Adrenal Gland Ultrasonography in Dogs with Hypoadrenocorticism

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ABSTRACT

Objective: To identify a reliable set of adrenal ultrasonography parameters that can be used to identify dogs with hypoadrenocorticism.

Methods: Retrospective review of adrenal gland measurements and morphology in 81 client-owned dogs that were presented for a variety of medical reasons. Based on adrenal gland measurements and morphology and an ACTH stimulation test, dogs were divided into three groups: hypoadrenocorticism (Group 1, 37 dogs), non-hypoadrenocorticism (Group 2, 19 dogs), and a control group (Group 3, 25 dogs).

Results: Median right adrenal length in Group 1–3 was 1.75 cm, 1.8 cm, and 2.03 cm, respectively. Median left adrenal length in Group 1–3 was 1.77 cm, 2.08 cm, and 2.1 cm, respectively. There was no statistically significant difference between the right and left adrenal gland measurements and within groups. Median right adrenal thickness in Group 1–3 was 0.34 cm, 0.37 cm, and 0.6 cm, respectively. Median left adrenal thickness in Group 1–3 was 0.31 cm, 0.4 cm, and 0.6 cm, respectively. In both right and left measurements, Groups 1 and 2 were statistically different from Group 3 but there was no statistical difference between Groups 1 and 2.

Conclusion: The ultrasound finding of small, flattened, isoechoic adrenal glands should be an alert for possible hypoadrenocorticism, prompting additional confirmatory function testing and/or therapeutic intervention, however, no reliable measurements were identified in this study.

INTRODUCTION

As variable non-specific clinical signs and biochemical changes typify canine hypoadrenocorticism, abdominal ultrasonography is often done as part of the medical work-up. There are only two studies in the English veterinary literature that have ultrasonographically evaluated the adrenal gland in dogs with hypoadrenocorticism. In one study of six dogs with hypoadrenocorticism, the range for adrenal gland thickness was 0.22–0.34 cm, whereas in a group of 20 normal dogs the range was 0.3–0.6 cm[1]. In the other study, 30 dogs with primary hypoadrenocorticism showed significantly thinner adrenal glands and a shorter left adrenal gland length. The study concluded that adrenal ultrasonography may be of diagnostic value in dogs with clinical signs suggestive of primary hypoadrenocorticism and that a left adrenal gland measuring less than 0.32 cm in thickness is strongly suggestive of the hypoadrenocorticism[2].

As abdominal ultrasonography is routinely used in veterinary practice, the purpose of this study was to identify a reliable set of adrenal ultrasonography morphology and measurement parameters that can be used to identify dogs with possible hypoadrenocorticism.

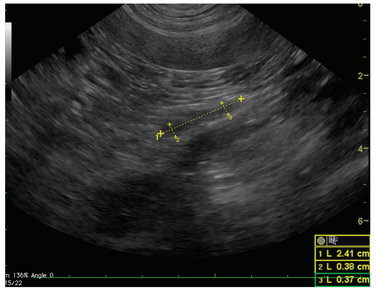
MATERIALS AND METHODS

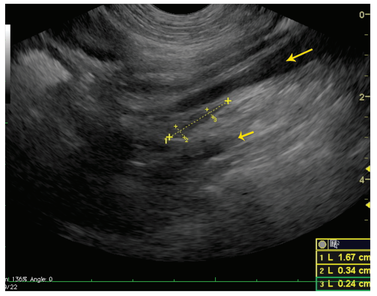
The records of 81 privately owned dogs that had abdominal ultrasonography done as well as an ACTH stimulation test were retrospectively evaluated. To exclude inter-observer bias, all adrenal gland measurements and morphology were retrospectively reviewed using both still and video clips by one person (EL) and correlated with clinical signs, biochemical changes, and results of an ACTH stimulation test.

Adrenal gland size and morphology was evaluated by abdominal ultrasound examination using an 8 MHz probe and an ultrasound machine (General Electric Logic E ultrasound machine, GE Healthcare Biosciences, Box 643065 Pittsburgh, USA).

The dogs were divided into three groups: Group 1 consisted of 37 dogs with clinical signs and/or an ultrasonographic appearance of their adrenal glands that was suspicious of hypoadrenocorticism and confirmed on an ACTH stimulation test. Group 2 consisted of 19 dogs with clinical signs and/or an ultrasonographic appearance of their adrenal glands that was suspicious of hypoadrenocorticism but ruled out by a normal ACTH stimulation test. Group 3 consisted of 25 dogs that had no clinical signs or biochemical evidence of hypoadrenocorticism, normal sonographic appearance of their adrenal glands, and a normal ACTH stimulation test. Dogs with a history of corticosteroid therapy were excluded from the study.

All data were tabulated in a spreadsheet program (Excel®) and statistical analysis was performed with the aid of a statistical software package (NCSS®, 329 North 1000 East, Kaysville, Utah, USA). Descriptive statistics were used to describe the data. For single parameters (age, bodyweight, adrenal length, and adrenal thickness), differences between the groups were tested using one-way analysis of variance with Bonferroni and Tukey-Kramer comparisons. The data was normally distributed and the level of significance was set at $p < 0.05$. Within each group, correlations between bodyweight and age and length and width of the adrenal glands were tested using the Spearman's rank-order correlation coefficient.





Images 1 & 2: Ultrasound image of the left and right adrenal glands from a dog with hypoadrenocorticism. Both glands appear flattened in contour and largely isoechoic to mildly hypoechoic to the surrounding fat. Subnormal width is evident on measurements. Large arrowindicates caudal vena cava and shorter arrow the aorta, which are landmarks for the right adrenal gland. *Images: Andi Parkinson RDMS*

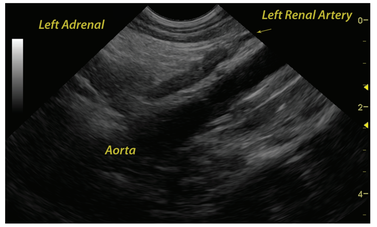


Image 3: Ultrasound image of the left adrenal gland from a normal dog demonstrating normal size, rounded contour, and distinct hypoechoic parenchyma compared to surrounding fat. Renal artery indicated by arrow. *Image: Eric Lindquist DMV, DABVP, Cert. IVUSS.*

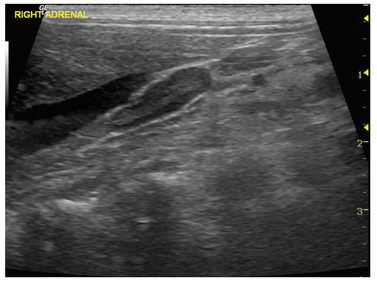
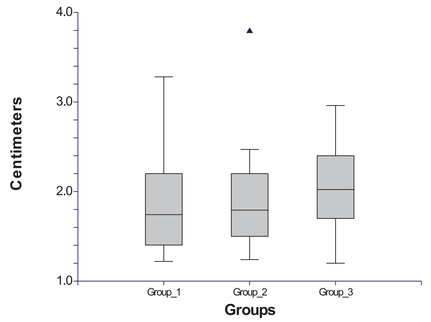
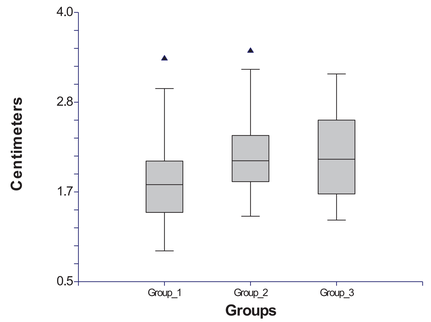


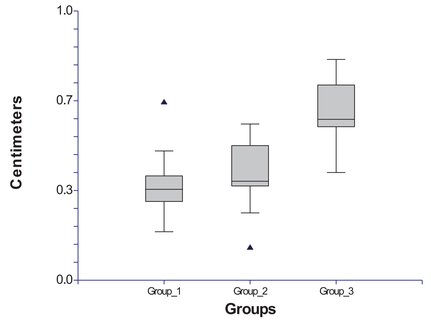
Image 4: Normal right adrenal gland in a Shih Tzu dog. Note the uniformly rounded contour and distinct separation of cortex and medulla typical of normal adrenal glands, both of which are lost in Addisonian adrenal glands. *Image: Doug Casey DVM, DABVP, Cert IVUSS.*



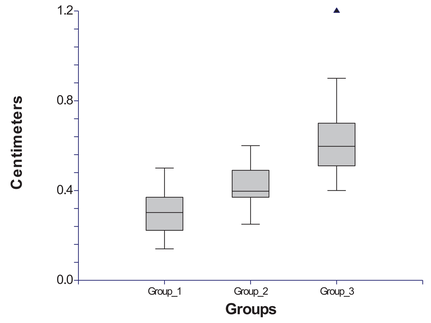
Graph 1: Right adrenal length. Data shown as median (horizontal line within box), 25th and 75th percentiles (horizontal ends of boxes), and 10th and 90th percentiles (T-bars). Black triangle represents an outlier. Group 1= hypoadrenocorticism; Group 2 = non-hypoadrenocorticism; Group 3 = control. There was no statistical difference between the groups.



Graph 2: Left adrenal length. Data shown as median (horizontal line within box), 25th and 75th percentiles (horizontal ends of boxes), and 10th and 90th percentiles (T-bars). Black triangles represent outliers. Group 1= hypoadrenocorticism; Group 2 = non-hypoadrenocorticism; Group 3 = control. There was no statistical difference between the groups.



Graph 3: Right adrenal thickness. Data shown as median (horizontal line within box), 25th and 75th percentiles (horizontal ends of boxes), and 10th and 90th percentiles (T-bars). Black triangles represent outliers. Group 1 = hypoadrenocorticism; Group 2 = non-hypoadrenocorticism; Group 3 = control. Groups 1 and 2 were statistically different from Group 3 but not between each other.



Graph 4: Left adrenal thickness. Data shown as median (horizontal line within box), 25th and 75th percentiles (horizontal ends of boxes), and 10th and 90th percentiles (T-bars). Black triangle represents an outlier. Group 1 = hypoadrenocorticism; Group 2 = non-hypoadrenocorticism; Group 3 = control. Groups 1 and 2 were statistically different from Group 3 but not between each other.

RESULTS

The median age in Group 1 was 7 years (range 1–14); Group 2, 8 years (range 1–11); and Group 3, 11 years (range 3–14), with Group 3 being statistically older than the other two groups. A similar sex distribution was present within the three groups. The median weight in Group 1 was 24 kg (range 4–65); Group 2, 18 kg (range 8–35); and Group 3, 18 kg (range 8–35), with no statistical difference between the groups. Diseases reported in Group 2 included gastrointestinal (8), CNS (1), renal failure (1), urinary tract infection (1), and non-specific disease (8).

The adrenal glands in Group 1 were subjectively found to be flattened in contour, largely isoechoic to mildly hypoechoic to the surrounding fat, and showed loss of cortico-medullary detail. Subjective change in gland length compared to a normal adrenal gland did not appear to be a common finding by the interpreter. The adrenal glands in Group 2 subjectively were interpreted to have similar morphological parameters compared to Group 1 with regards to comparative echogenicity and flattened glandular contour. In both Groups 1 and 2, the adrenal glands were not readily recognized with a distinct echogenic separation between gland, echogenic capsule, and surrounding fat despite proper sonographic positioning, adequate imaging window, and a scanning depth of less than 5 cm. All dogs in Groups 1 and 2 showed a varying degree of presence of the subjective parameters evaluated—flattened contour, tendency toward isoechogenicity to surrounding fat.

The median right adrenal length in Group 1 was 1.75 cm (range 1.22–3.28 cm); in Group 2, 1.8 cm (range 1.24–3.79 cm); and in Group 3, 2.03 cm (range 1.2–2.96 cm); with no group showing statistical difference. The median left adrenal length in Group 1 was 1.77 cm (range 0.9–3.4 cm); in Group 2, 2.08 cm (range 1.35–3.5 cm); and in Group 3, 2.1 cm (range 1.3–3.2 cm); with no group showing a statistical difference.

The median right adrenal thickness in Group 1 was 0.34 cm (range 0.18–0.48 cm); in Group 2, 0.37 cm (range 0.12–0.58 cm); and in Group 3, 0.6 cm (range 0.4–0.82 cm); with Groups 1 and 2 showing a statistical difference from Group 3. There was, however, no statistical difference between Groups 1 and 2. The median left adrenal thickness in Group 1 was 0.31 cm (range 0.16–0.5); in Group 2, 0.4 cm (range 0.25–0.6); and in Group 3, 0.6 cm (range 0.4–1.2); with Groups 1 and 2 showing a statistically significant difference from Group 3 (Graph 4). There was, however, no statistical difference between Groups 1 and 2.

Within all groups no correlation could be shown between the bodyweight and length and thickness of the adrenal glands, nor between age of the dogs and the length and thickness of the adrenal glands.

SUMMARY AND CONCLUSIONS

Hypoadrenocorticism can be a life-threatening and possibly fatal disease if not treated immediately. Although a tentative diagnosis can be made on clinical signs and laboratory findings, a definitive diagnosis can only be made on an ACTH stimulation test. Unfortunately typical clinical signs and laboratory findings are not evident in all cases and the ACTH stimulation test results are usually not immediately available. As ultrasonography is widely used and results immediately available, it would be ideal as a diagnostic aid for hypoadrenocorticism.

This study suggests that the ultrasonography finding of small, flattened, isoechoic adrenals that are difficult to locate despite adequate scanning window and position are useful in the support a suspicion of primary hypoadrenocorticism but unfortunately not diagnostic as similar changes can occur with other disease conditions. This finding should, however, prompt additional adrenal function testing.

In addition, abdominal sonography is a commonly performed procedure in the work-up of systemically ill dogs even prior to the suspicion of hypoadrenocorticism. The finding of flattened isoechoic adrenal glands should prompt the clinician to screen for hypoadrenocorticism especially as cases of atypical Addison's will not have typical electrolyte imbalances on the biochemical profile. However, an ACTH stimulation test is the gold standard since although other systemic conditions can result in small adrenal glands.

REFERENCES

1. Hoerauf, A. & Reusch, C. (1999) Ultrasonographic evaluation of the adrenal glands in six dogs with hypoadrenocorticism. Journal of the American Animal Hospital Association 35, 214–218
2. Wenger. M., Mueller, C., Kook, P. H. & Reusch, C. E. (2010) Ultrasonographic evaluation of adrenal glands in dogs with primary hypoadrenocorticism or mimicking diseases. Veterinary Record 167; 207–210