

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

Richard Gordon, MD

Matthew Lyon, MD

Department of Emergency Medicine

Medical College of Georgia

Georgia Regents University

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, iliac or femoral arteries
- Applying an effective tourniquet at the axilla or proximal thigh is difficult secondary to the anatomy of the regions.

Introduction

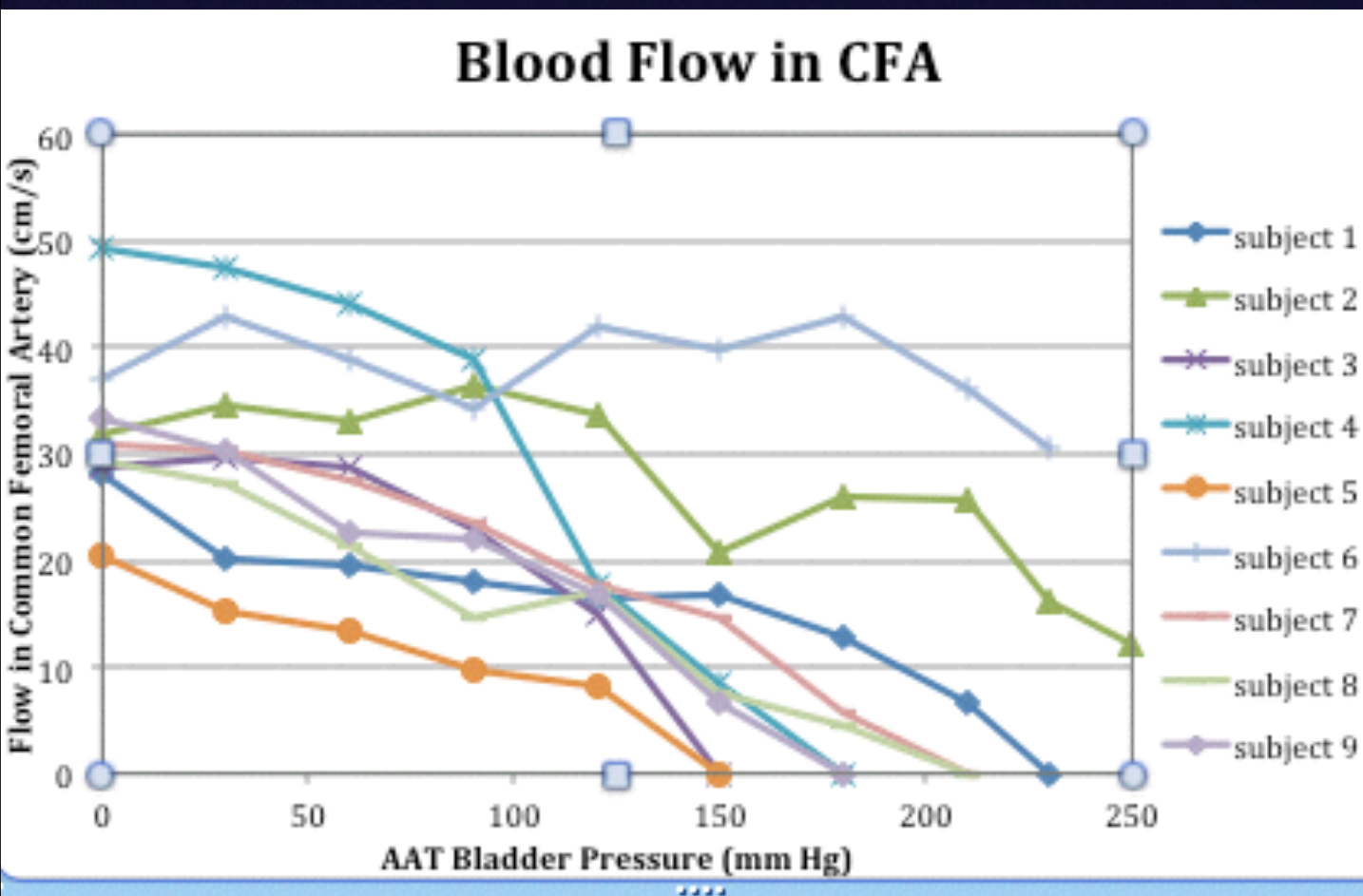
- Hemorrhage amenable to truncal tourniquets is now the most common cause of preventable death.¹
- Kelley et al. J. (Trauma 2008) estimated a device for junctional hemorrhage control could have saved an average of 3 casualties/month during the conflict in Iraq.²
- The traditional narrow strap windlass 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

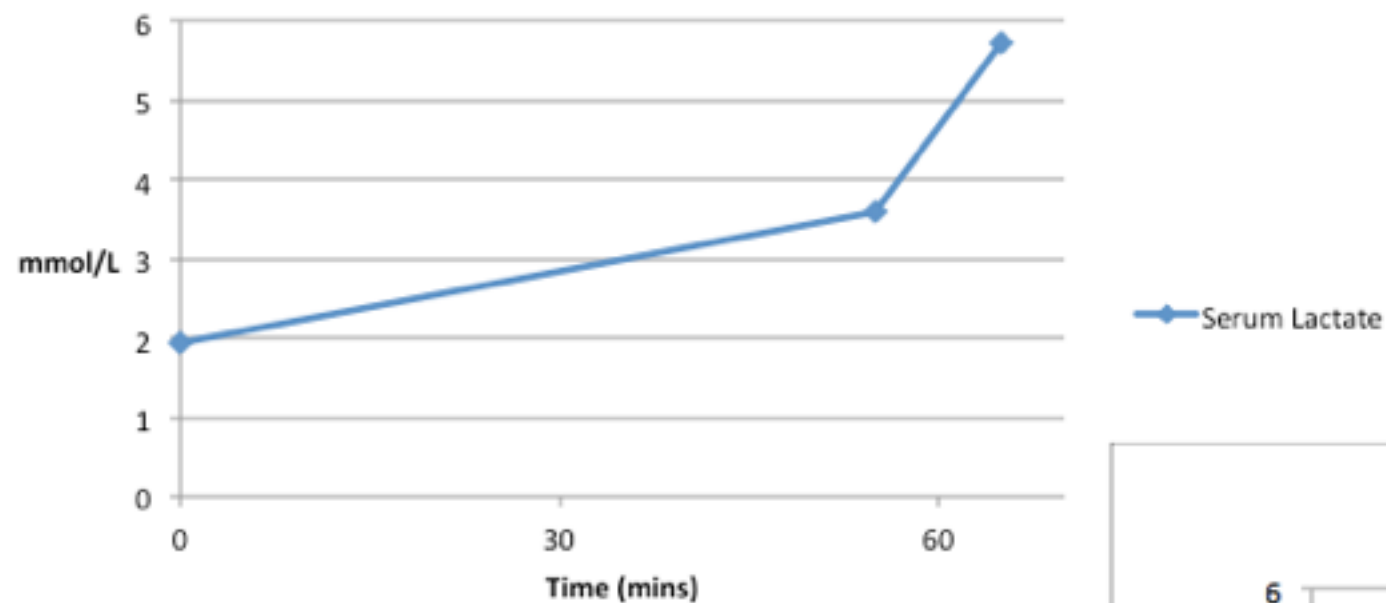
- Prior studies have shown that the Abdominal Aortic Tourniquet (AAT) effectively reduced blood flow in the Common Femoral Artery with application of the device around the lower abdomen. 9-11



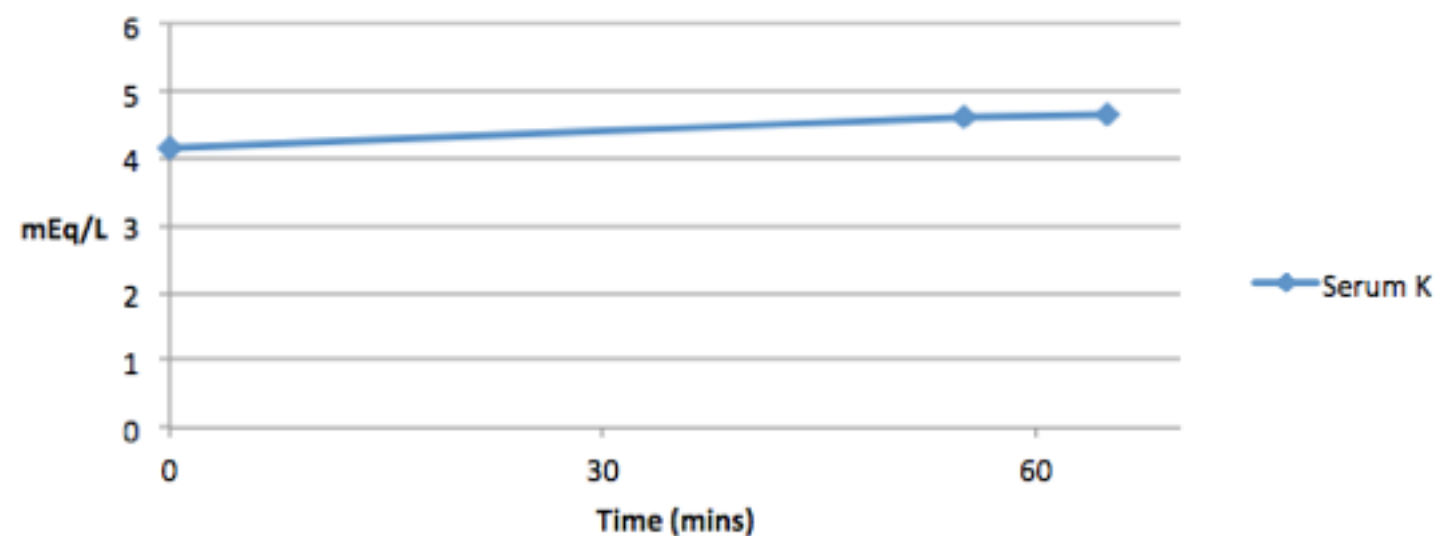
Introduction

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

Serum Lactate vs Time

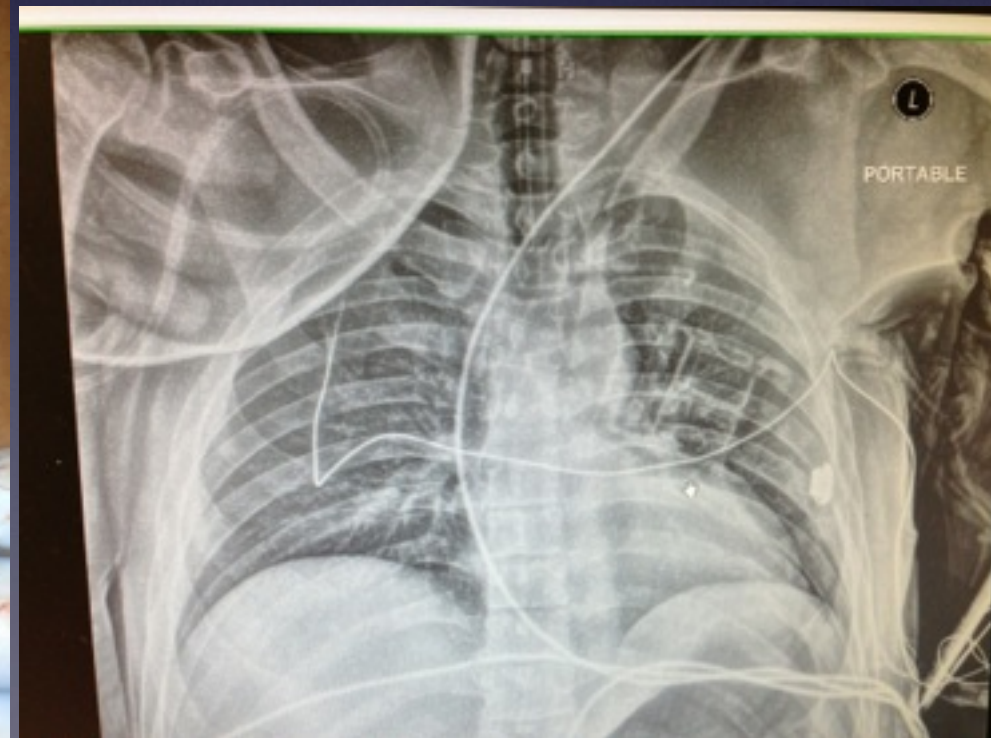


Serum Potassium vs Time



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

AAT 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

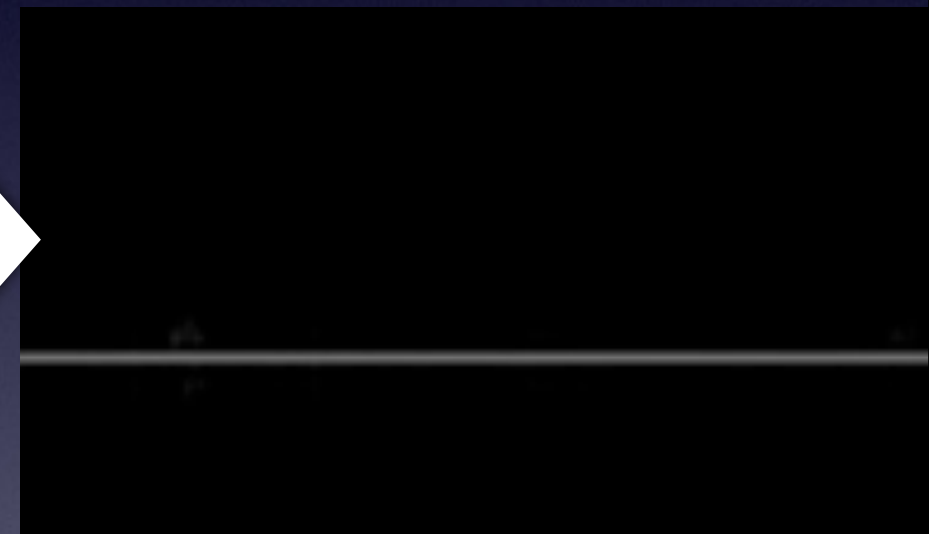
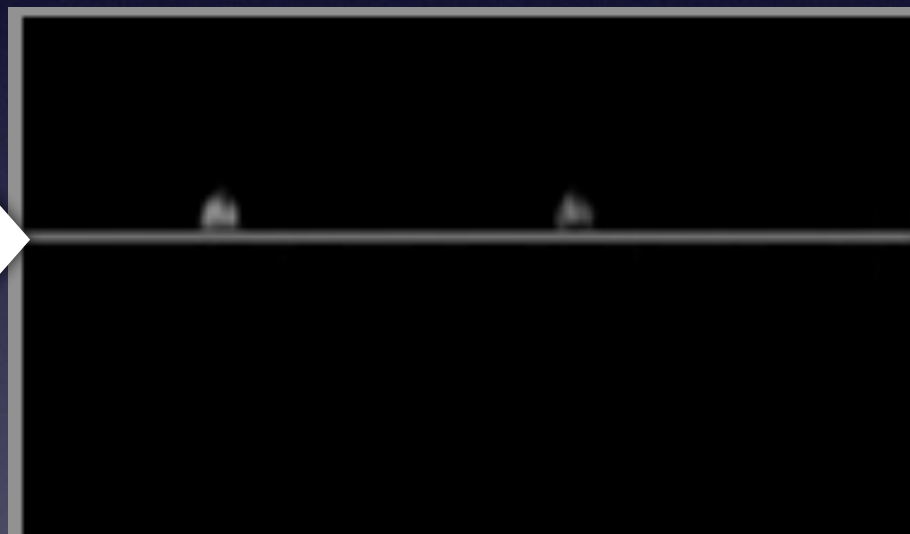
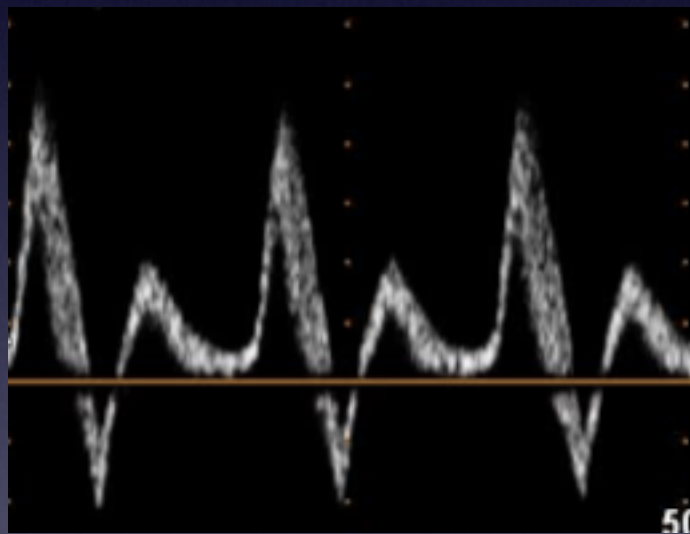
- Measurements

- 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 experiment.



- 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

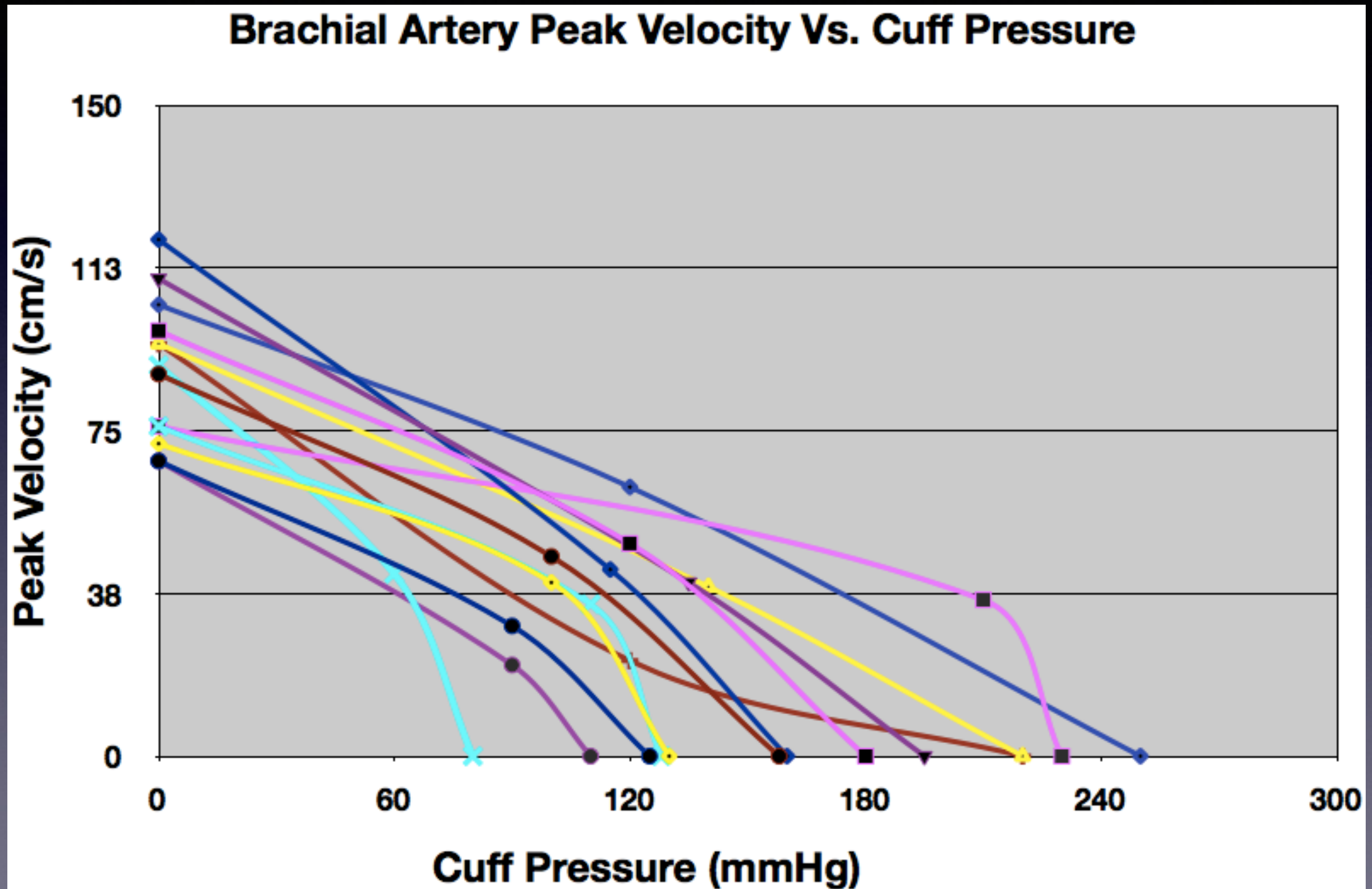
- Measurements
 - A visual analog pain scale (1-10) was used to query the subjects for degree of pain at:
 1. Pre-cuff inflation
 2. Transition from triphasic to monophasic flow
 3. Transition from monophasic to cessation of flow
 4. Immediately following cuff deflation

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.

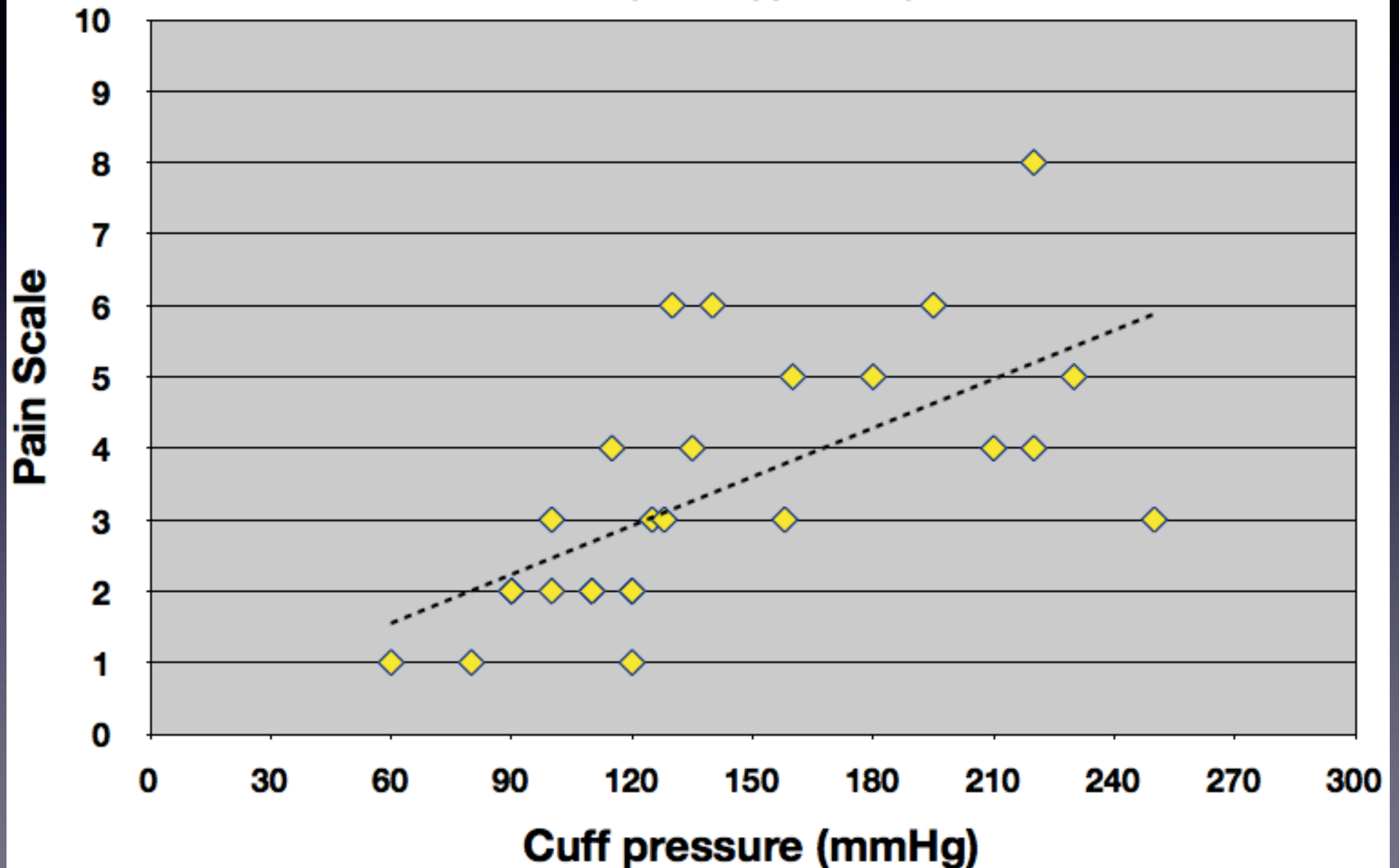
Results



Results

Cuff Pressure vs. Pain Scale

(Axilla Application)

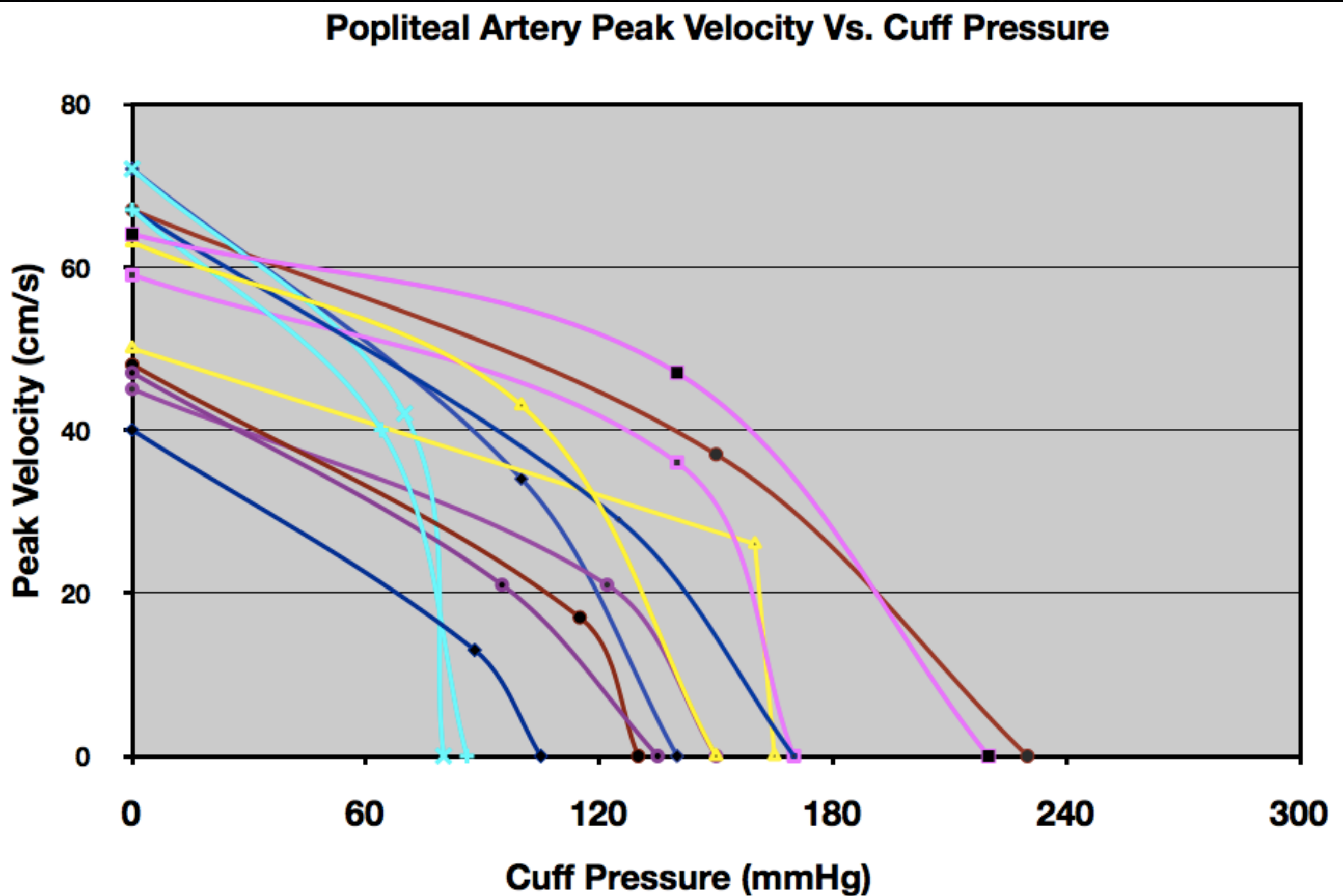


Results

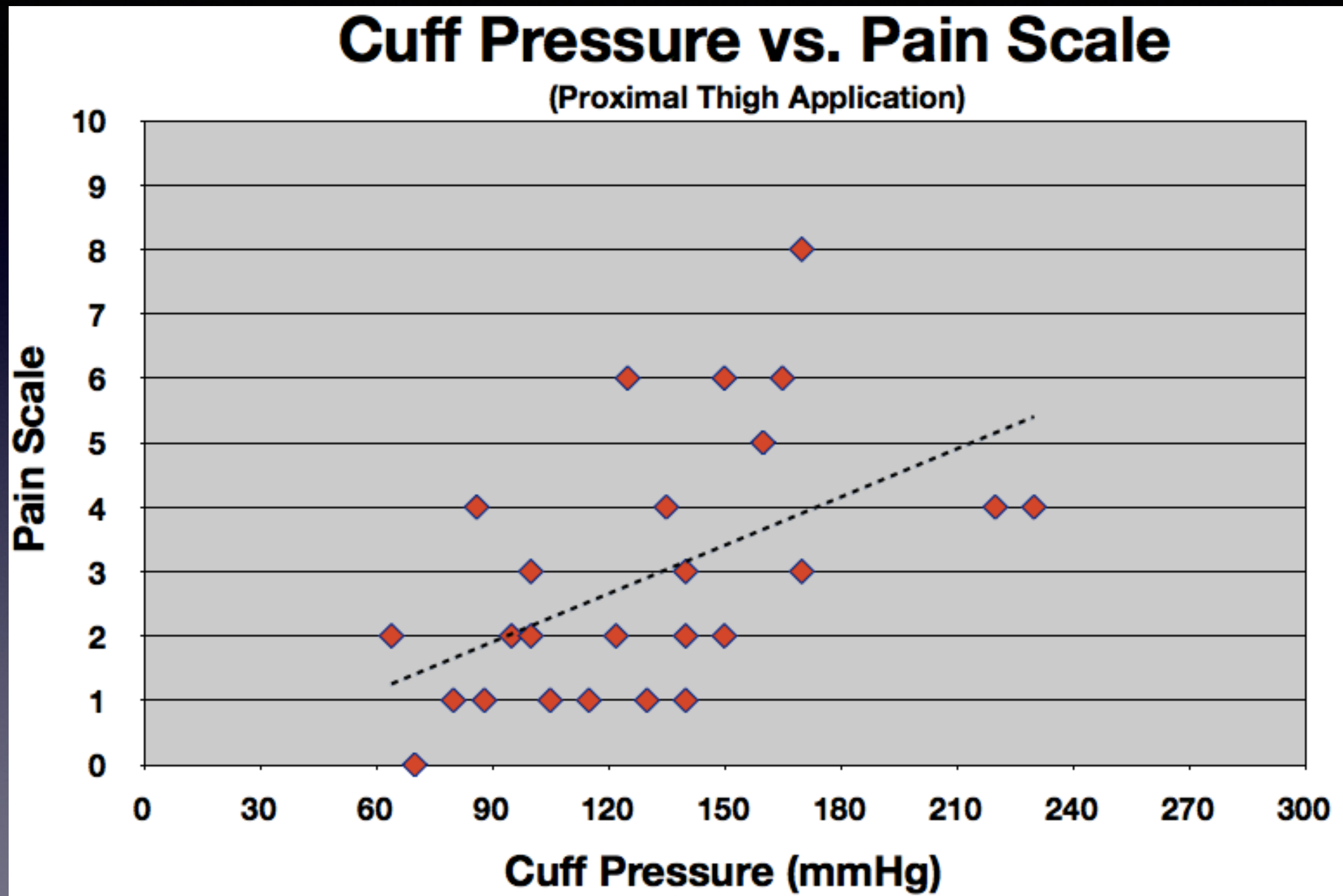


- In all participants (13/13) the blood flow in the PA was stopped.
 - mean bladder pressure at zero Doppler flow was 148.5 mm Hg (SD=44.8, max 230, min 80)
 - Average pain at maximum pressure = 3.6 (10 pt scale)
 - Pain scale returned to 0 immediately after deflating the cuff.

Results



Results



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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