

Prevention and control of Typhoid fever

S7-5

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Abstrak

Demam tifoid (DT) masih merupakan masalah kesehatan yang penting di sebagian besar negara-negara berkembang, walaupun sulit untuk menentukan insidens yang tepat, di Indonesia insidens demam tifoid sekitar 300-810 kasus per 100.000 populasi pertahun, yang berarti jumlah kasus pertahun adalah 600.000-1.500.000 kasus dan kematian penderita diperkirakan 50.000 pertahun. Demam tifoid adalah suatu infeksi sistemik dengan karakteristik: adanya demam yang berkelanjutan, terkenanya jaringan limfoid, terutama plak Peyer, pembesaran limpa, adanya bintik merah di daerah dada dan konstipasi yang lebih sering daripada diare. Transmisi demam tifoid terjadi secara kontak langsung maupun tidak langsung dengan pasien ataupun karier. Air dan makanan merupakan media utama penyebaran penyakit ini. Buah-buahan dan sayuran mentah merupakan faktor penyebaran yang penting di beberapa bagian dunia; susu, produk susu, dan kerang penting di tempat lainnya. Transmisi kepada pejamu yang baru terjadi secara langsung ataupun tidak langsung melalui makanan, minuman yang terkontaminasi, juga jari-jari tangan yang terkontaminasi, debu dan lalat. Semua golongan umur dan seks dapat terkena infeksi, namun, laki-laki lebih sering terkena infeksi ini daripada perempuan. Pencegahan DT berdasarkan faktor-faktor epidemiologi termasuk: pendekatan agen, strategi lingkungan dan pendekatan pejamu. Strategi pencegahan DT adalah sbb: surveilans penyakit, vaksinasi individu yang mempunyai resiko, deteksi dan pengobatan kasus (akut dan konvalesen) dan deteksi dan kontrol karier kronis, perbaikan sanitasi, perlindungan binatang ternak, peningkatan kebersihan makanan, dan pencegahan kontaminasi di dalam industri makanan. Pendidikan kesehatan komunitas mempunyai peranan penting dalam pencegahan DT, terutama kebersihan perorangan, seperti mencuci tangan sebelum makan atau sebelum menyiapkan makanan di tempat-tempat umum atau restoran, dan vaksinasi.

Abstract

Typhoid fever (TF) is still an important public health problem in many developing countries of the world, although it is difficult to estimate the exact incidence. In Indonesia, the incidence of TF is estimated about 300-810 cases per 100,000 population per year, which mean that the number of cases are 600,000 to 1,500,000 per year, and the case fatality of TF is estimated 50,000 per year. Typhoid fever is a systemic infection characterized by continued fever, involvement of lymphoid tissues, especially of Peyer's patches, enlargement of spleen, presence of rose spot on trunk, and constipation more commonly than diarrhea. Mode of transmission of TF is through direct and indirect contact with patients or carrier. Principal vehicles of spread are contaminated water and food. Raw fruits and vegetables are important factors in some parts of the world; milk, milk products and shellfish in others. Transmission to new host occurs directly or indirectly through contaminated food, fluids, fingers, fomites and flies. All ages and both sexes are equally susceptible to infection, however, males are more frequently infected than females. Prevention of TF based of epidemiologic factors influenced, ie. agent approach, environment strategies and host approach. Strategies of prevention and control of TF are: disease surveillance, vaccination of persons at risk, detection and treatment of cases (acute and the convalescent) and detection and control of chronic carriers, improvement of sanitation, protection of animal stocks, promotion of food hygiene and prevention of contamination in food production. Health education in community plays an important role in prevention of TF, particularly about personal hygiene, such as washing hands before meal or doing something, to serve of places for washing hands with clean water in public service and restaurant, and vaccination of typhoid fever.

INTRODUCTION

Communicable diseases like Typhoid Fever (TF) occur as a result of the interaction of the infectious agent, the transmission process and the host. The prevention of such disease may involve changing one or more of these components, all of which are influenced by the environment. This disease can have a

wide range effects, varying from inapparent infection to severe illness and death. A large number of micro-organisms cause disease in humans. Infection is the entry and development or multiplication of an infectious agent in the host. The end result of infection is determined by a large number of factors involving all stages in the chain of infection, ie. pathogenicity, virulence and infective dose. The environment plays a critical role in the development of infectious diseases. General sanitation, temperature, air pollution and water quality are among the factors that influence all stages in the chain of infection. In addition socio-economic factors, such as population density, over-

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crowding and poverty are of a great importance¹.

Based on the Leavell and Clark criteria, prevention of disease consisted of five levels prevention ie: health promotion, specific protection, early diagnosis and prompt treatment, disability limitation and rehabilitation. However, in the application in community, prevention of infectious diseases can be identified in four levels of prevention, ie: primordial, primary, secondary and tertiary prevention. The aim of primordial prevention is to avoid the emergence and establishment of the social, economic and cultural patterns of living that are known to contribute to an elevated risk of disease. The purpose of primary prevention is to limit the incidence of disease by controlling causes and risk factors. Secondary prevention aims to cure patients and reduce the more serious consequences of disease through early diagnosis and treatment, and tertiary prevention is aimed at reducing the progress or complication of established disease and aspect of therapeutic and rehabilitation medicine, it can mean a great improvement in individual well being and family income^{1,2}.

Typhoid fever is an acute infectious fever caused by *Salmonella typhi* and characterized clinically in typical cases by long continued pyrexia, headache, relative bradycardia, moderate enlargement of the spleen, abdominal tenderness, discomfort and rose colour eruption. However, typhoid fever often present atypical picture which hinder its diagnosis and thus makes it more difficult to treat^{1,2}.

Salmonella typhi enters to the human body via the gastrointestinal tract through the mouth. The bacilli invade and multiply in the lymphatic tissue of the small intestine and in the neighbouring lymphatic nodes. They enter to the blood stream via the lymphatic vessels. They tend to localize in the spleen and in the bone marrow. Gall bladder is always infected. During illness, the bacilli are discharged, from the body, to the stool and urine³⁻⁵.

The incubation period varies with an average of two weeks, and the usual range is 1 to 3 weeks, although many cases have been reported well outside this range. There is some evidence that when the disease is water-borne, the incubation period is longer, probably due to the small probably number of organisms likely to be present. Shorter period of four to five days only is also not uncommon. The onset of TF is normally insidious, with malaise as a vague aches & pains, anorexia but typical presenting symptoms.

Chills is another indefinite but characteristic symptom, but rigors is not common. The patients usually have headache, nagging and persistent rather than severe, but sometimes intense enough to suggest meningitis. Generalized aches in the muscles and joints is common, but usually amount to discomfort rather than severe pain. Abdominal pain is uncommon, although usually there is some discomfort, but occasionally a patient has quite sharp abdominal pain, and appendectomy has been performed on such patient. Diarrhoea is not common, though in minority of patients it may be severe. Constipation is much more common as this stage of the disease, and it should be emphasized that TF is characteristically not one of the diarrhoeal diseases. Symptoms and signs are vary according to severity of disease, longevity of illness and adequacy of therapy^{4,5}.

A high incidence is generally encountered in developing countries, and is usually related to standard of living and personal and environmental hygiene which is usually low. In developed countries, especially in cities with modern living norms, typhoid fever is nearly non-existent. This is usually considered due to adequate sources of safe drinking water, waste disposal, pasteurized milk and improved methods of detection and control of spread.

The case fatalities of TF could be caused by complications, such as septic syndrome, severe intestinal haemorrhage, intestinal perforation or secondary infections. Severe haemorrhage is usually indicated by a rapid increase of pulse rate, a fall in temperature and collapse, with air hunger. Perforation may occur over the same period. It is the most serious complication, which was frequently fatal until the introduction of antibiotic treatment. Perforation may occur in a case which appears to be doing well, with the clinical presentation include guarding of the abdominal wall, and vomiting, and loss of board sound due to paralytic ileus. In the severely toxæmic individual, the signs of perforation may develop more slowly, taking a day or two and are often masked by the patient's dullness and apathy, and may easily be missed unless the patient is under constant observation. With a small perforation there is usually evidence of increasing distress, some abdominal pain and guarding with tenderness on right side, over the terminal ileum. There is usually a rise in pulse rate and fall of temperature. Sign of free fluid may be detected and there may be reduction in liver dullness. Gross perforation produces rapid and profound collapse. In developing countries, the case fatality rate of intestinal perfora-

tion and haemorrhage is still high and varies (range 20 to 80%). This variability, depends on many factors such as delay in management, inadequate therapy, malnutrition or other accompanying diseases. Soeharyo's study in Semarang (1990) shows that factors which have great influence to the development of intestinal haemorrhage and perforation are low serum albumin (less than 2.5gr%), inadequate therapy and severity of illness^{6,7}.

INFECTIOUS AGENT

The causative organism is *Salmonella typhi*. This organism is non sporing, aerobic and motile Gram-negative, and usually produce acid and gas from dextrose but not from lactose. It is easily cultured in artificial media. It can be separated into several types by using bacteriophages, and this is of value in epidemiological investigation^{1,8}. Outside the human body, *Salmonella typhi* is easily destroyed. It is readily killed by sunlight and by disinfectant when it comes directly in contact with it, but survives freezing. The thermal death point in moist media such as water or milk is 60°C or 140°F. In boiling water, *S. typhi* died within 15 minutes. In dry condition, most of the organisms die in a few hours, but, very rarely, a few may survive for about a month. When embedded in faecal masses, the organisms are protected and may survive unless the faeces is carefully broken up to allow penetration of the disinfectant. Their viability in faeces, otherwise, depends on a considerable extent of the temperature, the composition of the faeces and the nature of the presence of other organisms. *Salmonella typhi* seldom survives in water for more than seven days and it is often killed within forty-eight hours if the acidity becomes high. It survives in butter for four months and in ice-cream for over a month. Under normal conditions, as a rule, it does not survive long in the soil. It has been shown that *S. typhi* persists in a crude sewage for twelve days and in a septic tank for fourteen days³⁻⁵.

EPIDEMIOLOGY

Exact incidence of typhoid fever is difficult to estimate, because the clinical picture may be confused with many other febrile infections and laboratory confirmation is not conducted in all areas. The annual global incidence of TF is estimated to be about 16 million cases. In Indonesia, the incidence of TF is estimated about 300 - 810 cases per 100,000 population per year, which means that the number of cases are from 600,000 to 1,500,000 per year⁸⁻¹¹.

Typhoid fever, which has a worldwide distribution, is still an important public health problem in many developing countries. It is widely prevalent in the tropic and subtropic areas, especially in underdeveloped countries. The incidence of this disease is tremendous and cannot be estimated easily. In fact, due to the notification of this disease to WHO is not compulsory, there is no precise epidemiological data of the countries most affected^{8,12,13}.

Human is the only reservoir of *S typhi* and the only source of infection is usually infected human excrement harbouring the organism. Every person who becomes infected with enteric organisms will excrete them at some time or other. Where no clinical signs and symptoms develop, the individual is classified as "symptomless excretor". Infected person may be as case or carrier. Potential sources of infection are active patients, the convalescent stage patients and chronic carriers. It is assumed that chronic carriers are dangerous source of infection due to prolonged or even life-long spread through the stool or urinary route^{13,14}.

Transmission to a new host occurs directly or indirectly through contaminated food, fluid, fingers, fomites and flies. In 90% of the cases, infection is indirectly by ingestion of water or food soiled with excrement from infected subjects. *Salmonella typhi* discharged in faeces and urine is disseminated into water, milk, or other foodstuffs. Infection follows ingestion of contaminated material. Such a contamination may occur by any one of the following agents^{3,13}.

Carriers

A proportion of infected persons who become carriers after clinical typhoid is unaffected by modern successful treatment of acute attack. However, in developing countries, treatment of carriers cases are still problem. Carriers are very important as a source of infection. Typhoid bacilli persist indefinitely in the bile passages and in the intestines of about three percents of patients who recover from the disease. Many typhoid patients will have negative stool culture after four months; persistence beyond that period usually indicates carrier. Faecal carriers are the commonest. The condition is most often seen in middle-aged persons and is more common in women than in men; it is rare in children. The carrier rate proportion to the population in a given geographical area depends on the hygienic situation. Increasing incidence which is in line with advancing age suggests that the

greater frequency of biliary tract disease in older females favour to development of carrier state. Removal of the gall bladder will eliminate carrier state in a significant number of cases. Urinary carriers are uncommon, bacilli are excreted intermittently in the typhoid case for the first 2 months. If excretion continues, some abnormality of the genito-urinary tract, such as chronic pyelonephritis or schistosomal vesical or ureteric lesion, may be present and should be dealt with. There are three types of carriers: (a) acute or convalescent carriers, (b) chronic carriers, and (c) contact or apparently healthy carriers^{3,5,13}.

Water supply

Outbreak of typhoid fever is often water-borne, although the organism is usually present in small number, except in a gross infection. Outbreaks will develop where pollution with infected faeces is heavy and persistent. The drinking water in cities may be contaminated by sewage, and in rural areas may be polluted by washing of infected clothes and linens in tanks and rivers. This is the usual cause of vast epidemics of typhoid. Contamination of the water may occur due to cross connection between a main and polluted water supply, infiltration of surface water or sewage into the aqueducts, contamination of wells by stools, or inadequate water purification systems. Besides contaminated water supply, another vehicle for the spread of *S. typhi* is shellfish, particularly oysters. Water may also be indirectly involved as a medium of transmission of *S. typhi* to another person as a result of eating uncooked contaminated edible water plants^{3,13}.

Milk and ice

Many outbreaks result from ingestion of milk and cream products. Milk could be infected as a result of using contaminated water while washing milk container. In milkborne outbreak of typhoid fever, the organism may gain access directly to the milk via contaminated hands of milker who are often as a chronic typhoid carrier. Ice made from infected water or handled by an infected person could also transmit the disease. Although the organisms can survive in freezing temperatures, but a proportion of them die during the process and the subsequent storage^{13,14}.

Food

Food can be contaminated in a number of ways. Contamination could occur if food is handled by infected person or exposed to flies or dust. The danger

of dust probably is not as great as that of flies since the organism can not survive too long in a dry condition. Vegetables can be contaminated by fresh human stool used as manure. In areas where sanitary condition is below the standard and where house-flies are plentiful, these can be a real danger. Flies which alight on infected stools and feed them will carry the organisms in their body and in their stools and vomit. If, then, they fly and alight on the food, they will drop the organisms. Flies play as active agents in the transmission of the disease by alternatively alighting and feeding on infected stools and foods; flies carrying the bacilli on the feet and proboscis. Cold and tinned meats may be similarly infected. Tinned meat in itself is extremely safe unless infection is introduced by dirty fluid used for cooling the occasional faulty tin during processing^{3,6}.

There is no clear difference in male-female incidence. Some authors contend that male prevalence is higher, as consequence of the more frequent chances of infection or contacts. All ages are susceptible to infection. However, TF is less severe and less commonly recognized in children under five years of age. Attack rate is the highest in adolescents and in young adults. Suharyo's study in Semarang shows that the mean of age of the cases is 23.1 years, 80% the cases are under 30 years old^{6,8}.

Behaviour conditions of the cases which are considered as high risk factors are the following: did not wash the hands before cooking, eating ice two weeks before getting ill, buying ice from street vendor, having a kitchen with the floor made of soil and overcrowded population density^{6,14,15}.

Incidence of TF frequently correlates to seasonal variation, especially in the area where typhoid fever is endemic. Increase incidence of typhoid fever is usually observed during a prolonged dry season or in the rainy season. This observation is attributed to the population of flies which plays as vector of spread^{6,8}.

PREVENTION AND CONTROL OF TYPHOID FEVER

Five level prevention by Leavel and Clark can be applied to typhoid fever prevention, particularly on primary prevention. Primary prevention can be implemented by a health promotion and specific protection. Promotion of health in the positive sense through nutrition, personal hygiene, suitable working environment, and healthy living habits has a definite

relationship to prevention of TF. Activation of specific protection can be done by a specific immunization, good personal hygiene, proper handling of vehicle of transmission (food, water etc), concurrent and terminal disinfection, satisfactory vector control and improvement of other environmental sanitation^{1,2,16}.

The development of effective therapeutic agent that has contributed significantly to preventing further progress of TF is the secondary prevention. When primary preventive measure are unavailable, the use of chemotherapy can minimize the infectious process, prevent disability, shorten the infectious period, and may prevent death.

Disability limitation and rehabilitation are the tertiary prevention. Activation of this prevention is complete therapy, hospitalization when indicated, hospitalization and work therapy in hospital and public education to utilize the rehabilitated^{1,2}.

The infection should be controlled by applying the principle of hygiene and public health. Therefore, the control and ultimate elimination of typhoid fever from a community depend on the improvement in economic and cultural level and on the achievement of personal and public hygiene standard. It will stop the dissemination of faecal matter from one person to another. In general, especially for the developing countries, the prevention of TF includes these strategies, ie. disease surveillance, treatment and control of sources of infection, detection and control of carriers, improvement of sanitation, promotion of food hygiene, prevention of contamination in food production and vaccination for healthy persons^{3,17,18}.

Disease surveillance

The main problem of the TF control in developing countries where the disease is usually endemic is the insufficiency of epidemiologic data. In most countries, case reporting is based on clinical diagnosis which may be supported by unreliable serologic test. Frequently, TF grouped with condition like fever of unknown origin, flu like syndrome etc. Improved surveillance is therefore needed to describe area specific epidemiologic characters of the diseases^{3,9,12,13}.

Treatment and control of sources of infection

As soon as the disease process is detectable, early prevention of pathogenesis so called secondary pre-

vention, may be accomplished by prompt and adequate treatment. Objective of early diagnosis and prompt treatment are (a) to prevent spread to others (b) to cure or arrest the disease process in order to prevent complication and (c) to prevent prolonged disability. All cases and suspected cases should be referred to the hospital and get good nursing care and barrier nursing. Disposals of the patient's urine and stools, have to be taken with care. The diet should be mild and nutritious and the fluid and electrolyte are in balance. Antibiotic treatment may have to be given before a definite diagnosis is available. In other word, it based only on suspicion especially when the patient is ill. The antityphoid drug of choice is still chloramphenicol. Other alternative drugs are thiamphenicol, trimethoprim with sulphametoxazole, ampicillin, amoxicillin, third generation of cephalosporines (ceftriaxone) and quinolon/fluoroquinolone (ciprofloxacin, pefloxacin, fleroxacin, norfloxacin, etc). Transmission of the disease is still large through undetected carriers and uncontrolled routes. Important activities that have to be done are disinfection of excreta by using live steam or by mixing the excreta with 1:1,000 bichloride of mercury solution; for patient's linen, clothing and utensil by autoclaving, boiling, or soaking in antiseptic solution; taking care of the parts of the attendants by suggesting them to wash their hands using soap, water, and disinfectant and also to sterilize their clothing^{7,8,13,14}.

Detection and control of carriers

Human carrier is the important source for TF. However, detection and control of Salmonella carriers are neither practical nor effective as a control measure, especially for developing countries. Carriers are detected through blood examination for Vi agglutination followed by repeated stools and urine examination. The convalescent carrier is easier to treat than the chronic carrier. Chronic carrier must be treated with the prolonged course of treatment. Ampicillin has been used successfully in treating chronic carrier. The dosage is 500 mg every six-hours for at least 14 days. A course of treatment for as long as six weeks is necessary especially for carriers without evidence of gallstones and gallbladder disease seen on cholecystogram. If gallstones or a nonfunctioning gallbladder are shown on the cholecystogram, antimicrobial treatment is unlikely to be effective to terminate the carrier state. These patients should have cholecystectomy which will cure the chronic state in about 85 percent of patients. Ampicillin should be administered in conjunction with cholecystectomy. Urinary carriers should be treated in the same way as

chronic stool carrier, if *Schistosoma haematobium* is present, this must also be treated^{7,9,18}.

Improvement of sanitation

In countries where TF is endemic, a usual source of infection is the water supply which is contaminated with faecal material from human. Incidence of the problem can be dramatically reduce by provision of safe water, protection of water sources from contamination, promotion for the use of latrines, a good management of waste and sewage disposal in the community. Efforts on environmental health must be made to trace the source of infection and to investigate possible routes of transmission. If epidemiological evidence indicates suspicion on a water supply, it has to be dealt with directly without waiting for laboratory confirmation. In many places, vegetables are manured with fresh human stool, and the usual methods of preparing raw salads for table will not rid of being infected. Chemical control using residual spraying insecticide plays an important role in reducing the house-flies population density. Other activity which could be done to prevent the places that enable reproduction of house-flies is to avoid of having open garbage pail or garbage dump^{3,8,13}.

Promotion of food hygiene

Contaminated food is the main sources of TF. Therefore, people should be educated on food hygiene practices through all channels. The golden rules for safe food preparation recommended by WHO should be promoted. Street food vendors which have become increasingly popular in communities are largely non-hygienic and are often implicated as sources of infection in food borne disease outbreaks. The vendors should be educated on proper food handling, and their hygienic practices should be regularly monitored. The WHO golden rules for safe food preparation are: choose foods processed for safety, cook thoroughly, eat cooked food immediately, store cooked food carefully, reheat cooked food thoroughly, avoid contact between raw foods and cooked foods, wash hands repeatedly, keep all kitchen surfaces meticulously clean, protect foods from insects, rodents and other animals, and use pure water^{9,18}.

Supervision on food products and restaurants

Supervision on sanitation of places of work, food processing, cleanliness of the equipment used in food processing, foodstuff selection and preservation should be done, so that, the good conditions of them are always kept. It is mandatory to always wash hands

before cooking or serving the food. Prohibition to employ people who have ever been infected by *S. typhi* and routine examination of stool culture of employee are important. If food is suspected as a medium of transmission, it should be traced back to get the source. Inquires should be instituted, regarding to the recent illness or anything which is associated with, among persons involved in handling that food. All milk and milk products should be pasteurized or boiled^{12,13}.

Health education on healthy person

One of the most important areas of control of TF is education, not only for new cases, but also ongoing, continuing education for all community. Changing human behaviour by education can be a very effective way to reduce of infection of *Salmonella typhi*. Many efforts could be done for healthy people, such as : (a) Supervision on the hygiene of food and drink, for example, boiling the water and cooking the food for a long time until *S. typhi* is killed. (b) Serving the food in hot condition, especially in the public places with the condition that usually is unhealthy (c) Health education for healthy person in community, particularly about Knowledge, Attitude and Psychomotor (KAP) of personal hygiene, for example, washing hands before meal or before doing something (d) Providing the places for washing hands using clean water in public service and restaurants and (e) Conducting vaccination of typhoid fever in endemic area.^{1,2,4,13}

Vaccine is a potensial tool for prevention and control of typhoid fever which is present only in man. The parenteral killed typhoid vaccine has been used in many countries. However, because of its high reactogenicity, the injectable vaccine has been withdrawn from national immunization programs in many countries^{8,12}.

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