

## The sensory pain of Dante`s Inferno - Semantics of chronic pain in patients with narcolepsy

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### ABSTRACT

**Objective:** To examine the semantics of chronic pain in narcolepsy and to compare with the poem Inferno, from Dante Alighieri. **Methods:** A cross-sectional study, in which type 1 (n=33) and type 2 (n=33) patients (hypocretin-1 quantification in cerebrospinal fluid), were studied at Departamento de Psicobiologia - Universidade Federal de São Paulo (Brazil). We assessed pain descriptors in the Present Rating Index (PRI) from McGill Pain Questionnaire. **Results:** There was no significant difference in PRI between narcolepsy groups. In both groups, the most frequent words had a sensory dimension: throbbing, jumping, and tugging. Multiple correspondence analysis revealed the predominance of sensory descriptors and the deficiency of affective descriptors in these groups. **Discussion:** A study that interpreted the poem Inferno, from Dante Alighieri, as McGill Pain Questionnaires descriptors suggested a contribution of the sensory dimension in pain of possibly narcolepsy patients, similar as in our results.

**Keywords:** Narcolepsy; Comorbidity; Chronic Pain; Literature.

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## INTRODUCTION

Narcolepsy is a rare chronic sleep disorder; in which daytime hypersomnolence occurs with *rapid-eye-movement* (REM) sleep dysregulation, usually in the habitual sleep period<sup>1</sup>, with or without cataplexy. Cataplexy is the REM sleep-like phenomena in wakefulness of patients with a specific genetic predisposition. The pathophysiology of cataplexy relies on autoimmune degeneration of peptide-producing hypothalamic neurons<sup>2</sup>. Diagnosis of narcolepsy is based on the objective confirmation of REM sleep dissociation through electrophysiologic tests, and the documentation of hypocretin-1 (Hcrt) or orexin-A levels in cerebrospinal fluid<sup>3,4</sup>.

Narcolepsy is classified as type 1 according to cataplexy presence or Hcrt deficiency, or type 2 if cataplexy is absent, and Hcrt levels are normal or undocumented<sup>5</sup>. In central and peripheral nervous systems, Hcrt modulates various physiological functions and homeostasis<sup>6</sup>. The interruption and decrease of Hcrt signaling results in imbalance of these processes and the patients exhibit multiple comorbidities at diagnosis and follow-up, especially obesity, psychiatric disorders, and obstructive sleep apnea<sup>7,8</sup>.

In the last years, strong evidence showing high frequency of chronic pain in narcolepsy has increased<sup>9,10</sup>. Our group recently demonstrated elevated risk of chronic pain and higher pain mean scores in two quantitative measures of the McGill Pain Questionnaire (MPQ) in patients with both narcolepsy types 1 and 2<sup>11</sup>. In this sample, narcolepsy groups did not differ in pain quality characteristics regarding the Number of Words Chosen and the Pain Rating Index (PRI) of the MPQ questionnaire. Thus, in the current study we aimed to describe the multidimensional descriptors of pain calculated in the PRI in these patients.

## MATERIAL AND METHODS

### Sample and Study design

From 2015 to 2016, at the Universidade Federal de São Paulo, São Paulo, Brazil, we performed a cross-sectional study in patients with narcolepsy type 1 (NT1) and narcolepsy type 2 (NT2) to identify chronic pain through questionnaires. The patients received regular pharmacologic treatment and filled Hcrt measurement criteria definition according to the American Academy of Sleep Medicine<sup>5</sup>. We compared 33 individuals in each group of narcolepsy, matched by mean of age (18 to 60 years old) and gender<sup>12,13</sup>. The participants also answered the Beck Depression Inventory (range 0-63)<sup>14</sup>. The University's Institutional Ethics Committee (CEP 0428/2015) approved protocol and consent forms.

Demographic and clinical data were collected in medical interview. All participants provided written informed consent and finished the questionnaires. Research staff elucidated doubts for the participant during the completion of the tools and checked then for missing responses.

Polysomnography, multiple sleep latency test, and cerebrospinal fluid Hcrt levels were collected in the charts. The cerebrospinal fluid Hcrt levels were measured by

radioimmunoassay at the Center for Narcolepsy in the Department of Psychiatric and Behavior Science at Stanford University (California, USA).

### McGill Pain Questionnaire

This classic questionnaire evaluates chronic pain in adults, with good reproducibility, validity and responsiveness in normal patients and in pathological conditions<sup>15,16</sup>. Its original form contains four subscales to assess pain through qualitative descriptors, which represent sensory, affective, evaluative and miscellaneous dimension of pain. Each descriptor has a value associated to its position in the group of words of the subclass of the pain dimension<sup>17</sup>.

The values of the descriptors are scored in subclasses and totally as quantitative measures of pain. On the other hand, the descriptors are designated qualitatively as well. The answers of the questionnaire constitute the PRI, obtained by summing the intensity values of the chosen descriptors. The index has 78 items of pain descriptors, categorized into 20 subclasses, each containing 2 to 6 words, within 4 major subscales of pain dimensions.

The participant was asked to choose the word that best described their present pain for each subclass of words. The items number of words chosen (accomplished by counting the number of words selected by the individual), body diagram and pain intensity scale were not applied in this study. We used the quality dimensions of pain of the Brazilian Portuguese language validated version<sup>18</sup>.

### Statistical analysis

Statistical Package for the Social Science statistical software for Windows 8<sup>®</sup>, version 21, executed these tests: Pearson's chi-square ( $\chi^2$ ) for categorical variables; Levene normality and Kolmogorov-Smirnov homogeneity, parametric/non-parametric and models of generalized linear model (Poisson log-linear and tweedy with log binary logistic regression) for continuous variables. Results are presented as means  $\pm$  standard deviation and percentages (%). Bonferroni post-hoc test performed pairwise comparisons.  $\alpha=0.05$  was the assumed error considered as statistically significant.

Multiple correspondence analysis is a descriptive statistical method for high-dimensional categorical data that explores cross-frequency tables (contingency tables) containing some measures of correspondence between the rows and columns. This technique was performed to visualize graphically the simultaneous relationship between the variables.

## RESULTS

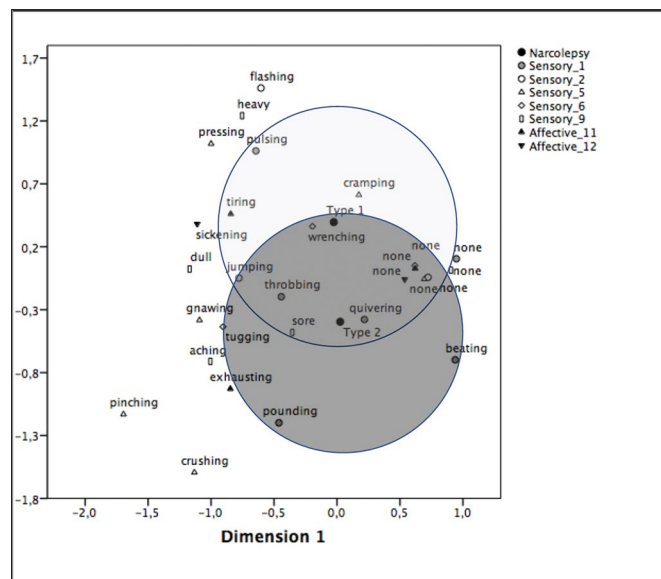
Most of the participants were female (68.7%). The mean age in years was  $36.3 \pm 9.7$  and  $35.3 \pm 10.8$  in NT1 and NT2, respectively ( $p=0.91$ ). The proportions of ethnicity and level of education did not differ statistically between the groups. 19 (54.5%) and 2 (6.1%) patients of narcolepsy types 1 and 2 were obese, respectively ( $p<0.0001$ ). NT1 presented lower levels of Hcrt (NT1= $31.25 \pm 30.85$  vs. NT2= $377.59 \pm 105.51$  pg/mL,

$p < 0.0001$ ). Patients with NT2 reported more history of depression (24.2% in NT1 *vs.* 3% in NT2,  $p = 0.004$ ). However, there were no significant differences between the groups regarding excessive sleepiness, psychostimulant/antidepressant use or depression symptoms (Beck inventory).

We found no difference between NT1 and NT2 in the pain descriptors (qualitative analysis) used in the sum-up of the intensity values of the chosen words in the PRI (quantitative analysis). Remarkably, more than one third of patients with NT1 and NT2 selected a word that belonged to a sensory dimension as the word that best explained their pain. We recognize that the questionnaire has ten groups of words of this dimension (50% of the total).

Nevertheless, we noticed that the three most frequent words were the same in NT1 and NT2: throbbing (48.5% *vs.* 39.4%); jumping (48.5% *vs.* 42.4%); and tugging (33.3% *vs.* 36.4%). Other recurrent words included affective dimension tiring (30.3% *vs.* 24.2%); sickening (27.3% *vs.* 30.3%) in both NT1 and NT2, respectively, and sensory elements [sore (24.2% in NT1 *vs.* 33.3% in NT2), burning (21.2% in NT1 *vs.* 27.3% in NT2), and pressing (27.3% in NT1 *vs.* 12.1% in NT2)].

A multiple correspondence analysis of seven pain groups of descriptors containing the five main words chosen by the patients to describe their pain, according to narcolepsy types, revealed the nearby connections among the dimensions of pain (Figure 1). There is a predominance of sensory descriptors and the words throbbing and jumping have a shorter distance to narcolepsy types than the others in the map. In groups 11 and 12 of affective dimension, the absence of a descriptor (none) is closer to narcolepsy types than the other words of these groups (Figure 1 - intersection area). Most of the patients did not select a specific word of these groups (60.6% in NT1 *vs.* 54.5% in NT2 of group 11 and 69.7% in NT1 *vs.* 66.7% in NT2 of group 12). No word was the top selection of affective descriptors in narcolepsy.



**Figure 1.** Two-dimensional map of seven groups of pain descriptors from the McGill Pain Questionnaire in patients with narcolepsy types 1 and 2 (joint plot of category points), using multiple correspondence analysis. Variables included: type of narcolepsy; affective dimension - groups 11 and 12; sensory dimension - groups 1, 2, 5, 6 and 9.

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## DISCUSSION

Chronic pain is a prevalent comorbidity in both types of narcolepsy. The documentation of this medical condition needs an extensive approach able to identify its main features. This evidence conduct measures of care that impact directly in patient's treatment. In line to this, and agreeing to NT1 and NT2 alike-elevated scores of PRI of our recent investigation, we ought to understand the multiple dimensions of pain perception in narcolepsy. Narcolepsy groups were different in physiopathology, but not in excessive sleepiness, medication or depression indicators.

Even if the statistical analysis did not evidence difference between NT1 and NT2 in pain qualitative descriptors, which were characterized in PRI, our results stand out the high proportions of sensory elements as the most used (words in both narcolepsy groups. The first semantic references to narcolepsy's pain in literature constitute mainly of throbbing, jumping, and tugging sensations, independently of the type of narcolepsy. The map interpretation of multiple correspondence analysis failed to differentiate the groups of patient's using the elements of the categories, as anticipated by the statistic test, but it clarified the minor position of affective descriptors in both types of narcolepsy.

In the Middle Age, Dante Alighieri (1265-1321) reported his understanding of anatomy and physiology of the nervous systems in his epic poem the *Divine Comedy*, mostly in its first part<sup>19</sup>. Based on the detailed expositions of neurological signs and symptoms consistent to physical disorders (epilepsy, metal intoxication, and narcolepsy), Dante's works is associated to medical science. His familiarity with these themes is estimated by his education or his own involvement.

Apart from the speculation of Dante's neurological diseases, the *Inferno of the Divine Comedy* describes an accurate knowledge of the medieval meanings of pain, based on the suffering experience of the characters through their afterlife travel. An motivating study interpreted the images and the expressions of this poem as McGill Pain Questionnaire's descriptors, presenting that more than 50% of the terms used (46 out of 78) were also present in all groups of words of the questionnaire, except for the group XII<sup>20</sup>. The most used items contained the affective sphere, but the terms related to the sensorial experience of pain were the most habitually encountered, suggesting a contribution of the sensory dimension in the qualitative description of pain, similar as provided by our results.

The irrefutable clue in the inscriptions of the gates of Hell "Through me you pass into eternal pain" guides us through the historians of medicine who suspect of the pathological condition or the understanding of narcolepsy by Dante. Nowadays, the *Inferno's* first verses explaining his journey with "full of slumber" and the associations with multiple physical and mental disorders (epilepsy, depression and pain) reinforce our interpretation that the poet himself suffered from narcolepsy. What else could it be?

## CONCLUSION

In narcolepsy, chronic pain descriptors are not significantly different in patients with types 1 and 2, but the first report in literature of semantics of pain in these patients showed that

the sensory dimension overcame the affective one. Throbbing, jumping, and tugging were the most frequent words represented in this dimension, independently of the type of narcolepsy. Multiple correspondence analysis exposed the minor importance of affective elements in both types of narcolepsy.

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### Abbreviations

Rapid-eye-movement (REM)  
 Hypocretin-1 (Hcrt)  
 McGill Pain Questionnaire (MPQ)  
 Pain Rating Index (PRI)  
 Narcolepsy type 1 (NT1)  
 Narcolepsy type 2 (NT2)  
 Pearson's chi-square ( $\chi^2$ )  
 Percentages (%)

### REFERENCES

- Kornum BR, Knudsen S, Ollila HM, Pizza F, Jennum PJ, Dauvilliers Y, et al. Narcolepsy. *Nat Rev Dis Primers*. 2017;3:16100.
- Singh AK, Mahlios J, Mignot E. Genetic association, seasonal infections and autoimmune basis of narcolepsy. *J Autoimmun*. 2013;43:26-31.
- Richardson GS, Carskadon MA, Flagg W, Van den Hoed J, Dement WC, Mittleman MM. Excessive daytime sleepiness in man: multiple sleep latency measurement in narcoleptic and control subjects. *Electroencephalogr Clin Neurophysiol*. 1978;45(5):621-7.
- Mignot E, Lammers GJ, Ripley B, Okun M, Nevsimalova S, Overeem S, et al. The role of cerebrospinal fluid hypocretin measurement in the diagnosis of narcolepsy and other hypersomnias. *Arch Neurol*. 2002;59(10):1553-62.
- American Academy of Sleep Medicine. *International Classification of Sleep Disorders*. 3rd ed. Westchester, IL: American Academy of Sleep Medicine; 2014.
- Li J, Hu Z, de Lecea L. The hypocretins/orexins: integrators of multiple physiological functions. *Br J Pharmacol*. 2014;171(2):332-50.
- Cremaschi RC, Hirotsu C, Tufik S, Coelho FM. Narcolepsy type 1 and type 2 - a 10-year follow-up: body mass index and comorbidities. *Sleep Med*. 2017;32:285-6.
- Jennum P, Ibsen R, Knudsen S, Kjellberg J. Comorbidity and mortality of narcolepsy: a controlled retro- and prospective national study. *Sleep*. 2013;36(6):835-40.
- Dauvilliers Y, Bayard S, Shneerson JM, Plazzi G, Myers AJ, Garcia-Borreguero D. High pain frequency in narcolepsy with cataplexy. *Sleep Med*. 2011;12(6):572-7.
- Cohen A, Mandrekar J, St Louis EK, Silber MH, Kotagal S. Comorbidities in a community sample of narcolepsy. *Sleep Med*. 2018;43:14-8.
- Cremaschi RC, Hirotsu C, Tufik S, Coelho FM. Chronic pain in narcolepsy type 1 and type 2 - an underestimated reality. *J Sleep Res*. 2018:e12715.
- Bertolazi AN, Fagundes SC, Hoff LS, Pedro VD, Menna Barreto SS, Johns MW. Portuguese-language version of the Epworth sleepiness scale: validation for use in Brazil. *J Bras Pneumol*. 2009;35(9):877-83.
- Chung F, Subramanyam R, Liao P, Sasaki E, Shapiro C, Sun Y. High STOP-Bang score indicates a high probability of obstructive sleep apnoea. *Br J Anaesth*. 2012;108(5):768-75.
- Gorenstein C, Andrade L. Validation of a Portuguese version of the Beck Depression Inventory and the State-Trait Anxiety Inventory in Brazilian subjects. *Braz J Med Biol Res*. 1996;29(4):453-7.
- Wilkie DJ, Savedra MC, Holzemer WL, Tesler MD, Paul SM. Use of the McGill Pain Questionnaire to measure pain: a meta-analysis. *Nurs Res*. 1990;39(1):36-41.
- Turk DC, Rudy TE, Salovey P. The McGill Pain Questionnaire reconsidered: confirming the factor structure and examining appropriate uses. *Pain*. 1985;21(4):385-97.
- Melzack R. The McGill Pain Questionnaire: major properties and scoring methods. *Pain*. 1975;1(3):277-99.
- Pimenta CA, Teixeira MJ. Proposal to adapt the McGill Pain Questionnaire into Portuguese. *Rev Esc Enferm USP*. 1996;30(3):473-83.
- Riva MA, Bellani I, Tremolizzo L, Lorusso L, Ferrarese C, Cesana G. The Neurologist in Dante's *Inferno*. *Eur Neurol*. 2015;73(5-6):278-82.
- Tonelli N, Marcolongo R. Dante's *Inferno* and the McGill Pain Questionnaire. *Reumatismo*. 2007;59(2):173-83.