A PROPOSAL FOR THE EVALUATION OF THE USE OF ELECTRODERMAL BIOFEEDBACK IN THE DIAGNOSIS AND TREATMENT OF SYMPATHETICOTONIC MEDIATED SOMATIC DYSFUNCTION

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Lower back pain is responsible for the loss of thousands of work days a year in the United States alone. Lifetime incidence of lower back pain (LBP) in industrial societies has been reported as high as 80%.[1] This paper will focus on primary idiopathic LBP, that is pain not secondary to any visceral pathology or obvious structural defect. Within this category alone , numerous etiologies are possible. From the clinical perspective, these can be grouped into acute and chronic conditions. 85 to 95% of acute backaches resolve uneventfully within three months,[2] or are amenable to treatment by heat or osteopathic manipulation.[3] Chronic back pain has been relieved by longer term therapeutic treatment using progressive relaxation, Alexander Technique, and various Biofeedback techniques.

This paper will further focus on LBP subjects in which chronic muscle spasm is the primary etiological factor, and for whom an increased or sustained response to stress is manifested by an elevated level of sympathetic nervous activity (sympatheticotonia).

Burish, in a paper published in 1983, concludes that "Electromyographic biofeedback (EMG) is not more effective than the less complex and less expensive relaxation training therapies in the treatment of migraine and tension headaches."[4] A review by this author of Psychological Abstracts for 1984 found over 25 papers related to EMG, showing continued interest in this area.On the other hand, papers related to electrodermal biofeedback were far fewer in number.

Electrodermal activity can be evaluated in two ways. The Galvanic Skin Response (GSR) measures the resistance of the skin to an externally applied current, while Skin Potential Response (SPR)

measures the electrical potential of the skin (no current applied).

In a review of Biofeedback applications in Behavioral Medicine, Pinkerton found no studies that demonstrated "the clinical efficacy of electrodermal biofeedback for any specific disorder"(1978),[5] while at the same time acknowledging a general concensus that "decreased skin resistance and increased skin potential is a reflection of increased sympathetic arousal or stress." [6]

A review of some of the basic research in peripheral sympathetic activity sheds some light on the difficulty of finding an application for this therapeutic mode. Two very different temporal patterns were found by Wallin and Delius (1972). One is derived from muscle nerve sympathetic activity. It occurs in bursts that follow the pulse rhythm and fluctuate inversely with spontaneous blood pressure suggesting a vascular component. Hypertensive subjects had a higher threshold for inhibitory response than normotensive subjects.The skin nerve sympathetic activity did not vary from normo to hypertensive subjects, but did appear to be loosely correlated with respiratory rhythm.[7]

This same group publishing under different primary authorship found that while skin nerve activity induced by mental stress would normally subside in 20-30 seconds, in some cases emotional stimuli would increase the length of outflow to several minutes. Further, over the length of a long recording session, the basal level at a particular nerve could slowly change to a higher or lower absolute level of activity than that found at the beginning of the experiment.[8]

Earlier, Korr (1958) noted that a possible reason why regional variations in the GSR of the trunk had been overlooked, was that the two to twenty fold differences in resistance required to

differentiate a spatially oriented pattern over the skin was easily lost in the 1000fold range of basal resistance found in normal subjects.[9]

With reguard to the research by Wallin and Delius, three points should be noticed:

1) The use of indwelling electrodes

2) GSR was summated temporally from one or a few points

3) The test points were all on the peripheral limbs.

Herein lies the crux; if we are looking for a peripheral sympathetic indicator of visceral or systemic malfunction, it would seem logical that the thorax, specifically the back would be the place to test. If we use indwelling temporally summated electrodes we gain specificity , but very little useful information for the degree of invasiveness of the procedure.

In 1958 Korr developed a system for evaluating sympathetic outflow spatially. A rolling GSR electrode produced photographic strips that when collated provided a blueprint or "backprint" of sympathetic activity for the dorsal thorax. The patterns were specific for a given person on a given day, but showed regularity for a given person over time.[10] While primitive in terms of today's technology, it gave a topographical map of sympathetic activity that correlated with areas of chronic LBP in selected subjects.[11]

Fig. 1 A and B

Photographic records of electrical skin resistance patterns obtained with the automatic dermohmeter. Each longitudinal strip represents the path of a light source (mounted over the exploring electrode) whose brightness varies with the resistance of the subjacent skin. The dark areas represent areas of low resistance; the darker the area, the lower the resistance. By means of appropriate double exposure the chart appears superimposed on the subject's body. The white dots in the midline represent the tips of the spinous processes, marked by a spot of light. The numbered strip at left of each record is the calibration, showing, for that exploration, the variations in light brightness with variations in current flow through the skin at constant voltage.

Proposal

Given the availability and cost of second generation microprocessors, it would not be too expensive to build an elastic body shirt embedded with a spatial matrix of silver impregnated electrodes[12] attached to a microprocessor programmed for a number of functions. These could include:

1) printing out a backprint that would serve as a diagnostic aid to the therapist and a visual reference point for the subject.

2) operate as a biofeedback devise responding to

   a) decreased sympathetic activity

   b) general symmetry

   c) variations from a "normal" backprint stored in the computer memory.

As with other forms of biofeedback, the goal would be the developement of internalalgorithms for what the optimal functioning patterns for a given subject are. Computerized biofeedback programs for skin temperature have already been developed by Krausman at Johns Hopkins University,[13] and separately by Cassel.[14]

Applications

Developing a protocal in conjunction with an osteopathic physician by which a backprint would be taken before and after spinal manipulation to correlate clinical reduction in pain and/or increase in mobility with decreased sympathetic outflow. As data accumulates, correlations may emerge between recalcicrant sympathetic ourflow patterns and various systemic or organ related disorders including cardiovascular disease, duodenal ulcer, asthma, ~~pancreatitis and colitis.~~

It is the opinion of this author, that while visual feedback will provide optimal diagnostic value, a program that can provide audio-biofeedback will encourage mobility and strengthen therapeutic response.

Where is CBP? - that's what you started with - showed and then too - I think.

NOTES

[1] Wilder, D.G., et. al., Vibrations and the Human Spine, SPine, 7:243-254, 1982.

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[3] Stiles, E.G., Safe Useful Manifulation Techniques, Patient Care, Aug 15, 1984, p.137-50.

[4] Burish, T.G., Holmes, D.S., Effectiveness of Biofeedback for treatment of migraine and tension headaches, J. of Psychosomatic Res., 1983, v 27(6), p.525-32.

[5] Pinkerton, S.S., et.al., Behavioral Medicine Clinical Applications, John Wiley and Sons, N.Y., 1982, p.339.

[6] ibid., p.27.

[7] Wallin, B.G., et.al., Comparison of sympathetic nerve activity in Normo and Hypertensive subjects, Circ. Res., v33, July 1973, p9-20.

[8] Delius, W., et.al., Manoeuvres affecting sympathetic outflow in human skin nerves, Acta physiol scand., v84, 1972, p.177-86.

[9] Korr, Irwin M., et.al., Patterns of electrical skin resistance in man, J. of Neural Transmission, 17:77-96, 1958.

[10] Price,T., Korr, I.M., The automatic recording of electrical skin resistance on the human trunk, EEG Clin. Neurophysiol. 3:361-68,1951.

[11] Korr, Irwin M., op.cit. , v25, 589-606, 1964.

[12] Fuller, G.D., Biofeedback: Methods and procedures in clinical practice, Biofeedback Press, San Fransisco, 1977.

[13] Krausman, D.T., Color Graphics terminal provides added dimensions to biofeedback systems, Psychophysiol. 1982, v19(2) , p.538-41.

Cassel, R.N., Casal Psychiatric Center computerized biofeedback clinic, Psych.: A Quarterly Journal of Human Behavior, 1982, v19(1), p.24-27.