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CHRONIC PAIN BIOMARKERS IN DOGS

from Research to a Service-Learning Intervention to Promote Scientific Curiosity and Critical Thinking in 11th Grade

1. INTRODUCTION

According to the World Organisation for Animal Health and the recent changes in human-animal relationships, ensuring animal welfare is fundamental in veterinary medicine. Within this framework, chronic pain stands out as a critical threat that persistently degrades quality of life. To address this challenge, biomarkers are emerging as essential tools that provide objective and measurable parameters for detection, diagnosis, and monitoring. The project is contextualized within the **Service-Learning modality i**n which a need is covered. In this case, a partnership with the public high school Institut Jaume Mimó was established to address the need to boost scientific curiosity and bridge the gap between high school students and the reality of university.

2. OBJECTIVES

- Analyze chronic pain pathophysiology and its impact on welfare.
- Review the main biomarkers used in dogs, describing their function, advantages, and disadvantages.
- Transfer the scientific knowledge to the students through structured educational sessions.
- Raise awareness regarding the importance of animal welfare.
- Foster scientific curiosity and critical thinking.

3. PATOPHYSIOLOGY OF CHRONIC PAIN

Features of nociplastic pain conditions

- Combined peripheral and central pain sensitisation
- Hyper-responsiveness to painful and non-painful sensory stimuli
- Associated features
  - Fatigue
  - Sleep disturbance
  - Cognitive disturbances
  - Hipersensitivity to environmental stimuli
  - Anxiety and depressed mood

Supraspinal mechanisms

- Hyper- responsiveness to pain stimuli
- Hyperactivity and connectivity in and between brain regions involved in pair
- Decreased activity of brain regions involved in pain inhibition
- Elevated cerebrospinal fluid substance P and glutamate concentrations, decreased GABAergic transmission
- Changes in the size and shape of grey and white matter regions involved in pain processing
- Glial cell activation

Spinal mechanisms

- Regional clustering and convergence of signals from different pain loci
- Spinal cord reorganisation
- Amplified spinal reflex transmission
- Diminished spinal inhibition
- Wind-up and temporal summation
- Glial cell activation

Peripheral features

- Minor local muscle pathology (eg, changes in pH, muscle fibre composition, and latent and active trigger points)
- Peripheral sensitization (eg, expansion of receptive fields, elevated cytokine and chemokine concentrations)
- Hyperalgesia, disesthesia and allodynia
- Localised or diffuse tendreness, or both

Figure 1. Mechanisms and features of nociplastic pain by Joe Kanasz
Fitzcharles, M. A., Cohen, S. P., Clauw, D. J., Littlejohn, G., Usui, C., & Häuser, W. (2021). Nociplastic pain: towards an understanding of prevalent pain conditions. The Lancet, 397(10289), 2098–2110.

4. CHRONIFICATION AND BIOMARKERS

Table 1. Biomarkers of chronic pain in dogs

CATEGORY	BIOMARKERS
Biochemical	Cortisol Substance P
Neurophysiological	Quantitative Sensory Testing Nociceptive Withdrawal Reflex
Behavioral	Questionnaires (CBPI, LOAD, SNoRE) Grimace Scales

A multimodal approach combining subjective behavioral observation with more objective biomarkers is essential, and more research is needed to standardize these parameters in clinical veterinary practice.

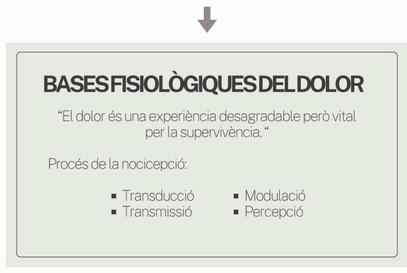
5. SERVICE INTERVENTION

The objective public was the 18 students from 11th Grade enrolled in the Human Biomedicine assignment. The service consisted of designing and implementing 4 consecutive 45-minute sessions to motivate and empower students.



1 & 2 Foundations and introduction to university

- Interactive debate on animal welfare, chronic pain, and biomarkers
- Advanced database navigation
- Gamified Kahoot!



3 Pathophysiological contextualization

- Collaborative board mapping of the physiological nociceptive pathway
- Analysis of the neurobiological changes that contribute to pain chronification.

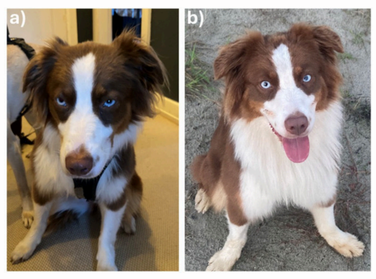


Figure 2. Facial expression as a behavioral aspect in the assessment of pain in dogs
Sander, A. N., Storz, S., Xenoulis, P. G., & Heilmann, R. M. (2025). Assessment of acute and chronic pain in canine internal medicine—what is missing in our diagnostic toolbox? Frontiers in Veterinary Science, 12, 1614403.

4 Biomarker evaluation

- Students analyzed the advantages and limitations of the current biomarkers.
- Practical workshop where applying the Horse Grimace Scale to real cases.

6. CONCLUDING THOUGHTS

Integrating the Service-Learning experience enriched the academic project. Driving to a profound self-evaluation, I would emphasize:

- Initial phases faced logistical challenges
- Academic knowledge only achieves true utility when shared beyond the university bubble.
- The Service-Learning process accompanied development of key communication and adaptation skills.
- Essential support leads to rewarding and meaningful success.

"Science and medicine only make sense when they contribute to improving quality of life and welfare."