ATROPHIC RHINITIS : SNOUT MORPHOMETRY FOR QUANTITATIVE ASSESSMENT OF CONCHAL ATROPHY

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INTRODUCTION Atrophic rhinitis (AR) of pigs is characterised by deformity of the snout, atrophy of the conchae and excessive space in the nasal cavity. Conventionally the clinical diagnosis is confirmed and the severity of the disease assessed by post-mortem examination of a coronal section of the snout. A number of systems for grading snouts in terms of severity of the macroscopic lesions has been evolved. All such systems essentially combine subjective judgment of a number of related elements to yield either a diagnosis (e.g. positive/inconclusive/negative) or a class score. In the Weybridge system (MAFF, 1978) snouts are graded from zero (complete normality) to 5 (complete conchal atrophy). Although snout scores within such systems show a logical positive arithmetic progression relative to severity of lesions, there is no direct quantitative relationship; i.e. they constitute a discontinuous series. Attempts to quantify nasal atrophy more objectively in terms of a continuous variable have concentrated on measuring the space between the ventral scroll of the ventral concha and the floor of the nasal cavity. However, such systems normally measure only a single variable, and they discount the influence of age/size of the pig on the total amount of available space in the nasal cavity.

METHODS AND RESULTS We have applied classical morphometric methods (cf Reid, 1980) to the measurement of conchal atrophy in a vertical transverse section of the pig's snout at a standard site (between premolars 1 and 2). For best results snouts should be removed at the level of premolars 2-3, fixed (e.g. in 10% formalin) and then re-sawn and cleaned up. Fixed and trimmed snout sections may be measured directly; or, preferably, they can be photographed and/or used to produce "snout prints". The "snout print" technique, developed by Lund (1977 unpublished), consists of impregnating the fixed, cleaned and dried snout with endorsing ink from a pad of suitable size and then making several impression prints on plain or graph paper. Such prints are, of course, laterally transposed; so the true orientation should be recorded when the prints are edited to resolve any ambiguities resulting from imperfect inking. Snout prints may be measured direct as originals or photocopies; or, they may be enlarged photographically with or without an integral graticule. Similar methods may be applied to photographs (on 35 mm film) of sectioned snouts. For ease of measurement and repeatability of results, the best image format is a photographic enlargement about 18 x 12 cm on matt paper. Whichever sort of specimen is used for the actual measurement, some means of editing the image is necessary to reduce the effects of subjective variation in interpretation; so a set of simple stochastic rules should be generated, and used.

For making actual measurements (see Fig. 1) by the point counting method, a graticule is needed which is large enough to be comfortable in use and which will position at least 300 points over the nasal cavities in one or two runs. With this number of points, the relative standard error will be better than 5%. The graticule (dots or crosses) can either be applied to the print as a transparent plastic overlay or integrated in the photographic image by laying it on the sensitive paper when the print is being made.

Alternatively the image may be measured by means of a digitising tablet linked to a microprocessor. We have used the General Digitising System I (Graphic Information Systems Ltd, Blairgowrie, Scotland) which utilises a Tektronix 4051 microprocessor with 32K RAM. At least 2 replicate sets of measurements per specimen should be made. The semi-automated image analysing system is faster and less subject to operator fatigue than point counting; it requires no additional mathematical input to manipulate the data in a variety of ways; and it outputs the results as hard copy. Nevertheless, as might be predicted, it is marginally inferior to point counting in terms of repeatability.

Of the various primary and secondary parameters available, we have found the mean area ratio of free space to total nasal cavity to be the most generally useful as a Morphometric Index (MI). It is conveniently expressed as a percentage (%). Since the MI is a ratio of areas, it may be applied to snouts irrespective of the age/size of the pig, and to prints/images irrespective of their magnification. The MI will tend to underestimate the degree of conchal atrophy in severely affected snouts, in which the overall area of the snout itself is reduced. This tendency will in turn be partially offset by the extra space (S) contributed by the more severely atrophied dorsal conchae in such pigs; which is why we have, pragmatically, disregarded the dorsal conchae in calculating the MI.

Estimates of the MI fall within a continuous range, from about 45% (for the completely normal snout) to 100% (when the conchae are completely atrophied). The distribution of MI versus snout grade is negatively skewed. This is because MI concentrates on the residual free space in the nasal cavity, ignores distortion and disregards compensatory re-growth of the ventral conchae. However, an Asymmetry Index may be calculated, if desired, by comparing the data already available from left and right nostrils.

CONCLUSIONS Morphometric methods, either point counting or semi-automated image analysis, can be applied to photographic or impression prints of pig snout sections to measure the extent of conchal atrophy on a continuous scale; = Morphometric Index (MI). Though relatively labour-intensive, the technique yields highly repeatable parametric data which do not depend heavily on expert subjective judgment. It is therefore particularly suitable for quantitative analysis of the effects of experimental treatments.

SELECTED REFERENCES

MAFF (1978) Atrophic Rhinitis : a system of snout grading. MAFF Booklet LPD 51. Ministry of Agriculture, Pinner, England.

REID, I.M. (1980) Morphometric methods in veterinary pathology : a review. Vet. Pathol. 17, 522-543.

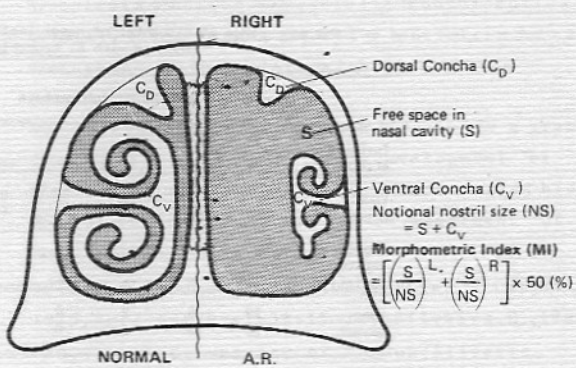

Fig.1. Formula for the Morphometric Index (MI) and the variables from which it is derived.