

Proteomic study of lumbar spinal cord after quadricipital eccentric exercise

Zoé Lacrosse^{1,2}, Stéphanie Hody¹, Pierre Leprince¹, Jean-Louis Croisier^{2,3}, Bernard Register^{1,4,5}

¹GIGA-Neurosciences, University of Liège, Liège, Belgium

²Department of Motricity Sciences, University of Liège, Liège, Belgium

³Department of Physical Medicine, CHU of Liège, Liège, Belgium

⁴Department of Neurology, CHU, University of Liège, Liège, Belgium

⁵GIGA-Development, Stem Cells and Regenerative Medicine, University of Liège, Liège, Belgium.

Introduction

Eccentric muscle contractions are characterized by an increase of muscle tension as it lengthens (slowing movements). Unaccustomed or intense eccentric exercise causes "Delayed-Onset Muscle Soreness" (DOMS). DOMS include muscle pain that appears 24 to 72 hours after exercise, but also stiffness, edema and muscle proteins release in plasma.

The only systematic intervention that brings a muscle protection against DOMS is to realize submaximal eccentric contractions with a progressively increased intensity. The mechanism of this protection, called the "Repeated Bout Effect" (RBE), is not understood. However, it is likely explained by cellular, mechanical and neural theories [Scand.J.Med.&Sci.Sports, 13, 88, 2003].

The objective of this study is to better understand which neural signal is released in the muscle synapse and which brings protection by RBE.

Methodology

C 57 BL ♂	Exercise modalities	Treadmill
4	Eccentric	Downhill running
4	Concentric	Uphill running
4	Control	/



Acclima-tization (10')	Warm up (10') +/- 15° 5cm/s to 20 cm/s	Run (8 bouts) 5' run + 2' recovery +/-15° 20 cm/s	Run (10 bouts) 5' run + 2' recovery +/-20° 20 cm/s
------------------------	---	---	--

1. Sacrifice = 24h after race
2. Lumbar spinal cord dissection
3. Compartmental extraction (nuclear and cytoplasmic proteins)
4. Proteomic analysis by 2D-DIGE coupled with mass spectrometry



Results

Nuclear proteins 24h		Cytoplasmic proteins 24h	
Eccentric - Control	7	Eccentric - Control	0
Concentric - Control	4	Concentric - Control	0
Eccentric - Concentric	0	Eccentric - Concentric	0

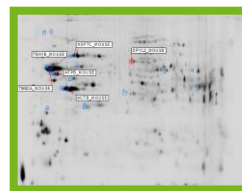


Figure 1: Comparison between eccentric and control group

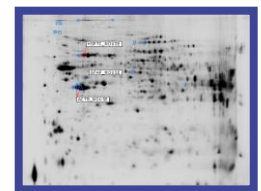
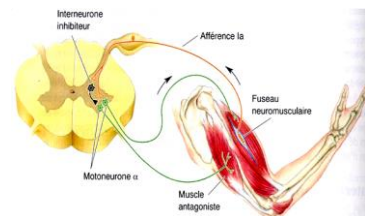


Figure 2: Comparison between concentric and control group

We do not observe any cytoplasmic protein modification while in the nuclear extract, seven spots were more abundant in eccentric group and four in concentric group in comparison with control group.

- Tubulin (beta-2A chain & alpha-1B chain)
- Heat shock cognate 71kDa protein
- Dihydropyrimidinase-related protein 2
- Actin, cytoplasmic 1

The mass spectrometry of these proteins reveals that they are implicated in axoplasmic transport.



Conclusion & Perspectives

At 24 hours, too few proteins modifications were detected in lumbar spinal cord, maybe as a consequence of a too short period between race and euthanasia. Implication of axoplasmic transport comforts our starting hypothesis that nervous system is able to protect muscle during the RBE by a synthesis and then a synaptic release of molecules modifying the muscle physiology.

1. Proteomic studies with sacrifice at 48h/72h/96h after race → identify when there are protein modifications in spinal cord
2. Transcriptomic analysis for eccentric/concentric/control groups → identify RNA modifications in spinal cord
3. Identify which genes are implicated in muscle typology remodeling especially after eccentric exercise