



Syndromic Surveillance of Neuroinfectious Diseases in Animals

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Key words

Surveillance, Neurology, Histopathology, Metagenomics, Cattle

Aim of the study

Neuroinfectious diseases in livestock, [such as bovine spongiform encephalopathy \(BSE\) and rabies](#), may pose a considerable risk to human and animal health and many of them are monitored by passive or active disease surveillance. Passive disease surveillance has [several](#) limitations in sensitivity due to low disease awareness, economic interest and difficulties in the interpretation of clinical signs, while active surveillance requires comprehensive logistics and is expensive. Both systems target only defined specific diseases. There is a need to improve the efficacy of current surveillance systems to detect new or re-emerging infectious diseases as early as possible. Syndromic surveillance relies on the analysis of real time data that may indicate changes in the prevalence of disease syndromes in a given population. Neuropathological examination is an unbiased tool to identify animals affected by neuroinfectious diseases. The aim of the present study was to assess the benefit of neuropathology derived data in the context of a syndromic surveillance concept for neuroinfectious diseases in the Swiss cattle population.

Material and methods

Over a one year period (April 2013- March 2014) we collected a representative number (n= 1816) of medulla oblongata brain samples from adult (> 36 months of age) fallen stock cattle and a normal slaughtered control group. These samples were analysed by histopathology for brain lesions categorized as (i) no and non-significant lesions, (ii) non-suppurative inflammation, (iii) suppurative inflammation, (iv) metabolic toxic and degenerative, (v) listeriosis and (vi) other. For each category the prevalence in the population was estimated, and questionnaires were sent to farms to assess the pathological-clinical correlation. Samples with non-suppurative inflammatory lesions were further tested by PCR, RT-PCR and immunohistochemistry protocols for specific viral pathogens (Herpesviruses, Borna virus, Astroviruses, Flaviviruses) and by next-generation sequencing and bioinformatics for RNA virus sequences. [Questionnaires were sent to the farmers, to reveal whether neuropathological lesions correlated with the observation of neurological clinical signs.](#)

Results and significance

In total 3.7% (n=67) animals revealed significant lesions in the medulla oblongata. The most frequent type of lesion was “non-suppurative inflammatory” (40.3%) which suggests a viral etiology, followed by “suppurative inflammatory” (28.4%), which indicates a bacterial etiology. Follow-up diagnostics identified infections with *Listeria monocytogenes*, *Ovine herpesvirus 2* and *Bovine astrovirus CH13*; all are known to be associated with encephalitis in cattle. In addition, *Bovine herpesvirus 6*, *Bovine retrovirus CH15* and, unexpectedly, *Posavirus 1* as well as porcine astrovirus sequences were found, for which a causal relationship with the disease needs being further investigated. [Based on these data, we estimated the number of cattle with neuropathological lesions in the adult cattle population to ~300 animals per year \(with ~120 cases of non-suppurative encephalitis ~86 cases of suppurative encephalitis, ~27 cases Listeriosis and ~67 cases with other lesions\). In the questionnaire survey, neurological clinical signs were observed by the farmers in ~50% of the animals with inflammatory lesions. In the same one-year time period only three clinical BSE suspect cases and none for ra-](#)

bies were reported to the authorities, which points towards a very low efficiency of passive surveillance for these notifiable diseases. This situation is in sharp contrast to the results of our study, which suggest that at least 150 animals with neurological signs per year are observed by the farmers. It is likely that these notifiable diseases are not considered as possible cause of the observed clinical signs by the owners, because of a general conception of them being eradicated. ~~Collectively, these data~~ Based on these findings, instead of a disease specific notification and laboratory confirmation scheme, we propose ~~support the notion~~ implementation of ~~that~~ a reporting system for neurological disease in cattle in general ~~in and to~~ combine ~~that~~ ~~ation~~ with ~~a~~ neuropathological examination and follow-up diagnostics. ~~could significantly enhance surveillance efficiency. By these means, we expect a significantly enhancement of surveillance efficiency not only for endemic or eradicated neuroinfectious diseases, but also for newly emerging pathogens in the sense of early warning and preparedness.~~

Publications, posters and presentations

Walland, J. Project presentation. Workshop on early-warning systems in Switzerland, March 4th 2013, Bern

Walland, J.; Lauper, J.; Frey, J.; Imhof, R.; Stephan, R.; Seuberlich, T.; Oevermann, A. Listeria monocytogenes infection in ruminants: Is there a link to the environment, food and human health? A review.

Schweiz Arch Tierheilkd. 2015 Jun;157(6):319-28. Review and Dissertation Dr. med. vet, University of Berne.

Seuberlich, T. Surveillance of listeric encephalitis in ruminants in Switzerland. Listeria Mini-Symposium. University of Berne. 14. November 2014.

Truchet, L. Scanning surveillance of neuroinfectious diseases in cattle livestock. Swiss Virology Meeting. Thun 2./3. February 2016.

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~~Manuscript in preparation.~~

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