# Efficacy of the Abdominal Aortic Tourniquet Device for the Control of Axillary and Femoral Artery Blood Flow

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# Introduction

- Injuries to the vasculature at the junction between the axial and appendicular skeleton is common among  battlefield and civilian patients, often resulting in death.

- Specifically injuries to the axillary, subclavian, illiac or femoral arteries

- Applying an effective tourniquet at the axilla or proximal thigh is difficult secondary to the anatomey of the regions.

# Introduction

- Hemorrhage amenable to truncal tourniquets is now the most common cause of preventable death.[1]
- Kelley et al. J. (Trauma 2008) estimated a device for junctional hemorrhage control could have saved an average of 3 casualties/month during the conflict in Iraq. [2]
- The traditional narrow strap windlass tourniquets are not as effective when applied at or above the mid-thigh. [3-7]

# Introduction

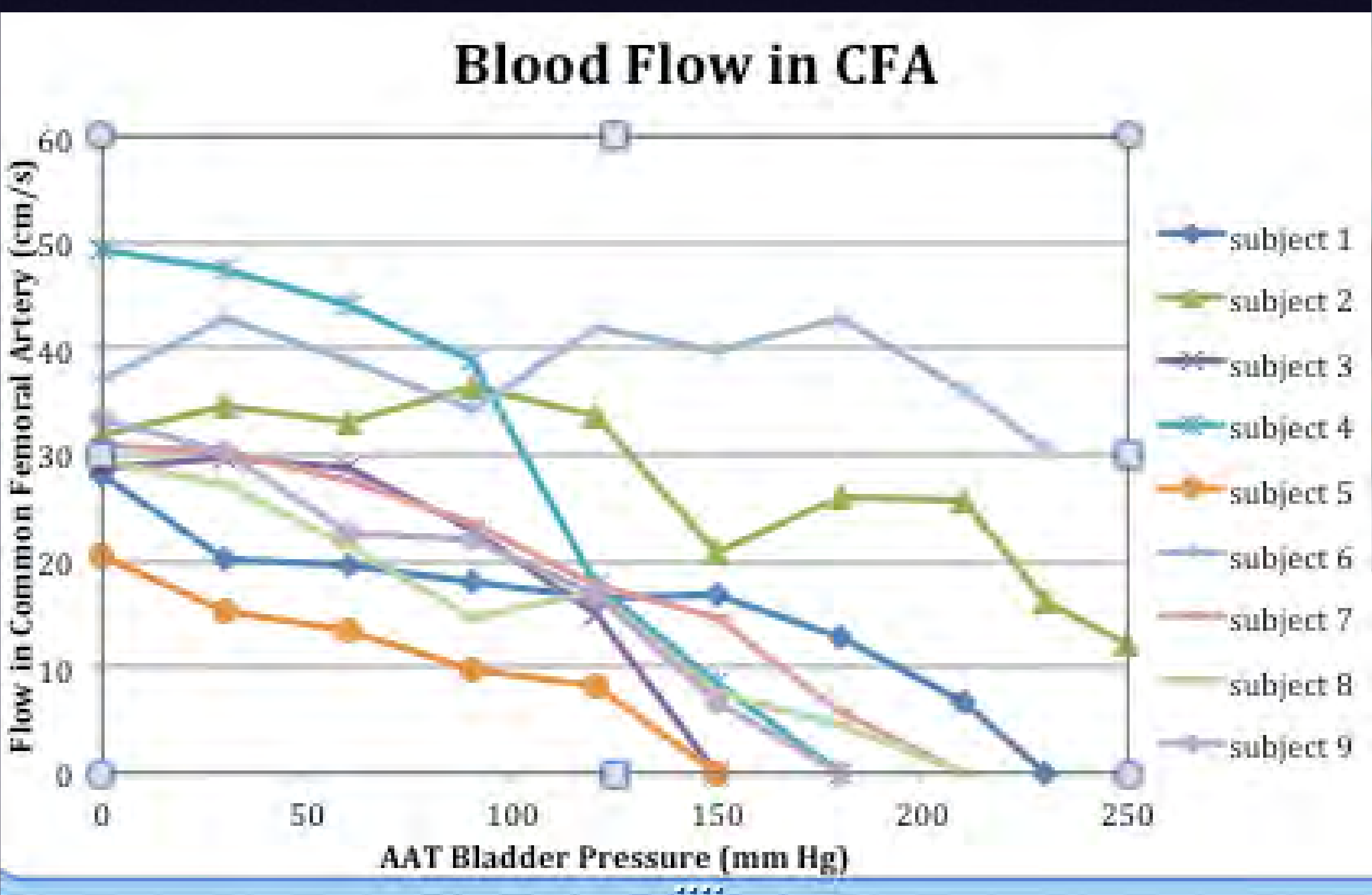
- Pneumatic tourniquets appear to be more efficacious, secondary to wider strap, but certainly not perfect. [3,7]

- Hemostatic dressings are not as effective as initially hoped in the setting of large vessel injury. [8]

- The axillary and subclavian artery is not amenable to compression by the standard extremity tourniquet.

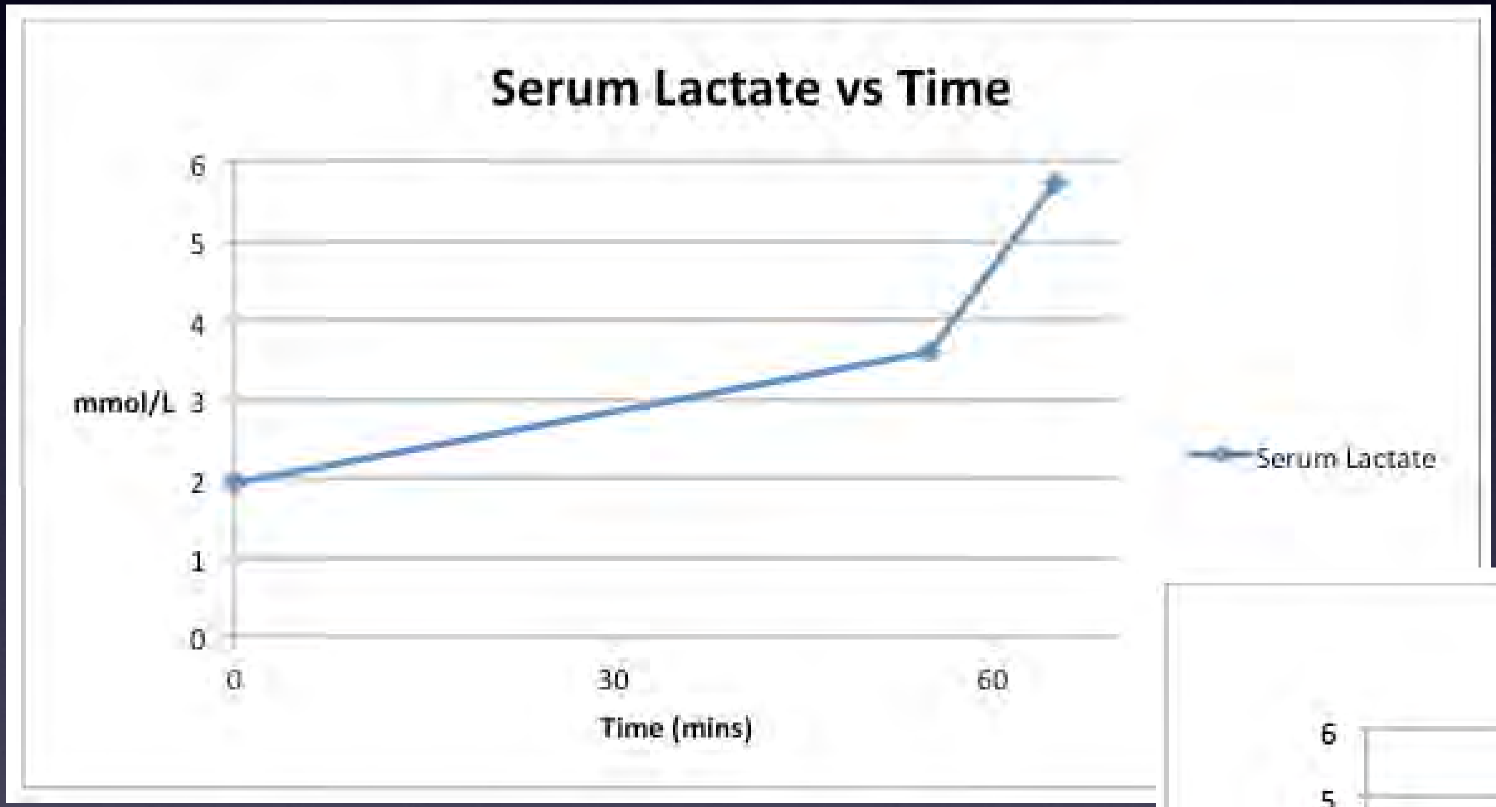
# Introduction

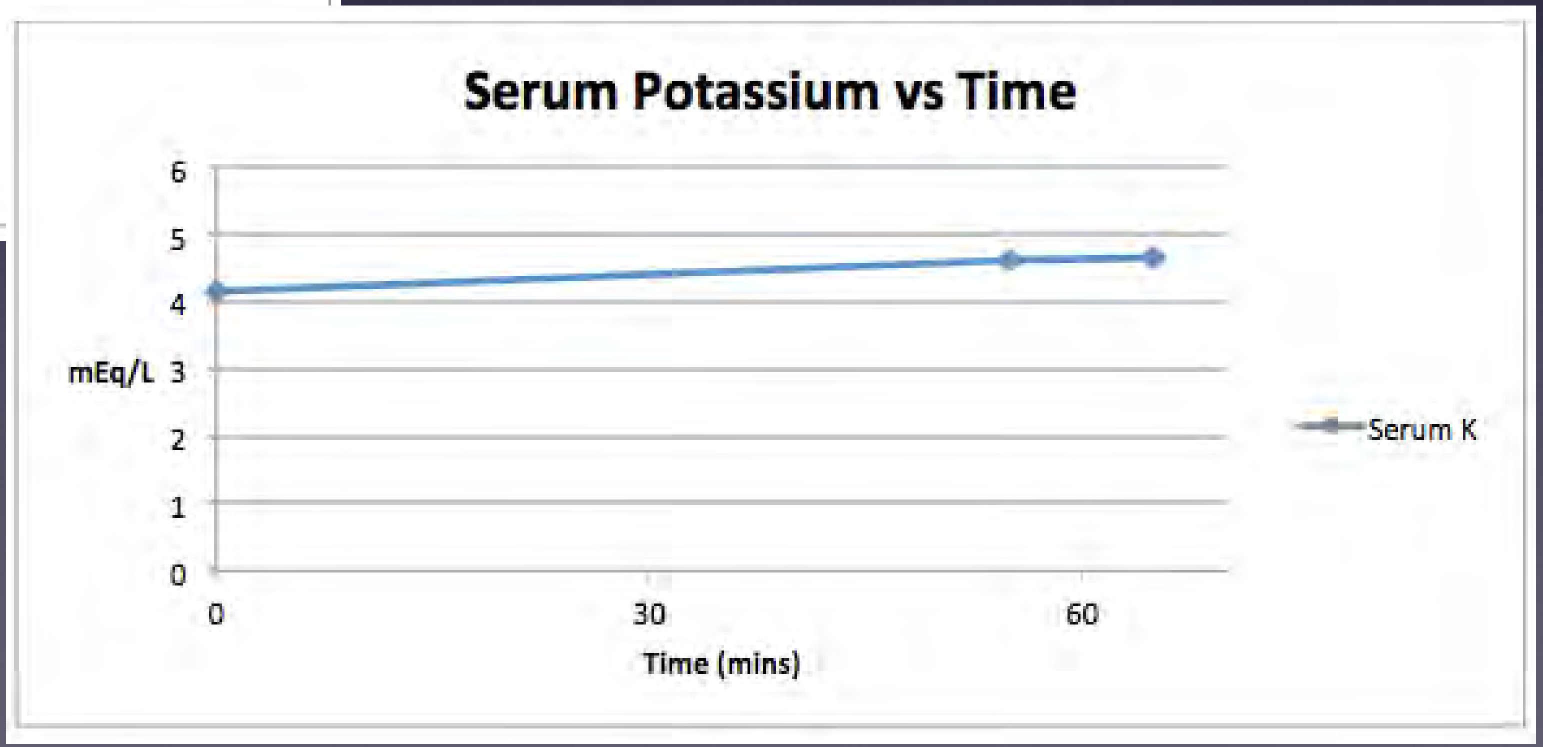
- Prior studies have shown that the Abdominal Aortic Tourniquet (AAT) effectively reduced blood flow in the Common Femoral Artery with application of the device around the lower abdomen. 9-11




# Introduction

- A porcine study demonstrated safety of the AAT with blood flow cessation for 60 minutes. There were no signs of direct injury. 10



# Introduction

- A case report from a civilian trauma center indicated that the AAT may be effective in decreasing hemorrhage from other large vessel injuries such as the axillary artery.[12]


# Objective

- To determine the effectiveness of the AAT for stoping blood flow at the axilla and proximal thigh.

# Methods

- Prospective Observational trial using 13 human volunteers
- IRB approved and Informed consent was obtained
- A manometer was integrated into the AAT for specific pressure measurements within air bladder

# Methods

T device placement #1:

- ***Axilla Application***
- The AAT bladder was positioned immediately below the right axilla with the bladder centered between the anterior and mid axillary line.
- The belt was secured and tightened around the opposite deltoid after which the windlass device was tightened and secured

# Methods

AAT device placement #2:

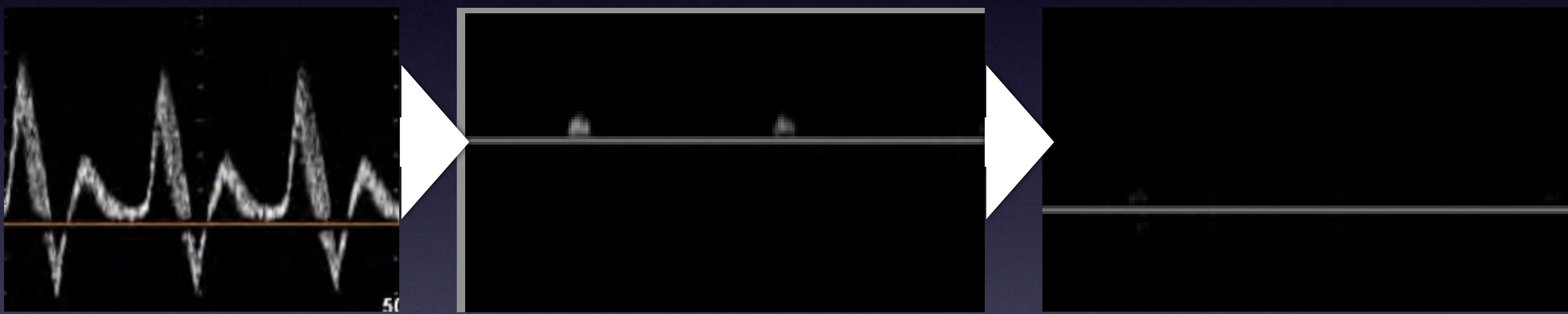
- ***Proximal Thigh Application***
- The AAT bladder was positioned over the right groin with the bladder centered over the approximate location of the common femoral artery.
- The belt was secured and tightened around the femoral greater trochanters after which the windlass device was tightened and secured

# Methods

- Measurements
  - Using a Phillips HDI 4000 US system and a 10 MHz linear transducer
  - Spectral Doppler analysis of the flow in the brachial artery and the popliteal artery down stream of the AAT.
  - A single sonologist used the same  location with optimized Doppler angle through out the entire study.

# Methods

- Measurements
  - Spectral Doppler was used to monitor blood flow through the brachial (BA) and popliteal arteries(PA).
  - We monitored peak velocity and waveform morphology through out the entire expirement.



  - 1. Peak systolic flow at baseline
  - 2. Cuff pressure required to convert triphasic flow to monophasic flow
  - 3. Cuff pressure required to cease distal blood flow.

# Methods

- Measurements

  - A visual analog pain scale (1-10) was used to query the subjects for degree of pain at:

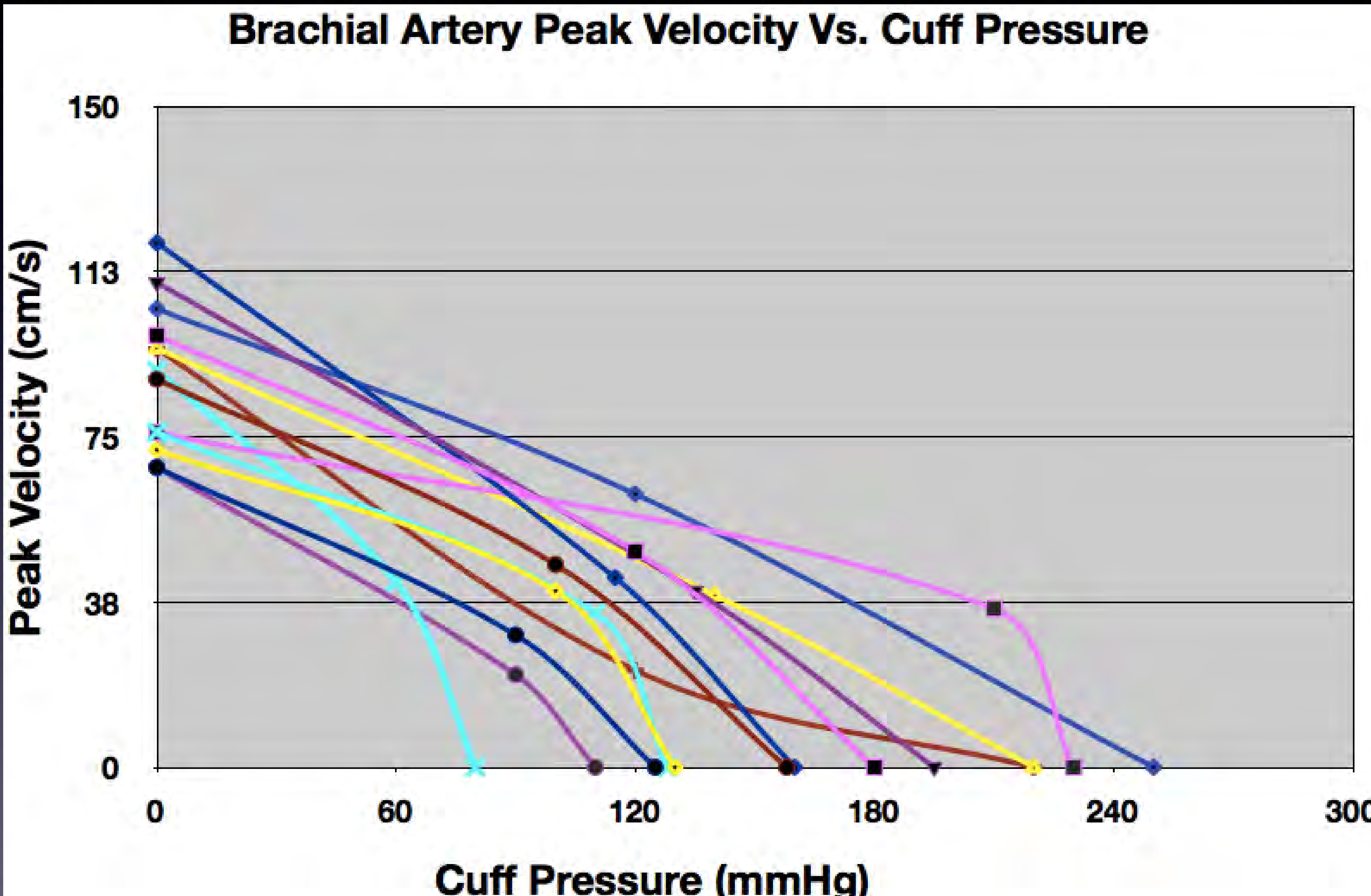
    1. Pre-cuff inflation
    2. Transition from triphasic to monophasic flow
    3. Transition from monophasic to cessation of flow
    4. Immediately following cuff deflation

# Results

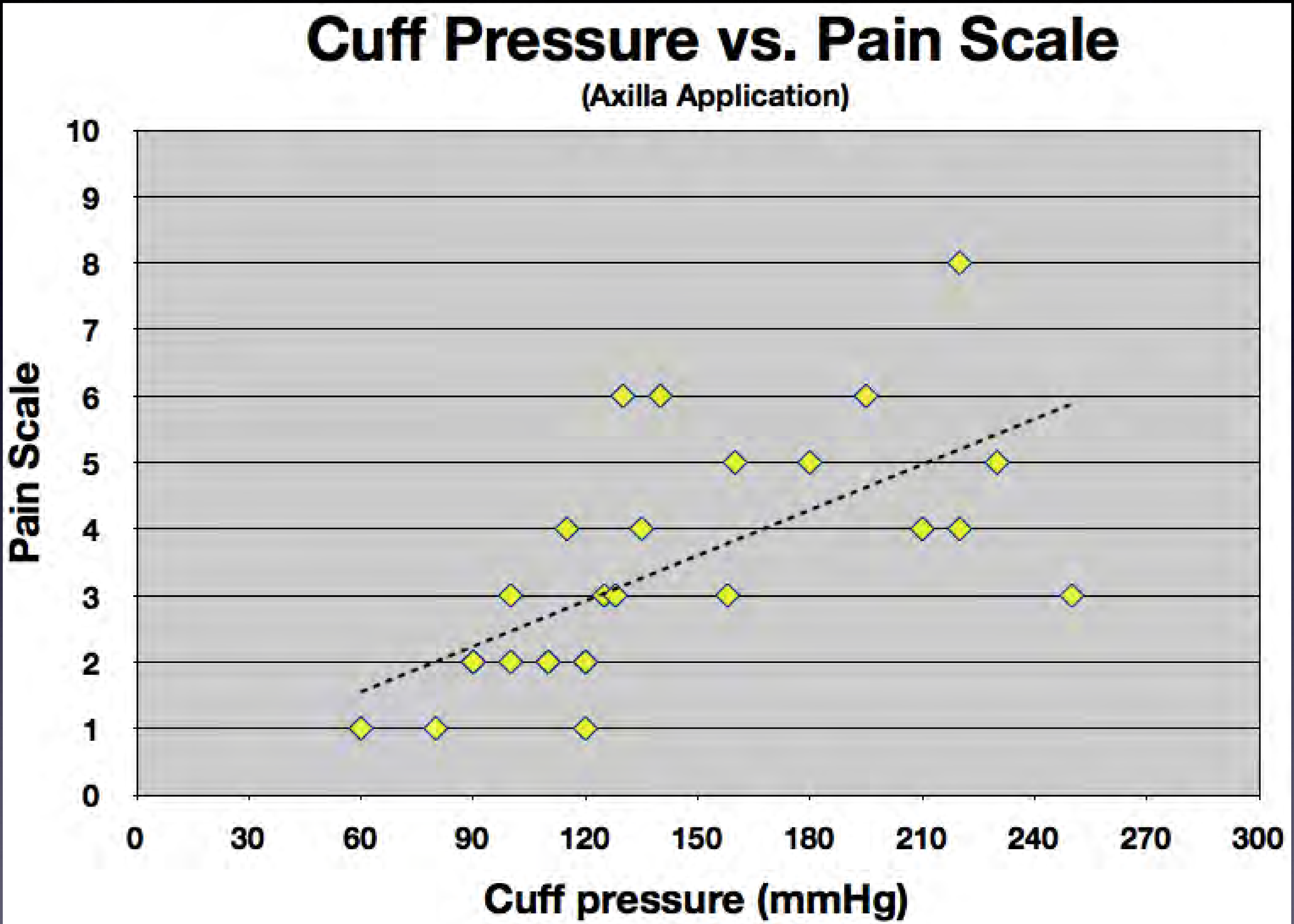
- In all participants (13/13) the blood flow in the BA was stopped.

  - Mean bladder pressure at zero Doppler flow was 168 mm Hg (SD=52.5, max 250, min 80)
  - Average pain at maximum pressure - 4.1 (10 pt scale)
  - Pain scale returned to 0 immediately after deflating the cuff.

# Results


Brachial Artery Peak Velocity Vs. Cuff Pressure
Peak Velocity (cm/s)
150
113
75
38
0
0
60
120
180
240
300
Cuff Pressure (mmHg)

# Results

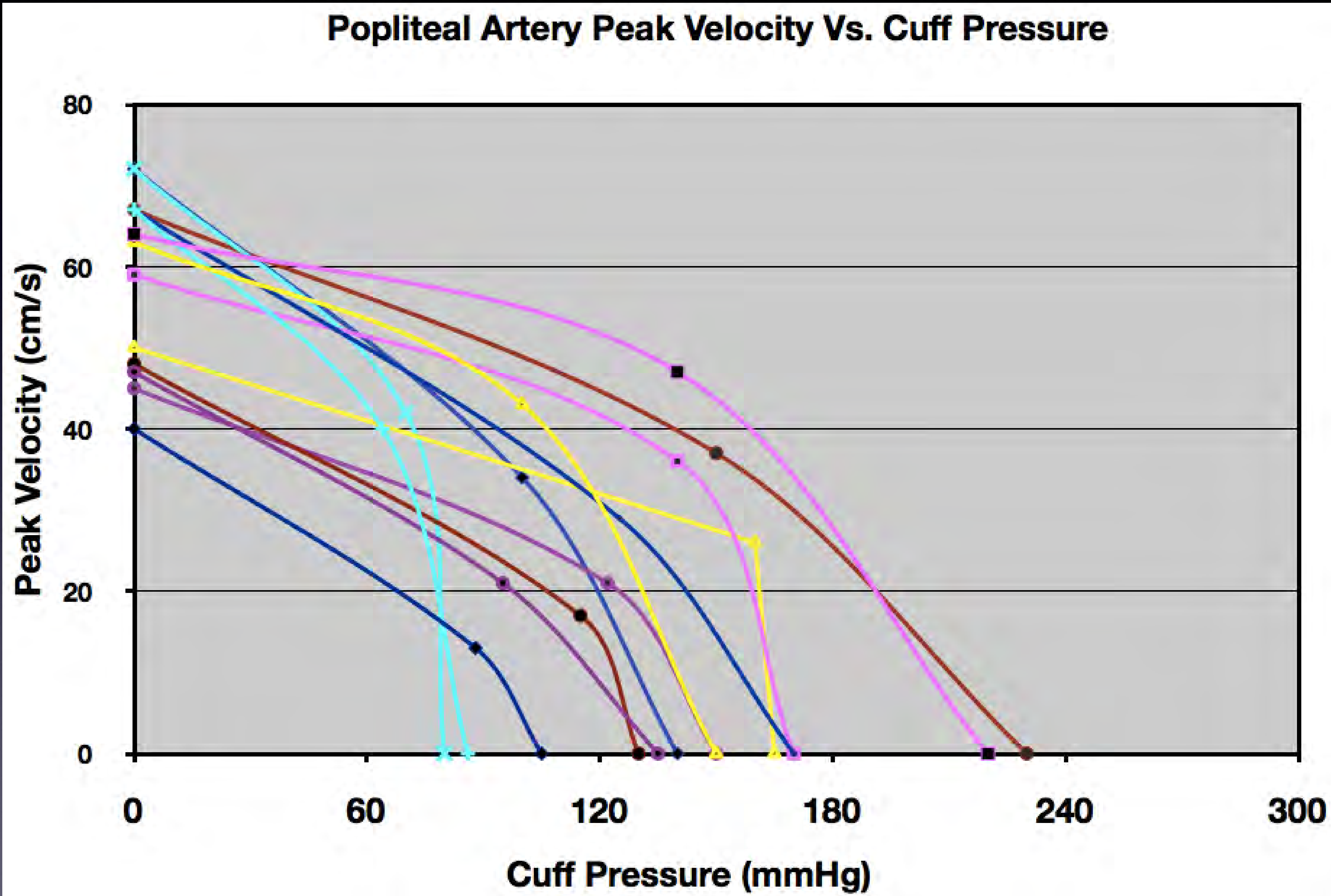


Cuff Pressure vs. Pain Scale
(Axilla Application)
Pain Scale
10
9
8
7
6
5
4
3
2
1
0
0
30
60
90
120
150
180
210
240
270
300
Cuff pressure (mmHg)

# Results

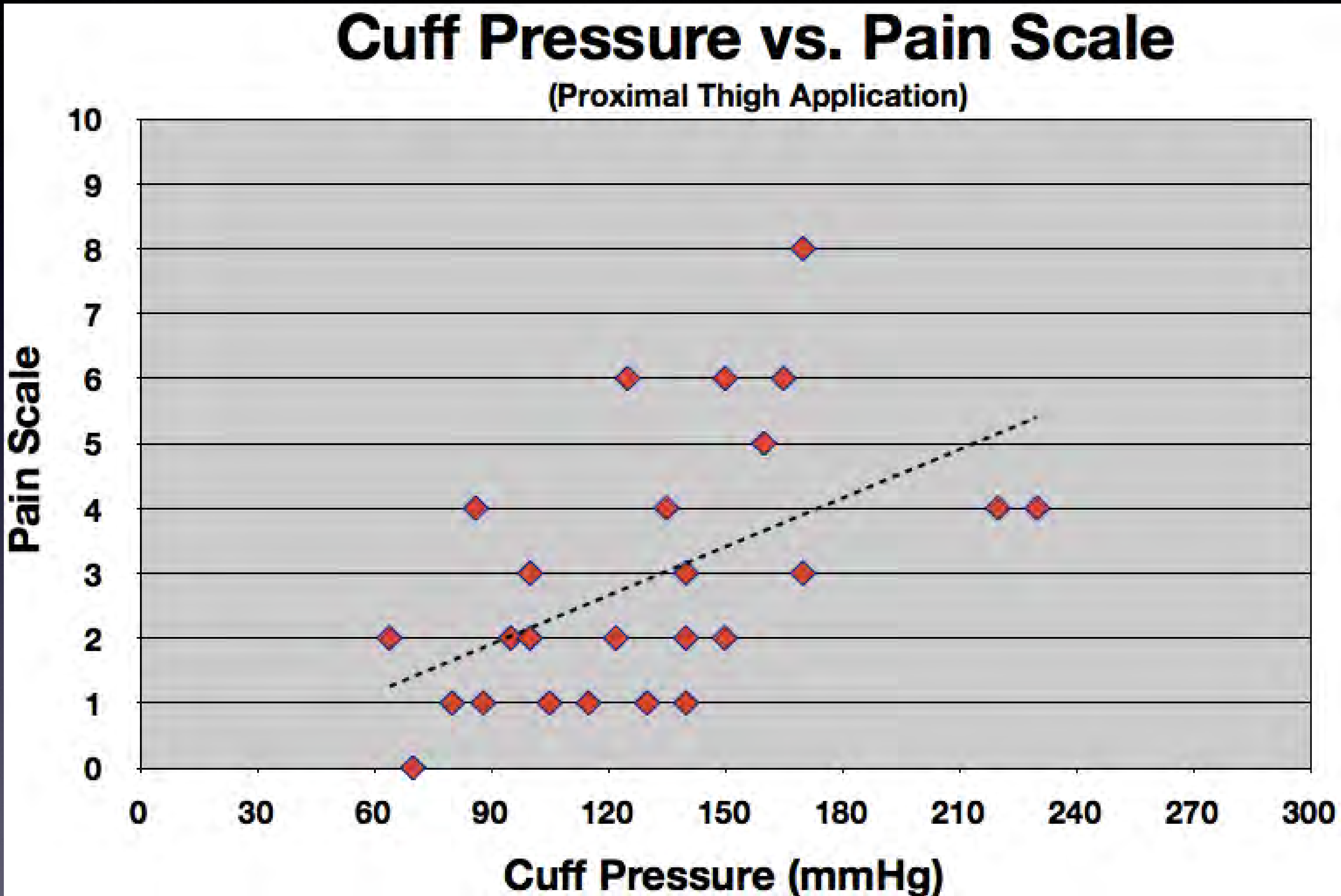
- In all participants (13/13) the blood flow in the PA was stopped.
    - mean bladder pressure at zero Doppler flow was 148.5 mm Hg (SD=44.8, max 230, min 80)
    - Average pain at maximum pressure = 3.6 (10 pt scale)
    - Pain scale returned to 0 immediately after deflating the cuff.

# Results



Popliteal Artery Peak Velocity Vs. Cuff Pressure
Peak Velocity (cm/s)
80
60
40
20
0
0
60
120
180
240
300
Cuff Pressure (mmHg)

# Results


Cuff Pressure vs. Pain Scale
(Proximal Thigh Application)
Pain Scale
0
1
2
3
4
5
6
7
8
9
10
0
30
60
90
120
150
180
210
240
270
300
Cuff Pressure (mmHg)

# Discussion

- Unclear how and where the artery is being occluded with application to the axilla.
- Normal subjects with normal blood pressure
- Subjects were all young healthy males

# Conclusion

- The AAT applied to the proximal chest and lower pelvis was uniformly effective in stopping blood flow at the axilla and proximal thigh

- The subjects uniformly endorsed tolerable pain in both junctional torso applications.

- All pain immediately subsided with bladder deflation.

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