 70 deg C.

From an epidemiological point of view, salmonellae can be classified into three main groups.

- (i) Those which infect only man e.g., *S. typhi*. Para typhi A and C.
- (ii) Those that are host-adapted for particular species of animals, e.g., *S. cholera-suis* in swine, *S. Dublin* in cattle, *S. abortus equi* in horses, *S. gallinarum* in poultry, etc. Some of these are also pathogenic for man, e.g., *S. cholera-suis*, *S. dublin*.
- (iii) Those with no particular host preference and can infect both man and animals e.g., *S. typhimurium*, *S. enteritidis*. In this group (approximately 2,200 serovars) are the principal agents of salmonellosis that occurs today. They can be transmitted from animals to man and vice versa. *S. typhimurium* is responsible for upto 50 per cent or more of all human salmonella infections all over the world. *S. enteritidis* has also emerged as an important pathogen.

Reservoir and sources of infection:

The main reservoir of *Salmonella* is the intestinal tract of man and animals. The source of the infecting agent could be contaminated food, animals, man or the environment.

(a) Foods

Foods of animal origin, particularly commercially prepared foods such as meat, poultry and egg products are considered to be the primary sources of salmonellosis. Most of these foods, e.g., meat and poultry become contaminated during slaughter. Every food that is produced or processed (including chocolates; spices, coconut) in a contaminated environment may become contaminated. Cross- contamination of cooked foods from raw ingredients, kitchen utensils or surfaces has been described frequently as a cause of salmonellosis. Eggs may be infected directly through shell-cracks. Recent investigations suggest that salmonellae may penetrate the ovaries of egg-laying chickens. What food will ultimately become the vehicle varies from country to country . For example, in the USA, beef is the main source of salmonella infection, while in England and Wales poultry accounts for more than 50 per cent of Salmonellosis outbreaks.

(b) Animals

Animals are the hosts and the principal vectors of the zoonotic salmonellosis. Many animals including cattle swine, rodents and fowl are naturally infected with a variety of salmonella and have the bacilli in their tissues (meat), eggs or excreta. Carriers occur among both man and animals.

(c) Environment

Salmonellae are widely distributed in the environment - in dust, water, manure, sewage, sludge, vegetables, insects, birds, fish, rodents and other mammals. They can survive in soil for months . They may even multiply in the warm environment provided by the high ambient temperatures of many countries. Man may be infected from these sources.

Mode of transmission

By ingestion of contaminated food or drink. In addition, man can contract infection following direct contact with domestic animals especially such as dogs, pigeons, rats, mice and insects. Once man is infected, he becomes a source (case or carrier) and the infection may spread to others by the fecal-oral route.

Transmission is facilitated by food handling methods, local customs, cooking and food habits, food processing, storage and distribution methods, and prevailing sanitary conditions.

Incubation period: 6 to 72 hours (usually).

Pathogenesis

After ingesting non-typhoid *Salmonella*, the bacteria colonize the mucosa of the colon, ileum, and caecum (occasionally, bacilli enter through the pharyngeal mucosa), attach to the intestinal villi's epithelial cells, induce their own intake into the cells through the process of endocytosis, pass through the cells (transcytosis), and within 24 hours, they are found in the lamina propria and submucosa, where they are quickly phagocytosed by polymorphs and macrophages. If the host's immune system is compromised, the bacteria spreads and multiplies within phagocytic cells mostly macrophages with the help of phagosomes⁶.

The organism's production of enterotoxins and cytotoxins probably contributes to gut injury and the induction of an inflammatory response. The intestinal mucosa subsequently releases prostaglandin, which triggers the activation of adenylate cyclase. The production of cytotoxic and enterotoxins in the body probably contributes to intestinal damage and the induction of an inflammatory response, after which prostaglandins are released from the intestinal mucosa, which activate adenyl cyclase, and the resulting increase in cyclic adenosine monophosphate (CAMP) induces water. excretion bicarbonate and chloride, which can cause significant fluid retention in the intestinal lumen and diarrhea, can also cause ulceration and mucosal destruction. Feces may contain blood, mucus, and neutrophils, but intestinal infections can cause bacteremia or septicemia, which can be fatal, or the infection can remain in internal organs.

Clinical features

The disease arises from the ingestion of the living organisms. Recent studies indicate that *Salmonella* spp. possess both invasive and cholera like enterotoxic properties. Clinically, the disease may manifest by one of the three symptoms

(i) *Salmonella* enterocolitis (gastroenteritis): This is the most common manifestation of *Salmonella* infection. 6 to 48 hours after ingestion of *Salmonellae* there is nausea, headache, vomiting and diarrhoea. Low grade fever is common. Most infections are mild with diarrhoea as the only symptom. In severe cases there may be dehydration requiring replacement of fluids and electrolytes. The episode usually resolves in 2 to 3 days, but the stools often remain loose for several weeks. The excretion of salmonella may be prolonged by antimicrobial therapy. Blood cultures are usually negative but stool cultures are positive for salmonella and may remain positive for several weeks after clinical recovery. Death is rare and occurs primarily in neonates, infants and elderly.

(ii) Septicemia with focal lesions: Non-typhoid salmonellae (e.g., *S. cholera-suis*) may occasionally invade the blood stream leading to generalized or localized infection presenting itself as pyrexia of unknown origin. Focal infection may result in osteomyelitis, pyelonephritis, arthritis, meningitis, cholecystitis and endocarditis. Stool cultures are negative but blood cultures are positive.

Prevention and control

Since salmonellosis is zoonotic in origin, preventive measures should begin at the farm and embrace all the elements of the food chain through live animals, animal products, processing, final food preparation to consumption. Approaches indicated at the farm level are: (i) disease control, e.g., immunization of farm animals against salmonellosis. (ii) the use of hygienic animal feed, and (iii) ensuring a sanitary environment for the animals. The aim is to raise "salmonella-free" animals.

The other approaches include: hygienic slaughtering and milking, pasteurization of milk and eggs; proper disposal of liquid and solid wastes, cold storage facilities, and health education and training.¹

RESULTS

This review shows the prevalence of zoonosis, their pathogens and also represent the role of Ayurveda in the preventive aspect which has a magical way to deal with such infections.

DISCUSSION

Ayurveda, an ancient system of medicine focuses on holistic health and prevention. In prevention of zoonotic salmonellosis ayurvedic principle can be applied at different levels. Ayurveda has an ability to enhance the immunity of an individual against diseases of various causes. In last few decades zoonosis has caused a severe loss of human lives. But now in recent age much of the disease are under control. Even though the disease is under control always there is a chance of re-emergence. Prevention and control through ayurveda could be adopted here, focusing on two main strategies.

1) Enhancing the *vyadhikshamatwa* of a person against any impending disease. 2) Ensuring a sanitary environment from farm to plate.

1) Enhancing the *vyadhikshamatwa* of a person against any impending disease

Vyadhikshamatwa comprises of two factors.

(a) व्याधिबलविरोधित्वम्: Capacity to prevent spread of diseases in the body and capacity of body for blocking the diseases in its primary stage

(b) व्याधिरुत्पादक प्रतिबन्धकत्वम्: Resistance to the formation of diseases and resistance to causative factors of diseases.

नहि सर्वाण्यपथ्यानि न च सर्वे दोषास्तुल्या बला ।

न च सर्वाणि शरीराणि व्याधिक्षमत्वे समर्थानि भवन्ति ॥

According to *Acharya charaka* due to some conditions or due to certain factors even unwholesome food does not cause disease immediately. All unwholesome food articles are not equally harmful; All doshas are not equally powerful and all individuals are not capable to resist the diseases. So here it explains the importance of immunity.³

2) Ensuring a sanitary environment from farm to plate

Janapadodwamsakara bhavas like *Vayu, Jala, and Desha* plays an important role here. The health of an individual's residing place is always influenced by the environmental changes. Widespread manifestation of diseases occurs due to lack of environmental hygiene⁴. The purification methods mentioned in ayurveda for water, air, and soil are useful in domestic level especially in rural area still have scientific basis, and these can be propagated through mass media to reach even in urban area.

Ayurveda describes some principles of food intake which have key elements for prevention of infectious diseases. According to *acharya Vagbhata* in *Ahara upayoga vyavastha* few principles are mentioned like, one should not consume food without taking bath, food should have prepared at good place, food should be cooked properly, without being contaminated by flies and hair etc, and do not take in the open ground and that which is not covered⁵. The source of infecting agent could be contaminated food, fluids, animals, man or environment. So, following the rules of *upayoga vyavastha* would be beneficial to curb the menace of zoonotic salmonellosis.

The context of *krimi chikitsa* also could be adopted here. In this context, *Nidana Parivarjana* refers to the removal of the causal elements that cause microorganisms to proliferate, germinate, and flourish. Therefore, it is best to avoid the causative factor that cause disease to be produced. As a result, *Nidana Parivarjana* is the primary principle for all ailments, *Prakriti Vighata* is drug that stop growth of pathogens by creating unpleasant medium for pathogens, *Apakarshana* approach that remove pathogen from body through purification⁶.

Dhupana karma /fumigation is an important modality and primitive method of sterilization. It has been found in research studies to have antimicrobial activity. It was used for the purpose of elimination of any remnant infections from the site as well as to prevent the subsequent contamination. The dropping of birds from the skies to the earth below in a tired condition is a distinct indication of the wind and the smoke (of the atmosphere) being charged with poison. It is further attended with an attack of cough, head ache, and of severe eye diseases among persons in-haling the same wind and smoke. In such cases the (poisoned) atmosphere should be purified by burning quantities of *Lākṣā, Haridrā, Ativiṣā, Abhayā, Abda (Musta), Hareṇuka, Elā, Dala (Teja-Patra), Valka (cinnamon), Kuṣṭha* and *Priyangu* in the open ground. The fumes of these drugs would purify the *Anila* (air) and the *Dhuma* (smoke) from the poison they had been charged with⁷. Though there is no mention of virus or bacterial infections, these measures are practical and significant even today and gives us an insight that role of microorganisms and knowledge of epidemics were known to ayurveda. Even in modern era Yajnas are done for the well-being of the mass population as it results in mass disinfection.

CONCLUSION

Better human health is the aim of ayurvedic medicine. Observing the contagious organisms, Ayurveda has distinct methods for managing and controlling them. Ayurveda holds that the most distinctive defence mechanism known to humans is called *Vyadhkshamatwa*. Therefore, employing modalities that improve *Vyadhkshamatwa* would surely help in the fight against zoonotic diseases. All the cases of non typhoidal salmonellosis infection should be reported to local public health department, since tracking and monitoring of these cases can identify the sources of infection and help authorities anticipate large outbreaks. Since the health sector alone cannot solve the problem of salmonellosis, responsibility for prevention and control measures may fall to agriculture, veterenary, and other ministries, outside the health sector too. WHO is working towards the strengthening of food safety systems in an increasingly globalized world. Setting international food safety standards, enhancing disease surveillance, educating consumers and training food handlers in safe food handling are amongst the most critical interventions in the prevention of zoonotic salmonellosis.

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