Vector-borne diseases

Introduction

Vector-borne diseases depend mainly or entirely upon an arthropod vector for transmission of the pathogen, which may be a virus, a bacterium, or a protozoan or helminth parasite. Common disease vectors include ticks, biting flies, mosquitoes and midges. For the overwhelming majority of such diseases the vector is a biological host of the pathogen, i.e. the pathogen replicates in the vector, which may even be essential for the completion of its life cycle in the case of protozoa. However, transmission of lumpy skin disease (LSD) by arthropods is, as far as is known, mechanical, but because direct transmission between cattle is inefficient, LSD is classified as a vector-borne disease. African swine fever (ASF) is strictly vector-borne in its sylvatic cycle between warthogs and argasid ticks that live in the burrows, but once a domestic pig is infected by an argasid tick, the disease manifests as highly contagious and vectors play only a minor role if any in further spread and ASF is therefore classified as contagious rather than vector-borne. Some diseases that are only transmitted by vectors to their target hosts may be directly transmitted to secondary hosts. For example, African horse sickness (AHS) and bluetongue (BT) may infect carnivores that feed on the carcasses of animals that have died of those diseases, and humans are usually infected with Rift Valley fever (RVF) virus through contact with bodily fluids of infected animals.

Importance of vector-borne diseases

Some of the most important diseases of livestock are transmitted by vectors. Indigenous African transboundary diseases such as AHS, BT and RVF are former OIE (World Organisation for Animal Health) List A diseases that can cause high mortality and RVF is additionally a zoonosis. RVF is transmitted by a number of different species of mosquitoes and outbreaks occur when climatic conditions result in the emergence of unusually large numbers of mosquitoes. Disease in humans is usually mild but can be fatal in cases that develop haemorrhagic fever or encephalitis. AHS causes high mortality in horses, which generally have a high value either in terms of money or the work that they perform. BT can cause high mortality in small ruminants, particularly sheep. Both diseases are transmitted by Culicoides midges, which occur worldwide and whose presence has allowed the diseases to become established in new areas.

Although the remaining vector-borne diseases were previously either included in List B or unlisted, most of them now require reporting and they include some of the most important livestock diseases. Trypanosomosis remains unlisted with the exception of dourine but there is little doubt about its importance in tropical areas. Various forms of trypanosomosis affect both humans and livestock; in Africa they include sleeping sickness in humans and nagana in cattle. With the exception of dourine in horses, which is venereally transmitted, trypanosomes are transmitted by biting insects. In Africa the vectors are tsetse flies (Glossina spp.), and earlier attempts to eradicate them have included killing of wildlife and destruction of forests. Nagana has

severe negative effects on productivity of cattle and also on crop production where cattle are used as draught animals. In some areas in tropical Africa pig keeping is impossible owing to a highly fatal form of trypanosomosis caused by Trypanosoma simiae.

Tick-borne diseases include heartwater (cowdriosis), theileriosis, babesiosis and anaplasmosis. Their effects range from high mortality (heartwater and the theilerioses East Coast fever and Corridor disease) to mainly production losses with a low but sometimes significant mortality rate. Managing them is challenging and costly and vector-borne diseases are not easily eradicable because it is usually impossible to eliminate the vectors.

Prevention and control

Prevention and control measures are largely aimed at controlling the vectors, although vaccination is available for most of the diseases. Controlling flying vectors is much more difficult than controlling ticks, which tend to spend long periods on the animal and can therefore be managed by acaricide treatment of the animal. However, problems include the logistics of mustering free-ranging animals for treatment, development of resistance to acaricides, and environmental concerns about their effects particularly on other invertebrates such as dung beetles, which play an extremely important role in removing cattle dung and thereby indirectly controlling fly populations. The use of chemicals also disrupted natural control of ticks on cattle by oxpeckers, which disappeared from various areas as a result of cattle dipping. The need for strategic dipping programmes to avoid resistance development and to achieve stability in endemic areas is recognised but this may be difficult to apply in practice. To eliminate tick-borne diseases, as East Coast fever was eradicated from South Africa, the frequency of acaricide treatment is based on the life cycle of the tick vector, and this may be more frequent than dwindling resources for animal health control will allow. Vaccination for the protozoal diseases still largely depends on an infection-and-treatment approach; some are blood vaccines that require careful handling and administration.

AHS and BT are mainly controlled by vaccination, with the added precaution of stabling animals from dusk to dawn (ideally in insect-proof stables, but difficult to achieve) and avoiding low-lying pastures where midges are more active. RVF is best controlled by vaccination because mosquito control is difficult and several of the species that transmit RVF are day-flying. A major problem is that outbreaks are linked to abnormal climatic conditions and are therefore sporadic, occurring at irregular intervals that can involve an absence of 20 or more years. It is difficult to convince producers to maintain vaccination when they never see the disease, and while suitable climatic conditions for outbreaks can be predicted in advance, the time is usually nevertheless too short to implement an efficacious vaccination campaign. Vaccine producers are unwilling to produce large stocks of vaccine that are likely to expire before the next outbreak so shortages may occur during outbreaks. Effective vaccines are available for LSD, caused by a capripoxvirus.

Trypanosomosis poses the greatest challenge for control, because there are no vaccines and the control of tsetse flies requires resources that many countries lack. Since the more drastic (but largely ineffective) measures like deforestation and wildlife depopulation are no longer acceptable, a number of methods have been developed to reduce tsetse fly populations, of which aerial spraying appears to be the most effective but the least environmentally acceptable. Other methods include trapping using olfactory or visual attractants and the release of sterile flies.

Find out more

Web-based modules on vectors and on a range of vector-borne diseases are available on the veterinary HUB for CPD purposes and provide an in-depth look at how the diseases are transmitted, how to recognise them, their prevention, control and socio-economic importance, and where to look for further information.

Web-based modules on animal health management and on the tools used for animal health management, including biosecurity, provide a broad overview of approaches to the management of high impact vector-borne diseases.

Author: Dr Mary-Louise Penrith