

# Prospective Validation of the Venous Excess Ultrasound (VExUS) Score



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## BACKGROUND

- **Venous congestion** is an under-appreciated contributor to mortality in critically ill patients and is difficult to quantify.
- **Right heart catheterization (RHC)** is the gold standard for assessing venous congestion.
- RHC is invasive, costly, and is not universally available.
- The **VExUS Score** is a novel noninvasive means of **determining venous congestion** using ultrasound measurement of the inferior vena cava (IVC) and of the hepatic vein, portal vein, and intra-renal venous Doppler waveforms<sup>1</sup>.
- While VExUS was validated retrospectively against RHC, it was not validated prospectively.
- We performed a **prospective analysis of VExUS against RHC measurements**: right atrial pressure (RAP), mean pulmonary artery pressure (mPAP), and pulmonary capillary wedge pressure (PCWP).

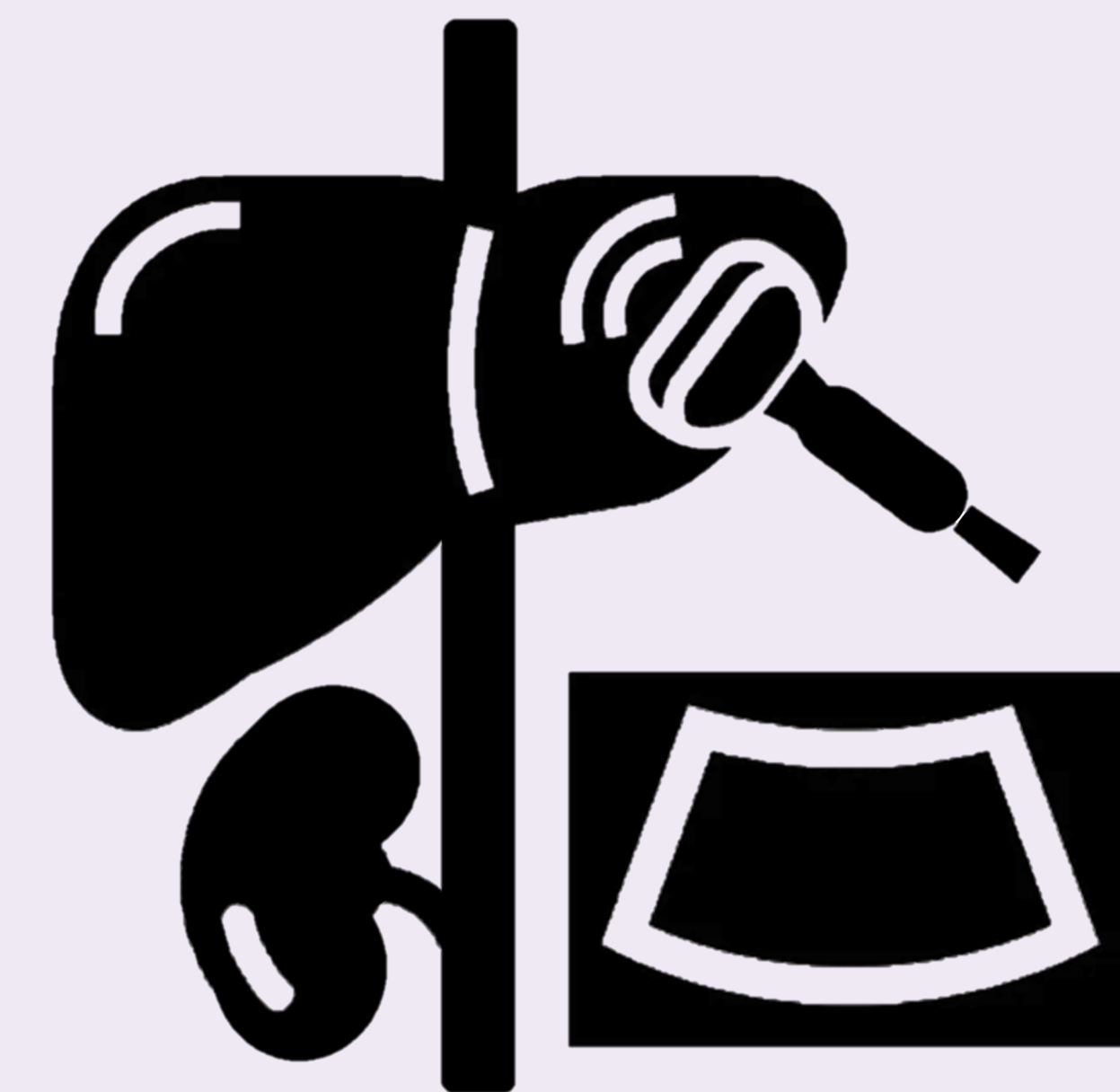
## METHODS

- 81 patients undergoing RHC for a wide variety of indications at Denver Health Medical Center underwent VExUS examination.
- Investigators were blinded to RHC data during VExUS scoring.
- We manually abstracted past medical history, demographic information, and echocardiogram data from patient charts.
- Multivariable linear regression was used to assess the relationship between VExUS and RAP, mPAP, PCWP and NT-ProBNP, controlling for age, sex, and Charlson Comorbidity Index.

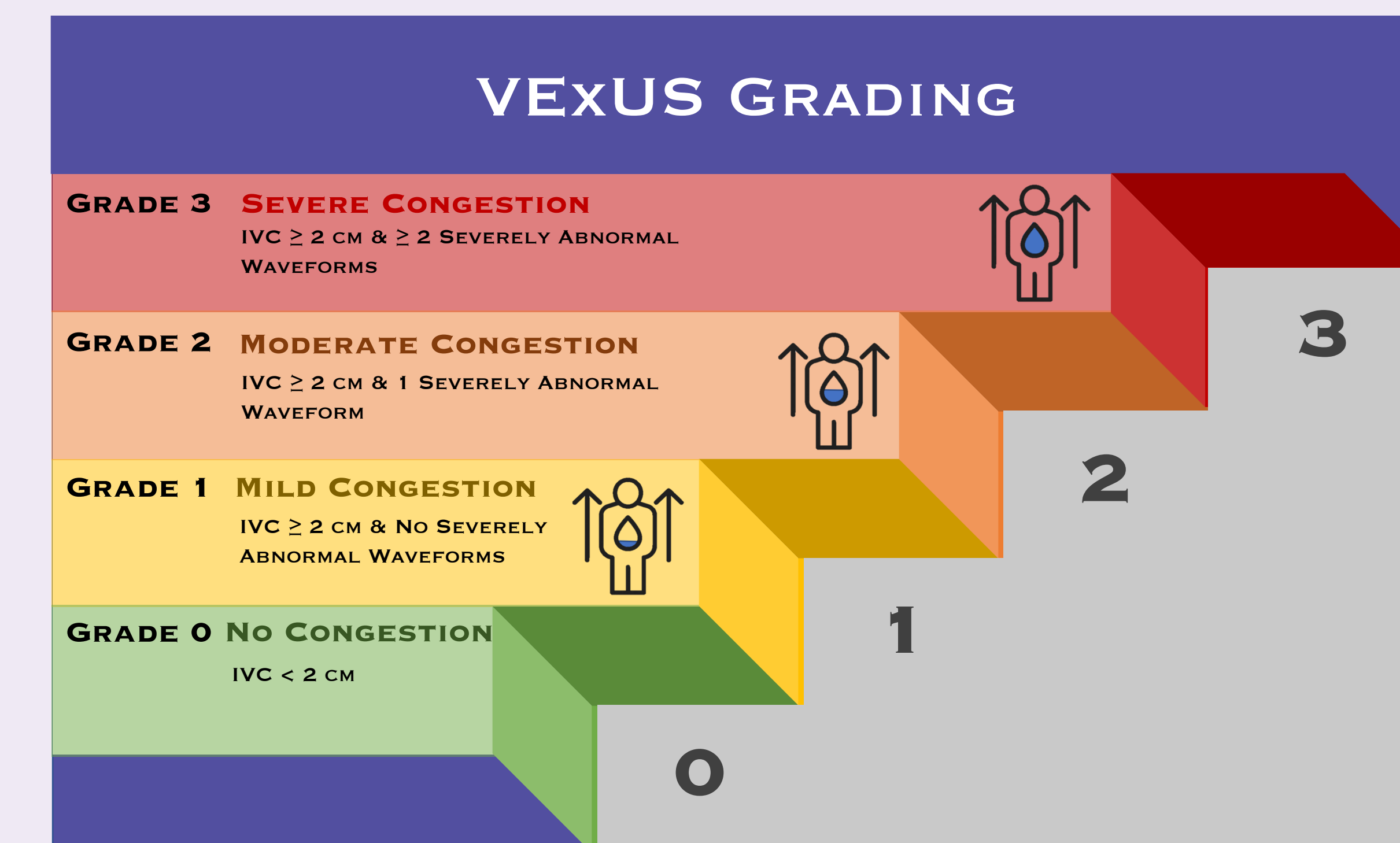
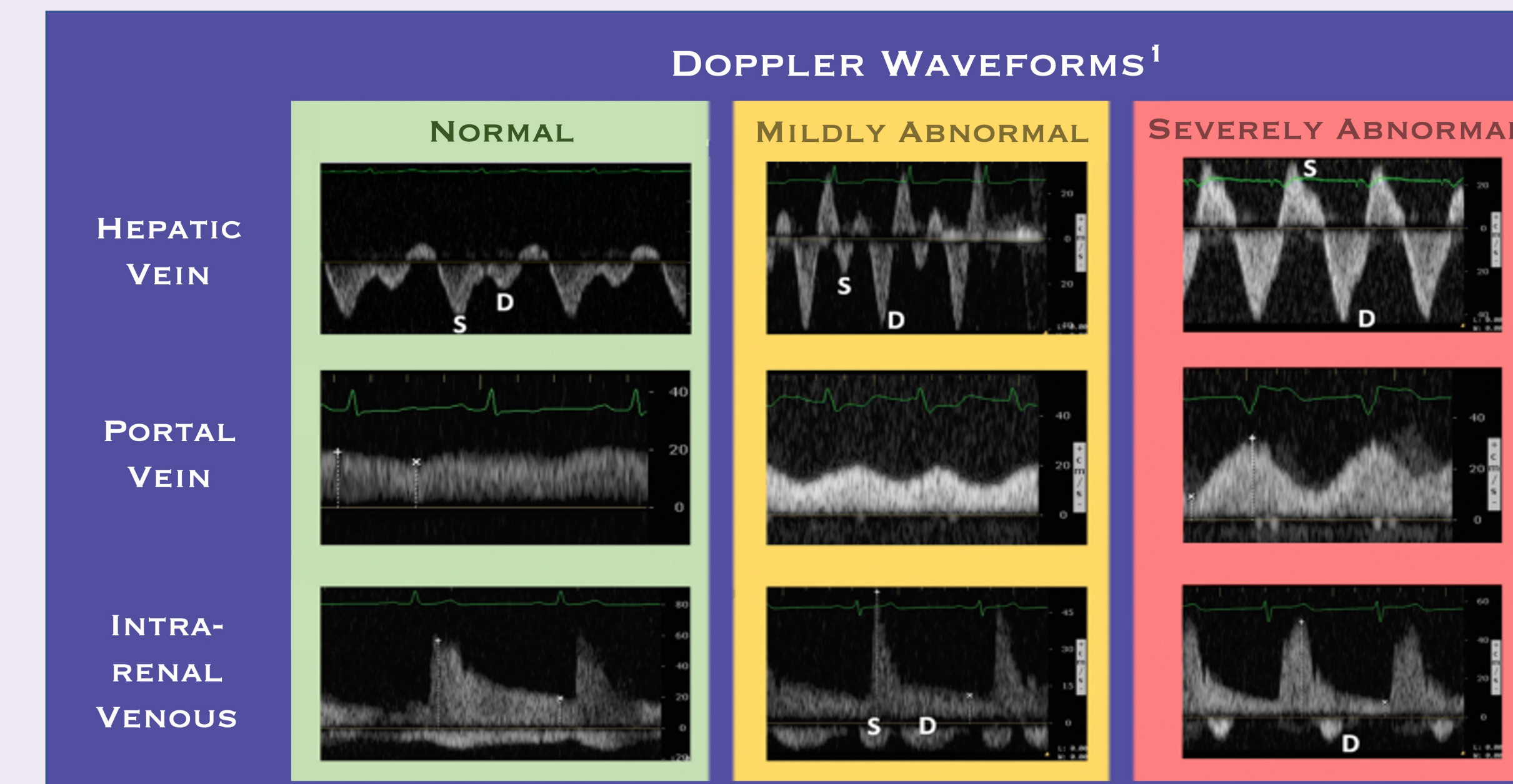
## RESULTS

- After controlling for age, sex, and Charlson Comorbidity Index, there was a linear association between VExUS Score and: Right Atrial Pressure (RAP), Pulmonary Capillary Wedge Pressure (PCWP), and Mean Pulmonary Artery Pressure (mPAP).
- After controlling for age, sex, and common comorbidities, we observed a **significant positive association between RAP and VExUS score** ( $P < 0.001$ ,  $R^2 = .68$ ).
- VExUS had a favorable AUC for prediction of a RAP  $\geq 12$  mmHg (0.99, 95% CI 0.96-1) compared to IVC diameter (0.79, 95% CI 0.65-0.92).

## USING VEXUS

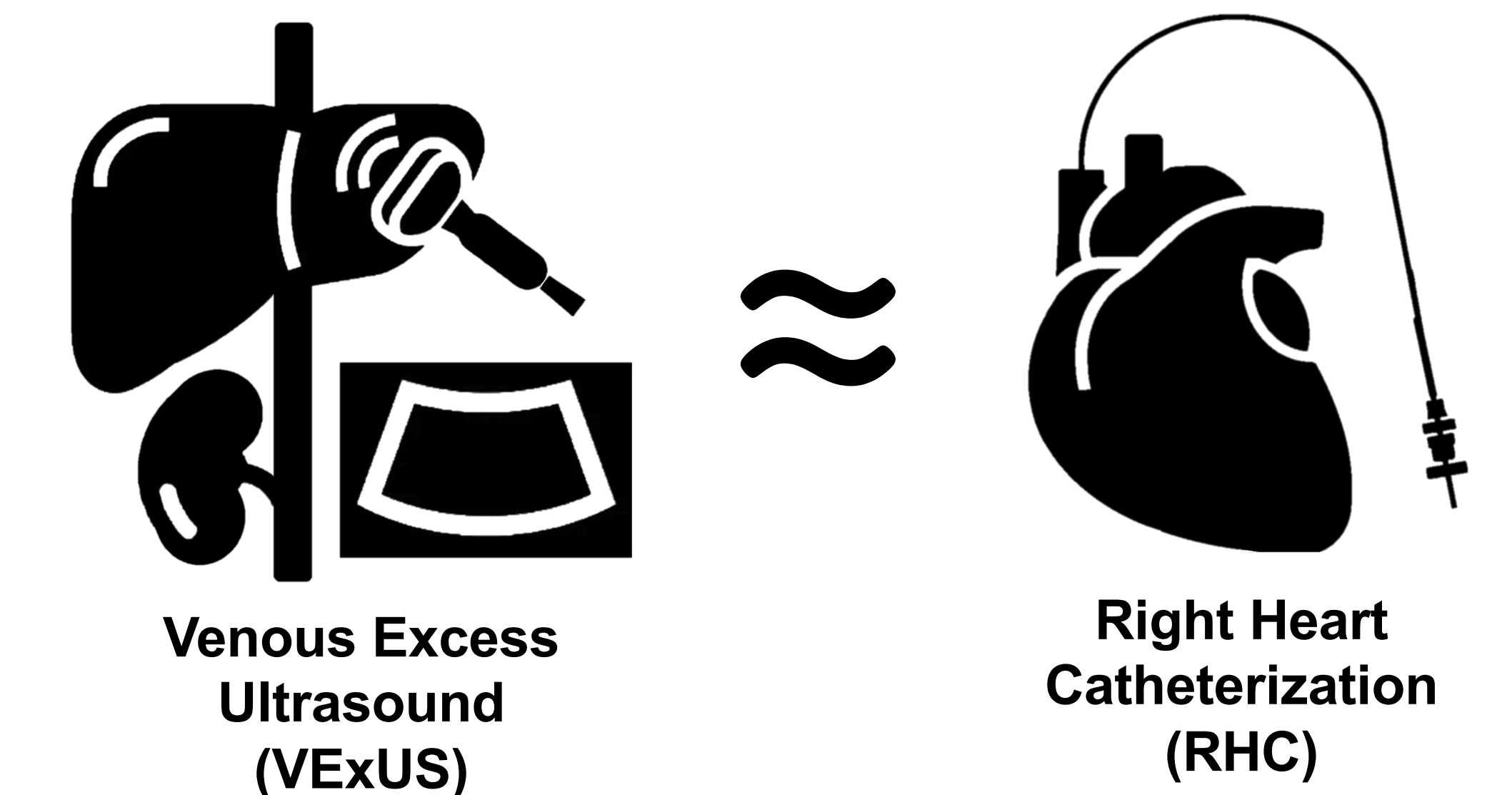


1. SCAN THE IVC AND MEASURE IT.
2. IF  $\geq 2$  CM, SCAN AND RECORD HEPATIC VEIN, PORTAL VEIN, AND INTRA-RENAL VENOUS DOPPLER WAVEFORMS.
3. ASSESS DOPPLER WAVEFORMS.
4. COUNT THE NUMBER OF SEVERELY ABNORMAL WAVEFORMS.
5. SCORE PATIENT USING THE GRADING CRITERIA PROVIDED.



## CONCLUSIONS

- For assessing venous congestion:



- **VExUS** is a promising noninvasive tool for **accurately assessing venous congestion**.
- A safer and more accessible alternative to right heart catheterization.

## FUTURE DIRECTIONS

- There are ongoing studies on inter-rater reliability, inter-user reproducibility, handheld vs. traditional ultrasound, & physiological changes from dialysis.
- Additional areas of interest include evaluating:
  - VExUS-guided diuresis in heart failure & fluid resuscitation in sepsis
  - Bench Science: Proteomics of Volume Overload
  - Many, many more!

## REFERENCES & ACKNOWLEDGEMENTS

1. Beaubien-Souligny, W., Rola, P., Haycock, K. *et al.* Quantifying systemic congestion with Point-Of-Care ultrasound: development of the venous excess ultrasound grading system. *Ultrasound J* 12, 16 (2020). <https://doi.org/10.1186/s13089-020-00163-w>
- Additional references citations available upon request.
- None of the investigators have conflicts of interest related to this research.

