行政院國家科學委員會專題研究計畫成果報告

中頻率干擾波電刺激對增加肌力電刺激法之肌肉痠痛其效果---臨床與基礎研究計畫編

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本研究結果分為兩部份即 : 1)**測量疼痛壓力測量器之效度與** 2)**以相同於臨床實驗之增加肌力之電刺激法刺激老鼠之腓腸肌。定量並定位** c-fos **在脊髓背根神經的分布，作為疼痛的客觀指標，以了解肌肉刺激後疼痛的機轉。**

1)**在比較壓痛計（**Pressure meter **以下簡稱** PM**）對正常人肌肉與肌腱上之壓痛閾值與最大壓痛值之信度。方法為選用**20**位正常人為測試者。其中**15**位為女性，**5**位為男性。測試者重複測量左右兩邊之斜方肌肌肉上及脊上肌肌腱上之壓痛閾值與最大壓痛值以比較測試前後之信度。採用兩位測試者作相同的測試以求得測試者間之信度。測試時以每秒一公斤之壓力漸增，每一點測試時間間隔至少兩分鐘。結果：從組間相關係數（**Intra-class correlation coefficients, ICC**）看來觀察者內信度（**Intra-rater reliability**）很高，肌肉上之**ICC**為**0.80~0.96**，肌腱上之**ICC**為**0.83~0.98。至於觀察者間信度（**Inter-rater reliability**），除了左邊脊上肌肌腱上之信度較差之外（**ICC為**0.27**），其餘各點之壓痛值均有中等至高的信度；其**ICC**為**0.68~0.97。結果顯示壓痛計為一觀察者內及觀察者間信度很高的測試儀器。其測試結果可用在臨床上壓痛的定量並可用來評估不同物理治療方法治療肌肉骨關節疾病之療效。

2)**在探討以中頻電刺激**(2500 Hz)**引起老鼠** (Sprague-Dawley rat) **之腓腸肌收縮時**FOS **模式之變化。方法為選用五隻老鼠用**1% halothane**輕微麻醉後將腓腸肌加以固定並連結至應力感測器，放置電極片(大小一公分平方、相距一毫米)以中頻電刺激**(2500 Hz)**予以刺激。使用之平均電流為** 49±15.80 **毫安培**(mA). **其中一隻採用連續模式、使用之電流為**64.0**毫安培，電壓為**22.3±0.22**毫伏特** （mV）,**讓肌肉之最大收縮十分鐘。另外一隻採用間斷模式** 10 **秒開** 50 **關，使用相等量之電流讓肌肉之最大收縮六十分鐘。刺激終了後兩小時老鼠用** 4% papaformaldehyde**沖洗，將老鼠腰椎第四節至薦椎第二節之脊髓切成** 30 μm **之薄片。 再利用** Fos immnuo -- cytochemical **反應去算出五次最高之表現並使用電腦去計算其面積。此種算法之觀察者內信度（**Intra-rater reliability**）很高，**ICC**為**0.96 ~0.98**，至於觀察者間信度（**Inter-rater reliability**）也很高**ICC**為**0.92~0.95。

結果顯示刺激後，連續模式比間斷模式更能引起老鼠脊髓深層及淺層FOS **之分**

佈。此外，連續模式刺激其老鼠脊髓深層及淺層FOS **之面積也較大。**

結論為：

1. **兩種不同刺激模式引起老鼠脊髓深層及淺層**FOS**分佈之不同可能和引起肌肉收縮與疼痛之機轉不同。**

2.**在產生肌肉最大收縮時, 兩種不同刺激模式引起老鼠脊髓深層及淺層**FOS**分佈之大小不同，可能和激發疼痛之感覺傳入神經纖維** A- delta **及** C- fibers**不同。**

3. **上述機轉有助於了解肌肉在最大收縮或痙攣時之疼痛。**

關鍵字：壓痛閾值、肌肉疼痛、信度測量、中頻電刺激、FOS**、肌肉最大收縮、疼痛**

This study contained two parts. 1) Inter- and intra-rater reliability of measurements of pressure threshold and tolerance by pressure meter on muscle and tendon in healthy subjects, and 2) The induction of FOS in dorsal horn neurons by maximal muscle contraction

1) This study was designed to evaluate the inter- and intra-rater reliability of measurements of pressure threshold and tolerance by using a commercially available pressure meter (PM). Repeated measurements of pressure threshold and tolerance on the upper trapezius muscle and supraspinatus tendon of both sides were obtained from 20 healthy adult volunteers (15F and 5M). Two examiners carried out the measurements. Each measurement from each point/spot was completed at least 2 minutes apart. Intra-class correlation coefficients (ICC) of these measurments revealed excellent intra-rater reliability for two examiners both on muscles (0.68~0.91) and on the tendons (0.83~0.98). There was also excellent inter-rater reliability (0.66~0.85) in all pressure and tolerance measurements on supraspinatus tendons. Only good reliability (0.54~0.76) on upper trapezius muscle was shown. These results revealed that PM was highly reliable in measuring pressure threshold and tolerance between and within examiners. Based on thease results, PM was suggested to be a useful tool in clinical diagnosis of abnormal tenderness. Further, the treatment effectiveness by using various types of physical therapy in treating musculoskeletal disorders could be quantified by PM.

2) This study was to investigate the FOS pattern induced by different types of muscle contraction which were stimulated by median frequency (2500 Hz) with very short pulse duration (400 μs) on the calf region of Sprague-Dawley rats. Median frequency (2500 Hz) electrical stimulation was applied to the calf region of the restrained rats with light anaesthesia by 1% halothane. The intensity of the median frequency was predetermined in 3 rats, by detaching the calf muscles and attaching it to a force transducer. The mean current of maximal muscle contraction is 49±15.80 mA. The calf muscles were stimulated by two small disposable electrodes (1 cm^2, 1mm apart). Two types of electrical stimulation were applied. One (334kg) was continuous electrical stimulation in the predetermined intensity (64.0 mA, 22.3±0.2 mV, constant voltage) for maximal muscle contraction 10 minutes. The other (321kg) was intermittent electrical stimulation, 60 minutes of 10 sec on/ 50 sec off, in the same intensity. After 2 hours at the end of electrical

stimulation, the rats were perfused with 4% papaformaldehyde. Spinal cord from L4 to S2 were cut in a cryostat at 30 μm each section. Fos immnuo --cytochemical reaction was performed to the sections of the spinal cord. The FOS-positive reaction neurons were counted in top 5 expressions and their size was measured by an image computer analysis system. The intra-reliability and inter-reliability of FOS count were r=0.96 ~0.98 and r= 0.92~0.95.

The results showed the FOS distribution after stimulation showed more diffuse in continuous type than in intermittent type in superficial and deep zones. Furthermore, the FOS amount of continuous stimulation in superficial and deep zones was larger than one of intermittent stimulation but the mean FOS cell size was smaller than the intermittent. However, there was the same size population in the two types.

CONCLUSION:

1. The two muscles' contraction induced by median frequency (2500 Hz) electrical stimulation resulted to different FOS expressions in pattern and cell count. This might showed the association between the muscle contraction type and muscle pain.
2. The different cell size population in the two contractions indicated that different nociceptive neurons could be activated by the afferent of A- delta and C- fibers during maximal contraction.
3. These results could contribute to our understanding of muscle pain from excess muscle contraction or prolong muscle spasm.

Key words: Pressure threshold, Pressure tolerance, Reliability, Muscle Pain median frequency, FOS, Muscle contraction, Pain

REFERENCES

1)-1 Fischer AA: Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. Pain 1987;30:115-126.

1)-2 Hogeweg JA, Langereis MJ, Bernard ATM, Faber JAJ, helder's PJM. Algometry: measuring pain threshold method and characteristics in healthy subjects. Scand J Rehab Med 1992;24:99-103.

1)-3 Fischer AA. Pressure threshold meter: Its use for quantification of tender spots. Arch Phys Med Rehabil 1986;67:836-838.

1)-4Fischer AA. Pressure tolerance over muscles and bones in normal subjects. Arch Phys Med Rehabil 1986;67:406-409.

1)-5 Jensen K, Andersen HO, Olesen J, Lindblom U. Pressure-pain threshold in human temporal region. Evaluation of a new pressure algometer. Pain 1986;25:313-323.

2)-1. Bullitt, E., et al., The effect of stimulus duration on noxious-stimulus induced c-fos expression in the rodent spinal cord. Brain Res. 580(1-2):172-9,1992.

2)-2. Bullitt, E., Somatotopy of spinal nociceptive expressions processing. J. Comp. Neuro. 312(2) : 279-90, 1991.

2)-3. Menace S., Nociception from skeletal muscle in relation to clinical muscle pain. Pain. 54(3):241-89.

2)-4. Nelson, R.M., et al., Clinical Electrotherapy, Norwalk, Conn, Appleton & Lange, 1987.

Reference

1. Fischer AA: Pressure algometry over normal muscles. Standard values, validity and reproducibility of pressure threshold. Pain 1987;30:115-126.

2. Hogeweg JA, Langereis MJ, Bernard ATM, Faber JAJ, helder's PJM. Algometry: measuring pain threshold method and characteristics in healthy subjects. Scand J Rehab Med 1992;24:99-103.

3. Fischer AA. Pressure threshold meter: Its use for quantification of tender spots. Arch Phys Med Rehabil 1986;67:836-838.

4. Fischer AA. Pressure tolerance over muscles and bones in normal subjects. Arch Phys Med Rehabil 1986;67:406-409.

5. Jensen K, Andersen HO, Olesen J, Lindblom U. Pressure-pain threshold in human temporal region. Evaluation of a new pressure algometer. Pain 1986;25:313-323.

6. Kosek E, Ekholm J. Modulation of pressure pain thresholds during and following isometric contraction. Pain 1995;61:481-486.

7. Ohrbach R, Gale EN. Pressure pain thersholds in normal muscles: reliability, measurement effects, and topographic differences. Pain 1989;37:257-263.

8. Fischer AA. Documentation of myofascial trigger points. Arch Phys Med Rehabil 1988;69:286-291.