

How to learn central venous pressure measurement with US:

The TeachPort Study

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Part 1

What is known:

Trained vascular physician + High-end ultrasound machine



Aim of the study (part 1)

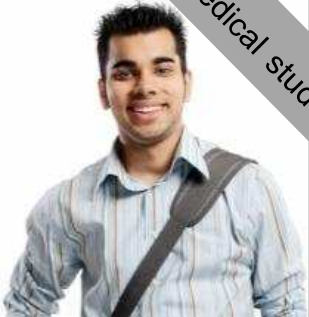
- Feasibility and accuracy of CVP measurements using a
 - a) high-end US machine vs.
 - b) simple portable US machine
- Feasibility and accuracy of CVP measurements by «non-vascular specialists» (after short training phase)



Training

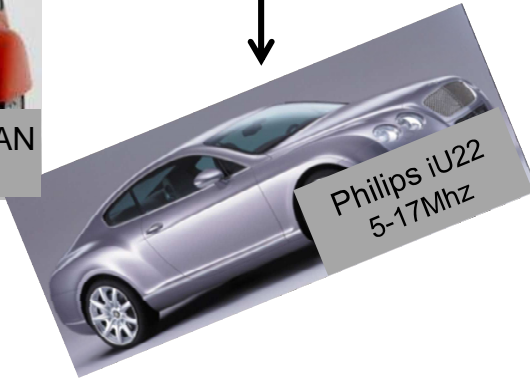
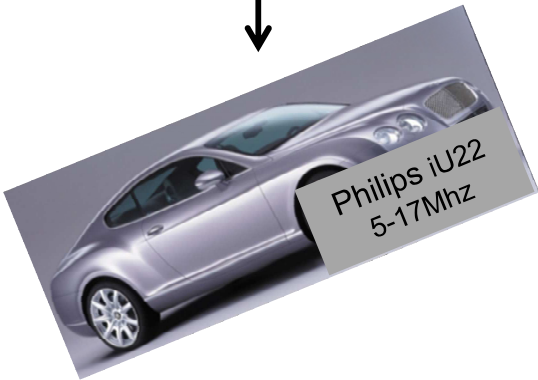
- Three 1h sessions
- 30 measurements on healthy volunteers
- Randomly selected different levels of peripheral venous pressure
(induced by inflated sphygmomanometer at the upper arm)
- «Goldstandard»: vascular physicians

Aim of the study



Medical student

Intensive care specialist



- Surgical intensive care unit
- Central venous catheter clinically indicated



Ready – Steady – Go!

Study design

- Technique: as mentioned
- Measured contralateral to subclavian catheters
- Best visible superficial vein at the forearm
- Corrected for the same level of atrium height as in catheter CVP measurement
- Feasibility: maximum time of investigation 8 min.

Patient characteristics

Parameter	Value	%
Patients (n)	50	100
male/female	34 / 16	68 / 32
Age* (years)	67 ± 14.5	--
Ventilated patients	27	54
Diameter of the vein* (mm)	2.4 ± 0.9	--

*mean± SD

Results

Investigator	US device	Time (min)	Feasibility (%)
Vasc. expert	high end	3.2 ± 1.4	92
Student	high end	4.2 ± 1.9	90
Vasc. expert	portable	2.9 ± 1.6	88
IC specialist	portable	3.7 ± 1.9	88
		n.s.	n.s.

Results

Group	CVP invasive mmHg*	CVP non invasive mmHg*	Mean difference mmHg*
All investigators	12.3 ± 4.8	9.8 ± 4.5	-2.5 ± 4.0
Vasc. expert / high end	12.4 ± 4.8	9.3 ± 4.8	-3.1 ± 4.4
Student / high end	12.3 ± 5.0	9.9 ± 4.0	-2.4 ± 3.8
Vasc. expert / portable	12.4 ± 4.8	10.0 ± 4.4	-2.4 ± 3.7
IC specialist / portable	12.2 ± 4.8	9.9 ± 4.8	-2.2 ± 4.1
High end US	12.3 ± 4.8	9.6 ± 4.4	-2.8 ± 4.1
Portable US	12.3 ± 4.8	10.0 ± 4.6	-2.3 ± 3.9
Vascular experts	12.4 ± 4.8	9.6 ± 4.6	-2.8 ± 4.1
Trainees	12.2 ± 4.8	9.9 ± 4.4	-2.3 ± 4.0

n.s.

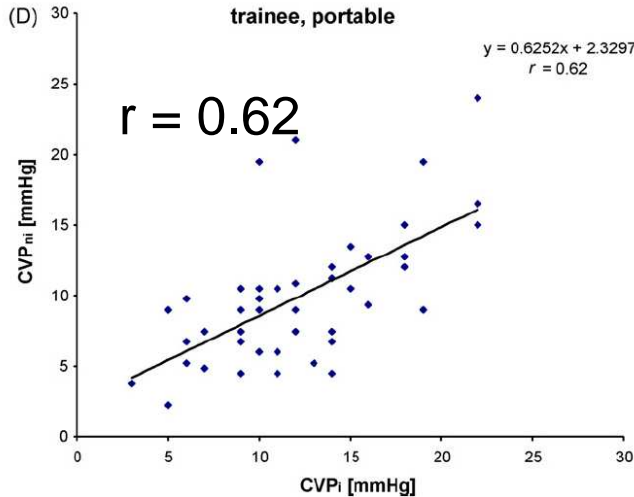
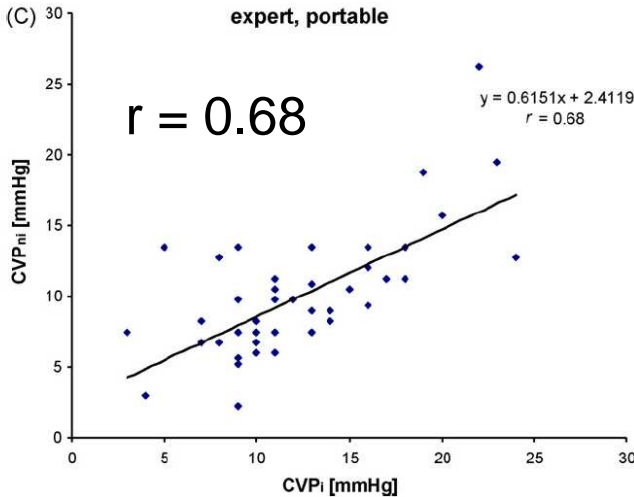
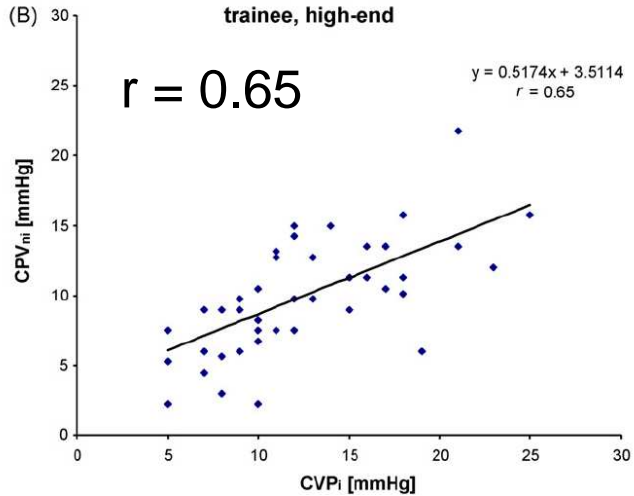
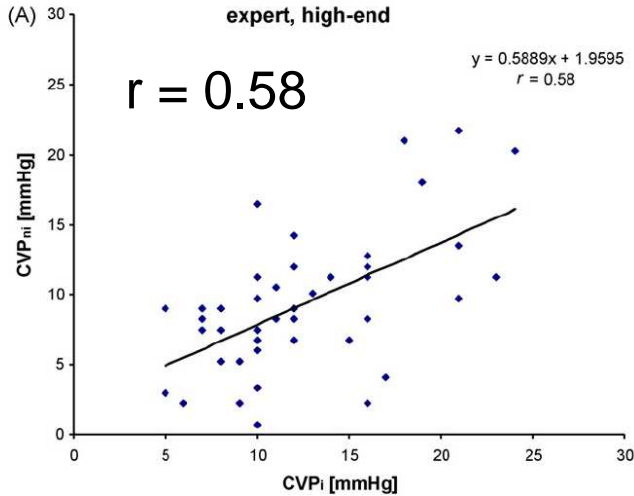
n.s.

n.s.

*mean ± SD

(Range 3 – 25)

XXV World Congress IUA, TeachPort



Part 2

Aim of the study (part 2)

- To test, whether the established US measurement method is precise enough to detect respiratory pressure changes during mechanical ventilation



Respiratory changes in CVP

- Compressibility of the veins is depending on respiratory cycle
- The deeper the respiration, the larger the pressure amplitude

Technique

- Lower CVP:
first time complete collaps of the vein
- Upper CVP:
persistent complete collaps of the vein during a whole respiratory cycle

- Team:



Patient characteristics

Parameter	Value (range)	range
Patients (n)	20	--
male/female	13 / 7	--
Age* (years)	65.5	--
Diameter of the vein** (mm)	2.0±1.2	
Ventilated patients	20	--
Blood pressure** (mmHg)	74	(45-101)
Mean airway pressure** (mmHg)	11.6	(7-21)
Respiratory rate** (/min)	15.4	9-32
Tidal volume** (ml)	611	500 – 800

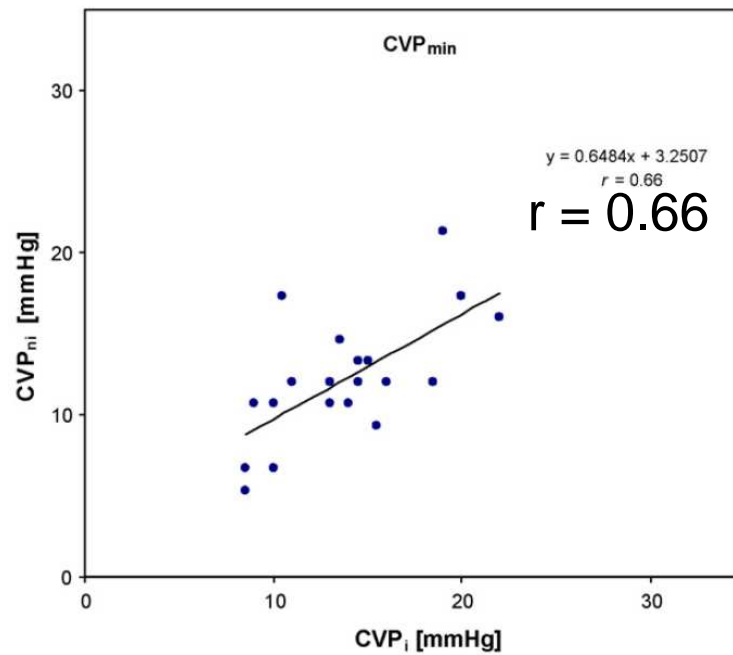
*median, ** mean

Results

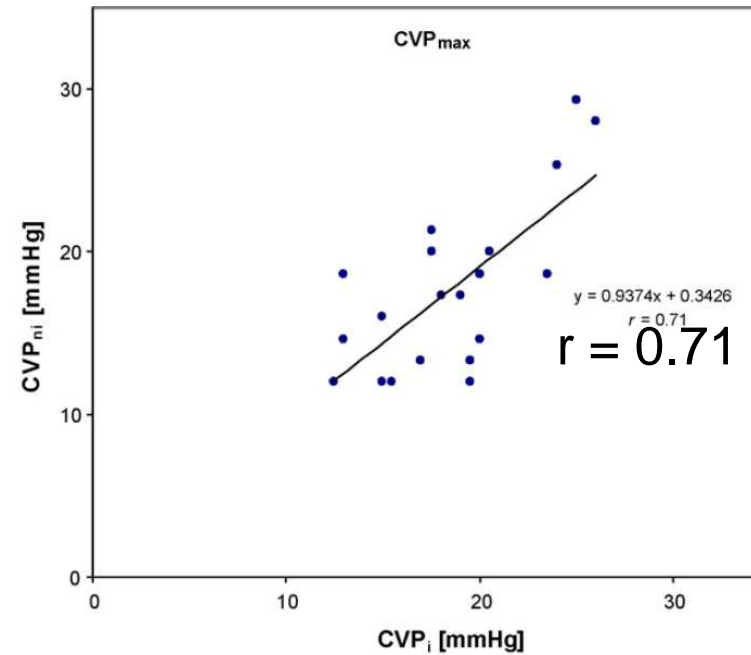
Group	invasive mmHg*	non invasive mmHg*	Mean difference mmHg*
Minimal CVP	12.2 ± 3.9	13.8 ± 3.9	+1.6
Maximal CVP	17.5 ± 5.2	18.6 ± 4.0	+0.8
Respiratory change	5.5	4.8	

*mean± SD

Minimal CVP



Maximal CVP



Conclusion (part 1)

- Non invasive CVP measurement with US is feasible and accurate
- No difference with respect to quality of US system or experience of the investigator (adequate transducer and training provided)

Conclusion (part 2)

- Non invasive CVP measurement method is accurate to distinguish higher and lower CVP levels during respiration
- This has to be considered when examining patients with spontaneous deep respiration or mechanical ventilation to avoid underestimation of the real CVP

Thank you for your attention

