



Internal Jugular Vein Location and Anatomy on Ultrasound



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- Methods
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- Discussion
- Conclusion
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Introduction

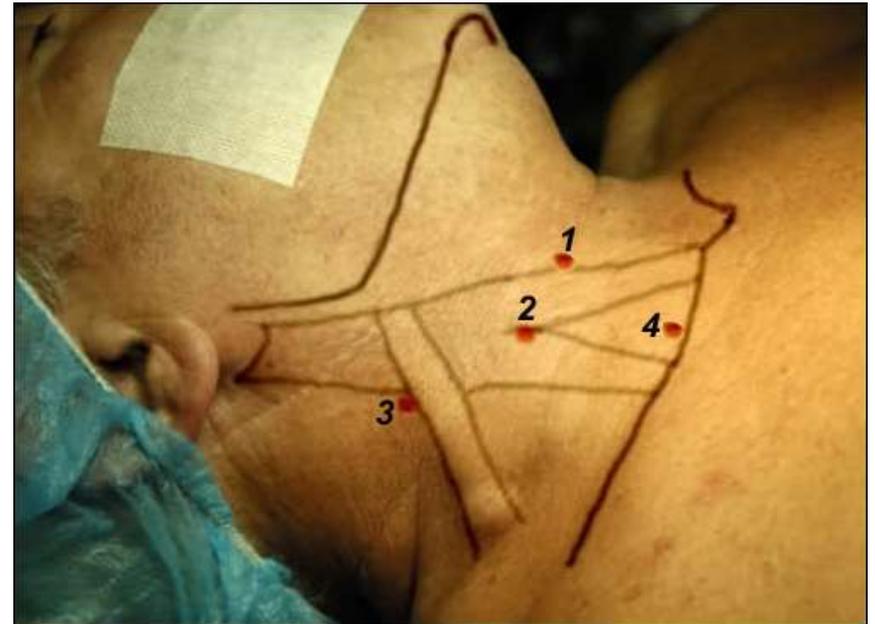


Venous access

- Peripheral
- Central
 - Jugular
 - Subclavicular
 - Femoral
 - PICC
- Mixed (surgical)

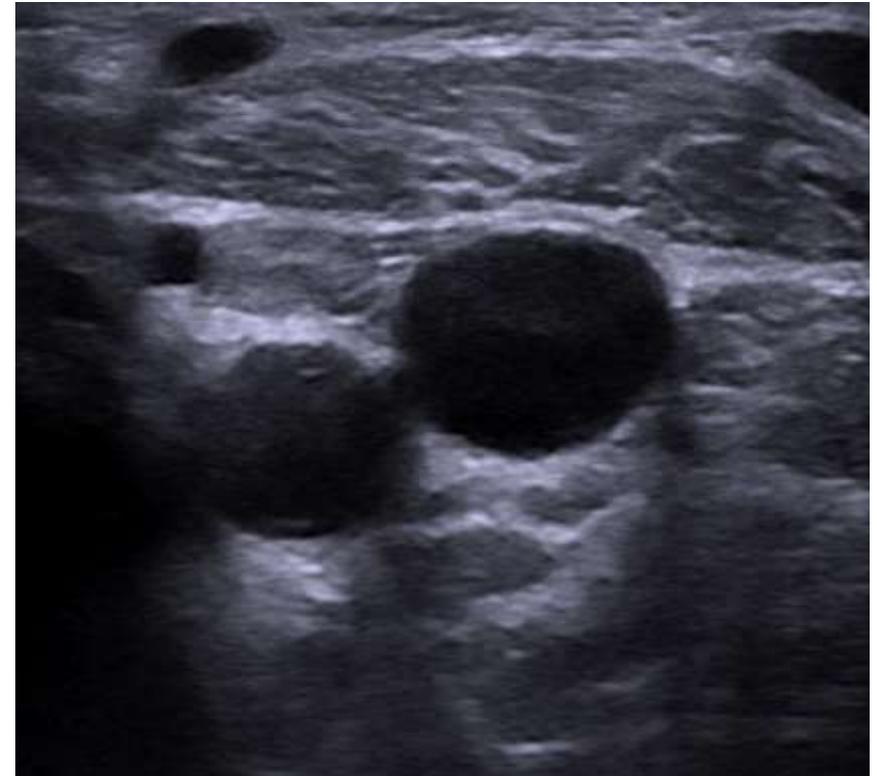
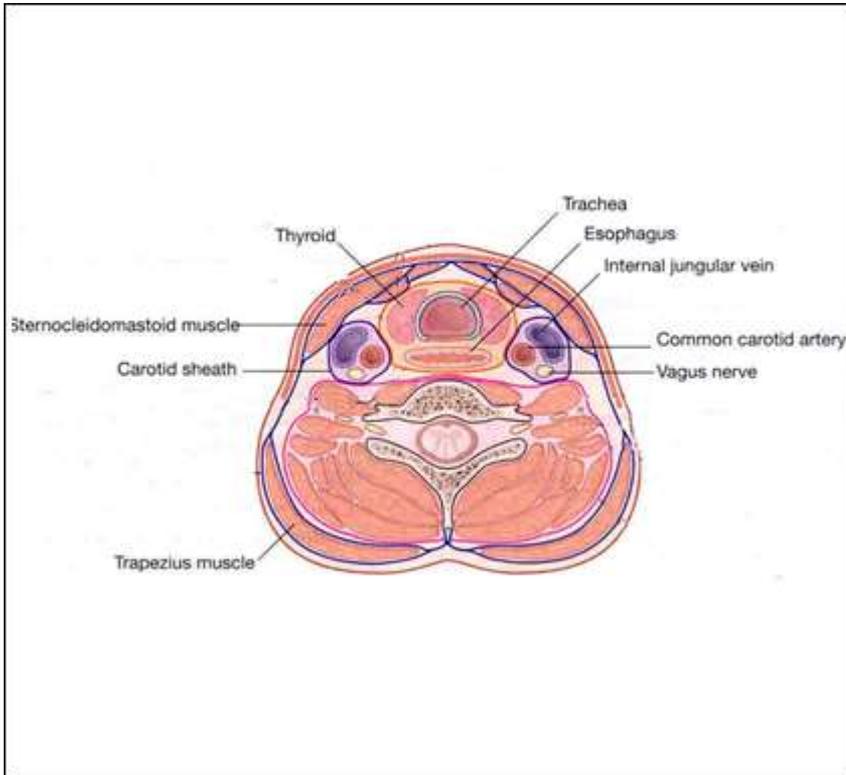
Jugular catheterisation

- Landmark approach
 - (1) Anterior
 - (2) Central
 - (3) Posterior
 - (4) Supraclavicular
- **Ultrasound-guided**
 - Indirect
 - **Direct (RTUS)**
 - LAX (in-plane)
 - **SAX (out-of-plane)**

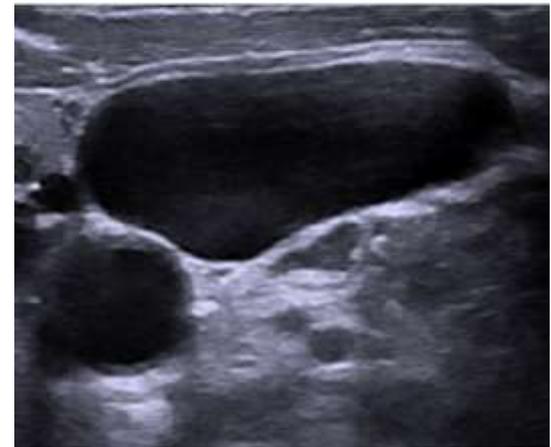
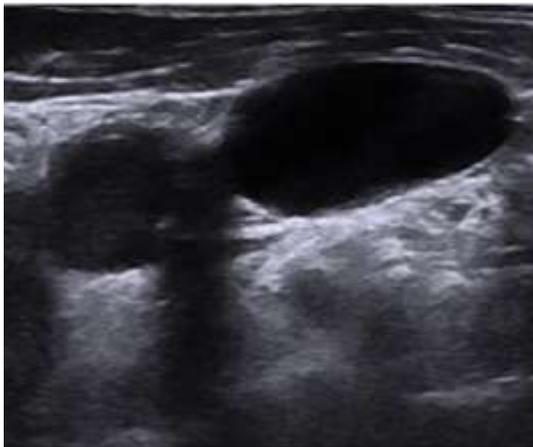
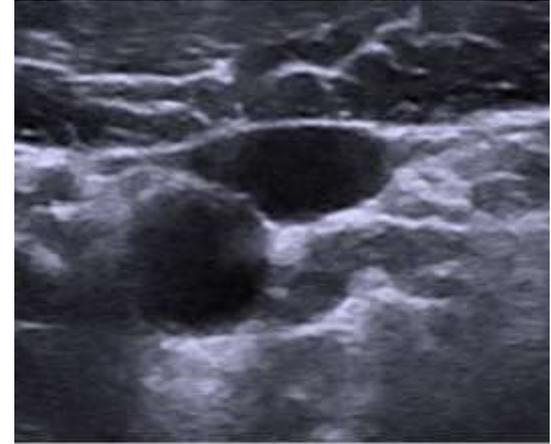
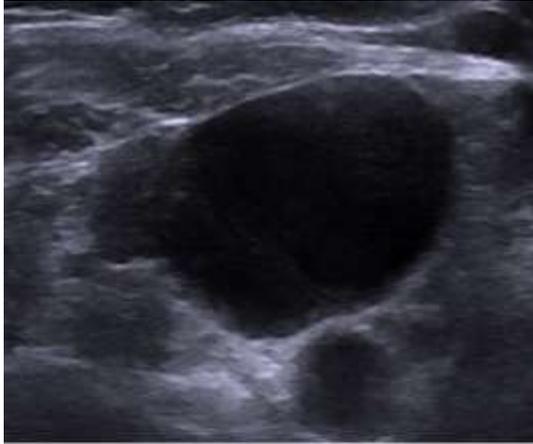


<http://www.thecardiaticu.com> [homepage on the internet], Cardiac Surgical ICU at Leningrad Region Hospital; 2006 [cited 5 April 2017]. Available from: http://www.thecardiaticu.com/for_experts/jugular_intro_eng.html

US SAX



Problem?



Goals

- To investigate the incidence of anatomical variants of the internal jugular vein
- To express a relationship between these variants and specific patient characteristics
- To assess whether certain variants yield an increased risk of complications

Methods



Methods

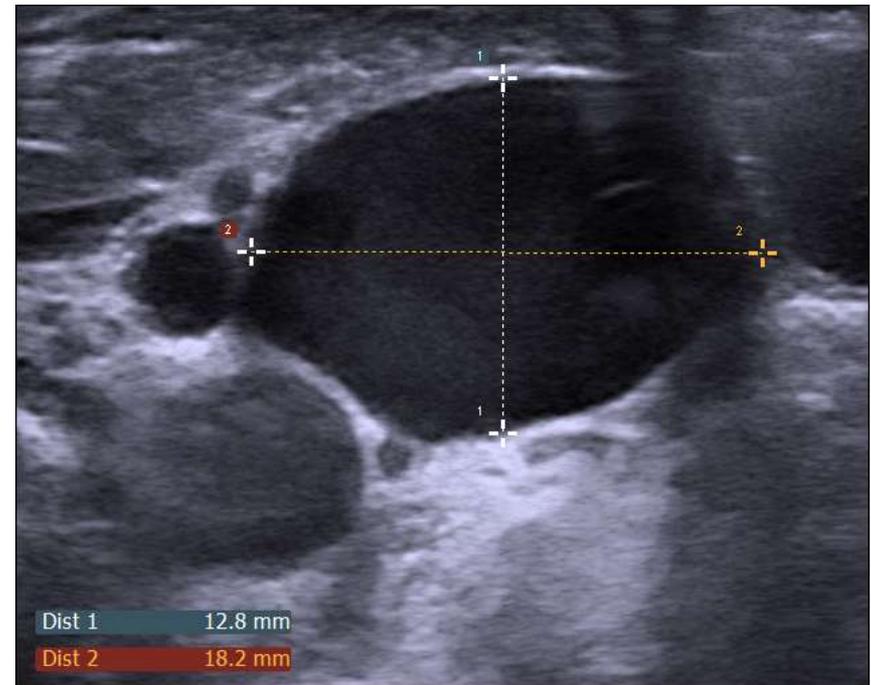
- Informed consent after ethical approval
- 50 patients to be included
- Patient positioning
 - Trendelenburg (10-15°)
 - Right-sided (unless contra-indicated)
 - Head rotated contralaterally (CAVE extreme rotation)
- RTUS
 - Linear transducer (BK Medical)
 - High frequency (10-12 mHz)
 - SAX
 - @ level of cricoid
- Timing
 - From start needling until aspiration of blood over catheter

Parameters

- Patient-related
 - Gender
 - Age
 - ...
- Ultrasonographic
 - Vein diameter
 - Vein position relative to the ICA
- Outcome
 - Success rate
 - Time until success
 - Number of attempts
 - Complications

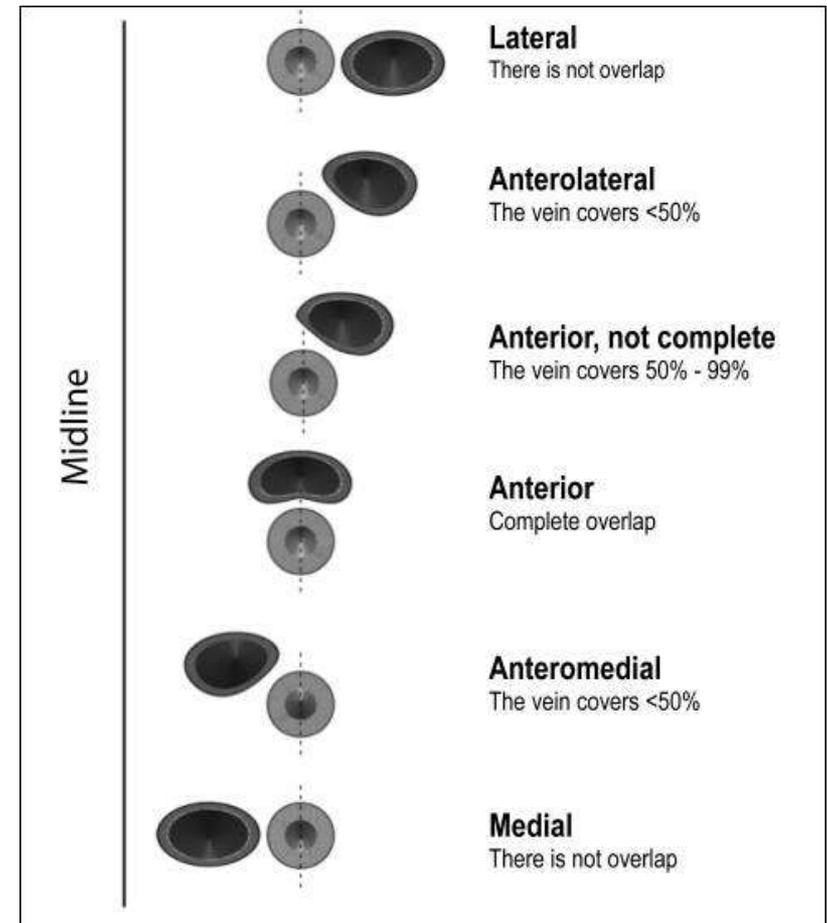
Parameters

- Patient-related
 - Gender
 - Age
 - ...
- Ultrasonographic
 - **Vein diameter**
 - Vein position relative to the ICA
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 - Success rate
 - Time until success
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Parameters

- Patient-related
 - Gender
 - Age
 - ...
- Ultrasonographic
 - Vein diameter
 - **Vein position relative to the ICA**
- Outcome
 - Success rate
 - Time until success
 - Number of attempts
 - Complications



Results



Diameter

Average:

Diameter: 13.11 mm

Cross-sectional area: 135.52 mm²

Side:

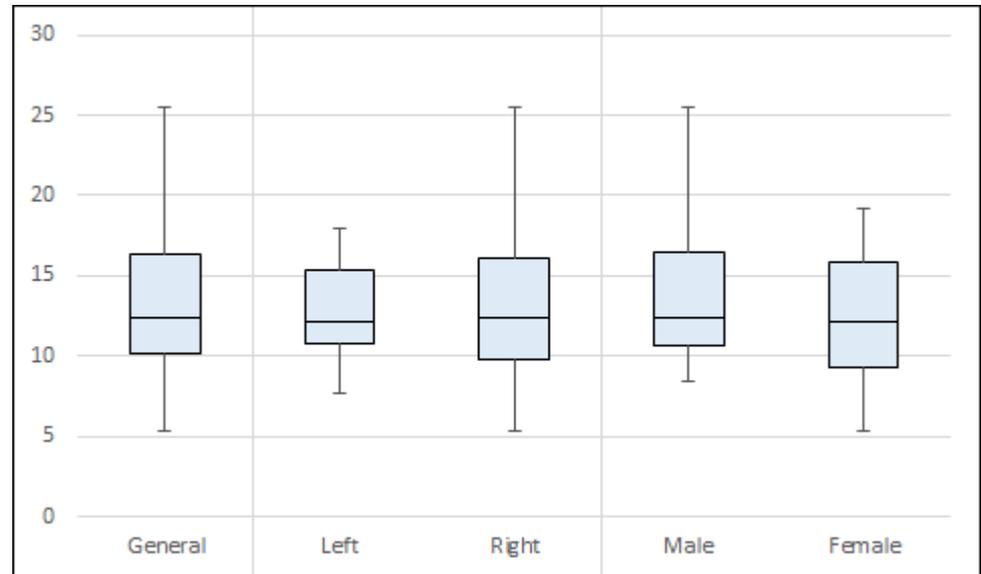
Left (12.85 mm) vs. right (13.17 mm)

$p = 0.85$

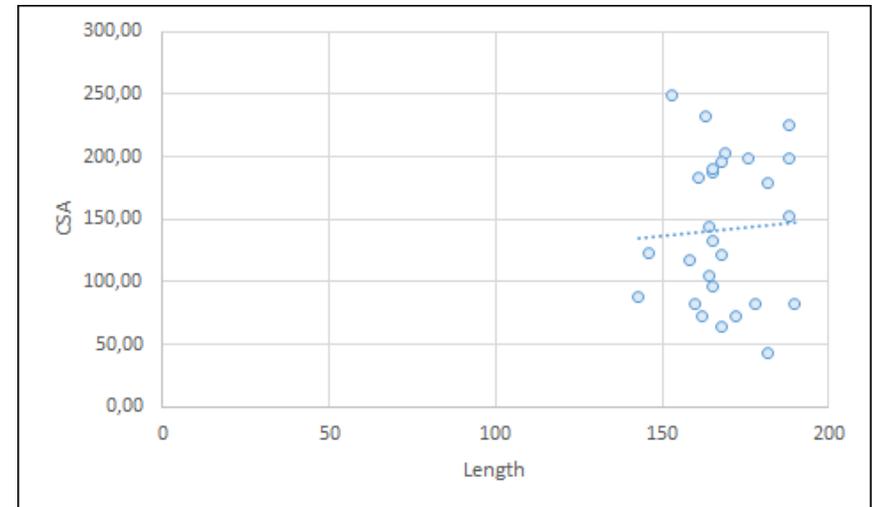
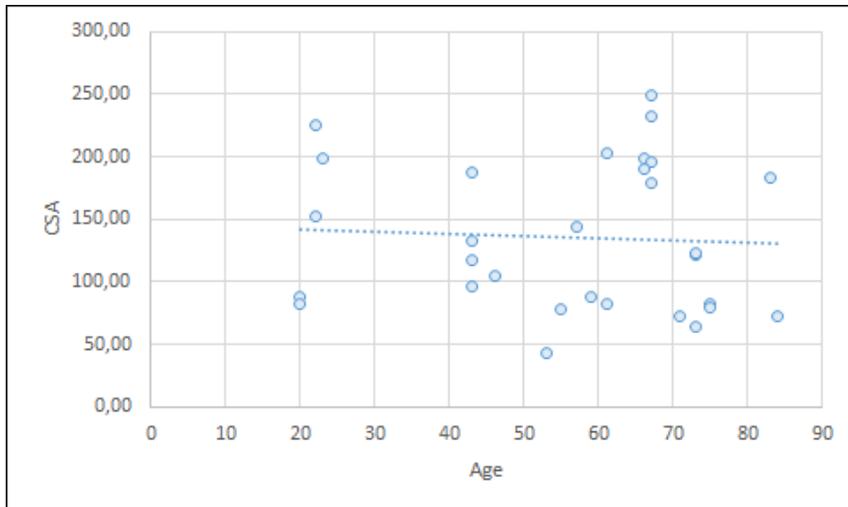
Gender:

♂ (12.48 mm) vs. ♀ (13.73 mm)

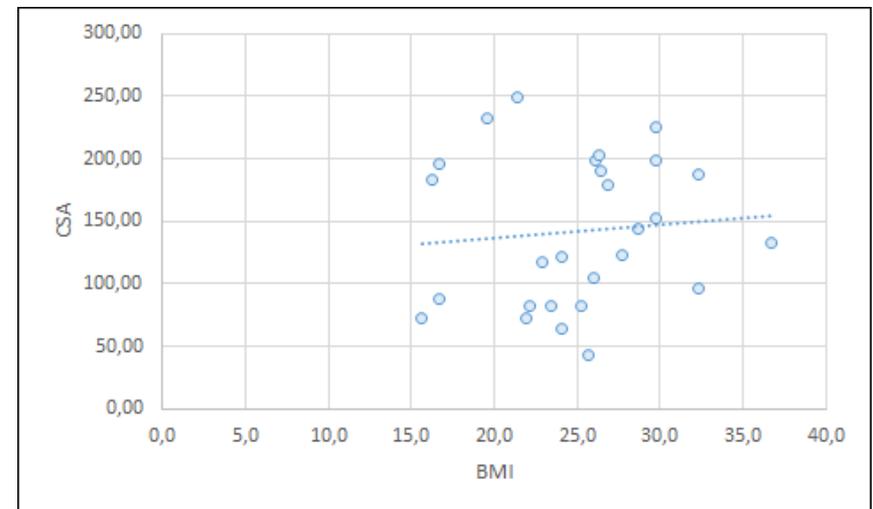
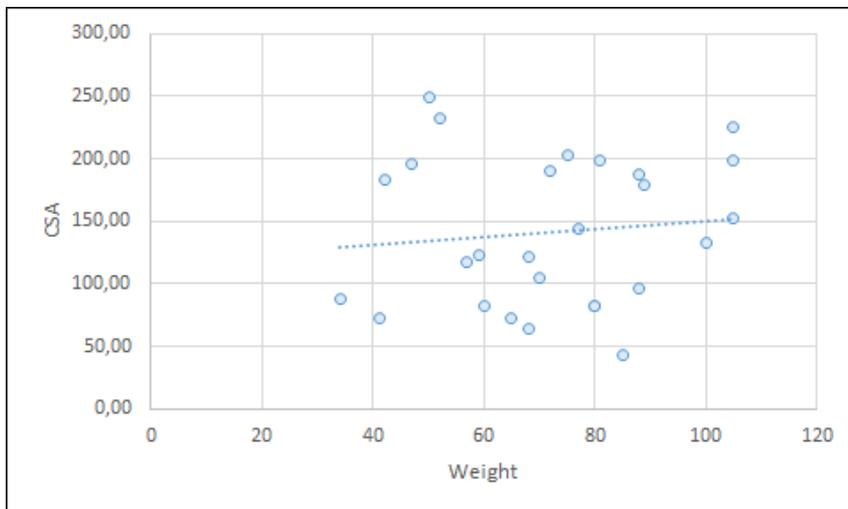
$p = 0.42$



Diameter



Diameter



Diameter

Age:

$$\rho^* = -0.06$$

Length:

$$\rho = 0.05$$

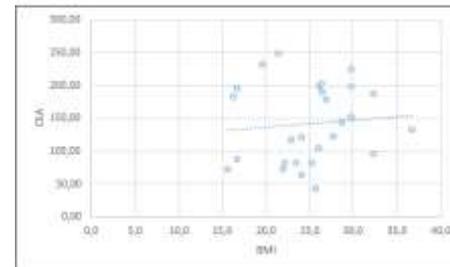
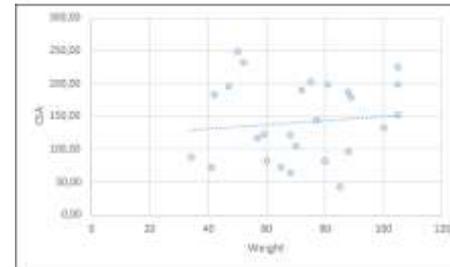
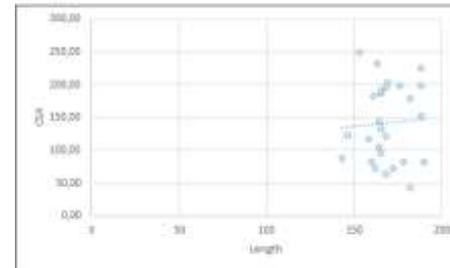
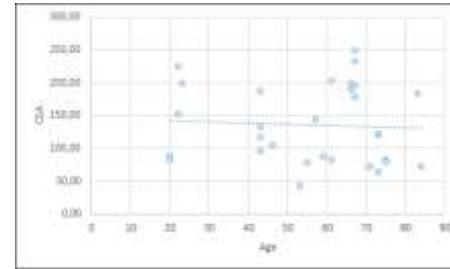
Weight:

$$\rho = 0.11$$

BMI:

$$\rho = 0.09$$

* Pearson's correlation coefficient



Position

Location	<i>Left</i>	<i>Right</i>	Total
<i>Medial</i>	0	0	0
<i>Anteromedial</i>	1	0	1
<i>Anterior</i>	2	4	6
<i>Anterior not complete</i>	2	3	5
	5 (83)	7 (29)	12 (40)
<i>Anterolateral</i>	1	9	10
<i>Lateral</i>	0	8	8
	1 (17)	17 (71)	18 (60)
Total	6 (100)	24 (100)	30 (100)

Position

Location	Male		Female	
	Left	Right	Left	Right
<i>Medial</i>	0	0	0	0
<i>Anteromedial</i>	0	0	1	0
<i>Anterior</i>	2	2	0	3
<i>Anterior not complete</i>	1	1	1	1
	3 (100)	3 (25)	2 (67)	4 (33)
<i>Anterolateral</i>	0	5	1	4
<i>Lateral</i>	0	4	0	4
	0 (0)	9 (75)	1 (33)	8 (67)
Total	3 (100)	12 (100)	3 (100)	12 (100)

Position

Side:

Left (83%*) vs. right (29%)

RR 2.86; 1.39-5.86**

p = 0.03

Gender:

(right)

♂ (25%) vs. ♀ (33%)

RR 0.75; 0.21-2.66

(left)

♂ (100%) vs. ♀ (67%)

RR 1.5; 0.67-3.34

Location	Left	Right	Total
<i>Medial</i>	0	0	0
<i>Anteromedial</i>	1	0	1
<i>Anterior</i>	2	4	6
<i>Anterior not complete</i>	2	3	5
	5 (83)	7 (29)	12 (40)
<i>Anterolateral</i>	1	9	10
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	1 (17)	17 (71)	18 (60)
Total	6 (100)	24 (100)	30 (100)

Location	Male		Female	
	Left	Right	Left	Right
<i>Medial</i>	0	0	0	0
<i>Anteromedial</i>	0	0	1	0
<i>Anterior</i>	2	2	0	3
<i>Anterior not complete</i>	1	1	1	1
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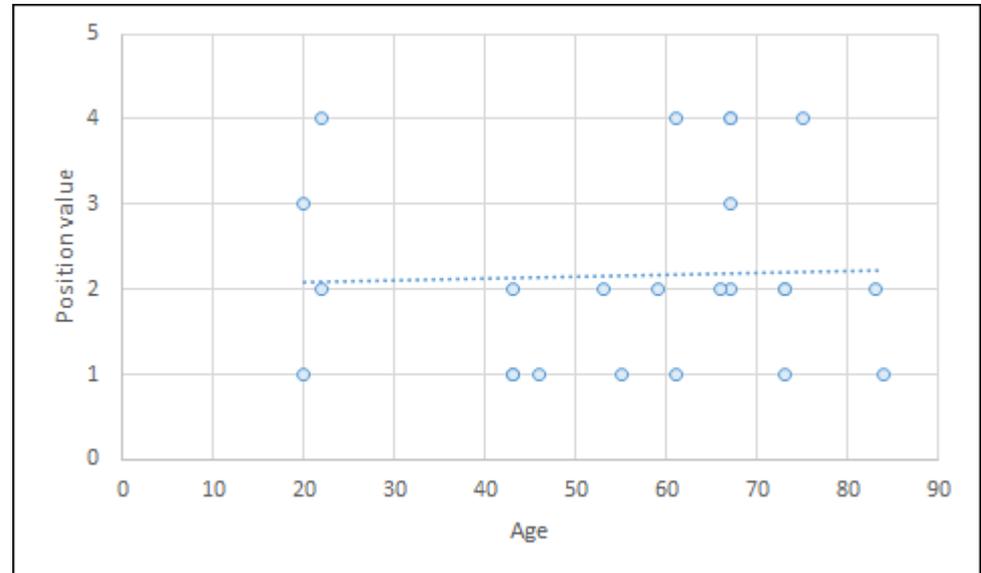
* Percentage of cases with significant overlap

** 95% confidence interval

Position

Age:

$\rho = 0.04$



Outcome measures

- **Success rate**
 - 28 / 30 (93.5%)
- **Number of attempts**
 - Difficult cannulations (more than 3 attempts): 3 / 30 (of which 2 failed)
- **Time until success**
 - Average: 03:54 (00:50 to 11:08)
 - Longer in...
 - Left-sided cannulation
 - Smaller veins
 - Significant overlap
 - Presence of co-assistants in a 10ft radius
- **Complications**
 - Unsuccessful cannulation: 2 / 30 (6.5%)
 - Accidental arterial puncture: 2 / 30 (6.5%)

Complications based on ...

- **Side**

- Left 2 / 6 (33.33%) vs. right 2 / 24 (8.33%)

RR = 4 (not statistically significant)

- **Diameter**

- Average diameter in complicated (12.04 mm) vs. non-complicated cannulations (13.27 mm)

p = 0.63

- Complication rate in smallest quartile (25%) vs. larger veins (9,09%)

RR 2.75 (not statistically significant)

- **Position**

- Complication rate with non-significant 0 / 18 (0%) vs. with significant overlap 4 / 12 (33.33%)

p = 0.02

Discussion



Landmarks versus ultrasound

Literature

- Higher success rate with US in a shorter time window, in general and at first attempt (98% vs. 87%)^{1,2}
- Lower general complication rate (13.5% vs. 3.9%)¹
- Higher failure rate in left-sided cannulation⁵

Study

- ↔ • Success rate of 93.5% (attempts performed by residents)
- ↔ • General complication rate 13% (attempts performed by residents)
- ↔ • Higher failure rate in left-sided cannulation (not statistically significant)

Vein diameter

Literature

- Higher failure rate in smaller vessels³
- Left IJV is more often the smaller vein (and is less prone to dilation with Valsalva manoeuvre)⁴
- Higher failure rate in left-sided cannulation⁵

Study

- ↔ • Higher failure rate and longer time until success in smaller vessels (not statistically significant)
- ↔ • Difference in right- and left-sided vein not significant
- ↔ • Higher failure rate in left-sided cannulation (not statistically significant)

Vein position

Literature

- The IJV often locates more anteriorly to the artery (41,9%) with a variable degree of overlap⁶
- The vein tends to overlap more in the elderly and when the head is rotated contralaterally, and to a lesser extend on the left side and in men⁶



Study

- Significant overlap in 40%
- Higher degree of significant overlap on the left side (83% vs. 29%)
- No strong correlation with gender and age
- Higher complication rate when significant overlap is present



Conclusion



What we already knew

- Real-time ultrasonographic guidance for central line placement increases success ratio and decreases the risk of complications
- Smaller vessels are more difficult to cannulate
- The left IJV is often smaller than the right one
- The IJV often does not lie lateral to the ICA but more anteriorly with a varying degree of overlap

What this study adds

- On average the left IJV tends to overlap with the ICA to a further extent than the right one does
- The hypothesis that an anteriorly located IJV yields an increased risk of complications has been confirmed

Limitations

- Relatively small sample size
- Central line placement performed by residents
- Different residents, not always same performer
- Study was not powered for VJI puncture complications

References



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