Beyond clinical signs: VExUS/LUS reveals heart failure's true volume

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Acute decompensated heart failure (ADHF) remains a leading cause of hospitalisation and readmission, with clinicians constantly seeking non-invasive tools to guide decongestion and predict outcomes. Current clinical assessments often fall short in accurately reflecting a patient's volume status and response to therapy, leaving a critical gap in prognostication. Recent research explores the utility of combining venous excess ultrasound (VExUS) scores and lung ultrasound (LUS) in this challenging population.

KEY TAKEAWAYS

- The Pivot: Integrating serial changes in VExUS scores and lung ultrasound provides a non-invasive, dynamic assessment of decongestion and prognosis in ADHF.
- The Data: A VExPLUs score reduction of 2 or more points correlated with a 34% lower risk of the composite endpoint (HR 0.66; 95% CI, 0.51-0.86; P=.002).
- The Action: Consider incorporating VExUS and LUS into routine ADHF management to guide decongestive therapy and identify patients at higher risk for adverse events.

Managing acute decompensated heart failure (ADHF) demands precise assessment of volume status and effective decongestion. Traditional methods, relying on clinical examination and static imaging, often lack the sensitivity to detect subtle changes in fluid overload or predict patient trajectories. This diagnostic lacuna contributes to suboptimal treatment and persistent high rates of readmission. The field has long sought a dynamic, non-invasive approach to guide therapy and improve prognostication.

Three recent studies explore the potential of combining venous excess ultrasound (VExUS) scores and lung ultrasound (LUS) to address this unmet need. Silvano, Saadi, and Scherer investigated whether early combined changes in VExUS and LUS, termed VExPLUs, correlated with outcomes in ADHF.1 Jimenez, Narula, and Callegari examined the correlation between lung and venous excess ultrasound findings and intracardiac pressures before and after decongestion in critically ill ADHF patients.2 Bhardwaj, Samprathi, and Saha explored the integration of femoral venous Doppler and VExUS for predicting organ dysfunction in acute heart failure.3

The VExPLUs Score and Prognostic Value

Silvano and colleagues enrolled 452 patients admitted with ADHF, assessing them at baseline and again at 48-72 hours post-admission.1 The primary endpoint was a composite of all-cause mortality or ADHF readmission within 90 days. The researchers calculated the VExPLUs score by summing the VExUS score (0-3) and the LUS B-line score (0-3) at both time points, then determining the change. A VExUS score of 0 indicated normal venous flow, while scores of 1-3 indicated increasing severity of venous congestion based on hepatic, portal, and renal vein Doppler patterns. LUS B-line scores were derived from a 28-zone scan, categorised into 0 (no B-lines), 1 (1-5 B-lines per zone), 2 (6-10 B-lines per zone), and 3 (>10 B-lines per zone or confluent B-lines).

Patients with a VExPLUs score reduction of 2 or more points demonstrated a significantly lower risk of the composite endpoint, cutting the risk by 34% (HR 0.66; 95% CI, 0.51-0.86; P=.002).1 This reduction was driven by both lower all-cause mortality (HR 0.61; 95% CI, 0.43-0.87; P=.006) and fewer ADHF readmissions (HR 0.70; 95% CI, 0.52-0.94; P=.019). The median follow-up was 90 days. The study population had a mean age of 72.4 years, with 58% male. Ischemic cardiomyopathy was the most common etiology (45%), and the mean left ventricular ejection fraction was 38%. The initial median VExUS score was 2, and the median LUS B-line score was 2. At 48-72 hours, these medians decreased to 1 and 1, respectively, in the responder group. The ability to track decongestion non-invasively and link it directly to hard clinical outcomes is a significant step forward.

The study also highlighted the predictive power of individual components. A reduction in VExUS score by at least 1 point independently reduced the composite endpoint risk by 28% (HR 0.72; 95% CI, 0.56-0.93; P=.011).1 Similarly, a reduction in LUS B-line score by at least 1 point reduced the composite endpoint risk by 31% (HR 0.69; 95% CI, 0.53-0.89; P=.004). The combined VExPLUs score, however, provided superior prognostic discrimination compared to either component alone, with an area under the receiver operating characteristic curve (AUROC) of 0.78 for the composite endpoint, compared to 0.69 for VExUS alone and 0.71 for LUS alone. This suggests a synergistic effect when combining these two ultrasound modalities.

Correlation with Intracardiac Pressures

Jimenez and colleagues focused on the physiological underpinnings of these ultrasound findings, investigating the correlation between LUS and VExUS with intracardiac pressures in 120 critically ill ADHF patients.2 Patients underwent right heart catheterisation (RHC) and comprehensive ultrasound assessments at baseline and after 48 hours of decongestive therapy. The study population was severely ill, with a mean central venous pressure (CVP) of 18 mmHg at baseline and a mean pulmonary capillary wedge pressure (PCWP) of 24 mmHg. The mean age was 68 years, and 65% were male. The primary objective was to determine if changes in ultrasound parameters mirrored changes in CVP and PCWP.

The researchers found a strong positive correlation between baseline VExUS score and CVP (r=0.78; P2 After 48 hours of decongestion, the mean CVP decreased to 12 mmHg, and PCWP to 16 mmHg. Changes in VExUS score correlated significantly with changes in CVP (r=0.82; PThe study also explored the predictive value of these ultrasound changes for clinical outcomes. Patients who achieved a reduction in both VExUS and LUS scores by at least 1 point had a significantly shorter length of hospital stay (median 7 days vs 12 days; P=.003) and lower incidence of acute kidney injury (AKI) during hospitalisation (18% vs 35%; P=.021).2 This suggests that effective decongestion, as monitored by ultrasound, translates into tangible clinical benefits beyond just pressure normalisation. The ability to non-invasively track the efficacy of decongestive therapy and predict complications like AKI could allow for earlier intervention and optimisation of treatment strategies.

Integrating Femoral Venous Doppler and VExUS

Bhardwaj and colleagues investigated a slightly different approach, integrating femoral venous Doppler (FVD) with VExUS for predicting organ dysfunction in 280 patients with acute heart failure.3 They hypothesised that FVD, a simpler and more accessible ultrasound modality, could complement VExUS in assessing systemic venous congestion and its impact on end-organ perfusion. The study population had a mean age of 65 years, with 60% male, and presented with symptoms of acute heart failure. The primary outcome was the development of new or worsening organ dysfunction (renal, hepatic, or gastrointestinal) within 7 days of admission.

The researchers found that a pulsatility index (PI) of the femoral vein greater than 0.5, indicating increased venous congestion, was independently associated with a 2.5-fold increased risk of organ dysfunction (OR 2.5; 95% CI, 1.6-3.9; P3 When combined with a VExUS score of 2 or 3, the risk of organ dysfunction escalated further, increasing by 4.1 times (OR 4.1; 95% CI, 2.3-7.2; PThe study also explored the dynamic changes in FVD and VExUS with decongestion. Patients who achieved a normalisation of both FVD PI (to 3 This reinforces the concept that early, effective decongestion, as monitored by these ultrasound parameters, is crucial for preventing or reversing end-organ damage. The ease of performing FVD, even by less experienced operators, makes this combined approach particularly attractive for busy emergency departments and critical care units. The 3M Littmann Classic III Stethoscope remains a staple for initial clinical assessment, but these ultrasound tools offer a deeper, more objective look at volume status.

Where the Evidence Falls Short

While these studies collectively present a compelling case for integrating VExUS and LUS into ADHF management, some limitations warrant consideration. The Silvano study, while prospective, was observational.1 This means it can establish associations but not definitively prove causation. Randomised controlled trials are needed to confirm whether guiding therapy based on VExPLUs scores directly improves patient outcomes. The study also relied on a relatively short 90-day follow-up period; longer-term outcomes remain to be fully elucidated. The generalisability of the findings may also be limited by the patient population, predominantly European, and the specific ultrasound protocols used. Variations in operator experience and equipment could introduce variability in real-world application.

The Jimenez study, while providing valuable physiological correlation, involved a critically ill population undergoing invasive RHC.2 This limits its direct applicability to all ADHF patients, many of whom do not require such intensive monitoring. The sample size of 120 patients, while adequate for correlation analysis, may be too small to draw definitive conclusions about clinical outcomes like length of stay or AKI incidence. The study also did not blind ultrasound operators to RHC results, which could introduce bias. Furthermore, the specific thresholds for VExUS and LUS scores used in these studies, while validated, may require further standardisation across different clinical settings and patient demographics.

Bhardwaj and colleagues' study on FVD and VExUS offers an interesting adjunct, but it too has limitations.3 The definition of 'organ dysfunction' was broad, encompassing renal, hepatic, and gastrointestinal issues, which might obscure specific organ-level effects. The study was also conducted in a single centre, potentially limiting external validity. The inter-observer variability for FVD measurements, while generally lower than for VExUS, still exists and could impact reproducibility. The practical implementation of these combined ultrasound protocols in a busy clinical environment requires dedicated training and resources, which may not be universally available. The Oxford Handbook of Cardiology provides a solid foundation, but these advanced ultrasound techniques demand specialised training. These studies, while advancing the field, do not yet provide a definitive algorithm for integrating VExUS and LUS into routine clinical practice. The optimal frequency of assessment, the specific thresholds for intervention, and the impact on resource utilisation all require further investigation. The absence of a direct comparison against current standard-of-care decongestion strategies in a large, randomised trial means that while these tools are promising, their place in the therapeutic hierarchy is still evolving. Clinicians must weigh the benefits of enhanced physiological insight against the practical challenges of implementation and the need for more robust outcome data.

CLINICAL IMPLICATIONS

The collective evidence from these papers suggests that VExUS and lung ultrasound are more than just research tools; they offer a tangible, non-invasive window into the dynamic process of decongestion in ADHF. For clinicians grappling with fluid management, the ability to track changes in volume status and predict outcomes without resorting to invasive monitoring is a significant advantage. This could mean more targeted diuretic therapy and potentially fewer readmissions.

The direct correlation between ultrasound findings and intracardiac pressures provides a physiological anchor for these techniques. This validation should encourage broader adoption, particularly in settings where right heart catheterisation is impractical or contraindicated. It moves us closer to a truly personalised approach to heart failure management, allowing for real-time adjustments based on objective, repeatable measures.

But the practicalities remain. Implementing these protocols requires dedicated training and equipment, which may not be universally available. The onus is now on guideline bodies to integrate these findings into clinical recommendations, providing clear algorithms for their use. Without standardised training and clear pathways, the promise of these tools risks being confined to specialist centres.

For patients, this could translate into more effective and less burdensome treatment. Fewer invasive procedures, more precise decongestion, and potentially shorter hospital stays are all desirable outcomes. The challenge for the industry is to develop user-friendly, cost-effective ultrasound devices and training programmes that can democratise access to these advanced monitoring capabilities.

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