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Tissue engineering and stem cell biology – Friday 15 June, 16.00-17.30/Forum Hall

SP0083 EFFORT-INDUCED HYPERTHERMIA: SIMILARITIES WITH MALIGNANT HYPERTHERMIA

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Effort-induced hyperthermia, also called exertional heat stroke (EHS) is due to an imbalance between internal heat production and heat loss, generally exacerbated by several factors such as inadequate fluid, caloric, and/or electrolyte intake, and is associated with a classical symptomatology, i.e. increased body temperature (higher than 40°C), neurological impairment that could lead to coma with the addition of rhabdomyolysis-induced myoglobinuria and acute renal failure. EHS generally occurs during strenuous activity under hot and humid environmental conditions. Subjects are often healthy young adults with no apparent clinical or biological deficits. The pathogenesis of a EHS episode differs from a malignant hyperthermia (MH) crisis. However, both conditions share some similarities in symptoms, such as the abnormal increase in core temperature. The triggering agent is different. MH is a disorder of skeletal muscle in which volatile anaesthetics and depolarizing muscle relaxants trigger a sustained increase in myoplasmic calcium concentration, thereby producing hyper-metabolic and contractile activities. MH crisis occurs in predisposed subjects and leads to a dramatic increase in core temperature. In addition, neurological signs are rarely recorded during a MH crisis, and dantrolene is used to prevent a fatal issue, whereas cooling is largely used as therapy during EHS. DNA mutations involved in the susceptibility to MH have been reported for only 50% of subjects susceptible to MH and for the remaining 50% this information is still not available. With respect to EHS subjects, no information regarding MH mutations has been reported so far.

Due to some similarities between MH and EHS, it could be hypothesised that EHS, in the same way as MH, is associated

with the existence of an infraclinical myopathy. In this respect, electromyographic, histological and metabolic studies have provided conflicting and scanty results. In the present study, we analysed the physiological (using *in vitro* contracture tests) and metabolic (using 31-phosphorus magnetic resonance spectroscopy, 31P MRS) bases of EHS. We addressed the issue of possible etiological similarity between the group of EHS subjects and MH susceptible (MHS) subjects for whom a noninvasive diagnostic strategy has been recently reported.

Using 31P magnetic resonance spectroscopy, we have analysed the muscle energetics of 26 EHS subjects for whom *in vitro* halothane-cafeine contracture tests were abnormal and investigated possible similarities with subjects susceptible to malignant hyperthermia. An early decrease of pH was noted during the first minute of exercise in EHS subjects as compared to controls. EHS subjects were divided into two subgroups according to the diagnostic score previously developed for MHS subjects. The 19 subjects (73%) with a score higher than 2 displayed a significantly larger caffeine-induced and earlier ryanodine-induced contractures on muscle biopsies as compared to the rest of the group (7 subjects). The results demonstrate that muscle energetics is abnormal in subjects who have suffered from EHS and suggest a possible link between MH and EH, although all EHS patients cannot be considered as MHS. Metabolic abnormalities in EHS subjects detected by 31P MRS may indicate a defect affecting the calcium release channel of the sarcoplasmic reticulum which translates as a very abnormal ryanodine contracture test by IVCT. We conclude that, similarly to MH crisis, EHS is related to a failure of muscle energetics that may be associated with a latent myopathy which is readily identified by non invasive 31P MR spectroscopy.

SP0084 DYSBARIC OSTEONECROSIS

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Dysbaric osteonecrosis is a serious complication for those exposed to a hyperbaric environment, occurring in 17% amongst compressed air workers and 4.2% amongst divers. The prevalence of bone lesions increases with age, the number of bends, the number of hours worked in the present contact, obesity, experience greater pressures of air or at greater depths. Dysbaric osteonecrosis appears to be independant of decompression sickness.

Bones lesions are mainly symmetrical and multiple, occurring in (1) the shafts of the femora or tibiae and the heads and necks of the humeri or femora, (2) next to the joint surface, the so-called "juxta-articular lesions". The juxta-articular lesions almost never occur near the articular surfaces of the knee or elbow joints. The sites in the skeleton at which the lesions occur are those at which fatty marrow is found in the mature adult.

The pathogenesis of osteonecrosis may involve several factors: circulatory impairment by extravascular or intravascular bubbles, lipid aggregation, fibrin-platelet thrombi, release of vasoactive substances, bas-induced osmosis. It has been suggested that injured marrow adipocytes can release vaso-active substances that can play a systemic procoagulant role in triggering disseminated intra-vascular coagulation.

The basic radiologic abnormality is usually an increase in the density, less often it may be a decrease. There may be a long

delay between the causal incident and the appearances of radiographic abnormalities. The radiographic abnormalities may be classified in three types: type A, juxta articular lesions leading to osteoarthritis; type B, head, neck and shaft lesions; type C, lesions looking like bone island. Early detection of the bone necrosis is important to monitor compressed air workers. Detection depends on good quality radiographs (modifications of the trabeculae in a susceptible area). Bone areas of bone damage may go completely unrecognised on a radiograph. Lesions, early or doubtful, can be confirmed by MRI or bone scintigraphy but only 18% of the positive bone scintigraphy will develop radiographic abnormalities.

Survey of caisson workers is necessary because they can develop lesions in previously normal areas in the absence of further exposure to hyperbaric pressures. It is not certain that a repair process always takes place and it is impossible to detect juxta articular lesions that do not progress to structural failure of the joint surface and those that are going to progress to a secondary degenerative joint disease. So, there may be a long delay in making a diagnosis in an individual susceptible worker resulting in continuous of the same type of work and thus exposure to the risk of further bone damage.

There is no good preventive treatment: prevention by the use of official decompression tables seems to be inadequate because decompression sickness tends to be underreported related to the delay of diagnosis and it has been found that the tables do not decrease the number of dysbaric osteonecrosis. Oxygen decompression seems to be one of the only viable method for the safely decompressing tunnel workers.

SP0085 MUSIC AND RHEUMATISM

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The relationship between music and rheumatism is strong, complex, and interesting. It can be classified into five general categories:

- Occupation-specific musculoskeletal diseases in musicians due to repetitive strain injury;
- Joint hypermobility-related benefits among musicians;
- Joint hypermobility-related disadvantages among musicians;
- Rheumatological pathography of famous composers (e.g., Beethoven, Schumann, Paganini);
- Joint music (acoustical analysis of joint sounds by digital phonarthrometry);
- Music therapy for pain and anxiety management.

Musculoskeletal symptoms are highly prevalent among musicians at all levels of performance.¹

This is not surprising in the context of activities involving repetitious movement and/or postural constraint. Increased tension in the affected muscles could play an important causative role.

Playing-related musculoskeletal disorders in musicians (PRMD) are chronic and disabling conditions that may lead to the loss of a career and incomes because of the weakness of the executant muscle actions and loss of agility, speed and accuracy. PRMD are also under-recognised and under-researched causes of pain and disability especially in music students. Data from previous surveys indicate that the prevalence of PMRD in adult classical musicians is comparable to the prevalence of work-

related musculoskeletal disorders reported for other occupational groups.

Clinical findings of PMRD are deeply related to size, weight, playing position of the instrument, playing time, posture, and technique.

Soft tissue rheumatism and predisposition to injury are common associations of joint hypermobility among musicians.² However, joint hyperlaxity may confer advantages in playing some instruments such as flute, piano, and violin.³ The outstanding virtuosity of the violinist Niccolò Paganini has been related to the remarkable laxity of his joints.

Hand pain is a very common complaint among classical musicians. Clinical syndromes include: piano and guitar cramp, traumatic synovitis of the wrist joint, dystonia, carpal tunnel syndrome, acro-osteolysis, ulnar neuropathy and premature closure of the growth of the fingers in adolescents.

The onset of clinical features is generally associated with an increase in playing or practice load.

Hand difficulties are more frequent among pianists. They include: pain, weakness, tightening, cramping, curling and drooping, and loss of control.

The diagnosis of PRMD can be difficult when symptoms are mild and only occur on playing.

The management of PMRD is often difficult. Early and regular prevention, rest, splinting, correction of technical problems by skilled teachers of the instrument, and ergonomic redesign of some instruments can be of critical importance. Non steroidal anti-inflammatory drugs and local steroid injection can provide good symptomatic relief. Occupational therapy can be very useful.⁴ Trills, arpeggios or octaves should be avoided or reduced in pianists with hand complaints. Some composers such as Tchaikovsky (Piano Concerto N. 1 in B-flat Minor) or Beethoven (Piano Concerto N. 3 in C Minor; Sonata in E Major, opus 109; Sonata in C Major, opus 2 N. 3) seem to be at higher risk of worsening hand pain and inability.⁵

Music therapy as a treatment for chronic pain disorders and for depression has been proposed.

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SP0086 OCCUPATIONAL PHYSICAL ACTIVITIES AND KNEE OSTEOARTHRITIS

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Assessing the contribution of occupational activities to knee osteoarthritis presents several methodological difficulties. Nevertheless, a strong body of evidence has accumulated that the disease is more common in people who have carried out heavy physical work, and particularly in those whose work has entailed prolonged or repeated kneeling or squatting. The precise