MEASUREMENT IN MICROGRAVITY-INDUCED FLUID SHIFTS

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Disclosure Information

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I have no financial relationships to disclose.

I will discuss the following investigational use in my presentation:

1. Ultrasound use to measure facial soft tissue thickness
Fluid Shifts Surrounding Space Flight

Credit: NASA
Fluid Shifts During Space Flight
Cardiovascular Countermeasures

- Fluid Loading
- G-Suits
- Exercise
- Meds
- LBNP
- Thigh cuffs (bracelets)
Facial Tissue Thickness

Additional Factors

• Hypergravity
  – Facial soft tissue thickness decreased 5% by 2G¹
  – No change in if NPO after 2 hours
• Altitude and Humidity
  – Facial soft tissue thickness increased significantly (.34mm) over time @ 2500m and 15% humidity²
• Head down tilt increased facial soft tissue thickness by 5%³
  – After 8hr with thigh cuffs facial thickness decreased by 3%
  – Compared to stoke volume, carotid systolic diameter changes, vascular resistance changes, vein area changes

¹Eichler, W., et al. Hypergravity and Dehydration-Induced Shifts of Interstitial Fluid in the Skin Monitored by Ultrasound. Aviation, Space, and Environmental Medicine. 75:9 760-763
Ultrasound Capabilities
Procedure
Inflight to Postflight Comparison

Tissue Thickness face (mm)

FD 36: 5.27
R+ 104: 4.745
Facial Tissue Thickness

**Area Measurement**

In-flight:
- Thicknesses: 5.2mm, 5.25mm, 5.43mm, 5.21mm
- Average: 5.27±.05mm

Post-flight:
- Thicknesses: 4.82mm, 4.58mm, 4.82mm, 4.76mm
- Average: 4.745±.06mm

Control group: 4.6±.8mm

In-flight:
- Area: 1.5cm from peak
- Area of 0.81cm²

Post-flight:
- Area: 1.5cm from peak
- Area of 0.72cm²
Facial Tissue Thickness

Area Measurement

Tissue Thickness face (cm²)

FD 36: 0.81
R+ 104: 0.72
Facial Soft Tissue Thickness

Measurement Caveats
Conclusion

• Facial tissue thickness measurement by ultrasound in microgravity is feasible
• Data suggests a decrease in facial tissue thickness upon return from microgravity
• Further study needed
  – Standardize technique across individual variability of local facial anatomy
  – Standardize technique of lower extremity
  – Objective tool to monitor fluid shifts, correlate with VIIP, evaluate countermeasures, etc.
Questions???
Backup Slides
Current Ultrasound

Setup: 30m/10m
Stowage: 15m/10m
Current Ultrasound - Probes

1. M4S – adult cardiac and abdomen
2. 8C – pediatric abdomen, neonatal head (220 degree)
3. 4C – abdomen, Ob/Gyn
4. 12L – vascular, small parts
Current Ultrasound - Telemed

PURPLE
Buttons number 1 through 6 change depending on mode selected. Select a mode below:

2D
- Pulse Wave
- Continuous Wave

2D function keys
1. Width of sector; increase/decrease frame rate
2. Frequency of Probe / 2.5 – 3.6 MHz fundamental / 1.5 – 2 MHz Octave = Harmonics
3. Inverts the image & flips the image Left or Right
4. Focal Zones; Gray Scale Mapping
5. Focus Position (Carrot) on the screen
6. Launches Power controls, Smart Depth, Tilt, Compress, Reject, DDP, UD Clarity, Dynamic Range, Contour and Diff

GE VIVID Q KEYBOARD