

Treatment and monitoring of naturally occurring Cushing's syndrome by primary care veterinarians in selected European countries

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Abstract

Background: Treatment of naturally occurring Cushing's syndrome includes surgery or medical management but there is little information on how primary care veterinarians (PCVs) select and monitor such treatment.

Hypothesis/Objectives: Determine how PCVs from selected European countries treat and monitor Cushing's syndrome in dogs.

Methods: Cross-sectional survey study assessing treatment and monitoring protocols used by PCVs when managing dogs with Cushing's syndrome.

Results: A total of 2178 responses from 9 European countries were included. Overall, 1694 (77.8%) respondents attempted to differentiate functional adrenal tumor (FAT) from pituitary-dependent hypercortisolism (PDH). Adrenalectomy and hypophysectomy were recommended in 67.8% and 30.5% dogs with FAT and PDH, respectively. When surgery was not considered, 23.9% of respondents did not always suggest medical management. Of those recommending medical treatment, 1895/2163 (87.6%) respondents used trilostane either once (60.7%) or twice (39.3%) daily. Time to first follow-up was < 10, 10-14, and 15-30 days for 6.1%, 59.8%, and 31.1% of respondents, respectively. Long-term follow-up was every 3-4 (41.7%) or 5-6 months (37.9%). Monitoring is performed using ACTH stimulation test (54.6%), pre-pill plasma cortisol concentration (18.4%), and both pre- and post-pill plasma cortisol concentration (13.3%).

Conclusions and clinical importance: Approximately one-third of PCVs do not recommend adrenalectomy for FAT and two-thirds do not recommend hypophysectomy in PDH. Despite demonstrated benefits of medical treatment, one-quarter of respondents do not always recommend it, which may adversely affect life expectancy and quality of life. Treatment and monitoring protocols vary among PCVs. These results suggest that further education of PCVs about management of Cushing's syndrome in dogs may be warranted.

Keywords canine, hypercortisolism, monitoring, PCVs, treatment

Abbreviations ACTHst, adrenocorticotropic hormone stimulation test; ADH, adrenal-dependent hypercortisolism; IQR, interquartile range; PCVs, primary care veterinarians; PDH, pituitary-dependent hypercortisolism; UCCR, urine corticoid-to-creatinine ratio; USG, urine specific gravity

Received: August 12, 2025. **Revised:** December 4, 2025. **Accepted:** December 12, 2025

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Introduction

Naturally occurring Cushing's syndrome or hypercortisolism is a relatively frequent endocrine disorder in dogs, with an estimated prevalence of 0.20%-0.28% in primary care practices across the United Kingdom (UK).^{1,2} Management of dogs with hypercortisolism includes medical treatment or surgery. The choice of treatment depends on several factors, including its origin (pituitary-dependent hypercortisolism [PDH] vs functional adrenal tumor [FAT]); the presence of concurrent diseases, severity of clinical signs; availability, efficacy, and possible adverse effects of the treatment; clinician and client preferences; and cost and the need for frequent follow-up evaluations.³

In humans with PDH, hypophysectomy is currently the treatment of choice.⁴ Transsphenoidal hypophysectomy is an effective treatment of PDH in dogs, with a remission rate of 85%, survival rates ranging from 67.8% to 83.5%, postoperative mortality of 8.8%, and recurrence rate of 27%.⁵⁻¹⁰ Although it has been increasingly studied in veterinary medicine,¹¹ hypophysectomy is only available at highly specialized institutions with well-trained teams, and this approach is not widely available. As for medical management, mitotane historically has been the drug most commonly available for PDH and FAT treatment.¹² Trilostane, a competitive inhibitor of 3- β -hydroxysteroid dehydrogenase, has largely replaced the routine use of mitotane for hypercortisolism management.¹³ Dosage and frequency of administration for trilostane vary according to recent veterinary literature and the recommendation of the manufacturer. Following commercial recommendations, the starting dosage is approximately 2 mg/kg, based on available capsule sizes, PO q24h with food.¹⁴ However,¹⁴ trilostane is metabolized within approximately 10 h, which may impact the effectiveness of a once-daily (q24h) administration in some dogs.^{15,16} Studies have reported the use of twice daily (q12h) protocols, with an initial dosage of 0.5-1 mg/kg PO q12h, as a newer approach.^{15,17-20}

In the case of FAT, the current recommended treatment is adrenalectomy. Surgery can be curative, and does not require long-term treatment when the tumor is unilateral. However, when surgery is not available or declined, or prior stabilization is needed, medical treatment can be suggested.³ Adrenocorticolytic drugs, such as mitotane, can be considered, but good control of hypercortisolism is rarely achieved and mitotane can have severe adverse effects.²¹ Although adrenalectomy is a curative option for hypercortisolism, trilostane is an effective alternative when surgery is not feasible. Trilostane helps control clinical signs, improves quality of life, and provides survival times comparable to those reported with mitotane.^{22,23} Nevertheless, medical treatment is considered palliative rather than curative.

Treatment of hypercortisolism, starting dosage, follow-up, and monitoring strategies used by primary care veterinarians (PCVs) are still unknown.

We aimed to determine which treatment options and monitoring protocols PCVs in selected European countries recommend for managing dogs with hypercortisolism.

Materials and methods

The survey methodology for investigating treatment and monitoring protocols for hypercortisolism was structured as follows. Initially, a pilot survey was conducted among 5 board-certified

internal medicine specialists, 9 PCVs and 1 epidemiologist to identify areas of confusion and unnecessary or missing questions. The final amended questionnaire was translated into 5 languages (English, French, Italian, Portuguese, and Spanish) and uploaded into an online survey tool (Google Forms; Alphabet Inc., Mountain View, California). The presented data were voluntarily provided by veterinarians with full knowledge of the study's objectives. Before starting the survey, respondents were required to confirm their understanding that the questionnaire was exclusively intended for PCVs and not for specialists. Respondents were required to specify their country of practice and only responses from Belgium, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, or Switzerland were included. These countries were selected based on the available translations of the questionnaires.

This survey was part of a more comprehensive survey that encompassed inquiries also regarding diagnosis and treatment of hypercortisolism. The information presented here only pertains to treatment and monitoring whereas results related to diagnosis are available in a companion paper.²⁴ The survey (Appendix S1) was divided into 3 sections: (1) demographics, encompassing inquiries about respondents' demographic information including year of graduation, location and type of practice, and number of dogs tested and diagnosed with hypercortisolism each year; (2) type of treatment for PDH and FAT, including both surgical treatment and medical management, and (3) questions about endocrine testing performed for monitoring of medical management and time-points for such assessment.

Responses were collected between January and October 2021. To increase response rate, each questionnaire submitted was entered into a drawing with a chance to win a €50 online shopping voucher. The questionnaire was advertised through social network veterinary groups, mailing lists, and continuous education events across Europe.

One non-native English author (M.C.) used a generative artificial intelligence tool (GPT 5, OpenAI) for rewriting particularly complex sentences in a clearer way, mainly in the discussion section and occasionally in other sections. The sentences generated by the tool were subsequently edited by the author before being incorporated into the manuscript. Furthermore, the draft was reviewed and corrected again by the coauthors.

Statistical analysis

Normality of continuous data was assessed using the Shapiro-Wilk test. Descriptive statistics were expressed as numbers and percentages, mean (\pm SD) for normally distributed variables and median (range, interquartile range [IQR]) for non-normally distributed variables. The distribution of respondents across the 9 countries was compared to the overall distribution of practicing veterinarians across these countries using the chi-squared test and post-hoc analysis. Adjusted *P* values were reported after Bonferroni correction. Data from the Federation of Veterinarians of Europe were used to estimate the distribution of practicing veterinarians in the 9 countries from which responses were collected (Belgium, France, Ireland, Italy, Luxembourg, Netherlands, Portugal, Spain, and Switzerland).²⁵ All analyses were performed using commercially available software (IBM SPSS v. 26; IBM Corporation, New York, NY).

Table 1 Number of respondents and overall number of practicing veterinarians* in the different European countries surveyed. All *P* values were adjusted following Bonferroni correction.

Country	Number, % of respondents	Number, % of practicing veterinarians*	<i>P</i> -values
Italy	1 297 (59.6)	28 358 (29.2)	<.001
France	329 (15.1)	19 874 (20.4)	<.001
Portugal	261 (12.0)	6 506 (6.7)	<.001
Spain	192 (8.8)	26 349 (27.1)	<.001
Belgium	57 (2.6)	6 200 (6.4)	<.001
Netherlands	18 (0.8)	4 742 (4.9)	<.001
Republic of Ireland	15 (0.7)	2 752 (2.8)	<.001
Switzerland	6 (0.3)	2 167 (2.2)	<.001
Luxemburg	3 (0.1)	288 (0.3)	.72
Total	2 178	97 236	

*Numbers according to the Federation of Veterinarians of Europe.²¹

Results

Respondents

Overall, 2210 responses were collected from 97,236 veterinarians with a response rate of 2.27%. After review, 32 responses were excluded because respondents indicated practicing outside of Europe. Consequently, 2178 responses from 9 European countries were included. The proportion of respondents distributed over the 9 countries was significantly different compared with the overall proportion of practicing veterinarians distributed over the same area ($P < .001$). Post-hoc analysis determined that the proportions of respondents practicing in Italy and Portugal were significantly higher compared with the proportions of veterinarians practicing in these countries ($P < .001$ for both). In addition, the proportions of respondents practicing in France, Spain, Belgium, Netherlands, Republic of Ireland, and Switzerland were significantly lower compared with the proportions of veterinarians practicing in these countries ($P < .001$ for all comparisons; Table 1).

Respondents had a median experience of 13.0 (range, 0-52; IQR, 13) years. Most respondents worked in urban ($n = 1368$; 62.8%) or suburban ($n = 538$; 24.7%) areas, whereas a smaller proportion practiced in rural ($n = 266$; 12.2%) or other ($n = 6$; 0.3%) locations. A substantial proportion of respondents (2031; 93.3%) worked exclusively in a small animal practice setting, whereas 140 (6.4%) worked in mixed practice and 7 (0.3%) worked in other practice settings.

Treatment of naturally occurring hypercortisolism

Among 1694 respondents who attempted to differentiate the cause of hypercortisolism, 1149 (67.8%) typically recommended adrenalectomy (Table 2) and 517 (30.5%) hypophysectomy (Table 3) in dogs with FAT and PDH, respectively.

Overall, the main reasons for not usually recommending adrenalectomy in dogs with FAT were a perception of high risk (187; 34.3%), a low perceived benefit compared to medical treatment (105; 19.3%), and lack of surgical expertise in the area (71; 13.0%). In addition, some respondents indicated that their

decision was influenced by a combination of these factors (143; 26.2%) or by all of them (14; 2.6%).

Similarly, the primary reasons for not recommending hypophysectomy included a perception of high risk (375; 31.9%), lack of surgical expertise in the area (210; 17.8%), and a low perceived benefit over medical treatment (113; 9.6%). Furthermore, 286 respondents (24.3%) cited a combination of high perceived risk and lack of surgical expertise, whereas others reported different combinations of the listed factors (83; 7.1%) or all of them (68; 5.8%) as influencing their decision.

When surgery (hypophysectomy or adrenalectomy) was not contemplated, 1658 (76.1%) respondents indicated recommending medical management, whereas 520 (23.9%) did not always suggest medical management. The main reasons for not recommending medical management included expected poor owner compliance (277; 53.3%), concurrent conditions that may benefit from glucocorticoid excess (205; 39.4%) and mild clinical signs (161; 31.0%). Overall, 1738 (79.8%) respondents reported always opting for trilostane when medical treatment was recommended, whereas 386 (17.7%), 39 (1.8%), and 15 (0.7%) reported using it most of the time, rarely, and never, respectively.

Among the 425 respondents who reported using alternatives to trilostane, 239 (56.2%) used mitotane, 93 (21.9%) used selegiline, 66 (15.5%) used ketoconazole, and 34 (8.0%) used cabergoline. In addition, 23 (5.4%) mentioned other treatments such as phytotherapy, alternative medicine, or hepatic protectants.

Of the 2163 respondents (99.3%) who used trilostane, 1895 (87.6%) were confident in reporting the frequency and dosage they currently use. In contrast, 236 (10.9%) were uncertain, and 32 (1.5%) provided inconsistent responses. Overall, 1150 (60.7%) and 745 (39.3%) respondents indicated typically prescribing trilostane once or twice daily, respectively. Among the PCVs that used trilostane once daily, 751 (34.7%) indicated typically starting at a dosage of 2 mg/kg q24h as indicated on the datasheet. Median (range) starting dosages were 2 (0.5-3.0) mg/kg once daily and 0.5 (0.5-6.0) mg/kg twice daily.

Trilostane monitoring

Of the 2163 respondents (99.3%) who used trilostane, the timing of the first follow-up was reported as < 10 days by 131 (6.1%),

Table 2 Percentage of recommended adrenalectomy by PCVs.

Country	Do you typically recommend adrenalectomy for patients diagnosed with PDH?				
	Yes	No	Total	Percentage of adrenalectomy within the country, %	Percentage of adrenalectomy within the overall, %
Belgium	15	24	39	38.5	1.3
France	130	112	242	53.7	11.3
Italy	763	284	1 047	72.9	66.4
Luxemburg	0	0	0	0	0
Netherlands	13	4	17	76.5	1.1
Portugal	131	60	191	68.6	11.4
Republic of Ireland	4	2	6	66.7	0.3
Spain	91	60	151	60.3	7.9
Switzerland	2	2	4	50	0.2
Total	1 149	548	1 697	–	67.7

Table 3 Percentage of recommended hypophysectomy by PCVs.

Country	Do you typically recommend hypophysectomy for patients diagnosed with PDH?				
	Yes	No	Total	Percentage of hypophysectomy within the country, %	Percentage of hypophysectomy within the overall, %
Belgium	3	36	39	7.7	0.6
France	34	208	242	14.0	6.6
Italy	406	641	1 047	38.8	78.5
Luxemburg	0	0	0	0	0
Netherlands	10	7	17	58.8	1.9
Portugal	42	149	191	22.0	8.1
Republic of Ireland	2	4	6	33.3	0.4
Spain	19	132	151	12.6	3.7
Switzerland	1	3	4	25	0.2
Total	517	1 180	1 697	–	30.5

between 10 and 14 days by 1294 (59.8%), and between 15 and 30 days by 673 (31.1%). In addition, 32 (1.5%) did not routinely schedule a first follow-up, and 33 (1.5%) respondents were uncertain about their typical approach.

When dogs were considered stable, monitoring intervals were reported as monthly by 67 (3.1%), every 2 months by 153 (7.1%), every 3-4 months by 903 (41.7%), every 5-6 months by 820 (37.9%), and yearly by 131 (6.1%). Notably, 81 (3.7%) respondents indicated not typically monitoring stable dogs and 8 (0.4%) gave inconsistent responses, respectively.

The ACTH stimulation test (ACTHst) was the most commonly used monitoring method (1181; 54.6%), followed by pre-pill plasma cortisol concentration (398; 18.4%) and both pre- and post-pill plasma cortisol concentrations (288; 13.3%). Post-pill plasma cortisol concentration alone, urine cortisol-to-creatinine ratio or a combination of different tests were used by 108 (5.0%), 82 (3.8%), and 18 (0.8%) respondents, respectively. Furthermore, 75 (3.5%) and 13 (0.6%) respondents reported not using endocrine

testing as part of their monitoring process. From the 1181 respondents who perform the ACTHst as part of monitoring, 1167 described it. Of these, 311 (26.6%) indicated starting the test 4 h post-pill, 229 (19.6%) at 2 h post-pill, 217 (18.6%) at 3 h post-pill, 167 (14.3%) at 1 h post-pill, 54 (4.6%) at 6 h post-pill, and 16 (1.4%) at 90 min post-pill. Notably, 88 (7.5%) of the respondents indicated not specifically paying attention to the time the test was performed. When pre-pill plasma cortisol concentration was assessed among 680 respondents, 356 (52.4%), 273 (40.1%), and 51 (7.5%) respondents measured it 1-2 h before trilostane administration, at the time of trilostane administration or were uncertain, respectively.

Besides endocrine testing, 2156 respondents monitored trilostane treatment using clinical signs and blood tests results. Among the former, 289 (13.4%) respondents used clinical signs alone, 42 (1.9%) performed only a CBC, 37 (1.7%) performed only a serum biochemistry profile, 14 (0.6%) performed only urine specific gravity (USG), 10 (0.5%) performed only serum

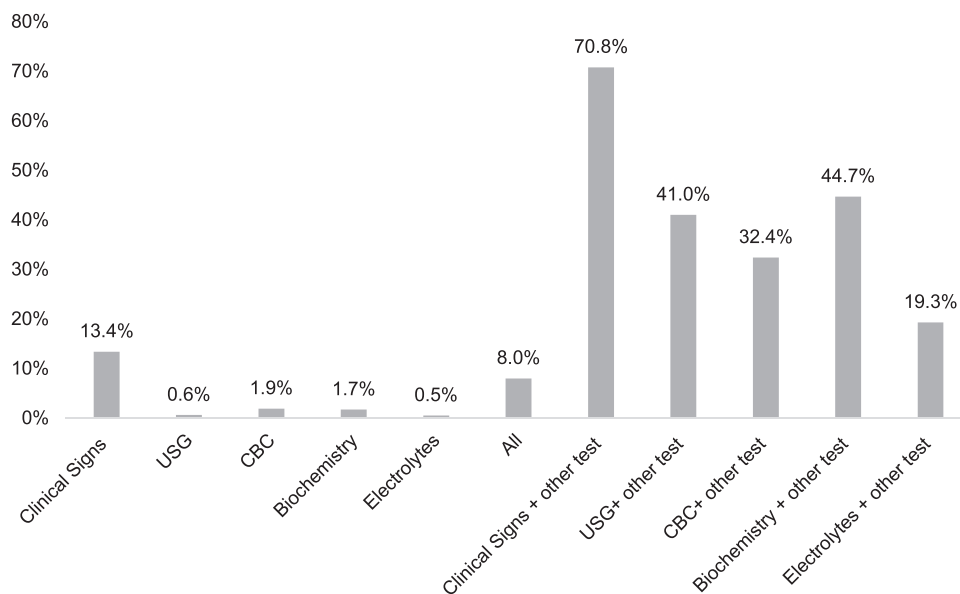


Figure 1 Tests typically performed as part of trilostane monitoring, besides endocrine testing ($n = 2156$). Abbreviation: USG = urine specific gravity.

electrolyte concentrations, and 172 (8.0%) performed all of these. A combination of the previously described tests was used by 1764 (81.8%) of the respondents (Figure 1). The highest combinations included clinical signs and biochemistry (225; 10.4%); clinical signs, USG, and biochemistry (196; 9.1%); or clinical signs, USG, and CBC (184; 8.5%).

Discussion

Our results illustrate the variety of approaches used by PCVs in treating and monitoring hypercortisolism in dogs. This variation may be attributed to several factors such as clinical experience, familiarity with different treatment protocols, and the influence of local academic institutions, clinical training programs, and professional organizations.

Approximately, one-third of respondents indicated recommending hypophysectomy in dogs with PDH. Considering this treatment is available only in a few centers in Europe, this number appears surprisingly high. However, the results may be influenced by the high percentage of Italian responses, because Italy is one of the few countries where hypophysectomy is available. Indeed, approximately 40% of Italian respondents recommended this procedure, accounting for 82.5% of the overall PCVs recommending this procedure. The high proportion of respondents recommending hypophysectomy in Italy (38.8%) and the Netherlands (58.8%) is probably because of the presence of local surgical expertise and opinion leaders who, during continuing education courses and conferences, are recommending this procedure. Adrenalectomy typically was recommended by approximately 70% of PCVs in dogs diagnosed with FAT. This higher rate of recommendation for surgery in dogs with FAT compared to PDH is likely because of more widespread surgical expertise with adrenalectomy. However, this surgery is still not recommended by one-third of PCVs who diagnose FAT. In addition, approximately 40% of all respondents do not consistently attempt to differentiate PDH from FAT.²⁴ Thus, a substantial number of owners are not offered the opportunity to benefit from a curative treatment option that has the potential to address FAT and

prevent consequences such as invasion of the caudal vena cava, metastasis, or adrenal mass rupture. The principal reason for not recommending adrenalectomy was a high perceived risk of this surgery by PCVs. This perception is not supported by recent studies, which showed a short-term survival of approximately 90% in dogs undergoing adrenalectomy for adrenal tumors ≤ 3 cm in diameter without vascular invasion.²⁶ In dogs with invasive adrenal tumors, adrenalectomy with cavotomy also was associated with high short-term survival.²⁶ Furthermore, dogs with adrenal tumors that had ruptured spontaneously and were treated by adrenalectomy also showed an overall favorable prognosis, as reported in a retrospective study of 59 dogs and 3 cats, suggesting that rupture does not necessarily worsen outcome.²⁷ Similarly, recent comparisons of laparoscopic versus open adrenalectomy in 70 dogs demonstrated that minimally invasive approaches are feasible and associated with favorable perioperative outcomes and survival,²⁸ emphasizing that surgical technique and tumor characteristics both influence prognosis. These high short-term survival rates must be considered because some FATs are malignant.²⁹ Approximately one-third of PCVs indicated a low perceived benefit over medical treatment as another reason for not recommending adrenalectomy in dogs with FAT. This finding emphasizes the need for further education on the topic. Indeed, adrenalectomy allows potential treatment of the underlying neoplastic process, prevents complications associated with an adrenal mass, and allows long-term management of hypercortisolism, improving prognosis over medical management alone. Finally, our study also highlights that although adrenalectomy is more widely available compared with hypophysectomy, lack of locally available surgical expertise was cited as a reason for not recommending the procedure by approximately one-third of PCVs.

Approximately one-quarter of respondents do not recommend medical management when surgery is not considered. One retrospective study suggested that withholding medical treatment in dogs with PDH might be associated with a higher risk of death.³⁰ Another study suggested that trilostane was associated with a better quality of life in dogs with Cushing's syndrome.³¹ As such,

not recommending medical management in dogs with HC should be considered carefully, because withholding treatment may compromise animal welfare. However, concerns can be raised that the disease might be erroneously diagnosed in a substantial portion of cases, as previously described, and that most PCVs would consider performing a screening test for HC in dogs without clinical signs but with consistent clinicopathologic abnormalities despite this scenario not being an indication for testing.²⁴ In addition, mild clinical signs were cited as a reason for not recommending medical management by one-third of PCVs in our study. Therefore, the impact of not offering treatment in cases that did not show clinical signs initially may be less important.

Although a proportion of dogs will have persistent clinical signs when receiving trilostane once daily, most respondents typically prescribe it once daily.¹⁸ The rationale of prescribing trilostane once daily may be driven by the goal of improving treatment compliance. Alternatively, considering that the manufacturer's recommendation specifies once daily administration, some PCVs may be unaware of the most recent scientific evidence describing better outcomes with twice daily dosing.³² This finding suggests that PCVs may benefit from further education regarding appropriate dosing regimens, and that the manufacturer's recommendations should be revised to reflect evidence supporting both once-daily and twice-daily administration.

Trilostane treatment monitoring method varied among PCVs. The ACTHst was most commonly used followed by pre-trilostane and 3-h post-pill plasma cortisol concentration. These findings are not surprising, because the ACTHst historically is used most frequently to monitor trilostane treatment and still is recommended by the manufacturer. More recently, limited availability of tetra-cosactide has led to the investigation of alternative monitoring methods including pre- and 3-h post-pill plasma cortisol concentration measurement,³³ which appear to be routinely used by many PCVs. Importantly, these tests do not replace the ACTHst to assess adrenal cortisol reserve and it is unclear from our results whether PCVs who reported using pre- and post-pill plasma cortisol concentrations also use the ACTHst in sick dogs to confirm trilostane overdosage.

Our study had some limitations. Notably, there is a discrepancy between the number of responses and the number of veterinarians within the same geographical area. This discrepancy led to a substantial overrepresentation from Italy. This skewed distribution potentially could have introduced bias in the reported behaviors, favoring Italian veterinary practices. Because Italian respondents represented nearly 60% of the total sample, their answers had a strong influence on the overall results. In fact, when excluding responses from Italy, the proportion recommending adrenalectomy decreased from 67.7% to 58.9%, and the proportion recommending hypophysectomy decreased from 30.5% to 17.1%.

This overrepresentation might be attributed to a more effective survey dissemination within these countries. Moreover, Portugal, France, Spain, Belgium, the Netherlands, the Republic of Ireland, and Switzerland were comparatively underrepresented, potentially diminishing the study's ability to fully capture the diversity of practices across this geographical area. The obtained sample had a relatively low proportion of responses from mixed practice veterinarians (<6%), implying that the study's findings might be more representative of behaviors within purely small animal practices. Recruitment methods could have inadvertently

targeted specific subsets of respondents, such as younger veterinarians or veterinarians actively engaged in continuing professional development. The voluntary nature of survey participation introduces the possibility of self-selection bias, where respondents with a heightened interest or awareness in the topic might have been more inclined to participate. Consequently, some behaviors could be overrepresented in the collected data. Although the survey provided valuable quantitative insights, it did not investigate qualitative aspects of respondents' decision-making processes. For example, although the data show that some clinicians did not recommend medical treatment, it is not clear based on these results if this choice is due to concerns about adverse effects, treatment monitoring or an unproven belief that dogs with Cushing's syndrome have a similar lifespan whether or not they receive trilostane. This absence of in-depth qualitative insights limits our understanding of the underlying motivations and barriers influencing treatment choices.

In addition, although it was strongly reinforced in the survey that the financial resources of the owners should not influence the responses and that these should only reflect the recommendations of each veterinary surgeon, some answers provided took into account the costs of the different treatments making them not entirely comparable. Such was particularly true in open-ended questions in which practitioners mentioned some answers were dependent on client financial resources.

Conclusion

Our study contributes to clarifying the different ways that PCVs treat and monitor naturally occurring canine Cushing's syndrome. Approximately one-third of PCVs do not recommend adrenalectomy for FAT and approximately two-thirds do not recommend hypophysectomy for PDH. Trilostane is the first-line drug for medical treatment of hypercortisolism among PCVs. Starting dosage, follow-up, and monitoring strategies vary among PCVs, although most follow the manufacturers' recommendations for starting dose, frequency of administration, first re-evaluation, and long-term monitoring. The ACTHst was the endocrine test most often performed by PCVs for monitoring trilostane treatment. Nevertheless, pre-trilostane plasma cortisol concentration was measured by a substantial percentage of the respondents, suggesting that this test is becoming more frequently used for assessing control. Despite demonstrated benefits, approximately one-quarter of respondents do not recommend medical treatment, which may contribute to decreased life expectancy and quality of life for dogs with hypercortisolism.

Our results suggest that there is an opportunity for further education of PCVs and emphasizes the need for newer and updated guidelines for the treatment and monitoring of naturally occurring hypercortisolism in dogs.

Author contributions

Miguel Alexandre Fogaça Carvalho (Conceptualization, Data curation, Formal analysis, Methodology, Writing—original draft, Writing—review & editing), Michael Bennaim (Conceptualization, Data curation, Formal analysis, Methodology, Project administration, Validation, Writing—original draft, Writing—review & editing), Stefania Golinelli (Visualization, Writing—review & editing), Federico Fracassi (Visualization, Writing—review & editing),

Carolina Arenas (Visualization, Writing—review & editing), Maria Pérez-Alenza (Visualization, Writing—review & editing), Sara Galac (Visualization, Writing—review & editing), Carmel Mooney (Visualization, Writing—review & editing), and Rodolfo Oliveira Leal (Conceptualization, Data curation, Formal analysis, Funding acquisition, Methodology, Project administration, Validation, Writing—original draft, Writing—review & editing)

Supplementary material

Supplementary material is available at *Journal of Veterinary Internal Medicine* online.

Conflicts of interest

The authors declare no conflicts of interest.

Funding

This work was supported by Dechra Veterinary Products Ltd with regard to promotion of the survey. This work was supported by Fundação para a Ciência e Tecnologia (FCT), grant UID/4585/2026.

Off-label antimicrobial declaration

The authors declare no off-label use of antimicrobials.

Institutional animal care and use committee or other approval declaration

The authors declare no institutional animal care and use committee or other approval was needed.

Human ethics approval declaration

The authors declare human ethics approval was not needed.

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