

Introduction

Third International Symposium on bluetongue

Executive Committee

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The timeliness of a Third International Symposium on bluetongue (BT) was emphasised by the unexpected and unprecedented recent occurrence of the disease throughout much of the Mediterranean Basin. Furthermore, international understanding of BT clearly has not kept pace with scientific developments since the last symposium in 1991, and now almost 10 years have passed since the Uruguay Round of negotiations of the General Agreement on Tariffs and Trade; these negotiations led to the introduction of the Sanitary and Phytosanitary regulations of the World Trade Organization that now guide international trade of animals and animal products.

The heightened international interest in BT and the BT virus (BTV) was reflected by the 300 individuals who attended the symposium, and in the 45 scientific oral presentations and over 90 posters in which the latest information was presented. In conjunction with the symposium, international experts were assigned to various working groups that were requested to provide constructive, transparent and science-based recommendations pertaining to the understanding and international regulation of BT.

Conclusions and findings from the symposium

Global occurrence of bluetongue virus episystems

Several researchers elegantly confirmed the original concept pioneered by P. Gibbs, A. Gould and others at the second BT symposium in 1991 that distinct strains of BTV (virus topotypes) are vectored by different species of *Culicoides* in specific regions of the world. It was further shown that the topotypes of BTV and the vector species that occur within each episystem are relatively stable, despite extensive and ongoing trade and movement of ruminants between individual episystems. Much remains to be learned about the ecological, climatic and environmental factors that lead to expansion of BTV episystems, such as that which recently occurred in the Mediterranean Basin. It is increasingly evident that an understanding of these factors is requisite to defining what limits the boundaries of individual BTV episystems.

It was shown that the northern distribution of BTV in Asia and Europe is similar to that in North America, and is far beyond the 40°N limit that traditionally was proposed. Specifically, BT recently has occurred to approximately 45°N in Europe, and BTV infection of ruminants has been documented as far as 50°N in Asia. Much remains to be understood about these northern Eurasian BTV episystems, in terms both of their species of insect vector as well as the specific strains of BTV that occur within each. Similarly, the strains of BTV and the relative importance of different potential vector species awaits adequate characterisation in variable areas of the extensive BTV episystems that occur in South America, Africa, the Middle East and Asia.

Although further refinement and sophistication is ongoing, existing diagnostic technology is adequate for comprehensive global surveillance and monitoring of the distribution and activity of BTV. Indeed, there has been remarkable international acceptance and adoption of virus-detection assays based on the polymerase chain reaction (PCR) since the second symposium, and the widespread use of PCR technology also has enhanced our understanding of the global ecology of BTV infection because it has facilitated sequence analysis of the strains of BTV that infect the insect vectors and ruminants that reside within each of the various BTV episystems. A potential disadvantage of the PCR technology is that it is so exquisitely sensitive that it can detect BTV

nucleic acid in the tissues of previously infected ruminants in the absence of infectious virus, an issue that is relevant to the regulation of animal movement from BTV-endemic areas. Clearly, however, the specificity and sensitivity of available diagnostic technologies enables identification of BTV infection of the insect and animal hosts of the virus. Thus, the global and regional distribution of BTV can now comprehensively be determined using appropriate surveillance and monitoring. Furthermore, the collation of such data should be an issue of the highest priority to the international community given that BTV has been identified on every continent except Antarctica, and that little information currently is available from many areas of the world. An integrated, comprehensive network of surveillance, monitoring and reporting is required to establish the global limits of the distribution of BTV and of competent *Culicoides* vectors.

Life-cycle of bluetongue virus infection

Several studies confirmed conclusions of the first and second symposia that BTV infection of ruminants is transient, whereas infection of the *Culicoides* insect vector is persistent. Detailed and elegant studies by Australian workers who evaluated large numbers of naturally infected cattle have unequivocally shown that BTV infection of these animals does not persist for more than a few weeks. Thus, international trade policies must increasingly reflect the reality that BTV infection of ruminants is transient, and that seropositive animals are resistant to reinfection with the homologous BTV serotype and can be safely moved. Attention should now be focused on the climatic, ecological and environmental factors that determine the range of the insect vectors that persistently harbour BTV within each epistystem, because a detailed understanding of these factors, and not unwarranted restrictions on animal movement, is a prerequisite to the ultimate control of BT.

Vaccines and vaccination

Inactivated, live-attenuated (modified live), and subunit vaccines all have been developed to immunise ruminants against BTV infection. Each of these different vaccine types has perceived inherent advantages and disadvantages, including their ease of production and cost, number of immunisations required, availability, efficacy, duration of immunity, and potential adverse side-effects. However, only live-attenuated BTV vaccines are currently available commercially in the quantities that are required to confront major outbreaks of BT; thus, these vaccines will continue to be utilised until viable substitutes are produced in sufficient quantities. Given the enormous range of recent outbreaks of BT in the Mediterranean Basin and elsewhere, there is a clear need to develop and evaluate all potential vaccine strategies to both protect animals and to facilitate trade from endemically infected areas. Provocative data also was provided suggesting that strategic vaccination of all susceptible animals reduced virus circulation during the recent incursion of BTV into the European epistystem, an observation that clearly warrants further study.

Conclusion

The third symposium showcased the remarkable progress that has been made on the understanding of BT and BTV since the first and second international symposia were held in 1984 and 1991. Attention has now shifted from ruminants to *Culicoides* insects as the primary host of BTV, meaning that animals can be moved safely between and within BTV epistystems using transparent, science-based criteria. Current diagnostic technology provides the tools for very accurate surveillance and monitoring within BTV epistystems, and to better predict incursion of BTV into previously unaffected areas and to guide the safe movement of animals. Critical deficiencies persist in regard to our understanding of the global ecology of BTV and its epistystems, however, including the lack of detailed understanding of the environmental factors that precipitated the recent expansion of the range of competent insect vectors and/or BTV in the Mediterranean Basin for example. Similarly, some global BTV epistystems are yet to be defined in any detail, including those in South America, areas of Africa and Asia, and at the northern margins of the range of the virus in Eurasia. Lastly, viable options (choices) of vaccines that can be produced in the quantities needed to confront an extensive BT outbreak are currently limited to live-attenuated vaccines, meaning that efforts should continue to evaluate all potential strategies to minimise the economic impact of BTV when it invades previously unaffected regions.

