Added value of lightning location data in the confirmation of lightning-related fatalities in livestock by the veterinary expert

B. Pardon[a], E. Vanneste[b], D.R. Poelman[c], K. Chiers[d], P. Deprez [a], P. Weyens[b]

[a] Department of Internal Medicine and Clinical Biology of Large Animals,[d] Department of Pathology, Bacteriology and Avian Diseases, Faculty of Veterinary Medicine, Ghent University, Salisburylaan 133, B-9820 Merelbeke, Belgium; [b] Veterinary Expertise Agency, Dr. P. Weyens, P.P. Rubenslaan 29, B-9820 Merelbeke, Belgium; [c] Belgian Royal Meteorological Institute, Ringlaan 3, B-1180 Brussels, Belgium

E-mail: Bart.Pardon@UGent.be

Introduction

For lightning related fatalities (LRF) expert veterinarians are contacted by the insurance company to determine whether a case is compatible with death due to lightning. These veterinarians base their decision on circumstantial evidence and on necropsy findings. Nowadays, the national meteorological institute is more frequently consulted for information on detection of lighting at the suspected time and location of death. The objective of the present study was to make a predictive model for compatibility with death due to lightning in livestock, evaluating the added value of using lightning location data (LLD).

Materials and methods

- A dataset of 410 LRF declarations (1997-2012) from a single expert veterinarian was analyzed
- Risk factors related to case history, circumstantial evidence (environment) and pathological findings were retrospectively collected.
- LLD were derived for each case from the lightning detection system of the Belgian Royal Meteorological Institute
- A risk model for compatibility with an LRF was made based on multivariable logistic regression.

Results

- Of 410 declarations only 47,2% was accepted as LRF; both accepted as declined declarations were highest between May and September
- Presence of singe lesions and of a tree with signs of lightning impact were 100% specific
- A basic model based on the expertise investigations is given in Table 1
- Table 2 shows the sensitivity/specificity of the different models, including LLD

Table 1. Multivariable logistic regression model to predict acceptance of a lightning related fatality (LRF) by the expert veterinarian

Factor	Level	Number of observations	β	SD	OR	OR (95% CI)	P-value
Age	< 1 year (ref.)	98	0	-			
	>1 year	312	0.5	0.3	1.7	1.0-3.0	0.06
Tree in the near surroundings	No (ref.)	344	0	-			
	Yes	66	0.8	0.3	2.3	1.2-4.5	0.01
Presence of open water in the near surroundings	No (ref.)	369	0	-			
	Yes	41	1.5	0.4	4.6	2.0-11.0	< 0.001
Tympanic at the time of the expertise	No (ref.)	45	0	-			
	Yes	365	2.6	0.6	13.2	4.3-40.0	< 0.001
Presence of feed in the oral cavity	No (ref.)	333	0	-			
	Yes	77	3.2	0.5	24.1	9.1-64.0	< 0.001
Declaration within 3 days of another LS declaration	No (ref.)	90	0	-			
	Yes	321	1.2	0.3	3.3	1.8-6.1	< 0.001

Table 2. Sensitivity and specificity of logistic models with and without lightning location system data to predict a diagnosis compatible with lighting strike by the expert veterinarian in livestock animals.

Model	Sensitivity (%)	Specificity (%)	Positive predictive value (%)	Negative predictive value (%)	Percentage correct (%)
Presence of singe lesions on the skin	43.3	99.5	98.8	33.8	72.9
Tree with signs of recent lighting stroke in the near surroundings	9.3	100.0	100.0	44.9	57.1
Cloud-to-ground lightning	91.2	41.5	58.2	84.1	65.0
Cloud-to-cloud lightning	94.3	41.5	59.0	89.1	66.4
Basic model (Table 2)	53.6	88.0	80.0	68.0	71.7
Basic model + 'Declaration within 3 days of another LS declaration'	54.1	89.4	82.0	68.4	72.7
Basic model + 'Cloud-to-ground lightning'	88.1	67.6	71.0	86.4	77.3
Basic model + 'Cloud-to-cloud lightning'	89.7	67.6	71.3	87.6	78.0

Figure 1. Presence of singe (burn) lesions are pathognomonic

Figure 2. Presence of a tree or open water within 10 meters of the case were associated with LRF

Figure 3. Presence of food in the oral cavity was found to be strongly associated with LRF.

Figure 4. Presence of high tension power lines or an electric fence within 10 metres of the case were not associated with LRF. .

Conclusions

- Wrong declarations account for more than half of the LRF declarations, highlighting the need for accurate diagnosis to avoid unjustified retribution.
- LLD have a very good sensitivity, but low specificity, resulting in too many false positives.
- The clinical veterinary expert investigation continues to be necessary and its value lies in the detection of true negatives (high specificity)
- Combination of the clinical veterinary investigation and LDD data results in the most accurate decision.