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RESEARCH PRESENTATIONS

Feasibility of a 10-week, School-based Childhood Wellness Intervention

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Purpose: Poor health practices such as suboptimum levels of physical activity, unhealthy dietary habits, risk taking behavior, low-self-esteem, and early exposure and use of tobacco, alcohol, and drugs threaten the health of our youth. Health habits learned early in life (both healthy and unhealthy) have been strongly associated with adult behavior. The purpose of this study is to examine the feasibility of a wellness initiative to promote positive health behavior in elementary school students. This pilot study will examine baseline health characteristics as well as the effectiveness of an educational intervention in modifying health-related knowledge, attitude, and behavior.

Methods and Study Design: Eight 5th grade classrooms were paired within schools and cluster-randomized to participate as either an intervention or control classroom. All participating classrooms were drawn from one “first-ring” school district in a large metropolitan city. Intervention classrooms received formalized instruction in the “Healthy Futures” curriculum, a program developed to meet age-appropriate health education standards to promote physical activity, nutrition, safety, confidence and self-esteem, and the dangers of tobacco, alcohol and drugs. Weekly sessions occurred during one classroom period over 10 weeks and were taught by physicians. Incentives were utilized to encourage participation and the completion of additional assignments. Baseline and post-program assessments were conducted in both intervention and control groups and consisted of measurement of height, weight, GB-23 survey (54 questions modified from the Middle School and High School Youth Risk Behavior Survey), and a one-mile run.

Results: One hundred and six of a possible 193 participants enrolled in the study. Seventy-eight completed both baseline and post-program surveys (47 intervention, 31 control). At baseline, 40 of 100 participants (20/63 (32%) intervention, 20/37 (54%) control) displayed a body mass index (BMI) >85th percentile for age-sex matched norms (NSS). Follow-up assessments revealed that 14/50 (28%) of the intervention group and 17/32 (53%) of controls demonstrated a BMI. 85th percentile for age-sex matched norms (NSS). Exploratory analysis of the GB-23 survey exhibited an underreporting of weight (1.5 kg for intervention and 4.1 kg for control groups) vs measured weight at baseline (NSS). At baseline, most participants reported never smoking (96%) or drinking alcohol (71%). Improvements in self-reported physical activity, alcohol consumption (less), and breakfast consumption (more) were reported at follow-up in the intervention group.

Conclusions: A 10-week, school-based wellness initiative was successfully implemented in this pilot study. Participation was lower than expected (55%) but in line with other school-based interventions. An improvement in BMI was noted in the intervention group but was not statistically significant. Further modification of outcomes instruments should be considered to reflect the needs of this age group.

Significance of Findings: This study examines the health knowledge and behavior of a large group of elementary school students. This study is the first step in a series of investigations designed to examine the efficacy of

interventions in this population. Additional outcomes tools (surveys, devices, fitness tests) may be beneficial to validate current techniques and address some of the limitations encountered in this study.

Acknowledgements: Cleveland Clinic Sports Health, Gary Baxter Second Line of Defense Foundation, Cleveland Clinic Childhood Wellness Committee, and my wife, Krista, for their time, support, and encouragement in this initiative.

Pre-race Sodium Concentrations Associated with Post-race Sodium Concentration but not Pre-race Fluid Intake Before a Marathon

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Purpose: Confusion exists among endurance athletes as to the best way to replace fluids lost during exercise. We have previously reported hyponatremia caused by excessive pre-race hydration. This prompted concern that athletes who over-hydrate prior to races may begin competition at low sodium levels. We sought to test this hypothesis in a marathon setting.

Methods and Study Design: Two hundred fifty subjects participating in The National Marathon to Fight Breast Cancer consented to complete a pre- and post-race survey and blood test. As part of this study, total fluid consumed by participants on the evening and morning before the race was estimated from continuous intake data and compared to pre- and post-race sodium using the Spearman correlation coefficient.

Results: There was a faint, but not statistically significant, correlation between total fluid intake and sodium levels before the race. Higher fluid intake correlated with lower sodium levels ($r = 20.13, P = 0.09$). There was no correlation between the amount of fluid intake before the race and sodium levels after the race ($r = 0.11, P = 0.14$). Pre-race sodium and post-race sodium correlated positively and was statistically significant ($r = 0.24, P = 0.0026$).

Conclusions: While pre-race sodium levels correlated with post-race sodium levels, the amount of fluid intake prior to the race did not correlate significantly with either. Increased fluid intake prior to endurance races would not seem to result in hyponatremia.

Significance of Findings: Presumably healthy athletes with normal homeostasis will physiologically correct for the increased volume, preventing hyponatremia. Indeed, in our previously reported case, the athlete was using prescription medication which may have affected antidiuretic hormone. It appears that dilutional hyponatremia occurring during endurance sports is likely due to other factors. We report separately in this forum sodium levels which correlate with race finish time during this same marathon.

Acknowledgements: Much appreciation is given to the Runners Science Group 2008 for their study organization and data collection.

Risk Factors for Medical Withdrawals in USTA Junior National Tennis Tournaments

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Purpose: There has been no large-scale epidemiologic study done to determine if match volume, age, sex, or singles are risk factors related to medical withdrawal in United States Tennis Association (USTA) junior national tennis tournaments. Such data can be used to provide evidence-based recommendations for the USTA to offer guidelines particularly for match volume in such tournaments.

Methods and Study Design: A retrospective cohort analysis of data collected of every match of all four supernatural (largest) tournaments (spring, summer, fall, winter) for both boys and girls divisions and all age divisions (12s, 14s, 16s, 18s) during a single year was performed. Data was obtained from USTA.com publicly available Internet site for all tournaments. Incidence and prevalence of medical withdrawals (retirements and walkovers due to injury or illness) was determined with matches played as the exposure. Logistic regression analysis was performed to determine relative risk of all interested factors. Additional analysis was performed to determine which match number in a tournament would substantially increase a player's risk of medical withdrawal.

Results: There were a total of 28 376 (14 108 male, 14 105 female) match exposures analyzed with an even distribution with respect to age as well (7056 in 12s, 7184 in 14s, 7002 in 16s, 7094 in 18s). The total medical withdrawal rate was 15.6/1000 match exposures. Every factor of interest was highly significant in predicting a higher rate of medical withdrawal/1000 match exposures: SEX: males (16.9/1000) vs females (14.0/1000), ($P < 0.01$); AGE: 12s (7.4/1000), 14s (11.7/1000), 16s (20.6/1000), 18s (22.7/1000), ($P < 0.0001$); main draw (8.1/1000) vs consolation (28.9/1000), ($P < 0.0001$), singles (17.9/1000) vs doubles (9.8/1000), ($P < 0.0001$). Medical withdrawal rate in the first through fourth matches in a tournament were (12.7/1000) vs fifth match and beyond (26.3/1000), ($P < 0.0001$). All of these results were highly significant even when only analyzing main draw matches or only main draw, singles matches.

Conclusions: In USTA national junior tennis tournaments, there is a highly significant increase in risk of medical withdrawal directly related to higher age division matches, male matches, singles matches and main draw matches. More specifically, there is a significant increase in medical withdrawal rates beyond the fourth match in the tournament regardless of whether it is a main draw, consolation, singles, or doubles match.

Significance of Findings: Recommendations can be made to exercise caution in tournaments that involve males, older age divisions, and singles. Additionally, there is sufficient evidence to suggest intervention within a tournament when players play beyond their fourth match.

Susceptibility of Hydrostatic Weighing to Intentional Error in Weight Certification Use for Wrestlers

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Purpose: Recent efforts at education and optimal weight certification for high-school and collegiate wrestlers have improved health and safety for these athletes. Nevertheless, the culture of the sport continues to value an unrestricted freedom to lose unsafe amounts of body weight, largely through fluid loss, in order to wrestle at weight classes lower than those which are safe and/or optimal for the wrestler. Ordinarily body composition is assessed by the use of skinfolds, but many governing bodies permit a wrestler who believes that his body fat has been underestimated to appeal the skinfold estimation by hydrodensitometry in an accredited laboratory. The presumptions of hydrodensitometry presume cooperation by the subject in obtaining accurate assessments of body composition. When wrestlers are motivated to generate an erroneously high body fat ratio which will gain permission to lose an unsafe amount of body weight, they are able to manipulate the results of hydro-

densitometry to achieve this end. This study was conducted to validate the susceptibility of hydrodensitometry to this intentional error.

Methods and Study Design: In the first portion of the study, 12 collegiate athletes had their body composition estimated by hydrodensitometry using a system which measured their residual volume by helium dilution at the same moment that the submerged weight was recorded. They also had their body composition estimated by hydrodensitometry using the methodology in most common use for the appeals process for wrestlers. This included measurement of vital capacity in air and estimation of residual volume from this value. During hydrodensitometry, athletes were coached first to exhale as fully as possible for the residual volume maneuver and were then coached to selectively exhale less than fully so that the actual residual volume during the weighing maneuver was greater than the estimated value.

Results: By selective retention of air during the residual volume maneuver, these athletes were able to raise their apparent body fat by 4% to 8% above the estimate made by actual measurement of residual volume.

Conclusions: This study demonstrates the susceptibility of hydrodensitometry to intentional error when carried out in the manner prescribed by the appeals process of most governing bodies, ie, estimation of residual volume from a measured in-air vital capacity.

Significance of Findings: Results of hydrodensitometry in this population need to be interpreted with great care.

The Role of Vision on Knee Kinetic and Kinematic Variables During Drop Jumps from Unknown Heights

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Purpose: To establish the role of vision on knee biomechanics during drop jumps from unknown heights.

Methods and Study Design: A one-group repeated measures design was used assessing 20 healthy collegiate football players. The independent variables were knowledge of the drop jump height (vision, no vision) and 2 drop heights (50 cm control height, 35 cm early landing height). Subjects self initiated a drop from a hydraulic lift platform (Central Hydraulics, Inc) onto an AMTI force plate (Watertown, Massachusetts), landing on both legs and jumping vertically as high as possible. Height and vision conditions were randomized during 12 jumps. Reflective markers defined the trunk, thigh, lower leg, and foot segments and were recorded (240 Hz) with 8 cameras (Motion Analysis Corp, Santa Rosa, California). Kinematic and kinetic data was imported into Visual3d software (C-motion, Inc, Rockville, Maryland) for processing. Two-way ANOVA's were performed on peak vertical ground reaction force (N), time to peak force (ms), knee angle at ground contact (deg), maximum knee flexion angle (deg) and knee excursion (deg).

Results: Time to peak force was significantly less in the no vision (time = 45 ± 12 ms) versus vision conditions (time = $.54 \pm 13$ ms) ($P = 0.003$), and peak force was significantly greater ($P = .018$) in the no vision (force = 2409 ± 874 N) versus vision conditions (force = 2016 ± 656 N). A significant ($P = .01$) interaction was identified whereby peak force was even greater in the no vision-50 cm condition. Knee angle was significantly less flexed when landing without vision and the least flexed during the no vision-35 cm condition.

Conclusions: Unanticipated early landings that occur without reliance upon visual cues leads to higher forces in a shorter period of time and with the knee in a more extended position.

Significance of Findings: The methodology used in this study creates biomechanical aberrations that may simulate, in a controlled laboratory setting, the unanticipated events leading to non-contact knee injuries where visual-spatial disorientation disrupts the dynamic restraint mechanism.

Effectiveness of a Neuromuscular Warm-up in Reducing Injuries Among Racially Diverse Female Athletes in Urban Public High Schools: A Cluster Randomized Controlled Trial

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Purpose: To determine the effectiveness of a structured neuromuscular warm-up in reducing knee injuries among female athletes in an urban, racially diverse, public high school league.

Methods and Study Design: We recruited 63 basketball and 31 soccer coaches and their corresponding athletes (837 and 655) from 46 Chicago public high schools. After stratifying for their team's competitiveness and their school population's socio-economic status, we randomized coaches to the intervention or control group. We trained intervention coaches to implement a 15-minute structured neuromuscular warm-up before team practices and instructed control coaches to perform their usual warm-up. Study personnel recorded all injuries that resulted in at least one missed practice or game. We used Fisher's exact test to compare injury rates between intervention and control groups.

Results: Of the 1492 athletes, 1078 (70%) reported their race: black/African American (39%), Hispanic (37%), white (14%), Asian (2%), American Indian (< 1%), Pacific Islander (< 1%), mixed race (5%), other (3%). Total athlete exposures and injuries were 28 095 and 72 in intervention group and 23 048 and 123 in control group. The intervention group had significantly lower rate of new non-contact knee ligament sprains than control group (0.107 vs 0.390 per athlete-exposure; $P = 0.036$). There was a trend toward lower rate of new non-contact anterior cruciate ligament injuries in the intervention vs control group (0.036 vs 0.217 per athlete-exposure; $P = 0.070$). Intervention coaches reported using the warm-up in 1425 of 1773 practices (80.4%).

Conclusions: This is the first study demonstrating that a neuromuscular warm-up reduces knee ligament sprains among a racially diverse group of female athletes in urban, public high schools.

Significance of Findings: Urban, public high school coaches can be trained to successfully implement a neuromuscular warm-up as a knee injury prevention strategy for their female athletes. Female athletes from varied racial backgrounds can benefit from neuromuscular training.

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Folic Acid Supplementation Improves Vascular Function in Amenorrheic Runners

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Purpose: This study determined the effects of high dose folic acid supplementation for 4–6 weeks on brachial artery flow-mediated dilation (FMD) in amenorrheic and eumenorrheic runners.

Methods and Study Design: This is a prospective cross-sectional study. Ten amenorrheic and 10 eumenorrheic women were treated with folic acid (10 mg/day) for 4–6 weeks, and their FMD was measured before and after folic acid supplementation with standard techniques. Amenorrheic runners with normal baseline FMD ($n = 3$) on initial study were excluded in the statistical analysis.

Results: The FMD response to reactive hyperemia normalized after folic acid supplementation in amenorrheic women when compared to their pretreatment baseline. In the amenorrheic group, the improvement between the baseline FMD and posttreatment FMD was statically significant ($3.03\% \pm 2.27\%$ vs $7.72\% \pm 4.53\%$; paired t-test, $P = 0.02$). In the eumenorrheic control group, the baseline FMD and posttreatment FMD group were similar ($6.66\% \pm 1.97\%$ vs $5.91\% \pm 2.58\%$; paired t-test, $P = 0.52$). In addition, the post-treatment FMDs were similar between the amenorrheic and eumenorrheic runners (t-test, $P = 0.3$).

Conclusions: Our study demonstrated that this measurement of vascular function improved in amenorrheic female runners after 4–6 weeks of supplementation with folic acid. Folic acid normalized the vascular function in the participants with reduced FMD secondary to amenorrhea.

Significance of Findings: We have previously shown that women with athletic-associated amenorrhea have reduced endothelial-dependent vasodilatation. This is the first study to demonstrate normalization of FMD after treatment with high dose folic acid in young female amenorrheic runners. Further large cohort studies in this area are needed to determine if folic acid may reduce future cardiovascular risks in this patient population.

Acknowledgements: The authors of this study would like to acknowledge the Cardiovascular Center at the Medical College of Wisconsin for their continued support of our research.

The Usefulness of Using Baseline Exhaled Nitric Oxide in Predicting Exercise-Induced Bronchoconstriction in the Division I College Athlete

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Purpose: Can measured exhaled nitric oxide (eNO) predict exercise-induced bronchoconstriction (EIB) in the Division I college athlete?

Background: Nitric oxide has been shown to be a marker of inflammation in those with asthma. Studies have suggested that elevated baseline eNO may be a predictor of airway hyper-responsiveness to exercise. Most of these studies have evaluated this in the pediatric population. There have not been any studies looking at this in the college athlete.

Methods and Study Design: Cohort study. All varsity athletes were eligible for this study. Athletes treated for or identifying themselves as having EIB or asthma as well as those free of any respiratory disease were enrolled. Subjects underwent baseline eNO, baseline spirometry, and eucapnic voluntary hyperventilation (EVH) challenge testing. Forced expiratory volume in one second (FEV1) measurements were recorded at 3-minute intervals for 21 minutes after the EVH challenge. An athlete was considered positive for EIB if they experienced a 10% drop in FEV1 from baseline after EVH challenge. eNO levels were compared between those who were positive for EIB and those who were negative for EIB.

Results: The proportion of cases recognized as having EIB due to a positive EVH challenge was 22% (16/74). The mean value of baseline eNO in the EIB group was 18.70 ppb. The mean value of baseline eNO in the non-EIB group was 21.62 ppb.

Conclusions: There was no statistically significant difference in measured baseline eNO between athletes who tested positive for EIB and those who tested negative for EIB.

Significance of Findings: While other studies suggest that a high baseline eNO may be used to predict the presence of EIB and correlate with severity, this study suggests that this may not be useful in determining EIB in the Division I college athlete.

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Warning Symptoms and Family History in Children with Sudden Cardiac Arrest

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Purpose: To determine the prevalence of warning symptoms or a concerning family history in a group of young persons who suffered sudden cardiac arrest (SCA).

Methods and Study Design: This study was a cross-sectional survey sent to the members of Parent Heart Watch – a national organization composed of families with a child who suffered SCA. A comprehensive questionnaire was developed based on national recommendations regarding symptoms and family history elements that may identify children at risk for SCA.

Results: Seventy-four of 138 (54%) families completed the survey regarding 74 children with SCA (mean age 16 years [$<5-29$]; survivors, 9; deaths, 65). Symptoms reported prior to SCA included fatigue (45.3%), near-syncope/lightheadedness (30.7%), chest pain (29.3%), palpitations (26.7%), shortness of breath (22.7%), tire more easily than friends (21.3%), syncope (18.7%), unexplained seizure activity (13.3%), and a decrease in physical activity (12%). Seventy-six percent of children had at least one of the above symptoms prior to SCA, and 68.2% of these children had at least one of these symptoms prior to their most recent pre-participation evaluation (PPE) or well child care (WCC) visit. There was no significant difference in prodromal symptoms between subjects with exercise-related SCA (76%) and non-exercise-related SCA (70%). Twenty-five point three percent of children had a family history of cardiac related death prior to the age of 50. Family history was also remarkable for a cardiac pacemaker (13.3%), unexplained syncope (13.3%), unexplained seizure disorder (4%), drowning or near drowning event (4%), and a relative with an implantable cardioverter defibrillator (1.3%). Forty-nine percent of children had at least one significant family history finding. The child's SCA led to the identification of other family members with the same cardiac disorder in 16% of cases.

Conclusions: Many children who suffered SCA are reported to have cardiac symptoms or a family history of cardiac disease that could be detectable during a screening PPE or WCC visit. Utilization of a standardized questionnaire to conduct a cardiovascular risk assessment is strongly recommended. **Significance of Findings:** Detailed personal and family history screening of children may improve identification of those at risk for SCA. Improved education of those conducting screening evaluations in children is critical. **Acknowledgements:** The authors are grateful to the support and participation of Parent Heart Watch.

ICD Sports Safety Registry: An Interim Report

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Purpose: The 36th Bethesda Guidelines recommend that athletes with implantable cardioverter-defibrillators (ICDs) refrain from participating in sports, yet anonymous physician surveys indicate that up to 70% of athletes with ICDs do participate in sports. To determine the safety and efficacy of ICDs in the athletic population, the prospective multi-center ICD Sports Safety Registry was created in 2006.

Methods and Study Design: Over 24 months, 173 athletes were referred. However, 30 athletes were excluded from analysis due to: ineligibility for the registry ($n = 20$), newly consented or have not completed enrollment process ($n = 5$), lost to follow-up or did not comply with interview ($n = 3$), withdrawn to arrhythmia-related complication or heart transplant ($n = 2$). Thus, 143 athletes were enrolled either individually or through 33 enrolling centers, range 0–10 athletes/site.

Results: Demographics: male/female = 87/56, 61%/39%; white/Hispanic/Asian/black/other = 130/5/3/2/3; aged 10–59 years. Enrollment sources: site, 55%; non-site individual physician, 20%; self-referral, 26%. Underlying cardiac conditions: long QT syndrome, 25%; hypertrophic cardiomyopathy, 17%; congenital, 11%; aged arrhythmogenic right ventricular cardiomyopathy, 10%; coronary artery disease, 9%; other, 29%. Indication for ICD implant: prophylactic, 42%; non-sustained ventricular tachycardia, 25%; ventricular fibrillation arrest, 14%; sustained ventricular tachycardia, 12%; records pending, 8%. Duration of ICD implant: 46.3 ± 45.3 months. Fifty-five percent of athletes were prescribed beta blockade. Athletes participated in 36 unique sports at various levels: grade school, 5%; high school, 19%; college, 8%; professional, 1%; other, 67%. ICD shocks were reported during sports in 11% before enrollment.

Conclusions: These data confirm that some athletes with ICDs are participating in sports. Continued enrollment and follow-up will provide insight into the safety of sports participation in this population.

Significance of Findings: These registry data confirm what was suggested by preliminary physician survey studies in 2004 and 2005. Some athletes with ICDs and underlying high risk cardiac conditions are participating in sports.

Sudden Cardiac Arrest at Collegiate Athletic Venues

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Purpose: Earlier studies have shown a poor survival rate from sudden cardiac arrest (SCA) in collegiate athletes. This study examined the details and outcomes of resuscitation in a series of recent cases of SCA occurring at collegiate athletic venues and the impact of on-site automated external defibrillator (AED) programs.

Methods and Study Design: SCA cases occurring at collegiate athletic venues were identified from the National Registry for AED Use in Sports. A school representative involved in the resuscitation completed a comprehensive questionnaire on the details and outcomes of the event. All cases were reported between December 2006 and August 2008 and occurred within 6 months of survey completion.

Results: Ten cases of SCA were analyzed, including 4 cases in student-athletes (mean age, 19; range, 15–22) and 6 cases in older non-students (mean age, 62; range, 42–72). Collapse was witnessed in 9/10 cases. Brief seizure-like activity was reported in 4/10 cases following collapse. CPR was initiated in 7/10 cases, and an on-site AED was utilized in all cases. The average time from arrest to CPR was 1.4 minutes (range, 0–4.5 minutes), and the average time from arrest to first shock was 2.0 minutes (range, 1.5–4.5 minutes). A shock was deployed in 8/10 cases, with a mean of 1.4 shocks delivered (range, 1–5). EMS was available on-site in only one case, with a mean interval from collapse to EMS arrival of 6.5 minutes (range, 2–15 minutes). Six of 10 cases (60%) survived to hospital discharge, including 3/4 student-athletes and 3/6 older non-students. Diagnoses were confirmed in the four student-athletes, including two cases of hypertrophic cardiomyopathy, one case of Wolff-Parkinson-White syndrome, and one case of Long QT syndrome.

Conclusions: Early defibrillation accomplished through on-site AED programs at collegiate athletic venues achieves a rapid response to SCA and a high survival rate for both student-athletes and older non-students with SCA. **Significance of Findings:** Access to early defibrillation through on-site AED programs is recommended in the college athletic setting.

Acknowledgements: The National Operating Committee on Standards for Athletic Equipment (NOCSAE) for partially funding the National Registry for AED Use in Sports.

Does Reversibility of EKG Precordial T-wave Inversions During Stress Testing Distinguish Athlete's Heart from Hypertrophic Cardiomyopathy?

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Purpose: Prior studies have suggested that T-wave reversibility is a marker of benign or physiologic changes and can be useful to exclude pathologic conditions. Therefore, we sought to determine the negative predictive value of resting precordial T-wave inversion reversibility during exercise stress testing for the absence of Hypertrophic Cardiomyopathy (HCM).

Methods and Study Design: We prospectively identified 5 Division I collegiate athletes and compared them to 10 Cleveland Clinic Florida patients with documented HCM. Athletes were selected for stress echocardiography because of a suspected abnormal EKG with precordial T-wave inversions. HCM patients were matched for similar T-wave inversions in precordial leads including V3 with or without the presence of left ventricular hypertrophy and strain pattern. We excluded patients who had T-wave inversions that did not include V3, those who had incomplete or uninterpretable exercise EKG tracings and those unable to exercise. Both groups underwent cardiovascular stress testing with EKG monitoring and stress echocardiography. All 5 athletes were found to have a manifestation of athlete's heart. A physician blinded to the patient's diagnosis performed interpretation of the pattern of EKG changes.

Results: Of the 15 subjects in this trial, 15 (100%) were men with a mean age of 37.6 years. All subjects in our study had normalization of their baseline T-wave inversion in lead V3 during exercise stress testing.

Conclusions: In our study, the null hypothesis was not rejected. Electrocardiographic T-wave inversion reversibility in precordial leads (including at least V3) during cardiovascular exercise stress testing had no negative predictive value for HCM.

Significance of Findings: Precordial T-wave inversion normalization as seen in the athlete's heart is not specific for physiologic hypertrophy vs HCM. A larger study is warranted to further examine the findings of this small observational study.

Acknowledgements: Cleveland Clinic Florida Department of Orthopedics/Sports Medicine; Cleveland Clinic Florida Department of Cardiology.

Automated External Defibrillators and Emergency Planning for Sudden Cardiac Arrest in Health and Fitness Facilities

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Purpose: To assess emergency response planning for sudden cardiac arrest (SCA) and the prevalence and past utilization of automated external defibrillators (AEDs) in health/fitness facilities located in King County, WA.

Methods and Study Design: This study was a cross-sectional survey of health/fitness facilities ($n = 136$) in King County, WA. Questions were based on national guidelines released in 2002 by the American Heart Association/American College of Sports Medicine and addressed emergency response planning for SCA, CPR training of employees, the number of on-site AEDs, and cases of SCA within the last 12 months.

Results: Sixty-three of 136 (46%) facilities completed the survey. Nineteen percent were small group exercise facilities with a single leader, 73% had general memberships, and 8% offered special programs for clinical populations. Thirty-five percent had < 500 members, 21% had between 501–1500, 16% had between 1501–2500, and 29% had >2500. Sixty-eight percent had an established emergency response plan for SCA. Staff trained in CPR included: 83% of fitness instructors, 73% of administrators, and 58% of front desk personnel. Forty percent of facilities had at least one AED on-site (mean, 1.7; range, 1–6). Facilities with membership >1500 were more likely to have an AED (71% vs 14%, $P < 0.0001$). Four facilities reported an incident of SCA within the last 12 months, all in facilities with >1500 members. The annual incidence of SCA was 6.4% in responding facilities (2.9% in the total surveyed) and 14% in responding facilities with >1500 members. Only 2 of 4 facilities with a case of SCA had an on-site AED. The SCA victims were all male, aged 50–65 years. Two of 4 victims were immediately resuscitated at the health/fitness facility.

Conclusions: The current level of emergency preparation for SCA in most health/fitness facilities in King County, WA, does not meet national standards set by the AHA/ACSM. Facilities with >1500 members are at higher risk for an incident of SCA.

Significance of Findings: SCA is the leading cause of death in the US, and the single greatest factor affecting survival is the time from cardiac arrest until defibrillation. Given the incidence of SCA in health/fitness facilities, on-site AED programs are strongly recommended, especially in facilities with >1500 members.

POSTER PRESENTATIONS

Plasma Brain Natriuretic Peptide in Endurance Trained Adolescents

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Purpose: Plasma brain natriuretic peptide (BNP) has been found to be elevated in several disease states causing increased left ventricular wall stress, including congenital cardiac disorders and asymptomatic hypertrophic cardiomyopathy. For this reason, it has been hypothesized that BNP may be an adjunct to preparticipation screening of young athletes. There are no data currently available comparing plasma BNP levels between healthy endurance trained and non-endurance trained adolescents.

Methods and Study Design: 10 endurance trained male adolescent cyclists (endurance group) were recruited from an elite cycling team. For comparison, 12 male adolescents who had not participated in endurance training were recruited from a local high school (non-endurance group). Participants underwent physical exam, EKG, echocardiogram, and plasma BNP measurement. BNP values were analyzed directly and correlations assessed with Spearman rank order coefficients.

Results: Endurance trained athletes had a significantly lower body mass index and body surface area. BNP was 23 pg/ml or less in both endurance and nonendurance athletes, with 5 of 10 endurance athletes and 9 of 12 non-endurance athletes having undetectable BNP levels (< 5 pg/ml). BNP levels did not differ between groups ($P = 0.274$). There was no significant correlation between BNP and LV mass, LV mass index, interventricular septal thickness, or mean arterial pressure (all $P > 0.05$). Linear regression revealed evidence for a relationship between BNP and FS, and possibly BNP and E/E' ($P = 0.006$ and $P = 0.032$, respectively).

Conclusions: There is no significant difference in plasma BNP levels between endurance trained and non-endurance trained male adolescent athletes. In addition, BNP does not appear to correlate to LV mass in adolescent athletes, even when corrected for body surface area.

Significance of Findings: These data imply that an elevation of BNP in adolescent athletes should be considered pathologic and not a result of prolonged endurance training.

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Surface EMG Assessment of Back Muscle Function Using Back Supports for Patients with Chronic Low Back Pain

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Purpose: Surface electromyographic (sEMG) analysis has been used successfully to identify muscle impairment in patients with chronic low back pain (CLBP). It is hypothesized that with decreased muscle efficiency passive tissues of spine are increasingly stressed, thus exposing the nerves and spinal structures to irritation or damage. Patients with CLBP often assume abnormal static postures with trunk bent forward, and shoulders rounded and protracted. The use of EMG biofeedback and effects of postural changes through the use of back supports has not been tested. Determining the effect of therapeutic interventions on muscle efficiency offers an objective technique to assess potential treatment modalities for CLBP. The purpose of this study is to determine the effect of back supports on lumbar paraspinal muscle activity utilizing sEMG.

Methods and Study Design: sEMG activity was recorded in 4 pairs of homologous paraspinal muscles (bilaterally from L5 level) in 25 patients satisfying inclusion criteria for non-specific CLBP. The effect of spinal supports on paraspinal muscle activity was assessed and body part discomfort questionnaire (BPDQ) measured. Root mean square (RMS) electromyographic amplitude was measured for a series of static positions (a) relaxed seated (b) typing, and (c) simulated driving, before and one-hour post introduction of spinal supports.

Results: 25 patients (14 female, 11 male) aged 21 to 57 years formed the study cohort. Images of lumbar muscle activity were obtained and demonstrated a multifocal and/or asymmetrical pattern prior to introduction of back support in all positions. One-hour post back support placement, the sEMG showed a symmetric activity pattern in all positions. Maximum RMS values one-hour post support placement was significantly lower than without back supports in all positions ($P = 0.02$). ANOVA analysis revealed significant BPDQ for lower back ($P = 0.01$).

Conclusions: The orthopaedic spinal support demonstrated improved paraspinal activity symmetry, decreased maximum RMS values and a significant BPDQ change.

Significance of Findings: There is a paucity of data looking at the efficacy of lumbar supports. To our knowledge, this is the first study showing a positive role of lumbar support use on paraspinal muscle activity.

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Do Kansas High School Coaches Follow the Recommendations of the USA Baseball Medical and Safety Advisory Committee?

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Purpose: The USA Baseball Medical and Safety Advisory Committee provide scientific information with the goal of reducing injury risk and maximizing performance. The authors sought to determine if Kansas baseball coaches follow the recommendations that when followed can minimize risk of future arm injury and maximize success.

Methods and Study Design: Institutional review board approval and waiver of informed consent were obtained. Kansas high school varsity baseball coaches (n = 221) were mailed a 20-question survey on their self-reported adherence to these recommendations. Contact information was obtained from Kansas State High School Activities Association. The proportion of coaches who follow each recommendation was estimated. Inferential analyses (chi-squared) compared the proportions of more knowledgeable and less knowledgeable coaches who followed each recommendation.

Results: Ninety-six surveys were returned (43%). Head coaches with 4 year degree or post graduate education comprised 98% of respondents with a median 10.5 years of coaching experience. Coaches were knowledgeable about removing a pitcher with arm pain (95%) and not returning a pitcher after removal (85%). Coaches were less knowledgeable about when to seek medical advice due to persistent arm pain (79%), pitching for more than one team during a season (78%), maximum number of months per year (70%), throwing in showcases (38%), maximum pitch counts per game (66%) and were least knowledgeable of pitch counts per week/season/year. Knowledge for age to begin throwing curveballs (81%) and screwballs (81%) was better than knuckleballs (60%) and sliders (51%).

Conclusions: Kansas baseball coaches lack knowledge of the recommendations and would benefit from further education.

Significance of Findings: Survey results can be utilized in education for Kansas baseball coaches. By increasing coaches' knowledge, we are hopeful that adherence to the recommendations can be maximized, minimizing arm injuries.

Knee Function and Symptoms in Division I Collegiate Field Sport Athletes

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Purpose: Lower extremity injuries are common among collegiate field sport athletes, with knee injuries being among the most common. Attempts to characterize the prevalence and severity of knee function and symptoms complaints should allow for improved understanding of care for the athlete.

Specific Aims: 1. To determine if there is a difference in knee function and symptoms in field sport athletes from different sports that have no history of knee surgery. 2. To determine if there is a difference in knee function and symptoms in field sport athletes with and without a history of knee surgery.

Methods and Study Design: Cross-sectional-study. A survey was distributed in Autumn 2007 to 147 varsity athletes from 5 Division I collegiate sports teams (women's field hockey, women's lacrosse, women's soccer, men's lacrosse and men's soccer) at The Ohio State University. Participants answered questions regarding demographic data and completed the KOOS (Knee Injury and Osteoarthritis Outcome Score) survey. Statistical analysis was performed using one-way ANOVA with post hoc Sheffe testing and two-tailed student t-tests. Level of significance was $P \leq 0.05$ for all tests.

Results: Women's and men's lacrosse and soccer athletes reported no difference in means for all 5 KOOS subscales; however, women's field hockey did show a significant difference with lower KOOS scores for all 5 subscales ($P < 0.01$) compared to other athletes. Athletes with a history of previous knee surgery reported a significant difference with lower KOOS scores for the pain ($P = 0.00005$), symptom ($P = 0.019$) and quality of life ($P = 0.003$) subscales but not in activities of daily living or sport activity subscales.

Conclusions: Women's field hockey athletes reported significantly decreased KOOS scores in all 5 subscales compared to women's and men's lacrosse and soccer athletes. Athletes with a history of previous knee surgery reported decreased KOOS scores for the pain, symptom and quality of life subscales compared to athletes without a history of previous knee surgery.

Significance of Findings: Further study is needed to determine risk factors for specific field sport athletes related to knee pain. These findings suggest that athletes with a history of knee surgery may have early degenerative changes that go undetected because of their ability to perform common daily and sport activities at the same level as their peers without a history of knee surgery.

Ethnic and Gender Differences in Creatine Kinase Distribution on Marine Corps Officer Candidates

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Purpose: Levels of serum creatine kinase (CK) are used in the diagnosis of exertional rhabdomyolysis (ER), a common problem in warfighters. Specifically, ER is diagnosed when severe muscle pain is accompanied by a CK > 5 times the reported laboratory upper limit of normal (ULN). The purpose of this study was to investigate the contribution of ethnicity and gender to variability in baseline CK levels.

Methods and Study Design: Observational study in officer candidates at Marine Corps Base Quantico. Subjects had a baseline CK level drawn, and completed a demographic survey and exercise history.

Results: The cohort included 471 persons: 368 Caucasians/CA; 22 African Americans/AA; 32 Asians/AS; 37 Hispanics/HI; and 14 Others/OT. Mean baseline CK for the cohort was 188 ± 588 (SD) IU/L, with a minimum of 20 and maximum of 9500 IU/L. Over 38% of the cohort had values above the ULN. No significant differences were noted among those who reported working out vigorously in the past 3 days, but CK was >5 times ULN in 5 men and 1 woman. When samples >5 times ULN were excluded, mean CK was significantly ($P < 0.01$) higher in men (146 ± 92 IU/L) than women (114 ± 87 IU/L), and significantly ($P < 0.01$) lower in CA (137 ± 87 IU/L), HI (143 ± 111 IU/L), and OT (124 ± 66 IU/L) than AA (216 ± 128 IU/L): 65% of AA had baseline CK $> ULN$ compared to 36% of OT, 35% of CA, and 26% of HI; AS (170 ± 93 IU/L) were between AA and HI. No ER cases were diagnosed during the training.

Conclusions: Baseline CK levels of men and women in military training vary significantly depending on both ethnicity and gender.

Significance of Findings: Both ethnicity and gender should be considered when laboratory ULN for CK are used to avoid a misdiagnosis of ER. Importantly, clinical laboratories should develop ethnic- and gender-specific ranges for CK.

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Assessing Attitudes and Understanding of the Female Athletic Triad among College Female Athletes

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Purpose: To assess the awareness and knowledge of the female athletic triad among female collegiate athletes.

Methods and Study Design: A survey, using a 5 point Likert scale, to explore the attitudes and understanding of Female Athletic Triad (FAT) and its

components, as well as the source of this information, was developed by the investigators. Female participants in college athletics age 18 years or older were asked to consent to and voluntarily complete this survey.

Results: A total of 30 athletes were surveyed. Only 10% had knowledge of the term Female Athletic Triad (FAT). There were high levels of awareness of the relationship between heavy training and abnormal periods (77%) as well as disordered eating and bone health (67%). An area of poor understanding was the relationship between abnormal menstrual periods and bone health (10%). Additionally, regarding the source (ie, coach/trainer, parent or physician) where the athlete obtained their information regarding FAT was examined and the results were low. Between 3%–27% of the above sources discussed the relationship between heavy training and abnormal menstrual periods and 7%–10% discussed the relationship between abnormal menstrual periods and bone health.

Conclusions: This study indicates that the participants had minimal awareness of the term FAT, yet had better understanding of certain relationships within the triad. This is most likely because more individuals, whether directly or indirectly, are aware of the relationship between heavy training and abnormal menstrual periods, which is most likely commonly experienced. This is consistent along the spectrum of pathophysiologic manifestations of FAT. Additionally, coaches/trainers, parents and physicians were not discussing many of these relationships, and this may be an area of further study.

Significance of Findings: There is a deficit in the knowledge regarding FAT among college female athletes, and this indicates a need for improved education for this population.

Acknowledgements: New Jersey Institute of Technology Women's Athletic Programs.

Influencing Factors of the Development of Hyponatremia: Does Race Pace Matter?

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Purpose: Prior studies of full marathon participants have demonstrated a higher incidence of hyponatremia in runners with completion times of four hours or more. The primary aim of our study was to determine if slower pace is associated with increased prevalence of hyponatremia. A secondary aim was to determine if there is a significant difference in the prevalence of hyponatremia in half versus full marathon participants.

Methods and Study Design: This is an observational, cross-sectional study of consenting runners in a National Breast Cancer Marathon, Florida 2008. Participants volunteered at the pre-race expo. Individuals less than 18 years of age were excluded. Participants in both half and full marathons agreed to provide pre- and post-race finger-stick blood samples on race day.

Results: The median race pace (minutes/mile) was found to be 12.7 (range, 6.9–27.4) for half marathoners and 12.7 (range, 7.4–15.22) for full. A significant negative association was found between pace and post-race sodium level (Spearman correlation, $r = -0.30$, $P < 0.0001$). The prevalence of post-race hyponatremia was 4% (4/102) among half marathoners and 13% (12/77) among full marathoners (Fisher's exact test $P = 0.018$). In those found to be hyponatremic, sodium levels ranged 125–134.3 mmol/L. Median finishing times for half and full marathoners were 166.1 (range, 90.6–358.5) and 333.7 (range, 194.4–398.7) minutes, respectively, with a negative correlation between finishing time and post-race sodium (Spearman correlation, $r = -0.28$, $P = 0.0001$).

Conclusions: Slower race pace and longer finishing times were associated with lower post-race sodium levels. Full marathoners had a significantly higher prevalence of hyponatremia than half marathoners.

Significance of Findings: The present study is the first to examine the influence of race pace on the prevalence of hyponatremia with the benefit of data from both half and full marathons. Although found to be technically hyponatremic, the clinical significance of such abnormalities remains to be determined.

Survey of Primary Care Sports Medicine Fellowship Program Directors on the Routine Use of Electrocardiograms in the Preparticipation Evaluation

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Purpose: To survey USA-based primary care sports medicine fellowship program directors (PCSM-PDs) on their practices and opinions about the use of screening electrocardiograms (ECGs) as part of the routine preparticipation evaluation (PPE).

Methods and Study Design: A 10-question web-based survey instrument was designed to access PCSM-PD practices and opinions on the use of routine ECGs as part of the PPE. The survey was distributed by e-mail to 100 USA based PCSM-PDs for voluntary and confidential completion. Passive consent to participate was obtained by subjects' acceptance to complete the survey.

Results: Of the 100 PCSM-PDs identified on the American Medical Society for Sports Medicine website and American Medical Association Frieda online databases, 54 (54% response rate) responded to the survey. Sixty-eight percent of respondents serve as full-time PCSM-PDs, and 43% are compensated as team physicians. Ninety-six percent are family medicine-certified, while 92%, 82%, 48%, and 41% of respondents cared for college, high school, professional and youth athletic teams, respectively. Ninety-three percent (50/54) of PCSM-PDs who completed the survey agree with American Heart Association (AHA) recommendations that screening ECGs not be obtained routinely during the PPE. Reasons cited for not using screening ECGs include financial and cost versus benefit concerns (89%) and interpretation capability limitations (72%). Six of the survey participants (11%) indicated that they use routine ECGs as part of PPE screening, and eight (15%) believe that the routine use of ECGs will have some benefit in the detection of cardiac abnormalities, in lowering the incidence of sudden death, or may result in the withholding of certain athletes from participation who would otherwise have been allowed to participate.

Conclusions: An overwhelming majority of USA-based PCSM-PDs agree with current AHA recommendations to not use screening ECGs as part of routine PPEs. A few respondents reported that they do include screening ECGs as part of the PPE and believe that ECGs may help detect and lower the overall incidence of sudden cardiac death in young athletes.

Significance of Findings: A large majority of PCSM-PDs concur with AHA recommendations that screening ECGs not be included as a routine component of the PPE.

Assessment of Cardiovascular Risk in College Football Players by Position

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Purpose: To determine if college football players, particularly linemen, exhibit cardiovascular risk factors and structural/functional abnormalities which predict mortality and future cardiovascular events.

Methods and Study Design: Three groups of 13 students each from a single university were enrolled in this cross-sectional, observational pilot study: varsity football linemen (L), varsity football backs/receivers (B), and non-athletes with body mass index (BMI) over 25 (NA). Visit 1: BP, anthropometrics, fasting serum lipids and glucose. Visit 2: brachial artery flow-mediated dilation, carotid ultrasound, echocardiogram. ANOVA statistical analysis performed with SPSS 15. Significance set at $P < .05$.

Results: BMI: L = 36.1, NA = 33.2, both significantly $> B = 26.3$. Body Fat Percentage: NA = 26.7, L = 24.9, both significantly $> B = 9.9$. Waist/Hip Ratio: L = 0.89 significantly $> B = 0.83$ with NA = 0.87 in between. Systolic BP: L = 123.5 significantly $>$ both NA = 123.5, B = 121.1.

HDL: L = 37.9 significantly $< B = 48.6$ with NA = 42.9 in between. Triglycerides: NA = 129.2 trend $> B = 75.3$ while L = 111.4. VLDL: NA = 25.9 trend $> B = 15.0$ while L = 22.2. No differences for Total Cholesterol

(NA = 168.6, L = 165.5, B = 158.3), LDL (L = 105.4, NA = 99.8, B = 94.7), or Glucose (L = 89.8, B = 85.9, NA = 85.5).

LV Mass: NA = 222, L = 203 both significantly > B = 165, but when LV mass indexed for BSA: NA = 92 significantly > both B = 79, L = 77. LV Mass/EDV ratio: NA = 1.59 significantly > both L = 1.31, B = 1.30 indicating lack of eccentric remodeling in the athletes. No difference found for wall thickness (Posterior: L = 0.98, B = 0.94, NA = 0.93, Septal: L = 0.95, NA = 0.91, B = 0.85) or Left Atrium Size (L = 3.99, NA = 3.81, B = 3.57).

No differences found for Carotid IMT (S = 0.56, L = 0.55, NA = 0.53), Compliance (NA = 1.41, L = 1.55, B = 1.58), Distensibility (L = 4.01, NA = 4.54, B = 4.80), Stiffness (L = 5.54, NA = 5.25, b = 4.85), or Brachial Reactivity (NA = 7.34, L = 6.25, B = 5.96).

Conclusions: Linemen had worse BMI, body fat, waist/hip ratio, HDL, and systolic BP values than backs/receivers and worse waist/hip ratio, HDL, and systolic BP values than overweight non-athletes.

Significance of Findings: College football linemen should be educated about how to improve their cardiovascular risk profiles, especially upon graduation, when activity levels may change.

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The Effects of Brief Immobilization Following Stable Knee Injuries (A Pilot Study)

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Purpose: To our knowledge, there is no data in the literature regarding the effects of knee immobilization or knee immobilizers on knee function following a stable knee injury. Our objective was to determine if there is a relationship following stable knee injuries between initial knee immobilization and both subjective and objective functional improvements.

Methods and Study Design: Prospective non-randomized observational cohort study. Subjects presented to Sports Medicine Clinic either from self referral or ER referral. At this first meeting, all eligible subjects were consented and completed a patient information sheet regarding use of knee immobilizer, as well as a validated knee function questionnaire International Knee Documentation Committee (IKDC) form, and were prescribed home exercises or physical therapy. Subjects were prospectively analyzed as either in immobilized group or non-immobilized group based on original treatment plan from ER. Subjects were then followed in clinic at regular intervals until they reached baseline, plateaued with their function, or had definitive surgical treatment.

Results: Twenty-nine subjects were consented and 21 subjects met inclusion criteria for the study. Of those included, 12 were immobilized for a mean of 3.89 days and had a mean initial IKDC and function scores of 31.03 and 4.17, respectively, and second IKDC and function scores of 55.17 and 6.63, respectively. Nine subjects were not immobilized and had a mean initial IKDC and function scores of 49.55 and 5.22, respectively, and second IKDC and function scores of 62.07 and 6.50, respectively. The non-immobilized group had higher initial baseline IKDC knee rating scores versus those that were immobilized ($P < 0.009$). There were no significant differences between second IKDC scores between immobilized and non-immobilized groups ($P = 0.357$). When collapsing both groups, there were significant differences between first and second IKDC scores ($P = 0.0001$), but not function scores ($P = 0.086$).

Conclusions: There is better baseline subjective functional improvement in non-immobilized group versus immobilized group following stable knee injuries. There is a significant difference between initial IKDC and follow up IKDC suggesting improvement in both groups with the given intervention. No differences between non-immobilized and immobilized groups were noted on follow-up assessments. Discontinuation of immobilization and initiation of an

exercise program regardless of initial immobilization treatment results in improvements at an average of 14.46 days.

Significance of Findings: Knee immobilization after stable knee injuries may result in poorer short-term outcomes than not immobilizing. Initiating early range of motion and strengthening exercises seems to have beneficial effects on function at an average of 14.5 days.

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The Effects of Iron Status on Performance in College Runners

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Purpose: To determine the relationship between hematologic levels, as measured by serum ferritin, and performance in college cross country and track runners. To determine if ferrous sulfate supplementation improves performance.

Methods and Study Design: A prospective, interventional cohort analysis of data. After giving informed consent, subjects filled out a brief questionnaire to assess risks for iron deficiency, nutritional status, and current activity level. Subjects were placed in iron control and iron supplement groups based on serum ferritin (sFer) levels. Subjects with sFer less than 30 $\mu\text{g/L}$ were given iron supplementation throughout the cross country and/or track season (27 mg ferrous supplement for women, 54 mg ferrous supplement for men). Performance was assessed as each athlete's first performance of the season compared to their last performance in middle and distance runners. Means 6 standard deviation and ANOVA was used for statistical analysis.

Results: Forty-four collegiate runners began the study with 31 (20 women and 11 men) completing all baseline surveys and both blood draws. Fifteen of 20 female subjects had sFer < 30 and were supplemented with 27 mg ferrous, while only 2/11 males has sFer < 30 and were supplemented with 54 mg ferrous. The 2 subjects in the male supplement (MS) group had an initial sFer of 22.7 with an average increase of 53.4 ng/ml after supplementation. The average initial sFer for the 15 subjects in the female supplement (FS) group was 19.1 ng/ml with an average increase of 8.2 ng/ml per subject. The 9 subjects in the male control (MC) group and the 5 subjects in the female control (FC) group had initial sFer levels of 82.2 and 43.9 ng/ml, respectively. The MS group saw an average performance decrease by 0.2%, the FS group increased performance by 1.7%, whereas the MC and FC groups improved by 1.1% and 3.5%, respectively.

Conclusions: Female collegiate runners have lower mean sFer than males. Overall sFer levels and ferrous sulfate supplementation do not appear to have a relationship to performance, although supplementation does appear to improve sFer levels.

Significance of Findings: Continued ferritin assessments in female athletes may target those in need of iron supplementation. Recommendations for future research are to obtain a larger sample size of athletes competing in more events to ascertain differences that might exist among runners in different events.

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Non-Invasive Pre-Participation Cardiac Screening in Division I Athletics

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Purpose: Sudden cardiac death (SCD) is the number one killer of athletes in the United States (US). Current US preparticipation examinations are known to be of relatively low sensitivity in detecting congenital conditions most often predisposing young athletes to SCD with activity. We sought to define current practices in US NCAA Division I football playing sports medicine programs.

Methods and Study Design: Cross-sectional observational survey of the entire population of football playing Division I collegiate sports medicine programs regarding current practices and rationale behind NICS. Surveys were sent to the head athletic trainers of all football playing National Collegiate Athletic Association (NCAA) Division I athletic programs listed in the National Athletic Trainers' Association directory. In all, 115 surveys were mailed; 74 departments (64%) responded.

Results: Seventy-four (64%) programs responded. Forty-seven percent of all participants have incorporated Non-Invasive Cardiovascular Screening (NICS) into their routine pre-participation protocols. For 91% of programs that do use NICS routinely in their preparticipation screening, ECG is the primary modality of screening. Sixty-four percent of the programs screen only incoming freshmen. Of non-screening institutions, American Heart Association (AHA) guidelines against NICS and cost were the most commonly cited reasons for not screening. Overall, 96% of participants felt pre-participation examinations at their school kept athletes safer. The majority of participants (54%) felt the quality of their pre-participation protocol was "the same" as those of their colleagues at other institutions, while 40% felt their exams were "better." **Conclusions:** Great variability exists, but there is a growing trend to "err on the side of caution" in incorporating NICS into high-level sports medicine programs that can afford the cost of screening and the evaluation of the false (and true) positives. Data indicating high sensitivity and specificity for ECGs in detecting hypertrophic cardiomyopathy may have played a key role in pushing sports medicine providers to further test athletes beyond the thorough history and physical examination recommended by the AHA.

Significance of Findings: A growing portion of high level sports medicine programs are incorporating NICS into their pre-participation examination policies.

Spinous Process Stress Injury as an Identifiable Cause of Back Pain in Adolescent Athletes

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Purpose: To identify the relative frequency of spinous process stress injury in adolescent athletes presenting with low back pain.

Methods and Study Design: Retrospective chart review of all patients age 13-18 years presenting to an outpatient suburban sports medicine practice from January 1, 2003, through October 21, 2008, with back pain. Age at time of diagnosis, initial diagnosis, duration of symptoms, final diagnosis, and sport of the athlete were entered into a database. The data was analyzed by standard statistical methods.

Results: Four hundred thirty-three adolescents presented with back pain. In this sample, 191 had a bony cause of back pain: 142/433 (32.8%) pars interarticularis stress fracture; 23/433 (5.31%) spinous process stress injury; 8/433 (1.85%) sacral stress fracture; 4/433 (0.92%) facet stress injury (0.92%); 4/433 (0.92%) vertebral body contusion; 3/433 (0.69%) vertebral body stress injury; 2/433 (0.46%) transverse process stress fracture; 2 (0.46%) pedicle stress fracture; 1/433 (0.23%) each acute vertebral fracture, spondylolisthesis, and sacral fracture (0.23%). Two hundred forty-two had non-bony causes of back pain (55.89%).

Conclusions: Spinous process stress injury is the second most common bone-related diagnosis in adolescent athletes presenting with low back pain.

Significance of Findings: With increasing reports of stress fractures, including stress fractures of the spine, little data exists regarding spinous process stress injury in adolescent athletes.

Incidence and Prevalence of Patellofemoral Pain in Middle School and High School Basketball Athletes

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Purpose: To determine if sex differences exist in the incidence and prevalence of patellofemoral pain (PFP) in female and male middle and high school aged basketball athletes. The tested hypothesis was that female athletes would have greater incidence and prevalence of PFP than male athletes.

Methods and Study Design: Two hundred forty female and 60 male middle and high school aged basketball athletes were evaluated by the same physician for PFP prior to the start of their basketball season. Subsequently, all athletes were re-evaluated for new PFP by the same physician at the conclusion of the basketball season. Athletic exposures (AE) and injuries were tracked on a weekly basis by a certified athletic trainer.

Results: The prevalence of PFP was 26% (95% CI, 20.3%–31.7%) in female athletes and 12% (95% CI, 3.0%–19.2%) in male athletes, which demonstrated a statistically significant difference ($P = 0.02$). During the season, the cumulative incidence (risk) of PFP in female athletes was 10% (95% CI, 5.4%–14.4%) compared to 4% (95% CI, 0%–8.7%) in male athletes ($P = 0.15$). Females had a PFP incidence density (rate) of 1.06 per 1000 AE's (95% CI, 0.55–1.57) and males had 0.33 per 1000 AE's (95% CI, 0–0.80). Females had 3.2 times greater rate of PFP than males.

Conclusions: The current study results supported the hypothesis that middle and high school-aged female basketball players have a higher prevalence of developing PFP during the season than male athletes. The prevalence of PFP is as high as 1 in 4 female athletes, and female athletes are 2 times more likely to demonstrate PFP symptoms than male athletes.

Significance of Findings: This is the first prospective study of prevalence and incidence of PFP in high school and middle school aged athletes.

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Marathon Training Injuries in Women Runners: Is Less More?

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Purpose: To evaluate the training patterns of female marathoners, their overall incidence of training injuries, and to identify potential high-risk training behaviors.

Methods and Study Design: In this cross-sectional survey study, a questionnaire was given to all marathon participants one week prior to the 2008 New Jersey marathon. Respondents were grouped according to gender, previous marathons, and total weekly mileage. Runners were asked to list training injuries and estimate the amount of training days missed.

Results: Of 1704 marathon finishers, 785 surveys were returned. Four hundred twenty-one respondents were female (53.4%). Two hundred twenty-seven women had no previous marathon experience (novice); the remainder had run at least one marathon (experienced). Of the novices, 178 ran less than or equal to 30 miles/week (78.4%) – "low mileage," and 49 ran greater than 30 miles/week – "high mileage." Among experienced marathoners, 109 (56.2%) ran less than or equal to 30 miles/week, while 84 ran greater than 30 miles/week. Women reported 221 injuries, the most common being shin splints, distal iliotibial band tendinopathy, and hamstring/groin strains. Others included: patellar and achilles tendinopathy, plantar fasciitis, proximal iliotibial band syndrome, patellofemoral pain, and lower extremity stress fractures. Forty-six point nine percent of experienced females had a training injury, compared to 57.3% of novice females (OR, 1.5; CI, 1.0 to 2.2, $P = 0.042$). Experienced high

mileage women were nearly twice as likely to sustain an injury compared to experienced low mileage women (OR, 1.9; CI, 1.1 to 3.4, $P = 0.024$). Novice females had an equal risk of injury independent of weekly mileage (OR, 1.0; CI, 0.5 to 1.9, $P = 0.90$). High mileage novice females who incorporated runs longer than 20 miles had a 40% higher likelihood of injury when compared to experienced women who ran similar distances (OR, 1.4; CI, 1.07 to 1.96, $P = 0.017$). **Conclusions:** Novice women had significantly more injuries than their experienced counterparts, so it is important to consider level of marathon experience when making training recommendations.

Significance of Findings: This is the most comprehensive injury training study to date in female marathoners. It provides evidence-based recommendations for safe marathon training mileage.

Acknowledgements: We would like to thank Rob Johnson, William Roberts, and Art Castellana for their invaluable advice and assistance with this project.

The Relationship between Purposeful Heading Exposure and Neuropsychological Test Performance in Collegiate Soccer Players

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Purpose: To examine the relationship between purposeful heading in soccer athletes and scores of neuropsychological test performance over the course of a collegiate playing career.

Methods and Study Design: A prospective, correlational design was used. Male (7) and female (5) Division I college soccer players were enrolled in the study. A baseline neuropsychological test using the ImPACT (ImPACT Applications, Inc, Pittsburgh, Pennsylvania) computerized battery was performed at the start of the freshman year. The ImPACT test measures multiple aspects of cognitive functioning including verbal memory (MCVER), visual memory (MCVIS), visual motor speed (VMSC), reaction time (RTC) and impulse control (ICC). The number of purposeful headers during all practices and games were counted during each competitive season. At the conclusion of each season, a repeat ImPACT test was performed. Data were analyzed using bivariate correlations to evaluate associations between the five ImPACT composite scores and the total number of headers accumulated during the playing career.

Results: Average number of purposeful headers was 488.1 ± 205.7 . No significant Pearson Product Moment Correlations were found between the total headers and any of the five ImPACT composite scores: MCVER = 0.395, MCVIS = 0.041, VMSC = 0.188, RTC = (-)0.413, ICC = (-)0.066.

Conclusions: Data presented here represent a collection effort involving five competitive soccer seasons, and this study is the first to include an accurate count of purposeful soccer headers during a collegiate career. It appears that neuropsychological function as measured by the five composite ImPACT scores is not significantly related to total heading exposure during a competitive soccer career. This finding counters previous speculation that exposure to soccer heading is detrimental to brain function.

Significance of Findings: Although some have argued for rule changes and restrictions with regard to soccer heading, the evidence presented here suggests that may be unwarranted. Soccer heading and changes in cognitive function continue to be monitored.

Practice and Match Volume Risks in USTA Junior Tennis Players

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Purpose: The purpose of this study was to investigate the relationship between medical withdrawals and practice volume, annual rest period, and sports specialization in United States Tennis Association (USTA) junior competitive tennis players.

Methods and Study Design: Prospective cross-sectional study. After institutional review board approval and informed consent, 540 USTA junior

tennis players completed a baseline survey, prior to their summer tournament season in 2008. We then monitored their progress throughout the 4-week period and attempted to validate reasons for medical withdrawals. We compared a cohort of tennis players who were unable to compete due to medical withdrawal with a cohort of players who were able to compete. Paired t-tests were used to compare these cohorts, and a regression analysis to determine association of potential risks of withdrawal.

Results: There were 519 (223 male, 257 female) surveys completed adequately to be analyzed (540 submitted). A total of 3366 match exposures were recorded during the summer season, including a total of 29 match withdrawals (incidence of 8.6 medical withdrawals/1000 match exposures). There was a normative distribution of practice hours/week with the median in the range of 20–25 hours/week. We found that 93.4% (478/512) of players compete at least 9 months/year. The average age to start playing tennis was 6.3 years. The majority (68.6%) of players compete only in tennis and specialize at an average age of 10.4 years. There was a significant relationship between players who specialize in only tennis and increased risk of medical withdrawal ($P = 0.047$). Additionally, players who reported having an injury or illness related to tennis in the past year were more likely to medically withdraw from a tournament this year (OR 5.4) ($P < 0.001$). There was no relationship of risk of medical withdrawal with annual rest periods, practice volume, or enjoyment in tennis.

Conclusions: Players specialize only in tennis beginning at a mean age of 10.4 years and were associated with a higher risk of medical withdrawal. Additionally, players who have suffered an injury or illness in the past year that prevented them from playing tennis for at least a week were >5 times more likely to suffer a medical withdrawal during their summer tournament season. **Significance of Findings:** Consider multiple sports at least past age of 10 years to mitigate risk of medical withdrawals in tournaments. Exercise caution in tournaments with prior history of injury. We cannot recommend any changes to weekly practice volume or annual rest periods based on our findings.

Acknowledgements: Andrea-Calvert Sanders, USTA Midwest Junior Competition Director; tennis pros and players at Score Tennis and Fitness Center, Countryside, IL.

The Effect of GO FAR, a 5K Training Program, on Elementary School Students' Activity Preferences

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Purpose: Sedentary behavior is epidemic in the United States, and studies have shown that childhood activity preference correlates with measured physical activity. This study was designed to determine if the GO FAR comprehensive 5K training and education program increased elementary-aged children's preferences for walking/running and decreased their preference of sedentary activity.

Methods and Study Design: A pre- and post-program survey was given to 4th and 5th grade students participating in the GO FAR program. Data were collected for enjoyment level of activities and preference of the same activities when compared to walking/running. The primary outcome measured was change in enjoyment level of walking/running and change in preference for walking/running compared to sedentary activities. Secondary outcomes included changes in level of enjoyment of sedentary and other physical activities and changes in preferences for walking/running compared to other physical activities.

Results: Baseline demographics for the 70 4th and 5th grade children that completed the study: 58.6% male, 75.7% white. Before intervention, 30.0% of them liked walking a lot and 84.1% of them liked running a lot, while 26.1% liked watching TV a lot. After GO FAR, there was no change in students' enjoyment of running/walking, but preferences for walking/running over sedentary activities increased including watching TV ($P = 0.005$), watching DVDs/Videos ($P = 0.021$), and talking on the phone ($P = 0.021$). There was also less enjoyment of playing video games ($P = 0.019$) and using the computer ($P = 0.029$).

Conclusions: Data from this study suggest that GO FAR may decrease elementary-aged students' preference for and enjoyment level of sedentary

activities. Limitations included a small sample study with a high level of baseline enjoyment for walking/running.

Significance of Findings: The GO FAR 5K training program may decrease elementary students' preference for and enjoyment level of sedentary activities, which may lead to increased rates of physical activity and lower rates of obesity in children.

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Validation of the Average Torque Angle Measured by the Velotron Cycle Ergometer

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Purpose: To validate the average torque angle (ATA) measured during maximal effort cycling by the Velotron ergometer.

Methods and Study Design: Six male, collegiate club cyclists aged 18–30 years who had been training without interruption for at least the past 2 months participated in the study. Familiarization to the protocol, including proper fit to the Velotron Elite cycle ergometer (RacerMate) and a practice Wingate test, were performed on days –7 to –4. On days 1 to 4, four 30-second Wingate tests were performed in random order using fixed and independent cranks (PowerCrank) on level and inclined surfaces. Velotron ATA were recorded at 30 Hz using Velotron Coaching v1.6 software. Criterion ATA were determined from pedal forces (Newmiller, 1988) and axis kinematics (tracked using 12 Eagle cameras) in the sagittal plane recorded at 200 Hz using Cortex v1.0 (Motion Analysis Corporation). Data were synchronized and analyzed in Matlab v2008b (Mathworks). For each cyclist and condition the ATA between Velotron and Criterion measurements were analyzed using levels of agreement (LOA; Bland and Altman, 1984).

Results: The average right ATA was $104 \pm 10^\circ$ for the Velotron and $100 \pm 5^\circ$ for the Criterion. These differences were similar for all four conditions, with the best and smallest LOA for the left fixed crank arm, level condition being -13° to 16° (95% confidence level).

Conclusions: The Velotron does not measure torque directly from each crank, but instead makes estimates based on measurements at the flywheel in conjunction with estimated crank position to calculate ATA. When comparing to Criterion ATA determined from direct pedal force and crank position measurements, the Velotron ATA results do not agree. The ATA provided by the Velotron Cycling Ergometer is invalid according to our criterion and direct measure during maximal effort cycling.

Significance of Findings: The ATA provided by the Velotron Cycling Ergometer should be viewed with caution when using ATA to assess performance during maximal effort cycling.

Acknowledgements: The independent crank arms used in this study were provided by PowerCranks.

The Effects of Lower Extremity Flexibility on Performance and Injury Rates in College Runners

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Purpose: (a) To determine how flexibility impacts incidence and severity of injury in college cross country and track runners. (b) To assess the relationship between flexibility and performance.

Methods and Study Design: A prospective, observational cohort analysis of data. After giving informed consent, subjects filled out a brief questionnaire to assess previous lower extremity (LE) injuries and stretching and training habits. Six bilateral goniometric measurements were obtained and the means of the measures were used to assess LE flexibility prior to the season. Performance was assessed as each athlete's best performance time during the

season following the flexibility measurements. Injuries were counted as one missed day from normal participation in practice or competition. Means 6 standard deviation and ANOVA were used for statistical analysis. Subjects were broken into a low flexibility group or a high flexibility group based on comparisons to standardized data in previous research.

Results: Seventy-five collegiate runners (34 men and 41 women) participated in the study between 2 universities. There were a total of 58 injuries amongst 36 athletes throughout the cross country and track seasons that caused the athletes to miss a mean of 10.6 days of participation per injury and 8.2 days of participation per athlete per season. Sprinters in the Inflexible Group (IS) missed an average of 8.8 days per season due to injury, whereas Flexible Sprinters (FS) only missed 1.6 days per season ($P = 0.022$). Mid-distance flexible athletes saw a similar decrease in days missed due to injury, 14.3 days missed for Inflexible Mid-Distance (IM) and 6.7 days missed for Flexible Mid-Distance (FM) runners, but with no statistical difference ($P = 0.308$). Long-Distance Inflexible (IL) runners saw fewer days missed than their more flexible counterparts (FL) (3.8 days vs 9.0 days), but without statistical differences ($P = 0.147$). Comparisons of subjects based on performance and flexibility revealed no significant relationships.

Conclusions: There appears to be significantly more days missed related to injury in inflexible sprinters and similar non-statistical trends in middle distance runners. Meanwhile, there is no statistical difference in days missed related to injury in distance runners. There does not appear to be a relationship between flexibility and performance in our study population.

Significance of Findings: Flexibility appears to be protective of injury for sprinters, but not for distance runners. There does not appear to be a clear relationship of flexibility to performance, but further study needs to be done.

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Electrolytes Supplementation and Cycling Performance: A Randomized Double Blind Trial

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Purpose: The aim of this study was to evaluate Enlyten's (an electrolyte supplementation product) effect on cycling performance. Typically electrolytes are supplemented orally and are absorbed through the gastrointestinal tract, however transit time and intestinal absorption can be altered during exercise. Enlyten is a dissolvable strip that delivers sodium and potassium via buccal absorption. We hypothesized that this may enhance absorption and thus performance during cycling.

Methods and Study Design: This was a randomized double blind study of 20 recreational cyclists (16 male), average age 35.5 years (SD, 11.5). Participants completed 2 1-hour time trials at maximum effort 1 week apart. During the trial, the subjects were either given electrolyte strips or placebo strips at 15-minute intervals. Pre-ride meals and water consumed during exercise were kept constant. Data collected include speed, distance traveled, average and max watts, and cadence. Additionally, blood samples were collected every 15 minutes, and sodium, potassium, chloride, hemoglobin, hematocrit and lactate were measured with an I-stat device.

Results: Using a 2-tailed paired student's t-test we compared performance results for the trials. There were no significant differences found in any of the cycling data collected. Distance E(Enlyten), 19.23, P(Placebo) 19.12 ($P = 0.56$). Watts E 205.5, P 202.8 ($P = 0.52$) percent change in plasma volume E -2.49 , P -4.38 ($P = 0.66$) We also compared the group differences in the blood parameters over the times tested using a repeated measures MANOVA with 2 repeated factors (condition and time). Significant differences were followed with a Tukeys analysis. There were no statistically significant differences in measured electrolyte, hemoglobin, or hematocrit levels.

Conclusions: The buccal supplementation of electrolytes during a one-hour time trial did not significantly improve performance.

Significance of Findings: Electrolyte supplementation by buccal absorption may be a more efficient method of absorption, but at the tested amounts it did not positively affect cycling performance.

Acknowledgements: Healthsport Inc. for providing grant funding for this study.

The Effects of Static Stretching on Injury Prevention in Young Soccer Athletes

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Purpose: To determine if there is any benefit to static stretching in the prevention of injury in young soccer athletes.

Methods and Study Design: Prospective randomized study. Prior to the onset of the 2007 fall season, 6 boys', soccer teams of different age and skill levels were randomized into 2 stretching protocols to be performed prior to the onset of all practices and games. Three teams (one high school varsity, one under 13 travel, and one under 11 travel) performed dynamic stretching plus static stretching exercises (D/S), and three teams (one high school junior varsity, one under 13 travel, and one under 10 travel) performed only dynamic stretching exercises (D). Both groups were instructed on the proper performance of the stretching exercises prior to the first practice of their seasons and completed the exercises before every practice and game. New lower extremity injuries encountered due to soccer participation were reported weekly by trainers and coaches and recorded.

Results: Eight-seven athletes completed the study. A significant association was found between D/S stretching and the occurrence of injuries (P value = 0.0289). Athletes in the D/S stretching group were 0.87 times as likely to encounter no injuries compared to those in the D stretching group (95% confidence interval for odds ratio = 0.782-0.9732).

Conclusions: D stretching alone prior to exercise is more effective than D/S stretching in the prevention of lower extremity injuries in young male soccer athletes. Young soccer athletes may not need to engage in static stretching prior to the onset of their practices and games.

Significance of Findings: This is the first study to analyze the effects of static stretching on injury prevention in young soccer athletes. Soccer coaches should be aware of the possible harmful effects that may occur with static stretching.

Acknowledgements: Mamtha Balsubramaniam, MS, statistical analysis.

Health-Related Quality of Life in Young Female Athletes One Year after Knee Injury

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Purpose: Describe the long-term (one year) changes in health-related quality of life (HRQOL) in young female athletes with knee injuries.

Methods and Study Design: Prospective cohort study of a convenience sample of 127 high school and college female athletes (age = 17.3 ± 1.3 years) in a sports medicine clinic and university student health service who sustained a knee injury while participating in a sport or fitness activity. Injuries included anterior cruciate ligament tears (ACL; $n = 51$), anterior knee pain (AKP; $n = 48$), patellar instability (PAT; $n = 20$) and meniscal tears (MT; $n = 8$). Subjects completed the SF12 v2.0 5 times (pre-injury, at diagnosis, and 3, 6 and 12 months after injury). Outcomes of interest included the paired differences in the SF12 subscales (physical function, role physical, bodily pain, general health, vitality, social function, role emotional, and mental health) and the Physical Composite Scores (PCS) and Mental Composite Scores (MCS) from pre-injury to 12 months post-injury for subjects in each injury category. Paired differences were assessed with the Wilcoxon Signed-

Rank Test ($P \leq 0.05$) reported as the median (interquartile ranges [IQR]: 25th and 75th).

Results: Subjects with ACL injuries had significantly lower median PCS scores 12 months post-injury (56.1 [37.4, 62.3]) compared to pre-injury (57.4 [42.6, 62.1]; $P = 0.048$). There were no significant differences in PCS scores at 12 months post-injury for subjects with the other 3 types of knee injuries (AKP, PAT, MT). No differences were found in the median subscale scores or median MCS one year after injury for any of the groups.

Conclusions: One measure of HRQOL was lower in young female athletes with ACL tears one year following injury. HRQOL measures did not change significantly for athletes with other knee injuries.

Significance of Findings: Understanding HRQOL after knee injury will enable sports medicine professionals to better affect health outcomes of their young female athletes, especially those with more serious knee injuries.

Back Pain in Collegiate Rowers

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Purpose: Back pain is the most common complaint amongst rowers. The objective of this study was to evaluate how back pain affects rowers.

Methods and Study Design: Cohort study. Participants were recruited from an NCAA Division I rowing team. A baseline questionnaire was administered and participants were followed for one season. Athletes who presented with back pain were evaluated by the principal investigator, completed an injury questionnaire and received a standard treatment protocol.

Results: One hundred and eight subjects participated, including 63 experienced and 45 novice rowers. Sixty-two point nine percent of experienced rowers had a history of back pain, 86.8% rowing-related. Of experienced rowers with a history of back pain, 63.1% continue to have pain. Forty-four point one percent were limited from rowing activities due to back pain, and 57.1% of those missed at least 3 weeks of training. At baseline, 68.3% previously sought medical attention for back pain, including chiropractor (57.1%), physical therapist (46.7%), certified athletic trainer (42.8%), and physician (35.7%). The majority of rowers performed core strengthening 2-3 times per week. At baseline, experienced rowers with a history of back pain performed significantly more core strengthening than teammates without such history (P -value 0.020).

Conclusions: Back pain is common among collegiate rowers and leads to missed practice/competition, often with continued symptoms. Athletes seek care from multiple providers. Core strengthening is part of rowing training, but rowers with back pain perform significantly more of these exercises.

Significance of Findings: This study emphasizes the frequency of back pain in rowers, the loss of practice/competition time due to back pain, the continued pain that rowers suffer, and the potential role of core strengthening. Future studies may include whether back pain experienced during collegiate rowing increases the likelihood of back pain beyond college, a quantitative evaluation of core strength and risk of developing back pain, and creating a core strengthening program to prevent back pain in rowers.

Model of Characteristic Heat-loss Patterns in the Pterygoid Plexus Region of National Football League Players as Measured by Infrared Thermography

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Purpose: Model thermoregulation in National Football League (NFL) players in the pterygoid plexus using quantitative infrared thermography.

Methods and Study Design: Over 16 NFL games the region of the pterygoid plexus in 53 players was imaged during in-game recovery periods using a Flir ThermaCam EX320, capturing 2101 images. For each series, the average temperature of the region in the first image was used as the threshold against which temperature distributions in all later images in the series were

compared. These changes were quantified as the percentage of pixels with associated temperatures above initial threshold. Mixed regression analysis was performed to model the trajectories of these changes, yielding an estimate of the quadratic time trend ($\text{temp} - \text{time} + \text{time}^2$). Thus, the function models the characteristic change in the percentage of pixels above threshold as vasculature in the pterygoid region responds to thermoregulatory demands.

Results: Players demonstrated a significant increase in blood flow to the face consistent with a compensatory heat loss through the pterygoid plexus. Mixed regression analysis of the population yielded a quadratic time trend function with intercept at 49.36712 ($P < .0001$), time parameter 0.21795 ($P < .0001$), and time^2 parameter -0.00028 ($P < .0001$). The function estimates a maximum value of 91.78 percent of pixels above threshold, occurring at 389 seconds post-exertion.

Conclusions: Quantitative analysis of infrared thermography of the pterygoid plexus region in NFL players yielded a statistically significant quadratic model of temperature changes over time. Based on the derived function, maximum heat exchange is expected at approximately 6.5 minutes post-exertion.

Significance of Findings: This statistically significant model of temperature changes in the pterygoid plexus region after exertion represents an important step in characterizing the physiological processes underlying normal thermoregulatory responses to the accumulation of internal heat. Improved models of thermoregulatory responses, both normal and pathological, will further delineate the physiological processes involved in heat stress and enhance the ability for early detection and treatment.

Acknowledgements: Dr. John York, National Football League Office, San Francisco Forty-Niners players, coaches, and staff, Alex Sox-Harris.

Thoracoabdominal Trauma in the National Football League: A Twenty-Eight Year Review

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Purpose: To describe the nature and frequency of thoracoabdominal injuries in the National Football League (NFL) over 28 years in order to determine their incidence.

Methods and Study Design: Utilizing the NFL Injury Surveillance System, a search for all traumatic injuries involving the thorax and abdomen from 1980–2007 was performed.

Results: A total of 1048 traumatic thoracoabdominal injuries were reported. Traumatic chest injuries are far more common (89.5% of total), although traumatic abdominal injuries have a higher average days lost/injury (20.2 days). The most common traumatic chest injury was rib contusion ($N = 389$, 41.5% of chest injuries). The most common traumatic abdominal injury was kidney contusion ($N = 59$, 53.6% of abdominal injuries). By position, the highest incidence of thoracic trauma occurred in running backs ($N = 164$, 17.5% of chest injuries) and wide receivers ($N = 151$, 16.1%); the highest incidence of abdominal trauma occurred in wide receivers ($N = 20$, 18.2% of abdominal injuries) and defensive backs ($N = 18$, 16.4%). The reported incidence of serious thoracic injury (defined as hemothorax, pneumothorax, pulmonary contusion, and myocardial contusion) is relatively low ($N = 25$, 2% of all chest injuries). Solid organ injury (kidney contusion/laceration, liver contusion/laceration, pancreatic injury, spleen laceration/rupture) was rare, but represented 71.8% ($N = 79$) of all abdominal injuries and resulted in significant days lost (mean, 78.7 days; SD, 33.4).

Conclusions: The incidence of traumatic thoracoabdominal injuries in the NFL is relatively low despite the high impact nature of the sport.

Significance of Findings: Despite the significant morbidity of these injuries, the potential for misdiagnosis remains high in sports, especially during game situations where medical providers may not have access to imaging technologies that normally play a central role in characterizing trauma severity. Further study is indicated to characterize the nature of impacts on field and initial presentations that are associated with these injuries to assist the event and emergency physician with appropriate diagnosis and management.

Acknowledgements: Dr. John York, National Football League Office, San Francisco Forty-Niners players, coaches, and staff.

Assessment of Physiological Parameters in Female Athletes with Menstrual Dysfunction Receiving a Nutritional Intervention: A Prospective Analysis.

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Purpose: To assess the effects of a nutritional and behavioral intervention on physiological parameters including resting metabolic rate (RMR), body composition, energy availability, and hormonal laboratory studies in collegiate athletes with functional hypothalamic amenorrhea (FHA) and oligomenorrhea (OA) at baseline and over a 6-month intervention.

Methods and Study Design: Twenty-four athletes from UCLA ages 18–24 years with FHA or OA have been identified. These athletes were referred to the dietitian and physician for assessment and implementation of an intervention aimed toward increasing energy availability. At baseline, 2 months, and 6 months, a dietary assessment, body composition and RMR were obtained. Hormonal laboratory tests were assessed at baseline and 6 months.

Results: Preliminary data of 4 of the 24 subjects reveals that the RMR in athletes with FHA and OA increased after 2 months of intervention. Using paired t-test analysis, the RMR increased by an average of 508 (with a standard deviation of 266.34). This is a significant increase with a P -value of 0.03.

Conclusions: After 2 months of a nutritional and behavioral intervention, a significant increase in the RMR of athletes with FHA and OA was observed.

Significance of Findings: Studies have demonstrated that female athletes with a low RMR have decreased energy availability. Low energy availability may impair reproductive and skeletal health. This study proposes to demonstrate physiologic changes that occur with increasing energy availability that may signify improving health in the athlete with FHA or OA. It is hypothesized that the measured RMR may be an objective marker of whether the nutritional intervention is helping restore a healthier physiologic state for the athlete. This study will serve as a preliminary study to assess if changes are found prospectively over time in athletes with FHA and OA. Based on the results of this study, future studies including eumenorrheic athlete and non-athlete controls will be planned.

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Prevalence of *Staphylococcus Aureus* Nasal Colonization and Incidence of Bacterial Skin Infections in High School Football Players in Northeastern Ohio

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Purpose: Determine the prevalence of both methicillin susceptible *Staphylococcus Aureus* (MSSA) and methicillin resistant *Staphylococcus Aureus* (MRSA) nasal colonization and the incidence of skin and soft tissue infections in high school football players over one season.

Methods and Study Design: Six high school football teams in Northeastern Ohio were recruited for this prospective observational study. Players or parents were asked to consent to participation in the study. Participation in the study included: 1) Completion of a two page questionnaire collecting information on demographics, risk factors for MRSA infection, and medical history by each player. 2) Nasal swab to identify colonization with *Staphylococcus Aureus*. 3) Consent for investigators to collect information regarding infections, if any, during the season. Further, athletic trainers (ATC) with each team collected information about infections in players not participating.

Results: One hundred ninety-two of 382 total players on the varsity and junior varsity of the 6 teams participated in the study. The other 190 players were monitored for infection by the ATC's. There were 11 cases of impetigo (2.8%

of players). There was not a MRSA infection documented among the 382 players. Forty-four participants had culture-positive nasal swabs for MSSA (22.9% of those swabbed). None were positive for MRSA.

Conclusions: We expected to have rates of colonization approximating those previously published (30% MSSA, 1%–3% MRSA). Our rates were lower in both cases. Based on past experience, we expected to have at least 10 MRSA infections, but had none. It is difficult to draw conclusions about the low level of infections, but anecdotal reports from the ATCs participating suggest the athletes are more aware of infection and take greater precautions than in the past.

Significance of Findings: To our knowledge this is the first prospective study designed to evaluate MRSA colonization and infection of high school athletes. While we were unable to assess risk factors for MRSA infection in athletes, we were able to document an absence of MRSA infection and nasal colonization and a rate of bacterial skin infection in HS football players of 2.8%.

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Emergency Department Visits for Concussion in Young Child Athletes

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Purpose: There is a paucity of data on sport-related concussion (SRC) in young athletes under the age of 14 years. Experts have stressed the need for research in this age group because the long-term sequelae are unknown. Our objective is to characterize SRC emergency department (ED) visits in athletes aged 8–13 years.

Methods and Study Design: A stratified probability sample of United States (US) hospitals providing emergency services in the National Electronic Injury Surveillance System (1997–2007) and All Injury Program (2001–2005) was used. Concussion-related ED visits were analyzed for patients aged 12–13 years. Population data were obtained from US Census Bureau; sport participation data were obtained from National Sporting Goods Association.

Results: From 2001–2005, children aged 8–13 years were diagnosed with approximately 175 736 (CI \pm 95%, 127 692–223 781) total concussions. Approximately 58% [102 155 (71 622–132 687)] of these were SRC with about one-quarter of SRC [25 376 (17 486–33 265)] occurring during organized team sport. The rate (per total number of US children aged 8–13 years) was \approx 4 per 1000 and 1 per 1000, respectively. The most organized SRC was seen in the game of football [9351 (6444–12 259)], followed by basketball, baseball, soccer, and hockey. However, the concussion rate in hockey appears to be much higher; looking at similar concussion and sport participation data in children aged 7–11 years, the rate of concussion in hockey was highest of the 5 sports at \approx 1 per 1000 participating children, with football at \approx 1 in 1250. From 1997–2007, although participation has declined, diagnosis of organized team SRC in children aged 8–13 years has increased by 97%.

Conclusions: SRC rates in younger children are significant and appear to be highest in hockey and football. The number of organized team SRC in younger children is on the rise, even as participation in these sports is declining.

Significance of Findings: Further research on SRC, prevention, and treatment in younger children is warranted.

Silverman Triathlon: Injuries from 2005 to 2008

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Purpose: The goals of this study are to present injury data for the 2005 to 2008 Silverman Triathlon. Injury rates will be shown by gender and age. In

addition, the different types of injuries will be illustrated. Finally, a comparison to other full and half distance Ironman triathlons will be made.

Methods and Study Design: All of the medical records for the 2005 through 2008 Silverman Triathlon were obtained. The athletes who participated in the full and half distance triathlon were included for a total of 1555 athletes. Three athletes were excluded due to lack of age and gender data. For each year, the injury data was tabulated by injury type, age, and gender.

Results: Results are given by years. Overall injury rates were 16.4%, 10.4%, 5.2%, and 7.9%; average injury rate was 10%. For males, injury rates were 16.2%, 9.3%, 5.5%, and 6.4%, respectively. For females, injury rates were as follows: 16.7%, 15.4%, 4.3%, and 12.3%. The full distance triathlon injury rates were 16.4%, 10.4%, 10.3%, and 11.7%; the half distance triathlon injury rates were 2.3% and 5.7%. Injury rates by age are illustrated in Table 1.

TABLE 1. Injury Rates By Age

Age	Injury %
18 to 24	11.86
25 to 29	4.79
30 to 34	6.90
35 to 39	4.84
40 to 44	7.80
45 to 49	6.94
50 to 54	4.60
Over 55	7.41

Conclusions: Comparing injury rates of the Silverman to other Ironman events, this event has fewer injuries (full: 12.2% vs 17%; half: 4.0% vs 10%). Females have an increased injury risk over males (12.18% vs 9.38%). Finally, unlike prior studies, there is no correlation of injuries with age. The types of injuries were comparable to prior studies, with the exception of hyponatremia which was not assessed for at these events. Percentage of injury type for the years 2005 to 2008 are illustrated in Table 2.

TABLE 2. Injury Type By Year

Injury Types	Year, %			
	2005	2006	2007	2008
n/v, dizziness, exhaustion	69.2	48.3	72.4	38.6
Hypothermia	3.9	37.9	10.4	18.2
Orthopedic	19.2	3.5	13.8	29.5
Respiratory	7.7	9	3.4	11.4
Ocular	0	6.9	0	2.3
Cardiac	0	3.4	0	0

Significance of Findings: This study provides injury data for an elite level triathlon event; medical providers involved with the care of triathlon athletes will benefit from this study.

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NSAID Use in a High Altitude Endurance Mountain Bike Race

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Purpose: To estimate the frequency of NSAID use and effects of training practices among participants in a high altitude endurance mountain bike race. The Leadville Trail 100 Mountain Bike Race is a 100 mile endurance

race in Leadville, Colorado. The course ranges in altitude from 9200 ft to 12 600 ft.

Methods and Study Design: We distributed an anonymous, self-administered survey to all competitors the day before the race. Major variables included information regarding NSAID or other medication use, altitude which cyclists lived and trained at, training habits, prior race completion, goal finishing time, age, and gender. We also collected data on injuries associated with the race.

Results: Out of 890 competitors, 634 responded (71%) to the survey. Average age was 41.8 years. Most participants (89%) were male. Only 83 racers (13%) reported taking pain medications/supplements prior to the race. Ibuprofen was the most commonly used medication ($n = 66$, 10%). Of the 41 racers (5%) who were treated for injuries, four had major injuries requiring ER referral. The majority of racers ($n = 652$, 73.3%) finished the race under the cut-off time of 12 hours. Secondary variables found to positively correlate with finishing included: residing at altitude >3000 ft ($P < 0.001$), training at altitude >3000 ft ($P = 0.001$), prior completion of the race ($P = 0.002$), male gender ($P = 0.002$), and increased training days/week ($P = 0.004$). Neither age nor NSAID use correlated with finishing the race or injuries.

Conclusions: In this high altitude event, the reported use of NSAIDs was low. Male gender, prior race completion, residing and training at high altitude, and number of days trained per week correlated with finishing the race.

Significance of Findings: Our data provides insight into factors which correlate with successfully finishing a high altitude endurance mountain bike race. The reported use of NSAIDs and rate of major injuries among competitors at this prominent high altitude mountain bike race is low.

Body Mass Index as a Predictor of Overweight and Obesity in High School Football Linemen

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Purpose: To compare body mass index (BMI) to body fat percentage (%fat) in high school football linemen and determine the accuracy of BMI in identifying overweight and obesity in this athlete population.

Methods and Study Design: This is an observational study. Eighty male varsity high school football players participated. Pre-season height and weight were measured and BMI calculated for each participant. %fat was measured by bio-impedance assay (Omron Body Fat Analyzer). Using BMI 24.9 (85th percentile for age, 17 males) and 17% fat as the cutoffs for overweight and BMI 28.2 (95th percentile for age, 17 males) and 22% fat as the cutoffs for obesity, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) of BMI in predicting overweight and obesity were calculated. Prevalence of overweight and obesity were also calculated using BMI and % fat cutoffs and compared.

Results: Sensitivity and NPV were 100%. Specificity (19.57% for overweight and 48.48% for obesity) and PPV (47.89% for overweight and 29.17% for obesity) were low. Using BMI, the prevalence of obesity was 60% compared to 17.5% using %fat. Based on the study population, more appropriate BMI cutoffs were 28.6 for overweight and 32.0 for obesity.

Conclusions: BMI, at current cutoffs, is not an accurate predictor of overweight or obesity in high school football linemen. New BMI cutoffs for overweight and obesity should be considered for this athlete population.

Significance of Findings: These findings are significant because they are the first to compare BMI to %fat to determine overweight and obesity in this population. They show that the prevalence of overweight and obesity in this population may be lower than previously believed. Finally, they recommend new BMI cutoffs for overweight and obesity in high school football linemen.

The Effects of Graft Type on Early Functional Recovery of ACL Reconstruction Patients Following a Specific Neuromuscular/Agility Program: A Retrospective Study

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Purpose: To determine if a specific ACL graft type produces superior functional test results following a 5-week advanced, sports-based rehabilitation program focusing on strength and neuromuscular training.

Methods and Study Design: Eighty patients who underwent ACL reconstructive surgery were included in this retrospective study. All patients had their reconstructive surgery done by one of two orthopaedic surgeons, with either hamstrings autograft (18 knees), patella tendon autograft (39 knees) or patella tendon allograft (23 knees). Each patient was enrolled in our Next Step Program, which consisted of neuromuscular re-education classes held twice per week for five weeks. During this program, three one-legged hop tests, a single-legged hop for distance, a single-legged triple hop for distance and a single-legged triple crossover hop for distance, were used to assess lower limb functionality. These hop tests were performed on both the surgical leg and non-surgical leg at the onset of the Next Step Program (3–4 months post-operatively) and at the completion of the Next Step Program.

Results: All three graft types showed significant improvement in mean functional test scores (distance in cm) from pre- to post-Next Step Program. There were no significant differences in mean functional test scores found between graft types at either Pre-Next Step Program or Post-Next Step Program ($P > .05$). Although Patella Tendon Allograft patients showed the greatest mean improvement in functional test scores for all three hop tests, there was not a significant difference in overall improvement between the three graft types ($P > .05$).

Conclusions: Completion of a neuromuscular training program following ACL reconstruction leads to significant improvement in overall mean functional test scores. There is no statistical evidence that one graft type is superior in terms of functional improvement following a post-ACL reconstruction neuromuscular rehabilitation program.

Significance of Findings: All three graft types produce statistically similar results in terms of post-surgical functional test improvement.

Body Morphology Changes in Division I Collegiate Football Players

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Purpose: There is a lack of literature documenting the body morphology changes that occur in collegiate athletes. The intention of this study is to illuminate the changes that occur with respect to body weight, body fat percentage, and lean muscle mass during the athletes' matriculation.

Methods and Study Design: This is a retrospective study reviewing the mean total body weights, mean fat body weights, and mean lean body weights of Division I collegiate football players. The data were collected from January 2006 through April 2008 on 27 players. The machine that measured body composition used air displacement plethysmography. A two-tailed paired Student's t-test was used to analyze the change in means between the players' weights in January 2006 and April 2008.

Results: Total body weight increased from 228.7 pounds (lbs) to 233 (SD, 44.2) lbs, but was not statistically significant with a P -value of 0.055. Lean body weight increased from 188.8 lbs to 192.2 (SD, 20.4) lbs with a P -value of 0.01. Total fat weight decreased from 44.5 lbs to 36.5 (SD, 26.8) lbs with a P -value of 0.0002. The corresponding body fat percentage decreased from 17.8% to 15.1% (SD, 7.8) with a P -value of 0.0001.

Conclusions: These data show the total body weight did not change with statistical significance over the two and one-half year period, but lean body weight and fat body weight changed in favorable ways for a collegiate football player.

Significance of Findings: These results are significant because they can help assess the adequacy of strength and conditioning and formal nutritional regimens. Their role is to help improve athletic performance. One can easily imagine performance and results to strongly correlate with favorable sport-specific body composition.

Comparison of Baseline ImPACT Scores in Athletes Over Successive Years

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Purpose: To determine if there is a practice effect in taking baseline Immediate Postconcussion Assessment and Cognitive Testing (ImPACT) tests over successive years in collegiate athletes.

Methods and Study Design: This is a retrospective review study analyzing composite ImPACT scores in Division I college athletes. The inclusion criteria is athletes with no concussions during their collegiate career who have three years of baseline ImPACT tests performed at least eight months apart ($n = 93$). A subgroup of athletes having four years of data ($n = 32$) is also examined. Both groups are subdivided into athletes who have no previous concussions (67 of 93; 26 of 32) and those who have had a concussion prior to beginning college (26 of 93; 6 of 32). Four composite scores are investigated: verbal memory, visual memory, motor processing speed, and reaction time.

Results: An ANOVA calculation reveals no statistical significance over three successive years in verbal memory ($P = 0.44$), processing speed ($P = 0.44$), or reaction time ($P = 0.49$), with no difference in previously concussed or never concussed athletes. However, visual memory demonstrates statistical significance ($P = 0.0097$), with the never concussed athletes also yielding significant difference ($P = 0.018$). The previously concussed athletes exhibit no significant difference ($P = 0.45$). Analysis of data over four successive years, however, displays no statistical significance in any composite scores (verbal memory ($P = 0.8$), visual memory ($P = 0.22$), processing speed ($P = 1$), and reaction time ($P = 0.83$)), even within the concussion subdivisions.

Conclusions: There appears to be no practice effect in baseline ImPACT scores followed over successive years in collegiate athletes.

Significance of Findings: Current studies utilize a practice effect coefficient when analyzing results within an athletic season. This study demonstrates that this is unnecessary in baseline tests over years and proves the need for further studies to investigate the idea of a practice effect, especially if sports medicine physicians are to continue to use ImPACT testing as a tool in the care of concussed athletes.

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Association of Waist Circumference and Body Mass Index with Blood Pressure in Collegiate Athletes

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Purpose: Elevated blood pressure (BP) is one of the most common abnormalities detected during the preparticipation evaluation (PPE). In the general population, body mass index (BMI) is associated with elevated BP. More recently, waist circumference (WC) has become recognized as an independent risk factor for elevated BP and additional co-morbidities. However, there is little data available regarding the effects of BMI and WC on BP in young competitive athletes. Therefore, the purpose of this study was to determine if a relationship exists between BP, WC and BMI in this population.

Methods and Study Design: Cross-sectional survey of NCAA student-athletes at a single university. During the annual PPE, BP's were measured by designated physicians and nurses. Height and weight were recorded. BMI was calculated. WC was measured. If WC was not measured within one month of PPE, then BP and weight were rechecked and BMI was updated. BP was classified as elevated (systolic BP > 140 mmHg or diastolic BP > 90 mmHg), pre-hypertensive (SBP 120–139 or DBP 80–89) or normal (SBP < 120 and DBP < 80).

Results: Preliminary univariate analysis of 77 subjects (35 women, 42 men) found that BMI was associated with systolic BP ($P = .036$) but not diastolic BP ($P = .150$), while WC was associated with both systolic BP and diastolic BP ($P = .002$ and $p = .008$, respectively). Multivariate regression revealed

that WC was associated with systolic and diastolic BP ($P = .023$ and $.026$, respectively). BMI was not associated with BP in multivariate models.

Conclusions: Both BMI and WC appear to be associated with BP in young competitive athletes. In this population, however, WC may be a more significant factor associated with BP.

Significance of Findings: If the role for WC in BP is substantiated in this population, recording of WC during the PPE may prove to be valuable in identifying athletes at risk for hypertension and other co-morbidities.

Pilot Study: CA-MRSA Survival on Artificial Turf Substrates

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Purpose: Infections with CA-MRSA are an emerging problem for athletic teams. Artificial turf has been suggested as a risk factor. This is a prospective pilot study looking at viability of CA-MRSA on artificial turf.

Methods and Study Design: Beakers containing Pro Grass (Pittsburgh, Pennsylvania) turf were inoculated with $\sim 5 \times 10^7$ MRSA (USA-300-0114) grown as planktonic cells or biofilms with or without nutrient carry-over from the cultures and incubated at 37°C. Surviving CFU were determined by plating on mannitol salt agar. To determine if MRSA could survive under environmental conditions 1 ft² pieces of artificial turf were swabbed with MRSA (USA-300-0114; CDC 16705) resuspended in sterile water. Samples were incubated in open (low humidity) or closed containers with water (high humidity) placed in secure areas with similar environmental conditions as actual fields during summer months in Pennsylvania. To determine survival, agar plates were pressed on the surface of the turf and incubated.

Results: In turf beakers, MRSA survived for >20 days. Survival was biphasic with a CFU drop from $\sim 5 \times 10^7$ to $\sim 5 \times 10^5$ the first week followed by survival between 10^4 and 10^3 bacteria until completion (20–60 days). Survival was dependent on nutrients, and washed cells survived less than 1 day. Biofilm formation did not influence survival. Similar to laboratory results, MRSA without nutrients exposed to environmental conditions did not survive past 3–4 days. High humidity only slightly increased survival.

Conclusions: MRSA can survive in significant numbers on artificial turf for 1 week and lower numbers for at least 1 month if provided with some residual nutrients. Ongoing experiments include determining whether keratinocytes or mucus can provide the necessary nutrients for survival and what environment conditions increase survival.

Significance of Findings: These findings suggest MRSA can survive on turf in high numbers, suggesting further laboratory and epidemiologic studies are needed to determine if artificial turf exposure increases the risk of MRSA infection.

Marathon Training and Injury in Novice Runners

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Purpose: To identify incidence and correlation of training injuries in novice marathon runners.

Methods and Study Design: A survey was sent to participants of the 2008 Jersey Shore Marathon one week prior to the race regarding training patterns and injury. The responses were collected via an Internet service (Survey-

monkey.com) and compiled into a spreadsheet from which the data were modeled using a logistical regression analysis.

Results: Of 1704 participants, 783 surveys were received. In total, 392 runners noted injuries, and a total of 596 injuries were reported. The two most common injuries were iliotibial band tendinitis (20.6%) and shin splints (15.6%). Of those surveys received, 350 responders had no previous marathon experience. Those runners had a 55.1% (193/350) incidence of injury during training, compared to a 46% (199/433) incidence in runners who had run at least one marathon. A 9% reduction in the odds of injury was seen for each successive marathon run (OR = 0.91; 95% CI, 0.87 to 0.95, $P < 0.0001$). The most experienced runners (4+ marathons) were less than half as likely to be injured during training compared with novice runners (OR = 0.47; 95% CI, 0.32 to 0.69, $P < 0.0001$). Amongst novice runners, an increased incidence of injury was seen with increased duration of training. For each 3-week increase in training, a novice runner was 17% more likely to have an injury (OR = 1.17; 95% CI, 1.02 to 1.36, $P = 0.028$).

Conclusions: The results of this study indicate that novice marathon runners have a greater incidence of injury than more experienced marathoners.

Significance of Findings: While there has been research on training injuries in runners, those studies focused mainly on training for races of shorter distances. Few studies have focused on marathon training, especially novice marathon runners. This study indicates that future research is necessary to identify risk factors and to develop proper training regimens for first-time marathon runners.

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CASE PRESENTATIONS

Not Your Typical FOOSH Injury

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Affiliation: Crozer Sports Medicine Fellowship, Springfield, PA.

History: An 18-year-old right-hand dominant amateur skateboarder presented to the sports medicine office with right hand and wrist pain following a fall 6 weeks earlier. The pain was located in the hypothenar area. The patient initially experienced numbness and tingling in the palmar aspect of the 5th digit that was occurring infrequently at the time of his initial evaluation. Along with the pain, he had also noticed a "lump" in the hypothenar area. He denied any weakness in the wrist or hand.

Physical Examination: Right upper extremity examination demonstrated normal range of motion at the wrist. There was tenderness to palpation at the hook of the hamate. There was a firm, palpable, mobile mass that was tender to palpation at the hypothenar eminence. Tinel's was negative over the ulnar tunnel. Allen's test was positive.

Differential Diagnosis:

Ulnar Tunnel Syndrome
Hook of the Hamate Fracture
Ulnar Artery Thrombosis
Flexor Carpi Ulnaris Tendonitis

Tests & Results: Radiographs of the wrist were negative for fracture or other abnormality. MRI of the wrist showed dilation of the ulnar artery with abnormal flow related signal and probable flow restriction. No evidence of fracture.

Final/Working Diagnosis: Ulnar Artery Thrombosis

Treatment: The patient was evaluated by hand surgery and underwent ulnar tunnel release, excision of the thrombosis, and vein grafting to the ulnar artery.

Outcome: The patient was initially placed in a short arm splint. He underwent a course of hand therapy and was able to achieve normal range of motion of the wrist with full strength. Following surgery, there was improvement in pain and numbness of the wrist and 5th digit.

Return to Activity and Follow-Up: The patient was able to return to skateboarding 6 weeks after surgery without any difficulty. Additionally, the patient was found to have an ulnar artery thrombosis and TFCC tear in the left wrist and underwent successful surgical repair.

Forearm Pain After Intense Overuse, Oarsman's Syndrome... Or Is It?

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Affiliation: New York University School of Medicine, New York, NY.

History: 25-year-old right-hand dominant male who presented with progressive pain and swelling of the dorsoradial aspect of the distal right forearm for the past 1 month. He attributed the pain to a military training exercise which required repetitive motion of the right thumb and index finger an entire day. He was not accustomed to doing this maneuver. He described the pain as severe and was exacerbated by squeezing or lifting things. He said the pain was not relieved by ibuprofen. The pain interfered with his ability to write, type and sleep. No numbness or tingling. He denied fever, night sweats or fatigue. He denied trauma to the forearm. No prior forearm problems.

PMH: PPD+

Meds: none

SH: pre-med student at NYU; he was a Private in the US Army; denied illicit drug use

Physical Examination: Temp = 97.7. He had marked point tenderness and swelling at the dorsoradial aspect of the distal radius, between 4 and 12 cm proximal to the radial styloid process. There was no crepitus or erythema. ROM was full but there was pain at end range. Strength was normal but pain was reproduced with resisted wrist dorsiflexion and radial deviation as well as with resisted thumb extension and abduction. Sensation to light touch was normal.

Differential Diagnosis:

Tendinitis (Intersection Syndrome a/k/a Oarsman's Syndrome)
Bursitis

Distal radius stress fracture
Infectious process (cellulitis, osteomyelitis)
Tumor

Tests & Results: X-ray (AP and lateral): poorly demarcated cortical lucencies involving a 3 cm portion of the distal radius. There was an accompanying periosteal reaction. There was no evidence of pathologic fracture.

ESR: 7

CRP: 0.2

CBC: WBC = 5.9 (62.5% poly's); Hb = 15.9

Chem: normal

PPD: 10 mm of induration 48 hours after placement

MRI with Contrast: 4.0 × 0.5 cm destructive lesion involving the cortex of the distal radial shaft. It is associated with small focal areas of intramedullary penetration. There is somewhat mature-appearing periosteal reaction. There is prominent reactive marrow edema of the distal radius and surrounding soft tissues. The musculoskeletal radiologist felt these findings could represent infection, eosinophilic granuloma or neoplasm (Ewing's sarcoma, osteosarcoma or lymphoma). He recommended histological diagnosis.

Bone Scan: Delayed images show intense increased uptake along the distal half of the radius. SPECT images showed cortical destruction. The patient was referred to an orthopaedic oncologist who took him to the OR for open biopsy and frozen section pathologic examination of the bone lesion. The frozen section demonstrated a suppurative osteomyelitis. Further studies determined the organism was Salmonella, sensitive to Ciprofloxacin.

Final/Working Diagnosis: Salmonella osteomyelitis.

Treatment: The diseased portion of the distal radius was curetted and resected in the OR. This left the bone in a weakened state, so medullary cement was added to provide strength. An antibiotic was placed in the cement to deliver the antibiotic locally. He was placed on oral Levaquin. After surgery, ID consult was obtained but no cause for the infection was identified. Signs of his infection abated. The antibiotic was continued for 6 weeks. Two months later, he was brought back to the OR for removal of the antibiotic cement and placement of bone graft from the iliac crest to fill the defect.

Outcome and Further Follow-Up: The patient is currently doing well, 11 months after presentation. He has no evidence of infection. X-rays of the right forearm reveal a well-healed distal radius. He was cleared to return to active military duty in October of 2008 and is able to do pushups and lift weights without a problem.

Right Upper Extremity Pain in Skateboarder

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Affiliation: Florida State University College of Medicine, Tallahassee, FL.

History: A 19-year-old male skateboarder presented with right shoulder pain radiating to his elbow with accompanying finger paresthesias. The pain initially presented 1 week ago as vague pain along the right subscapular area, but then localized to the right anterior shoulder. This pain was associated with swelling, first noticed 2 days ago. He noticed slight bluish discoloration and superficial varicosities of the right arm several weeks before. He reports several episodes of falling onto the palmar surface of his right hand and right shoulder while skateboarding. He denies any abrasions. He denies chest pain, shortness of breath, fever, lymphadenopathy, pleuritis, night sweats, tachycardia, or diaphoresis. He does state his fingertips turn white, especially when it is cold. He denies facial rash, photosensitivity, or eye problems. At age 8 months, he underwent bronchoscopy for a subsequently diagnosed respiratory virus with croup-like symptoms that was slow to recover. At age 16 years, he was seen in an ER for acute dyspnea and chest pain. He was subsequently transferred to a tertiary care hospital and diagnosed with allergic asthma. He has allergic rhinitis which is being treated. He has had several other episodes of nonexertional dyspnea, starting around age 16 years, that were diagnosed as asthma. SocHx-smoker FAMHx-negative.

Physical Examination:

General: appeared stated age, normal habitus, no acute distress

Vitals: afebrile; pulse 80; respiratory rate of 24; BP: 118/69; Sat O₂: 98%

HEENT: PERRL, EOMI, sclera anicteric, no conjunctivitis

Neck: supple, no lymphadenopathy; full ROM

Lungs: CTA bilaterally; no egophony; normal tympany to percussion

Heart: S1, S2, RRR, no murmur

Abdomen: non tender, no masses

Genitourinary: no testicular masses

Extremities: No clubbing, cyanosis, or edema of lower extremities; there was asymmetry of upper extremities, with right larger than left; right upper extremity was edematous from axilla to proximal forearm; some superficial varicosities are noted; there is tenderness to palpation in the proximal right arm.

ROM: Abduction 120 degrees, forward flexion 150 degrees, external rotation is 45 degrees; internal rotation to right hip; pain is worsened above 100 degrees; sensation to light touch decreased to RUE; Spurling's test negative; Adson's test positive

Differential Diagnosis:

Right Upper Extremity DVT

Thoracic outlet syndrome

Glenohumeral joint injury (shoulder contusion, rotator cuff strain)

Possible occult pulmonary emboli

Scapular contusion/fracture

Cervical radiculopathy

Raynaud's syndrome

Tests & Results:

CBC: WNL

BMP: WNL

INR 1.1, PT 27.5

Toxicology screen: positive for cannabinoids

CXR: no evidence of cardiopulmonary disease

Upper extremity ultrasound: thrombosis at right subclavian vein

CTA chest: multiple bilateral thromboemboli within lower lobe arterial tree bilaterally; collateral vessels seen along R upper extremity

SVC venogram: discovery of short segment focal occlusion of right medial subclavian vein

Final/Working Diagnosis: Right upper extremity DVT, secondary to costoclavicular type thoracic outlet syndrome, with multiple pulmonary emboli.

Treatment: Patient was started on therapeutic Heparin, then switched to therapeutic Lovenox dosing. Thrombolytic therapy was given with tPA during venography. Following fibrinolytic therapy, significant narrowing with stenosis remained, refractory to treatment with balloon angioplasty. Started

on therapeutic Coumadin. Positional venography showed complete obstruction with right arm abduction.

Outcome: Remain on anticoagulants 4-6 months. He has been scheduled by vascular surgery for resection of the right 1st rib. We frequently see adolescents in high impact sports with arm pain and dyspnea, either concurrently or consequentially, as in this case. Thoracic outlet syndrome is not a rare diagnosis. Rarely, however, do we consider that the patient may actually be critically ill and at high risk for death, as was the case with this patient.

Return to Activity and Follow-Up: Avoid skateboarding and other high impact sports while on anticoagulants. Avoid hyperabduction of extremities. Strengthen neck extensors and anterior scalene muscles.

Traumatic Lateral Knee Pain in a College Softball Player

Christopher McGrew, MD, Tienanh Pham, DO, and Robert C. Schenck Jr, MD.

Affiliation: University of New Mexico Hospital, Albuquerque, NM.

History: A 20-year-old female Division I softball player presented to the athletic training room with left lateral knee pain after sliding into second base during a practice session. During the slide, the cleats of her left shoe caught in the dirt resulting in her twisting and rolling over her left leg. She then felt a sharp pain over the outer aspect of her left knee, but could not recall a "pop". She immediately was unable to extend her knee fully and could not bear weight on the affected extremity. She reported numbness over the top of her foot and was unable to dorsiflex or evert the ankle. The certified athletic trainer noted that the head of the fibula appeared to be "out of place". The physician in the training room confirmed this exam and additionally noted that the distal vascular status was intact for pulses and capillary refill. It was also noted that she had a healing abrasion over the anterior proximal tibia along with some soft tissue swelling around the ankle from minor trauma earlier in the week. She did not have any significant ankle tenderness. By history she was otherwise healthy with no previous left knee injury or problems. She was then transported to the emergency department for imaging and further evaluation.

Physical Examination: Physical examination by emergency room (ER) personnel revealed a soft tissue prominence and mild edema at the left proximal tibiofibular joint. The patient had tenderness to palpation over the proximal fibula as well as along the lateral collateral ligament of the left knee. The player was still unable to fully extend her knee because of pain but was now able to demonstrate normal ankle dorsiflexion and eversion. The distal neurovascular exam was at this time documented as intact.

Differential Diagnosis:

Meniscal pathology

Lateral collateral ligament injury

Iliotibial band syndrome

Biceps femoris tendonitis

Extoses

Tests & Results: Plain radiographs of the knee joint, lower leg and ankle joint showed no fracture. The fibular head appeared displaced laterally. Soft tissues were unremarkable. There was no plain radiograph of contralateral knee for comparison. The patient was diagnosed with left proximal tibiofibular joint sprain and lateral collateral ligament strain by the ER personnel. She was placed in a knee brace with crutches and discharged home with follow up the next day with team physicians.

The next morning, the patient was seen at the primary care sports clinic. The patient continued to have pain over the lateral aspect of her left knee. There was bony prominence of the fibular head which was tender to palpation. She was still unable to fully extend the knee secondary to pain. She had mild peroneal sensory changes over the mid-calf, but normal motor function with normal strength of ankle dorsiflexion and eversion. Anteroposterior and true lateral view x-rays of both knees demonstrated asymmetric anterior and lateral displacement of the left proximal fibular head with respect to the tibia.

Final/Working Diagnosis: A diagnosis of isolated proximal tibiofibular joint dislocation was made at this time and the patient was referred to the team orthopedic surgeon who agreed with the diagnosis.

Treatment: The patient was consented for closed reduction of the left proximal tibiofibular joint with the possibility of open reduction if close

reduction failed or if the peroneal nerve motor function became abnormal. Under conscious sedation, with her knee flexed, ankle externally rotated and dorsiflexed, the fibular head were reduced posteriorly with an audible snap. The reduction maneuver was performed approximately twenty-three hours post injury and required significant force to gain reduction. Initial manipulative efforts partially reduced the dislocation and only after a second attempt did the joint reduce with an audible crepitated snap.

Outcome: Plain radiographs were obtained which revealed closed reduction of the tibiofibular joint. Post-reduction examination showed stable knee with good range of motion and minimal pain.

Return to Activity and Follow-Up: Patient was placed in soft dressing on crutches with partial weightbearing and by two weeks post injury was walking normally without assistive aids.

Student Athlete with Knee Pain

Stacy L. Lynch, MD,¹ Kevin Walter, MD,² Anne Z. Hoch, DO,³ and David King, MD.⁴

Presenter: Stacy L. Lynch.

Affiliation: ^{1,3,4}Medical College of Wisconsin and Froedtert Memorial Lutheran Hospital, Milwaukee, WI, and ²Children's Hospital of Wisconsin, Greenfield, WI.

History: A 14-year-old Caucasian male presented to sports medicine clinic at the end of football season with 4 month history of left knee pain. He cannot recall a specific trauma that caused his pain. His pain has progressively gotten worse, now being an 8–10/10 requiring Vicodin. The pain is localized to the medial knee with some radiation to the medial proximal tibia. This pain does wake him at night when he moves the knee. He gets comfort from an over the counter neoprene compression sleeve. He denies paresthesias, erythema, or swelling of the left knee. He denies fever, chills, nausea, vomiting, or weight loss. Previous work up included a plain film X-ray from an outside clinic which was read as normal one month after onset of symptoms. A MRI done one week prior to sports medicine evaluation, per patient's mother, was read as having scar tissue under the kneecap. An outside provider prescribed naproxen and crutches for non-weight bearing status.

PMH/FH/SH: no significant history, plays baseball, football, and basketball; A/B 8th grade student

MEDS/ALL: none, NKDA

Physical Examination:

General: A&O, moderate amount of distress secondary to pain

CV: RRR, no murmurs; BP: 130/84

Lungs: clear

Gait: antalgic gait, almost unable to weight bear on the left

Extremities: inspection revealed swelling over the left proximal medial tibia; there was exquisite tenderness to palpation of the left proximalmedial tibia; left knee ROM was limited to 0-90 degrees secondary to pain; knee ROM on the right was normal; Lachman's, varus/valgus stress test, and McMurray's were negative; patellar apprehension and compression were negative; no distal neurovascular deficits were noted; bilateral hips had full, pain-free ROM

Differential Diagnosis:

Medial Meniscal Tear

MCL sprain

Pes Anserine Bursitis

Osteomyelitis

Eosinophilic granuloma

Neoplasm (chondroblastoma, leukemia, lymphoma, osteosarcoma/blastoma)

Intraosseous arteriovenous malformation

Pathologic fracture

Tests & Results: X-rays were repeated in clinic. No abnormalities noted or changes from outside films.

MRI from outside was reviewed. He was found to have edema in proximal medial tibial epiphysis. Labs: WBC: 10.2; Hbg: 14.4; Hct: 42; platelet count: 431; ESR: 10; CRP: 0.8. Patient course: Patient was admitted to CHW for pain control and orthopedic consultation for biopsy. He underwent a CT scan to further evaluate proximal tibial edema. CT showed left tibial lucent lesion with

sclerotic margins 1cm in size and smaller lucencies in the epiphysis adjacent to the central lesion. He was taken to the operating room for biopsy and lesion removal. Cultures were negative and pathology consistent with large B-cell non-Hodgkin's lymphoma.

Final/Working Diagnosis: Large B-cell non-Hodgkin's lymphoma.

Treatment: He underwent a CT of the chest, abdomen, and pelvis, a bone scan, and a bone marrow evaluation. Staging workup revealed enlarged right axillary mesenteric and bilateral inguinal and femoral lymph nodes. He was also found to have questionable abnormalities of the 6th, 7th, and 9th right ribs as well as the skull. Staging work up was consistent with stage II large B-cell non-Hodgkin's lymphoma. Chemotherapy "CHOP" was started within two weeks of initial presentation to the sports medicine clinic.

Outcome: Approximately 55 000 to 60 000 new cases of non-Hodgkin lymphoma are diagnosed annually in the United States, B-cell lymphomas accounting for approximately 90% of these. Lymphoma is the third most common cancer in children and adolescents. Non-Hodgkin's lymphomas are now among the most successfully treated cancers in the pediatric population with a chemotherapeutic response rate as high as 99% and a long-term survival rate as high as 85%.

Return to Activity and Follow-Up: The patient's knee pain improved after surgery and he is currently undergoing chemotherapy directed by pediatric oncology. The patient is NWB and has not returned to gym class, sports, or extracurricular activities at this time.

Progressive Lower Extremity Numbness and Weakness with Exercise

Rowan V. Paul, MD, and David J. Petron, MD.

Presenter: Rowan V. Paul.

Affiliation: University of Utah, Salt Lake City, UT.

History: This is a 43-year-old woman with 2 months of intermittent numbness in her R plantar surface and 1st toe starting after an aggressive workout on the elliptical. With subsequent workouts she developed pain in her right lateral knee, progressing to tightness in her right hamstrings. Pain is 3/10, is intermittent with exercise, becoming constant, and eventually affecting her ability to exercise, and she started to trip more with aggressive activities or hikes. She denies change in bowel or bladder function. She has no knee swelling, pain with stairs, squatting and no knee locking, buckling or painful catching. She has a remote history of a likely congenital asymptomatic lipomyelomeningocele that was debulked at age 15 for cosmetic reasons only. Rest and ibuprofen have helped minimally.

Physical Examination: Heel and toe, tandem walking and gait intact. Trace Patellar and Achilles reflexes on her right side with bilateral down going Babinski reflexes, no clonus or signs of upper motor neuron changes. Motor: Foot dorsiflexion 4/5, Extensor Hallucis Longus 3/5, Iliopsoas 4/5, Quadriceps and Hamstrings 5/5. Sensory: Right-sided decreased sensation to light touch laterally, on the dorsum of foot, and posterior calf. There is a positive slump test on the right causing numbness in plantar surface of right foot, left side is completely normal. She has a healed midline incision over lumbar spine with congenital port wine stain in the midline of old incision scar over spine.

Differential Diagnosis:

Lumbar Radiculopathy

Peripheral Neuropathy

Cobb Syndrome

Tethered Cord from Lipomyelomeningocele

Tests & Results:

MRI: Remnant of a lipomyelomeningocele.

Cord ends at L3. Lipoma is dorsal to cord and intertwined with cord. No pseudomeningocele or spinal fluid leak.

EMG: No change in nerve conduction velocities with sural sensory, peroneal motor, superior peroneal sensory, peroneal F-Resp, Tibial Motor, Tibial F-resp and no EMG changes in anterior tibialis, medial gastrocnemius, vastus medialis, gluteus medius and peroneus longus.

Final/Working Diagnosis: Tethered Spinal Cord secondary to Lipomyelomeningocele.

Treatment: Referral to neurosurgeon for evaluation for surgical de-bulking and to release the tethering fat from the cord.

Outcome: Neurosurgeon and patient opted for watchful waiting as risks of surgical complications outweigh benefits and since symptoms of numbness, pain and weakness improved over the course of one month. The patient has had residual and nonprogressive numbness but no functional weakness and has been able to resume exercise with symptomatic treatment only.

Return to Activity and Follow-Up: Patient has resumed her daily exercise regimen and will follow up if she has progressive pain, weakness or bowel or bladder changes.

Disordered Sleeping in a Softball Player

Veronica M. Jow, MD, and Thomas Trojjan, MD.

Presenter: Veronica M. Jow.

Affiliation: University of Connecticut Health Center and Saint Francis Hospital and Medical Center, Hartford, CT.

History: A 19-year-old college softball player was referred to the sports medicine clinic by strength staff and teammates for not eating during the daytime and a concern for possible anorexia nervosa. For most of the day, she reported a lack of appetite until approximately 3 PM, when she ate her first meal. She attempted to restrict calories during meals because of a bloated feeling in the morning. She denied bingeing or purging activities.

She was seen three months prior by another physician for a complaint of insomnia. She denied difficulty with initiating sleep, but experienced frequent nighttime awakenings, on average three to four times per night. She had one roommate, and denied excessive noise, poorly regulated temperature, or light disturbances. She also denied nightmares or night terrors. She had attempted over-the-counter sleep aids without improvement in her symptoms. She was started on zolpidem tartrate, which also did not diminish the number of awakenings.

Upon each awakening she would consume a snack, consisting of carbohydrate-rich food, such as cookies or crackers, often more than 1000 calories over the night. Although she tried to refrain from eating, she felt unsatisfied and unable to reinitiate sleep until consuming food. At times she would only be made aware of the episodes by food wrappers surrounding her bed the next morning. After eating she easily returned to sleep, but reawakened 1-2 hours later. Her roommate reported having her personal food confiscated by the patient at night, and engaging in conversations that the patient could not recall the following day.

The next morning, she experienced a moderate amount of guilt related to her eating and modest weight gain of 7–10 lbs. She admitted to a mildly depressed mood and intermittent anhedonia. She reported anxiety related to increased life-stressors over the past few months associated with softball, classes, and a new relationship. She denied difficulty concentrating or a decline in academic work. However, she noticed decreased endurance and performance during softball practice and competitions, especially with morning activities during which she felt tired, bloated and groggy. By not eating for most of the day, she often lacked enough energy to complete an entire afternoon practice. She denied suicidal or homicidal ideation.

She was no longer taking any medications. She denied a personal or family history of eating disorders. A complete review of systems was otherwise negative.

Physical Examination: Well-appearing; normal vital signs; Ht = 5'6"; Wt = 160; unremarkable physical exam; normal psychiatric exam; Zung depression scale was 24.

Differential Diagnosis:

NES: Night Eating Syndrome
Nocturnal eating/drinking syndrome
Nocturnal sleep-related eating disorder
BED: Binging Eating Disorder

Tests & Results: All lab values were normal, including electrolyte panel, glucose, thyroid and liver function.

Final/Working Diagnosis: Night Eating Syndrome

Treatment: The patient was initially instructed in basic sleep-hygiene practices. Specifically, she focused on reserving her bed for sleep only, eliminating ambient lighting, removal of adjacent food and adhering to regular sleep hours. However, her nighttime eating persisted. She was started on Zolof 50 mg, which was titrated up to 200 mg daily over the next few months.

She had a reduction in symptoms as the dose increased. She was simultaneously sent to mental health counseling.

Outcome: Number of nighttime awakenings decreased to approximately 1 per night. No compulsion to eat upon awakening. Returns to sleep immediately. Eats three regular meals per day with 1–2 snacks. Depressed mood and anhedonia resolved. Discontinued counseling after three sessions.

Return to Activity and Follow-Up: Currently, continues on Zolof 200 mg daily. Able to continue softball participation throughout with improved and more consistent performance once nighttime eating reduced.

Marcus Gunn Jaw Winking Syndrome

Stephen A. Hopkins, MD, Brian Coleman, MD, and Jim Barrett, MD.

Presenter: Stephen A. Hopkins.

Affiliation: University of Oklahoma Department of Family and Preventative Medicine, Oklahoma City, OK.

History: 16-year-old white male high school football player presented for preparticipation evaluation (PPE) in his normal state of health without complaints. During the medical interview he was noted to exhibit frequent right eye winking associated with simultaneous jaw opening. He had a baseline mild right eye ptosis. He denied any other symptomatology such as headache, change in vision, nausea, vomiting, or fever. Further questioning revealed "I've had this as long as I can remember." He had no history of trauma, injury, or falls, and had been able to play football without significant difficulty. His only past medical and surgical history consisted of congenital ptosis and blepharoplasty on two separate occasions.

Physical Examination:

VSS AF

General: WNWD WM AAOx3 NAD

Mild right sided ptosis covering 1mm of superior iris

PERRLA EOMI

HEENT/CV/RESP/ABD/MSK: All WNL

Neurological: CN:II-XII grossly intact, visual fields grossly WNL; cover testing was unremarkable. Baseline right sided ptosis: partially retracted eyelid with voluntary jaw-opening maneuvers: inferiorly and when cocked to the left; symmetric smile, uvula and tongue protrude to midline. No other motor or sensory deficits noted.

Differential Diagnosis:

Amblyopia
Congenital Ptosis
Oculomotor Nerve Palsy
Aberrant Third Nerve Regeneration
Double Elevator Palsy

Tests & Results: Preliminary lab work: CBC, CMP were WNL. Referral to local neurologist revealed diagnosis.

Final/Working Diagnosis: Marcus Gunn Jaw Winking Syndrome.

Treatment: Although there are many surgical treatments available for this condition, at the time of this evaluation, this patient had not elected to do so. He has learned to live with this condition and stated "other kids think it's kind of cool!" He and his mother are aware that there are options available to correct the ptosis and/or the jaw winking symptomatology. While there is ongoing controversy regarding surgical management of this condition, correction of the jaw wink appears to involve ablation versus removal of the levator muscle, and resuspension of the eyelid to the brow.

Outcome: The patient did well with no untoward problems.

Return to Activity and Follow-Up: At the time of the PPE there was some initial hesitation regarding RTP. After consulting several other physicians, reassurance was given (via telephone) from a local ophthalmologist that this was a benign condition. The patient was then given full medical clearance for sports participation.

It is my personal opinion that educating other clinicians performing PPE's of this condition would decrease the potential for confusion and anxiety, as well as expedite the overall process. Furthermore, in doing so, this could eliminate any foreseeable clinician fears regarding its severity, such as neoplasm, seizure, nervous tic, etc.

Despite the above stated condition, repeat history and examination after completion of football season revealed that the patient was able to play the entire football season without significant difficulty or limitation.

Please click on the following link to view a video of Marcus Gunn Jaw Winking Syndrome: <http://www.youtube.com/watch?v=czK6mDgOYkI>.

The Importance of Evolution

Amy M. Oldenburg.

Affiliation: Hennepin County Medical Center Primary Care Sports Medicine Fellowship, Minneapolis, MN.

History: A 17-year-old male football player was seen during halftime for right shoulder pain. During a tackle at the end of the first half the athlete reports that his right shoulder was forced into abduction and external rotation with concurrent left cervical rotation. He reports pain in the right shoulder over the deltoid region and also complains of pain when he takes a deep breath. He denies sensation of dislocation or subluxation at the time of injury. He denies shortness of breath or difficulty breathing. No numbness or tingling in right upper extremity.

Physical Examination:

General: NAD, no increased work of breathing or tachypnea; visible right pectoralis major intermittent muscle spasm

Lungs: clear bilaterally with good air flow throughout

Cardiac: regular rate and rhythm

Cervical: range of motion full and pain free; negative spurling's testing bilaterally

Right Shoulder: Right clavicle, AC joint, and biceps tendon non tender to palpation; right shoulder with full range of motion with mild increase in shoulder pain with active abduction; 5/5 strength testing, pain with resisted rotator cuff strength testing; negative apprehension and impingement testing; mild tenderness to palpation over right pectoralis major laterally; neurovascular status intact.

Differential Diagnosis:

Anterior Subluxation

Pectoralis Major strain

Contusion

Rotator cuff strain

Labral tear

Tests & Results: Right clavicular radiographs done at follow up visit by orthopaedist 3 days later negative for fracture or AC separation. At the time of follow up, the athlete presented with pain in the right shoulder as well as pain in the right upper chest. Enhanced CT of the neck soft tissue and enhanced CT scan of the chest was ordered. Results: mildly displaced right upper sternal/manubrium fracture with a small amount of surrounding hemorrhage.

Final/Working Diagnosis: Sternum/manubrium fracture.

Treatment: Patient initially held out of the second half of the football game secondary to pain. No increase in pain or development of dyspnea or tachypnea during the second half. He was sent home with his parents with instructions to follow up either in training room or with patient's personal physician prior to return to play. Athlete was instructed to go to the emergency room if pain increased or if he developed any increased work of breathing or dyspnea. He was seen the following day informally by a family friend who is an orthopaedic surgeon who arranged formal follow up 2 days later in the clinic. After the diagnosis of the sternum fracture was made the patient was held out of football for 4 weeks. Repeat CT scan 4 weeks later showed healing fracture with periosteal new bone formation and bridging callus formation without change in anatomic alignment.

Outcome: Returned to play after 4 weeks to finish out the season.

Return to Activity and Follow-Up: Completed the football season without any problems.

Abdominal Pain after a Double Overtime Soccer Game

Teri Metcalf McCambridge, MD and Melissa Sparrow, MD.

Presenter: Teri Metcalf McCambridge.

Affiliation: Johns Hopkins School of Medicine/Towson Orthopaedic Associates, Towson, MD.

History: 17-year-old male presented to community ED with diffuse abdominal pain presenting 12 hours after a 100 minute soccer game. No specific collision or abdominal trauma is recalled. Athlete had no constitutional symptoms of fever, nausea, vomiting, diarrhea, dysuria, or hematuria. Initial evaluation in the ED revealed a well-appearing male with stable vital signs and a benign abdominal exam (no ecchymosis, no rebound or guarding, and normal bowel sounds). Pain was reproduced with palpation of rectus abdominus. Patient was discharged home with diagnosis of muscle strain. Patient returns to ED 12 hours later (24 hours post game) with increasing severity of abdominal pain in the epigastric region (8/10). Patient still denies vomiting, diarrhea, or urinary symptoms. He has decreased appetite.

Physical Examination: Wt: 64.2 kg; Temp: 35.8; P: 67; RR: 16; BP: 124/64 pulse ox 97%. Patient presents in mild distress. Neck is supple. Chest is CTA. CV regular rate and rhythm without murmurs. Abdominal exam is notable for diffuse tenderness to palpation, voluntary guarding, and decreased bowel sounds. No hepatosplenomegaly is appreciated. No CVA tenderness is noted. No ecchymosis is seen. Extremities demonstrate no edema.

Differential Diagnosis:

Appendicitis

Liver injury (subcapsular/intrahepatic hematoma, biliary disruption, contusion, or laceration)

Splenic injury (subcapsular hematoma, laceration, or hilar vascular injury)

Mesenteric tear with bleeding

Intestinal perforation

Intestinal hematoma

Renal trauma

Peritonitis

Pancreatitis or pancreatic laceration, abdominal wall contusion

Rectus Sheath Hematoma

Tests & Results: Imaging studies: Chest Radiograph: normal. Abdominal Radiograph: non-specific bowel gas pattern without obstruction. CT Abdomen and pelvis with oral and IV Contrast: Free Fluid in the abdomen. Fluid surrounding the gall bladder. Fluid surrounding the pancreas. Contour abnormality of the head and body of the pancreas. Triangular defect in the anterior margin of the pancreas consistent with a pancreatic laceration. Patient transferred to a tertiary care center. ERCP is performed to discern if the pancreatic duct is patent, test is unsuccessful. Magnetic Resonance Cholangiopancreatography is performed and the distal pancreatic duct was normal in caliber without evidence of obstruction.

Laboratory tests 9/14: CBC: 10.6/14.4/42/269; Na: 138; k: 3.8; cl: 103; co2: 24; Bun: 13; Creat: 0.3; glucose: 113; AST: 27; ALT: 18; Amylase: 298 (nl 28-100); Lipase: 397 (nl 28-100); Alkaline phosphatase: 96.

Laboratory test 9/15: CBC: 10.5/12.6/36/6/204; Amylase: 329; Lipase: 390; Alkaline Phosphatase: 92.

Final/Working Diagnosis: Pancreatic laceration without pancreatic duct disruption.

Treatment: Patient was transferred to tertiary care center admitted to the TAU, made NPO, given parenteral nutrition, observed and had serial hematocrits and multiple imaging studies. Patient was transferred to the floor after MRCP demonstrated no disruption of the pancreatic duct. He was advanced to a clear liquid diet on HD#5 and discharged home on HD#6.

Outcome: He remained stable throughout his course. He was seen for follow-up 2 weeks postdischarge and was asymptomatic.

Return to Activity: He was held out of contact sports for 6 weeks. CT scan at 4 weeks post discharge demonstrated wedge-shaped contour deformity of the pancreas with resolution of free pancreatic fluid.

Acute Flank and Left Lower Quadrant Pain Presenting on the Sideline of a Collegiate Football Game

Jeremy J. Reed, DO.

Affiliation: St. Louis University Primary Care Sports Medicine Fellowship, Department of Family and Community Medicine, Saint Louis University School of Medicine, St. Louis, MO.

History: A healthy 20-year-old Latino-American safety presented on the sideline during a collegiate football game complaining of acute left flank and lower quadrant pain. He stated that the pain began after a tackle, in which he believed he fell on top of the football. He experienced immediate left flank pain, but was able walk off the field on his own. His pain became more intense on the sideline. He felt improvement in the "hands and knees position" on the ground. He also reported dyspnea. He noted that he had not experienced pain like this before. He reported feeling well prior to this and denied recent illness. Over the next couple of minutes, his pain migrated from his left side to his left lower abdomen without change in intensity. Review of systems revealed a negative history of vomiting, diarrhea, constipation, melena, or hematochezia. He also had experienced no change in his urine, including hematuria or oliguria prior to the injury.

Physical Examination: Examination revealed a healthy-appearing male in moderate distress. On presentation, he was in the "hands and knees position", and was somewhat tachypneic, speaking in three-word phrases. He was alert, and oriented to situation. He answered questions appropriately and was cooperative. His pulse was 108, palpated radially. Other vital signs were immediately unavailable. Auscultation revealed lungs that were clear in all fields anteriorly and posteriorly. The heart was regular in rate and rhythm, and S1 and S2 were heard without murmur. Auscultation of the abdomen revealed somewhat decreased bowel sounds in all quadrants. There was point tenderness in the left lower quadrant to palpation, with some guarding. The abdomen was mildly rigid. There was no rebound tenderness. Percussion of the left costovertebral angle caused pain that radiated to the left lower quadrant. The skin over the area was free of ecchymosis or erythema. There were no other apparent injuries.

Differential Diagnosis: The differential diagnosis of abdominal pain is vast. In the setting of acute injury, the differential diagnosis includes splenic injury, renal, pancreatic, hepatic, or hollow viscera injury, abdominal wall contusion, and strain of abdominal oblique musculature. Also included were non-traumatic injuries such as ureteral calculus, colitis or bowel perforation.

Tests & Results: On presentation to the emergency room, CT scan of the abdomen and pelvis showed rupture of the ureter at the ureteropelvic junction, with a large urinoma in the left retroperitoneal space. Urinalysis was not obtained, because the patient had not been able to void. CBC showed a WBC of 11.3, with normal parameters otherwise. CMP, amylase and lipase, and PT/PTT were also unremarkable.

Final/Working Diagnosis: Distal ureter rupture.

Treatment: The patient was taken for emergent exploratory laparotomy with mobilization of the splenic flexure and repair of a dilated, ruptured left renal pelvis, with stent placement.

Outcome: The patient was kept in the hospital post-operatively for 3 days. He required Foley catheter placement, which was discontinued several days post-op. His stent was also removed without complication several weeks later. He is currently doing quite well.

Return to Activity and Follow-Up: Unfortunately, he missed the rest of his football season due to his injury. The season was about half over at the time. He is conditioning now without problems, and is expected to return next year.

Bilateral Lower Extremity Numbness in a Young Female Runner

Cory Keller, DO, and Thomas Sisk, MD.

Presenter: Thomas Sisk.

Affiliation: University of Pittsburgh Medical Center Primary Care Sports Medicine Fellowship, Pittsburgh, PA.

History: 14-year-old female cross country athlete presented with 8-week history of bilateral lower extremity numbness associated with ataxic gait when running distances greater than one mile. Symptoms would resolve within seconds after cessation of running. Denies back pain, bowel/bladder dysfunction, trauma.

Physical Examination:

Vitals: 112/62; HR: 64; RR: 13

General: healthy appearing female in no acute distress

Cardiac: RRR; No MGR

Pulm: B CTA; No WRR

Abd: soft, NTND, BS present all quadrants, No masses or hepatosplenomegaly, No JVD

Lumbar Exam: no deformity or TTP, FROM, Neg Stork test

Lower Extremities: no erythema, ecchymosis, soft tissue swelling, or atrophy; full range of motion of hips, knees, ankles; normal manual muscle testing; 2+ Dorsalis Pedis, Post Tibialis, Popliteal and Femoral pulses

Neuro: negative straight leg raise and slump test bilaterally; normal deep tendon reflexes throughout; normal sensation; normal cerebellar; CN 2–12 intact Patient ran on treadmill in office until reproducing symptoms and appeared to have an uncoordinated gait pattern.

Differential Diagnosis:

Deconditioned Athlete

Conversion Disorder

Lumbosacral Radiculopathy - Herniated Nucleus Pulposas, Spinal Stenosis, Spondylolisthesis

Pregnancy

Nutritional Deficiency exacerbated by exercise - B12 or Folate Deficiency

Vascular Anomaly - Arteriovascular fistula, Arteriole/Pulmonary Stenosis, Congenital Absence

Brain Tumor

Head Trauma (omitted from history)

Guillain-Barre syndrome

Abdominal/Gynecological Neoplasm

Ovarian Cyst

Multiple Sclerosis

Tests & Results: X-ray Lumbar Spine: no fractures, no instability of flexion extension views.

MRI Lumbar Spine: extensive paravertebral and vertebral canal collateral vasculature. Mild degenerative lumbar disc changes. No significant central canal stenosis.

CT Abdomen/Pelvis: congenital absence of inferior vena cava and common iliac veins bilaterally; as a result of this, the internal/external iliac veins drain into the ascending lumbar veins and then into the azygous and hemi-azygous systems; no mass seen.

US bilateral lower extremities: no evidence of DVT; indirect evidence of venous occlusion more proximally, consistent with absent IVC.

2D Echocardiogram: chambers normal in dimension and contractility; normal valvular structures with normal Doppler flow.

Final/Working Diagnosis: Congenitally absent inferior vena cava and common external iliac veins resulting in extensive venous collateral vasculature. During exercise, increased venous return results in compensatory venous dilation of the collateral venous system causing diffuse lumbosacral neural impingement, which generated the patient's symptoms of leg numbness and ataxia.

Treatment: The patient was advised not to participate in cardiovascularly demanding activities. She was counseled on DVT risk and advised not to smoke or take any oral contraceptives. She was placed on prophylactic daily aspirin. Patient was also counseled on the risks involved with pregnancy. She was seen by vascular surgery, who agreed with our opinion to delay consideration of surgical intervention until adulthood.

Outcome: Patient is currently allowed to exercise at levels which do not reproduce symptoms. She and her parents were told to notify physician with any new or worsening symptoms. Will return to office in three months.

Return to Activity and Follow-Up: Will not return to exertional activity at the present time.

Double Vision in a Concussed Athlete

Jake D. Veigel, MD, and J. Herbert Stevenson, MD.

Presenter: Jake D. Veigel.

Affiliation: University of Massachusetts, Fitchburg, MA.

History: 19-year-old male lacrosse player was hit during game striking his occiput on the ground suffering immediate headache, confusion, double vision, and an inability to remember the incident. His confusion lasted the remainder of the game and resolved that day. He remains amnesic to the

incident. The following day his headache persists, but diplopia is his most prominent symptom. He denies nausea, vomiting, tinnitus, focal weakness, lightheadedness, or vertigo. No epistaxis or other nasal drainage. Unremarkable past medical history and no prior head injury or concussion.

Physical Examination:

General: alert and oriented to person, place, and time.

HEENT: pupils equal, round, and reactive to light and accommodation; fundoscopic exam shows normal vasculature and cup to disc ratio. He reports diplopia worsened with down and left gaze and normal vision with upward and right gaze. Gaze is conjugate to the observer.

Neurological: cranial nerves II–XII intact, reflexes 2+ throughout, upper and lower extremity strength 5/5, Romberg is negative, Cerebellar function intact with finger to nose and rapid alternating movements; gait normal

Modified MMSE: short-term recall 1/3, months in reverse 11/12, and serial 7's 5/5
Cardiopulmonary and abdominal examinations are normal

Differential Diagnosis:

Postconcussive syndrome

Cerebral contusion

Right IV cranial nerve paresis

Left VI cranial nerve paresis

Partial III cranial nerve paresis

Orbital floor fracture with extraocular muscle entrapment

Monocular diplopia secondary to intrinsic eye dysfunction

Intracranial hemorrhage

Traumatic optic neuritis

Tests & Results: MRI brain was negative for any brain contusion, volume loss, diffusion abnormalities, or intracranial hemorrhage. MRI orbits shows normal extraocular muscle in course and caliber and was negative for any optic nerve abnormality. Referral to neurology and neuro-ophthalmology revealed a right hypertropia consistent with right cranial nerve palsy.

Final/Working Diagnosis: R Cranial nerve IV palsy.

Treatment: He was withheld from participation in lacrosse for the remainder of the season. He was followed by neuro-ophthalmology and showed resolution of his diplopia over the course of approximately 6 months. Surgical options including resection of the right inferior oblique muscle were offered if his diplopia persisted.

Outcome: He redshirted that season with full recovery to begin practice with the team in late fall.

Return to Activity and Follow-Up: He was permitted aerobic activity workouts approximately two weeks after his initial concussion. His headache and other symptoms never returned and he remained amnesic to the event. Contact permitted in the late fall when diplopia resolved. He was followed approximately every 6 weeks by neuro-ophthalmology until cleared for contact activity. He did not require surgery.

Head Trauma in a Senior College Football Player

Irfan M. Asif, MD, Kimberly G. Harmon, MD, and John W. O'Kane, MD.
Presenter: Irfan M. Asif.

Affiliation: University of Washington, Seattle, WA.

History: 22-year-old senior college football free safety sustained a head injury while making a tackle. Initially, he drove his helmet, with his neck slightly flexed, into the ball carrier. His helmet flew off and his occiput was driven into the ground. The ball carrier subsequently landed on top of him. Medical staff responded immediately. The player was unconscious, heart rate was in the 120s, with shallow respirations, and a GCS of 6. He was spine boarded. After ~4 minutes, he regained consciousness, but was confused and extremely combative. He was transferred to an ambulance, given 200 mg of succinylcholine, 20 mg of Valium, 10 mg of Pancuronium and intubated. He was transported to a Level I trauma center.

PMHx:

Concussion 8/11/05: out of activity × 1 wk

Concussion 10/13/07: out of activity × 1 wk

Allergies: Penicillin, Sulfa, Azithromycin

Meds: none

Physical Examination: Temp: 36.9; HR: 110; BP: 140/70; RR: 30; he was intubated, but arousable; 2 cm laceration on upper lip; cardiovascular, pulmonary and abdominal exams were normal; pupils were 4 mm and reactive, EOMI, +corneal reflexes; normal reflexes; Babinski downgoing bilaterally.

Differential Diagnosis:

Concussion

Neck /spinal cord injury

Epidural hematoma

Subdural hematoma

Subarachnoid hemorrhage

ER Tests & Results: CBC, Chem-10, Coags: normal; CXR: normal; CT Head: no acute intracranial abnormalities; no fractures; CT Cervical Spine: normal alignment; no fractures.

Initial Diagnosis: Concussion

Hospital Course: He was given fluids, extubated, and transferred to the ICU for observation. A routine evening neuro exam was notable for disconjugate gaze. A MRI was ordered to evaluate for possible slow-onset hemorrhage or hematoma. 3 Tesla Brain MRI/MRA: Multiple punctate microhemorrhages throughout the cerebral hemispheres, pituitary and parietal lobes, consistent with shear injury. Normal MRA of the brain and neck.

Twelve hours post-injury, alert, but “foggy”. He could remember recent events, but could not recall what had led him to the hospital. EOMI and PERRLA. He could tandem walk, had a negative Romberg, but inaccurate finger to nose testing. He had difficulty with 3-word recall at 5 minutes and months of the year backward. He was able to do serial 3's and sequencing up to 4 digits forwards and backwards, although he could previously do 5.

Neurology consultation recommendations: “the patient should avoid contact or collision sports at least for the season with serious discussion about permanent discontinuation given intracranial pathology (based on the 1997 AAN Guidelines).”

Consultations from neurosurgery and a sports neurologist were to repeat MRI at 6 weeks and consider return to play if microhemorrhages and symptoms were resolved. Microhemorrhages may be acute phenomena found “incidentally” vs sequela from previous head injuries.

He was restricted from activity. For several weeks, he felt “not right” and had persistent headaches. He had difficulty with concentration and memory in school. He was started on Bupropion for depressive symptoms at 5 weeks post-concussion.

Follow-up MRI (7 weeks post-concussion): Persistent microhemorrhages throughout brain parenchyma.

Neuropsychological Testing: Well-preserved abilities in reading, spelling, and math. Good immediate working memory and ability to retain information over time, especially with practice on most tasks. Mild to moderate impairments in left hand fine motor speed, measures of complex attention, and frontal executive function; specifically, with error detection/correction and initial strategy development. There was mild disruption in delayed recall of more complex verbal memory information, fluency, and inference. Regions affected correlated with areas of microhemorrhage on MRI.

Final Working Diagnosis: Concussion with postconcussive syndrome, as well as diffuse cerebral microhemorrhages seen on MRI.

Treatment and Outcomes: Patient was restricted from play for the rest of the season and advised to discontinue football. The implications of microhemorrhages, usually seen only post-mortem or in those with chronic traumatic brain injury, pertaining to injury severity, prognosis, and return to play in concussions is unknown as advanced imaging is often not obtained. This case brings up provocative issues regarding concussion evaluation and management.

64-Year-Old Male Recreational Tennis Player with Shoulder and Chest Pain, Fever, and Weakness

David G. Liddle, MD, and Amy Powell, MD.

Presenter: David G. Liddle.

University of Utah, Department of Internal Medicine, Salt Lake City, UT.

History: 64-year-old right-handed tennis player presents with right shoulder and chest pain, fever, and weakness. The patient is blind in his right eye secondary

to a detached retina. One month prior to presentation the patient was playing doubles tennis and could not see his partner coming from the right and the two collided at full speed, forcing his right shoulder posteriorly. He sought no medical therapy and treated his pain with over the counter analgesics. Seven days prior to presentation he had acute onset of pain at the right SC joint, clavicle, and shoulder; worse with active ROM or weight bearing. The pain progressed to involve the right chest to the 8th rib and the soft tissues of the arm, chest, and neck. Shoulder series X-rays showed no evidence of fracture. In addition to his pain, he complains of a new course voice with hypophonia. He endorses fevers, chills, and rigors. He denies SOB, dyspnea, LEE, recent surgery, known cancers, recent immobility, or h/o DVT. ROS was otherwise negative. He has no significant PMH. He works as a painter but family and social history is otherwise noncontributory.

Physical Examination:

VS: Temp: 38.6; RR: 24; HR: 105; BP: 110/57; Sat O₂: 85% RA; Pain: 10/10. Moderately ill appearing with dry mucous membranes, JVP 5 cm ARA with patient at 30 degrees, neck ROM limited by pain with induration and erythema overlying the right SC joint and that spreads over the right anterior chest as well as onto the bilateral neck from the larynx to the sterna notch. CV, respiratory, and abdominal exams were unremarkable. The right shoulder is TTP with pain out of proportion to the stimulus and the right brachium is swollen and TTP.

Differential Diagnosis:

SC joint dislocation with local inflammatory reaction
Septic Arthritis
Cellulitis
Subcutaneous Emphysema

Tests & Results: WBC 21K w/ 96% PMNs and 30% Bands; Cr. 1.6; Lactate 1.2. CBC and CMP otherwise WNL. Shoulder Series X-Rays: OA for GH and AC joints without fracture or dislocation.

CXR: No acute cardiopulmonary process. No subcutaneous air.

CT Neck: Large inflammatory change centered at the right sternoclavicular joint likely representing septic arthritis with adjacent phlegmon.

CT Neck & Chest with Contrast: Right sternoclavicular septic arthritis with several fluid collections, most prominent posterior to the right SC joint, the largest measuring 2.3 × 2.1 cm. The right subclavian vein is compressed at the first rib but is patent.

Final/Working Diagnosis:

Sepsis secondary to right SC joint septic arthritis with associated abscess and ARF.

Hypophonia secondary to compressive edema on the right. recurrent laryngeal nerve.

Treatment: Patient initially treated with aggressive IVF resuscitation as well as Vancomycin, Zosyn, and Clindamycin.

Eventually the abscesses were drained and cultures grew E. Coli sensitive to Ciprofloxacin.

Outcome: By discharge he was able to move his right arm without pain and near normal ROM, he had no more visible erythema, was afebrile and his WBC had returned to normal. A repeat abscessogram revealed residual pocket of at least 20 ml volume. He was discharged with the drain in place and scheduled for repeat imaging and possible drain removal. Infectious disease recommended 3 weeks of Ciprofloxacin followed by repeat imaging and ID follow up. Patient was scheduled for Colonoscopy given E. Coli infection and concern for neoplasm.

Return to Activity and Follow-Up: Once the drain was removed he participated more effectively in physical therapy and eventually returned to painting and tennis. He now plays singles.

Chest Pain: An Unlikely Culprit and Complex Return to Play Considerations

Joseph Armen, DO, and Jason Blackham, MD.

Presenter: Joseph Armer.

Affiliation: East Carolina University, Greenville, NC.

History: A 19-year-old African American NCAA Division I offensive lineman developed substernal chest pain after an off-season conditioning

session. The discomfort progressed over a two-hour period with radiation to the back and a sensation of heaviness and tingling in the left upper extremity. Mild shortness of breath, nausea and one episode of emesis were also reported. Approximately 6 weeks prior to developing chest pain, he suffered from a gastrointestinal illness with abdominal cramping, nausea, vomiting and diarrhea. At that time, he had a transient mild elevation in his creatinine and liver transaminases along with a mild microcytic anemia. More recently within a week of the onset of his chest pain, he was suffering from a respiratory infection with a frequent productive cough.

Physical Examination:

Vitals: BP: 202/94; P: 84; RR: 20; T: 98; Sat O₂: 97%

General: mild distress and diaphoresis

Neck: supple; no JVD or bruit; carotid pulse 2+ with a brief upstroke

Heart: RRR; S1 and S2 normal; no murmurs, rubs or gallops

Chest Wall: moderate tenderness to palpation

Lungs: decreased air movement bilaterally without wheezing or crackles

Abdomen: soft and nontender without masses; normal bowel sounds

Extremities: 2+ bilateral femoral artery pulses; no lower extremity edema

Differential Diagnosis:

Costochondritis

Bronchitis

Reactive Airway Disease

Pulmonary Embolus

GERD / Esophageal Spasm

Acute Coronary Syndrome

Myocarditis / Pericarditis

Aortic Dissection

Tests & Results: An electrocardiogram (ECG) demonstrated ST elevations in the anterior leads. Troponin-I and CKMB were both elevated. A heart catheterization demonstrated a heavy thrombus burden in the proximal left anterior descending coronary artery with a 30%–40% ostial plaque noted distally in the first diagonal branch. The ejection fraction was estimated to be 45% with anterolateral hypokinesis present. A thrombectomy was performed and intracoronary thrombolytics were given. A transesophageal echocardiogram was subsequently completed and negative for any intracardiac defect that may have resulted in a paradoxical embolism.

Hypercoagulable work-up was remarkable for heterozygous factor V lieden, mild hyperhomocysteinemia, dyslipidemia, and an equivocal presence of a lupus anticoagulant.

A 6-week follow-up echocardiogram demonstrated hypokinesia of the mid-to-basal septum and an ejection fraction of 55%–65%. An exercise cardiolute scan was completed reaching 95% of his maximum predicted heart rate with no evidence of exercise induced ischemia. However, a fixed defect of moderate severity consistent with scar involved the apex and distal half of the anterior wall.

At approximately 3 months, a T-wave alternans and a signal average ECG were both positive suggesting an increased arrhythmogenic potential. A 24-hour holter monitor was then completed with just minimal ventricular ectopy noted, and an electrophysiologic study could not induce clinically significant supraventricular or ventricular tachycardia.

At approximately 9 months, a repeat exercise nuclear stress test demonstrated no evidence of ischemia. Coronary angiography was also repeated with no angiographically significant coronary artery disease. An intravascular coronary ultrasound (IVUS) demonstrated mild luminal plaques in the proximal LAD without ulceration or other high risk findings. A LipoProfile demonstrated a small (Pattern B) LDL particle size with a borderline quantitative particle number.

Final/Working Diagnosis: ST-elevation myocardial infarction/coronary thrombosis.

Treatment: After his acute interventional treatment, he was medically managed with aspirin, plavix, lisinopril, metoprolol, lipitor, niaspan, fish oil and folic acid. Plavix was discontinued after one year.

Outcome: No recurrent cardiovascular events over a 21-month interval to date.

Return to Activity and Follow-Up: Began light cardiovascular exercise after his 6-week follow-up. Resistance exercise initiated at 12 weeks, and full

unrestricted noncontact activity after 24 weeks. Close follow-up with primary care sports medicine, cardiology and hematology. He was medically red-shirted, and returned to competitive contact athletics after one year.

Chest Pain in a Collegiate Basketball Player

Lora Harrison, MD, Jon Divine, MD, Michael Miller, MD, and Lisa Lee, MD. Presenter: Lora Harrison.

Affiliation: Cincinnati Children's Hospital Medical Center, Cincinnati, OH.

History: 18-year-old AA male, Division III basketball player presented for freshmen preparticipation evaluation (PPE). He described three episodes of "cramping" chest pain, light-headedness, and tiredness with intense exercise within the past three years. Two episodes occurred while exercising in the heat, and one occurred at rest. The pain resolved with a few minutes rest and he returned to play without difficulty. He denied any nausea, vomiting, syncope, shortness of breath, or palpitations. He thought someone told him he had "high blood pressure," but he was otherwise healthy with no hospital admissions or surgeries. He had a "normal" EKG two years ago, but had no further evaluation. No one ever told him or his family members that they could not play sports. There was no family history of sudden death. He took no medications, vitamins, or supplements.

Physical Examination:

V/S-height of 196 cm, weight of 94 kg, pulse of 48, and blood pressure of 158/78 (with appropriate-sized cuff and similar results on repeat measurements)

General: well appearing 18-year-old male

Chest: clear bilaterally with no tenderness to palpation

CV: 1/6 systolic murmur at the left sternal border, resolved with standing and Valsalva

The remainder of his physical exam is unremarkable.

Differential Diagnosis:

Cardiac: Structural = hypertrophic cardiomyopathy, athlete's heart, mitral valve prolapse, dilated cardiomyopathy; Conduction = prolonged QT, supraventricular tachycardia, arrhythmogenic right ventricular dysplasia; Coronary arteries = anomalous coronary artery, coronary artery disease (with history of Kawasaki's disease or hyperlipidemia), coronary artery fistula
Musculoskeletal: costochondritis, muscle strain, trauma

Respiratory: exercise-induced bronchospasm, acute infection

GI: gastroesophageal reflux

Heme: sickle cell trait with sickling in the heat

Other: anxiety, supplement/medication/drug use

Tests & Results:

EKG:

Sinus bradycardia with HR of 52/min

LVH with strain pattern

QT/QTc = 420/390 msec

Stress echocardiogram: concentric LVH

Septal thickness 1.6 cm / wall thickness of 1.4 cm = ratio 1.14

Normal systolic performance: max. E_JF = 85%, 65% at rest

No outflow tract obstruction

24-hour Holter:

No symptomatic events

One × 7 beat run of monomorphic, non-sustained ventricular tachycardia

140–150/min

Final/Working Diagnosis:

Systolic hypertension.

Concentric left ventricular hypertrophy: the etiology of his hypertrophy is unknown and he falls into the "grey zone" between Athlete's Heart and HCM.

Treatment: The adult cardiologist who read the echo was uncomfortable clearing the athlete due to this "grey zone." He recommended that the athlete have a formal evaluation to examine his risk for sudden death. Pediatric cardiologist: recommended stopping all exercise for 2 months, evaluate and treat the hypertension, repeat testing in 2 months. Rx'ed: atenolol 50 mg qday. Second adult cardiologist (patient sought) who felt that his findings were athlete's heart and cleared him to play. A third adult cardiologist reviewed the

case as a courtesy and was concerned about HCM, but he wished to discuss the case with his department before making any formal recommendations.

Outcome: The sports medicine department is awaiting the cardiology department recommendations. After receiving recommendations from the third cardiologist group, the potential risks and benefits of participation will be reviewed with the player, his family, the athletic director, college president, coaches, and athletic trainers. If needed, they will refer him to another city to see an expert in differentiating athlete's heart from hypertrophic cardiomyopathy. This may include cardiac MRI and genetic testing.

Return to Activity and Follow-Up: The athlete is participating without restrictions or symptoms. He is taking atenolol as prescribed. He will need annual cardiac evaluations to look for any progression in his left ventricular hypertrophy.

Palpitations in a Surfing Triathlete

Jennifer A. Roth, MD, and Walter C. Taylor, MD.

Presenter: Jennifer A. Roth.

Affiliation: The Mayo Clinic, Jacksonville, FL.

History: Forty-five minutes after completing the half-mile swim portion of a sprint triathlon relay, a 29-year-old male triathlete presented to the medical tent with complaint of palpitations. The patient reported feeling vaguely fatigued during the race, but completed the swim. He then surfed for approximately 30 minutes and at this point he became aware of an irregular racing pulse. At the medical tent, the patient denied initial chest pain or shortness of breath. He was placed on a monitor and the rhythm was evaluated. Shortly thereafter, the patient developed shortness of breath and was transferred to a local hospital for continued care.

Physical Examination: Vitals: Afebrile, BP: 110/80 sitting, 120/70 supine; HR: irregular, 120s palpated, 160s auscultated; Respirations: 16

General: well nourished fit male, anxious, but in no acute distress

CV: irregularly irregular tachycardia, no murmurs, rubs or gallops

Respiratory: clear to auscultation bilaterally

Extremities: no clubbing, cyanosis, edema

Differential Diagnosis:

Supraventricular Tachycardia

Atrial fibrillation

AV nodal Re-entry Tachycardia

Sinus

Tachycardia

Long QT syndrome

Wolff Parkinson White

Tests & Results:

July 12, 2008: Initial monitor strip 9:30 AM - irregularly irregular narrow complex tachycardia with average rate of 180.

EKG: 10:24 AM Sinus tachycardia, rate 145 with Mobitz Type I 2nd degree AV block and premature atrial contractions.

11:38 AM: Atrial fibrillation with rapid ventricular response, rate ~137.

CXR: Within normal limits, normal heart size, lungs and bony thorax.

Troponin 0.12, 0.10, 0.05

TSH 1.46

Final/Working Diagnosis: Lone Atrial Fibrillation.

Treatment: July 12, 2008: Patient was admitted to local hospital for new onset atrial fibrillation; treated with Cardizem and Heparin drip. Remained in atrial fibrillation for less than 24 hours.

July 13, 2008: He spontaneously converted to normal sinus rhythm, rate 70; echocardiogram demonstrated left ventricular ejection fraction 50%–55%, otherwise normal; discharged without anticoagulation or antiarrhythmics.

Outcome: July 25, 2008: Patient noted recurrence of symptoms 12 days after discharge while working on an archeological dig in Gainesville, FL. Patient reports vague chest tightness and fatigue. No shortness of breath, diaphoresis, nausea or palpitations. Presented to local ER. Initial EKG showed normal sinus rhythm, rate 70. Given recent history of atrial fibrillation, he was admitted for monitoring. At 2:20 AM, patient was noted to have narrow complex tachycardia, rate 220. He converted to sinus rhythm with one dose of

adenosine. Conduction pattern during tachycardic episode was suspicious for Wolff-Parkinson-White syndrome. Discharged in stable condition and referred for electrophysiology (EP) study with possible ablation.

July 28, 2008: Exercise treadmill test adequate HR achieved, normal study.

August 20, 2008: EP study found inducible sustained AV nodal reentrant tachycardia that was successfully ablated.

Return to Activity and Follow-Up: December 2008: the patient reports doing very well. He has returned to swimming and biking for fitness, but has not competed in another triathlon. He also continues to surf as much as possible. He denies any recurrence of chest pain or palpitations.

Sudden Death in a 17-Year-Old Baseball Catcher

Nathan T. Holmes, MD, David Berkson, MD, and Dug Su Yun, DO.
Presenter: Nathan T. Holmar.

Affiliation: Crozer Keystone Family Medicine Residency Program, Springfield, PA.

History: During a Keystone State Games baseball game on July 25, a 17-year-old catcher was struck by a foul-tipped regulation baseball in the left chest. He was wearing a standard chest protector at the time. He immediately stood up, took 3 steps, rubbed his left chest, paused for a second and collapsed onto his back. Medical coverage at the game, 2 resident physicians, immediately rushed to the aid of the player.

(Note: Video of the incident will be shown during the presentation.)

Physical Examination: Initially he was unresponsive, with a weak carotid pulse and shallow breathing at 10 respirations per minute with some myoclonic movements in his lower extremities. He had clear breath sounds in all lung fields. Within 30 seconds he became pulseless, respirations decreased to 4 per minute, and he began to show perioral cyanosis.

Differential Diagnosis:

Comotio Cordis
Hypertrophic Cardiomyopathy
New onset seizure
Ruptured aortic aneurysm
Cardiac channelopathy

Tests & Results: No tests were available on the field other than physical examination.

Final/Working Diagnosis: Comotio Cordis.

Treatment: Immediate 2-person CPR was initiated, EMS activated, and an AED was called for. Two cycles of CPR (30:2) were done followed by reassessment showing no pulse and no spontaneous breath attempts. Five more cycles were completed with no change. After reassessment, another 2 more cycles were completed. Five minutes after the athlete collapsed 4 additional physicians arrived with an AED that was immediately placed. Cardiac rhythm was analyzed and a shock recommended. One shock was given and CPR resumed. After approximately 1 minute and 75 compressions the athlete regained strong carotid and radial pulses and spontaneous respirations. He remained unresponsive and unconscious with a left medial eye drift. Nine minutes after the event EMS arrived and the athlete was transported to the hospital. The AED unit was taken for interrogation. While in the ambulance, he continued to have left eye medial deviation. He seized once in the ambulance, and then again in the emergency department.

Outcome: Initial work up in the emergency department was for a seizure, until on-field events were relayed to the emergency physician by the medical staff at the field. He regained consciousness in the emergency room but was confused and had visual loss. His vision returned over the next few hours. The athlete was then admitted to the ICU for observation. While there, he had aphasia, delayed reaction time and altered memory. Over the next 48 hours, his mental status returned to baseline and he was discharged from the hospital on July 27th.

(Note: Tracings of the AED interrogation will be shown during the treatment/outcome portion of the presentation.)

Return to Activity and Follow-Up: Discharge instructions included no activity for 4–6 weeks and further testing as determined by his follow-up cardiologist. He was initially evaluated by an adult cardiologist and placed on amiodarone. Subsequent evaluation by a pediatric cardiologist led to

discontinuing the amiodarone and a stress test at 6 weeks. His testing was completed on September 12, 2008 and was negative. He returned to play the next day. He is back to his “normal” routine with no adverse effects from the episode. He is looking at Division II colleges and entertaining scholarships.

An Unusual Cause of Exercise Associated Collapse

Jamie M. Nuwer, MD.

Affiliation: O'Connor Hospital, San Jose, CA.

History: A 27-year-old female distance runner collapsed at mile eleven during the San Jose Rock n' Roll Half Marathon. The runner was assisted to the medical station at mile eleven by two volunteers. At that time she limped on her right leg. The patient was fully conscious and talking. She was brought to the tent and laid on a cot. On further history the patient admitted to a similar episode while training 3 days prior to the race. It was a milder episode, and she was able to recover with a brief period of rest. She took the following 2 days off from training and decided to continue with her participation in the half marathon. The patient had recently been diagnosed with multiple sclerosis (MS).

Physical Examination: Her exam revealed normal blood pressure and pulse rate. Generally, she was not in any distress. Heart and lung exam were normal. Neurologic testing revealed numbness to light touch of the right-sided lower extremity from hip to foot. Motor abnormalities were subtle, still scoring a 5/5 on motor strength, but slightly decreased compared with the left side. Reflex testing of the lower extremity revealed a relative hyper-reflexia of the right side compared to the left. Cranial nerve testing was normal.

Differential Diagnosis: Differential diagnoses included TIA, CVA, and CNS mass or lesion. Given the patient's recent MS diagnosis, MS flare was highly suspected.

Tests & Results: The race coordinator and EMS were notified at this time, but the patient refused transport to the ER.

Final/Working Diagnosis: Uhthoff's phenomenon in a young patient recently diagnosed with multiple sclerosis. Uhthoff's phenomenon is a transient worsening of MS symptoms when body temperature increases. It is due to temperature-induced decreases in axonal conduction in patients with MS.

Treatment: The patient sat herself up on the cot and drank some rehydration fluids. After about 30 minutes, the patient declared that she felt better and wished to return to the race. At this time her neurologic signs had almost completely resolved.

Outcome: Against our advice she returned to finish the last 2.1 miles of the race and promised to receive care at the final medical tent.

Return to Activity and Follow-Up: At the time of diagnosis of MS the patient had already been training for the half marathon. Furthermore, despite an MS flare 3 days before the race, she decided to continue participation in the event. In the past, patients with MS were discouraged from participating in athletic activities. However, over the last few years that view has changed. According to a 2008 review published in the journal *Multiple Sclerosis*, sufficient evidence exists for recommending endurance training at low to moderate intensity. MS patients gain the same fitness and psychological benefits from exercise as healthy controls.

In retrospect it may have been an appropriate management decision to approve the patient's decision to continue the race after cooling down and complete resolution of symptoms. Currently, some devices are being developed to help MS patients stay cool while exercising. These devices may help MS patients more easily reap the benefits of exercise.

49-Year-Old Female with Neck/Shoulder Pain and Exertional Dyspnea

Modern Weng, DO.

Affiliation: Kaiser Permanente of Walnut Creek, CA, Dublin, CA.

History: 49-year-old white female runner with PMH significant for right-sided rib fractures about 25 years ago, not on any medications, non-smoker who initially presented to her PCP 11 months previously with a worsening sore throat, dry cough, subjective fever, and ear pain just 8 days after running the San Diego Rock 'n Roll Marathon. She was diagnosed with bronchitis and given azithromycin. Fifteen days later, the patient returned to her PCP's office

complaining of dyspnea on exertion. She usually runs 5–15 miles/day, but now feels dyspneic after running less than one mile. The patient also notes left sided chest pressure with inspiration and exertion. The dry cough, sore throat, subjective fever symptoms have now decreased significantly. Patient adds that her current symptoms started when she woke up one morning with “terrible pain” in the left posterolateral neck going toward the left shoulder.

Physical Examination:

117/68, 60, 12, 97.9°F, 99% on RA

General: WNWD, NAD, A/O × 3

HEENT: no oral or nasal lesions

CV: RRR, no murmurs.

Lungs: CTA b/l.

Abd: soft, NT, ND, +BS

Ext: no swelling, Neg Homan's sign

Differential Diagnosis:

Arrhythmia

HOCM

Angina

PE

Mycoplasma pneumonia

Pneumothorax

Exercised induced asthma

Vocal cord dysfunction

Diffuse interstitial lung disease

GERD

EBV infection (mono)

Sarcoidosis

Tuberculosis

Primary lung malignancy

Cervical radiculopathy

Tests & Results: CBC, BMP, ESR, D-dimer are all normal.

EKG: NSR, no ST elev/deprsn, TWI in lead II.

CXR: Negative.

ETT: Negative. Albuterol, Advair, Spriva all without any benefit.

Omeprazole: no benefit.

Flexible endoscopy: no vocal cord dysfxn.

CT: elevation of left hemidiaphragm.

Sniff Test: left hemidiaphragm paralysis.

EMG: absent left phrenic nerve response.

Final/Working Diagnosis: Parsonage-Turner Syndrome or acute brachial neuritis/plexitis.

Treatment: Physical therapy with scalene, trapezius, peri-scapular, and core strengthening. Rib, diaphragm, and soft tissue mobilization. Incentive spirometer. Breathing/posture conditioning.

Outcome: After 4 months of consistent physical therapy, spirometer measurements increased from initial 1800 ml to 2700 ml. Patient was able to gradually increase her mileage and run comfortably about 40 miles/week. Still, the patient complained of occasional dyspnea on exertion. Patient did achieve goal of running a marathon without complications. No difficulty with work as personal trainer. The patient's initial neck/shoulder pain resolved spontaneously after a few weeks.

Return to Activity and Follow-Up: Parsonage-Turner Syndrome or acute brachial neuritis/plexitis can, in about 5% of cases, involve extra brachial nerves such as the phrenic nerve. Parsonage-Turner Syndrome is a relatively rare condition, with incidence of 2 cases per 100 000. About 25% of patients present with antecedent flu-like symptoms. Then a characteristic pattern of pain in the shoulder and arm, followed by profound weakness, typically in the digits of the hand.

An Uncommon Metabolic Deficiency with a Common Complaint in a College Track and Field Athlete

Jeevan Errabolu, MD, John Leddy, MD, FACSM, and Victoria Mitchell, ATC. Presenter: Jeevan Errabolu.

Affiliation: University Sports Medicine, SUNY at Buffalo School of Medicine and Biomedical Sciences, Buffalo, NY.

History: 20-year-old Caucasian female long distance runner complained of increasing exercise fatigue for several months. Patient started noticing worsening

exercise intolerance especially for the past 2 months. Patient states that her legs feel tired and heavy during running with associated labored breathing. No history of asthma or VSD. She had a history of iron deficiency anemia in high school. Two months prior to presentation she had a low serum ferritin with a normal hemoglobin. Iron supplementation, however, did not improve her symptoms.

She and her coach have reviewed her training routine very carefully and confirm that she has not been over-trained. She reports significantly worsening times in 5K and 10K runs. Her mileage peaked at 55 miles/week for 4 weeks and she was on a taper at the time of presentation. Taking appropriate breaks from training and nutritional adjustments did not help. Patient reports occasional diarrhea but denies excess caffeine intake, lactose intolerance or food allergies. She is on OCPs with no menstrual irregularities. Patient is otherwise in good health. Remainder of pertinent review of systems is negative for wheezing, muscle swelling, pain, rashes, joint swelling, fever, chills, weight loss, nocturnal symptoms or travel history. Past medical and surgical history: none. Family history: non-contributory. Allergies: NKA. Social history: non-smoker, non-drinker. Current medication: Iron Sulfate 325 mg bid.

Physical Examination: Appears well and fit at 5'3", 112 lbs

Vitals: Afebrile; BP: 110/70 mmHg; Respirations: 12/min; Pulse: 60 bpm

Head and neck: unremarkable (no lymphadenopathy or thyromegaly). CVS-SI, S2 regular rate and rhythm, no murmur, rubs or gallops

Lungs: within normal limits

Abdomen: soft, non-tender, bowel sounds positive, no organomegaly, no masses, no inguinal

Lymphadenopathy

Musculoskeletal: muscles non tender to palpation, good tone and bulk, joints non-tender, no joint swelling

Neurological: CN II- XII, DTRs, sensations, and strength intact; no rash

Differential Diagnosis:

Anemia

Iron deficiency

Thyroid dysfunction

Infectious etiology

GI Disorder

Metabolic Disorder

Nutritional deficiency

Mitochondrial dysfunction

Skeletal muscle disorder

Tests & Results: CBC, TSH, CMP, Urinalysis, ESR, Amylase, Lipase, Celiac Panel, Iron studies, Ammonia, CK, LDH, Aldolase, Lactic acid, Vitamin D, B12, Folic acid-WNL; infectious mononucleosis negative for acute infection

Total Carnitine: 20 - low (normal range 31–67 umol/L)

Free Carnitine: 18 - low (normal range 25–55 umol/L)

Carnitine Esters: 2 - low (normal range 3.8–19 umol/L)

Resting plasma lactate: 10 mg/dl (normal 4–16 mg/dl)

Post 6-minute walk plasma lactate: 7 mg/dl (4–16 mg/dl normal)

Final/Working Diagnosis: Serum Carnitine deficiency leading to mitochondrial dysfunction as a cause of exercise intolerance and exertional fatigue.

Treatment: Oral Carnitine supplementation 330 mg tid. Repeat blood work and clinic follow up every 2–3 months.

Outcome: Serum Carnitine levels returned to normal by 4 months of treatment and she ran her personal best indoor 3-mile run 5 months into therapy.

Return to Activity and Follow-Up: She is participating in the college track and field season without any restrictions. She and her coach are monitoring her performance and symptoms. Carnitine supplementation and regular clinical follow ups are ongoing.

Markedly Abnormal Electrocardiogram in a Division I College Basketball Player

Chadwick M. Palmer, MD, and Jonathan Drezner, MD.

Presenter: Chadwick M. Palmer.

Affiliation: University of Washington, Seattle, WA.

History: A 19-year-old African American male Division I college basketball player presented with an anterior cortical tibial non-union stress fracture. After failed conservative treatment, he was scheduled for percutaneous intramedullary nailing. During his pre-operative evaluation, an electrocardiogram (ECG) was found to be markedly abnormal with deep negative T-waves and ST depression in the inferior limb and lateral precordial leads. He had no history of cardiac disease and denied any history of chest pain, dyspnea with exertion, palpitations, near-syncope or syncope. His father had a history of hypertension and hyperlipidemia, but there was no family history of sudden cardiac death, cardiomyopathy, or other heart disease. He did have an aunt who died in her forties of unknown cause.

Physical Examination:

Ht: 78"; Wt: 269 lbs; BP: 120/80; Pulse: 72

Neck: no lymphadenopathy, no JVD, no bruits

Lungs: CTAB

CV: RRR, no murmurs standing, supine, or with Valsalva, no gallops/rubs, normal S1/S2

Pulses: 2+ with symmetric femoral and radial pulses

ABD: soft, non-tender, non-distended, normal bowel sounds

Differential Diagnosis:

Hypertrophic Cardiomyopathy

Dilated Cardiomyopathy

Left Ventricular Non-compaction

Hypertensive Left Ventricular Hypertrophy

Infiltrative Myocardial Disease (Amyloidosis, Sarcoidosis, Hemochromatosis)

Athlete's Heart

Structurally Normal Heart

Tests & Results:

1. Echocardiogram showed concentric LV hypertrophy with a wall thickness of 16 mm. Diastolic relaxation and filling pressures were normal, and there was no evidence of LV outflow tract obstruction.
2. Cardiac MRI showed normal LV function/size/mass: EF: 61%; LV mass 83.1 g/m²; maximal LV wall thickness 12–13 mm. There was a small portion of delayed enhancement in the apical mid-septum of uncertain significance.
3. Cardiopulmonary Exercise Test showed a maximal oxygen uptake of 36.2 ml/kg/min which is within the normal range for a young male, but lower than expected for an active aerobic athlete, especially one at the Division I level. He showed no signs of ventilatory or gas exchange limitation, and his maximal exercise limitation was cardiac in pattern. Maximum BP was 190/68 during exercise with more exercise-associated hypertension than expected for an active subject his age.
4. Nuclear Stress Test showed no wall motion abnormalities and no evidence of myocardial ischemia or infarction.

Final/Working Diagnosis: 1 Markedly abnormal ECG without evidence of structural heart disease.

Treatment and Outcome: After careful cardiology consultation and reassessment of all cardiac imaging, it was determined that no structural heart disease was present. While the initial echocardiogram suggested concentric LV hypertrophy, subsequent cardiac MRI was within normal limits and thought to be a more accurate depiction of cardiac morphology.

Return to Activity and Follow-Up: The athlete was cleared to return to athletic participation and will be followed closely by cardiology and monitored for the development of cardiomyopathy with repeat echocardiogram and cardiac MRI (if needed) every 6 months while participating in competitive athletics.

Markedly abnormal ECGs in apparently healthy young athletes may represent the initial expression of underlying cardiomyopathy. Pelliccia et al (NEJM 2008) found that 6% of athletes with markedly abnormal ECG patterns and initially normal structural evaluations developed cardiomyopathies when followed longitudinally. This case exemplifies the complex nature of interpreting ECGs and the subsequent diagnostic evaluation in young competitive athletes. Sports medicine physicians must recognize that abnormal ECGs with diffusely distributed and deeply inverted T-waves may indicate the initial sign of underlying cardiac disease. The potential for adverse outcomes and the development of cardiomyopathy warrants continued surveillance with serial morphologic evaluations.

A Rare Cause of Syncope in a High School Athlete

Andy Peterson, MD.

Affiliation: University of Wisconsin, Madison, WI.

History: 17-year-old high school wrestler and football player suffered 2 episodes of syncope with exertion. During the first episode, he was doing a strenuous wrestling drill set in a slightly dehydrated state. The second occurred while running "suicides" at the end of practice. He and his coaches ignored the first episode, but he was evaluated by his primary care physician following the second episode. He had a normal physical examination, including detailed cardiovascular and neurological examination. Resting and stress electrocardiogram as well as resting transthoracic echocardiogram were normal. He was cleared to return to full participation. He successfully completed the high school wrestling season without further incident.

During the following 3 months, he conditioned for football and suffered 2 additional episodes of syncope. Both occurred while lifting weights. These were not brought to medical attention.

In July, he was working on his family's farm, including heavy lifting, when he suffered stroke-like symptoms. Specifically, he had abrupt onset of right arm and right leg weakness, lightheadedness, dysarthria and dizziness. He collapsed to the ground, unable to stand or walk, but awake and alert. The collapse was witnessed. No headache or other symptoms prior to onset. He was transported to the Emergency Department.

Physical Examination: Awake, but fatigued appearing. Vital signs were normal. Well-developed muscular body type. Responds to questions quickly and appropriately, but is mildly dysarthric. Normal head and neck, fundoscopic, cardiovascular, pulmonary, abdominal, and dermatological examinations.

On neurological examination, the patient was unable to walk or stand because of right leg weakness and imbalance. Cerebellar function was otherwise normal. Mild lower-right facial droop. Remainder of detailed cranial nerve examination was normal. Deep-tendon reflexes were normal at the biceps, triceps, brachioradialis, patella and Achilles. Babinski was down-going. Sensation was intact to light touch, sharp-dull discrimination and hot-cold discrimination throughout.

Normal left-sided strength. Profound right-sided weakness throughout. Specifically: 3+/5 deltoid, 4-/5 biceps, 4-/5 triceps, 3+/5 hip flexion, 4-/5 knee extension, 4-/5 knee flexion, 3/5 ankle dorsiflexion, 3+/5 ankle plantarflexion.

Differential Diagnosis:

Ischemic stroke due to intracranial hemorrhage, vascular occlusion, malignancy/mass effect, increased intracranial pressure

Atypical migraine headache

Intoxication

Malingering/factitious disorder

Tests & Results:

CT head without contrast: normal; no evidence of hemorrhage, mass or ischemia.

MRI brain: normal; no evidence of ischemia, mass or other abnormality

MRA brain: stenosis at the origin of the left Middle Cerebral Artery (MCA); normal brain perfusion

CT angiogram brain: bilateral high-grade stenosis of the M1 segments of the MCAs. Most likely congenital; likely Moyamoya variant

Final/Working Diagnosis: Bilateral MCA stenosis; likely Moyamoya.

Treatment: Symptoms resolved within 24 hours of onset. Started on aspirin therapy.

Outcome: Follow-up CT angiograms have demonstrated bilateral progression from stenotic MCAs to complete occlusion of both vessels. MRA perfusion studies continue to demonstrate normal brain perfusion. Patient has been completely asymptomatic. Neurosurgery service is currently recommending bilateral encephaloduroarteriosynangiosis (EDAS).

Return to Activity and Follow-Up: The patient is currently barred from returning to football, wrestling, weightlifting or any activities that could cause rapid acceleration/deceleration head and neck movements or receiving chiropractic manipulation. It is unlikely that he will ever be able to return

to any of these activities. He is allowed to cross-train with low-weight repetitive activities, swim, jog, compete in endurance running events, bicycle and drive a car.

ALTERNATE CASE PRESENTATIONS

Triathlete with Right-Sided Chest and Flank Pain

Aaron Gray, MD, and James Kinderknecht, MD.

Presenter: Aaron Gray.

Affiliation: University of Missouri-Columbia, Department of Family and Community Medicine, Columbia, MO.

History: 46-year-old male triathlete, who was previously healthy, presented to clinic with a 1-month history of slight fatigue while training, a 3-week history of right flank pain, and 4-day history of right upper chest pain. The right flank pain began while lying in bed at night and became so severe that he went to the emergency room. CMP, CBC and urinalysis were normal and his pain improved with NSAIDS. Four days later he returned to the ER with the same right flank pain. He did not have fever, cough, shortness of breath or GI symptoms. CBC and urinalysis were repeated and were normal. Abdominal CT without contrast showed posterior right lower lobe infiltrate with no abdominal pathology. He was treated for pneumonia with levofloxacin for 5 days and an additional 5 days when his pain did not resolve. Four days prior to presenting to clinic he developed right upper chest pain. The pain is intermittent, stabbing, and worse when he lies down on his right side or when he bends forward. He continued to train during this month only noticing a slight decrease in his endurance. In the immediate days prior to presenting to clinic he swam 1000 yards and cycled on an indoor trainer for 1 hour without pain or shortness of breath. He did, however, report that running reproduced the sharp pain in his right upper chest and forced him to stop.

ROS: denies fever, chills or weight loss; denies cough or SOB; denies N/V/D or melena.

Social History: denies smoking or anabolic steroid use; no history of recent traveling

Family History: no significant cardiac history

Surgical History: no recent surgery; right inguinal hernia repair 18 years ago

Medications: multivitamin, vitamin C, glucosamine/chondroitin

Physical Examination:

VS: Temp: 36.4 C; HR: 47; BP: 129/84; Resp: 20; Pulse ox: 99%; Wt: 75 kg
General: no acute distress

CV: bradycardic, regular rhythm w/o murmur, rub, or gallop; no JVD

Resp: clear to auscultation bilaterally without crackles or wheeze; right upper chest pain with deep inspiration and tender to palpation over same area; pain is also reproduced when patient bends forward to touch toes

Abd: tenderness to palpation of RUQ; no rebound tenderness or palpable masses; bowel sounds present

MSK: full ROM of right shoulder without pain; rotator cuff testing normal; full range of motion of right hip without pain; right calf slightly tender to palpation which patient attributes to recent muscle strain; left calf non-tender

Skin: warm, no rashes

Differential Diagnosis:

Pneumonia

Pleuritis

Costochondritis

Pulmonary embolism

Pneumothorax

Muscle strain

Intra-abdominal process

Referred shoulder pain

Acute coronary syndrome

Tests & Results: Hgb: 13.1; Hct: 37.6; Plt: 261 000; d-dimer: 1.89 (NL 0-0.5)

CT chest PE protocol: bilateral lower lobe acute pulmonary artery embolus with Hampton's hump in the right lower lobe costophrenic angle

Bilateral lower leg Doppler U/S: negative

Final/Working Diagnosis: Bilateral lower lobe pulmonary artery embolus.

Treatment: Anticoagulation for 6 months. Advised 2 weeks of initial rest followed by gradually resuming training as tolerated.

Outcome: Pending at time of submission.

Return to Activity and Follow-Up: Protein C, Protein S, Antithrombin-III, and fibrinogen levels were normal prior to start of anticoagulation Factor V Leiden- negative; Prothrombin Gene Mutation- negative; Anti-Cardioliipin Antibody – negative; Testicular exam normal and PSA 0.7.

Six weeks after starting anticoagulation he had recurrence of right chest and flank pain that was worse with training, especially running. A repeat chest CT PE protocol showed resolved pulmonary emboli, but a 3 cm × 2 cm persistent mass density in the right posterior costophrenic angle was found. Further workup is pending at time of submission.

Division I Rower with Bilateral Arm Pain

Margaret E. Gibson, MD, and Jeanne Doperak, DO.

Presenter: Margaret E. Gibson.

Affiliation: University of Pittsburgh Medical Center, St. Margaret Hospital, UPMC Shadyside Hospital, School of Nursing, Pittsburgh, PA.

History: A Division I female collegiate rower presents with bilateral forearm pain, right greater than left, for several weeks. She reports the pain which originates at the elbow and radiates into her hand is causing weakness and decreased sensation in the hand approximately 3 minutes into rowing. She does recall some forearm pain last season which was never severe enough to warrant evaluation or treatment. She denies any trauma, night pain, or neck symptoms. The pain does occur with activities of daily living that require prolonged arm use such as carrying grocery bags.

Physical Examination: The athlete is a 5'10", 170 lb healthy appearing female in no distress. Her forearms appear symmetric without any rashes or skin changes. She has no tenderness to palpation in the elbows, forearms, or hands. She has full ROM at her elbow, wrist, and digits bilaterally. She has 5/5 strength with manual muscle testing of the hands, wrists, and forearms. She has a normal radial pulse and capillary refill bilaterally. Tinel testing at the carpal and cubital tunnels are negative. Her Phalen test is also negative. She has a negative cervical exam including Spurlings test.

Differential Diagnosis:

Stress fracture

Exertional compartment syndrome

Nerve compression-cubital or carpal tunnel

Epicondylitis

Cervical Radiculopathy

Tests & Results:

Compartment pressure testing:

	Right Forearm		
Superficial Flexor	Rest	1 Minute	5 Minutes
	14–15	37	–

The patient exercised with dumbbells for 14 minutes and 48 seconds with good reproduction of symptoms. The catheter placement was confirmed with compression.

	Left Forearm		
Superficial Flexor	Rest	1 Minute	5 Minutes
	23	–	–

Pressure elevated at rest.

Final/Working Diagnosis: Exertional compartment syndrome of the bilateral superficial flexor compartments of the forearm.

Treatment: Right forearm fasciotomy through 2 incisions with complete decompression of entire volar compartment.

Outcome: The patient tolerated the procedure well without any complications. At her two-week follow-up her incisions were healing well and she was asymptomatic.

Return to Activity and Follow-Up: The athlete will increase her activity and monitor for symptom development in her right arm. At the time of submission she is scheduled for fasciotomy of her left arm.

Leg Pain Associated with Moderate Exertion

Phillip T. Henning, DO, Diane Dahm, MD, and Jay Smith, MD.

Presenter: Phillip T. Henning.

Affiliation: Mayo Clinic, Rochester, MN.

History: A 56-year-old male runner was referred to the sports medicine center for evaluation of focal exertional anterolateral leg pain of 8–9 months duration. He reported pain and focal swelling occurring after approximately 15 minutes of jogging at a moderate pace, gradually resolving with rest. He denied any antecedent trauma or major change in training habits or equipment. There was no alteration in his sensation or strength at rest or with exertion. His past medical history was otherwise negative.

Physical Examination: Physical examination revealed a well nourished male with a normal gait pattern. Right lower leg inspection revealed a tender, non-pulsatile area of focal swelling, which enlarged with dorsiflexion and

partially reduced with plantarflexion. Neurovascular examination was normal and unchanged with provocative positioning at rest.

Differential Diagnosis:

Muscle hernia
Lipoma
Varicosity
Arteriovenous malformation
Angioma and soft tissue tumors

Tests & Results: A non-contrast right leg magnetic resonance image (MRI) and non-invasive vascular studies were normal. Diagnostic ultrasound revealed a 5 mm × 4 mm fascial defect overlying the tibialis anterior and extensor digitorum longus muscles. An easily reducible varicose vein was protruding through the defect. A post-exercise scan revealed herniation of the medial edge of the extensor digitorum longus muscle along with the varicose vein through the fascial defect, correlating with the onset of pain and the clinically palpable swelling. The muscle herniation gradually resolved with rest.

Final/Working Diagnosis: Extensor digitorum longus herniation; varicose vein herniation.

Treatment: Right leg anterior compartment longitudinal fasciotomy; ligation of varicose vein.

Outcome: Post-operatively, the patient had complete resolution of his symptoms.

Return to Activity and Follow-Up: He was able to return to his pre-morbid level of function 3 months after the surgery.

The University of Kentucky Department of Orthopaedics & Sports Medicine will be hosting its 11th Annual Sports Medicine Symposium on Friday (all day), May 15, 2009, and Saturday (half day), May 16, 2009. The keynote speaker is Claude Moorman, III, M.D. Dr. Moorman is the Director of Sports Medicine at the Duke University Medical Center and team physician for Duke Athletics. The symposium is being held at the Embassy Suites, Lexington, KY. Audience: Physicians, nurses, athletic trainers, physical therapists, physician assistants and students. CME, NATA CEU's (10.75), Kentucky PT offered. For further information or registration, please visit <http://ukyce.cecentral.com/event/1810>.