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Anxiety in dogs: when motor symptoms mimic neurological disorders. An interdisciplinary case report

Luigi Sacchettino[1*], Alessandro Testa[2], Asahi Ogi[3]

[1] *Department of Veterinary Medicine and Animal Production, University of Naples Federico II, Naples, Italy*
[2] *Veterinary neurologist, Clinica Animal Life, Caserta, Italy*
[3] *Department of Clinical Sciences and Translational Medicine, Tor Vergata University, Rome, Italy*

Abstract: Differential diagnosis of paroxysmal movement disorders in dogs can be a considerable challenge, as emotional states such as anxiety can manifest as motor symptoms that mimic neurological conditions like paroxysmal dyskinesias or focal seizures. This case report describes a 4-year-old male Shiba Inu referred for behavioral consultation due to recurrent "epileptiform" motor episodes triggered by specific environmental stressors, such as thunderstorms and power outages. While neurological and metabolic examinations were unremarkable, a behavioral assessment revealed paroxysmal anxiety, characterized by hypervigilance, autonomic activation, and excessive attention-seeking. A multimodal therapeutic approach was implemented, combining the administration of a nutraceutical containing alpha-casozepine and fish muscle hydrolysate (Zylkene Plus©) with a cognitive-olfactory enrichment program and environmental management as part of a rehabilitation plan. Within 30 days, the caregivers reported an improvement in well-being and a substantial decrease of motor episodes. Sustained stability was observed during the follow-up period, including after gradual discontinuation of the nutraceutical therapy, alongside continued behavioral and environmental management. This case suggests the potential value of interdisciplinary collaboration between veterinary neurologists and behavioral specialists in the assessment of paroxysmal motor episodes, to ensure accurate diagnosis and effective management of canine disorders.

Key Words: anxiety, dog, neurology.

* *Corresponding Author*: luigi.sacchettino@unina.it

Background

The differential diagnosis of paroxysmal disorders in dogs represents one of the most complex challenges in contemporary veterinary clinical practice (Mandigers et al., 2024). When caregivers report recurrent episodes of abnormal movements—tremors, muscle rigidity, hypertonia, or motor agitation—clinical suspicion frequently points towards neurological disorders, particularly paroxysmal dyskinesias (PD) or focal epileptic seizures (Lowrie & Garosi, 2017). However, recent evidence highlights how negative affective states, particularly anxiety and stress, can manifest through motor symptoms that mimic such neurological conditions (Mandigers et al., 2024; Edwards et al., 2023), necessitating a diagnostic process that also involves a behavioral medicine specialist (Camps et al., 2019).

Anxiety in dogs is a complex neurobiological state characterized by hyperactivity of the hypothalamic-pituitary-adrenal axis and altered GABA-glutamate signaling (Siniscalchi et al., 2021; Zhang et al., 2021; Lodrini et al., 2025). These changes can reduce the motor activation threshold, generating involuntary manifestations—tremors or muscle rigidity—that may be misidentified as paroxysmal dyskinesias or other organic motor dysfunctions (Mandigers et al., 2024). The motor symptoms of anxiety frequently exhibit a 'productive' nature: environmental hypervigilance, accelerated respiration, generalized tremors, tachycardia, and motor agitation may be misinterpreted as precursors to epileptic seizures or focal epileptiform activity (Masson et al., 2024; Mandigers et al., 2024). The distinction between anxiety disorders and paroxysmal dyskinesias re-

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quires careful evaluation of episode semiology, environmental context, and clinical course. While both conditions may present with paroxysmal motor signs and preserved consciousness, anxiety manifestations typically exhibit hypervigilance, autonomic activation, and immediate recovery upon trigger removal, in contrast to the dystonic postures and sustained hypertonicity characteristic of paroxysmal dyskinesias (Mandigers et al., 2024; Lowrie & Garosi, 2017). The response to anxiolytic interventions may support a behavioral diagnosis, though this is not pathognomonic, as certain paroxysmal dyskinesias have also shown responsiveness to serotonergic modulation. This case supports the need for an interdisciplinary approach, in which the management of anxiety and the promotion of emotional regulation can lead to the resolution of motor symptoms, suggesting the psychogenic aetiology of the disorder.

Presentation

A 4-year-old intact male Shiba Inu (body weight: 12 kg; BCS 6/9) was referred for behavioural consultation following evaluation by a veterinary neurologist.

History

The caregivers reported that the dog experienced frequent episodes of unusual motor activity, which they referred to as "epileptiform." The occurrence of these episodes was contingent upon specific circumstances, including thunderstorms, power outages, and emotionally taxing events. The dog had been purchased from a breeder at 8 weeks of age. A moderate degree of sociability, independence, and a reserved demeanor when interacting with strangers were among the behavioral traits that were characteristic of the breed (Turcsán et al., 2011). This particular animal was chosen by the caregivers based on observational video evidence, which revealed a more contemplative and less exuberant behavior compared to his littermate, suggesting a potentially more sensitive temperament from the earliest stages of development. As a puppy, the dog had undergone extensive socialization, encountering individuals, other dogs, and various locations. Despite a recent trend toward greater selectivity, the dog's interactions with other dogs were generally appropriate, regardless of gender. Within the home environment, the dog demonstrated behaviors that exceeded breed standards in terms of dependence and attention-seeking. These behaviors included following family members around the house and exhibiting more demanding behaviors. The caregivers observed a gradual increase in anxiety-related behaviors in the months preceding this evaluation, including a tendency to follow the caregivers "like a shadow"; a more frequent search for attention, agitation during thunderstorms and when visitors arrived. The patient experienced sleep disturbances on some nights, which included increased restlessness and a tendency to seek contact with caregivers even during the night. The caregivers reported that the dog was walked three times daily; during these outings, he was exploratory and did not exhibit particular fears. The patient was fed a commercial salmon-based dry diet (Monge®) twice daily. He was up to date with routine vaccinations (Nobivac® Ceppi + L4 and Letifend®) and monthly parasite prevention (Advantix®). No previous or concurrent medications, supplements, or relevant medical comorbidities were reported by caregivers.

Physical examination findings and laboratory results

Neurological examination

The neurological examination revealed no abnormalities. Assessment of the cranial nerves, postural reactions, spinal reflexes, and gait was normal. No signs of proprioceptive deficits, atax-

ia, or segmental spinal cord dysfunction were found. The neurologist suggested a diagnostic protocol to rule out structural or metabolic organic causes, given that the reported episodes were paroxysmal. An MRI of the brain was included in this protocol as the gold standard to investigate potential structural, inflammatory, or hydrocephalic abnormalities that can mimic movement disorders or partial seizures (Mandigers et al., 2024; Lowrie & Garosi, 2017). Electroencephalography was not available at the referring institution. The family elected to forgo advanced imaging due to concerns regarding anesthetic risks, instead opting for biochemical screening exclusively. The complete blood count and serum biochemistry panel showed results within the normal range, effectively ruling out metabolic causes of the episodic movement disorders. These included hypoglycemia, hypocalcemia, electrolyte imbalances, hepatic encephalopathy, renal dysfunction, and hypothyroidism (Mandigers et al., 2024; Royaux et al., 2015).

Diagnosis

In accordance with established diagnostic approaches for canine anxiety disorders (Landsberg et al., 2023; Lodrini et al., 2025), the patient's behavior and signs were analyzed, resulting in a diagnosis of paroxysmal anxiety—characterized by multi-contextual triggers—which highlights the sudden-onset episodic motor crises and autonomic activations. The patient exhibited overt clinical signs that satisfied the following diagnostic criteria: hypervigilance, which involved constant monitoring of the environment and disproportionate reactions to mild stimuli; the presence of autonomic symptoms, including tachypnea, tremors, and tachycardia, during episodes; and the absence of a post-ictal phase, as caregivers reported that the dog immediately resumed normal interaction with the environment upon the conclusion of the motor episode, a critical element in the differential diagnosis (Masson et al., 2024). The behavioral examination integrated detailed history-taking, direct clinical observation, and systematic review of video recordings documenting both routine behavior and the reported motor episodes. This multimethod assessment confirmed the reported symptoms and permitted characterization of the motor semiology in the absence of impaired consciousness or post-ictal signs, supporting the presumptive behavioral origin of the episodes. These findings provided evidence of situational anxiety, manifested as decreased environmental exploration, polypnea, increased seeking of caregiver contact and reassurance, and an inability to maintain a calm demeanor, even in the non-threatening, enriched clinical environment.

The following differential diagnoses were considered based on the clinical presentation:

Paroxysmal dyskinesia. Paroxysmal dyskinesia was considered because of the episodic nature of the symptoms and preserved consciousness (Mandigers et al., 2024; Royaux et al., 2015) but excluded due to the presence of documented emotional triggers and the positive response to anxiolytic intervention.

Focal epileptic seizures. These were ruled out due to preserved consciousness during episodes and a normal neurological examination between them (Mandigers et al., 2024).

Psychogenic movement disorder. The diagnosis was considered because of the clear emotional triggers and the presence of anxiety symptoms (Mandigers et al., 2024).

Metabolic encephalopathy. This condition was excluded based on normal laboratory results.

Treatment

The therapeutic strategy adopted followed a multimodal approach, as recommended in the literature (Masson et al., 2024; Denenberg, 2020). The patient received a commercially available complementary feed (Zylkene Plus©, Vétoquinol) providing alpha-casozepine at 22 mg/kg SID and fish muscle hydrolysate. This was administered in conjunction with a cognitive-olfactory en-

richment program and an environmental management protocol, aimed at improving the predictability of stimuli (Zulch, 2022; Sacchettino et al., 2023a).

The caregivers conducted daily scent-search exercises with the dog, concealing small treats throughout the house (under cups, behind furniture, in various rooms) and allowing him to locate them by scent. This was conducted once daily, typically in the late afternoon, for about 15 to 20 minutes. They also provided a Kong® filled with wet food daily, which prolonged foraging behavior. The dog was provided with durable chew items daily, including desiccated rabbit ears and deer antlers. These exhibited adequate durability to endure chewing sessions lasting 15–20 minutes and were deemed safe for this patient. These items were typically offered in the morning or just before expected stressors, such as thunderstorms. The caregivers moved the dog's bed to the section of the bedroom most distant from the windows and electrical outlets, creating a quieter, more protected environment during storms or power failures. The Kong® and chew items were first offered while family members were present and the patient was placed on his bed, such that he would associate these activities with a pleasant, shared moment with his caregivers and develop a positive emotional connection with his bed. Once these positive associations were established, the caregivers began offering the Kong® and chew items during trigger events (e.g., at the onset of a thunderstorm or a power outage), following a graduated exposure approach. The aim was to redirect the dog toward a functional coping strategy — engagement in foraging and mastication — replacing his previous anxiety response (trembling, motor agitation). The caregivers were instructed to remain present with the dog during these episodes, offering calm physical proximity and verbal reassurance, rather than leaving him to manage the anxiety alone. This relational approach aimed to strengthen the dog's security and reinforce the bed as a positive refuge. They upheld consistent daily schedules for feeding, walks, and enrichment. They also commenced nutraceutical and enrichment activities promptly upon receiving weather alerts forecasting thunderstorms. The nutraceutical was tapered and discontinued after 3 months. Cognitive-olfactory enrichment, masticatory activities, and environmental management were maintained throughout the follow-up period and continue to form part of the dog's daily routine.

Several clinical and biological factors influenced the initial use of nutraceutical therapy as an alternative to pharmacological intervention with psychotropic drugs (e.g., fluoxetine or benzodiazepines). First, the paroxysmal but situational nature of the symptoms indicated the possibility of testing molecules with a high safety profile and few side effects before committing to long-term therapies. Alpha-casozepine was chosen for its "benzodiazepine-like" activity on GABA-A receptors (Landsberg et al., 2023), which can modulate the underlying anxiety state without causing sedation or cognitive changes that could interfere with the planned behavioral rehabilitation program and olfactory enrichment. Furthermore, the literature suggests that in stress-related disorders, supplementation with marine bioactive peptides can improve the dog's resilience and reactivity threshold (Porcheron et al., 2023), suggesting a viable alternative to psychotropic intervention in cases where emotional balance can be restored through neurochemistry 'de-escalation' and environmental management (Beata et al., 2007; Masson et al., 2024).

Follow up

Assessment 30 days following the beginning of treatment suggested significant reduction in baseline anxiety levels. Caregivers reported an estimated 80% improvement in overall well-being based on sleep quality, trigger responsiveness, and daily activity compared to baseline, with no occurrence of motor episodes since the start of treatment. This stability continued despite significant environmental triggers, such as thunderstorms and power outages, suggesting a heightened reactivity threshold and enhanced adaptive capacity (Zulch, 2022).

During the 3-month follow-up, the patient exhibited stabilization of his emotional equilibrium. A protocol for the gradual reduction of nutraceutical therapy was established in accordance

with the caregivers' consent. The nutraceutical was discontinued over a 2-week tapering period.

Six months post-onset and three months following the total discontinuation of therapeutic intervention, the patient continued to be free of motor episodes or anxiety recurrences. The dog was characterized as emotionally stable, exhibiting adequate social integration and better resilience to previously anxiety-provoking environmental stressors.

Discussion

This case underscores a challenge within veterinary clinical practice: the inclination to attribute motor disorders solely to neurological causes, thus overlooking the behavioral and emotional aspects. Differentiating focal epileptic seizures, paroxysmal dyskinesias, and psychogenic movement disorders poses a difficulty in veterinary neurology (Mandigers et al., 2024). Nevertheless, as suggested by this case, the absence of neurological examination abnormalities, the identification of specific emotional triggers, and the "productive" nature of anxiety symptoms should prompt the clinician to prioritize an early behavioral assessment. Physical health and behavior must be viewed as an interdependent system where emotional arousal directly shapes somatic presentations. Thus, exclusion of metabolic causes through blood control, although necessary, should not be considered sufficient in the presence of such symptoms. The caregivers' decision to forgo MRI, due to concerns around anesthesia, demonstrated the necessity of a comprehensive behavioral assessment. This clinical scenario frequently arises in veterinary practice, suggesting the necessity of accessible diagnostic methods that incorporate behavioral assessment as an initial screening tool, especially in the absence of advanced imaging tools. A distinctive element of this case is the "productive" nature of the anxiety manifested by the patient. Contrary to the popular conception of anxiety as a simple state of "avoidance" or behavioral inhibition, the subject presented with hypervigilance, excessive seeking of contact, and motor agitation. This "active" manifestation of anxiety is consistent with the neurobiological model that recognizes chronic stress as a condition of hyperactivation of the HPA axis and the sympathetic nervous system (Siniscalchi et al., 2021; Zhang et al., 2021). The distinction between "productive" and "passive" anxiety symptoms has relevant diagnostic and therapeutic implications. The productive symptoms seen in this Shiba Inu could easily be mistaken for sudden neurological events, given their strong motor activity and how they come and go. Therefore, understanding this variation in how canine anxiety shows up should be a key part of training for both veterinary neurologists and behavioral medicine specialists.

The choice of nutraceutical protocol fell on a dual-action formulation containing alpha-casozepine and fish muscle hydrolysate (a commercially available product). A pioneering study by Beata (2007) and colleagues documented a comparable ameliorative effect of both selegiline and alpha-CZP treatment in anxious dogs following 56-day therapies, suggesting that such a biological compound might be considered a valuable alternative strategy to pharmacological intervention for such behavioral disorders. Given the functional similarities with benzodiazepine-like activity, the promising role of alpha-CZP in alleviating physical and psychological anxiety has already been characterized in different clinical and preclinical settings (Miclo et al., 2001; Benoit et al., 2020; Sacchettino et al., 2023a). While alpha-CZP acts as a modulator of GABA-A receptors by reducing underlying anxiety, the addition of bioactive marine peptides has been documented to significantly improve resilience and quality of life in dogs with stress-related disorders (Porcheron et al., 2023). Protein hydrolysis enhances the functional properties of the product, thus allowing the release of low-molecular-weight peptides with diverse bioactivities, which have various effects, such as antioxidant, antimicrobial, antihypertensive, anti-inflammatory, antihyperglycemic, skin anti-aging, and anxiolytic ones (Bernet et al., 2020; Carrera et al., 2013; Gevaert et al., 2016; Le Faouder et al., 2022; Zamora-Sillero et al., 2018). This combination has helped to raise the

patient's threshold of reactivity to environmental triggers (temporary episodes and blackouts), facilitating a more rapid return to homeostasis following the stressful event.

The behavioral intervention strategy focused on a multi-modal approach, integrating environmental engineering with specific cognitive and sensory rehabilitation (Denenberg, 2020; Sacchettino et al., 2023b). The primary focus was directed toward mitigating trigger exposure and enhancing environmental predictability (Denenberg, 2020). The environment was enriched through structured olfactory stimulation and the systematic introduction of long-lasting chewing activities (Binks et al., 2018; Uccheddu et al., 2024). Clinical evidence suggests that therapeutic success cannot be achieved without strict control of triggers and structured management of the living environment (Mandigers et al., 2024; Royaux et al., 2015). This approach is grounded in the neurobiology of stress, where the reduction of aversive stimuli is essential to allow the rebalancing of emotional homeostasis (Denenberg, 2020). Chronic exposure to unpredictable environmental triggers keeps the hypothalamic-pituitary-adrenal axis in a state of constant hyper-reactivity, drastically lowering the firing threshold of motor circuits (Denenberg, 2020). As highlighted by Masson and colleagues, environmental management should be viewed as a strategy for neurochemical "de-escalation" (Masson et al., 2024). Reducing the cognitive and emotional load helps minimize fluctuations in glutamate and cortisol, stabilizing the limbic circuits that indirectly influence the basal ganglia and motor areas (Masson et al., 2024). Regarding the enhancement of cognitive function and the olfactory system, this strategy has been shown to lower cortisol levels and enhance parasympathetic activity (Binks et al., 2018; Duranton & Horowitz, 2019; Wells, 2022). Engagement in sniffing activities correlates with improved behavioral results in cognitive bias evaluations and facilitates emotional regulation via the activation of the default mode network (Duranton & Horowitz, 2019). Furthermore, the present case report emphasizes the necessity of providing appropriate masticatory stimuli (Uccheddu et al., 2024). Mastication activates the masseter muscles and stimulates the trigeminal nerve, which has autonomic pathways that can influence vagal tone and, consequently, the stress response (Uccheddu et al., 2024). The trigeminal-vagal system may function as a pathway for bottom-up modulation of emotional states, offering a non-pharmacological approach to arousal regulation (Uccheddu et al., 2024). Additionally, mastication could act as a displacement coping mechanism, dissipating accumulated tension and furnishing a suitable mechanical release for the nervous energy associated with anxiety (Uccheddu et al., 2024). Consequently, the integration of structured mastication protocols into canine anxiety treatments should be considered standard practice, rather than merely an "accessory recommendation" (Uccheddu et al., 2024).

Limitations and future directions

The limitations of this case report derive primarily from the absence of advanced brain imaging and electroencephalography, tools that would have permitted definitive exclusion of neurological etiology and corroboration of the behavioral diagnosis. However, the clinical manifestation, negative neurological examination, and marked positive response to nutraceutical treatment (alpha-casozepine-based therapy) offer considerable validation for the presumptive diagnosis. It is important to recognize that symptom remission following anxiolytic treatment does not constitute definitive proof of an exclusively behavioral etiology; however, the absence of recurrence months after discontinuation of nutraceutical therapy renders drug-resistant epilepsy or primary paroxysmal dyskinesia improbable. The sustained remission following discontinuation of the nutraceutical does not establish a direct causal link between the supplement and long-term outcome; behavioral and environmental interventions continued throughout the follow-up period and may have contributed independently to the observed stability. Future research directions should include prospective studies that systematically evaluate the prevalence of anxiety disorders in dogs

with diagnosed PD, the efficacy of anxiolytic treatments (nutraceutical and pharmacological) as primary or adjunctive therapy, and the potential of exclusive behavioral interventions in preventing relapse.

Conclusion

This case report suggests that paroxysmal-like episodic occurrences in this patient were consistent with behavioral expressions of underlying anxiety. However, without advanced neuroimaging, a primary neurological disorder cannot be definitively excluded, and the relative contribution of each treatment component—nutraceutical supplementation, behavioral rehabilitation, and environmental management—to the observed improvement remains undetermined. A comprehensive treatment strategy was associated with the resolution of episodic events and a lasting reduction in anxiety. These findings support the consideration of collaborative efforts between veterinary neurologists and behavioral medicine specialists when evaluating neurological disorders.

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L'ansia nel cane: quando i sintomi motori mimano i disturbi neurologici. Un case report interdisciplinare

Luigi Sacchettino[1], Alessandro Testa[2], Asahi Ogi[3]

[1] *Dipartimento di Medicina Veterinaria e Produzioni Animali, Università di Napoli Federico II, Napoli, Italia*
[2] *Neurologo veterinario, Clinica Animal Life, Caserta, Italy*
[3] *Dipartimento di Scienze Cliniche e medicina traslazionale - Università di Tor Vergata - Roma*

Sintesi

La diagnosi differenziale dei disturbi parossistici del movimento nel cane può rappresentare una sfida considerevole, poiché stati emotivi come l'ansia possono manifestarsi come sintomi motori che mimano condizioni neurologiche quali le discinesie parossistiche o le crisi epilettiche focali. Questo caso clinico descrive un Shiba Inu maschio di 4 anni riferito per una consulenza comportamentale a causa di episodi motori ricorrenti di tipo "epilettiforme", scatenati da specifici stressor ambientali come temporali e interruzioni di corrente. Mentre gli esami neurologici e metabolici sono risultati nella norma, la valutazione comportamentale ha rivelato un'ansia parossistica, caratterizzata da ipervigilanza, attivazione autonomica ed eccessiva ricerca di attenzione. È stato implementato un approccio terapeutico multimodale, combinando la somministrazione di un nutraceutico contenente alfa-casozepina e idrolizzato di muscolo di pesce (Zylkene Plus©) con un programma di arricchimento cognitivo-olfattivo e gestione ambientale come parte del piano riabilitativo. Entro 30 giorni, i proprietari hanno riferito un miglioramento del benessere e una diminuzione sostanziale degli episodi motori. Il paziente è rimasto stabile anche dopo la sospensione della terapia nutraceutica. Questo caso sottolinea l'importanza della collaborazione interdisciplinare tra neurologi veterinari ed esperti in comportamento animale per garantire una diagnosi accurata e una gestione efficace dei disturbi nel cane.