Episode 1 Show Notes

Paper title: Inferior vena cava collapsibility index and stroke volume as predictors of blood transfusion in upper gastrointestinal bleeding in the emergency department

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Background:

- Clinical scoring systems exist to risk stratify GI bleeding
    - Glasgow-Blatchford scale
    - Rockall scale
- IVC has been studied extensively, does not seem to correlate to volume responsiveness in undifferentiated shock[1]
    - IVC diameter
    - Collapsibility index of (max – min) / max
    - IVC is a good, if rough, surrogate for CVP and RA filling pressure
    - However, not a pure measure of fluid volume
        - Proximal factors such as vasoplegia affecting stressed volume or third spacing[2]
        - Distal factors such as RV contractility, afterload, LV hemodynamics
- More of an open question with pure hypovolemia; more specifically GI bleeds

[1] Di Nicolò P, Tavazzi G, Nannoni L, Corradi F. Inferior Vena Cava Ultrasonography for Volume Status Evaluation: An Intriguing Promise Never Fulfilled. J Clin Med. 2023 Mar 13;12(6):2217. doi: 10.3390/jcm12062217. PMID: 36983218; PMCID: PMC10053997.

[2] https://www.icuedu.org/reframingshock-2

    - Studies of healthy volunteers with simulated blood loss or donating blood[3,4,5] have had mixed results
    - Trauma victims[6]
    - Chen et al w/ findings suggesting worse outcomes with sonographic signs of hypovolemia[7]

The paper:

- Population: Pts with UGIB in tertiary care center
    - Most presented with melena, some with hematochezia and syncope
    - Transfusion group had more comorbidities but not statistically significantly so
    - Transfusion group had worse outcomes (as expected)
        - Significantly fewer discharges (7.1% vs 34%)
    - GBS of 12.3 +/- 3.4 vs 6.8 +/- 3.6
- Intervention: Ultrasonographic measurement of IVC, IVC CI, SV before and after EGD, done by EM provider on arrival and at 24-hour mark after "admission to the ED"
    - SV taken from CO measurement of LVOT and VTI
- Comparison: Prior risk scoring
- Outcome:
    - Analysis of pre- and post-treatment
    - Paired sample T-test if normal, Wilcoxon matched pairs if not
    - CI: pretreatment difference between groups $p < 0.001$
        - Transfusion group w/ IVC CI of 28.9 +/- 10.8 %
        - Nontransfusion group w/ IVC CI of 20.4 +/- 4.5

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[3] Johnson BD, Schlader ZJ, Schaake MW, O'Leary MC, Hostler D, Lin H, St James E, Lema PC, Bola A, Clemency BM. Inferior Vena Cava Diameter is an Early Marker of Central Hypovolemia during Simulated Blood Loss. Prehosp Emerg Care. 2021 May-Jun;25(3):341-346. doi: 10.1080/10903127.2020.1778823. Epub 2020 Jul 7. PMID: 32628063; PMCID: PMC8672380.

[4] Resnick J, Cydulka R, Platz E, Jones R. Ultrasound does not detect early blood loss in healthy volunteers donating blood. J Emerg Med. 2011 Sep;41(3):270-5. doi: 10.1016/j.jemermed.2010.11.040. Epub 2011 Mar 21. PMID: 21421294.

[5] Pasquero P, Albani S, Sitia E, Taulaigo AV, Borio L, Berchialla P, Castagno F, Porta M. Inferior vena cava diameters and collapsibility index reveal early volume depletion in a blood donor model. Crit Ultrasound J. 2015 Dec;7(1):17. doi: 10.1186/s13089-015-0034-4. Epub 2015 Nov 4. PMID: 26537114; PMCID: PMC4633475.

[6] Yazlamaz NO, Ozakin E, Bastug BT, Karakilic E, Kaya FB, Acar N, Koruk R. The Flatness Index of Inferior Vena Cava can be an Accurate Predictor for Hypovolemia in Multi-Trauma Patients. Prehosp Disaster Med. 2021 Aug;36(4):414-420. doi: 10.1017/S1049023X21000418. Epub 2021 May 6. PMID: 33952376.

[7] Tung Chen Y, Blancas Gómez-Casero R, Quintana Díaz M, Oliva B. Inspiratory collapse of the inferior vena cava and the kissing ventricle sign: markers of poor prognosis in emergency gastrointestinal bleeding. Emergencias. 2019 Abr;31(2):79-85. English, Spanish. PMID: 30963734.

- Would appreciate confidence interval b/w groups
- CI: no significant difference between post-treatment groups
- SV: pretreatment difference between groups P,0.001
  - Transfusion w/ SV 58.0 +/- 5.1 cc
  - Nontransfusion group w/ SV 66.3 +/- 5.2
- SV: posttreatment groups had no significant difference (64.7 +/- 4.9 vs 65.0 +/- 5.8)
- Comparison to GBS and RS

Table 2 Measurements of the patients at the time of admission to the ED and at the 24th hour

Parameters		Group 1 Fluid therapy ($n = 44$)		Group 2 Fluid therapy and blood transfusion ($n = 56$)		*P* value
		Mean ± SD	Median (min–max)	Mean ± SD	Median (min–max)	
Hemoglobin (g/dL)	Pretreatment	11.4 ± 1.9	11.1 (7.4–16.3)	7.0 ± 1.6	7.1 (3.6–11.7)	<0.001†
	Posttreatment	10.4 ± 2.0	10.1 (6.8–14.5)	9.0 ± 1.0	8.8 (7.3–12.2)	<0.001‡
	P value	<0.001§		<0.001¶		
LVOT Diameter (mm)	Pretreatment	19.6 ± 0.3	19.5 (19.0–20.2)	19.0 ± 0.5	19.0 (18.0–20.5)	<0.001‡
	Posttreatment	19.5 ± 0.3	19.5 (18.8–20.2)	19.5 ± 0.4	19.4 (19.0–20.8)	0.620‡
	P value	<0.001§		<0.001¶		
Stroke Volume (ml)	Pretreatment	66.3 ± 5.2	65.0 (60.0–82.0)	58.0 ± 5.1	58.0 (48.0–68.0)	<0.001‡
	Posttreatment	65.0 ± 5.8	64.0 (55.0–81.0)	64.7 ± 4.9	64.0 (54.0–78.0)	0.799‡
	P value	<0.001¶		<0.001¶		
IVC CI (%)	Pretreatment	20.4 ± 4.5	20.4 (12.0–33.3)	28.9 ± 10.8	26.6 (12.1–52.9)	<0.001‡
	Posttreatment	21.1 ± 4.7	21.0 (12.2–33.9)	23.0 ± 6.1	22.5 (10.4–34.8)	0.090†
	P value	0.006§		<0.001¶		
VCI max (mm)	Pretreatment	15.8 ± 1.5	16.0 (12.3–18.3)	14.7 ± 1.4	14.5 (11.4–18.1)	<0.001†
	Posttreatment	15.5 ± 1.5	15.5 (12.0–18.2)	15.3 ± 1.3	15.1 (12.0–19.0)	0.492†
	P value	<0.001§		<0.001§		
VCI min (mm)	Pretreatment	12.6 ± 1.4	12.5 (10.0–15.8)	10.5 ± 2.1	10.5 (6.4–14.1)	<0.001†
	Posttreatment	12.3 ± 1.5	12.0 (9.7–15.2)	11.8 ± 1.6	11.7 (8.0–14.6)	0.157†
	P value	<0.001§		<0.001§		

†Independent samples *t*-test.
‡Mann Whitney *U* test.
§Paired samples *t*-test.
¶Wilcoxon test.
IVC CI, inferior vena cava collapsibility index; LVOT, left ventricle outflow tract; max, maximum; min, minimum; VCI, vena cava inferior.

Commentary:

- Study focuses on the prevalence of IVC and SV findings in populations of GI bleeders requiring transfusion or not
  - More useful clinically would be requirement of transfusion *given* ultrasound findings
- Limitations include:
  - Unclear whether pre- or post-endoscopy RS, but seems post
  - Unclear who exactly obtained the images, described as “emergency medicine specialist experienced in ultrasound”

        - Just one provider who has to be called in? (would affect availability leading to time of day effects)
    - Blinding
        - Did having ultrasound findings cause providers to move faster on getting EGD performed?
    - Patient weights not regularly recorded
        - Unknown how much fluids patients got in relation to body weight
        - Stroke *index* may be more useful than SV
    - Interestingly, sensitivity/specificity of IVC data for transfusion needs were not discussed despite the title of the paper
- Also compared to GBS/RS
    - RS was not very good
    - GBS did have AUC of 0.864 compared to 0.891 and slightly worse Sn/Sp, but somehow had better PPV and NPV

Takeaways

- Despite the limitations, does add to the body of literature suggesting more specific use cases of the IVC
- The GBS is actually pretty good in predicting need for transfusion
- I may try measuring the stroke volume on borderline GIB patients to help with determining the need for transfusion (but this is more of an educational/recreational ultrasound than a mission-critical one)
- Combining GBS + SV may be the way to go if able to do the U/S at bedside
- Would like to see a prospective study, perhaps with a trial of U/S-guided vs normal care with more patient-centric outcomes