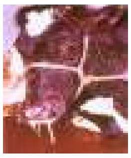
THE INFLUENCE OF AGE ON BLUETONGUE VIRUS INFECTION IN CATTLE



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Context & Objectives

Starting in August 2006 from the original focus in the area where Belgium, the Netherlands and Germany share borders, an epidemic of BTV serotype 8 gradually disseminated throughout the Northern European countries. The findings of a cross-sectional serological study performed among the Belgian cattle population in January 2007 (1) emphasized the rapid and non-confined spread of the virus in 2006. In 2007, BTV-8 re-emerged in Northern Europe. A second cross-sectional study was undertaken in January 2008. At that moment, there were at least some of the host sub-populations that had obtained high levels of antibodies. In order to control the devastating effect of BTV-8 in Northern Europe, the European Union decided to start vaccination before the next vector season. The campaign intended to reach a target of at least 80% of coverage.
Several studies focused on the effect of cattle age on the risk of BTV infection and demonstrated an age relationship, e.g. older cattle are more incline to be BTV seropositive than younger cattle. It has been suggested that herds keeping younger animals result in a reduced level of herd immunity and therefore assist in the maintenance and the spread of BTV (2). The understanding of the age profiles of BTV infection and the identification of a high risk age group is of utmost importance to subsequently enable the establishment of the most appropriate surveillance and control measures. Therefore, another cross-sectional serological study was organised in Belgium during the 2008 vector-free season, focusing this time on cattle younger than two years of age. The objective of this study was to assess the influence of age on BT infection and to characterize the distribution of BTV seroprevalence among different age groups.

Materials & Methods

The study population consisted of dairy cattle housed in dairy farms with on-farm delivery of dairy products. In January-February 2008, a cross-sectional study was undertaken. In this survey, every adult animal above 2 years of age was sampled in the 344 selected herds. In April-March 2008, a cross-sectional screening among the young(er) cattle was organised in those same herds. Twenty animals less than 2 years of age were sampled within each selected herd. The sample was further stratified by year of birth: 10, 5 and 5 animals born in 2006, 2007 and 2008, respectively, were selected per herd. The serum samples were assayed using a commercially available competitive ELISA (c-ELISA) kit (ID Screen® Blue Tongue Competition for detection of anti-VP7 antibodies; ID.VET, Montpellier, France).
After consideration of the exploratory results, a change point model with a linear effect on the left-hand side of the cut off point in age and a fractional polynomial model on the right-hand side was assumed to model the serological response according to the age of the animal. The initial model considering age as the unique variable of interest was further adjusted by taking into account several other potential confounding variables (province, gender, herd size and sampling date)

Results & Discussion

This study shows the seroprevalence decreasing until the age of 7 months and subsequently increasing until reaching a maximal threshold around 30 months (figure 1). The second part of the curve is S-shaped, which is a typical form for a risk curve. Age was demonstrated to be a significant risk factor for BTV seropositivity. This relationship is most likely associated with increased duration of exposure, rather than increased age susceptibility to infection per se (2). However, variation with age in susceptibility to *Culicoides*' bites is also biologically plausible: Older cattle could be more exposed to the midges because of their larger total body surface area for instance (3). Also, at least some of the vector species were shown to be effectively attracted by cattle-born chemicals such as carbon dioxide which's productions greatly fluctuates during the ruminant's life (4).

The detection of BTV antibodies in calves as young as 0–3 months was expected since, at this age, passively transferred colostral antibodies are in high titre in the serum of the animals. These maternal antibodies are typically not related to the infection of the young animal itself. By the age of 3 months, the colostral antibodies progressively wane to undetectable levels (5). In the present study, the final decline of the first serological peak seemed to occur around 7 months. Recent laboratory analyses provided evidence of the capacity of the BTV strain currently circulating in Northern Europe to pass the placental barrier (6). Thus, it may well be that these birth-cohorts infected in utero contributed to this high seroprevalence level before seven months of age and, as time passes, will progressively lead to a shift and enlargement of the first seroprevalence peak.

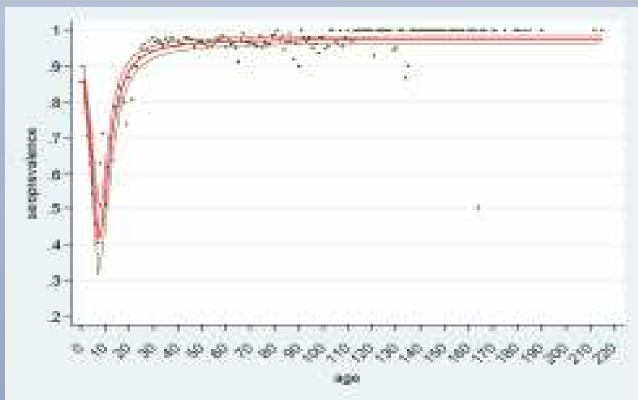

Figure 1. Bluetongue serotype 8 seroprevalence by cattle age in months. Population-average estimates (red line), 95%CI (black lines) and mean seroprevalence by age (black diamonds).

After two years of presence of BTV-8 in Belgium, almost every bovine animal older than 18 months has been infected by the virus at one point. Therefore, we are now dealing with a situation where at least some of the host sub-populations have obtained nearly full long lasting protective immunity towards BTV-8. An empirical evaluation indicates a level of vaccination coverage (herd immunity threshold) of 80% to be attained to stop the spread of the infection and eradicate the disease (Charles Nicolle's law). This would allow to consider a prioritization in vaccinating the less protected sub-populations of ruminants (cattle between 3 and 18 months), especially in the situation of lacking vaccine doses. On the other hand, several studies suggested an association between age of cattle and the risk of showing BT disease (7); both experimental and field BTV infection produced less clinical signs in young ruminants compared to older animals. This seems important to pinpoint knowing that the other main goal of vaccination is to reduce the clinical impact of the disease.

Conclusions

After two years of presence in Belgium, almost every adult cattle has been infected by the virus at one point and the population has therefore obtained a high level of natural immunity. The current study indicated that BTV-8 seroprevalence in cattle was dependent on age. An age category (3-18 months) where cattle are less naturally protected against the virus has been delimited, highlighting the need to target surveillance and control of BT towards this class of animals.

References

(1) Méroc, E., Faes, C., Herr, C., Staubach, C., Verheyden, B., Vanbinst,T., Vandenbussche, F., Hooyberghs, J., Aerts, M., De Clercq, K. and Mintiens, K., 2008. Establishing the spread of Bluetongue virus at the end of the 2006 epidemic in Belgium. Veterinary Microbiology 131, 133-144.
(2) Ward, M.P., Carpenter, T.E., Osburn, B.I., 1994, Host factors affecting seroprevalence of bluetongue virus infections of cattle. Am. J. Vet. Res. 55, 916-920.
(3) Uhaa, I.J., Riemann, H.P.M., Thurmond, C., Franti, C.E., 1990. A seroepidemiological study on bluetongue virus in dairy cattle in the central valley of California. Vet Res Commun, 14, 99-112.
(4) Kline, D.L., Hagan, D.V., Wood, J.R., 1994. Culicoides responses to 1-octen-3-ol and carbon dioxide in salt marshes near Sea Island, Georgia, U.S.A. Med. Vet. Entomol. 25-30
(5) Lancelot, R., Calvez, D., Waller, J., Kremer, M., Sanite, L., Lefevre, P.C., 1989. Observations épidémiologiques sur la Fièvre Catarrhale maligne du mouton (Bluetongue) en Guyane Française. Epidémiologie et Santé Animale
(6) De Clercq, K., De Leeuw, I., Verheyden, B., Vandemeulebroucke, E., Vanbinst, T., Herr, C., Meroc, E., Bertels, G., Steurbaut, N., Miry, C., De Bleecker, K., Maquet, G., Bughin, J., Saulmont, M., Lebrun, M., Sustronck, B., De Deken, R., Hooyberghs, J., Houdart, P., Raemakers, M., Mintiens, K., Kerkhofs, P., Goris, N., Vandenbussche, F., 2008. Transplacental Infection and Apparently Immunotolerance Induced by a Wild-type Bluetongue Virus Serotype 8 Natural Infection. Transboundary and Emerging Diseases. 29.
(7)Elbers, A.RW., A. Backx, E. Méroc, G. Gerbier, C. Staubach, G. Hendrickx, A. van der Speck, and K. Mintiens, 2008: Field observations during the bluetongue epidemic in North-West Europe.I. Detection of first outbreaks and clinical signs in sheep and cattle. Preventive Veterinary Medicine 87, 21-30

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