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Objective—To determine results of cytologic examination of fine-needle aspirates and impression smears of gastrointestinal tract tumors in dogs and cats.

Design—Retrospective case series.

Animals—38 dogs and 44 cats with histologically confirmed gastrointestinal tract tumors.

Procedures—Results of cytologic examination of fine-needle aspirates (n = 67) or impression smears (31) were compared with the histologic diagnosis, and extent of agreement was classified as complete, partial, none, or undetermined (ie, cytologic specimen was unsatisfactory because of hypocellularity, hemodilution, or necrosis).

Results—For 48 of the 67 (72%) fine-needle aspirates, there was complete or partial agreement between the cytologic and histologic diagnoses. For 12 (18%) aspirates, the extent of agreement could not be determined because the cytologic specimen was considered unsatisfactory. For 29 of the 31 (94%) impression smears, there was complete agreement between the cytologic and histologic diagnoses, and for 2 (6%), there was partial agreement. None of the impression smears were considered unsatisfactory. Proportion of samples with complete agreement and proportion of samples with complete or partial agreement were significantly higher for impression smears than for fine-needle aspirates.

Conclusions and Clinical Relevance—Results suggest that there was moderate agreement between results of cytologic examination of fine-needle aspirates from dogs and cats with gastrointestinal tract neoplasia and the definitive histologic diagnosis. The agreement between results of cytologic examination of impression smears and the histologic diagnosis appeared to be higher. (J Am Vet Med Assoc 2006;229:xxx–xxx)

Gastrointestinal tract tumors account for <1% of all malignancies in dogs and cats. Nevertheless, they are an important clinical problem. Adenocarcinoma, carcinoma, leiomyoma, leiomyosarcoma, fibrosarcoma, lymphoma, and extramedullary plasmacytoma are the most commonly reported gastrointestinal tract tumors in dogs, whereas lymphoma, adenocarcinoma, and mast cell tumor are the most commonly reported gastrointestinal tract tumors in cats.

Only a few previous reports have described the cytologic features of gastrointestinal tract tumors in dogs and cats or described the use of ultrasound-guided fine-needle biopsy to establish a diagnosis of gastrointestinal tract neoplasia. Percutaneous ultrasound-guided fine-needle biopsy is potentially useful in human patients in whom poor patient condition precludes the use of endoscopic biopsy and in human patients with submucosal lesions that cannot be reached endoscopically. The same would also likely be true in dogs and cats. However, little information has been published on the accuracy of cytologic examination. Accordingly, the purpose of the study reported here was to determine the diagnostic value of cytologic examination of percutaneous ultrasound-guided fine-needle aspirates and impression smears of tissue specimens obtained during surgical exploration in dogs and cats with gastrointestinal tract tumors.

Criteria for Selection of Cases

Medical records of dogs and cats examined at the authors’ institutions between 2001 and 2004 were reviewed. Dogs and cats were eligible for inclusion in the study if a diagnosis of gastrointestinal tract neoplasia had been confirmed histologically and cytologic slides consisting of smears of percutaneous ultrasound-guided fine-needle aspirates or impression smears of tissue specimens collected during surgical exploration or necropsy were available for review.

Procedures

Information obtained from the medical records of cases included in the study consisted of signalment and histologic diagnosis. For all animals included in the study, biopsy specimens had been fixed in neutral-buffered 10% formalin and submitted to various commercial laborato-
rieries where they were routinely processed. For all specimens, sections stained with H&E had been examined histologically to determine the diagnosis. In select instances, immunohistochemical staining had been performed as necessary to allow a definitive diagnosis to be made or to allow for immunophenotyping of some lymphomas. For purposes of the present study, gastrointestinal tract tumors were classified as epithelial, neuroendocrine, hematopoietic, or mesenchymal.

For each case included in the present study, 2 to 3 cytologic slides were reviewed by 4 clinical pathologists (UB, WB, DDL, and CM) who were not aware of the histologic diagnosis. Although these 4 individuals worked independently in different laboratories, they regularly met to discuss possible differences in cytologic interpretations and to resolve disputes. All slides had been air-dried and stained with May-Grunwald-Giemsa stain. If a diagnosis of neoplasia was made, participating pathologists were instructed to indicate cell lineage (ie, epithelial, neuroendocrine, hematopoietic, or mesenchymal) and cell type (eg, adenocarcinoma vs carcinoma or leiomyosarcoma vs liposarcoma). If cells appeared clustered and tightly arranged, cell lineage was classified as epithelial; if cells appeared loosely cohered as free nuclei in a background of cytoplasm with few cytoplasmic borders, cell lineage was classified as neuroendocrine; if cells appeared individual, roundish, or discrete, cell lineage was classified as hematopoietic; and if cells appeared oval or spindle-shaped, cell lineage was classified as mesenchymal.

Data analysis—For each case, the cytologic diagnosis was compared with the histologic diagnosis, with the histologic diagnosis considered the gold standard, and the extent of agreement between the cytologic diagnosis and the histologic diagnosis was classified as complete agreement, partial agreement, no agreement, or undetermined. Complete agreement was defined as agreement in regard to both cell lineage and cell type. Partial agreement was defined as agreement in regard to cell lineage, but a lack of agreement in regard to cell type (eg, a cytologic diagnosis of adenocarcinoma and histologic diagnosis of carcinoma) or an inability to characterize cell type on the basis of cytologic examination. No agreement was defined as a lack of agreement in regard to cell lineage or a cytologic diagnosis of any non-neoplastic lesion (eg, inflammation). Extent of agreement was classified as undetermined if the cytologic specimen was unsatisfactory because of hypocellularity, hemodilution, or necrosis.

Proportions of cases for which there was complete agreement, partial agreement, no agreement, or undetermined agreement between cytologic and histologic diagnoses were calculated for cytologic specimens obtained from fine-needle aspirates versus impression smears; for animals grouped according to anatomic location of the tumor (ie, gastric vs intestinal tumors); and, within anatomic location subgroups, for animals grouped according to species (ie, dog vs cat). For subgroup analyses, proportions were calculated only if there were a minimum of 10 cases in the subgroup. Proportions of cases with complete agreement and with complete or partial agreement were compared between groups with the Fisher exact test; a value of P < 0.05 was considered significant. Sensitivity and specificity of cytologic examination in predicting histologic type of specific tumors were then calculated. To achieve an adequate number of cases, tumors were grouped into 3 categories (lymphoma, carcinoma or adenocarcinoma, and leiomyoma or leiomyosarcoma) for these calculations.

Results
Forty-four cats and 38 dogs fulfilled the criteria for inclusion in the study. The cats consisted of 27 (61%) castrated males, 16 (36%) spayed females, and 1 (2%) sexually intact male. Median age was 11 years (range, 3 to 18 years). There were 28 (82%) domestic cats, 3 (9%) Persians, and 3 (9%) Siamese (information on breed was not available for 10 cats). The dogs consisted of 15 (39%) sexually intact males, 10 (26%) sexually intact females, 9 (24%) castrated males, and 4 (11%) spayed females. Median age was 9 years (range, 3 to 14 years). There were 15 (48%) mixed-breed dogs; 3 (10%) Doberman Pinschers; 2 (6%) Labrador Retrievers; 2 (6%) Marenmanos; and 1 each (3%) of the following breeds: Basset Hound, Boxer, Cocker Spaniel, Dalmatian, Golden Retriever, Irish Wolfhound, American Staffordshire Terrier, Pekingese, and Shar Pei (information on breed was not available for 7 dogs).

Fourteen animals (3 cats and 11 dogs) had gastric tumors. Histologic diagnoses included lymphoma (n = 6, including all 3 cats), adenocarcinoma (2), carcinoma (2), histiocytic sarcoma (1), leiomyoma (1), leiomyosarcoma (1), and mast cell tumor (1). Sixty-nine animals (41 cats and 28 dogs [1 dog had both a gastric and an intestinal tumor]) had intestinal tumors. Histologic diagnoses for the 41 cats included lymphoma (n = 26, of which 7 had large granular lymphoma), adenocarcinoma (6), leiomyosarcoma (4), mast cell tumor (2), carcinoma (1), histiocytic sarcoma (1), and liposarcoma (1). Histologic diagnoses for the 28 dogs included lymphoma (n = 9), adenocarcinoma (7), leiomyosarcoma (6), carcinoma (5), and neuroendocrine tumor (gastrinoma; 1). Information on localization of tumors to the small or large intestine could not be reliably retrieved from the medical records.

Smears of fine-needle aspirates were available for all 14 animals with gastric tumors and for 53 (37 cats and 16 dogs) of the 69 animals with intestinal tumors. Impression smears were available for only 3 animals (1 cat and 2 dogs) with gastric tumors and 28 animals (12 cats and 16 dogs) with intestinal tumors.

Proportions of cases with complete agreement or with complete or partial agreement were significantly higher for impression smears than fine-needle aspirates (P = 0.002 and 0.001, respectively; Table 1). For animals with gastrointestinal tract lymphoma, the sensitivity and specificity of cytologic examination of fine-needle aspirates were 71% (27/38; 95% CI, 55% to 83%) and 100% (29/29; 95% CI, 88% to 100%), respectively, whereas the sensitivity and specificity of cytologic examination of impression smears were both 100% (12/12 [95% CI, 76% to 100%] and 19/19 [95% CI, 83% to 100%], respectively). For animals with gastrointestinal tract carcinoma or adenocarcinoma, the
sensitivity and specificity of cytologic examination of fine-needle aspirates were 63% (10/16; 95% CI, 39% to 82%) and 98% (50/51; 95% CI, 90% to 100%), respectively, whereas the sensitivity and specificity of cytologic examination of impression smears were 90% (9/10; 95% CI, 60% to 98%) and 100% (21/21; 95% CI, 83% to 100%), respectively. For animals with gastrointestinal tract leiomyoma or leiomyosarcoma, the sensitivity and specificity of cytologic examination of fine-needle aspirates were 44% (4/9; 95% CI, 19% to 73%) and 100% (38/38; 95% CI, 94% to 100%), respectively, whereas the sensitivity and specificity of cytologic examination of impression smears were both 100% (5/5 [95% CI, 57% to 100%] and 26/26 [95% CI, 87% to 100%], respectively).

### Discussion

Results of the present study suggest that there was moderate agreement between results of cytologic examination of fine-needle aspirates from dogs and cats with gastrointestinal tract neoplasia and the definitive histologic diagnosis for those animals. The agreement between results of cytologic examination of impression smears and the histologic diagnosis appeared to be higher, but collection of tissue specimens for creation of impression smears generally requires surgery, making this technique more invasive.

Proportions of cases for which there was complete or partial agreement between the cytologic and histologic diagnoses in the present study were somewhat higher than values reported previously. In 1 study, sensitivity of cytologic examination reportedly ranged from 33% to 66%, but animals with dysplastic and hyperplastic diseases, which are difficult to diagnose cytologically, were included. Moreover, a large number of the specimens were collected by veterinary students who lacked experience in the technique, potentially reducing the number of diagnostic samples. In contrast, a separate study reported a sensitivity of 96%, but in that study, many of the specimens were obtained at surgery or necropsy, which may have improved diagnostic sensitivity because of the lowered risk of sampling mistakes and the higher probability of obtaining larger specimens. Results of the present study confirm that results of cytologic examination of impression smears were more likely to agree with histologic findings than were results of cytologic examination of fine-needle aspirates.

In the present study, 12 of 67 (18%) fine-needle aspirates were considered unacceptable because of hypocellularity, hemodilution, or necrosis, but none of the 31 impression smears were considered unacceptable. Unfortunately, the invasiveness of the sampling technique required for making impression smears makes it a less suitable option for diagnostic purposes in a clinical setting. Moreover, many dogs and cats with masses involving the gastrointestinal tract are already in moderate or poor body condition and are therefore less suitable candidates for exploratory abdominal surgery, further limiting the usefulness of this technique. Finally, despite the high level of agreement found in the present study, if a tissue sample is obtained, then results of cytologic examination of an impression smear should not be considered definitive and the sample should still be submitted for histologic examination. Nevertheless, in animals in which intraoperative identification of the specific tumor type may provide the attending surgeon with useful information about the necessity for more aggressive surgery, cytologic examination of an impression smear may be useful. Moreover, cytologic examination of impression smears can be helpful in detecting malignant cells at resection margins. Finally, results of cytologic examination of impression smears may provide additional input for important therapeutic decisions that need to be made in the immediate postoperative period.

In the present study, proportions of complete or partial agreement were between results of cytologic examination of fine-needle aspirates and the definitive histologic diagnosis were 68% and 76%, respectively, for animals with intestinal tumors. These values were somewhat lower for animals with gastric

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**Table 1—Extent of agreement between results of histologic examination in dogs and cats with gastrointestinal tract tumors and results of cytologic examination of impression smears and fine-needle aspirates.**

<table>
<thead>
<tr>
<th>Group</th>
<th>Complete</th>
<th>Complete or partial</th>
<th>None</th>
<th>Undetermined</th>
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<tr>
<td></td>
<td>FNA</td>
<td>IS</td>
<td>FNA</td>
<td>IS</td>
</tr>
<tr>
<td>All animals</td>
<td>43 (64)</td>
<td>29 (94)</td>
<td>48 (72)</td>
<td>31 (100)</td>
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<td>Animals with gastric neoplasia</td>
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<td>2 (ND)</td>
<td>8 (57)</td>
<td>3 (ND)</td>
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<tr>
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<td>1 (ND)</td>
<td>2 (ND)</td>
<td>1 (ND)</td>
</tr>
<tr>
<td>Dogs with gastric neoplasia</td>
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<td>1 (ND)</td>
<td>6 (55)</td>
<td>2 (ND)</td>
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<tr>
<td>Animals with intestinal neoplasia</td>
<td>36 (68)</td>
<td>27 (96)</td>
<td>40 (76)</td>
<td>28 (100)</td>
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<tr>
<td>Cats with intestinal neoplasia</td>
<td>11 (92)</td>
<td>9 (92)</td>
<td>29 (78)</td>
<td>12 (100)</td>
</tr>
<tr>
<td>Dogs with intestinal neoplasia</td>
<td>10 (63)</td>
<td>16 (100)</td>
<td>11 (69)</td>
<td>16 (100)</td>
</tr>
</tbody>
</table>

Data are given as number (% of cases).

FNA = Fine-needle aspirates. IS = Impression smears. ND = Not determined because there were < 10 cases.

Complete agreement was defined as agreement in regard to both cell lineage and cell type. Partial agreement was defined as agreement in regard to cell lineage but a lack of agreement in regard to cell type or an inability to characterize cell type. No agreement was defined as a lack of agreement in regard to cell lineage or a cytologic diagnosis of any non-neoplastic lesion (eg, inflammation). Extent of agreement was classified as undetermined if the cytologic specimen was unsatisfactory because of hypocellularity, hemodilution, or necrosis.
tumors (50% and 57%), suggesting that this technique may be more useful in animals suspected to have intestinal neoplasia. More often, with gastric tumors, it appeared that cytologic examination of fine-needle aspirates led to inconclusive or incorrect diagnoses because of concomitant inflammatory processes and necrosis of the inner portions of some tumors. Thus, results of cytologic examination of fine-needle aspirates should be interpreted cautiously, especially in animals with a gastric mass that is suspected to be neoplastic.

Finally, sensitivity of cytologic examination of fine-needle aspirates was somewhat higher for animals with gastrointestinal tract lymphoma in the present study (71%) than for animals with leiomyoma or leiomyosarcoma (44%). This difference was probably related to the intrinsic tendency of round cell and epithelial tumors to exfoliate easily, compared with mesenchymal neoplasms. On the other hand, for all tumor types, the specificity of cytologic examination with either method was high (98% to 100%), indicating that if neoplastic features are clearly observed during cytologic examination, the likelihood of making an incorrect diagnosis is low.

Finally, some limitations of the present study need to be addressed. First, because the study was retrospective, the information included in the study had been generated over a period of 4 years by various observers. Consequently, pertinent information was not systematically recorded in each medical record. In particular, the location of intestinal tumors in the large or small intestine could not be reliably determined from the medical records, precluding analysis of this factor. In addition, most of the specimens were routinely stained with H&E for histologic examination. Thus, many smooth muscle tumors were diagnosed on the basis of morphologic criteria, and immunohistochemical staining was used infrequently to confirm the diagnosis. Nonetheless, we believe that this had little effect on our results because for most stromal gastrointestinal tract tumors in dogs, immunostaining is not required to verify their myogenic origin.

References


