eJBio

Electronic Journal of Biology, 2013, Vol. 9(2):24-28

Animals as Reservoir of Some Human Diseases

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Abstract

Infectious diseases of animals are important especially when they are capable of infecting humans. Such diseases are called zoonoses. Based on their aetiologies, zoonoses may be bacterial, viral, mycotic or parasitic. Examples of bacterial zoonoses include; brucellosis, tuberculosis, anthrax etc, parasitic zoonoses include; taeniasis, cryptosporidiosis, balantidiosis etc while viral zoonoses include; Lassa fever, Ebola fever, SARS, avian flu etc. Some mycotic zoonoses include Dermatophytoses, sporotrichosis, cryptococcosis and histoplasmosis. Zoonotic infections occur worldwide and often spread to humans through their companion domestic animals as well as through wild animals. As a result of our interconnectedness, infectious diseases emerge more frequently, spread greater distances, pass more easily between humans and animals, and change rapidly into new and more virulent strains. Every zoonosis is a present or potential threat to human health. The public health importance of zoonotic diseases is exemplified by the morbidity and mortality caused by recent worldwide outbreaks of SARS, avian flu and swine fever. Many of the major zoonotic diseases prevent the efficient production of food of animal origin and create obstacles to international trade in animal products. Considering the pandemic risk of zoonoses, this review is aimed at creating awareness to limit the exposure to and transmission of zoonotic agents between domestic and wild animals and humans.

Keywords: Animals, Disease, Human, Zoonoses.

1. Introduction

The World Health Organization / Food and Agriculture Organization (WHO/FAO) Expert Committee on Zoonoses defines zoonoses as those diseases and infections naturally transmitted between vertebrate animals and humans [1] The intelligence encyclopaedia also defines zoonoses as diseases of microbiological origin that can be transmitted from animals to people [2]. The causes of the diseases can be bacteria, viruses, parasites, fungi and some unconventional agents such as prions.

Black [3], identified zoonotic reservoirs to be either uni or bi - directional depending on whether they are transmitted only from non-humans to humans or back and forth between non-human animals and humans. About 150 zoonotic human diseases are known [3], some of which include: anthrax, brucellosis, bubonic plague, cat-scratch fever, chagas' disease, hydatid cyst, influenza, leptospirosis, Lyme disease, malaria, pneumonic plague, psittacosis, Q fever, rabies, ringworm, Rocky Mountain spotted fever, salmonellosis, tapeworm, trichinosis, toxoplasmosis, tularemia, typhus fever, western equine encephalitis, yellow fever. All arthropod-borne diseases with an animal host belong to the group of zoonotic infections.

According to the Committee on Emerging Microbial Threats to Health, [4] and the Committee on Emerging Microbial Threats to Health in the 21st century [5], there has been a disturbing trend of re-emergence of previously recognized zoonoses that were thought to be under control as well as the emergence of new zoonotic diseases. Zoonoses and other vector-borne diseases have repeatedly been identified as high ranking among the most important Emerging infectious diseases.

2. Geographical spread of infections

In their work, Daszak et al. [6] pointed out that the impact of both new and re-emerging infectious diseases on human populations is affected by the rate and degree to which they spread across geographical areas, depending on the movement of human hosts or of the vectors or reservoirs of infections. Travel has an important role in bringing people into contact with infectious agents. An increase in travel-associated importations of diseases was anticipated as early as 1933 when commercial air travel was still in its infancy [7]. This has since been demonstrated dramatically by an international airline hub-to-hub pandemic spread of acute haemorrhagic conjunctivitis in 1981, and more recently by the exportation of epidemic SARS from Guangdong Province, China, to Hong Kong, and then to Beijing, Hanoi, Singapore, Toronto and elsewhere [8]. The persistent spread of HIV along air, trucking, drug-trafficking and troop-deployment routes is a deadly variation of this theme [9].

Morens, et al., [7] highlighted factors affecting the emergence and re-emergence of diseases especially zoonotic diseases. These include microbial adaptation and change, human susceptibility to infection, climate and weather, changing ecosystems, human demographics and behaviour, economic development and land use, international travel and commerce, technology and industry, breakdown of public health measures, poverty and social inequality, war and famine, lack of political will and intent to harm.

The continuous emergence and re-emergence of vector-borne diseases will lead to unpredictable epidemics and difficult challenges to public health, especially when we realise that zoonoses may be contracted from both ill and apparently healthy animals [10]. The key elements in controlling emerging zoonoses are surveillance and response. These depend on rapid clinical diagnosis, early detection and containment of infections in populations and in the environment. Globally, such efforts are coordinated by the World Health Organization, which recently led a multi-faceted effort to successfully contain the global SARS outbreak of 2002 - 2003, and in the United States, the US Centres for Disease Control and Prevention (CDC) is responsible for handling such threats [11]. The enormous influx of US government-funded research resources (largely through the National Institutes of Health) and public health resources (mainly through the CDC, and state and local public health agencies) in response to the increased threat of a bioterrorist attack will fortify the response capabilities related to all emerging zoonoses [12].

Several animals serve as reservoir for many diseases that affect man. These animal reservoirs include different species of fish, wild and domestic animals, birds, and even insects. In this review, we shall highlight the major zoonotic diseases transmitted by different classes of animals, with the hope that this will lead to an early warning system to monitor pathogens infecting individuals exposed to animals.

3. Cases

3.1 Birds/animals capable of flight and fish

Because of their high mobility, animals such as bats and birds may present a greater risk of zoonotic transmission than other animals due to the ease with which they can move into areas of human habitation.

Psittacosis, Newcastle Disease, almonellosis and campylobacter infections are some examples of diseases transmissible from birds to humans. In recent times however, avian influenza and West Nile virus have spilled over into human populations probably due to interactions between the carrier hosts and domestic animals [13]

Outbreaks of diseases for which bats serve as reservoirs include Hendra virus, Nipah virus, Ebola haemorrhagic fever and Lyssa viruses [14, 15]. These are serious and often fatal diseases. Bats are increasingly becoming a source of protein in the diets of some communities, making contact with these creatures unavoidable [16, 15].

Newcastle disease

Newcastle disease is caused by a paramyxovirus. It affects both wild and domestic birds. Transmission is mainly by aerosol but contaminated food, water and equipment can also transmit the infection within bird colonies. Pathogenic strains produce anorexia and respiratory disease in adult birds and neurologic signs are seen in young birds. In humans however, the disease is characterized by conjunctivitis, fever, and respiratory symptoms. The disease can be prevented by immunization and obtaining birds from infection - free flocks. Proper personal-hygiene practices such as hand washing after handling animals or their waste and the use of antiseptic dips at the entrances of poultry houses are good preventive measures [7].

Internal capilariasis

Marine birds and fresh water fish also serve as reservoir for capillaria species, the causative agent of *internal capillariasis.* The disease is transmitted to humans through the ingestion of fish or marine birds that has been infected with *Capillaria philippinensis*. Signs of the disease in humans include enteropathy, protein maladsorption and vomiting. Internal capillariasis is predominant in Northern Philippines, Thailand, East Asia and Egypt [7].

Diphyllobrothriasis

Another zoonotic disease of fish is fish tapeworm infection also known as Diphyllobrothriasis. It has a worldwide distribution and is caused by species of *Diphyllobothrium*, particularly *D. latum*, *D. latus* and *D. pacificum*. Dipyllobothriasis can infect humans, dogs, bears and other fish eating - animals. Transmission is mainly by ingestion of raw or partially cooked infected fish. The infection is usually assymptomatic but may cause mild abdominal distress and rarely megaloblastic anaemia [17]

3.2 Rodents

Campylobacteriosis

Campylobacter species infect both pet and laboratory animal species causing *Campylobacteriosis*. Transmission to humans is by the faecal-oral route and can produce acute enteritis. Symptoms include diarrhoea, abdominal pain, fever, nausea, and vomiting. Transmission of campylobacter infections may be prevented by use of protective clothing, good personal hygiene, and sanitation measures [18]

Campylobacter species are also known to infect rodents such as mice, rats, hamsters etc, [18]. Other zoonotic diseases transmitted by rodents

include lymphocytic choriomeningitis, leptospirosis, salmonellosis, hantavirus Infection, rodentolepsis etc.

Rat-Bite Fever

Rat-bite fever is caused by *Streptobacillus monilformis* or *Spirillum mino*. These organisms are found in the respiratory tracts and mouths of rodents, especially rats. Most human infections are the result of a bite wound. Symptoms include chills, fever, malaise, headache and muscle pain. A rash may develop along with painful joints, abscesses, endocarditis, pneumonia, hepatitis pyelonephritis, and enteritis [19]. Prevention of rat - bite fever is achieved by proper handling of animals to prevent bites.

3.3 Canines

This group of intelligent carnivorous mammals include coyotes, wolves, foxes, jackals, racoons, but dogs are the most important since they are the closest animal companions of man and therefore pose a higher risk of transmitting zoonotic infections. Dogs are reservoirs of many human infections including rabies, brucellosis, campylobacteriosis, cryptosporidiosis, sporotrichosis, dermatophytosis, leptospirosis, salmonellosis, etc. Depending on the disease, transmission may be through bites and scratches, or the faecal - oral route [20].

Rabies

Rabies is a viral encephalitis transmitted from animal to animal and from animal to man through infective saliva. The virus is introduced into muscle and nerve ending-rich tissues following animal bite. It then penetrates into nerve cells where it replicates and progressively travels through the spinal cord to the brain causing hydrophobia, hallucinations, aggressive behaviour, and paralysis, eventually leading to coma and death. The virus also spreads to salivary glands and the skin, cornea, nasal and intestinal mucosa and other organs. The disease persists especially in developing countries in Africa, in South and South-East Asia, and to a lesser extent Latin America.

Reservoirs of rabies vary depending on geographic location but generally include wild animals including wolves, foxes, coyotes, jackals, raccoons, skunks and also bats as reservoirs and vectors but the domestic dog represents the most significant reservoir for the disease in humans. Rabies has one of the highest case fatality rates [20] and about 55,000 humans die annually from the disease following dog bites [21]. Recent reports have modified the epidemiology of the disease, following transmission from transplantation of infected organs [20]. The declaration of an Annual World Rabies Day, September 28 [22] is intended to raise public awareness on the severity of the disease and means of preventing and controlling the disease. Measures to prevent rabies include mass vaccination of reservoirs where feasible and proper education to reduce chances of exposure and transmission.

Cryptosporidiosis

Cryptosporidium species have a world-wide distribution and can be found in many animal species. Cryptosporidiosis is caused by a protozoan parasite which inhabits the intestines of many mammals including dogs and rabbits. Cryptosporidiosis is transmitted by the faecal-oral route and may cause diarrhoea in humans which is usually self-limiting but having a prolonged course in immunocompromised individuals. As of now, no known treatment exists for cryptosporidiosis. Appropriate personal hygiene practices including washing of hands after contact with animals or their waste may prevent spread of the infection.

Salmonellosis

Dogs are reservoirs for Salmonellosis, a gastrointestinal disease of man with a world-wide distribution. Salmonellosis is caused by any of the 2,000 serovars of *Salmonella enteric* [23]. In humans, Salmonellosis produces gastroenteritis which can be febrile with septicaemia. As with most of the other diseases transmitted through the faecal - oral route, appropriate personal hygiene is a good preventive measure along with prompt diagnosis and appropriate treatment. Thorough cooking of poultry, ground beef, and eggs and avoidance of drink or foods containing raw eggs, or unpasteurized milk are helpful in preventing the disease, Additional preventive measures include washing of hands, kitchen work surfaces, and utensils with soap and water immediately after they have been in contact with raw meat or poultry, being particularly careful with foods prepared for infants, the elderly, and the immunocompromised, and avoidance of contact between reptiles (turtles, iguanas, other lizards, and snakes) and infants or immunocompromised persons [12,13].

3.4 Cattle and other ruminants

Food of animal origin are an important source of the nutritional requirement of human beings since they provide the essential amino acids., Cattle and other ruminants like sheep, goats and camels fall into this group. Some of the many human diseases transmitted by ruminants include anthrax, brucellosis, Borna virus infection, bovine tuberculosis, campylobacteriosis, cowpox, Creutzfeldt-Jakob disease (CJD), cryptosporidiosis, etc.

Anthrax

Anthrax, a deadly zoonotic disease caused by *Bacillus anthracis* is a serious zoonotic disease that has a wide distribution. Humans acquire anthrax from contact with anthrax-infected animals or anthrax-contaminated animal–products such as

sheep wool or goat hair that are processed into yarns used in the textile and carpet industry, as well as cattle hides that are processed into leather goods, or bones used for the manufacture of gelatine and/or fertilizer. Symptoms in infected animals include very high fever and presence of blood in the urine, faeces or milk. They often have difficulty breathing and usually collapse and die within three days. In a dead animal, dark coloured blood often oozes from the nose, mouth and anus. This blood stays liquid and the body does not go stiff after death. Most at risk are people working with carcases especially animals that died suddenly [24]. The carcase of the animal should be deeply buried (at least six feet below ground.) or burnt and the site should be surrounded by a foot thick layer of quicklime [25]. Antibiotics therapy for anthrax is usually effective if given early and sufficiently. The disease can also be controlled through the vaccination of livestock [13].

Brucellosis

Brucella species remain a major source of brucellosis in humans and domesticated animals worldwide. Brucellosis is considered by FAO, WHO and OIE as the most widespread zoonosis in the world [20]. Brucellosis is caused by *B. abortus, B. melitensis, B.canis* or *B. suis*. Cattle, sheep and goats and their products remain the main source of infection through contact with contaminated tissues, blood, urine, vaginal discharges, aborted foetuses or placentas [26]. Clinical signs and symptoms in animals are stillbirths, abortions, reduced milk yield and sterility and in humans, symptoms include continued, intermittent or irregular fever of variable duration, with headaches, weakness, profuse sweating, chills, depression and weight loss [27].

Prevention of brucellosis in humans majorly depends on the eradication or control of the disease in animal hosts, the observation of hygienic precautions, reduction of exposure to infection through occupational activities, and the effective heating of dairy products and other potentially contaminated foods [28,29].

Bovine spongiform encephalopathy (BSE)/variant Cruetzfeldt-Jacob Disease (vCJD)

Bovine spongiform encephalopathy (BSE), commonly known as mad-cow disease is a fatal, neurodegenerative disease in cattle causing a spongy degeneration in the brain and spinal cord [30]. Prions are believed to be the infectious agents of BSE [31]. The primary source of BSE infection in cattle is commercial feed contaminated with the infectious agent [30].

The disease may be most easily transmitted to human beings by eating food contaminated with the brain or spinal cord of infected carcasses [30]. In humans, it is known as variant Creutzfeldt - Jakob disease (vCJD), which by October 2009 had killed 166 people in Britain and 44 elsewhere [32]. Cattle affected by BSE experience progressive degeneration of the nervous system and affected animals may display nervousness or aggression, abnormal posture, difficulty in coordination and rising, decreased milk production, or loss of body weight despite continued appetite. All infected cattle die and there is neither any known treatment nor a vaccine to prevent the disease [30].

4 Discussions and Conclusions

Man cannot completely avoid contact with animals and for many, the benefits of having pets far outweigh their fear of zoonotic infections. It is therefore the duty of the veterinarians, medical practitioners and public health personnel to provide the necessary education for safe handling of animals to minimize the risk of zoonotic disease transmission.

One of the most important public health protective measures is the removal from the human food supply of specified risk materials. Other preventive means include good personal hygiene and biosecurity. Effective control of zoonoses will best be tackled from the angles of appropriate and timely management of industrialization, deforestation, agriculture, global human and animal movements, co-infections, immunosuppression and development of drug resistance.

Zoonoses have a negative impact both on human health and economic development through reduced production. The control of zoonotic diseases requires both medical and veterinary interventions, the emerging interdisciplinary field of conservation medicine, which integrates human and veterinary medicine, and environment al sciences, is largely concerned with zoonoses. The emergence or re-emergence of zoonotic diseases poses serious threat to public health on a global scale; therefore international cooperation is required for meaningful control.

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