

# REHAB IN REVIEW

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## PHYSICAL ACTIVITY AND GLUCOSE TOLERANCE IN SPINAL CORD INJURY

Insulin resistance and type II diabetes are more prevalent among persons with spinal cord injury (SCI) than in the general population. Previous research has suggested that the level of neurological injury and physical activity may impact the development of glucose intolerance in this patient group. This study sought to clarify the role of these variables in the development of disordered glucose metabolism among patients with SCI.

Subjects included 25 persons with SCI for more than six months with no major comorbidities. The primary outcome measure was a fasting glucose tolerance test. Independent variables included the level of SCI, age and physical activity. Physical activity was assessed using the Physical Activity Scale for Individuals with Physical Disabilities (PASIPD), which incorporates both planned and incidental activity, expressed as MET-hours day<sup>-1</sup>.

No significant difference was seen in physical activity level among the three SCI lesion level categories. Subjects with normal glucose tolerance were more physically active than those with impaired glucose tolerance. Stepwise multiple regression revealed that physical activity level and age were independent contributors to plasma glucose level, explaining 47% of the variance ( $p=0.001$ ).

**Conclusion:** This study of patients with SCI found that physical activity levels are important and independent contributors to the development of impaired glucose metabolism.

Raymond, J., et al. Glucose Tolerance and Physical Activity Level in People with Spinal Cord Injury. *Spinal Cord*. 2010, August; 48(8): 591-597.

## PROLONGED MECHANICAL VENTILATION

Approximately 300,000 patients per year receive prolonged mechanical ventilation in intensive care units. As these patients incur disproportionately higher health care costs and utilize post-acute care facilities more frequently than do other patient groups, this group is of special interest to healthcare payers. This single center, prospective, cohort study describes the resource utilization, financial cost and patient outcomes of patients receiving prolonged mechanical ventilation.

This one-year, prospective study identified 126 patients receiving mechanical ventilation for at least four days with a tracheostomy, or for at least 21 days without a tracheostomy. These patients and surrogates were interviewed in the hospital and at three and 12 months, in an effort to determine survival, functional status, quality of life, post-discharge facilities and post-discharge treatment duration. Medical and billing records, participant interviews, and Medicare claims data were used to estimate acute hospital and post-discharge resource utilization.

The mean age of the participants was 55 years, with 98% admitted from home. Of the 126 patients, 103 survived the initial hospitalization. At one year, 70 of the 126 patients were alive. Eleven were independently functioning and 19 reported good quality of life. Among the hospital survivors, 457 transitions of care location occurred after discharge, with a median of four transitions per patient. A total of 67% were readmitted to the hospital after discharge. At one-year follow-up, it was determined that the patients had spent an average of 74% of their days in a hospital, a post-acute care facility or receiving home health. The mean cost per patient was \$306,135. The average cost per independently

functioning survivor at one year was \$3.5 million.

**Conclusion:** This study demonstrates that, even with substantial use of health-care resources, patients receiving prolonged mechanical ventilation demonstrate poor survival, low functional outcome and multiple transitions of care.

Unroe, M., et al. One-Year Trajectories of Care and Resource Utilization for Recipients of Prolonged Mechanical Ventilation. *Ann Intern Med*. 2010, August; 153(3): 167-175.

## ALCOHOL AND ACUTE ISCHEMIC STROKE ONSET

Moderate alcohol intake has been found to be protective against ischemic stroke within weeks or years of consumption. However, moderate intake of alcohol also has acute, potentially deleterious effects. These problems include impaired fibrinolysis and increased platelet activation, blood pressure and heart rate. This study sought to determine whether the acute risk of ischemic stroke is also affected by recent alcohol consumption.

The Stroke Onset Study was conducted by three medical centers between January of 2001 and November of 2006. The researchers interviewed 390 patients after stroke, in an effort to determine whether alcohol was consumed within the hours before stroke symptoms. The authors then compared the rate of observed exposure frequency in the hazard period to the expected frequency, and determined the rate ratio as a measure of relative risk.

Of the 390 patients, 248 reported they had consumed alcohol in the prior year. Compared with non-drinkers, those who reported alcohol consumption were more likely to be male and to have ever smoked cigarettes. Among those who had

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consumed alcohol in the prior year, 12% reported drinking at least one serving of alcohol per day, 10% at least once per week and 66% at least once per month.

A total of 14 had consumed alcohol within one hour of stroke onset. Using these data, it was determined that the risk of stroke onset was 2.3-fold higher within one hour of alcohol consumption than during periods of non-use ( $p=0.002$ ). The relative risk was 1.6 in the second hour after drinking, returning to baseline thereafter. At 24 hours, there was a 30% lower risk ( $p=0.02$ ).

**Conclusion:** This study suggests that alcohol consumption is associated with a transient, increased risk of ischemic stroke, evident within the first one to two hours after consumption. The risk returns to baseline by three hours, with a modestly lower risk by 24 hours.

Mostofsky, E., et al. Alcohol and Acute Ischemic Stroke Onset: The Stroke Onset Study. **Stroke**. 2010, September; 41: 1845-1849.

### **STANDARD VERSUS GENDER SPECIFIC KNEE PROSTHESIS**

Recently, gender specific total knee prostheses have been introduced to address the anatomical differences between males and females. This prospective, randomized study sought to compare clinical and radiographic differences between patients receiving either a standard posterior cruciate substituting prosthesis or a gender specific posterior cruciate substituting prosthesis.

Eighty-five women underwent bilateral knee replacements. Each was randomized to receive one knee with a gender specific prosthesis and the other with a standard prosthesis. The patients were followed for a median of 2.13 years. Routine follow-up was scheduled at three months, one year and then yearly afterwards. Knee range of motion, function, patient satisfaction, radiographic results, femoral component fit and complication rates were assessed and compared between knees.

At the final follow-up, no significant difference was seen between the knees in total knee scores, function, pain scores, range of motion, walking distance, or for stair climbing. Further, no significant

differences were seen in radiographic alignment, femoral component position, tibial component position, joint line, posterior condyle offset, radiolucent lines or patellar tilt angle.

**Conclusion:** This study, comparing standard to gender specific knee prostheses, did not find a significant difference between the two.

Kim, Y., et al. Comparison of a Standard and a Gender Specific Posterior Cruciate Substituting High Flexion Knee Prosthesis: A Prospective, Randomized, Short-Term Outcome Study. **J Bone Joint Surg (Am)**. 2010, August 18; 92(10): 1911-1920.

### **RHEUMATOID FACTOR AND INCREASED MORTALITY**

Epidemiological studies have revealed increased cardiovascular disease related mortality among individuals with rheumatoid arthritis (RA). Studies have also shown that, even in subjects without RA, the rheumatoid factor is associated with increased mortality. This study was designed to determine the effect of elevated rheumatoid factor on mortality and coronary heart disease in the general population.

This population-based, cohort study involved males living in Iceland who underwent a baseline evaluation between 1974 and 1984. This evaluation included rheumatoid factor testing, cardiovascular risk screening and musculoskeletal symptoms screening. Those with baseline cardiovascular disease were excluded. A total of 11,694 subjects were followed until December of 2005 or until death. The main study outcomes were all cause mortality, cardiovascular mortality and incident coronary heart disease.

During the study period, rheumatoid factor positive patients without any joint symptoms had increased all cause mortality, as compared to rheumatoid factor negative subjects. This relationship was maintained even after adjustment for cardiovascular risk factors. These individuals also had an adjusted increased risk of cardiovascular mortality. Similar to results of previous studies, rheumatoid factor positive subjects with inflammatory joint symptoms demonstrated markedly increased all

cause mortality, as compared with rheumatoid factor negative subjects.

**Conclusion:** This large, population based study found that positivity for rheumatoid factor is independently associated with increased all cause and cardiovascular mortality, even among subjects without joint symptoms.

Tomasson, G., et al. Effect of Rheumatoid Factor on Mortality and Coronary Heart Disease. **Ann Rheum Dis.** 2010, September; 69(9): 1649-1654.

### BONE MARROW VERSUS MICROFRACTURE FOR CARTILAGE REPAIR

Focal chondral or osteochondral defects have been identified in a significant proportion of knee arthroscopic procedures. Several surgical procedures have been used to enhance cartilage repair, in an attempt to diminish knee pain, restore joint function and delay the development of osteoarthritis. Techniques ranging from debridement and/or microfracture to those using synthetic materials have been developed and used for cartilage repair. This study assessed the effect of using marrow aspirate to enhance the outcome of microfracture repair.

This animal study included 12 adult horses. All underwent full thickness cartilage defects of 15 mm on the trochlear ridge of the femur. Bone marrow was aspirated from the sternum and centrifuged into a concentrate. Half of the horses were treated with microfracture surgery alone and the other half with both microfracture and bone marrow concentrate. Microscopic, histologic and MRI imaging scoring systems were used to evaluate the animals at eight months.

At follow up, the bone marrow group obtained better macroscopic ( $p=0.009$ ) and histologic scores ( $p=0.02$ ) than did the microfracture alone group. Treatment with bone marrow concentrate resulted in a thicker, more hyaline appearing repair tissue that appeared to be better integrated into the surrounding host cartilage.

**Conclusion:** This animal study of subchondral bone defect repair revealed that, compared with microfracture surgery alone, the

addition of bone marrow concentrate resulted in better integrated repairs, with thicker tissue and a smoother surface.

Fortier, L., et al. Concentrated Bone Marrow Aspirate Improves Full Thickness Cartilage Repair Compared with Microfracture in the Equine Model. **J Bone Joint Surg (Am).** 2010, August 18; 92: 1927-1937.

### AEROBIC CAPACITY AND LOW BACK PAIN

Physical therapy programs are widely used to treat chronic low back pain (LBP). Low aerobic capacity has been associated with LBP, and is considered both a cause and a consequence of chronic LBP. However, the literature concerning aerobic capacity in patients with chronic LBP is inconclusive. As maximum oxygen uptake ( $VO_2$  max) is considered the best parameter for measuring aerobic capacity (AC), this study sought to determine the significance of AC in patients with chronic LBP, while measuring  $VO_2$  max at maximum effort.

Two groups of subjects participated in the study, including patients with chronic LBP, referred by rheumatology and a healthy asymptomatic group serving as controls. The subjects were matched for age, gender and level of physical activity at work and during sports activities. All were tested using maximal exercise until exhaustion. Exercise was performed on a cycle ergometer, with  $VO_2$  max measured by indirect calorimetry.

The absolute and normalized-for-weight values of  $VO_2$  max measured in patients with chronic LBP were significantly lower than those in the control group. This was true for both men and women. Women reached absolute and normalized-for-weight  $VO_2$  max values which were significantly lower than those of men, both in the back pain and control groups.

**Conclusion:** This study found that patients with chronic low back pain, especially women, have poorer aerobic capacity than healthy, asymptomatic control subjects.

Duque, I., et al. Maximal Aerobic Power in Patients with Chronic Low Back Pain: A Comparison with

Healthy Subjects. **Eur Spine J.** 2010, DOI 10.1007/S00586-010-1561-0.

### INTERMITTENT HYPOXIA AND ENDURANCE TRAINING

Over the past several decades, altitude training has been used to assist in preparation for endurance competitions at altitude, as well as to enhance sea level performance. Many endurance athletes have adopted the training model, "Live high-train low," which is thought to maximize acclimatization at high altitudes, resulting in increased hemoglobin mass and oxygen sharing capacity, while avoiding the negative effects of exercise in a hypoxic environment. Studies have demonstrated mixed results of the effects of hypoxia on relative oxygen consumption during submaximal running. This study investigated the combined effects of training and of periods of hypoxic exposures on the running performance of well trained runners.

This non-blinded, randomized, controlled trial included 11 male and female middle distance runners. Both groups were involved in a 13 week training period, with exercise testing before and up to 13 weeks after training. Six subjects were randomly assigned to an intermittent hypoxia group and five to a control group. The intermittent hypoxia group spent two hours at rest, three days a week, under hypoxic conditions, from baseline to week five, and then from week eight through week 13. This intermittent hypoxia group spent a total of 60 hours in hypoxia during the study period. Performance was assessed at the end of the study period.

Running economy improved in both groups during the study. Running economy further improved more in the intermittent hypoxia group, although only during the first five weeks when compared with the control group. At the end of the study period, no significant difference was seen between the two groups.

**Conclusion:** This study suggests that intermittent hypoxia may improve running economy during the first five weeks of training, with its effects diminishing thereafter.

Burtscher, M., et al. Effects of Intermittent Hypoxia on Running

### AMPLITUDES OF MOTOR UNITS IN TRAINED AND UNTRAINED MALES

Routine electrophysiologic parameters may be impacted by demographic variables, although strength training has not been previously evaluated. This study sought to determine whether strength training impacts the amplitude of action potentials, as obtained by nerve conduction studies, electromyography and direct muscle stimulation

Subjects were 33 men who had not participated in strength training within the previous two years, and 30 who had participated in strength training at least three times per week for more than 18 months. The groups were matched for age. All of the men were healthy, with no history of anabolic steroid use. With supramaximal stimulation of the musculocutaneous nerve, the resulting compound muscle action potential was recorded from the brachialis, using standard recording techniques. The interference pattern analysis was obtained by inserting a concentric needle in the brachialis muscle, with the subject exerting maximal force against resistance. Two needle electrodes, one stimulating and one recording, were inserted into the brachialis muscle in order to obtain direct muscle stimulation amplitude data.

The median compound muscle action potential amplitude was significantly greater in trained than untrained subjects ( $p < 0.01$ ). The mean interference pattern analysis and amplitude were also significantly greater in the trained subjects ( $p < 0.05$ ). Further, compound muscle action potentials and interference pattern analysis amplitudes were significantly related in trained, but not in untrained, subjects. Amplitudes of action potentials obtained by direct muscle stimulation did not differ significantly between the groups.

**Conclusion:** This electrophysiological study of compound muscle action potential and interference pattern analysis found that amplitudes are significantly greater in weight trained subjects than in untrained subjects.

Duez, L., et al. Electrophysiological Characteristics of Motor Units and Muscle Fibers in Trained and Untrained Young Male Subjects. **Musc Nerve.** 2010, August; 42: 177-183.

### COGNITIVE FUNCTION AND MORTALITY IN FIRST EVER STROKE SURVIVORS

The prevalence and incidence of neurological disorders is associated with aging and greater dependency. Stroke is a major cause of long-term physical, neuropsychiatric and neuropsychological disability. This study sought to determine whether a stroke alone is predictive of increased risk of development of incident cognitive impairment or dementia.

A total of 171 first-ever stroke survivors were initially recruited for this investigation. However, 73 were then excluded due to severe aphasia, recurrent stroke, severe medical illness or withdrawal from the study. In addition, a control cohort was recruited from two general practices in the same geographic region. The patients were assessed for the presence and severity of cognitive impairments, based upon information obtained from the subjects, informants, medical record review and neuropsychological testing.

At 48 months, 53% of the patients were reassessed. Thirty-six of the original patients had died, and 10 were lost to follow-up. At long-term follow-up, 70% of the control group participated. At baseline, 37 stroke survivors and four control subjects fulfilled the criteria for dementia. This was found to reflect more than an eight-fold excess risk for dementia at baseline, as compared to the stroke free cohort. After controlling for dementia at baseline, the risk for dementia at follow-up was found to be more than twofold for the stroke cohort. In addition, the risk for cognitive impairment was greater in the stroke cohort than in the controls, with a relative risk of 2.02.

**Conclusion:** In this study of stroke survivors, those who were considered cognitively normal at baseline had more than double the risk of developing dementia at two years' follow-up than did a matched, stroke free group.

Hobson, P., et al. Cognitive Function and Mortality in a Community-Based

Elderly Cohort of First-Ever Stroke Survivors and Control Subjects. **J Stroke Cerebrovasc Dis.** 2010; September-October;19(5) 382-387.

### INCREASED STROKE RISK AND NONSTEROIDAL ANTI-INFLAMMATORY DRUGS

Nonsteroidal anti-inflammatory drugs (NSAIDs) are among the most commonly used medications worldwide. Several studies have suggested that cyclooxygenase-2 enzyme selective NSAIDs, also known as coxibs, are associated with increased risk of adverse cardiovascular outcomes. This study examined the risk of ischemic and hemorrhagic stroke associated with the short-term use of coxibs.

This crossover design study included patients with ischemic or hemorrhagic stroke leading to hospitalization. The source population comprised all beneficiaries using the Taiwan National Health Insurance Database, identifying all patients ages 20 years and over. For each patient hospitalized with stroke, and all matched controls, data concerning drug exposure and confounding factors were gathered. These measures included pharmacy prescriptions for NSAIDs. Using these data, the adjusted odds ratio (OR) was calculated.

A total of 47,634 patients were hospitalized for acute ischemic or hemorrhagic stroke. Of those 20,424 with ischemic, and 9,456 with hemorrhagic, stroke were included in the final analysis. For ischemic stroke, a modest increase was evident for all oral NSAIDs, both selective and nonselective, with odds ratios ranging from 1.2 for celecoxib to 1.9 for ketorolac. For hemorrhagic stroke, oral ketorolac was associated with a higher risk of stroke, with an odds ratio of 2.69. Parenteral dosing resulted in an even greater risk, with an OR of 3.92 for ketorolac.

**Conclusion:** This stroke study found that the use of both selective and nonselective nonsteroidal anti-inflammatory drugs is associated with an increased risk of both ischemic and hemorrhagic stroke, with the risk highest for parenteral ketorolac.

Chang, C., et al. Increased Risk of Stroke Associated with Nonsteroidal Anti-Inflammatory Drugs: A Nationwide, Case Crossover Study.

**Stroke.** 2010, September; 41(9): 1884-1890.

### MEASURING CEREBRAL AUTOREGULATION AFTER SUBARACHNOID HEMORRHAGE

Cerebral autoregulation, when disrupted, can aggravate cerebral edema and brain tissue hypoxia. Near infrared spectroscopy (IRS) is a noninvasive technique that can provide a surrogate marker of changes in cerebral blood flow (CBF) in the form of a tissue oxygenation index. In contrast to transcranial Doppler, IRS sensors are easy to apply and do not require frequent calibration, making them more suitable for long-term monitoring. This study compared near infrared spectroscopy with transcranial Doppler for the assessment of cerebral autoregulation in adults after subarachnoid hemorrhage.

Between June of 2008 and June of 2009, 27, consecutive patients were recruited for this study. All were diagnosed with subarachnoid hemorrhage and all underwent intracranial pressure monitoring. Basic clinical data were collected and neurological status was graded during hospitalization. The amounts and locations of blood on CT scan were classified. Arterial blood pressure, intracranial pressure, mean flow, velocity and the tissue oxygenation index were recorded. Indices of autoregulation, including Mx (index of cerebral autoregulation based on measures of cerebral perfusion pressure and mean flow velocity on transcranial Doppler) from IRS and Tissue Oxygenation Index (TOx) from TCD, were calculated.

A total of 51 individual recordings sessions were obtained. Linear regression analysis revealed a highly significant relationship between the averaged Mx and TOX ( $p=0.001$ ). This relationship was stronger after correcting for multiple sampling for each patient.

**Conclusion:** This study of patients with subarachnoid hemorrhage found that the efficacy of near infrared spectroscopy is similar to that of transcranial Doppler for the continuous assessment of cerebral autoregulation.

Zweifel, C., et al. Continuous Assessment of Cerebral Autoregulation with Near Infrared

Spectroscopy in Adults after Subarachnoid Hemorrhage. **Stroke.** 2010, September; 41(9): 1963-1968.

### AGITATED BEHAVIOR AND BRAIN INJURY REHABILITATION

Agitated behavior, often seen during the early stages of brain injury recovery, has diverse presentations which can lead to challenges in patient management. Variations in behavior are often exhibited among and within individuals, at different times of the day and in changing environments. This study monitored daily, shift by shift changes in agitated behavior during adult acute brain injury rehabilitation.

This prospective study was conducted in an inpatient brain injury unit. The ten participants were first-time brain injured who still had posttraumatic amnesia and demonstrated agitated behavior at a Rancho level IV or V. Nursing staff administered the Agitated Behavior Scale at the end of each shift for the first 28 days. Agitation severity, peak intensity and concomitant behaviors were assessed.

Two patients were transferred, leaving eight to complete the study. All subjects received customary management for agitation, including multidisciplinary rehabilitation in a secure environment. First-line pharmacologic management for seven of the eight patients was clonazepam. Haloperidol was used as a second line treatment for three patients, as needed, in stat doses. Three patients received temazepam for sleep initiation.

The most commonly recorded behaviors on the ABS were seen on the Disinhibition subscale, which included poor attention, impulsivity and restlessness. Weekly peak intensity ranged from 14 to 55 out of a possible score of 56 on the ABS. Rancho level V participants who emerged from posttraumatic amnesia showed a decrease in agitated behavior. Higher levels of agitation were noted during the afternoon shift than during the other two shifts.

**Conclusion:** This study of patients on a brain injury rehabilitation unit found that cognition and agitation were inversely related, particularly among those emerging from posttraumatic amnesia. In addition, agitated behavior was

recorded more often during afternoon shifts.

Nott, M., et al. Patterns of Agitated Behavior during Acute Brain Injury Rehabilitation. **Brain Inj.** 2010, September; 24(10): 1214-1221.

### MRI AND WHIPLASH ASSOCIATED DISORDERS

Whiplash injury was first reported by Crowe in 1928. As the world becomes more motorized, the incidence of whiplash associated disorders (WADs) continues to rise. Some have hypothesized that abrupt directional changes and associated forces can lead to trauma affecting the vertebral discs, with eventual degenerative changes in the cervical spine.

Between 1993 and 1996 the authors completed a study of patients presenting with WADs, comparing their cervical spine MRIs with those of a control cohort of asymptomatic individuals. This study reports on the 10-year follow-up of those subjects, including results of repeat MRI imaging of these same individuals.

At the time of entry, neck pain was present in 94% of the patients with WADs. Other symptoms included shoulder stiffness in 61%, headache in 38% and arm pain/numbness in 13%. At follow-up, more than half of the WADs patients felt that their symptoms had improved. However, this group continued to complain of neck pain, shoulder stiffness, headache and arm pain/ numbness significantly more frequently than did the control group ( $p<0.0001$ ).

MRI results demonstrated that those with WADs were more likely to have a decrease in the intensity of the disc signal and an increased prevalence of posterior disc protrusion, but were also less likely to have foraminal stenosis, with equivalent rates of disc space narrowing.

**Conclusion:** This prospective, cross-sectional, cohort comparison of patients with whiplash associated disorders found that, at 10-year follow-up, these patients had greater, long-term neck pain than did controls, although no significant relationship was seen between pain and MRI findings.

Matsumoto, M., et al. Prospective, 10-Year, Follow-Up Study Comparing

Patients with Whiplash Associated Disorders and Asymptomatic Subjects Using Magnetic Resonance Imaging. *Spine*. 2010, August 15; 35 (18): 1684-1690.

### PERIOPERATIVE STROKE AFTER TOTAL JOINT ARTHROPLASTY

While the issue of stroke following cardiac and vascular surgery has received considerable attention in the literature, relatively few studies have examined this issue following total joint arthroplasty (TJA). As these surgeries are being performed more frequently, this study investigated the prevalence of perioperative stroke in patients undergoing TJA.

This case controlled study evaluated patients undergoing TJA at one institution between January of 2000 and December of 2007. Using a prospective electronic database, which served to record complications that occurred after surgery, all patients who were deemed to have had a stroke within 30 days after TJA were identified. A total of 18,745 patients underwent primary or revision total knee or total hip arthroplasty. Patients sustaining a stroke within 30 days of surgery were then identified, with data collected from the charts of these individuals.

A total of 36 cases of perioperative stroke were diagnosed during the study period. These included 17 men and 19 women with a mean age of 68.2 years. All but two strokes were ischemic. Four patients died during the hospital stay. After adjusting for age, gender, history of cerebrovascular disease and history of coronary artery disease, it was found that a history of non-coronary cardiac disease, the priority of the surgery, general anesthesia and intraoperative arrhythmia or changes in mean heart rate during surgery were independent predictors of postoperative stroke.

**Conclusion:** This study found that, among patients undergoing total joint arthroplasty, the perioperative stroke rate is 0.2%. These events were more likely among those with a history of non-coronary heart disease, urgent surgery, general anesthesia or intraoperative arrhythmia.

Mortazavi, J., et al. Perioperative Stroke after Total Joint Arthroplasty: Prevalence, Predictors and Outcome.

*J Bone Joint Surg (Am)*. 2010, September; 92(11): 2095-2101.

### RADIATION THERAPY FOR HETEROTOPIC OSSIFICATION

Heterotopic ossification (HO) is believed to result from the inappropriate differentiation of pluripotential mesenchymal cells into osteoblastic stem cells. A retrospective review at the author's institution revealed a prevalence of HO of 35% among patients with intra-articular distal humeral fractures. This study sought to determine whether radiation is safe and effective for the prevention of HO due to acute trauma.

This prospective, randomized, clinical trial included 48 patients with either an intra-articular distal humeral fracture or a fracture dislocation of the elbow with proximal radial and/or ulnar fracture. The patients were assigned to one of two groups, to receive radiation therapy immediately postoperatively or to a control group. Clinical and radiographic assessments were performed at six weeks to six months. The primary outcome measure was the Mayo Elbow Performance Scale. Radiographic outcomes were assessed for the presence of HO, healing of the fracture and the site of the osteotomy (if performed).

The radiation treatment group was found to have a significantly higher nonunion rate than the control group. This finding was of such significance that the study was terminated early. No significant differences were seen between the groups with regard to the presence of HO, postoperative range of motion or Mayo Elbow Performance Scores at the time of study termination.

**Conclusion:** This study was terminated early due to concerns that postoperative radiation was causing the inhibition of bone healing. The clinical efficacy of radiation therapy could not be determined on the basis of sample size.

Hamid, N., et al. Radiation Therapy for Heterotopic Ossification Prophylaxis Acutely after Elbow Trauma. *J Bone Joint Surg (Am)*. 2010, September 1; 92(11): 2032-2038.

### LACTOFERRIN IN RAT LUMBAR DISC HERNIATION

Lactoferrin is an iron binding glycoprotein which is present in plasma in relatively low concentrations. The anti-inflammatory and anti-nociceptive effects of this substance have been reviewed by a number of previous studies. In recent years, the symptoms of lumbar disc herniation, such as low back pain and sciatica, have been considered to be related to the formation of inflammatory cytokines. Thus, this study evaluated the efficacy of lactoferrin in reducing pain in an animal lumbar disc herniation model.

Adult male rats underwent partial laminectomy with compression of the left nerve root proximal to the dorsal root ganglion. Then, nucleus pulposus was harvested and inserted to induce hypersensitivity and to mimic allodynia. The rats were next divided into three experimental groups, to receive ovine lactoferrin at 100 mg per kilogram, diclofenac at 10 mg per kilogram or a normal saline control. Behavioral analysis was performed before surgery and on days three, seven, 14 and 21 after surgery to measure the escape response of the rat after perpendicular stimulation of the plantar surface of the hind limb.

Rats treated with diclofenac could withstand higher intensity stimulation on postoperative days three and seven than could controls. This difference had dissipated by days 14 and 21. Those treated with lactoferrin had significantly higher pain thresholds on all postoperative days relative to the controls.

**Conclusion:** This study found that lactoferrin, an iron binding glycoprotein, can produce analgesic effects which are similar to, although longer lasting than, those of diclofenac.

Dows-Martinez, M., et al. Anti-Nociceptive Effect of Bovine Milk Derived Lactoferrin in a Rat Lumbar Disc Herniation Model. *Spine*. 2010, August 15; 35(18): 1663-1667.

### LUMBAR INTERLAMINAR INJECTIONS WITH AND WITHOUT STEROIDS

Epidural injections are commonly performed interventions for the

management of chronic low back pain (LBP). The interlaminar approach is often the preferred method of entry. This study assessed the effectiveness of lumbar interlaminar injections, with or without steroids, for the management of LBP and lower extremity pain due to disc herniation.

This randomized, double-blind, controlled trial included 70 patients who had experienced function limiting LBP for more than six months. Using fluoroscopy, 35 patients in group I received 6 mL of lidocaine, while 35 patients in group II received 5 mL lidocaine and 1 mL of betamethasone. Outcomes were measured at intervals up to 12 months using the Numeric Rating Scale (NRS), and the Oswestry Disability Index (ODI). Significant pain relief and functional status were predefined as a greater than 50% reduction in scores on the NRS and the ODI, respectively.

At 12 months, pain was significantly reduced in 74% of group I and in 86% of group II, with function improved in 69% of group I and in 83% of group II. At six months, these findings differed significantly ( $p < 0.02$ ), although this significance dissolved at 12 months. Both groups received four injections that year, with relief lasting for a total of 42.2 weeks in group I and 41.4 weeks in group II.

**Conclusion:** This study of patients with chronic low back pain found that interlaminar epidural injections are equally effective using a local anesthetic with, versus without steroids.

Manchikanti, L., et al. Evaluation of the Effectiveness of Lumbar Interlaminar Epidural Injections in Managing Chronic Pain of Lumbar Disc Herniation or Radiculitis. **Pain Physician.** 2010; 13: 343-355.

### **TAI CHI AS A COMPONENT OF A MULTIDISCIPLINARY APPROACH TO FIBROMYALGIA**

Fibromyalgia (FM) is a clinical syndrome with numerous musculoskeletal, psychological and psychiatric manifestations. Tai chi is a mind-body practice that originated in China as a martial art. It combines meditation with slow, gentle movements, deep breathing and relaxation to move vital energy (Qi) through the body. This study

assessed the physical and psychological benefits of tai chi for patients with FM.

Patients who were at least 21 years of age and met the American College of Rheumatology diagnostic criteria for FM were included. Sixty-six patients were randomized to one of two groups. These include a tai chi group or a control group, involved in stretching exercises and lifestyle counseling. Twice a week for 12 weeks, the tai chi group underwent one-hour sessions focusing on principles and practice of tai chi. The control group met for stretching and counseling of the same frequency and duration. Patients were measured before and after treatment with the Fibromyalgia Impact Questionnaire (FIQ) and other assessments of quality-of-life.

At the end of 12 weeks, the tai chi group demonstrated a greater improvement in total FIQ scores than did the control group. Compared to the control group, the tai chi group also demonstrated significantly greater overall benefits in sleep quality, subjective global assessments, functionality, and mood ( $p = 0.001$ ,  $p = 0.002$ ,  $p = 0.007$  and  $p = 0.005$ , respectively). The differences between groups were maintained at 24 weeks.

**Conclusion:** This study of patients with fibromyalgia found that tai chi has greater benefits than traditional exercise for the treatment of this condition.

Wang, C., et al. A Randomized Trial of Tai Chi for Fibromyalgia. **NEJM.** 2010, August; 363(8): 743-754.

### **REPETITIVE FACILITATION EXERCISES**

The standard neurophysiological facilitation techniques used for hemiplegic upper limbs have not been confirmed as successful for the improvement of functional capacity. Repetitive facilitation exercises (RFEs) are designed to repeat intended movements of patients in order to facilitate movement. A novel approach to this technique is to provide sufficient stimulation, such as through a stretch reflex, to elevate the level of excitation of the descending motor tract at the time that the patient attempts movement. This study assessed the effect of repetitions of

this training on improvement of stroke related hemiparesis.

Twenty-three stroke patients were enrolled in a crossover design study wherein two weeks of RFE sessions (100 repetitions each of five to eight types of facilitation exercise per day) were alternated with two weeks of conventional rehabilitation (CR) sessions, for a total of four sessions. One group began with RFE treatment, while a second group began with CR sessions.

After the first two-week RFE period, both groups showed improvement in the Brunnstrum stages of the upper limb and hand. Only small improvements were noted after the first conventional session. The combined improvement in isolation from synergy seen in the RFE sessions was significant in all 23 patients, while that seen during the CR sessions did not reach statistical significance.

**Conclusion:** This study found that repetitive facilitation exercises promote functional recovery of a hemiplegic limb.

Kawahira, K., et al. Effects of Intensive Repetition of a New Facilitation Technique on Motor Functional Recovery of the Hemiplegic Upper Limb and Hand. **Brain Inj.** 2010, September; 24(10): 1202-1213.

### **SWIMMING AND ENERGY COST: SPRINTERS VERSUS LONG DISTANCE SWIMMERS**

The energy cost of human locomotion is much less when the activity is performed on land than when performed in water. Swimming has one of the highest energy costs when compared with other types of exercise. It has been estimated that the energy expenditure in swimming is 4.7 times that of running and 8.7 times that of cycling. This study compared the energy expenditure and motor organization of sprinting and long distance swimmers.

Twelve, elite, male swimmers, including six sprinters and six long-distance swimmers, were selected. Both groups completed six, consecutive, 300 m trials, separated by 30-second rest intervals. Speed was monitored by cameras over 5m distances. Arm coordination was measured by the Index of

(Continued from page 2)

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Coordination. Minute ventilation, oxygen uptake and carbon dioxide production were recorded. Blood was drawn for laboratory evaluation at baseline and immediately following exercise.

Throughout the test, both groups increased their energy costs, aerobic costs, and stroke lengths ( $p < 0.05$ ). However, sprinters had higher values for energy costs, anaerobic costs, stroke lengths and indices of coordination, and lower values for aerobic costs, oxygen uptake, stroke rates and stroke distances than did long-distance swimmers ( $p < 0.05$ ). The long-distance swimmers had higher average speeds ( $p < 0.001$ ) and stroke rates ( $p = 0.02$ ).

**Conclusion:** This study, comparing swimmers who train for sprint races with those who train for long-distance races, found that long-distance swimmers are able to reach maximum speeds and higher efficiency, with less change in arm coordination than sprinters.

Seifert, L., et al. Swim Specialty Affects Energy Costs and Motor Organization. *Intern J Sports Med.* 2010; 304(9): 976-982.

*Rehab in Review* is a monthly publication produced by physicians in the field of Physical Medicine and Rehabilitation (PM&R). The summaries appearing in this publication are intended as an aid in reviewing the broad base of literature relevant to this field. These summaries are not intended for use as the sole basis for clinical treatment, or as a substitute for the reading of the original research.

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