Assessing External Forces on Peripheral Intravenous Catheter Movement through Ultrasound: A Randomized Pilot Investigation

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BACKGROUND

- Micro-movements or pistoning of the PIVC has been described as a source of recurrent damage to the vein wall. It is likely a major contributor to PIVC complications and failure.

OBJECTIVE

- While external forces cause movement of the PIVC within the vein, the magnitude of movement is unknown. It is the aim of this study to quantify this movement when external forces are applied to the PIVC.

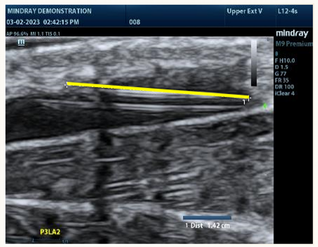
OUTCOMES

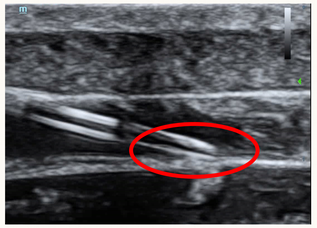
- **Primary**:
  - Quantify the change in PIVC movement with application of forces (4,5,6 lb)
  - PIVC measured pre and post application of force
- **Secondary**:
  - Describe the interaction of the PIVC tip with the vein wall during application and release of a 4 lb force

METHODS

- **Design**:
  - Prospective exploratory trial
  - Randomization of forces
  - Blinding of investigator/participants
- **Setting**:
  - Outpatient research laboratory
- **Participants**:
  - Healthy adult volunteers

RESULTS





Variable	N=11
Age (yr.)	40.36±16.10
Gender · Female · Male	Gender 5 (45.45) 6 (54.55)
Ethnicity · White · Asian	Ethnicity 10 (90.91) 1 (9.09)
Height (in)	67.82±5.02
Weight (lb.)	187.36±63.26
Body mass index (kg/m2)	28.25±8.22
Diabetes	2 (18.18)
Current Smoker	4 (36.36)
Vein Diameter (mm)	3.61±1.06)
Vein Depth (mm)	5.06±1.71

Pull Force Placed on the PIV Line

	4 lb	5 lb	6 lb
Catheter Movement (mm):			
Mean ± SD	4.65±1.88	3.88 ± 2.28	5.25 ± 2.06
Minimum	2.10	1.30	2.10
Maximum	6.90	8.10	8.10
Range	4.80	6.80	6.00
Interquartile Range	2.50, 6.30 (3.80)	1.90, 5.20 (3.30)	3.40, 6.90 (3.50)

RESULTS

Catheter Tip Interaction with Vein Wall

- Movement without vein wall contact
  - 5 participants (45.5%)
- Contacted and remained in contact with the vein wall
  - 6 participants (54.6%)

STUDY LIMITATIONS

- Sample size: small exploratory study
- Angle of the pull force: one direction and one angle (20 degrees); may not represent clinical situations
- Study population: all participants in this study were healthy volunteers
- Future studies should be conducted in a hospital setting with actual patients

CONCLUSIONS

External forces triggered substantial movement of the PIVC within the vein. In many cases, there was significant contact of the PIVC tip with the vein wall suggesting vein trauma. Strategies that reduce PIVC movement and/or remove or limit external pull forces from the PIVC are needed.