

Intravascular fluid assessment

Comparison between ultrasound on the inferior vena cava and bioimpedance spectroscopy

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Why was this study undertaken?

- Intradialytic hypotension (IDH) is still the most common side effect and adverse event during HD treatment¹.
- Repeated episodes IDH have detrimental effects on the heart, brain, GI tract and residual renal function²
- Current clinical nursing fluid assessment methods lack sometimes accuracy and predialytic fluid assessment consists often only of weight and BP measurements

1 - Rocha, A., Sousa, C., Teles, P., Coelho, A., & Xavier, E. (2015). Frequency of intradialytic hypotensive episodes: Old problem, new insights. *Journal of the American Society of Hypertension*, doi: 10.1016/j.jash.2015.07.007

2 - McIntyre, C. W. (2010). Recurrent circulatory stress: the dark side of dialysis. *Seminars in Dialysis*, 23(5), 449-451. doi: 10.1111/j.1525-139X.2010.00782.x

Aim: Comparative, observational study of two additional fluid assessment methods for their reliability on volume status and correlation to clinical outcomes.

1. **Ultrasound on the inferior vena cava** (Sonosite M Turbo)
2. **Bioimpedance spectroscopy (BIS)** (Body Composition Monitor – BCM Fresenius)





Mean Arterial Pressure (MAP) as additional indicator for asymptomatic IDH

➡ $MAP = (\text{systolic BP} \times 0.33) + (\text{diastolic BP} \times 0.66)$

If $MAP < 70 \text{ mmHg}$  asymptomatic IDH^{1,2}

1 - Bradshaw, W., & Bennett, P. N. (2015). Asymptomatic Intradialytic Hypotension: The Need for Pre-Emptive Intervention. *Nephrology nursing journal : journal of the American Nephrology Nurses' Association*, 42(5), 479.

2 - Bradshaw, W., Bennett, P. N., Hutchinson, A. M., Ockerby, C., & Kerr, P. G. (2017). Preventing Intradialytic Hypotension: Translating Evidence into Practice. *Nephrology Nursing Journal*, 44(2), 131-140.



Setting:

nurse-led clinic, no doctors present during treatment hours

30 patients on maintenance HD in satellite dialysis clinic (120 patients) during a single session

Nurse 1: performing standard HD treatment blinded to results of additional measurements using regular fluid assessment method

Setting (cont.)

Nurse 2:
competent¹ in
performing
IVC-US and
BCM
measurements

Treatment initiation:
1x BCM + 1x IVC-US
measurement + mean arterial
pressure (MAP)

Treatment “halftime”:
1x IVC-US measurement
+MAP

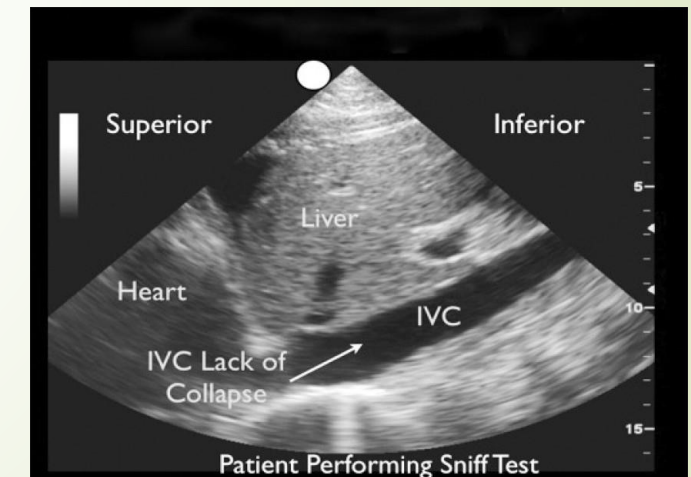
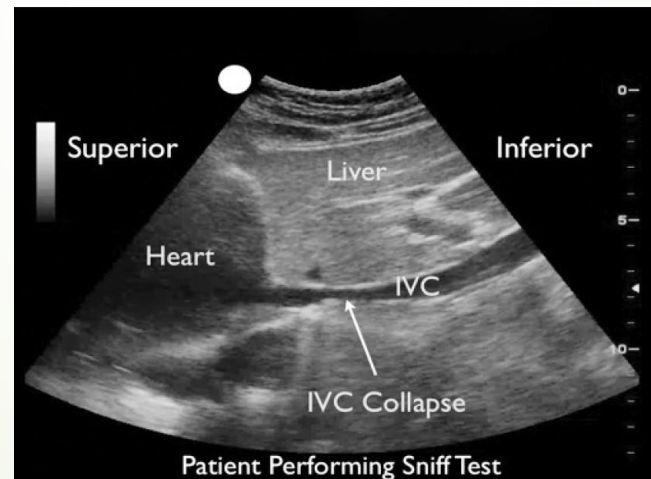
Treatment cessation:
1x IVC-US measurement + MAP

1 - Steinwandel, U., Gibson, N., Towell, A., Rippey, J. J. R., & Rosman, J. (2018). Can a renal nurse assess fluid status using ultrasound on the inferior vena cava? A cross-sectional interrater study. *Hemodialysis International*, 22(2), 261-269. doi: 10.1111/hdi.12606

Classification of fluid status with IVC-US

Definition of Inferior vena cava collapsibility index (IVCCI) cutoffs of IVC-US according to the 'Guidelines for the Echocardiographic Assessment of the Right Heart in Adults' (Rudski et al., 2010) ¹

Volume status	Collapsibility Index (%) = 100 (max - min diameter) / max diameter	Maximum IVC diameter
Hypovolemia	> 50%	< 2.1 cm
Euvolemia	> 50%	> 2.1 cm
	< 50%	< 2.1 cm
Hypervolemia	< 50%	> 2.1 cm



1 – Rudski, et al. (2010). Guidelines for the Echocardiographic Assessment of the Right Heart in Adults: A Report from the American Society of Echocardiography. Endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. *Journal of the American Society of Echocardiography*, 23(7), 685-713. doi: 10.1016/j.echo.2010.05.010

Classification of fluid status with Body Composition monitor (BCM)

Definition of volume status (Jeong, Lim, Choi & Oh, 2010)¹

Volume status	Initial BCM measurement
Hypovolemia	IBW -1.1 ltr
Euvolemia	IBW +/- 1 ltr
Hypervolemia	IBW + 1.1.ltr



1 – Jeong, H., Lim, C. W., Choi, H. M., & Oh, D. J. (2016). The source of net ultrafiltration during hemodialysis is mostly the extracellular space regardless of hydration status. *Hemodialysis International*, 20(1), 129-133. doi: 10.1111/hdi.12323

Results

- ▶ IVC-US vs BIS **exact agreement in 13 out of 30 patients** on predialytic fluid status
- ▶ Weighted Kappa statistics value (κ_w) of 0.25 ($p=0.16$, 95% CI: 0.09 – 0.41) reflecting **a fair agreement between the two additional methods** for predialytic measurements
- ▶ **Postdialytic measurements** agreed in **15 patients in both methods**, resulting in a weighted kappa value of (0.49) ($p=0.06$, 95% CI:0.22-0.76) (**moderate agreement**)
- ▶ **10 Patients (33%)** experienced an episode of IDH during the observation period, **with 23% (n=7) had a symptomatic IDH**,
and **3 patients had an asymptomatic IDH (MAP<70 mmHg)**

Algorithm to predict intradialytic hypotension

	IDH	No IDH	Sum
BIS negative or IVC-US negative or MAP < 70 mmHg or UFR > 900 ml/hr	10	1	11
BIS positive or IVC-US positive or MAP > 70 mmHg UFR < 900ml/hr	0	19	19
Sum	10	20	30

Sensitivity 100% and Specificity 95%



Take home message:

- Traditional predialytic fluid assessment methods lack accuracy
- Both methods hold essential information and can be preventative for episodes of IDH
- IVC-US can be applied at any time during HD and visualizes intravascular status

Thank you for your attention !



Questions ?

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