HYPERFUNCTIONAL AFFECTIONS OF THE STATO-KINETIC APPARATUS SPECIFIC TO SPORTSMEN OF HIGH PERFORMANCE

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SUMMARY

The statistical analysis of the traumatic affections treated by the author during 1967 in the traumatic service of the Centre of Sports Medicine, Bucharest shows the fact that traumatic affections amount to 34.1% whereas hyperfunctional lesions to 22.9%.

The author does not agree with the denomination of "sportive micro-traumatism" given to these affections because of the aetio-pathogeny and the sportive specificity of this kind of lesions. Relying on clinical history and examination; on physiopathological and especially on biochemical and histological and histochemical data, he proposes the name of hyper-functional localized affections. Among the arguments put forward by the author the following are to be retained: parallelism between biochemical data (increase of sialic acid and generally of blood mucoproteins) and histochemical aspects of tissue mucopolysaccharides of lesions (proved by microscopic sections which underwent enzymatic extractions).

The author considers these affections to be expressions of some forms of overtraining, localized in the stato-kinetic apparatus, admitting as an aetio-pathogenic mechanism, the imbalance between biochemical stresses of the training effort "technopathy" and physiochemical dismetabolic and functional properties of the respective tissue, expressed by imbalance of tissue enzymes within the complex limits of the changes of overtraining.

INTRODUCTION

Within recent years, examination of data obtained from the medical history of many sportsmen has shown the emergence of a group of clinical conditions in which there is no clear record of any definite traumatic incident. This category is of interest not so much from an academic view as from the practical considerations of diagnosis and treatment, and has been separated as a specific group, specific to sportsmen, on statistical grounds, anatomical localisation and pathology. In the series described below, this category amounts to 23% of the cases, as opposed to 34% of straight-forward acute trauma.

Several workers have already attempted to describe and classify these conditions:-

La Cava, Palacco and Clerle (1954) in Italy, and in 1960 several workers from Eastern Europe, under the heading of "Microtrauma in Sportsmen" attempted to explain the aetiology, pathology and specific population at risk. These workers included Mathe (Czechoslovakia), Priorov, Philippova and Mironova (Russia), Sanko (Bulgaria), Horvath (Hungary), and Heize (East Germany).

The aetiology of some of these conditions was discussed by Poli and Pasini (1961), Mironova reviewed 1865 cases collected between 1952 - 1957. La Cava, in examining data on 450,000 sportsmen in Italy from 1954 - 1959 found that 6% of all traumatic cases fell into this category; but Stavrache (1961) considered that the figure was 28.5% of microtraumatic affections as opposed to 34.1% for acute trauma. An accurate review of the literature is made difficult by the rich variety of descriptive terms used by different authors, tabulated below.

"Microtraumatisms". Priorov, Mironova, Novak, Kejici.

"Fibroclastic Myopathy". Zacala, Vincenti.

(for muscular injuries)

"Entesitis" to express pathogenesis) La Cava.

"Technopathy" specific to sportsmen)

"Dynamic Periostopathy" Bankov.

(for periosteal localisation)

"Myositis". Moraru, Ionete, Pop, Joja.

In attempting to explain the aetiology and pathology, the following factors have been incriminated.

"Micro Traumatism". Priorov, Vinogradova, Dorthheimer, Popescu.

"Chronic Traumatism". Mkritchyn, Sebastian.

"Circulatory and Lymphatic Disorders". Bankov, Mateev, Horvath.

"Overtraining and Fatigue" Seririakov, Kolytchrova,

"Limited Micro-Injuries" Dobrovolski.

"Disorders of Central and Autonomic Nervous Systems". Novak. Krejci.

"Peripheral Nervous Disorders" Kassavina, Mousykent.

In order to rationalise these problems, during the past ten years we have carried out a series of clinical, statistical, biochemical, histological, histochemical and therapeutic studies. Some of this data has already been published elsewhere, but in this article we shall try to take a general view, synthesising the collected data.

WORKING METHOD

First precise methods of positive diagnosis had to be developed, no matter at what level in the stato-kinetic apparatus the lesions occurred. In this article we shall use "hyper functional sportive traumatic affections" as the most logical term to use, as we shall argue later in the study. The cases selected have been studied statistically, and the author's data compared with that of others. As well as clinical examination, we made use of histochemical and biochemical investigations. In practice, selection was made by examining those with lesions of the stato-kinetic apparatus, the locomotor system, in whom no clear account of any single traumatic incident could be remembered, in which the onset was insidious, and the progression closely related to the patient's training or performance in his own particulars sporting event. Upon these cases biochemical tests were carried out.

Blood levels of:

- Syalic Acid.
- Mucoproteins.
- Glycoproteins.
- 17 Keto-steroids.
- Electrophoresis of V.S.H.

Biopsy puncture of tissue Mucopolysaccharides and their degree of Depolymerisation using enzyme extraction with Heparin and Hyaluronidase, at the site of the lesion.

RESULTS

The statistical data obtained from the study of morbidity in sportsmen of high performance due to trauma showed an increased percentage of hyperfunctional affections. In the Sports Medicine Centre at Bucharest in 1967 215 (22.9%) of such conditions were recorded, which acute traumatic conditions amounted to 315 (34.1%) of all cases treated. Anatomically, the tissues most frequently involved were muscle - 7.5% followed by tendon 5.2%. In all cases there was lack of any history of definite injury that could be remembered, but also all patients had been undergoing heavy training under intermittent anaerobic phases; (controlled interval training, circuit training, isometric training); all had complained of fatigue and many had exhibited signs suggestive of overtraining and staleness.

TABLE No. 1.AETIO-PARTHOGENIC ANALYSIS OF TRAUMATIC AND HYPER-FUNCTIONAL AFFECTIONS TREATED DURING 1967 AT THE CENTRE OF SPORTS MEDICINEBucharest (Dr. Stanescu Nicholae)

Total of treated cases of traumatic affections 938 of which:

Tissue	<u>Pure traumatisms:</u>		<u>Hyperfunctional:</u>	
	clinical forms Nr. cases		clinical forms Nr. cases	
Muscles	Stretching - tearing	83	Myositis	53
Tendons	Tearing tendons	-	Tendonitis	50
Ligaments, apo- neuroses, inser- tions	Stretching - tearing	38	Entesitis	22
Periostium	Contusions	12	Periostitis	22
Articular tions	Sprains	176	Periarthritis - peri-arthritis 8 Periarthritis 21 Arthrosis 32 Capsulitis 1 Synovitis <u>4</u>	
			total:	66
Total cases		319 = 34.1%	213=22.9%	
Other traumatic affec- tions. cases:		406		
Total - All Cases.		938		

The onset of the condition is insidious, with discrete peripheral neuro-circulatory disturbances which often follow physical or mental strain such as school examination, followed by increasing pain or discomfort when training is resumed or made more intensive. Frequent remissions occur, but as time passes the condition slowly becomes progressive. Clinically, the muscular lesions are characterised by stiffness, local hyperaemia, pain on palpation, and during active movement of the muscle involved. Laboratory tests showed a pronounced increase in serum syalic acid up to 80 - 100 mg. % (Seifer -

Gerstenfeld method), of serum mucoprotein (la Huego-Popper method) and glycoprotein (Solovieva method), in some cases long before the appearances of clinical manifestations. Other substances such as blood sugar and alkaline phosphatase were within normal limits.

In those cases which had progressed severely enough to require operative treatment, biopsy specimens of damaged muscle and tendon were removed for examination. Besides the routine morphological examination of the tissues, sections were stained specifically for mucopolysaccharides - (Hotchiss), for MPZ neutral (by McManus periodic - Acid - Schiff) and MPZ acid, especially hyaluronic acid, by the Halle method. From the same biopsy specimens and second series of sections were prepared, and enzyme extractions were carried out using heparin and hyaluronidase. After such enzyme treatment, subsequent depolymerisation M.P.Z. showed a reduced staining reaction, and by functional extraction at 30 - 60 - 90 minutes, it is possible to appreciate the rapidity of depolymerisation of the respective tissue and therefore, in an indirect way, the degree of "ageing" of the collagen tissue in the respective regions.

DISCUSSION

The results of our observations, especially the histochemical and biochemical investigations, allow us to come to the conclusion that at the basis of these muscular and tendinous conditions these are first of all changes in the metabolism of mucopolysaccharides localised in certain anatomical regions of the stato-kinetic apparatus - the locomotor system. In this way there is disharmony between the biochemical changes induced by athletic effort and the physico-chemical and functional qualities of the tissues that carry out this effort. These conditions which in the beginning appear as mere alterations in tissue metabolism will not progress if hard training is discontinued or at least diminished.

This metabolic disorder is brought about in the first place by tissue enzyme imbalance, expressed locally as symptomatic of overtraining. This in turn can be detected by suitable biochemical tests, as described.

We consider therefore that such generic terms as "microtraumatism" does not convey either the aetio-pathological contents of these conditions, or their specificity for sport. In training for sport, mistakes in the coaching can lead to "hyperfunctionality", to overuse of muscles and supporting tissues not strong enough to withstand the stresses applied, and we consider that a more appropriate and descriptive term would be "Hyperfunctional Reiterative Localised Affection (H.R.L.) of the stato-kinetic apparatus."

The fundamental pathological mechanism is expressed by disorders in the metabolism of the mucopolysaccharides in the cell, especially in the acceleration of their depolymerisation and of a higher lability of their valencies. We bring forward our bio-chemical and histochemical data in support of this statement. The most significant fact is that these cellular modifications often precede the appearance of obvious clinical manifestations, which are strongly in support of our interpretation. The pre-existence of such modifications has also been shown by the histopathological studies of Stavrache and Georgescu 1960.

All the other phenomena previously observed; circulation troubles (Novak and Krajci) - lymphatic (Horvath) - peripheral neuro-circulatory (Priorov) - or morphological re-organisation (Dobrovolski) - are either secondary or at the utmost accessory factors. Nearer would be the views of Kassavina and Mousykent (1958) who, starting from the basis of microtraumas and progressing through ischaemia come to the problem of alterations in protein-fibre components by disturbances in the energy - producing phosphorylation enzymes of muscle albumen.

In our interpretation the conception is more complex. We consider that the metabolic alteration concerns the non-specific collagen tissue, which permits us to explain in the same context the other hyperfunctional affections localised in tendon, ligaments, or other articular and periarticular sites: rather than the muscular tissue with its energy metabolism as profounded by these other authors.

We also consider that these affections are only local expressions of some general systemic condition, especially in the neuro-endocrine system, particularly in the hypothalamic - pituitary - adrenal - gonadal chain of hormone links. This site is confirmed by our findings in the changes of urinary 17 - keto - steroids, with or without activation by means of the adreno corticotrophic hormone (ACTH). In support of these hypotheses are the results of electro encephalographs performed on trained and untrained sportsmen by Priorov, which were compared with those of patients presenting lesions in these areas. Polivoda's work dealing statically with fatigue in different periods of competition, strengthens the view that overtraining produces physical factors, especially neuro-vegetative, which start with emotional upsets and produce affections specific to competitive events.

CONCLUSIONS

1. In some sportsmen the complex changes brought about through over-training ("super-solicitation") may materialise at various levels in the statokinetic apparatus (skeletal or loco-motor systems).

2. Earlier descriptive terms for these conditions, such as "micro-traumatic lesions" are not altogether correct, as they express neither the aetio-pathological concepts nor the specificity to sportsmen in whom there is a transition from the healthy stresses of training to the harm of overtraining.
3. In our opinion these affections are localised forms of overtraining of the stato-kinetic apparatus, but form part of a more general syndrome.
4. The fundamental pathological mechanism is a breakdown in the metabolic changes due to training and the physico - chemical and functional properties of the tissues involved. Overtraining or other errors of coaching lead to a disturbance in the balance of tissue enzyme systems, leading to depolymerisation of the mucopolysaccharides in the Collagen tissue, as shown in our laboratory investigations.
5. This interpretation supports our concept and explains how stress may affect muscle, but also non-muscular tissues such as tendons, ligaments and other connective tissue.
6. We consider that the most descriptive title for this class of lesions is hyperfunctional localised affections of the stato-kinetic apparatus.
7. In this concept the lesions covered arouse very important problems in their differential diagnosis, in their therapeutics, and in the coaching methods used for their specific event.

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