

# REHAB IN REVIEW

TM

WWW.REHABINREVIEW.COM

Volume 26 Number 3

Published by Physicians  
In Physical Medicine and Rehabilitation

March 5, 2018

## MORTALITY AMONG FORMER PROFESSIONAL FOOTBALL PLAYERS

In 1994, the National Institute for Occupational Safety and Health found that professional football players who played between 1959 and 1988 had a lower mortality rate compared to the reference population. There was however a great variability in mortality rates based on body habitus and position. This study was designed to determine the most common causes of death among a recent cohort of former National Football League (NFL) players.

Subjects were 9778 NFL players with at least one year in the NFL, playing between 1986 and 2012. Player records from the NFL Player Information Office were matched with the National Death Index to determine vital status, date of death, and cause of death. Player positions were categorized as specialists (quarterbacks, kickers, punters), speed (wide receivers, defensive backs, tight ends, running backs, linebackers), and power (linemen).

Of the 9778 players in the study, 227 were deceased at a median age of 38 years. Causes of death were heart disease (21%), violence (17%) and transportation injuries (15%). Former NFL players had a significantly lower standardized mortality rate (SMR) as compared to the US general population (SMR 0.46;  $p < 0.01$ ). This was true across all categories of race, player positions, and years in the NFL. Players with a body mass index of greater than 30 kg/m<sup>2</sup> had higher mortality rates than players with a lesser body mass index.

**Conclusion:** Despite media reports to the contrary, NFL players have a significantly reduced mortality as compared to the general population.

Lincoln, A et al. Risk and Causes of Death among Former National Football League Players (1986–

2012). *Med Sci Sports Exerc.* 2018; 50(3): 486–493.

## YOUR DIET AFFECTS GREENHOUSE GASES

It has been estimated that up to 30% of greenhouse gas (GHG) emissions are caused by food production and consumption. This Dutch study assessed the effect of dietary changes on GHG emissions.

Food consumption in the Netherlands was assessed by the Dutch National Food Consumption Survey (DNFCS) 2007 to 2010, including two, nonconsecutive dietary questionnaires provided to adults 19 to 69 years of age. In addition, questionnaires were provided to determine various sociodemographic and lifestyle factors. Estimates were made of the GHG emissions associated with different foods. From these data, scenarios were developed wherein diet quality could be improved and also result in reduced GHG emissions. Examples included replacement of cheese by plant based alternatives, red meat consumption reduction by 50% or 75% without replacement, alcoholic drinks and soft drinks replaced by tap water and a combination thereof.

In this study, the foods contributing most to GHG emissions were meat products (40%), milk (10%), cheese (10%) and beverages (10%). For those individuals with the highest tertile of dietary GHG emission, food consumption was associated with mean emission of 6.7 kg CO<sub>2</sub>-eq per day for men and 5.1 kg CO<sub>2</sub>-eq per day for women, with meat consumption contributing to 42% in men and 39% in women. Of the diet change scenarios, a 75% reduction in red and/or processed meat during dinner resulted in a 24% reduction in GHG for men and 22% for women. The most dramatic reduction was obtained with the combination of a reduction of meat by 75%, the replacement of cheese between meals with nuts and cherry tomatoes, and the replacement of soft

drinks and alcoholic drinks by tap water.

**Conclusion:** This Dutch study found that healthy changes in the diet, especially a 75% reduction in red meat consumption, could significantly reduce greenhouse gas production while advancing the health benefits of the diet.

Van de Kamp, M., et al. Reducing GHG Emissions While Improving Diet Quality: Exploring the Potential of Reduced Meat, Cheese and Alcoholic and Soft Drink Consumption at Specific Moments during the Day. *BMC Public Health.* 2018, February 20; 18(1): 264.

## VAGUS NERVE STIMULATION ENHANCES STROKE RECOVERY

Recent human and animal studies have demonstrated that vagus nerve stimulation (VNS), paired with motor training, promotes motor recovery after a stroke. This study investigated whether VNS can promote long-lasting recovery, generalized to untrained movements.

In this rat model, the animals were trained in a supination assessment task. Following training, the subjects underwent unilateral, ischemic lesioning of the primary motor cortex and dorsolateral stratum, as well as vagus nerve stimulator implantation. At one week post-surgery, the animals were randomized to receive training on the supination task with or without VNS. All subjects underwent four weeks of testing on a task assessing forelimb strength as a means to evaluate generalization of the recovery. Testing was repeated at two months. Synaptic activity was tested by the injection of a retrograde transynaptic tracer into the extremity digit flexors, with labeled cortical neurons counted six days later.

Compared to those undergoing rehabilitation only, the VNS plus rehabilitation group had significantly greater supination performance during all six weeks of therapy ( $p < 0.001$  for all measures). This

#### **Editor-in-Chief**

David T. Burke, M.D., M.A.  
Emory University, Atlanta, GA

#### **Executive Editor**

Randolph L. Roig, M.D.  
Emory University, Atlanta, GA

#### **Copy Editor**

Roberta Alysoun Bell, Ph.D.  
Emory University, Atlanta, GA

#### **Contributing Editors**

\*John Schmidt, M.D.  
Lauren Chambers, D.O.  
Jenny Smith, M.D.  
Carolinas Rehabilitation, Charlotte, NC

\*Veronica Sudekum M.D., MA  
Jamie Jiao, M.D.  
Ryan McCarty, M.D.  
Joseph Porter, M.D.  
Stephen Porter, M.D.  
Payton Reiter, M.D.  
Michael Rozak, M.D.  
Emory University, Atlanta, GA

\*Adrian Darryll Sulindro, M.D.  
Icahn Sch. of Med. at Mt. Sinai, N.Y., NY

\*Brandon Hicks, M.D.  
R. Patrick Owens, M.D.  
LSU Health Sci. Ctr., New Orleans, LA

\*Alexander Sheng, M.D.  
Joseph Dadabo, M.D.  
Neil Droppers, D.O.  
Benjamin Ingraham, D.O.  
N.W.U. /R.I.C., Chicago, IL

\*Yu M. Chiu, D.O.  
Elizabeth Chan, M.D.  
Anna King, D.O.  
Kyaw Z. Lin, D.O.  
New York University, New York, NY

\*Sharon Bushi, M.D.  
Danya P. Anouti, M.D.  
Min Chen, M.D.  
Molly McGue, M.D.  
Michael Pico, M.D.  
Rutgers-NJMS/Kessler, W. Orange, NJ

\*Sarah Yang, M.D.  
Wyatt Kupperman, D.O.  
Schwab/University of Chicago, Chicago, IL

\*Tim Calvert, M.D.  
Temple University, Philadelphia, PA

\*Audrey Kohar, D.O.  
Alex Miner, D.O.  
University of California/Irvine, Irvine, CA

\*Andrew Chang, M.D.  
University of Miami, Miami, FL

\*Jennifer Haewon Lee, M.D.  
Kenton Hagan, M.D.  
Ann Hulme, M.D.  
Alyssa Marulli, M.D.  
Univ. of Pennsylvania, Philadelphia, PA

difference was demonstrated again at two months after VNS cessation. On the isometric pull task, the VNS group demonstrated significantly improved forelimb strength at weeks seven to 10 ( $p < 0.05$ ). On the synaptic activity test, those in the VNS group demonstrated a six-fold increase in labeled sensorimotor cortical neurons in the affected hemisphere, and a three-fold increase in the unlesioned hemisphere, demonstrating enhanced synaptic connectivity in descending motor circuits.

**Conclusion:** This animal study demonstrates that vagal nerve stimulation can accelerate recovery during rehabilitation and can promote plasticity in descending motor circuits.

Meyers, E., et al. Vagus Nerve Stimulation Enhances Stable Plasticity and Generalization of Stroke Recovery. **Stroke**. 2018, March; 49(3): 707-717.

#### **MEDICATION, PHYSICAL THERAPY AND ACUPUNCTURE FOR SPINAL STENOSIS**

Lumbar spinal stenosis (LSS) is associated with neurological symptoms, resulting in a reduced quality of life, particularly for the elderly. This study compared acetaminophen, exercise and acupuncture as conservative treatments for patients with LSS.

Subjects were adult patients with L5 radiculopathy associated with LSS, treated between December of 2000 and January of 2014. The subjects were randomized to receive one of three interventions. These included 900 mg of acetaminophen, three times per day, physical therapy, including six sets of 10 repetitions of back flexion exercises, or acupuncture twice in the first week and once each week from weeks two to four.

A total of 119 patients were randomized into the three groups. Scores on the Zurich Claudication Questionnaire (ZCQ) revealed significant improvement in symptom severity with acetaminophen ( $p = 0.048$ ), exercise ( $p = 0.003$ ) and acupuncture ( $p = 0.04$ ), with no significant difference between the groups. The mean improvement in physical function scores for the acupuncture group was significantly greater than for the exercise group ( $p = 0.02$ ). Scores on the ZCQ were better in the acupuncture group than in the medication group ( $p = 0.0004$ ), and trended toward being better in the exercise group ( $p = 0.06$ ).

**Conclusion:** This Japanese study of patients with lumbar spinal stenosis suggests that pain and function can be better improved by acupuncture than by exercise or acetaminophen.

Oka, H., et al. A Comparative Study of Three, Conservative Treatments in Patients with Lumbar Spinal Stenosis: Lumbar Spinal Stenosis with Acupuncture and Physical Therapy Study (LAP Study). **BMC Complementary Altern Med**. 2018; 18: 19.

#### **ANTI-INFLAMMATORY TREATMENT FOR IMPROVED OLFACTION AFTER HEAD INJURY**

Head trauma is one of the major causes of olfactory dysfunction. Previous reports have demonstrated that the rate of recovery from olfactory dysfunction after head trauma is only 10-38%. As prior studies have suggested that olfactory dysfunction might be amenable to treatment with anti-inflammatory medications, this animal study explored the importance of the timing of such an intervention.

Using adult mice, a surgical transection of the olfactory nerve was performed. For behavioral and electrophysiological studies, the transection was performed bilaterally, and for histologic studies only the left nerve was transected, leaving the right for an internal control. Dexamethasone sodium phosphate was administered as an anti-inflammatory drug for five consecutive days, starting at days seven, 14, 28 and 42 after the surgery. For control animals, only the vehicle was injected. After surgery, the animals were assessed for olfactory function. On days five through 42 after the steroid treatment, the olfactory bulbs were removed for histological assessment.

The histologic studies revealed that the olfactory nerves degenerated until day 14, with evidence of regeneration at day 42. During olfactory testing, among the animals in the early (seven-day) interval series, 67% of the steroid group achieved 100% success on the olfactory function test, compared to only 11% of the control mice. Among the 14, 28 and 42-day interval series, the level of nerve recovery in the steroid treated animals did not differ significantly from that of the controls.

**Conclusion:** This animal study demonstrated that anti-inflammatory treatment was effective in preserving

olfactory function after a surgical lesion, but only when started within seven days.

Kobayashi, M., et al. A Time Limit for Initiating Anti-Inflammatory Treatment for Improved Olfactory Function after Head Injury. *J Neurotrauma*. 2018, February 15; 35 (4): 652-660.

### EPIDEMIOLOGY OF OUTPATIENT PEDIATRIC HEAD INJURY

Cases of head trauma and treatment outside of emergency departments remain largely underreported. This study investigated the epidemiology of head injuries, their temporal and seasonal variability and overall burden in patients seeking care.

Data for this study were derived from the Truven Health Analytics MarketScan Research Databases, which represent the largest national record of pediatric outpatient data. Included were children who presented for clinic, urgent care or emergency department (ED) visits with an ICD-9 code consistent with traumatic brain injury (TBI), and who were not admitted for further care.

Of the 1.7 million ambulatory pediatric visits, 32% were initially evaluated at an ED, 66% at a clinic and two percent at an urgent care facility. Temporal variation was consistent with school sports schedules, with peaks in March through April and September through October. The overall, annual rate of presentation for outpatient treatment of head trauma increased from 1,021.3/100,000 in 2004 to 1,575/100,000 in 2013.

**Conclusion:** The frequency of outpatient visits for pediatric traumatic brain injuries increased by more than 50% between 2004 and 2013, with more than half of the initial medical visits occurring in non-hospital outpatient settings.

Zogg C., et al. The Epidemiology of Pediatric Head Injury Treated Outside of Hospital Emergency Departments. *Epidem*. 2018, March; 29 (2): 269-279.

### KINESIO TAPE FOR STROKE RELATED SHOULDER PAIN

Following stroke, estimates of the incidence of hemiplegic shoulder pain (HSP) range up to 70%. One treatment, Kinesio tape (KT), developed by Kenzo Kase, has seen increasing popularity. This study

investigated the potential benefits of KT for patients with HSP.

Subjects were 21 adults with HSP following unilateral stroke and within six months of onset. The participants were randomized to a KT group or to a sham KT group. Both groups participated in conventional rehabilitation programs. The KT was applied using the insertion origin muscle and space-correction technique. The control group underwent similar taping patterns without tension, and without crossing the joints. The tape was left in place for three days, removed for one day, with the pattern repeated for three weeks. All subjects were assessed for pain intensity, using the Shoulder Pain and Disability Index (SPADI), and by ultrasound examination.

Scores on the ten-point numerical rating scale for pain improved between baseline and follow-up in the KT group by 2.36 points and in the sham group by 1.3 points ( $p=0.008$ ). In addition, significantly better improvement was noted for the KT group than for the control group for SPADI total score ( $p<0.001$ ), as well as for internal rotation ( $p=0.04$ ) and external rotation ( $p=0.006$ ) scores.

**Conclusion:** This double blind, randomized, placebo controlled study found that Kinesio tape is effective for decreasing pain and increasing range of motion in patients with stroke-related shoulder pain.

Huang, Y., et al. Effects of Kinesio Taping for Stroke Patients with Hemiplegic Shoulder Pain: A Double Blind, Randomized, Placebo Controlled Trial. *J Rehab Med*. 2017, March; 49: 208-215.

### DIFFUSION TENSOR IMAGING IN EARLY BRAIN INJURY

Innovations in imaging techniques have improved physicians' ability to identify structural injury after traumatic brain injury (TBI). This study assessed the microstructure tissue integrity and brain regions involving major white matter tracts and subcortical structures in patients with a recent TBI.

The participants were 20 patients admitted to a TBI unit with an admission Glasgow Coma Scale score of less than 13, all of whom were within the first 21 days post-injury. Controls were 18, age- and gender-matched adults with no history of TBI. All subjects were evaluated with 3 Tesla MRI with diffusion tensor imaging (DTI). Data were assessed for 25 regions of

interest, and were compared by subject group.

All subjects had sustained a blunt force TBI, with a mean GCS of 6.47 after hospital stabilization with scanning performed at a mean of 10.47 days post-injury. The TBI subjects had nine regions of interest in seven brain regions, which, when compared to controls showed significant group differences on DTI metrics (fractional anisotropy, radial diffusion or mean diffusion). These areas included the corpus callosum (genu and splenium), superior longitudinal fasciculus, internal capsule, right retrolenticular internal capsule, posterior corona radiata and thalamus.

**Conclusion:** This study of patients admitted for moderate to severe TBI found that diffusion tensor imaging may be useful for identifying abnormal axonal integrity and neuro-inflammation in areas with apparent normality on routine MRI

O'Phelan, K., et al. Common Patterns of Regional Brain Injury Detectable by Diffusion Tensor Imaging in Otherwise Normal-Appearing White Matter in Patients with Early Moderate to Severe Traumatic Brain Injury. *J Neurotrauma*. 2018, March; 35(5): 739-749.

### TRANSCRANIAL DIRECT CURRENT STIMULATION FOR DYSPHAGIA AFTER STROKE

Swallowing dysfunction is a frequent complaint following stroke, and is related to complications including aspiration pneumonia. As transcranial direct current stimulation (tDCS) has been found to promote brain plasticity, this randomized controlled trial investigated whether this treatment modality might be effective for treating dysphagia after stroke.

Subjects were 60 adult patients, admitted to a university hospital stroke unit with dysphagia. All were at least 24 hours post-ischemic stroke. Those randomized to the intervention group received anodal tDCS to cover the motor cortical swallowing network. Stimulation was delivered at one mA for 20 minutes once a day for four consecutive days. In the control group, tDCS stimulation was administered for only 20 seconds, with the electrodes left in place for another 20 minutes. Activation changes in the swallowing network were measured with a magnetoencephalograph (MEG). At baseline and after the intervention,

the participants were assessed endoscopically using the Fiberoptic Endoscopic Dysphagia Severity Scale (FEDSS).

At follow-up, the treatment group demonstrated greater improvement on the FEDSS than did the control group (1.3 versus 0.4 points;  $p < 0.0005$ ). This functional recovery was accompanied by a significant increase in the contralateral swallowing network activation after real, but not after sham, treatment.

**Conclusion:** This randomized, controlled trial of patients with acute ischemic stroke found that treatment with direct current stimulation can accelerate the recovery of dysphagia.

Suntrup-Krueger, S., et al. Randomized Trial of Transcranial Direct Current Stimulation for Post-Stroke Dysphagia. *Ann Neurol*. 2018, February; 83(2): 328-340.

### VITAMIN D AND STROKE RISK

A number of studies have demonstrated that low serum levels of vitamin D are associated with an increased risk of stroke. Despite this, studies investigating the relationship between dietary vitamin D intake and the risk of cardiovascular disease are few and inconclusive. This Japanese study explored the relationship between dietary vitamin D intake and the risk of mortality from stroke.

The Japan Collaborative Cohort (JACC) Study recruited inhabitants across Japan, ranging in age from 40 to 79 years. At baseline, the participants completed a self-administered questionnaire querying demographic characteristics, lifestyle and food frequencies, with dietary vitamin D calculated. For those in the original cohort who died, death certificates were located for cause of death. Dietary vitamin D levels were compared to risk of death from stroke.

From the dietary questionnaires, the greatest contributors of vitamin D were fish (80%) and fried vegetables (15%). The intake levels were divided into four categories, including  $<110$  [less than half the daily recommended input (DRI)], 110 to 219 (half the DRI up to less than the DRI), 220 to 439 (the DRI up to less than double the DRI) and  $\geq 440$  IU/d. During the 19-year follow-up, 702 deaths due to CHD and 1,514 due to stroke were documented. A multivariable analysis revealed that the hazard ratios for death comparing the groups with the highest to the lowest category of dietary intake of

vitamin D were 0.82 ( $p=0.07$ ) for total stroke, 0.70 ( $p=0.04$ ) for hemorrhagic stroke and 0.66 ( $p=0.04$ ) for intraparenchymal hemorrhage.

**Conclusion:** This Japanese study found that higher dietary intake of vitamin D is associated with a reduction in stroke mortality, particularly intraparenchymal hemorrhage.

Sheerah, H., et al. Relationship between Dietary Vitamin D and Deaths from Stroke and Coronary Heart Disease. *Stroke*. 2018, February; 49(2): 454-457.

### ELECTRICAL STIMULATION AFTER ACL SURGERY

After anterior cruciate ligament (ACL) surgery, interventions must be started early to counteract quadriceps muscle inhibition, an ongoing reflex inhibition of knee extensor muscles. As neuromuscular electrical stimulation (NMES) is a tool that can be used to create extremity generated muscle contractions, this study investigated the efficacy of adding NMES of the quadriceps muscle superimposed on sit to stand exercises (STSE) after ACL reconstruction.

Subjects were 63 adult male patients who underwent unilateral ACL reconstruction. After surgery all groups underwent a standardized rehabilitation protocol, five days per week. The patients were randomized to one of three groups: NMES + STSTS group, the STSTS-only group, and the no additional treatment group (control). The NMES and STSTS were initiated from the 15<sup>th</sup> to the 60<sup>th</sup> day. During NMES, to stimulate both slow and fast twitch muscle fibers, the stimulation was delivered 35 and 50 Hz on alternative days, at a maximum intensity of 120mA. Measurements of maximal isometric strength were made at 60 and 180 days after surgery.

Patients in the NMES + STSTS group had significantly higher knee extensor muscle strength when compared to the other two groups at 60 and 180 days after surgery ( $p < 0.001$  for all comparisons). In addition, the NMES + STSTS group had significantly higher knee flexion strength than did the control group at 60 days after surgery. Knee strength symmetry between legs was also better in the NMES + STSTS group as compared to the other two groups at both 60 and 180 days after surgery.

**Conclusion:** This study found that after anterior cruciate ligament reconstruction, the addition of neuromuscular electrical stimulation superimposed on a functional movement exercise could improve muscle strength and reduce limb asymmetry.

Labanca, L et al. Neuromuscular Electrical Stimulation Superimposed on Movement Early after ACL Surgery. *Med Sci Sports Exerc*. 2018, March; 50(3): 407-416.

### PLATELET RICH PLASMA FOR GLUTEAL TENDINOPATHY

Tendinopathy of the tendons of the gluteus medius or minimus is a major cause of lateral hip pain or the greater trochanteric pain syndrome. This study compared the efficacy of injections with glucocorticoids with that of platelet rich plasma (PRP) for the treatment of gluteal tendinopathy.

Eligible subjects were 18 to 80 years of age with a history of gluteal tendinopathy of longer than four months' duration. The participants were randomized to a glucocorticoid group or a PRP group, with both groups undergoing blood withdrawal of 55 mL. In the PRP condition, six to seven mL of autologous PRP was injected into the affected area of the tendon using ultrasound guidance. In the corticosteroid group, a similar volume was injected using the same procedure. The primary outcome measures were pain and function, assessed with the modified Harris Hip Score (mHHS), measured at two, six and 12 weeks. As the minimal clinically important difference (MCID) on that scale has been established at eight points, this cutoff was used to estimate clinical efficacy.

At 12 weeks, the mean mHHS scores improved to 74.05 in the PRP group and to 67.13 in the corticosteroid group ( $p=0.048$ ). The proportions of subjects who had achieved the predefined MCID change from baseline at 12 weeks were 56.7% in the corticosteroid group and 82% in the PRP group ( $p=0.016$ ). The proportions of participants who achieved an outcome score of 74 or greater at 12 weeks were 45.9% in the corticosteroid group and 64.1% in the PRP group ( $p=0.11$ ). No treatment related significant adverse events occurred in either group.

**Conclusion:** This study of patients with chronic gluteal tendinopathy found better clinical improvement with a single injection of

platelet rich plasma than with a single injection of corticosteroid.

Fitzpatrick, J., et al. The Effectiveness of Platelet Rich Plasma Injections in Gluteal Tendinopathy. A Randomized, Double-Blind, Controlled Trial Comparing a Single Platelet-Rich Plasma Injection with a Single Corticosteroid Injection. *Am J Sports Med.* 2018; 10.1177/0363546517745525

### VESTIBULAR AND OCULOMOTOR SYMPTOM PROVOCATION IN CONCUSSION

Studies have demonstrated that incorporating brief vestibular/ocular motor tests may increase the probability of detecting a concussion by 50%. This study evaluated the clinical utility of these tests for tracking recovery after a concussion.

Subjects were students participating in either a Division I NCAA sport or a club sport. Subjects included 21 with concussion symptoms lasting three to 12 days, 10 with concussion symptoms lasting 16 to 120 days and 58 healthy controls. The dependent variable was a validated, subjective assessment of dizziness, headache and nausea. All underwent clinical testing at baseline, two weeks and six weeks. These tests included the Rapid Eye Horizontal Eye (REH) test, Smooth Pursuit, Slow (SPS), Smooth Pursuit, Fast (SPF), Opticokinetic Stimulation (OKS), and the Horizontal Gaze Stabilization Test (GST). Oculomotor function was assessed with near point of convergence (NPC) and King-Devick (KD) tests.

An ANOVA revealed that total KD improved over time as measured at both two ( $p=0.04$ ) and six ( $p=0.002$ ) weeks in the prolonged recovery group, while in the acute group it did not improve until six weeks ( $p=0.001$ ). The combined symptom provocation scores decreased over time for the acute group at both two and six weeks ( $p=0.005$  for both), and for the prolonged recovery group at six weeks ( $p=0.037$ ). A multivariate regression analysis revealed that the best subset of independent predictors of concussion were NPC and the number of symptoms on the REH, OKS, and GST ( $p=0.001$ ).

**Conclusion:** This study suggests that a brief oculomotor and vestibular screening could be useful in diagnosing patients with a suspected concussion.

Cheever, K., et al. Concussion Recovery Phase Affects Vestibular and Oculomotor Symptom Provocation. *Intern J Sports Med.* 2018, February; 39 (2): 141-147.

### CRITICAL DYSPHAGIA IN PARKINSON DISEASE

Dysphagia is a well-known complication of Parkinson disease (PD). Data reporting on the frequency of dysphagia among patients with PD vary significantly. This study was designed to better understand the prevalence, severity and characteristics of dysphagia among patients with this disease.

Consecutive outpatients with a confirmed diagnosis of PD were assessed with the Movement Disorder Society's version of the United Parkinson Disease Rating Scale, with a Hoehn and Yahr stage assigned. All underwent a flexible endoscopic evaluation of swallowing (FEES). The penetration and aspiration, leakage and residues were evaluated for each consistency. A control group comprised adults at least 50 years of age with no history of swallowing issues.

Only six of the 119 patients with PD had unremarkable FEES results, with laryngeal penetration affecting 55%. Aspiration was observed in 30/119 (25%), including 24/119 (20%) with silent aspiration. Leakage was the only infrequent finding in patients with PD. While 73% reported that they had no difficulty swallowing food or drinks, or any problems with choking, 16% of the asymptomatic group had critical aspiration.

**Conclusion:** This study demonstrated a high prevalence of dysphagia in all stages of Parkinson disease, with a discrepancy between objective swallow study results and self-reported symptoms.

Pflug, C., et al. Critical Dysphagia is Common in Parkinson Disease and Occurs Even in Early Stages: A Prospective Cohort Study. *Dysphagia.* 2018, February 33(1): 41-50.

### RISK OF STROKE WITH PROTON PUMP INHIBITORS AND THIENOPYRIDINES

Thienopyridines are antiplatelet medications which have been increasingly used for the secondary prevention of cardiovascular and cerebrovascular diseases. Proton pump inhibitors (PPIs) are often

prescribed concurrently with these medications used to prevent gastrointestinal bleeding. However, PPIs are competitive inhibitors of the cytochrome P450 pathway, a pathway also used by thienopyridines. This meta-analysis was designed to determine whether the concurrent use of these two medications affects the risk of stroke.

A systematic review of the literature was completed to identify studies reporting on the cerebrovascular outcomes of patients treated with thienopyridines and PPIs versus thienopyridines alone. From this review, 22 studies met the inclusion criteria, involving 131,714 participants with a median follow-up of 12 months.

The concurrent use of PPIs and thienopyridines was positively associated with increased risk of ischemic stroke ( $p<0.001$ ), as well as with a composite of stroke/myocardial infarction/cerebrovascular disease ( $p=0.04$ ).

**Conclusion:** This meta-analysis found an increased risk of ischemic stroke, as well as a composite of stroke/myocardial infarction/cerebrovascular disease, among those who concurrently use proton pump inhibitors and thienopyridines.

Malhotra, K., et al. Cerebrovascular Outcomes with Proton Pump Inhibitors and Thienopyridines. A Systematic Review and Meta-Analysis. *Stroke.* 2018, February; 49(2): 312-318.

### TIMING OF VENOUS THROMBOEMBOLIC EVENTS AFTER SPINE SURGERY

Patients undergoing major surgery, including spine surgery, are at increased risk for venous thromboembolic events. The timing of venous thromboembolisms (VTEs) and the effect of chemoprophylaxis after spine surgery remain unclear. This prospective study examined the occurrence and timing of VTEs after spine surgery.

The authors followed all patients who underwent spine surgery at a single institution between 2009 and 2015. For each surgery included in the study, data were collected including, procedure and postoperative management. Chemoprophylaxis was defined as anticoagulation given from one day prior, to three days post surgery. The rates of VTEs and spinal epidural hematomas were compared between

those receiving versus those not receiving anticoagulation.

Data were collected for 6,869 procedures. Of these, 4,965 did not receive chemoprophylaxis and 1,904 did. A multivariable analysis determined that age, length of surgery, history of DVT, and fusion surgery were all significantly related to the use of chemoprophylaxis. The median time to initiate chemoprophylaxis was postoperative day 1.46. The rates of epidural hematoma development did not differ significantly between the two groups ( $p=0.619$ ). The cumulative incidence of VTE was significantly related to the postoperative day in both groups ( $p<0.0001$  for both comparisons). The cumulative incidence increased in both groups in the first two weeks postoperatively and then plateaued.

**Conclusion:** This study found that chemical anticoagulation reduces the cumulative incidence of venous thromboembolism, and that the cumulative risk of venous thromboembolism rises until two weeks postoperatively, and then plateaus.

Cloney, M., et al. The Timing of Venous Thromboembolic Events after Spine Surgery: A Single-Center Experience with 6,869 Consecutive Patients. *J Neurosurg Spine*. 2018, January; 28(1): 88-95.

### PROPHYLAXIS AFTER TOTAL HIP OR TOTAL KNEE ARTHROPLASTY

Perioperative prophylactic administration of anticoagulants is associated with reduced rates of death and complications associated with venous thromboembolism (VTE). Evidence-based guidelines recommend anticoagulant prophylaxis for a minimum of 14 days, and suggest that this treatment continue for up to 35 days post-surgery. This study was designed to determine whether aspirin may be an effective option after a short course of a factor Xa inhibitor.

This double-blind, multicenter study included patients undergoing elective total hip arthroplasty (THA) or total knee arthroplasty (TKA). Beginning on the day of surgery, all patients received five days of rivaroxaban at 10 mg daily. The participants were then randomly assigned to receive extended prophylactic treatment with either rivaroxaban or aspirin, 81 mg per day, for nine additional days after TKA or 30 additional days after THA. The primary efficacy outcome was

symptomatic VTE or pulmonary embolism (PE) within 90 days of surgery. The primary safety outcome was major or clinically relevant, non-major bleeding.

Symptomatic, proximal deep-vein thrombosis or PE developed in 11 of 1,707 patients (0.64%) in the aspirin group, and in 12 of 1,717 patients (0.70%) in the rivaroxaban group ( $p=0.84$ ). Six PEs occurred in the rivaroxaban group, and five in the aspirin group. Major bleeding occurred in five patients in the rivaroxaban group and eight in the aspirin group ( $p=0.42$ ). A combination of major bleeding and clinically relevant, non-major bleeding occurred in 22 patients (1.29%) in the aspirin group, and in 17 (0.99%) in the rivaroxaban group.

**Conclusion:** This study of patients undergoing elective total hip or total knee arthroplasty found that, after five days of rivaroxaban, extended prophylaxis with aspirin was as effective as extended treatment with rivaroxaban for the prevention of venous thromboembolism.

Anderson, D., et al. Aspirin or Rivaroxaban for VTE Prophylaxis after Hip or Knee Arthroplasty. *N Engl J Med*. 2018, February 22; 378: 699-707.

### SCLECTROTHERAPY AND PROLOTHERAPY FOR CHRONIC ACHILLES TENDINOPATHY

Of the treatments for chronic Achilles tendinopathy, heavy tendon loading seems most effective. Among alternative treatments, prolotherapy and sclerotherapy have been investigated, though the utility of these remains unclear. This literature search was designed to better understand the effects of these two interventions for the treatment of Achilles tendinopathy.

This literature review included athletes and non-athletes with chronic, painful Achilles tendinopathy, as well as animal studies. From this review, 18 articles were available for qualitative synthesis, with six included in the meta-analysis.

All four of the randomized, controlled trials demonstrated positive effects of the treatment. In addition, eight of the nine nonrandomized studies investigating sclerotherapy or prolotherapy in humans confirmed these favorable outcomes. The meta-analysis found a significant improvement in pain with activity as compared with placebo ( $p<0.001$ ).

**Conclusion:** This literature review and meta-analysis suggests that sclerotherapy and prolotherapy may be effective and safe as a treatment for chronic Achilles tendinopathy.

Morath, O., et al. Effect of Sclerotherapy and Prolotherapy on Chronic, Painful Achilles Tendinopathy: A Systematic Review Including Meta-analysis. *Scan J Med Science Sports*. 2018, January; 28 (1):88-95.

### PROPRANOLOL AND OXANDROLONE FOR MUSCLE RECOVERY AFTER BURNS

Severe burns result in acute critical illness with profound metabolic dysregulation. As oxandrolone is a testosterone analog that promotes lean body mass formation, and propranolol can reduce tachycardia and the resting metabolic rate, this study was designed to determine the effects of combining these two medications during the rehabilitation of severely burned children.

Subjects were 7-17 years of age with severe burns over 30% of their total body surface area (TBSA) between 2013 and 2016. All patients received standard acute burn care and had agreed to a six-week rehabilitation program which included resistive and aerobic exercise. The patients who consented were randomized to receive standard care and a placebo or standard care plus oxandrolone at 0.1 mg/kg twice per day and propranolol at 0.33 mg/kg every four hours. Beginning within 96 hours of their admission, subjects were assessed for body composition, resting energy expenditure, muscle protein turnover, and muscle function.

Of the 47 patients consented, 25 were in the control and 22 in the treatment group. After six weeks, the change in absolute muscle strength was greater in the treatment group than in the control group ( $p<0.05$ ). In addition, the magnitude of the change in power was greater in the treatment group as compared to the control ( $p<0.01$ ). The treatment group had significantly lower resting energy expenditure as well as resting heart rate at both baseline and at follow up as compared to the control group.

**Conclusion:** This study of children with severe burns found that a combination of a testosterone analog (oxandrolone) and a beta blocker (propranolol) during a six-week exercise program could

accelerate strengthening and cardiorespiratory fitness.

Chao, T et al. Propranolol and Oxandrolone Therapy Accelerated Muscle Recovery in Burned Children **Med Sci Sport Exerc.** 2018; 50 (3):427-435.

### CHAI HU SHU GAN SAN FOR DEPRESSION

Given a history of poor compliance with antidepressant medications, some have looked to traditional Chinese medicine for alternatives. One such option, Chai Hu Shu Gan San, has been described in writings dating to the Ming Dynasty. While widely used in China, acceptance of this treatment in Western medicine is limited. This literature review and meta-analysis was designed to assess the efficacy of this alternative treatment.

Data review included PubMed, the Cochrane Library, the Chongqing VIP Database, the China National Knowledge Internet (CNKI) and the Wanfang Database. From this review, 42 records met the inclusion criteria and were included in the meta-analysis. Of the 42 studies published between 2006 and 2016, data from 3,234 patients with depression were included in the analysis.

The diagnoses most often included depression, postpartum depression, and post-stroke depression. This meta-analysis found that, as compared to a control condition, depression was better treated using Chai Hu Shu Gan San. In a subgroup analysis, Chai Hu Shu Gan San compared favorably with fluoxetine for depression and for post-stroke depression, and provided better treatment results for postpartum depression.

**Conclusion:** This meta-analysis found that the traditional Chinese medication Chai Hu Shu Gan San is effective for the treatment of depression.

Sun, Y., et al. Treatment of Depression with Chai Hu Shu Gan San: A Systematic Review and Meta-Analysis of 42, Randomized, Controlled Trials. **BMC Complementary Altern Med.** 2018; 18: 66.

### GENDER DIFFERENCES IN PLATELET RICH PLASMA

The benefits of platelet rich plasma (PRP) are thought to derive

from growth factors released by platelets, as well as anti-inflammatory effects that help tissue heal. This study was designed to determine whether the composition of PRP differs by age and by gender.

Subjects were 39, healthy patients with a body mass index of less than 25 kg/m<sup>2</sup>, including a young group, 18 to 30 years of age, and an older group, 45 to 60 years of age. All underwent blood draws, with PRP samples isolated. From the samples, a cytokine and growth factor composition analysis was completed.

Platelet counts did not differ by age or gender. Differences between female and male patients were observed for proinflammatory cytokines, including IL-1 $\beta$  (p=0.008) and TNF- $\alpha$  (p=0.048), for the anti-inflammatory IL-1 receptor antagonist protein (IRAP) (p=0.001) and for growth factors, including platelet-derived growth factor (PDGF-BB) (p=0.01) and TGF- $\beta$ 1 (p=0.002). No significant differences were noted between the young and older age groups for any of these cytokines or growth factors except IGF-1 (97.6 versus 53.8 ng/mL, respectively; p=0.001). The percent difference of the biomarkers that showed significant differences between sexes were IRAP (40.3%), VEGF (33.8%), IL-1 $\beta$  (30.6%), FGF-basic (24.7%), PDGF-BB (24.3%), TNF- $\alpha$  (23.1%) and TGF- $\beta$ 1 (21.9%).

**Conclusion:** This study of healthy patients found that males have higher cytokine and growth factor levels in their platelet rich plasma than do females.

Xiong, G., et al. Men and Women Differ in the Biochemical Composition of Platelet-Rich Plasma. **Am J Sports Med.** 2018, February; 46 (2): 409-419.

### DETERMINANTS OF PATIENT SATISFACTION IN AN OUTPATIENT SPINE CLINIC

As healthcare increasingly shifts towards a consumer model of care, patient satisfaction scores have become an important measure of healthcare quality. This study was designed to identify factors related to higher patient satisfaction in an outpatient spine clinic.

Subjects were 200 patients of an outpatient spine center who were contacted by phone within three weeks of a new patient encounter. All answered a 25-question satisfaction survey using a one-to-ten scale. A linear regression analysis was

performed to determine whether these factors were related to provider satisfaction, overall clinical satisfaction, and quality of care.

Satisfaction with the provider was significantly related to appointment scheduling, parking, office staff teamwork, wait time, radiology, provider interactions behavior and treatment, and follow-up communication (p<0.0001). These were also true of the patients' perceptions of overall quality of care. A multivariate analysis revealed that explanation of the medical condition (p=0.002) and provider empathy (p=0.04) were significantly associated with provider satisfaction scores, while the amount of time spent with the provider was not. For 25% of the patients, some pre-provider aspect of the visit was rated as the most important element in their visit satisfaction.

**Conclusion:** This study of patients seen in an outpatient spine center found that satisfaction with their provider was significantly linked to many pre-visit services and team interactions.

Bible, J., et al. Are Low Patient Satisfaction Scores Always Due to the Provider? **Spine.** 2018, January. 43; (1): 58-64.

### CAFFEINE AND MUSCLE TORQUE COMPLEXITY

Neuromuscular fatigue during exercise decreases muscle torque output, a measure of the complexity of musculoskeletal physiology. This study evaluated the effect of pre-exercise caffeine ingestion on the rate of decrease in torque during isometric knee extension, and explored the contributions of peripherally and centrally related mechanisms.

This randomized, double-blind, controlled study involved 11, healthy participants who were asked to perform repeated isometric knee extensions with maximum voluntary contraction (MVC) until task failure. Failure was defined as a reduction to 50% of the baseline MVC. Torque and EMG output during contraction were measured continuously, beginning before and continuing until one hour after caffeine or placebo ingestion. Complexity and fractal scaling of torque were quantified using approximate entropy (ApEn) and the detrended fluctuation analysis (DFA)  $\alpha$  scaling exponent. Global, central, and peripheral fatigue were quantified using MVCs with



(Continued from page 2)

\*Anna Coles, M.D.  
Alicia Fuhrman, M.D.  
Jacob Kneeman, M.D.  
Sean Matsuwaka, M.D.  
University of Washington, Seattle, WA

\*Bonnie Weigert, M.D.  
David Schwanebeck, D.O.  
University of WI, Madison, WI

\*Joe Seacrist, M.D.  
Timur Korshin, M.D.  
Va. Commonwealth Univ., Richmond, VA

\*Sean Smith, M.D.  
Andrew Creighton, D.O.  
Gregory Decker, M.D.  
Washington U. in St. Louis, St. Louis, MO

**Executive Editor Emeritus**  
Donald F. Langenbeck, Jr., M.D.

**Subscription Manager**  
Michael P. Burke, M.S.

**\*Regional Managing Editors have attested that they have no financial conflict of interest when choosing articles that appear in Rehab in Review.**

were quantified using MVCs with femoral nerve stimulation.

Caffeine ingestion increased the time to task failure (endurance) by 30% ( $p=0.019$ ). Both conditions resulted in significant reductions in potentiated doublet torque ( $p<0.001$ ), indicating the presence of peripheral fatigue. Voluntary activation significantly declined in both conditions indicating the presence of central fatigue. At the time point in the caffeine condition equivalent to task failure in the placebo condition (isotime), MVC torque was significantly higher in the caffeine group, indicating that subjects still had a significant reserve of maximal torque. Furthermore, the rate of decrease in MVC torque was significantly attenuated in the caffeine condition. The rate of decrease in torque complexity was significantly lower in the caffeine group than in the placebo group ( $p<0.05$ ).

**Conclusion:** This study found that caffeine ingestion slowed the fatigue-induced loss of torque during isometric knee extension through predominantly central mechanisms.

Pethick, J., et al. Caffeine Ingestion Attenuates Fatigue-Induced Loss of Muscle Torque Complexity. **Med Sci Sports Exerc.** 2018, Feb; 50(2): 236-245.

*Rehab in Review (RIR)* is produced monthly by physicians in the field of Physical Medicine and Rehabilitation (PM&R), with the cooperation and assistance of Emory University School of Medicine, Department of Rehabilitation Medicine. 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.

The Emory University School of Medicine designates this journal based activity for a maximum of 3 AMA PRA Category 1 Credits™. Physicians should only claim credit commensurate with the extent of their participation in the activity. The Emory University School of Medicine is accredited by the ACCME to provide continuing medical education for physicians.

*RIR* is affiliated with the Association of Academic Physiatrists, the World Health Organization, and the Chinese and Indian Societies of PM&R and endorsed by the International Society of Physical and Rehabilitation Medicine.

Private subscriptions are available by email at [rehabinreview@aol.com](mailto:rehabinreview@aol.com) or by fax or phone at (800) 850-7388.

ISSN # 1081-1303  
[www.rehabinreview.com](http://www.rehabinreview.com)



## REHAB IN REVIEW

Produced by the Department of  
Rehabilitation Medicine, Emory  
University School of Medicine



EMORY  
UNIVERSITY  
SCHOOL OF  
MEDICINE

Department of  
Rehabilitation  
Medicine

*Expanding the frontier of rehabilitation sciences in research, teaching, and patient care*