Positive predictive value of albumin: globulin ratio for feline infectious peritonitis in a mid-western referral hospital population
Unity Jeffery, Krysta Deitz and Shannon Hostetter
DOI: 10.1177/1098612X12454862

The online version of this article can be found at:
http://jfm.sagepub.com/content/14/12/903

Disclaimer

The Journal of Feline Medicine and Surgery is an international journal and authors may discuss products and formulations that are not available or licensed in the individual reader's own country. Furthermore, drugs may be mentioned that are licensed for human use, and not for veterinary use. Readers need to bear this in mind and be aware of the prescribing laws pertaining to their own country. Likewise, in relation to advertising material, it is the responsibility of the reader to check that the product is authorised for use in their own country. The authors, editors, owners and publishers do not accept any responsibility for any loss or damage arising from actions or decisions based on information contained in this publication; ultimate responsibility for the treatment of animals and interpretation of published materials lies with the veterinary practitioner. The opinions expressed are those of the authors and the inclusion in this publication of material relating to a particular product, method or technique does not amount to an endorsement of its value or quality, or the claims made by its manufacturer.

Published by:
International Society of Feline Medicine

American Association of Feline Practitioners

http://www.sagepublications.com

Additional services and information for Journal of Feline Medicine and Surgery can be found at:
Email Alerts: http://jfm.sagepub.com/cgi/alerts
Subscriptions: http://jfm.sagepub.com/subscriptions
Reprints: http://www.sagepub.com/journalsReprints.nav
Permissions: http://www.sagepub.com/journalsPermissions.nav

>> Version of Record - Nov 26, 2012
OnlineFirst Version of Record - Jul 18, 2012
Positive predictive value of albumin: globulin ratio for feline infectious peritonitis in a mid-western referral hospital population

Unity Jeffery¹, Krysta Deitz² and Shannon Hostetter¹

Abstract
Low albumin to globulin ratio has been found previously to have a high positive predictive value for feline infectious peritonitis (FIP) in cats with clinical signs highly suggestive of the disease. However, FIP can have a more vague clinical presentation. This retrospective study found that the positive predictive value of an albumin:globulin (A:G) ratio of <0.8 and <0.6 was only 12.5% and 25%, respectively, in a group of 100 cats with one or more clinical signs consistent with FIP. The negative predictive value was 100% and 99% for an A:G ratio of <0.8 and A:G<0.6%, respectively. Therefore, when the prevalence of FIP is low, the A:G ratio is useful to rule out FIP but is not helpful in making a positive diagnosis of FIP.

Accepted: 20 June 2012

Feline infectious peritonitis (FIP) cannot be diagnosed definitively without histopathology. Many owners are reluctant to pursue ante mortem biopsy when FIP is considered likely because of the poor prognosis associated with FIP. Therefore, there is considerable interest in non-invasive tests which can support or refute a clinical suspicion of FIP. A serum albumin:globulin ratio (A:G) of <0.8 has been reported to have a sensitivity of 0.80 and specificity of 0.82 for FIP.¹ Hartmann et al reported a 92% positive predictive value for A:G <0.8 based on a theoretical population with a 75% prevalence of FIP.¹ In an earlier study using only cats with effusions, an A:G ratio of <0.6 was reported to be ‘highly diagnostic for an inflammatory process, nearly exclusively for FIP’.²

Positive and negative predictive values depend greatly on the prevalence of the disease in the tested population.³ The positive predictive value is the probability that an animal with a positive test truly has the target disease.³ When prevalence of the disease is high, the positive predictive value of a test will be greater than when prevalence is low.³ Both the previous studies were based on populations of cats in which the prevalence of FIP was high. However, FIP can be a differential diagnosis for vague signs of ill-health and also rarely afflicts older cats.⁴ Among such populations, FIP prevalence is likely to be low and many other diseases are potential diagnoses. Cats presenting to a veterinary referral clinic in the American mid-west may also have a different prevalence of the various causes of low A:G ratio (eg FIP, lymphoma, chronic infection) from the German cats used in the previous studies.

In order to investigate the performance of low A:G ratio as a diagnostic test for cats with vague signs of ill-health consistent with a possible diagnosis of FIP, this study aimed to establish the positive predictive value of A:G <0.8 and <0.6 for FIP in a referral hospital population of mid-western cats with one or more clinical signs compatible with FIP.

Medical records of cats admitted to the Lloyd Veterinary Medical Center (Iowa State University) were reviewed in reverse chronological order from September 2011 until January 2009. One hundred cats were identified which met all the following inclusion criteria: first, a biochemistry profile, including albumin was recorded; second, clinical signs included lethargy and inappetence, together with one or more of the other signs

¹Department of Veterinary Pathology, Iowa State University, Ames, IA, USA
²Department of Veterinary Clinical Sciences, Iowa State University, Ames, IA, USA

Corresponding author:
Unity Jeffery BA VetMB MRCVS, Department of Veterinary Pathology, Iowa State University, Ames, Iowa, 50011, USA
Email: ublocke@iastate.edu
commonly considered consistent with FIP (i.e., weight loss, pyrexia, effusion, neurological signs, diarrhea, mild upper respiratory tract signs, ocular lesions, and jaundice); and, third, histopathology either conclusively proved the presence or absence of FIP or, where histopathology was not performed, there was evidence that the cat survived at least 1 year after initial presentation. FIP was considered a highly unlikely cause of clinical signs in cats surviving more than 1 year based on previously reported survival times in confirmed cases of FIP. The following was recorded for all cases: age, breed, sex, clinical signs, diagnosis, and serum A:G ratio.

There were three intact females, two intact males, 46 neutered males, and 49 spayed females. Breeds were domestic shorthair (n = 83), domestic long hair (n = 6), Siamese (n = 6), Persian (n = 3), Abyssinian (n = 1) and Devon Rex (n = 1). Mean age was 9.6 years. The age range for cats with confirmed FIP was 6 months to 7 years. The age range for cats without FIP was 18 months to 18 years. The number of cats with the various clinical signs compatible with FIP is summarized in Table 1. The basis for classification of clinical signs as not due to FIP was histologic confirmation of another disease for 42 cats and survival of more than 1 year for 54 cats. This is summarized by A:G ratio in Table 2.

A diagnosis of FIP was confirmed histologically in 4/100 cats. All four FIP cats had an A:G < 0.8 (range 0.4–0.7) and 3/4 had an A:G < 0.6 (range 0.5–0.4). Of the 96 cats with a final diagnosis other than FIP, A:G was < 0.8 in 28/96 (range 0.7–0.1) and < 0.6 in 9/96 (range 0.5–0.1). For the referral population of mid-western cats included in the study, this results in a positive predictive value of 12.5% for A:G < 0.8 and 25% for A:G < 0.6, and a negative predictive value of 100% for A:G < 0.8 and 99% for A:G < 0.6. The calculations performed are shown in Table 3.

The findings of this study emphasize the importance of interpreting diagnostic test performance in relation to the population in which the test will be used. Sensitivity and specificity are not greatly population dependent. However, positive and negative predictive values vary greatly with the population prevalence. Our negative predictive value supports the findings of previous studies: in our population, a cat with an A:G of 0.6 or more is highly unlikely to have FIP. However, our positive predictive values of 12.5% for A:G < 0.8 and 25% for A:G < 0.6 are considerably lower than has been reported previously. This means that in the population of cats visiting a referral hospital in the mid-west of the USA (amongst which the prevalence of FIP is low), a low A:G is of little value in confirming FIP.

### Table 1 Clinical signs in cats with signs compatible with feline infectious peritonitis

<table>
<thead>
<tr>
<th>Clinical sign</th>
<th>Number of cats</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anorexia/inappetence</td>
<td>100</td>
</tr>
<tr>
<td>Lethargy</td>
<td>100</td>
</tr>
<tr>
<td>Weight loss</td>
<td>50</td>
</tr>
<tr>
<td>Pyrexia</td>
<td>19</td>
</tr>
<tr>
<td>Effusion</td>
<td>16</td>
</tr>
<tr>
<td>Neurological signs</td>
<td>16</td>
</tr>
<tr>
<td>Effusion</td>
<td>12</td>
</tr>
<tr>
<td>Mild upper respiratory tract signs</td>
<td>9</td>
</tr>
<tr>
<td>Ocular lesions</td>
<td>8</td>
</tr>
<tr>
<td>Jaundice</td>
<td>5</td>
</tr>
</tbody>
</table>

### Table 2 Criteria for classification as feline infectious peritonitis (FIP) affected and FIP unaffected

<table>
<thead>
<tr>
<th></th>
<th>A:G &lt;0.6</th>
<th>0.8 &lt; A:G ≥ 0.6</th>
<th>A:G ≥ 0.8</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Histologically confirmed FIP</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Histologically confirmed diagnosis other than FIP</td>
<td>4</td>
<td>8</td>
<td>30</td>
<td>42</td>
</tr>
<tr>
<td>Survived &gt; 1 year</td>
<td>5</td>
<td>11</td>
<td>38</td>
<td>54</td>
</tr>
<tr>
<td>Total</td>
<td>12</td>
<td>20</td>
<td>68</td>
<td>100</td>
</tr>
</tbody>
</table>

A:G = albumin:globulin

### Table 3 Calculations used for positive and negative predictive value

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Formula</th>
<th>Calculation for A:G &lt; 0.8</th>
<th>Result for A:G &lt; 0.8 (%)</th>
<th>Calculation for A:G &lt; 0.6</th>
<th>Result for A:G &lt; 0.6 (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Positive predictive value</td>
<td>[TP/(TP + FP)]*100</td>
<td>4/(4 + 28)</td>
<td>12.5</td>
<td>3/(3 + 9)</td>
<td>25</td>
</tr>
<tr>
<td>Negative predictive value</td>
<td>[TN/(TN + FN)]*100</td>
<td>68/(68 + 0)</td>
<td>100</td>
<td>87/(87 + 1)</td>
<td>99</td>
</tr>
</tbody>
</table>

TP = true positive; FP = false positive; TN = true negative; FN = false negative; A:G = albumin:globulin
In the study population, cats with FIP were considerably younger than many of those without FIP. It is well recognized that FIP most commonly affects younger cats. However, FIP has been reported in middle-aged and old cats. For example, a recent survey of 382 Australian cats with FIP found an age range of 2 months to 15 years. Therefore, we consider that FIP was a reasonable differential diagnosis for the older cats included in this study.

Two cats with histological diagnosis of FIP were excluded because of lack of albumin result and one cat was excluded because FIP was considered unlikely but not completely ruled out on histopathology. This may have underestimated the prevalence of FIP and thus falsely reduced the positive predictive values. However, if these cats are all assumed to be FIP-positive with an A:G <0.6, the positive predictive value of A:G <0.8 remains only 20% and of A:G <0.6 only 40%.

In conclusion, using an A:G of <0.8 or <0.6 to support a diagnosis of FIP in a cat from a population in which FIP is one of several possible differential diagnoses carries a high risk of a false-positive diagnosis.

Funding This research received no grant from any funding agency in the public, commercial or not-for-profit sectors.

Conflict of interest The authors declare that there is no conflict of interest.

References