'A hair of the dog'

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THE 'hair of the dog' originally had nothing to do with alcohol. In the seventeenth century, it was believed that to fry such a hair and place it with rosemary on the wound caused by the dog was protection against rabies!

Rabies is the best known and most feared of all the zoonoses. From time immemorial, man has had a dread of this disease, but it probably did not reach the UK until the Middle Ages. The peak number of deaths in the UK from rabies occurred in 1874, when there were 74 deaths, and the last human death due to endemic rabies was in 1902. Since 1946, there have been 11 confirmed cases of human rabies in Britain, which have all been the result of infection contracted abroad in countries where the disease is still rife.

During 1975 there were 3,758 dogs and 1,216 cats imported into Britain under licence and, on average, 4,500 dogs and cats have been imported annually over the past 15 years and detained in quarantine kennels for the statutory six-month period. Ships of the Royal Navy are no longer allowed to have cats or dogs on board as pets and, as from 1 March 1977, the National Maritime Board have forbidden the keeping of cats or dogs on British ships. Native animals are banned from boarding vessels carrying animals from abroad.

Routine animal vaccination against rabies is illegal in this country but many other countries allow it. All dogs and cats imported are vaccinated before entering quarantine and again one month later. Regrettably, vaccination is not a hundred per cent effective. In Britain over the past 50 years, 27 animals have died from rabies while in quarantine, five dogs and one cat since 1960. In addition, two dogs died 14 and 90 days respectively after release from quarantine, but fortunately both of them had been kept in isolation following the diagnosis of rabies symptoms. There has been no case of rabies in or out of quarantine in Britain since 1970.

In 1974, according to the World Health Organization (1976), 332,523 people throughout the world were given prophylactic treatment and 412 died from rabies. This is probably a gross underestimate as Schwabe (1971) quotes 15,000 deaths from rabies in India annually.

It does not necessarily follow that a large number of animals have to be infected with rabies before infection in humans occurs. Naturally, it needs only one rabid animal to bite a human for the disease to be confirmed in that person. Puerto Rico has a population of just under three million and the number of positive animals has varied from 81 in 1971 to 48 in 1975—the main reservoir is the mongoose, in which rabies is six times more common than in dogs. In spite of this small population, a 51-year-old man died in Puerto Rico on 16 July 1975 from rabies (World Health Organization, 1976).

In 1975, 143 dogs and 38 cats were detected being smuggled into Britain, and over the last few years approximately 200 owners have been caught each year trying to smuggle their pets, but it is estimated that hundreds of other cases are not detected. The irresponsibility of one person in smuggling an animal into Britain could change our whole way of life, including our attitude to pets and wildlife. It is in order to try and catch such people that stringent measures are necessary and are taken.

Antirabies regulations

In early summer 1976, a Ministry of Agriculture veterinary officer toured the French and Belgian coastal towns to co-ordinate the publicity about Britain's antirabies regulations with the local authorities. At cross-channel ports, embarking and disembarking passengers are now given leaflets about the antirabies regulations, and the DHSS leaflet, *Advice to Travellers Going Abroad,* gives the same information.

As it stands now, the law states that a dog or cat can be imported into Britain at an authorized port (S. I. 2211, 1974). The animal must have a licence to be imported and it must be met at the port or airport of arrival by an approved carrying agent and then carried by him (*not* by the owner) without delay to the approved quarantine kennels chosen by the owner. The carrying container must be "nose and paw proof", provided with a padlock, and immediately put into an authorized vehicle without touching dry land, for transport to the approved kennels.

In exceptional circumstances, if the vessel or aircraft has been diverted, in the interests of safety, for example, to an unauthorized port, then the animal may, with due precautions, be landed. There is no prohibition on animals brought from Northern Ireland, the Republic of Ireland, the Channel Islands, or the Isle of Man unless the animals have been brought to those countries from elsewhere and have not undergone at least six months' quarantine before being landed in Great Britain. At no time may the animal touch dry land until it arrives in the quarantine kennels. Shipping and airline companies are required to ensure that animals are not put on board without a boarding document showing that an import licence has been granted. Airlines are also required to ensure that animals travel as "manifested" freight in an approved container in the freight compartment. At Gatwick airport a lady passenger was noticed to have three bosoms. On examination she was found to be attempting to smuggle a kitten (Raeburn, 1977).

On the other hand, if a ship arrives in this country with a dog or cat on board and it is intended to keep them on board, then the cat or dog must be kept confined below deck on the vessel and be prevented from contacting any other animals and in no circumstances be permitted to land. In this way, it is hoped that there will be no contact with animals running wild on the docks. Many small vessels which go back and forth between here and the Continent have a guard dog on board.

Some contraventions of the rabies regulations have been cases where such a guard dog has not been kept confined in an enclosed part of the vessel according to the regulations. Occasionally, a stray cat boards, for example, a cross channel ferry and may make the journey to and from the Continent before being spotted; it then returns ashore in this country to its former companions in the dock area. I then recommend that all cats and dogs in the area should be rounded up and destroyed. In Hull, in addition to dogs and cats in the dock area, we also have foxes, and despite efforts to exterminate them, they are still to be found.

Unfortunately, the actual control of animals in ports is not a port health responsibility. It comes under the control of the county council who appoint a Diseases of Animals Act inspector. Under the Local Government Act, 1972, local authorities have no power of delegation of functions under the Diseases of Animals Act. Personally, I believe that port health staff should be appointed as county council officers for Diseases of Animals Act functions.

Missing link?

Is there a missing link in the spread of rabies? Could this missing link be a rat or another small rodent which is infected by the rabies virus? If this were so, rabies could well be introduced into Britain by a small rodent or something similar escaping from a ship or aircraft, or from a container landed from a ship or aircraft.

In early autumn 1976, colorado beetles were found amongst imported rye at the point of sale in this country. A few years earlier a container which had been filled with peas on the prairies of Canada was found to contain rats when it was emptied at a processing factory in southern England. On 24 November 1976, two live cats were found in Peterborough inside a frozen meat container which had been sealed in Turkey on 8 November. One would have thought that no cat could survive the temperature of minus 16 degrees but the Hull chief port public health inspector knows of a case of a rat which had apparently made its home in the refrigerated hold of a ship (Williams, 1976). The rat had adapted to its environment by growing its hair long. Authenticated records are available, therefore, of colorado beetles, rats, and cats passing through all the normal checks at ports within the last five years, in spite of public awareness of the inherent dangers.

Animals have been known to recover from both inapparent and overt rabies infection. Dogs in Ethiopia have been found excreting the rabies virus for more than six months, while appearing perfectly healthy (Fekadu, 1975). Vampire bats have been known to be similarly infective after more than two years. Research workers in Czechoslovakia have found a rhabdovirus in rat brains which is very similar to the rabies virus (Sodja *et al.*, 1971). In the Lebanon, rats are a regular source of bite wounds causing rabies in humans (World Health Organization, 1976).

During the Korean war in 1951, hundreds of American soldiers became ill with a disease which was characterized by fever and bleeding from the mouth, nose, and internal organs, known as 'epidemic haemorrhagic fever'. The cause of the disease and its transmission was unknown. The disease was first described by Russian doctors after an outbreak in Vladivostok in 1913, and a rodent-borne virus was suspected as the cause. Lee Ho Wang of South Korea (1976) showed that the disease is caused by a virus borne by a tiny field mouse. In the course of his research, he has isolated a further 16 unknown viruses from rodents. In spite of detailed American research, it took 25 years to find the 'missing link' in the spread of the Korean war disease, and happily it has not spread further than Korea and far eastern Russia.

Rabies is a self-limiting disease in most animals. This means that when they become infected with rabies, they die and theoretically, therefore, all susceptible wildlife in an area should die. When the area becomes repopulated with wildlife after an interval of a year or two, no rabies should occur as all the susceptible animals have theoretically died off. However, in practice this does not happen, as rabies does occasionally reappear in wildlife repopulating the area. The fox is one animal which can be infected with rabies without being bitten by another rabid animal; it may, for instance, contract the disease by eating the carcase of an animal which has recently died from rabies.

If rabies recurs in an area some months after repopulation, it means that either a smuggled contact has been introduced or that the virus has found a suitable host which can survive infection. I have postulated (Dunlop, 1977) that this host is a rat or small rodent and it is this animal which is the vector and major factor in the continuance of rabies within an area. Serial passaging through small rodents to foxes may alter the virulence of the virus. In a few cases, as in the case of the dogs in Ethiopia and vampire bats (Office of Health Economics, 1976), the virulence is not altered and the animal survives and excretes the virus. According to the WHO Expert Committee on Rabies, "it is possible to categorize many animal hosts for their susceptibility to rabies infection" (WHO, 1972). Susceptibility is extremely high in kangaroo rats, cotton rats, and common field voles, whereas it is high in cats, bats, and rabbits but only moderate in dogs and non-human primates. "In parts of Europe repeated isolations of rabies viruses with unusually low virulence in early mouse passages have been made from wild rodents (Microtinae and other Muridae). These have not been obviously associated with fox rabies and their epidemiological significance has not yet been determined" (WHO, 1972).

This hypothesis can account for Denmark having kept free from rabies, as either the rats or small rodents did not cross the Kiel Canal or the rabies virus did not become established in the native rodents. For a similar reason, rabies died out in Britain in 1903 (among the last animals to be affected were the deer in Richmond Park) and did not spread after the importation of a rabid dog in 1918 (though it was 1922 before Britain was declared free from rabies). In this country, rabies has been a typically self-limiting disease in that all animals infected died and either the postulated 'missing link' rodent was not present or the virus had not become established in the native rodents, so the disease burnt itself out. In Denmark and Britain the 'missing link' rodent has neither become established nor infected with the virus.

Only when rabies infects the 'missing link' small rodent does the disease become endemic in a country, and I believe that if rabies ever does become endemic in Britain it may not be the result of a smuggled animal bringing the disease into the country: it could well be the result of a small rodent infected with a rabies-like virus escaping from a ship, in a container of food or goods. This small rodent will then pass on the infection to native contacts and apart from the complete extermination of all susceptible rodents, there will be no chance of ridding the country of rabies.

For years in Britain we have tended to neglect taking precautions against rats leaving ships, such as having rat guards on hawsers or gang planks floodlit at night. The time has now come when we should once more ensure that all these precautions are rigorously carried out. It is rare nowadays for a ship to require deratting, and many ships from the time they are built and at their six-monthly inspection are found to have no evidence of rats and are issued with a deratting exemption certificate. Nevertheless, if my hypothesis is correct, it needs only one infected rat, from a ship which still has rats, to escape and mix with rats on shore for rabies to become endemic in Britain. If the rat which has escaped is the 'missing link' and is infected with the virus, and if the theory is correct, then none of the measures which have been drawn up as a contingency plan for dealing with an outbreak of rabies will have any effect.

The contingency plan, which covers the situation only with regard to such animals as cats, dogs, and foxes, could not deal with an outbreak among small rodents if the theory of a missing link is correct. The majority of authorities state that rats and mice have not been shown to be likely natural carriers of rabies anywhere in the world and therefore no plans have been made for controlling infection from this source. Meanwhile fortunately we have never in this country had to fight a rodent source of rabies and the present rules, if strictly adhered to, should prove a sufficient safeguard.

Posters emphasizing the dangers from illegally landed animals and the penalties for contraventions should be on display in all harbours and coastal marinas. Local yacht clubs and small boat owners are advised concerning the regulations. Indeed, special publicity is arranged through yachting associations to remind boat owners that animals taken abroad, whether or not they have landed, are subject to import controls and quarantine on return to this country. It is unrealistic to attempt comprehensive surveillance over every point on the coast where yachts can berth. The current national publicity about rabies has led to a much greater public awareness and concern and it is hoped that this will help to guard against illegal landings. Incidentally, for the purposes of the rabies regulations, oil rigs are classed as places outside Great Britain. Animals landed from these structures are subject to the normal six-month quarantine requirement whether or not they come from outside territorial waters or have had contact with foreign animals.

Action after notification

The action which a medical officer for environmental health should take after being notified of a case of human rabies will depend on the circumstances of infection of the patient concerned:

1. Where the patient is known or suspected of having been exposed to infection by an animal abroad, action will generally be limited to offering, where appropriate, prophylactic vaccination to the patient's intimate home contacts and arranging for the disinfection of soiled articles contaminated by the patient before removal to hospital.

2. Where the suspected source of infection is believed to be an animal in this country, then, in addition, the medical officer for environmental health must ensure that the appropriate divisional veterinary officer and

the Department of Health and Social Security are informed of the circumstances urgently.

Control of an outbreak of rabies involving animal cases and human contacts requires the concerted efforts of both animal and human health services working in close liaison. Many government departments as well as local authorities, port health authorities, and the police will be involved. Operational control of an outbreak rests entirely with the Ministry of Agriculture, Fisheries, and Food.

It is estimated that about 40 dog bites per month per 100,000 population are routinely treated in general practice and in accident and emergency departments in this country. About 1,000 dog bites are treated each year at the Hull Royal Infirmary.

If rabies is introduced into the UK, the health services will have to shoulder a considerable additional burden. Robinson (1976) wrote clearly on "Dog Bites and Rabies: an Assessment of Risk".

Procedure

At the Hull Royal Infirmary accident and emergency department, the procedure for dealing with dog bites to people who have a legitimate right to enter any part of a ship is clearly stated. These people may have entered the place where the dog has been quite legitimately kept confined on board a vessel, but at the moment the law does not require the dog to be either tied up or muzzled, it simply has to be confined. Therefore people such as rodent searchers or customs rummage officers are liable to enter and be attacked by a dog. If they are bitten, then they are told to notify the docks police immediately. The docks police in turn notify both the diseases of animals act inspector and also the local divisional veterinary officer. The latter examines the dog at once and decides whether or not any action should be taken to confine it under suspicion of rabies being present. The casualty officer at the Hull Royal Infirmary contacts the divisional veterinary officer to find out his views on the possibility of the dog having rabies. In a case which occurred recently, the dog had been on board German ships for seven years and had been immunized against rabies. The divisional veterinary officer decided that in view of the circumstances he had no option but to remove the dog into quarantine for 14 days, although he agreed that the possibility of rabies was remote. If at any time during the 14 days quarantine period the dog begins to show any symptoms whatsoever suggestive of rabies, then the person who has been bitten is immediately started on antirabies treatment. If at the time of his initial inspection the divisional veterinary officer thinks that there is a possibility of rabies, then antirabies treatment is started that day. Because some ships' masters disappear before the dog has come out of quarantine, and in order to ensure that the local authority is not then faced with a bill for looking after the dog in quarantine, the master has to put up a bond which is sufficient to cover the cost of quarantine at the time of the dog being taken from the ship. In the final analysis, if the doctor in the accident and emergency department considers it expedient, he will start antirabies treatment immediately without consulting the divisional veterinary officer. Conversely, it does not necessarily happen that if a dog is removed to quarantine, antirabies treatment will automatically be given.

If a holidaymaker on return from abroad alleges that he or she was bitten on holiday, then the following procedure should be adopted:

The date and precise geographical location of the incident should be ascertained, and as much information as possible obtained about the animal involved and treatment given. This information should be passed on to the local medical officer for environmental health, who may then contact the overseas section of the DHSS or the communicable disease reference section at Colindale. Enquiries will then be instigated in the foreign country and the likelihood of rabies being present in the animal established. Advice will then be given on the appropriate form of treatment.

The inactivated human rabies vaccine, which has been cultivated on human diploid cells and is supplied by the *Institut Merieux,* has now been licensed for both pre-exposure and post-exposure use. This vaccine is expensive and is available through the public health laboratory service. For pre-exposure immunization, two 1·0 ml doses injected by the deep subcutaneous route should be given with a month's interval between each injection, and a booster should be given one year later and thereafter every three to five years. For post-exposure, the vaccine should be given on days 0, 3, 7, 14, 30, and 90, and the initial dose may or may not be accompanied by rabies antiserum, depending on the circumstances. In all cases, routine first aid treatment of the bite wound (including immunization against tetanus) should not be overlooked.

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