Alternative Scoring Method of Pleurisy in Slaughtered Pigs: Preliminary Investigations

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Abstract. The slaughterhouse is very useful in monitoring the health status of livestock, the profitability of their breeding and the effectiveness of therapeutic and/or prophylactic strategies. Over the years, a number of methods have been developed to quantify lesions - especially those effecting the respiratory tract, observed in slaughtered animals. Among these is the “Slaughterhouse Pleurisy Evaluation System” (SPES), which is widely used to score pleural lesions caused by Actinobacillus pleuropneumoniae. The aim of the present study is to develop and assess an alternative method to score pleurisy in slaughtered pigs, based on the inspection of the parietal pleura. This method has been compared with the SPES grid, which is considered as the “gold standard” in this field of study. Preliminary data indicate that the two methods provide almost overlapping results, showing very high correlation coefficients. Scoring pleurisy on the parietal pleura proved to be fast and easy, it could represent a valuable alternative to the SPES method.

Keywords: pig · slaughterhouse · pleurisy · scoring systems.

1 Introduction

The slaughterhouse represents an extremely useful observation point for the monitoring the health status of livestock and providing feedback regarding veterinary and management activities (i.e. vaccinations, treatments, etc.) performed over the animal’s lifetime. This is particularly relevant in pigs: the short productive cycle of this species does not permit the full healing of lesions, which are therefore still detectable at post mortem inspection. Over the years, many systems have been developed which quantify the impact of diseases such as; sarcoptic mange, atrophic rhinitis, and ascaridiosis. Despite this, the most importance has always been given to diseases of the lower respiratory tract (pneumonia caused by Mycoplasma hyopneumoniae, pleuropneumonia caused by Actinobacillus pleuropneumoniae) which have an important economic impact on pig farming. Regardless of the disease considered, the lesion evaluation system must respect certain criteria a) it must be simple and permit evaluation at the speed of slaughter, b) it should be easy to standardise and reproduce c) it should produce results which are easily interpretable and can be analysed statistically. Pleurisy is a
common finding in pigs and is frequently seen at post mortem inspection of car-
casses. Over the years, various scoring systems have been developed for pleurisy,
including the “Slaughterhouse Pleurisy Evaluation System” [1]. This system ade-
quately responds to the above-mentioned criteria and is commonly used to quan-
tify lesions caused by infections of Actinobacillus pleuropneumoniae [2][3][4]. This
study aims to develop and evaluate an alternative method for scoring pleurisy
in slaughtered pigs, through the inspection of the parietal pleura. This method
was compared with the SPES system which is the most widely used method in
field conditions.

2 Materials and Methods

Animals A total of 216 pigs, between 9-11 months of age and weighing be-
tween 140-180 Kg live weight, normally slaughtered between November 2017
and January 2018 in abattoirs in the province of Teramo (Italy) were taken into
consideration.

Scoring Pleurisy The scoring was performed by three veterinary surgeons,
after a short training period during which they agreed on how to interpret the
different lesion classes. For each pig, the presence/absence and the “severity” of
pleurisy was recorded as follows:

– A veterinarian was stationed where the post mortem inspection of organs
  is normally performed. Inflammatory reactions of the visceral pleura (the
  pleural sheet lining the pulmonary parenchyma) were recorded and quanti-
fied according to the SPES grid [1];
– A second veterinarian was stationed at a later point of the slaughter chain
  and inspected the parietal pleura (the pleural sheet which lines the chest
  wall).

Cases of pleurisy were quantified as follows: The parietal pleura was divided
into three easily identifiable areas (a) from the 1st to the 3rd intercostal spaces;
(b) from the 4th to the 6th intercostal spaces; (c) the remaining intercostal
spaces, caudal to this point. In each of these areas, the presence of pleural le-
isons was recorded, regardless of their extension, with the aim of limiting the
subjectivity of the score as much as possible. Considering the SPES system, and
the fact that lesions caused by Actinobacillus pleuropneumoniae usually involve
both diaphragmatic lobes, the following point system was given:

– pleurisy effecting the first three intercostal spaces = 1 point;
– pleurisy effecting the 4th through 6th intercostal spaces = 2 points;
– pleurisy effecting the caudal intercostal spaces = 3 points.

Each pig was thus given a “total” score ranging between 0 and 12 which was
obtained by adding the individual scores of all the areas of the 2 half carcasses.
This scoring method will be known herein with the acronym PEPP (“Pleurisy
Evaluation on Parietal Pleura”).
**Statistical Analysis** The numerosity of the sample was determined for a generalised linear model, calculated with G*Power \(^2\). The averages of scores obtained with the two methods was compared based on outcome (negative/positive) through one-way variance analysis. The relationship between the scores obtained with the two methods was evaluated through a linear Pearson’s correlation coefficient (r). The functional relationship between the variables measured with the two systems was resolved through linear regression analysis, whose statistical significance was measured through variance analysis.

### 3 Results

**Fig. 1:** Graphical representation of the scores obtained by applying two different pleurisy evaluation systems. Approximately, the 50% of the pigs under study showed no pleural lesion and obtained score 0 using both scoring systems. The distribution of scores obtained by means of the SPES system was rather uniform, score 2 being more frequently recorded. By applying the PEPP method, most of the pigs with pleural lesions fell in the score interval 1-6, with a “tail” of pigs which scored >7.

**Pleurisy scores using the SPES grid** After the inspection of the lung and the visceral pleura, the presence of pleurisy was demonstrated in 109/216 pig (50.46%), whereas no pleural inflammation was found in the remaining 107/216 pigs (49.53%). The distribution of scores obtained with the SPES method is shown in Figure 1.

**Pleurisy scores using the PEPP method** The inspection of the parietal pleura and its scoring using the PEPP method required very little time (5-10 sec/pig). The presence of inflammatory reactions on the parietal pleura was observed in 108/216 pigs (50%), whereas the remaining 108/216 pigs (50%) were considered “healthy”. Fig. 2 shows two examples. The distribution of scores obtained with the PEPP method is shown in Fig. 1.

**Statistical analysis** The PEPP method proved capable of effectively differentiating “diseased” pigs from healthy ones (p<0.01). The analysis of the correlation
between results obtained with the two scoring methods show a very high correlation coefficient ($r = 0.913$) and are statistically significant ($p<0.01$). Linear regression analysis indicates that the determination coefficient is very high ($R^2 = 0.833$) and statistically significant ($p<0.0001$). Fig. 3 shows a graph with an analysis of the linear regression and equation between the two scoring systems.

3.1 Discussion
Considering the usefulness of the slaughterhouse for monitoring the management of swine farms, and more generally modern animal production, new evaluation methods, which more fully adapt to the specific needs of each production system are a positive development. In this sense, the PEPP method, shows itself as a possible alternative to the SPES system, which has been amply documented and recognized on a worldwide scale. As expected, the two scoring methods gave overlapping results, with an extremely high correlation coefficient. In fact, with rare exceptions (for example limited extension of pleurisy, circumscribed to the interlobar spaces), such lesions normally involve both pleural sheets (visceral and parietal). A confirmation of this was seen in the almost complete overlapping of pigs considered “healthy” (score 0) using both evaluation methods. In fact, only eight pigs with interlobar adherences were not correctly identified as “diseased” through the application of the PEPP method; whereas seven pigs with small lesions confined to the first few intercostal spaces were not correctly identified as “diseased” through the application of the SPES grid. Obviously the PEPP method has both pros and cons, for example, the inspection of the carcass halves at the end of the slaughterchain does not permit the veterinarian
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Fig. 3: Analysis of the linear regression and equation between the two scoring systems SPES and PEPP.

to inspect other lesions (es. Pneumonia, pericarditis, hepatitis). On the other hand, this system permits the veterinarian to perform the scoring in a cleaner and more relaxed environment, in a potentially extremely short period of time. In addition, the scoring of the parietal pleura is simpler, and less influenced by other factors (es. Blood staining, pulmonary scarring, etc.) and can potentially be performed at a later time through the analysis of digital images. To this aim other studies are currently being carried out, to try to standardise the scoring between veterinarians, using different systems both in the slaughterhouse, and remotely on digital images.

4 Conclusions

The inspection of the parietal pleura and the scoring of any lesions present proved simple and rapidly applicable. It is herein proposed as an alternative to the SPES system.

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