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Commentary on: Intarapanich NP, McCobb EC, Reisman RW, Rozanski EA, Intarapanich PP. Characterization and comparison of injuries caused by accidental and non-accidental blunt force trauma in dogs and cats. J Forensic Sci 2016 Jul;61(4):993–9.

Sir,

With great interest we have read "Characterization and comparison of injuries caused by accidental and non-accidental blunt force trauma in dogs and cats."(1) The authors address an important topic: How to distinguish NAI (nonaccidental injury) from MVA (motor vehicle accident, accidental injury), when evaluating the cause of injuries in dogs and cats?

Veterinary data of 426 dogs and cats after MVA, and data of 50 dogs and cats classified as NAI victims, were evaluated. Relative frequencies of injuries were reported as odds ratios (ORs) according to injury site or type.

An OR incorporates all observations in the "present" **and** "absent" squares (the four inner squares of a 2-by-2 table) and combines both positive **and** negative findings. By doing this, all information is somehow incorporated, but this makes an OR hard to interpret and difficult to incorporate in a more (forensic) decision theoretical framework. What one would prefer from a forensic perspective is the evidential value of a specific finding. What is the evidential value of the observation of the presence of a specific injury with respect to weighing NAI versus MVA? By what factor do the prior odds change after the observation of the presence of this specific injury has been made?

We propose, using the same data as in the article (Table 2, p.996), a more informative approach of expressing evidential value: likelihood ratios (LRs). Let us illustrate this approach.

For older fractures, the OR equals 120 ($11 \times 425/1 \times 39 = 120$, see Table 2). This does *not* mean that NAI is 120 times more likely than MVA, in case of older fractures. It also does *not* mean that older fractures are 120 times more prevalent given NAI compared to MVA (two examples of common misinterpretations).

In calculating LRs, in contrast to ORs, the observations in the "present" square (in case of a positive finding) and the "column total" of each trauma category in a 2-by-2 table are used. We recalculated the raw data in Table 2 to LRs. For older fractures, this results in a LR of 94 (11/50 divided by 1/426). This essentially means that the presence of older fractures is 94 times more likely under the scenario of NAI (i.e., *assuming NAI actually has happened*) compared to the scenario of MVA (i.e. assuming MVA actually has happened). Using this perspective, the mere presence of older fractures on X-rays (callus) has high evidential value in a forensic evaluation.

So, no matter what the prior odds are with respect to whether the animal was, for example, hit by a car or abused, after observing older fractures on X-rays the odds, of NAI versus MVA are increased by a factor of 94.

The article yields more interesting information. Other LRs with substantial evidential value in favor of NAI compared to MVA are skull fractures LR = 10.5 (16/50 divided by 13/426), teeth fractures LR = 5.5, and rib fractures LR = 3. LRs with substantial evidential value but for the reverse comparison (in favor of MVA compared to NAI) are abrasions LR = 7 and pneumothorax LR = 5.

Limitations of the study are well addressed in the article. For example, medical records from different regions were used for MVA (city) and NAI (rural area). Also, the number of NAI cases was relatively small ($n = 50$). The relevance of these limitations is difficult to estimate. Nevertheless, the study yields valuable information to interpret a veterinary finding in a forensic evaluation of NAI versus MVA in dogs and cats.

The field of veterinary forensics is growing(2–4). To our knowledge, this is the first study which makes LR calculations possible, because a case–control study design was used and raw data were published. Further studies are needed to corroborate the results of this study (including the LRs we calculated).

In future studies, another aspect may be explored as well. A quick look at Table 3A and 3B shows that injuries may occur in combination (based on the factor loadings, it can be inferred that there is correlation between injuries). The LR approach also allows for a logically correct assessment of the evidential value of a combination of injuries.

In conclusion, by recalculating raw data from this article to likelihood ratios (LRs), we add a new dimension of expressing evidential value of a medical or veterinary finding in a forensic evaluation when weighing two scenarios: in general (after ruling out disease) expressed as NAI versus AI (nonaccidental versus accidental injury, such as MVA), in a way which is understandable and easy to use in a more forensic decision theoretical approach.

References

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