



Acute Hemodynamic Effects of Bracelet-M device on the International Space Station

Michael Barratt, MD

Douglas R. Hamilton, MD, PHD

Ashot E. Sargsyan, MD

Kathleen M Garcia

Scott A. Dulchavsky, MD, PHD

J. Michael Duncan, MD

*National Aeronautics and Space Administration at Johnson Space Center and
Space Medicine , Houston, Texas*

Wyle Integrated Science and Engineering, Houston, Texas

Henry Ford Hospital and Foundation, Detroit Michigan

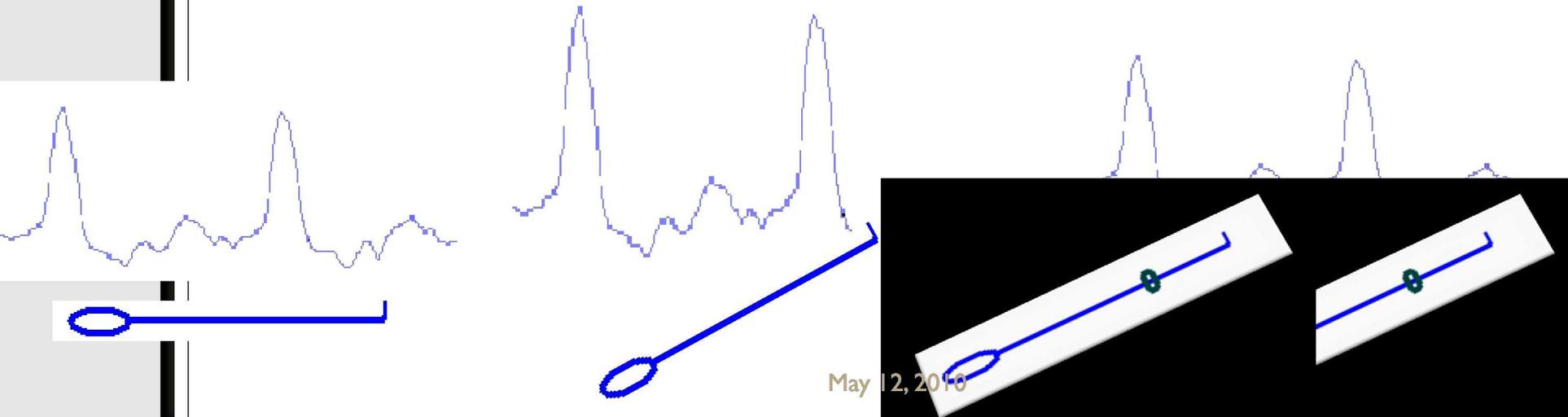


Background

- The Braslet-M is a Russian countermeasure device
- A set of custom-designed elastic/ridged straps that fit tightly around the upper thighs
- Medical prevention strategy that reduces fluid shifts in microgravity in long-duration crew
- Symptoms relieved early microgravity exposure:
 - pulsations in head, nasal congestion, painful eye movement, vestibular disorders, nausea & vomiting
 - Improved cognitive capacity

Background

- The tightness setting is prescribed
 - Custom fitted and adjusted settings for the individual using subjective feedback
- *Cerebral Rheography=Impedance Plethysmography*





May 12, 2010

Результаты тарировки

Показатели	Горизонтальное положение оператора	Положение оператора в антиортостазе 30° <i>Negative 30 degree Head Down Tilt</i>						
		Рабочие зоны на затяжном ремне						
<i>Bracelet Setting</i>	0° ✓	0	1	2	3	4	5	6x .0
Показа- ПИ	262	305		245	252	250		300
тели А	162	159		42	90	48		133
РЭГ К	149	243		117	99	89		245
ППКГ	99.7	138		75	69	63		133
Выраженность внешних признаков		<i>Не видно</i>						
Самочувствие оператора		<i>Хорошее</i>						

*Примечание. Для изделия "Браслет".

- 
- Subjective measures define the custom fitting and prescription
 - Subsequent microgravity physiology changes that compound the setting:
 - Leg size reduces
 - Lower-extremity interstitial tissue extracellular water decreases
 - Reduce fluid-volume muscle volume



Mechanism

- Creates a venous hydrostatic pressure that is more similar to the 1 G environment
- Reduce effective circulation



ISS Experience

- Crew remotely guided ultrasound experiment looking at a small subset of cardiac and peripheral vascular changes before and after application of Braslet-M
- Primary objectives and secondary objectives
- Review some interesting changes indicating bracelets do reduce preload in microgravity

Ultrasound parameters

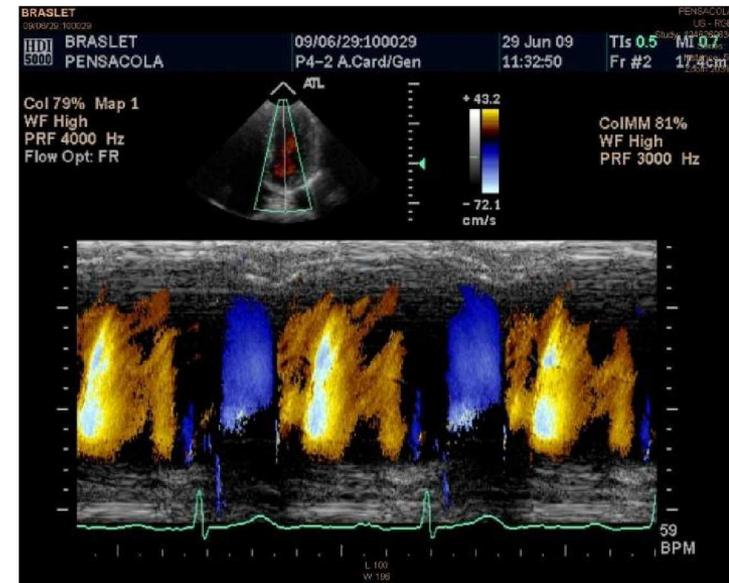
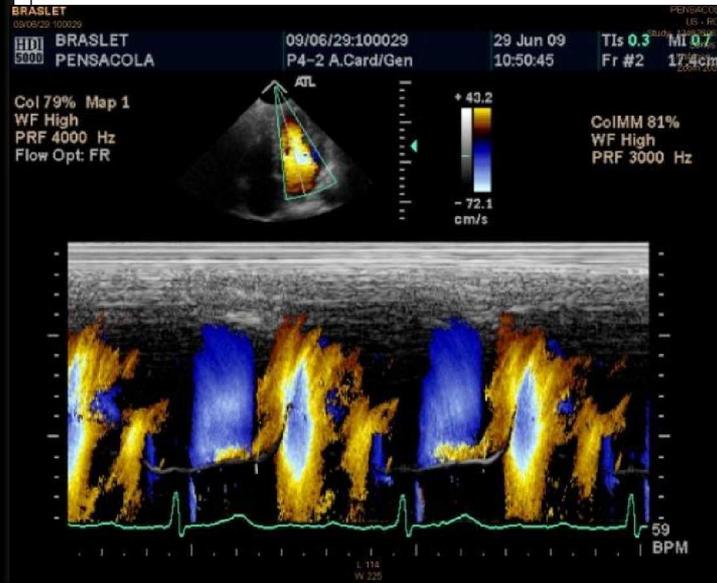
- The femoral vein
 - Cross-section area before and after Braslet-M
- The femoral artery
 - Blood flow before and after Braslet-M
- Left ventricular in-flow pattern
 - Color M-Mode before and after Braslet-M

Color M-Mode

- Graphic representation of blood flow through the mitral valve into the left ventricle: slope of the first aliasing velocity

Slope w/o Braslet=56ms

Slope w Braslet=42ms



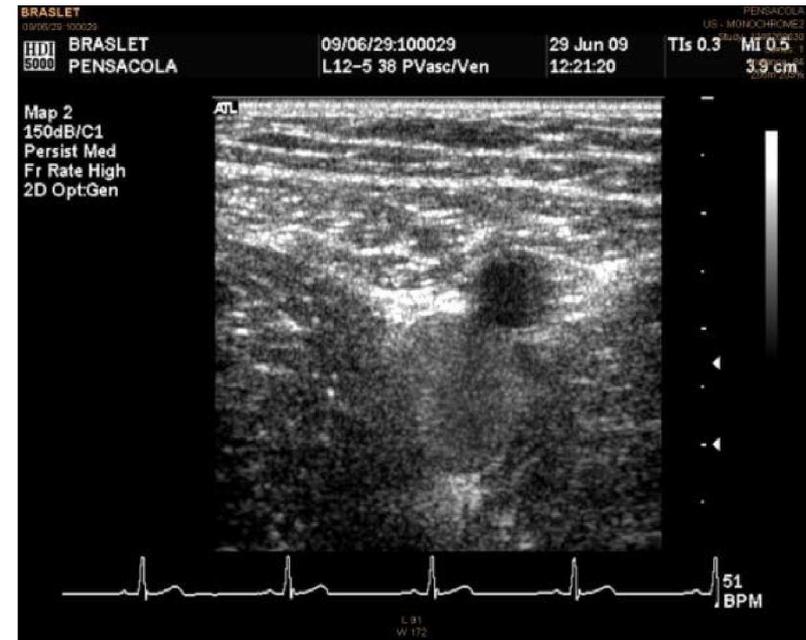
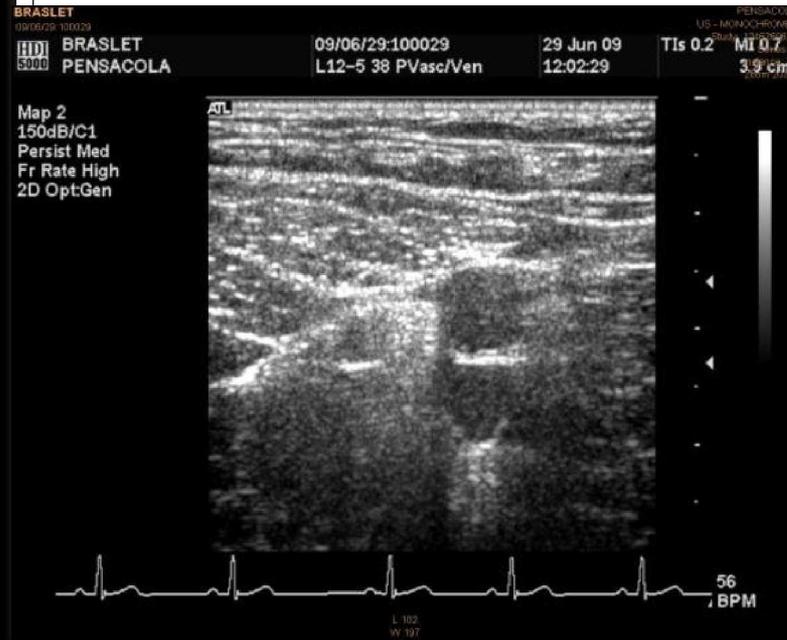
Femoral Blood Flow

- Doppler arterial blood flow
- After Braslet peak velocity decreased, time integral increased, resistivity and pulsatility increased, no significant change in HR



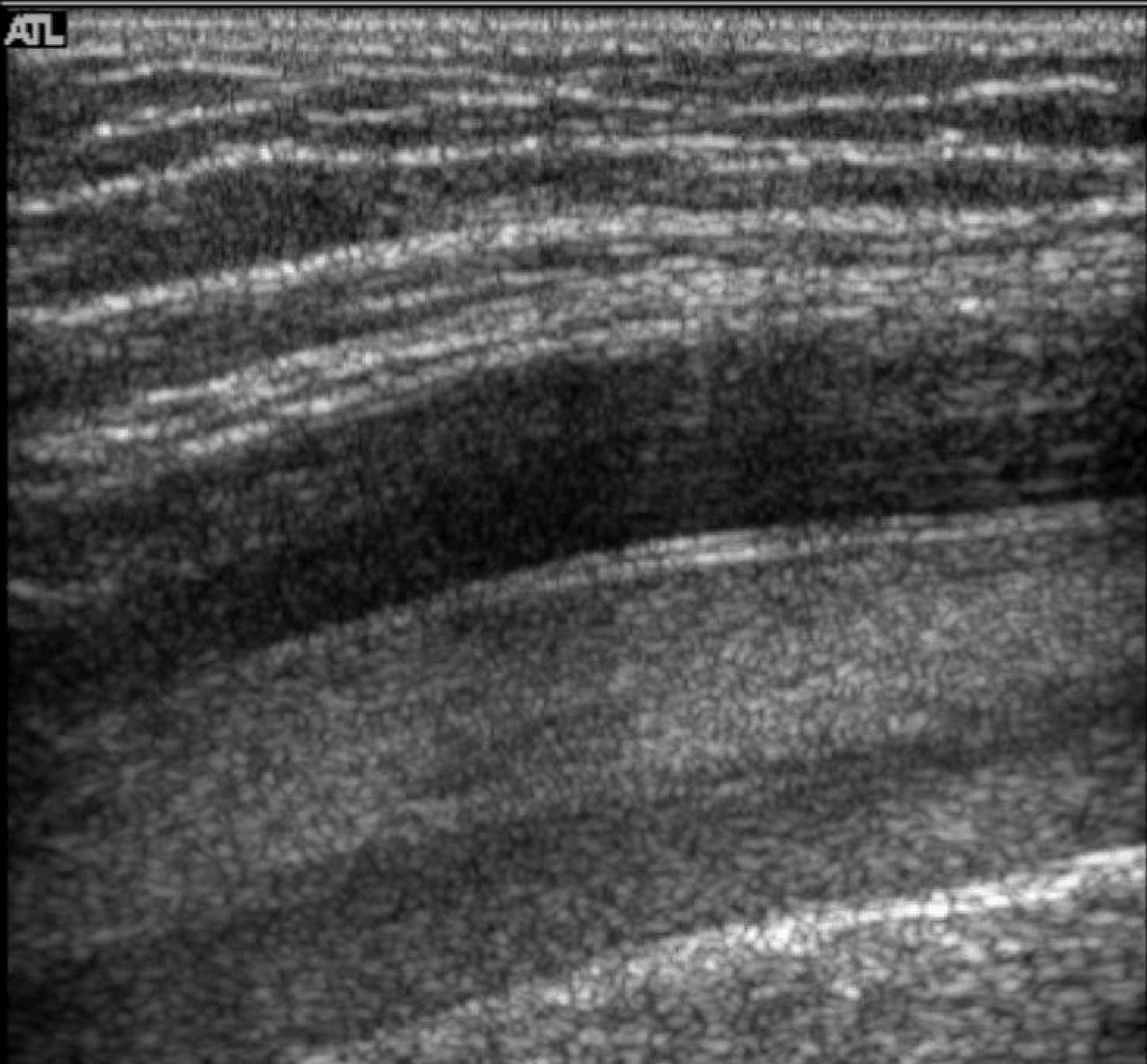
Femoral Vein Crossection

- 300% increase in crosssection area
- Roleaux formation: stacking of red blood cells increased spectral reflection seen on US



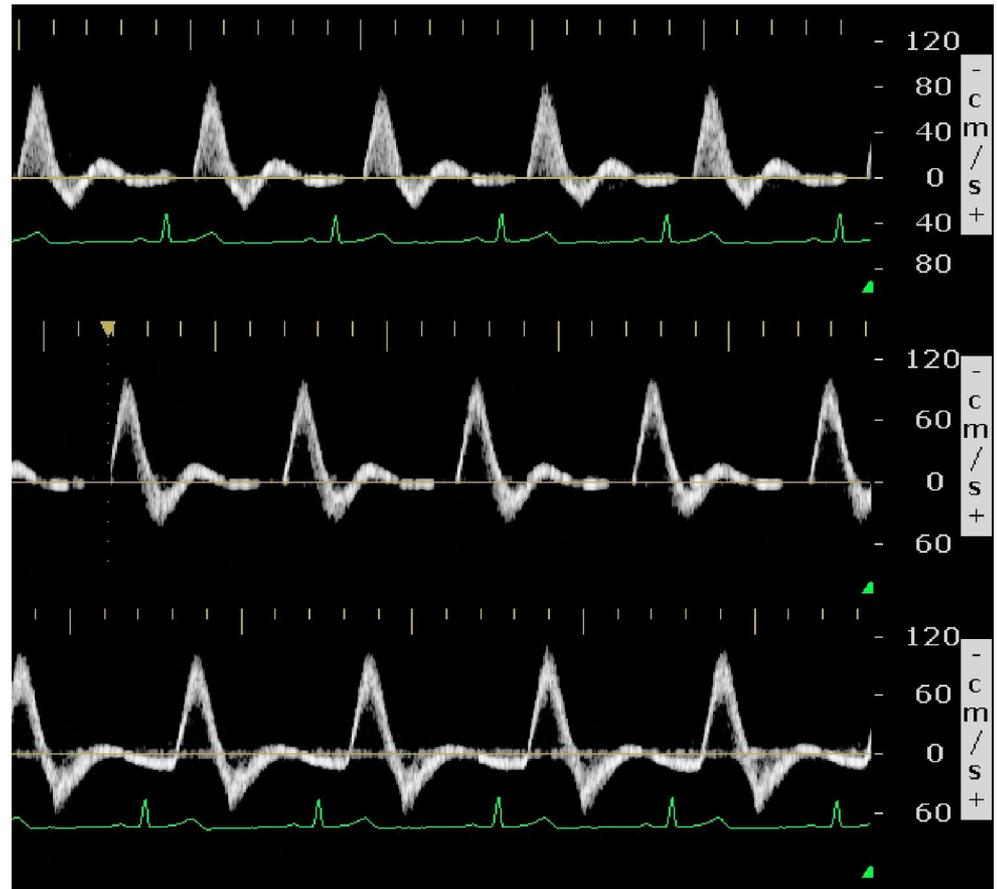
ATL

7C1
Med
e High
t:Gen



Preliminary Ground example

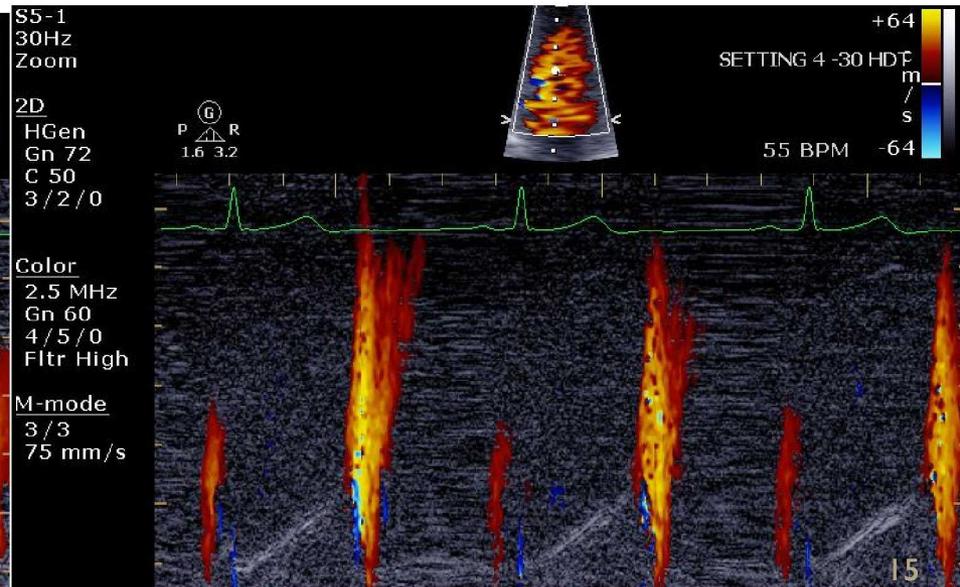
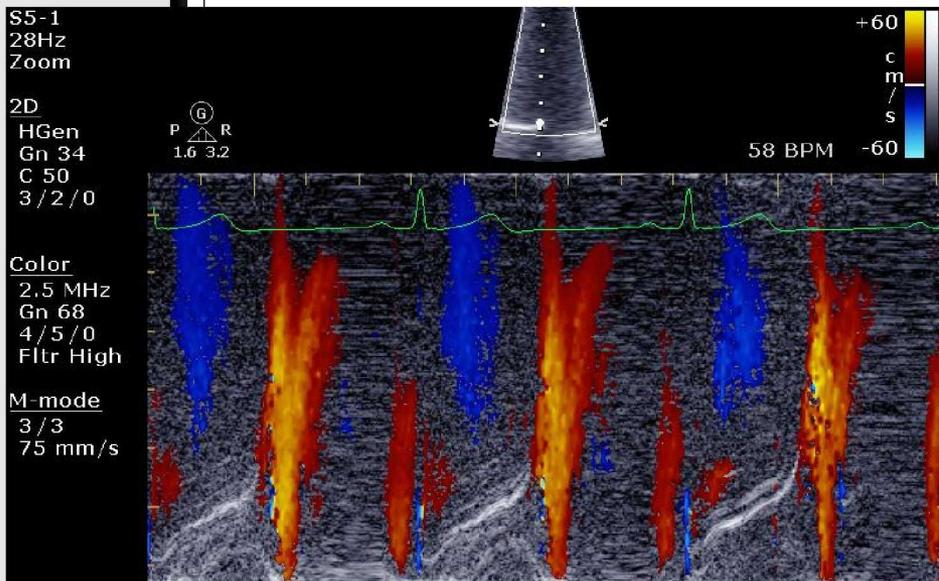
- **Baseline**
 - -30 HDT
- **Braslet @ I**
 - -30 HDT
- **Braslet @ 4**
 - -30 HDT

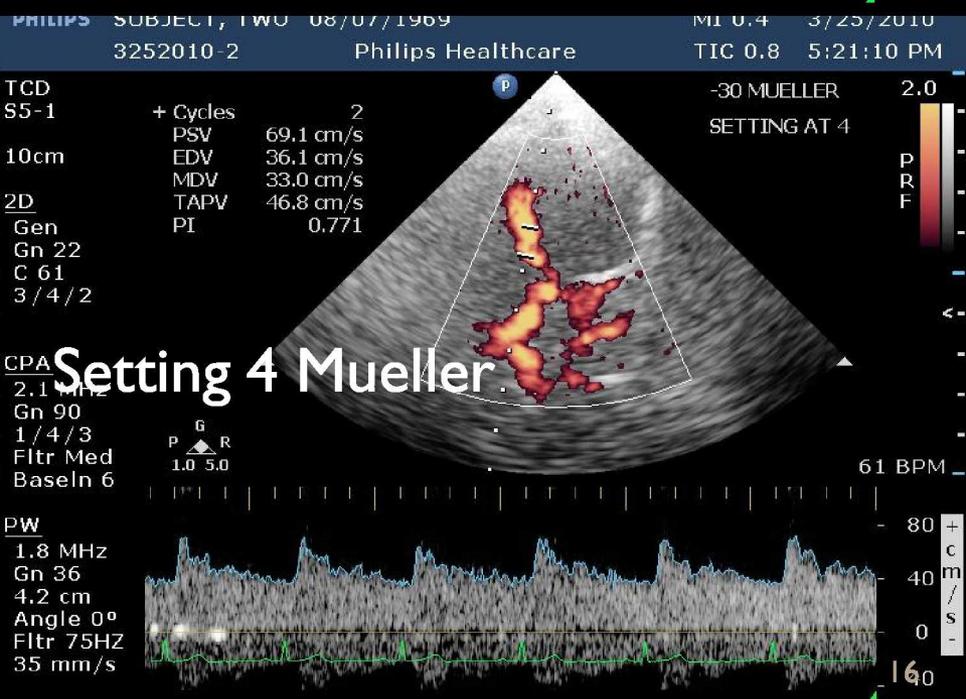
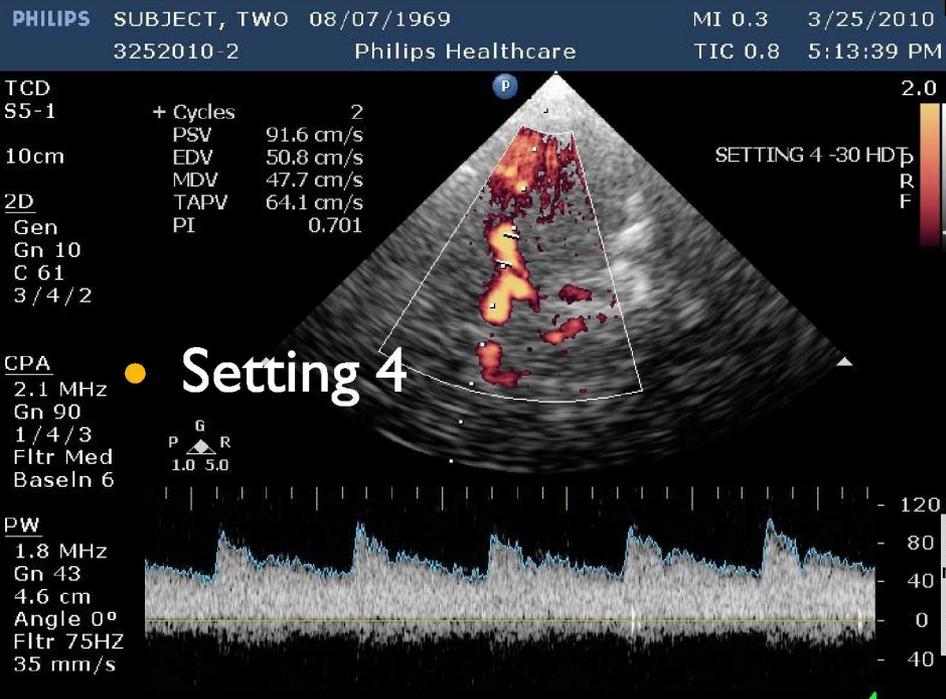
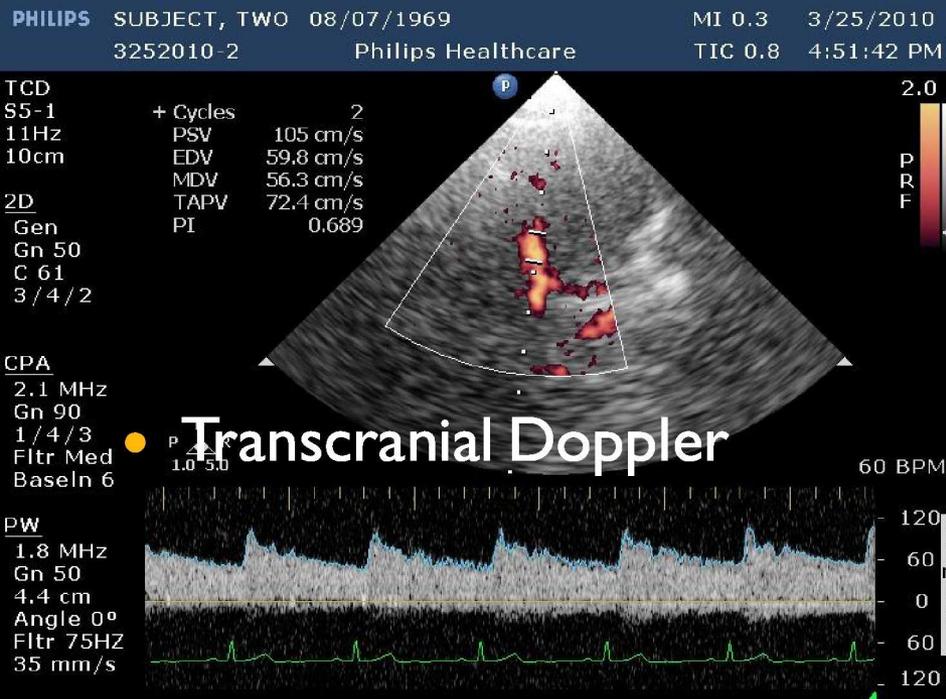


Preliminary Ground Example

- Baseline
 - -30 HDT
 - Slope 64ms

- Braslet @ 4
 - -30 HDT
 - 70ms





Pre Release Vein under pressure

PHILIPS TWO 08/07/1969

MI 1.2 3/25/2010

SUBJECT Philips Healthcare

TIS 0.2 5:24:47 PM

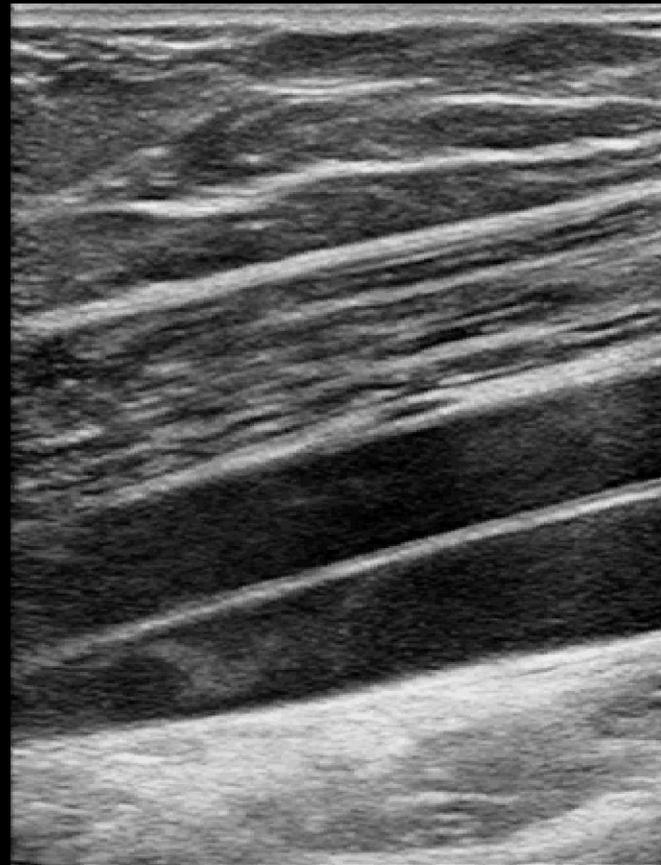
Venous
L12-3
19Hz
5cm

P

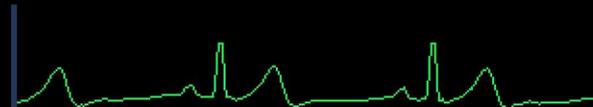
2D
HGen
Gn 72
C 41
3 / 3 / 2
35 mm/s

SETTING4
30

MUELLER



G
P R
4.4 8.8



56
BPM

Release monitoring images

PHILIPS TWO 08/07/1969

MI 1.2 3/25/2010

SUBJECT Philips Healthcare

TIS 0.2 5:25:14 PM

Venous
L12-3
19Hz
5cm

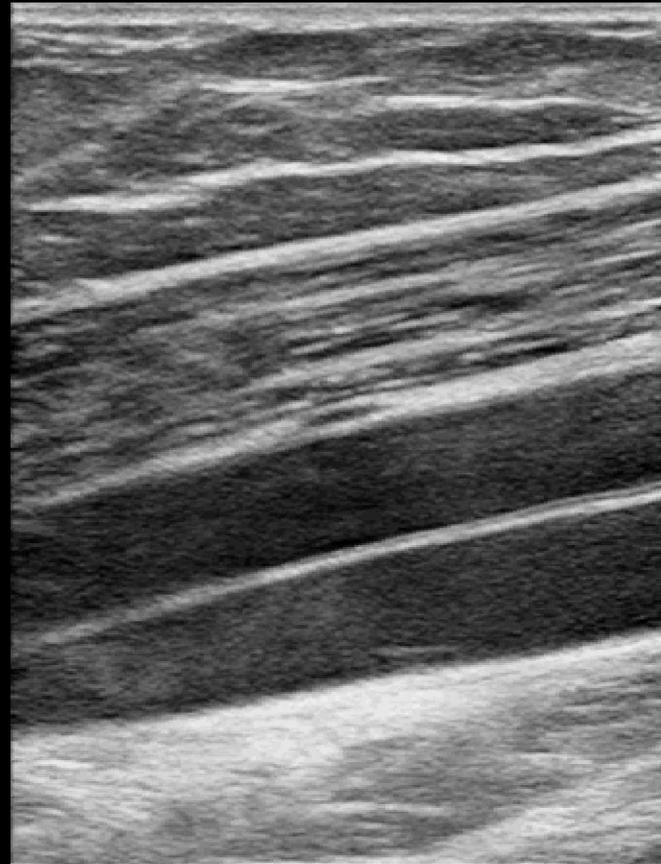
P

2D

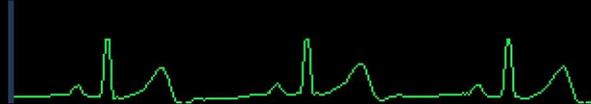
HGen
Gn 78
C 41
3/3/2
35 mm/s

SETTING4
30

MUELLER



G
P R
4.4 8.8



58
BPM



Conclusion

- Increasing the venous pressure in the lower extremities causes the corresponding artery to respond in a hyperemia
- The safety of the therapeutic range is being investigated in this ground study