Cancer Related Fatigue (CRF): Perception of Effort or Task Failure?

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Introduction

- Patient's rating of perceived effort (RPE) has been used to assess central fatigue. CRF is believed to be of central origin.
- The increased RPE with a motor task, such as the Finger Tapping Test (FTT), can easily be measured in the clinical setting.

Research Objectives

To correlate the FTT, RPE and the brief fatigue inventory (BFI) rated fatigue severity in cancer patients.

Methods

- Subjective fatigue was assessed in adult patients with cancer by the BFI.
- Participants performed a modified FTT with the index finger of the dominant hand using a grocery counter: 15 seconds x 2, 30 seconds x 2 and 60 seconds x 2 with 1 minute of rest between each time trial.
- RPE at the end of task was measured by the Borg 10 scale. Exclusions were brain metastasis, history of brain radiation, Parkinson's disease, Huntington's Chorea, multiple sclerosis, delirium and depression.
- Pearson's correlation coefficients were used to describe the relationships between BFI, FTT and Borg 10 scale.

Results

- Thirty patients participated. Mean age was 56.2. 16 were females (53.3%). The BFI mean score was 4.1, median 4.4
- Tapping rate diminished with time

Table 1. Change in Tapping Speed

	Mean	SD
15 Second Tapping Speed/Second	4.4	1.1
30 Second Tapping Speed/Second	4.0	0.9
60 Second Tapping Speed/Second	3.7	0.8
Change in Speed from 15 to 30 Second Trials (30 second speed/sec - 15 second speed/sec)	-0.31 (0.38) p -value = 0.0001	
Change in Speed from 30 to 60 Second Trials (60 second speed/sec - 30 second speed/sec)	-0.38 (0.29) p -value < 0.0001	
Change in Speed from 15 to 60 Second Trials (60 second speed/sec - 15 second speed/sec)	-0.69 (0.50) p -value < 0.0001	

- Tapping rate did not correlate with fatigue severity.
- The RPE to accomplish the FTT correlated with mean BFI: p 0.513, p -value 0.0038 and median BFI: p 0.541, p -value 0.0020.

Table 2. Pearson Correlations Between Overall Tapping Speed and Borg 10 with BFI Survey Scores, Borg 10 and Age

Tapping Speed and Fatigue Pearson's Correlation Coefficients	Overall Tapping Speed (total taps/total seconds)		Overall Tapping Speed (mean of trial taps/second)		Borg 10	
	ρ	p-value	ρ	p-value	ρ	p-value
BFI Mean Score	-0.075	0.6954	-0.082	0.6651	0.513	0.0038
BFI Median Score	-0.078	0.6807	-0.085	0.6537	0.541	0.0020
Fatigue Right Now	-0.191	0.3125	-0.194	0.3044	0.440	0.0151
Fatigue Usual Level	-0.248	0.1870	-0.261	0.1643	0.517	0.0034
Fatigue Worst Level	-0.189	0.3171	-0.206	0.2751	0.342	0.0646
Borg 10	-0.230	0.2212	-0.247	0.1891		
Age	-0.364	0.0477	-0.381	0.0380	0.096	0.6148

Discussion

- Central fatigue is a progressive reduction in the ability of the central nervous system to maximally activate muscle
- Supraspinal fatigue is characterized by reduced output from the motor cortex to the spinal motor neuron pool which contributes to reduced activation of muscle
- Inability to maintain adequate drive from premotor areas to the primary motor cortex contributes to voluntary activation failure.
- Supplementary cortex upstream to the corticospinal motor neuron is associated sense of effort during and after a fatigue task.
- A sense of effort and other specific sensations such as temperature, pain and other muscular sensations have two separate neurological mechanisms.
- The sense of effort is centrally generated while temperature, pain and muscular sensations are based on afferent sensory feedback.
- The RPE in our study increased rapidly before task failure which correlated with the pre-task fatigue as measured by the BFI and is consistent with central fatigue. The FTT with measured RPE is a reasonable test to use as an outcome in interventional trials
- Limitations include the unknown reliability when repeated over time

1. Sharples, S. A., et al. (2016). "Cortical Mechanisms of Central Fatigue and Sense of Effort." *PLoS One* 11(2): e0149026.
2. Srimmaul Bde, P. (2012). "Sense of effort and other unpleasant sensations during exercise: clarifying concepts and mechanisms." *Br J Sports Med* 46(5): 308-311.

Conclusion

- Patients with CRF exert a greater effort to complete a motor task which is a sensitive indicator of CRF.
- The sense of effort is largely related to a central corollary discharge from the supplementary cortex as demonstrated in other studies and hence is a measure of central fatigue.