WHAT TECHNIQUES ATHLETES ARE USING TODAY
January 18, 2017
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Objectives
• Review techniques/fads and scientific evidence for trends/techniques seen in athletic competition

Cupping
• The Orthopedic Triad: famous athlete, famous doctor, untested treatment
  • Dr. John Bergfeld, an orthopedic sports medicine specialist at the Cleveland Clinic
• Having an athlete report that a treatment worked “is almost like direct-to-consumer advertising,” said Dr. Fred Azar, a sports medicine orthopedist in Memphis.


Cupping
• Practiced in most cultures in one form or another throughout history
• Alternative medicine
  • Chinese
  • Egyptian
• Creates a vacuum
• Dry vs wet

Cupping
• Gaining publicity
  • Rio 2016
• There is still no reliable scientific data clarifying the exact mechanism which can determine the therapeutic effect of cupping
  • Stagnant blood/lymph
  • Chi


Cupping
• Illustration from a medical textbook “Exercitationes practicae”
  • published in 1694

Wikipedia
Live High Train Low

- Hope of improving exercise performance at sea level
- Obtain the beneficial effects of altitude
  - Cardiovascular, respiratory and metabolic adaptations
- Avoiding
  - The need for a decrease in training intensity
  - The detrimental effects of chronic hypoxia
    - Muscular mass loss, fatigue or deteriorated aerobic performance
    - 10% of athletes are susceptible to pulmonary hypertension and high-altitude pulmonary edema
  - Known cardiovascular disease is associated with an increased risk for sudden cardiac death during mountaineering and downhill skiing
  - Healthy athletes who exercise at increased altitude are at low risk for ventricular arrhythmias


Physiologic Changes at Altitude

- Hyperventilation
  - The first change noted during hypoxic exposure at increased altitude
- Respiratory alkalosis
  - Created by hyperventilation
  - Corrected within a few days by increased urinary excretion of bicarbonate
- Hyperpnoea
  - Increased depth of breathing
  - Occurs above 2500 m


Physiologic Changes at Altitude

- Decrease in plasma volume from loss of water due to
  - Increased ventilation
  - Increased perspiration
  - Increased urine output
  - Decreased oral intake by hypoxia-induced adipsia
  - The lack of thirst despite dehydration
- Decreased stroke volume in athletes at increased altitude has been attributed to a reduction in preload
- LVEF does not change with hypoxia and increased altitude


Live High Train Low

- Ambient air (21% O2)
- 15% O2 – 8,500 ft (2,591 m)
- Hyperventilation
  - The first change noted during hypoxic exposure at increased altitude
- Hyperpnoea
  - Increased depth of breathing
  - Occurs above 2500 m


Physiologic Changes at Altitude

- Decreased arterial oxygen content
  - Causes HR to increase to maintain cardiac output
- Hemoglobin
  - Initially increases due to hemoconcentration
  - Eventually increases due to increased erythropoietin
- Erythropoietin release
  - Correlates with degree of hyperventilation elicited by hypoxia and degree of respiratory alkalosis
  - Increase Hgb
  - Increase arterial oxygen content


Live High Train Low

- Technical development of new devices
  - Artificial altitude/normobaric hypoxia
    - Nitrogen dilution
    - Oxygen extraction
    - Altitude tents/hypoxic sleeping units
    - Decompression chambers
    - Supplemental oxygen
- Additional training stimulus without traveling to the mountains

Several altitude training sites exist around the world.

- Third Space Gym (London)
- 15% O2/8500 ft
- LHTH camps are mostly carried out two to three times a year.

**Phases**
- Acclimatization Phase
- Primary Training Phase
- Recovery and Preparation for Return to Sea Level
- Return to Sea Level

- Optimal altitude for living high
  - 2000–2500m to provide an optimal erythropoietic effect
  - up to 3100m for non-haematological parameters
- Optimal duration at altitude
  - 4 weeks for inducing accelerated erythropoiesis
  - <3 weeks (i.e. 18 days) are long enough for beneficial changes
    - economy, muscle buffering capacity, the hypoxic ventilatory response or Na+/K+-ATPase activity.
- Daily dose of altitude:
  - altitude of 2500m for 20–22 h/day
  - travelling down to the valley only for training
  - sufficient to increase erythropoiesis and improve sea-level performance
  - minimum daily dose
    - 12 h/day.
Leadville 100

- Low point, 9,200 feet; high point is Hope Pass, 12,600 feet. Majority is on forest trails with some mountain roads.

Sports Nutrition Assessment

- At moderate altitudes up to 4000 m
  - Respiratory water loss may be increased
    - 1900 mL per day in men
    - 850 mL per day in women
  - Urinary water loss
    - May increase up to 500 mL per day
- Fluid intake
  - Increased even up to 7 L per day to insure adequate hydration
  - Tour de France mountain stages of the race, several cyclists drank more than 10 L of fluid per day


- How much you sweat
- What you sweat
- Salty sweater
  - 1700 mg/L sweat
- Average sweater
  - 200 mg/L sweat
**Precision Hydration**

- Sweat tests
- Electrolyte tablets
- Personalized electrolytes
- Advise you on when, what and how much to drink before, during and after training and

http://www.precisionhydration.com/pages/sweat-testing

**Personalized Continuous Monitoring**

- Biomed wearable tech
- Adhesive radio-frequency identification (RFID) sensor bandage (patch)

Adhesive RFID Sensor Patch for Monitoring of Sweat Electrolytes: Rose DP, Ratterman ME, Griffin DK, Heikenfeld JC.

**Physiological Testing**

- VO2 Max (Aerobic Capacity)
  - The highest VO2 (oxygen consumption) value recorded during maximal exercise
  - i.e. knowing what you are physically capable of
  - College age males average VO2max of 40ml/kg/min
  - College age females average VO2max of 33ml/kg/min
  - VO2max can increase with training
    - An untrained individual may be able to increase VO2max by as much as 15-20%.
  - Well trained athletes increases in VO2 max may not be as great
  - Velocity at VO2 Max is a better measure of fitness

http://www.ohio.edu/people/schwiria/Athlete%20&%20Coaches%20page/VO2max%20summary%20results%20Runners.htm

**Lactate Threshold Assessment**

- Controversial
  - When exercising at or below the LT, any lactate produced by the muscle is removed by the body without it building up

http://www.ohio.edu/people/schwiria/Athlete%20&%20Coaches%20page/VO2max%20summary%20results%20Runners.htm

- Rationale for training
  - Evaluating endurance capacity


- With regards to accuracy, no single portable analyser was perfect
  - low bias for BLA <15 mM
  - the Edge and Xpress
  - low bias for high lactate concentrations
  - the Edge and Lactate Pro2
  - influential for training zone prescription

**Body Composition**

- Proposed to be a significant predictor of performance
  - Vertical jump
  - Sprint performance
  - Isometric force is directly related to the muscle mass of that individual


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**Gravity defying running**

- Findings suggest there are significant differences between reported and measured BW support on the AlterG Anti-Gravity Treadmill
- Largest differences (.5%) found at 100% BW
- Greatest BW support (30 and 20% BW)
- Participants were young adults who were relatively light


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**Gravity defying running**

- Axial knee forces
  - Increased with increasing treadmill speed
  - Decreased with increasing chamber pressure

Gravity defying running

- Peak knee forces did not change with treadmill incline
- Average normalized stride length increased with increasing treadmill speeds
- Metabolic cost of running decreased with increased BWS
- A blunted increase in metabolic cost with increasing velocity at higher levels of BWS


Kobe Bryant Twitter post
- 2013
- ~ 4 months after Achilles surgery

Therapy used to prevent or reduce muscle soreness after exercise and to enhance recovery
- Single or repeated exposure(s) to extremely cold dry air (below -100 °C) in a specialized chamber or cabin for two to four minutes per exposure

Whole Body Cryotherapy

- Popularized by celebrities and athletes
- Athletes treat like an ice bath

There is insufficient evidence to determine whether whole-body cryotherapy reduces self-reported muscle soreness, or improves subjective recovery, after exercise compared with passive rest or no WBC in physically active young adult males.

There is no evidence on the use of this intervention in females or elite athletes.

The lack of evidence on adverse events is important given that the exposure to extreme temperature presents a potential hazard.

Further high-quality, well-reported research in this area is required and must provide detailed reporting of adverse events.


The FDA has not cleared or approved any of these devices for medical treatment of any specific medical conditions.

Potential hazards
- Loss of consciousness/Asphyxiation
- When liquid nitrogen is used for cooling, the addition of nitrogen vapors to a closed room lowers the amount of oxygen in the room and can result in hypoxia, or oxygen deficiency:
  - Frostbite
  - Burns
  - Eye injury

http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm508739.htm

In 2015, Chelsea Ake-Salvacion, who worked at a Nevada spa that offered cryotherapy, decided to hop into one of the chambers at the end of the day to relieve sore muscles. The 24-year-old was found dead the next day, “rock-hard solid,” according to CNN.

There has a higher tendency to non-rearfoot strike in both interventions, but more acute changes in the minimalist footwear.


ASICS
Analyses your foot using laser and micro cameras
“Find the shoes that match your feet best”
Measurements made by the system
- foot length, forefoot width, ball girth, arch height and heel tilt

Footwear alters the load rates during running, even with similar foot strike patterns.
- ILR = instantaneous loading rate

It is absolutely clear that low pre-exercise muscle glycogen stores result in reduced exercise intensity.

Endurance athletes experience glycogen debt/depletion after long periods of exertion.

“Hitting the wall”

Present methods for measuring glycogen involve the intrusive process of biopsy into the muscle tissue:
- pain, soreness and repair process may degrade performance.

Analysis of a biopsy to determine glycogen store:
- time consuming process
- gauge of the glycogen levels at a past time.

2011
Working with professional cyclists
Discovered that they could see glycogen through the use of everyday ultrasound.


Dr. John Hill  Dr. Iñigo San Millán
 Validation study
 Direct glycogen quantification from pre and post-exercise muscle biopsy samples was compared with glycogen content estimates made through a portable, diagnostic high-frequency ultrasound and cloud-based software system.


Pre-exercise muscle with high glycogen stores display darker pixel intensities. Post-exercise muscle with lower glycogen stores display brighter pixel intensities.

**Validation of Musculoskeletal Ultrasound to Assess Muscle Glycogen Content.** A Novel Approach – Colorado University School of Medicine

Glycogen store is conceptually shown to be high by the use of large dark dots providing a substantially dark appearance to the scanned portion of the target muscle. A pre-established glycogen concentration scale also shown. The pre-establishment of the glycogen concentration scale aids in the effective identification of attributes that are correlated to glycogen store, e.g., color, contrast, darkness, luminance and combinations thereof.
Identify a balance point
- Eat proactively if stores are low
- Avoid eating to avoid diverting blood flow for digestion

Platelet Rich Plasma
- Concentration of platelets from whole blood
- Platelets are filled with growth factors
  - Platelet-derived growth factor (PDGF)
  - Transforming growth factor (TGF-B)
  - Insulin-like growth factor (IGF)
  - Epidermal growth factor (EGF)
  - Vascular endothelial growth factor (VEGF)
  - Fibroblast growth factor (FGF)

Platelet Rich Plasma Isolation Devices

Platelet Rich Plasma
- Biomet – GPS
- Harvest
- Arteriocyte
- Cytomedix / Angel

- Cascade
- Arthrex / ACP
- RegenKit

PRP – Leukocyte Poor
- Plasma + platelets
- WBCs
- RBCs + WBCs

Leukocyte rich
- Buffy coat based

Leukocyte poor
- Plasma based
Platelet concentration
- 1.5-9x baseline
- ? Optimal concentration

Optimal concentration in human tendon, muscle, joint is unknown

Most commercial preparation kits produce PRP in the range of 500,000 to 1,500,000 µ

Variability in platelet concentration is also highly dependent on variability in patient platelet count

Leucocytes
- In acute muscle injuries leukocyte poor product may be better
- Because neutrophils are larger cells their concentration could be expected to be decreased compared to other fractions of WBCs in buffy coat products
- Leukocyte rich may be helpful in a chronic injury because of phagocytic properties

The studies of intra-articular cellular therapy injections for osteoarthritis and focal cartilage defects in the human knee suggested positive results with respect to clinical improvement and safety.

However, the improvement was modest and a placebo effect cannot be disregarded.

Questions?