

Clinical Assessment of Volume Status in Heart Failure is Inaccurate at Detecting Hypervolemia and Anemia as Quantified by Blood Volume Measurement

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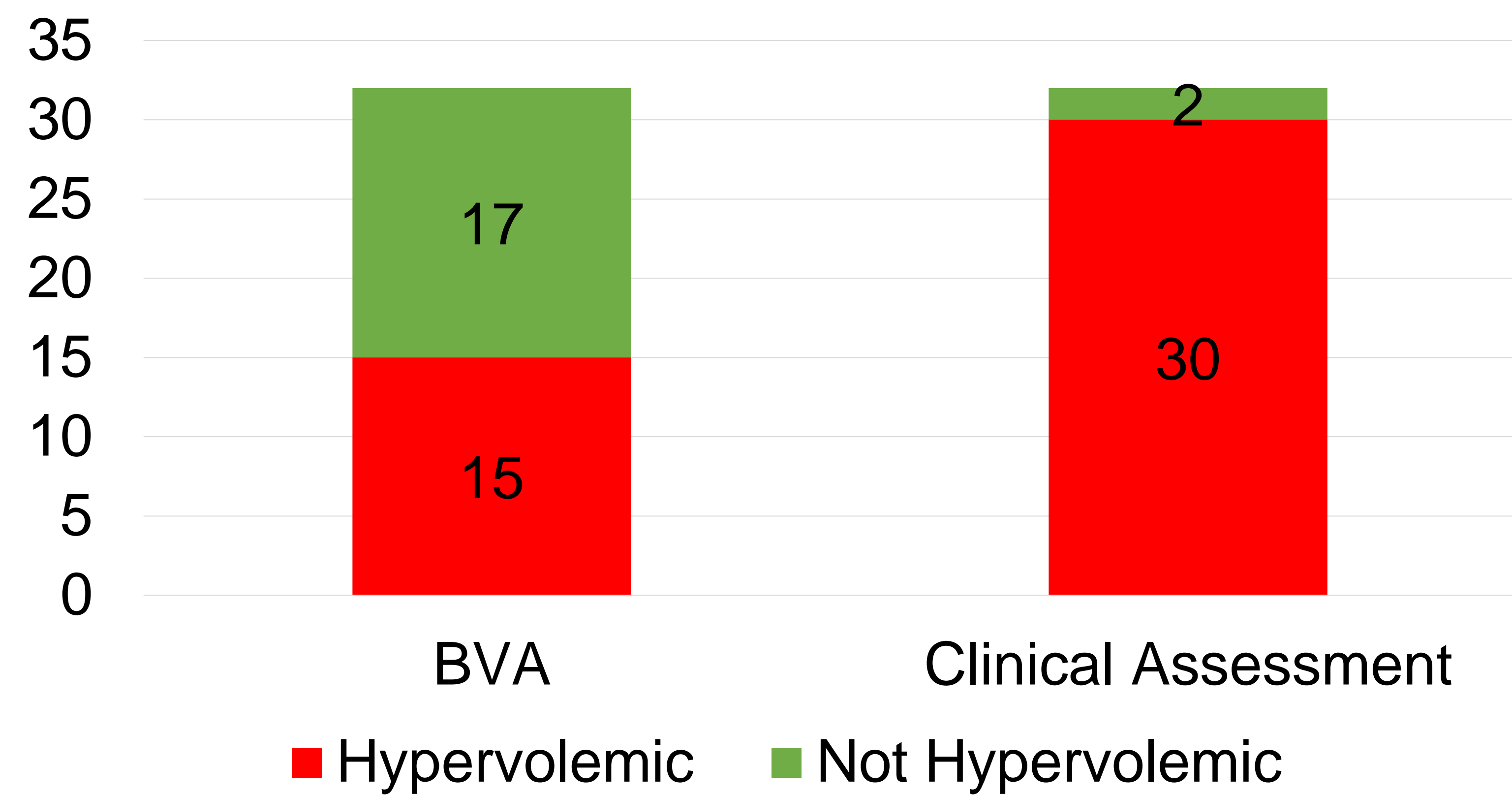
Background & Objectives

- Accurate determination of volume status is crucial for guiding treatment decisions for acute decompensated heart failure (ADHF).
- Volume status is typically determined using signs and symptoms such as edema, increase in weight, jugular venous distension, ascites, orthopnea, among others.
- A recent retrospective analysis showed that direct measurement of blood volume (blood volume analysis (BVA)) was associated with better outcomes in ADHF.
- The objective of this study is to prospectively compare the appropriateness of standard care treatment decisions to those in a BVA-guided fluid management protocol.

Methods

- ADHF patients admitted to two Veterans Affairs Medical Centers (Boston, Minneapolis) were randomized to either a usual care (n=16) arm or a BVA-guided (n=16) arm.
- Clinician assessments of volume status were collected for all patients prior to BVA measurement.
- Total blood volume (TBV), plasma volume (PV) and red blood cell volume (RBCV) were measured for all patients at admission and prior to discharge by BVA utilizing an I-131 labeled albumin indicator-dilution technique (Daxor BVA-100).
- Clinicians in the usual care arm were blinded to the BVA results and provided standard of care for ADHF based on clinical assessment of volume.
- TBV status was defined relative to patient norms as Hypovolemic (< -10%), Euvolemic (-10% to +10%), and Hypervolemic (> +10%)
- RBCV status was defined as Anemic (< -10%) Not Anemic (> -10%)

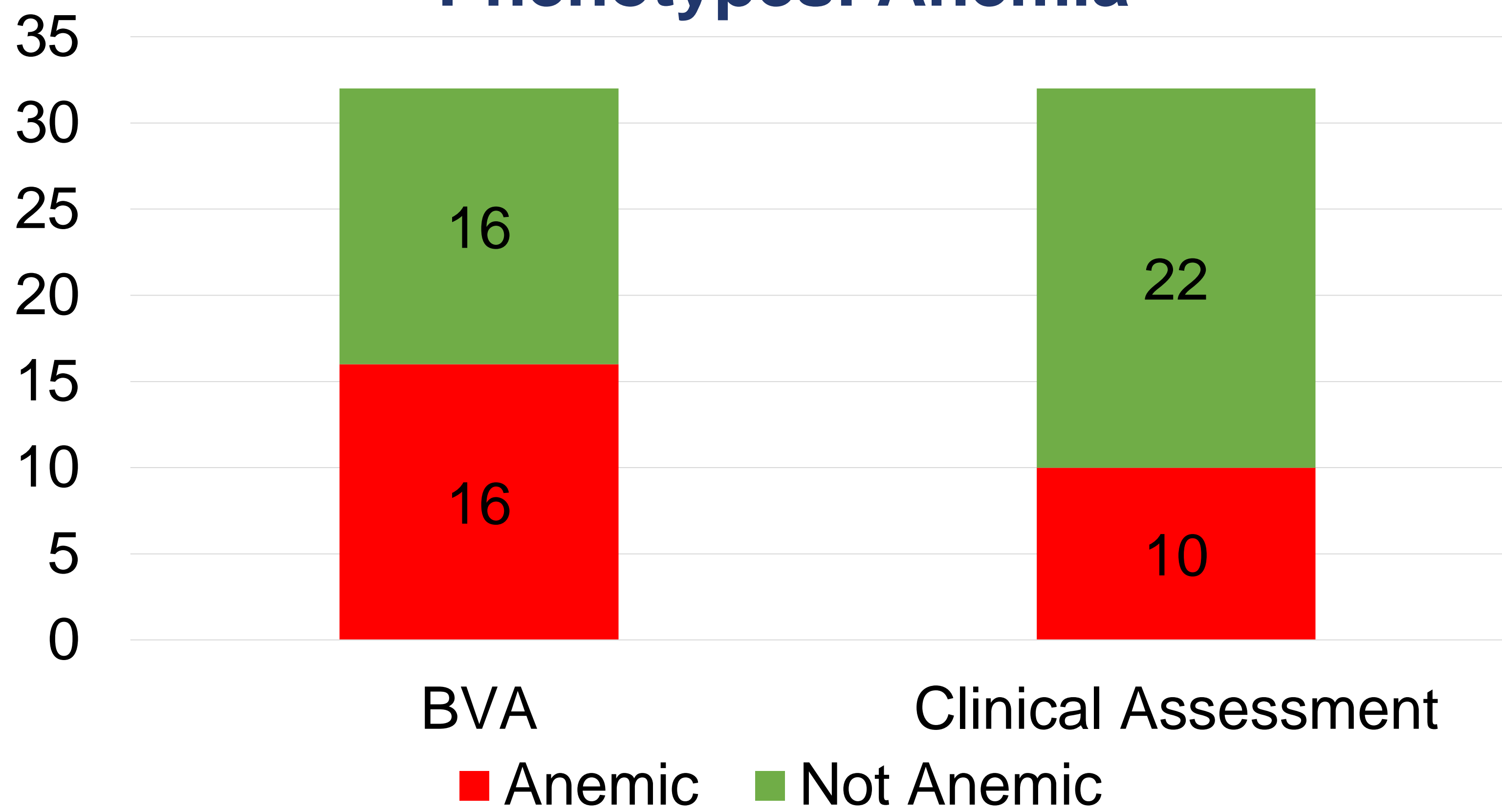
Phenotypes: Hypervolemia



		Clinical Assessment of Volume Status	
		Not Hypervolemic	Hypervolemic
BVA Assessment of Volume Status	Not Hypervolemic	6%	47%
	Hypervolemic	0%	47%

Table 1: Confusion matrix for Hypervolemia – Accuracy 53%, Specificity 12%, Sensitivity 100%

Phenotypes: Anemia



		Clinical Assessment of Anemia	
		Not Anemic	Anemic
BVA Assessment of Anemia	Not Anemic	38%	12%
	Anemic	31%	19%

Table 2: Confusion matrix for Anemia – Accuracy 56%, Specificity 75%, Sensitivity 38%

Acknowledgements

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- Conflicts of interest: None

Results

- Measured volume status (BVA) at admission was quite heterogeneous:
 - 22% Hypovolemic | 31% Euvolemic | 47% Hypervolemic
- 94% of patients were clinically assessed to be hypervolemic; compared to BVA, the accuracy of clinically assessed volume status was only 53% (sensitivity 100%, specificity 12%).
- Hypovolemic and euvolemic patients in the BVA-guided arm received less diuretics than those in the usual care arm.
 - 9 out of 10 (90%) hypovolemic/euvolemic patients in the usual care arm received diuretics.
 - Only 2 out of 7 (29%) hypovolemic/euvolemic patients in the BVA-guided arm received diuretics.
- True anemia (not dilutional) was common (50%) based on measured RBCV.
- Clinical assessment of anemia was 56% accurate compared to measured RBCV (sensitivity 38%, specificity 75%).
- Anemic patients in the BVA-guided arm were much more likely to receive anemia-focused treatment (IV iron and/or blood).
 - 5 out of 6 (83%) anemic patients in the BVA-guided arm received anemia-focused treatment
 - Only 1 out of 10 (10%) anemic patients in the usual care arm received anemia-focused treatment.

Conclusions

- We successfully embedded a BVA-guided treatment protocol into the clinical workflow of ADHF management at two separate large medical centers.
- Clinical assessment of volume status was a poor predictor of actual intravascular volume as determined by direct BVA measurement.
- We demonstrated that treatment decisions could be guided by BVA, with volume-appropriate treatment for both volume overload and red blood cell deficit being significantly more likely in the BVA arm than in the usual control arm.
- Future studies will address whether BVA-guided treatment leads to better outcomes in ADHF.