Optimization of surveillance of Bovine Viral Diarrhea in Danish dairy herds

This thesis comprises studies on surveillance of Bovine Viral Diarrhea (BVD) in Danish dairy herds. BVD is caused by a Pestivirus of the Flaviviridae family (BVDV) that can infect domestic and wild ruminants (e.g. deer). The main sources of infection are the persistently infected animals (PI) which shed BVDV during all life, while transiently infected (TI) animals only shed the virus for a short time period in small amounts compared to PIs. BVD is considered to be distributed worldwide and although its course is usually subclinical, outbreaks can have an important impact on animal health and income of farmers. In Denmark, the BVD eradication program started in 1994. During the last twenty years, while the BVD herd incidence decreased to only sporadic cases, the average herd size has increased. Currently (2014), BVD is considered eradicated from Denmark. In this situation, newly infected dairy herds (e.g. after import of infected cattle) could be more difficult to detect compared to the past, due to the lower prevalence of antibody positive milking cows and the (expected) higher dilution of antibodies in bigger milk containers. Therefore, an evaluation and an eventual optimization of the BVD surveillance system in Danish dairy herds were considered necessary by the Danish Cattle Federation. In study I, we verified how the BVD herd prevalence, the herd size and the dilution of individual milk within the bulk tank milk (BTM) changed, between 2003 and 2010. Moreover, the Danish blocking ELISA (Rønsholt et al., 1997; Bitsch et al., 1997) and the SVANOVIR ELISA (Juntti et al., 1987; Niskanen, 1993) were compared on milk and serum samples. The prevalence of antibody positive milking cows, which can be detected by each of those tests, was estimated by diluting positive individual milk and making artificial milk pools. We found that the median herd size increased noticeably during the investigated years, whereas the prevalence of BVDV infected dairy herds decreased from 0.51% to 0.02%, together with the BTM antibody levels in the National dairy population. We also found that the SVANOVIR ELISA could detect a lower prevalence of antibody positive cows compared to the Danish blocking ELISA (0.78% vs. 50%). Hence, the former could detect newly infected herds shortly after infection when only few milking cows have seroconverted in the herd. In blood, the two tests performed similarly. Thus both ELISAs can be used to test serum (e.g. in imported live cattle). In study II, a stochastic simulation model was developed in R and was validated using field data from an infected herd. Using this model the Danish blocking ELISA, the SVANOVIR ELISA and the indirect ELISA BVD/MD p80 Institute Pourquier (Beaudeau et al., 2001a) were compared regarding their BVD detection time in different herd sizes. The SVANOVIR ELISA appeared to give the fastest response and so, was the test of preference for an early-warning surveillance system where infected herds are detected as soon as possible by BTM testing. In study III, the risk of introducing BVD from abroad into Danish cattle dairy herds was assessed per year and per trimester. Imports of live cattle, semen, embryos, truck visits, use of vaccines and veterinarians and hoof trimmers practicing across borders were considered as possible routes of BVDV introduction. The main source of infection was represented by the import of live cattle from countries where BVD is endemic. With the current situation, the overall median risk was estimated to one BVDV introduction per 9 years (5th percentile = 59; 95th percentile = 3). By introducing simple measures of risk mitigation, such as testing all imported animals and always disinfecting the tools used abroad for hoof trimming, the risk can be reduced to one introduction per 33 years (200; 8). Finally in study IV, the temporal sensitivity (SSe) of the current Danish surveillance system (based on BTM testing with the blocking ELISA) was evaluated, according to the information obtained in studies I, II, and III and using stochastic scenario trees (Martin et al., 2007a). Additionally, the confidence in complete freedom (PFree) from BVD in Danish dairy herds (< 1 infected herd) and the confidence (PLOw) in low herd prevalence (<0.02% infected herds) were estimated. BVDV introductions from abroad, e.g. due to import of a PI calf or a TI milking cow were taken into account. Moreover, alternative surveillance strategies were considered. These were (i) using the SVANOVIR ELISA on BTM and (ii) testing dairy herds at higher risk of BVDV introduction (importing live cattle) in individual serum and other dairy herds in BTM. From a general point of view, the temporal SSe, the PLOw and the PFree were higher testing at 365 days from BVDV introduction, than testing at 90 days. Estimates were usually higher for the SVANOVIR than for the blocking ELISA, and when a PI calf rather than a TI cow was introduced to the herd(s). Hence, if the SVANOVIR ELISA was used to test BTM samples, the temporal SSe would be increased together with the related PFree and PLOw. Testing individual blood in herds importing cattle would not increase the temporal SSe noticeably, due to the very low number of dairy herds which import live animals during a year period (only 8/4109 herds in 2010).

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