Discharge-ready volume status in acute decompensated heart failure: a survey of hospitalists

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ABSTRACT
Acute decompensated heart failure is the leading cause of hospitalization in older adults. Clinical practice guidelines recommend patients should be euvolemic at hospital discharge – yet accurate assessment of volume status is recognized to be exceptionally challenging. This conundrum led us to investigate how hospitalists are assessing volume status and discharge-readiness of patients hospitalized with heart failure. We collected audience response data during a didactic heart failure presentation at the 2019 Society of Hospital Medicine annual meeting. Respondents (n = 216), 76% of whom were practicing physician hospitalists caring for more than 20 acute heart failure patients per year, were presented six questions. Eighteen percent of respondents reported not being able to determine the completeness of decongestion on discharge and 32% reported that complete decongestion was not a treatment target. These findings suggest important differences between guideline recommendations and how hospitalists treat heart failure in current clinical practice.

1. Introduction
Acute decompensated heart failure (ADHF) is the leading admitting diagnosis in patients 65 and older with >1 million hospitalizations per year in the USA alone [1]. Because patients discharged with signs of congestion, or fluid overload, are more likely to be rehospitalized within 2 months or die within 6 months post-discharge [2], current clinical practice guidelines recommend careful evaluation for signs of congestion and attainment of complete decongestion, or removal of all excess fluid, prior to discharge. Specifically, the 2013 American Heart Association guidelines for the management of heart failure state, ‘careful evaluation of all physical findings, laboratory parameters, weight change, and net fluid change should be considered before discharge.’[1] Similarly, the 2016 European Society of Cardiology Heart Failure guidelines recommend discharge ‘when haemodynamically stable, euvolaemic, established on evidence-based oral medication and with stable renal function for at least 24 hours.’[3] However, evaluation of decongestion is inaccurate based on symptoms (e.g., orthopnea), physical examination (e.g., jugular venous distention), chest x-rays, and serum biomarkers (e.g., brain natriuretic peptide) [1,4]. Given the discrepancy between guideline recommendations for assessing euvolemia and the limited accuracy of traditional available bedside tools to detect it, we sought to evaluate how hospitalists assess volume status and discharge-readiness of patients hospitalized with acute decompensated heart failure.

2. Methods
During an interactive didactic session entitled, ‘Is the tank drained? Discharge-Ready Volume Targets for Acute Heart Failure’ at the Society of Hospital Medicine national conference in Washington, D.C. in March 2019, the session moderator (BPL) conducted a live survey using an audience response system. Eight multiple-choice questions were administered during the 40-min session, and 6 pertained to respondents’ behaviors, beliefs, and attitudes regarding inpatient management of heart failure. Deidentified data on respondent characteristics were collected. Audience response results were displayed in real-time immediately after each question, and these results informed subsequent discussion. The Investigational Review Board determined this project did not qualify as human subjects research and these results informed subsequent discussion. The Investigational Review Board determined this project did not qualify as human subjects research because it posed no risk to respondents. A summary of the questions and responses is displayed in Table 1, and a complete version is available in the Appendix.
3. Results

3.1. Respondent characteristics

Among all participating audience members, between 152 and 216 responded to each question. Demographics revealed 76% of respondents were practicing physician hospitalists, 9% were physician assistants, 8% were nurses (including nurse practitioners or advanced practice registered nurses), and 6% were physicians-in-training. Eighty-nine percent of respondents had cared for >20 patients with heart failure in an acute care setting in the prior year.

3.2. Assessing changes in volume status

Sixty-five percent of respondents estimated that the recorded 24-h net fluid output recorded likely differed from the true value by >1 l in their practice setting. When queried about the most important finding used in their practice setting to assess day-to-day changes in net fluid removal, approximately one-third (37%) reported using changes in weight, one-third (35%) reported using changes in symptoms, and smaller proportions reported using 24-h net urine output (15%) or improvement in physical exam findings (11%).

3.3. Assessing for completeness of decongestion

When asked about the most important findings used to assess the adequacy of decongestion, the most frequently reported were resolution of symptoms with activity (52%), resolution of signs of congestion (49%), weight loss since admission (48%), resolution of symptoms of congestion at rest (39%), achievement of a known dry weight (37%), cumulative net urine output (22%), worsening renal function (20%), target reduction in natriuretic peptides (11%), metabolic alkalosis (6%), and point-of-care ultrasound findings (4%).

3.4. Discharge-readiness

When asked whether decongestion should be ‘complete’ prior to discharge, 58% of respondents responded ‘yes’ while 32% responded ‘no’ and 10% responded ‘I don’t know.’

| Table 1. Abbreviated survey questions and results. |
|-----------------------------------------------|
| Question # | Question | # of total respondents | Answer choice | # of respondents (%) |
|-----------|----------|------------------------|----------------|----------------------|
| 1         | Type of provider | 197 | practicing physician | 150 (76) |
|           |          |                        | practicing physician assistant | 18 (9) |
|           |          |                        | practicing nurse | 16 (8) |
|           |          |                        | physician in-training | 11 (6) |
| 2         | # of Heart Failure patients respondent has care for | 215 | 75 or more | 99 (46) |
|           |          |                        | 21 to 75 | 92 (43) |
|           |          |                        | 1 to 20 | 19 (9) |
| 3         | How accurate is urine volume recorded | 213 | by more than 1 liter (‘bad’) | 139 (65) |
|           |          |                        | by less than 1 liter (‘not too bad’) | 72 (34) |
|           |          |                        | not applicable | 2 (1) |
| 4         | Best measure of urine output | 216 | weight difference from previous day | 79 (37) |
|           |          |                        | improvement in symptoms | 76 (35) |
|           |          |                        | 24-hour net urine output | 33 (15) |
|           |          |                        | improvement of signs | 24 (11) |
| 5         | % with dry weight | 206 | 0% | 59 (29) |
|           |          |                        | 1 to 50% | 113 (55) |
|           |          |                        | 51% to 99% | 22 (11) |
|           |          |                        | 100% | 1 (0) |
|           |          |                        | I don’t know | 11 (5) |
| 6         | 3 most important measures of decongestion | 201 | resolutions of symptoms with activity | 109 (52) |
|           |          |                        | physical exam | 102 (49) |
|           |          |                        | weight loss since admission | 101 (48) |
| 7         | Should decongestion be complete prior to discharge | 152 | Yes | 88 (58) |
|           |          |                        | No | 49 (32) |
|           |          |                        | I don’t know | 15 (10) |
| 8         | What % of patients are euvolemic on discharge | 164 | 0% | 1 (1) |
|           |          |                        | 1 to 20% | 2 (1) |
|           |          |                        | 21 to 50% | 37 (23) |
|           |          |                        | 51 to 80% | 69 (42) |
|           |          |                        | 81 to 99% | 24 (15) |
|           |          |                        | 100% | 2 (1) |
|           |          |                        | I cannot determine | 29 (18) |
When asked what percentage of patients they discharged had achieved ‘complete’ decongestion prior to discharge, 18% responded they could not determine the completeness of decongestion, 23% responded between 21% and 50% of patients, 42% responded between 51% and 80% of patients, and 15% responded between 81% and 99% of patients.

4. Discussion

The results of our audience polling revealed considerable practice variation among hospitalists with regard to the assessment of pulmonary vascular decongestion, volume status, and attitudes toward the importance of attaining complete decongestion prior to discharge. Our data reveal a broad distribution of responses about the most important parameters for assessing decongestion and volume status without a clear preference among most respondents. Additionally, a large proportion of respondents reported routinely discharging patients prior to attaining complete decongestion and indicated that attainment of complete decongestion was not a goal of hospitalization. To our knowledge, this is the first survey of hospitalists from multiple institutions evaluating approaches and attitudes toward the management of congestion and discharge-readiness based on the volume status of patients hospitalized for heart failure.

When asked to estimate the proportion of patients that achieved complete decongestion prior to discharge, one-fifth of hospitalists responded that they were unable to assess whether complete decongestion had been achieved. Indeed, hospitalist providers reported the three most commonly used findings to determine whether adequate decongestion was achieved were symptoms with activity, resolution of signs, and weight loss since admission. However, the traditional approach of using symptoms and physical exam findings to assess the severity of congestion due to heart failure is unreliable [5]. Because congestion at the time of hospital discharge is associated with readmissions and death, identifying a more accurate diagnostic approach to detect and monitor congestion is considered a research priority by the National Heart, Lung, and Blood Institute [6] and is an active area of inquiry [7]. One tool that has demonstrated superior sensitivity relative to traditional tools in multiple cohorts is point-of-care ultrasound (POCUS) [8–10]. Two recent randomized controlled trials demonstrated the use of point-of-care lung ultrasound both decreased length of stay and number of urgent visits in patients recently hospitalized for heart failure [11,12]. Further, lung ultrasound is a relatively easy POCUS application for to learn [13] and perform [14]. Although POCUS has become more readily available in all hospitals over the past 25 years, only 4% of respondents indicated POCUS was among their most useful bedside tools, suggesting a provider training gap exists and should be a focus of future quality improvement efforts.

Most striking, almost half of respondents did not believe attainment of complete decongestion was a goal of hospitalization and reported a large proportion of patients were discharged with signs of congestion. These findings are in contrast to recommendations in the 2013 American Heart Association guidelines [1] and the European Society of Cardiology guidelines for the management of acute and chronic heart failure [3]. These findings also require further validation in a larger study sample. If validated, further study would be warranted to determine the underlying reason for this discrepancy. Lack of knowledge of guideline recommendations, inability to determine or achieve complete decongestion due to disease severity, or competing priorities, such as length of stay, may all be contributing factors.

Limitations of our data include a small sample size and selection bias since the practice of hospitalist providers at a national conference may not represent hospitalists generally. Additionally, responses were shared in real-time among the audience, and subsequent responses may have been influenced by previous responses. Finally, the phrasing and order of questions may have introduced framing or anchoring bias [15,16].

In conclusion, these data highlight the variability among hospitalists in the management of patients hospitalized with acute decompensated heart failure and reveal the need for more accurate bedside tools to assess decongestion. Our finding that a large proportion of respondents do not consider the attainment of complete decongestion a goal of hospitalization suggests an important gap between the current clinical practice of hospitalists and guideline recommendations for a condition that is the most common cause of hospitalization in older adults. Although these data should be verified in a larger study sample of hospitalists, we suspect our findings will be confirmed due to the inaccuracy of traditional bedside tools for assessing decongestion in heart failure.

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References

[1] Yancy CW, Jessup M, Bozkurt B, et al. ACCF/AHA guideline for the management of heart failure: a report of the American college of cardiology foundation/ American heart association task force on practice guidelines. J Am Coll Cardiol. 2013;62(16):e147–239.

[2] Rubio-Gracia J, Demissei BG, Ter Maaten JM, et al. Prevalence, predictors and clinical outcome of residual congestion in acute decompensated heart failure. Int J Cardiol. 2018;258:185–191.

[3] Ponikowski P, Voors AA, Anker SD, et al. ESC guidelines for the diagnosis and treatment of acute and chronic heart failure: the task force for the diagnosis and treatment of acute and chronic heart failure of the European society of cardiology (ESC) developed with the special contribution of the heart failure association (HFA) of the ESC. Eur Heart J. 2016;37(27):2129–2200.

[4] Gheorghiade M, Follath F, Ponikowski P, et al. Assessing and grading congestion in acute heart failure: a scientific statement from the acute heart failure committee of the heart failure association of the European society of cardiology and endorsed by the European society of intensive care medicine. Eur J Heart Fail. 2010;12(5):423–433.

[5] Collins S, Storrow AB, Albert NM, et al. Early management of patients with acute heart failure: state of the art and future directions. A consensus document from the society for academic emergency medicine/ heart failure society of America acute heart failure working group. J Card Fail. 2015;21(1):27–43.

[6] Peacock WF, Braunwald E, Abraham W, et al. National Heart, Lung, and Blood Institute working group on emergency department management of acute heart failure: research challenges and opportunities. J Am Coll Cardiol. 2010;56(3):343–351.

[7] Lucas BP, D’Addio A, Block C, et al., Limited agreement between two noninvasive measurements of blood volume during fluid removal: ultrasound of inferior vena cava and finger-clip spectrophotometry of hemoglobin concentration. Physiol Meas. 2019;40(6):065003.

[8] Bistola V, Polyzogopoulou E, Ikonomidis I, et al. Lung ultrasound for the diagnosis of acute heart failure: time to upgrade current indication? Eur J Heart Fail. 2019;21(6):767–769.

[9] Pivetta E, Goffi A, Nazerian P, et al. Lung ultrasound integrated with clinical assessment for the diagnosis of acute decompensated heart failure in the emergency department: a randomized controlled trial. Eur J Heart Fail. 2019;21(6):754–766.

[10] Maw AM, Hassanin A, Ho PM, et al. Diagnostic accuracy of point-of-care lung ultrasonography and chest radiography in adults with symptoms suggestive of acute decompensated heart failure: a systematic review and meta-analysis. JAMA Network Open. 2019;2(3):e190703.

[11] Mozzini C, Di Dio Perna M, Pesce G, et al. Lung ultrasound in internal medicine efficiently drives the management of patients with heart failure and speeds up the discharge time. Intern Emerg Med. 2018;13(1):27–33.

[12] Rivas-Lasarte M, Alvarez-Garcia J, Fernandez-Martinez J, et al. Lung ultrasound-guided treatment in ambulatory patients with heart failure: a randomized controlled clinical trial (LUS-HF study). Eur J Heart Fail. 2019. DOI:10.1002/ejhf.1604.

[13] Swamy V, Brainin P, Biering-Sorensen T, et al. Ability of non-physicians to perform and interpret lung ultrasound: A systematic review. Eur J Cardiovasc Nurs. 2019;18(6):474–483.

[14] Al Deeb M, Barbic S, Featherstone R, et al. Point-of-care ultrasonography for the diagnosis of acute cardiogenic pulmonary edema in patients presenting with acute dyspnea: a systematic review and meta-analysis. Acad Emerg Med. 2014;21(8):843–852.

[15] Tversky A, Kahneman D. The framing of decisions and the psychology of choice. Science. 1981;211(4481):453–458.

[16] Tversky A, Kahneman D. Judgment under uncertainty: heuristics and biases. Science. 1974;185(4157):1124–1131.
Appendix Survey questions and results

Question 1: What kind of health care provider are you?

| Select single-best description | n (%) |
|--------------------------------|-------|
| practicing physician          | 150 (76) |
| practicing physician assistant| 18 (9) |
| practicing nurse (including NP or APRN) | 16 (8) |
| physician in-training (intern or resident) | 11 (6) |
| medical student               | 1 (1) |
| other                         | 1 (1) |
| nurse in-training             | 1 (1) |
| physician assistant in-training| 0 (0) |
| total                         | 197   |

Question 2: In the last year, how many patients with acute heart failure have you managed in an acute care setting, such as a hospital, emergency department, observation unit, or short stay unit? Your role in management can be as a primary provider or as an extender to the primary provider(s).

| Select single-best estimate | n (%) |
|-----------------------------|-------|
| 75 or more                  | 99 (46) |
| 21 to 75                    | 92 (43) |
| 1 to 20                     | 19 (9) |
| 0                           | 1 (0) |
| I am not sure               | 4 (2) |
| total                       | 215    |

Question 3: At your own hospital what is your best estimate for how much reported 24-h net urine outputs might differ from true (actual) 24-h net urine outputs? (For this and all remaining questions, if you work at more than one hospital, choose the hospital where you see more patients over the course of a year.)

| Select single-best estimate | n (%) |
|-----------------------------|-------|
| by more than 1 liter ('bad')| 139 (65) |
| by less than 1 liter ('not too bad') | 72 (34) |
| not applicable              | 2 (1) |
| total                       | 213    |

Question 4: What is the most important finding that you use at your own hospital to determine if a patient is undergoing net negative fluid removal from day to day?

| Select single most important finding | n (%) |
|-------------------------------------|-------|
| weight difference from previous day | 79 (37) |
| improvement in symptoms             | 76 (35) |
| 24-hour net urine output            | 33 (15) |
| improvement of signs                 | 24 (11) |
| laboratory values                    | 2 (1) |
| other                               | 2 (1) |
| patient’s own perception of urine produced | 0 (0) |
| total                               | 216    |

Question 5: What proportion of heart failure patients at your own hospital have a retrievable established dry weight? Established dry weight is a weight that was recorded when a patient was known to be ‘euvolemic.’ This weight is intended to be used as a baseline for comparison. ‘Retrievable’ means that a health-care provider would be able to find the dry weight in the medical record within 2 minutes.

| Select single-best estimate | n (%) |
|-----------------------------|-------|
| 0%                          | 59 (29) |
| 1 to 50%                    | 113 (55) |
| 51% to 99%                  | 22 (11) |
| 100%                        | 1 (0) |
| I don’t know                | 11 (5) |
| total                       | 206    |

Question 6: What are the 3 most important findings that you use at your own hospital to determine if a patient is adequately decongested (euvolemic)?

| Select TOP 3 most important findings | n (%) |
|-------------------------------------|-------|
| resolution of symptoms of congestion (difficulty breathing, body swelling) with activity | 109 (52) |
| resolution of signs of congestion (JVP, rales, edema) | 102 (49) |
| weight loss since admission         | 101 (48) |
| resolution of symptoms of congestion (difficulty breathing, body swelling) at rest | 82 (39) |
| achievement of a known dry weight   | 77 (37) |
| cumulative net urine output         | 46 (22) |
| worsening renal function (increase in BUN and/or serum creatinine) | 41 (20) |
| target reduction in BNP or NT-proBNP | 23 (11) |
| metabolic alkalosis (increase in serum bicarbonate) | 13 (6) |
| point-of-care ultrasound (IVC and/or lung) | 8 (4) |
| other                               | 2 (1) |
| hemoconcentration (change in hemoglobin or hematocrit) | 1 (0) |
| total                               | 605    |

Question 7: Should decongestion be ‘complete’ prior to discharge?

| Select best answer | n (%) |
|--------------------|-------|
| Yes                | 88 (58) |
| No                 | 49 (32) |
| I don’t know       | 15 (10) |
| total              | 152    |

Question 8: What proportion of heart failure patients that are discharged by you (as a primary provider or as an extender to a primary provider) achieve ‘complete’ decongestion prior to discharge?

| Select best estimate | n (%) |
|---------------------|-------|
| 0%                  | 1 (1) |
| 1 to 20%            | 2 (1) |
| 21 to 50%           | 37 (23) |
| 51 to 80%           | 69 (42) |
| 81 to 99%           | 24 (15) |
| 100%                | 2 (1) |
| I cannot determine the completeness of decongestion | 29 (18) |
| total               | 164    |