

BIOLOGY

The Search for Better Health

TOPIC: THE SEARCH FOR BETTER HEALTH

Context: Humans have recognized the symptoms of disease for a long time. Today increased understanding of the causes of disease together with accompanying advances in technology has changed the approach to treatment and management of disease.

The World Health Organization (WHO) defines health as; 'A state of physical, mental and social well-being and not merely the absence of disease or infirmity.' The definition of disease can be very broad. "An illness, sickness or ailment of some organ or part of a plant or animal body." Disease can cover a wide range of conditions that fit the above definition including minor conditions, as well as major conditions. A more precise definition may be noted "Any disturbance of structure or function of the body of an organism is a disease. Most diseases are associated with characteristic structural changes to the body and with characteristic symptoms.

Diseases fall into 5 main categories: congenital and hereditary diseases; inflammatory diseases; degenerative diseases; metabolic diseases and abnormal cell growth (neoplastic) diseases.

Infectious Disease

An infectious disease can be passed from one organism to another.

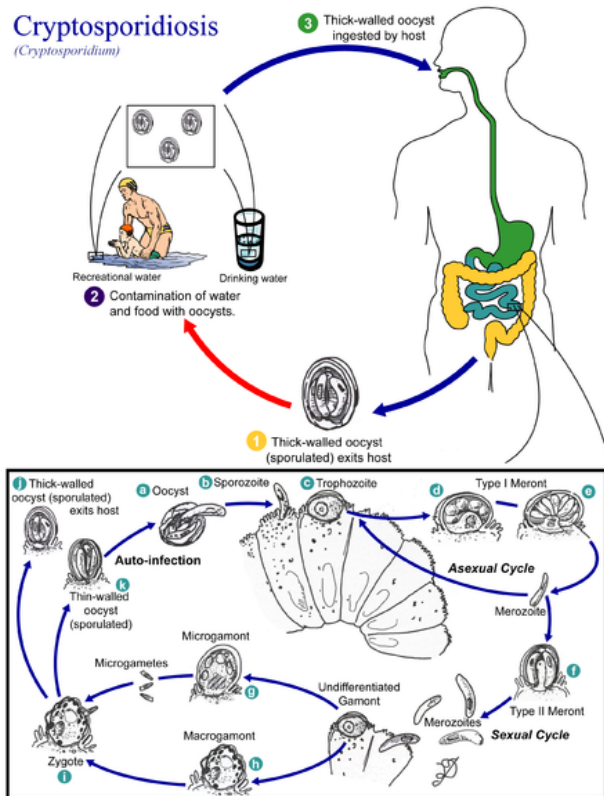
a. Name and causative agent

Cryptosporidium is a parasite that causes the disease Cryptosporidiosis. It appears in the warmer months and can survive chlorination. It is also referred to as crypto, it is a parasitic disease caused by a protozoan parasite called Cryptosporidium, located in the phylum Apicomplexa (large group of protists). It affects the intestines and is typically an acute short-term infection. It is spread through the fecal-oral route often through contaminated water.

b. Transmission

Cryptosporidiosis is a disease that is spread through contaminated material such as earth, water, uncooked or cross-contaminated food that has been in contact with the faeces of an infected individual or animal. Contact must then be transferred to the mouth and swallowed. It is especially prevalent amongst those in regular contact with bodies of fresh water such as swimming pools and people that work with children. Other potential sources include insufficiently treated water supplies, contaminated food, or exposure to faeces. Cryptosporidium was first described by E.E Tyzzer in 1907. He identified the parasite in the gastric glands of a mouse. No none human cases were identified until 1976 when Nime, et al. described Cryptosporidiosis in a 3 year old girl who was "vomiting everything taken by mouth and had severe watery diarrhea." She was diagnosed with an abdominal x-ray that showed "large amounts of gas in the colon, and fluid levels present in both the large and small bowel." Light microscopy was then used to verify the cause of these signs and symptoms, these showed the parasites as "spherical or ovoid organisms lying in the crypt lumens attached to the apical surface of the epithelial cells." Since 1976, there have been multiple outbreaks within the United States. The most notable was the 1993 outbreak in Milwaukee, WI where 403, 000 died. These cases were linked to the contamination of drinking water supplies.

Life cycle of *Cryptosporidium*



c. Major symptoms

Symptoms of infection include watery diarrhea, cramps, fever and vomiting. In immunocompromised individuals, such as AIDS patients, the symptoms are particularly severe and often fatal. It is the organism most commonly isolated in HIV positive patients presenting with diarrhea.

d. Host response

In an affected person the parasite that causes cryptosporidiosis invades and multiplies in the gastrointestinal tract, causing illness and producing oocytes, the infective form of the parasite.

The intestinal inflammatory response seems to mediate diarrhea (a symptom of cryptosporidiosis). Despite the difficulties of investigating human intestinal immune responses, such studies provide important insights into the human mucosal immune response. Since cryptosporidiosis has a significant impact on the health of immunocompromised patients and children in developing countries, further study of the pathogenesis and host immune response in patients with cryptosporidiosis is warranted.

e. Treatment

Depending on the symptoms present will greatly affect the treatment available to the patient. Treatment is symptomatic, with fluid rehydration, electrolyte correction and management of any pain. However, the treatment is not for the whole disease, it treats the symptoms and healthy people usually recover within two weeks. People with weakened immune systems should take special care with the water they drink.

f. Prevention

Personal hygiene practices are related specifically to preventing the transmission of infectious diseases. Cryptosporidiosis transmission is faecal-oral, including person to person, animal to person, waterborne and foodborne transmission. Washing hands after going to the toilet removes the bacteria to prevent transmission to others or to yourself. Cooking meat kills bacteria and flatworm cysts in the meat. Modern meat inspection practices ensure that the occurrence of parasites is far less common in meat. Regular bathing/showering removes accumulated bacteria living in fats, oils and moisture on skin. Interestingly there is one school of thought that says that by not washing at all the bacteria on the skin eventually reach a natural balance that is not harmful to the body. Regularly brushing your teeth. Boiling water when traveling kills micro-organisms in the water. Those local to an area often develop a resistance to microbes in the local water, but travellers are frequently susceptible to the new micro-organisms they encounter. By covering your mouth and nose when sneezing or coughing and by washing a wound and then covering this will remove the bacteria by washing. Covering prevents airborne bacteria from entering. Cleanliness and hygiene are important to reduce the transmission of disease. At a personal level this means ensuring to wash hands before eating and using tongs when handling food. If you have diarrhoea do not prepare food for others, avoid swimming pools if you are infected to stop the spread and keep away from people with lowered immunity. At a government level it includes sewage disposal, water treatment and safe food handling laws.

g. Control/ management

Cleanliness and hygiene will reduce the transmission of Cryptosporidiosis therefore it will be confined and limited to a small area. By practicing cleanliness and hygiene in the areas that are at the highest risk of contracting the infection this will prevent further spreading and allow people to keep healthy and not constantly stress about the possibility of contracting the disease. It is spread through contaminated material such as earth, water, uncooked or cross-contaminated food that has been in contact with the faeces of an infected individual or animal. Contact must then be transferred to the mouth and swallowed. If the disease is present in a population it is important to deter the infection from further spread by trying to confine the disease/infection. Past outbreaks highlight the need for public education about cryptosporidiosis. The public health regulation 1991 (Part 4) clearly states the rules and regulations that need to be followed. Especially for the operation of public swimming pools and spa pools and states, e.g. Clause 14: the occupier of a swimming pool or spa pool to which the Part applies must not allow a person to use the water in the pool unless the water in the pool is disinfected in such a way as to prevent the transmission of scheduled medical conditions to the user of the pool." Additional legislative powers are prescribed allowing Environmental Health Officers to inspect and to close public swimming pools and spa pools and where it is believed, on reasonable grounds, that the public pool is a risk to public health. This will prevent the disease from being able to spread to humans and therefore it will contain the infection.

Non-Infectious Disease

A non-infectious disease cannot be transmitted from one person to another. Non-infectious diseases fall into three main categories; genetic, nutritional and environmental.

a. Name

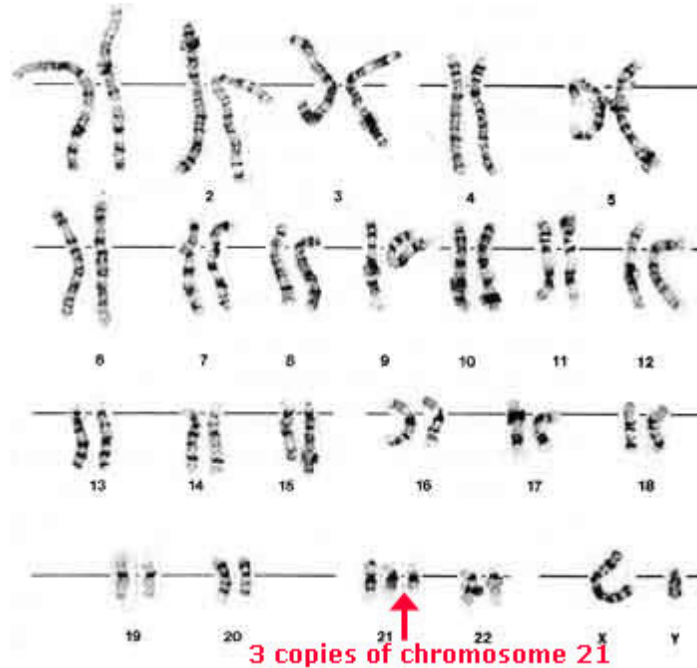
Down Syndrome (Trisomy 21)

b. Type of disease

Down Syndrome is a genetic disease and is non-infectious.

c. Cause

This is a genetic disease caused by chromosomes inherited from parents. In a normal meiotic division each sex cell gets a single strand of each chromosome. Sometimes the division is abnormal and both strands end up in the same sex cell. When fertilization occurs the embryo receives one strand of chromosome 21 from one parent and two from the other parent. The result is three chromosomes 21. However, Down Syndrome does not have to involve a whole extra chromosome 21. In milder cases of the disease, only a tiny extra bit of chromosome 21 is involved.



d. Occurrence

1 child in every 733 births

e. Symptoms

The symptoms vary according to the severity of the disease. Some typical symptoms include; prominent forehead, small flat skull, wide-set eyes, furrowed tongue, spinal weakness, heart defections, flattened nasal bridge, an habitually open mouth, projecting lower lip, skin fold at the inner corners of the eye and mental retardation.

f. Treatment

Children with Down Syndrome will need special care in many areas of life including basic living requirements like eating, washing and general hygiene. The reduced mental capacity, a symptom of the disease, may be a limiting factor on the development on the individual in respect to social development, schooling and the workforce, this is an important factor to address when considering a person suffering from Down Syndrome. Physiotherapy may be needed as children born with Down Syndrome have weakened muscles, and shorter arms and legs. Consideration of the increased risk of several diseases must be noted and kept under close surveillance, most notably cardiovascular failure, is an important issue that must be managed with Down Syndrome patients.

g. Control/ management

The only preventative measure is genetic counseling of couples at risk (more prevalent in babies born to older parents than in babies born to younger parents). Older couples have a higher risk of having a Down Syndrome child because a woman produces all of her eggs before birth. They stop dividing after the first meiotic division and only complete the second meiotic just before ovulation. The older the woman, the greater the chance that the egg will be defective. Although men produce sperm all their adult life, it has been shown that male sperm has a higher chance of being defective as the male ages. In Australia a woman who is over 35 can have amniocentesis or chorionic villus sampling. These tests will show whether the foetus has a chromosomal abnormality and a decision is then made whether to continue with the pregnancy or to terminate the pregnancy.

The management of Down Syndrome sufferers depends upon the severity of the disease. There have been a number of education programs for Down Syndrome children that have had outstanding success in the education and management of Down sufferers.

You can not contract Down Syndrome from a person with the disease, even blood transfusions from a person that suffers from Down Syndrome pose no risk for the person receiving the blood.

Quarantine procedures

a. Role of quarantine in Australia

The role of quarantine in Australia is the controlling of the import or export of animals, plants, and other products for the purpose of controlling the spread of disease. It protects the health of the human, animal and plant populations of Australia. Also prevents the entry of foreign pests and contagious diseases into Australia. Quarantine laws prevent the entry of items considered a risk. Important animals face a time in isolation to ensure that no disease is present. Living plants are also quarantined to make sure they are not carrying pests or suffering from any infectious disease. Plant seeds are examined to check that no weed seeds are present. Used vehicles and agricultural machinery are inspected and cleaned to ensure no soil/plant matter enters the country. It is essential in Australia as we have a unique but yet fragile ecosystem, which can be destroyed by foreign species e.g. rabbits after being introduced have endangered native species.

b. Case study – Eucalyptus/Guava Rust

Eucalyptus/Guava Rust is a serious disease caused by the fungus *Puccinia psidii*. This pathogen is very unusual in that it has a very wide host range in the plant family Myrtacaceae, this family includes about 3000 tree and shrub species. The plants that are susceptible to this disease that are native to Australia include the Eucalyptus, bottlebrush and paperbark.

This disease is native to parts of South America. It is also now evident in North America and parts of Central America including the Caribbean.

Eucalyptus/Guava rust causes disease of young shoots, flower buds and young fruit depending on the host plant. The Eucalyptus species are the most important hardwood forest plantation trees in the world and are grown in many countries. *Puccinia psidii* is the only rust known to infect Eucalypts and is capable of causing serious disease in Eucalypt plantations. The disease is particularly severe on susceptible eucalypt seedlings, cuttings, young trees, coppice or damaged mature trees.

This disease can be managed in plantations by producing resistant trees through selection and breeding. This is happening in countries like Brazil, but the disease would be impossible to manage in natural environments and would have devastating effects on Australian ecosystems where susceptible species occur.

Their spores are easily dispersed in air currents (wind) and could enter Australia on clothes, hair or luggage.

Forestry workers or tourists who have visited plantations or forests in countries with Eucalyptus/Guava rust should make sure they thoroughly clean their clothing before returning to Australia.

Due to the hard work of the workers at Australian Quarantine and Inspection Service, Australia has remained rabies free. This is an obvious result because of the strict rules and regulations that are constantly enforced and checked on a regular basis.

c. Case study – Rabies

Rabies is a fatal disease which can kill warm-blooded animals including humans. It is usually spread by the bite of an infected animal, most commonly associated with bats. It can also be spread if body fluids (blood, saliva etc) touches broken skin or a mucous membrane. It is caused by a lyssavirus which attacks the central nervous system (brain and the spinal cord) and then spreads to the salivary glands and other organs of the body.

Rabies is present in many countries in the world. However, Australia does not have rabies. If rabies were to be present in the Australian environment it would become practically impossible to eradicate. Other countries that also are free from rabies include New Zealand, the United Kingdom, Japan and a number of small islands. Most of the countries that do not have rabies present are island nations with strict controls on the entry of animals, these two factors would be a major contributor to the absence of rabies to prevent the entry of the disease. There are two types of rabies. "Furious rabies" makes the animal foam and drool at the mouth and become unpredictable. Animals with this type of rabies may become vicious and attack without warning. Animals with furious rabies become unusually restless, seldom lying or sitting in the one place, and if confined move around ceaselessly. The pupils dilate and the animal sometimes squints and may snap at imaginary objects. An important sign of the disease is that the animal assumes a watchful, puzzled or apprehensive look. The animal will become progressively uncoordinated and eventually paralysed and usually dies within four or five days. The second type of rabies is "dumb rabies". In the dumb form, the animal remains quiet, is not irritable and bites only when provoked. The watchful, apprehensive look in the eyes is also present. It causes paralysis followed by drooling of saliva and death. The animal is unable to eat but tries hard to drink fluid.

The incubation period is variable in all species and is influenced by factors like the strain of the virus, the amount of virus injected by the animal bite and the amount of nerves at the bite site. Between 40 000 and 70 000 people die of rabies worldwide each year, with a further 10 million receiving treatment after being exposed to animals suspected of contracting rabies.

This disease could profoundly change our way of life and it would be very difficult to eradicate if it became established in Australian wildlife and domestic animals. All imported animals are subject to strict quarantine requirements, including vaccinations for dogs and cats from all affected countries of the world. Dogs and cats may enter Australia from approved countries where rabies is absent or well-controlled and must serve a minimum post-arrival quarantine period of 30 days. Pets from South Africa where dog-mediated rabies is endemic must serve a minimum post-arrival quarantine period of 120 days. Before arriving in Australia, all dogs and cats must be properly vaccinated against rabies using an approved inactivated rabies vaccine.

When an animal is given an inactivated or killed vaccine the body develops antibodies to protect it if the animal is later exposed to that disease. The vaccine does not give the animal the actual disease. This vaccination, the primo-vaccination (first vaccination given), can be given to the animal when it is three months old, with a booster shot being given every 12 months of the animal's life. To ensure that the vaccination is effective, blood is then drawn from the animal.

The level of rabies antibodies must be sufficiently high in the blood to prevent the animal from contracting the rabies infection if exposed to it, and potentially spreading rabies to other animals. If there is insufficient rabies antibody in the dog's serum it will be required to remain in quarantine for up to 180 days at the importers' expense.

Due to the hard work of the workers at Australian Quarantine and Inspection Service, Australia has remained rabies free. This is an obvious result because of the strict rules and regulations that are constantly enforced and checked on a regular basis.

d. Effectiveness of quarantine procedures

Due to the hard work of the workers at Australian Quarantine and Inspection Service, Australia has remained rabies free. This is an obvious result because of the strict rules and regulations that are constantly enforced and checked on a regular basis.

Epidemiology

a. Definition

"Epidemiology is the study of a particular disease in a particular place." The study looks at groups of people rather than at individuals. The information is used to plan and evaluate strategies to prevent illness and as a guide to the management of patients in whom disease has already developed. Epidemiology is a science for 'medical detectives'. It is often regarded as one of the most interesting areas of medical research. With any study of epidemiology there has to be discussion about cause and effect. When any disease is linked to a cause it has to be shown that the cause is the direct reason for the disease.

b. Epidemiology case study – (smoking and lung cancer)

Researchers have been for many years trying to link smoking with lung cancer. There have been numerous epidemiological studies undertaken in order to establish if tobacco smoke is an actual cause for lung cancer. These studies have been important in showing that smoking does increase the chance of getting lung cancer. The first large studies that demonstrated a link between tobacco smoke and lung cancer was in the 1950's. These showed a statistical link between smokers and lung cancer but not a causative effect. The results demonstrated that smokers did not live as long as non-smokers. In result of these results the cigarette companies brought out a healthier low tar cigarette to counter the bad publicity. In 1964 the Surgeon General's Advisory Committee concluded that cigarette smoking was causally responsible for lung cancer. By the 1970's lung cancer had gone from a rare condition that did not affect many people to being the number one cause of cancer deaths.

Once the link between smoking and cancer became more obvious the rate of smoking decreased. Over time there has been a consequential fall in the number of lung cancer cases.

The U.S Environmental Protection Agency (EPA) in 1993 conducted an epidemiological case study on the effects of smoking and if it really did cause lung cancer. This study enabled people to label that environmental tobacco smoke is a human carcinogen. The EPA's report was based on 30 epidemiological studies from around the world, including a large multicellular case-control study. The study used a questionnaire specifically designed to evaluate the role of environmental tobacco smoke exposure in the development of lung cancer among lifetime nonsmokers. This study revealed that any exposure from a spouse who smoked was associated with at least a 30% excess risk. Results from the first three years of the study contributed the greatest individual study weight to the relative risk estimated for lung cancer in the EPA report. After completion the investigators confirmed excess risk among women exposed to ETS in the household, in the workplace, and in social settings. Another interesting finding was the predominance of a particular histology,

adenocarcinoma, supporting the theory that side stream smoke differs in character from mainstream smoke and the type of inhalation, nasal rather than oral, can affect the deposition of vapour and particles in the lung.

At the same time, researchers were examining other health outcomes of exposure to tobacco smoke, and studies were done in the workplace to measure nicotine concentrations in office air where smoking was permitted. The cumulative results of these investigations motivated the American Medical Association (AMA) to review the evidence and join with other organizations in a call for the health community and government regulatory agencies to deal with this threat to public health. Since these results have been analyzed and discussed, smoking policies have been developed for workplaces, transportation, and other public sites to prevent the involuntary inhalation of tobacco smoke e.g. no smoking in pubs or clubs.

Today lung cancer is still the leading cause of lung cancer in NSW.

c. Cause and effect relationship

Lung cancer is the uncontrolled growth of tumours in the lungs. Tobacco contains many carcinogens (cancer causing chemicals) such as benzene. The smoker introduces smoke into her or his environment each time a cigarette is lit (and incidentally into the environment of the passive smokers who have the smoke added to their environments as well). The carcinogens turn proto oncogenes into oncogenes resulting in uncontrolled growth in the form of tumours. As the tumours grow, the tissue in the lungs is destroyed and breathing becomes more and more difficult. The lungs may collapse and abscess and the patient may begin coughing up blood. There are five criteria aspects considered for linking cause and effect with evidence from epidemiological studies. These are:

- High relative risk
- Consistency
- A graded response to a graded dose
- A time relationship
- A possible mechanism

Looking at lung cancer epidemiological studies the criteria are met for the link between smoking and lung cancer.

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