Pulmonary Congestion in Hemodialysis: An Old Chestnut Worth Screening For?

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It is well documented that pulmonary congestion is common among patients undergoing treatment with hemodialysis, and recent evidence suggests a strong association with mortality (1–4). The cyclical, and very predictable, nature of each hemodialysis session carries several major risks that may compromise cardiorespiratory function and threaten the patient’s well-being (5). One major consequence is the accumulation of fluid during the interdialytic period, which has a propensity to collect in the lungs and lead to progressive pulmonary congestion, particularly among patients with compromised left ventricular function (1). Although the pathogenesis of this process is generally well understood and the inevitable consequences are obvious, our ability to effectively diagnose and treat this common condition has been less than satisfactory, exposing patients to unnecessary and potentially lethal clinical consequences (6). Pulmonary congestion that becomes clinically apparent from symptoms of shortness of breath prompts the clinical team to conduct a rapid set of clinical investigations and follow through with a personalized treatment strategy. Changes in the dialysis treatment prescription such as increased ultrafiltration, provision of extra dialysis treatments, re-evaluation of a patient’s dry weight, and a cardiac assessment are some of the recognized treatment practices that may be required. Pulmonary congestion that is not clinically apparent to the team or indeed the patient presents an even more challenging scenario (7,8). This “silent” pulmonary congestion by its very nature is difficult to detect, develops insidiously, and poses a serious threat to patient welfare.

In this issue of CJASN, Enia and colleagues (9) provide a novel and unique perspective into the association of pulmonary congestion with physical functioning in hemodialysis. Using data from a multicenter study of 270 Italian hemodialysis patients, they describe for the first time an independent and inverse association of pulmonary congestion with impaired physical functioning measured before hemodialysis treatments. The primary exposure, pulmonary congestion, was assessed by chest ultrasonography, which measures the amount of extravascular water that accumulates in the lung from the thickness of the interlobular septa (1). The extent of water accumulation in the lungs was calculated by a cumulative score that indicated the thickness of the interlobular septa. Physical performance assessment was based on self-report using the physical functioning scale of the Kidney Disease Quality of Life Short Form (KDQOL-SF).

There are three major findings that merit discussion in this editorial. First, 58% of hemodialysis patients in this survey had evidence of moderate to severe lung congestion before each hemodialysis session, whereas almost 40% of these patients had apparently no pulmonary symptoms. As a practicing clinical nephrologist, one must be alarmed at the observation that almost two thirds of patients have moderate to severe pulmonary congestion before a hemodialysis treatment at a time when classic thrice-weekly hemodialysis remains the “gold” standard prescription for most hemodialysis programs. Assuming good external validity, one might also infer that most patients in standard hemodialysis programs are in a perpetual state of central volume overload that possibly begins soon after a hemodialysis treatment and progressively worsens before the next treatment. There is an increasing body of evidence that supports the finding of excessive fluid gains with elevated mortality (1–4,10). Indeed, Zoccali and colleagues recently demonstrated the independent prognostic effect of severe pulmonary congestion on all-cause and cardiovascular mortality in a multicenter prospective cohort study (10). The risk of all-cause death increased >4-fold, whereas that of fatal and non-fatal cardiovascular events increased >3-fold. These data highlight the detrimental effect of pulmonary congestion on clinical outcomes among maintenance hemodialysis patients and our inability to effectively manage them as we continue with conventional hemodialysis treatment practices.

A second, and equally noteworthy finding, was the strong correlation of pulmonary congestion with poorer physical functioning before hemodialysis treatment. Regardless of age, coexisting cardiovascular comorbidity, and several nutritional markers, the greater the degree of pulmonary congestion before hemodialysis, the higher the probability of poor physical functioning. For many readers, it may not be surprising to learn that overt pulmonary congestion was linked with poor patient physical performance and indeed, one might have expected to see the graded effect of increasing pulmonary congestion with reduced physical functioning. What was surprising was the complete lack of association of commonly measured nutritional and...
metabolic indicators of health with poor physical function-
ing in the adjusted analysis. It is possible that this may relate
to the performance characteristics of the KDQOL-SF because
it does not capture quantitative performance such as cardio-
respiratory fitness, which may be related to nutritional param-
ters (11). Nevertheless, the KDQOL-SF, adapted for use in the
Italian dialysis population (12), is a validated metric for cap-
turing physical functioning in hemodialysis, and is a strong
determinant of morbidity and mortality (13).

Third, and even more striking, was the finding of lower
physical functioning among the subgroup with asymptom-
atic pulmonary congestion. The relationship between symp-
tomatic central fluid overload and poor physical performance
could well have been expected. Patients with the most severe
physical symptoms based on New York Heart Association
class had the poorest physical performance and this was
confirmed in multivariable analysis. However, the discovery
that patients who had sonographic evidence of pulmonary
congestion but without symptoms and had equally poor
physical performance sheds new light on its importance. This
study would suggest that asymptomatic pulmonary conges-
tion is a distinct clinical entity with measurable consequences.
Indeed, asymptomatic pulmonary congestion explained 16% of the variability in impaired physical functioning.

The findings from this study raise important questions on
the value of chest ultrasonography in routine assessment of
volume status among patients undergoing maintenance
hemodialysis. Equally important, these results raise signif-
ificant concerns regarding the current clinical practice of
thrice-weekly hemodialysis for volume control in this high-
risk population. This Italian study demonstrates that the
standard practice of clinical volume assessment and man-
agement is suboptimal in contemporary hemodialysis co-
horts. A large percentage of patients had moderate to severe
pulmonary congestion before hemodialysis treatment based
on a validated ultrasonography technique. Equally worrisome
is the observation that many patients receiving hemodial-
ysis treatment have ultrasonographic evidence of pulmo-
nary congestion, but this does not come to the attention of
the clinical team because these patients are completely
asymptomatic.

This study is not without limitations. The study design
was cross-sectional and consequently limits causal infer-
ence, and thus one cannot state with any degree of certainty
that pulmonary congestion led to the development of poor
physical functioning. One might also criticize the self-report
measure of physical functioning that was utilized from the
KDQOL-SF 36 and perhaps its lack of specificity for quan-
titative physical performance measures (11). For example, to
what extent does a self-report instrument capture other
components of physical functioning and physical fitness
(e.g., muscle strength, cardiorespiratory fitness)? Indeed,
the lack of association of nutritional and metabolic indica-
tors with physical functioning in this study may reflect this
limitation. Nevertheless, its validity as a physical function-
ing metric has been well established in large-scale epidemi-
ologic studies in the nephrology literature (13). The
characteristics of the population were representative of a
predominantly European dialysis population, with an aver-
age age of 66 years and a 28% prevalence of diabetes, al-
though it will be necessary to validate these findings in
racially and ethnically diverse non-European populations.

To what extent can this new-found information advance
the practice of hemodialysis and improve volume manage-
ment in at-risk patients? Although there are a number of
methods for estimating volume status in day-to-day clinical
practice, the nephrology team has traditionally depended on
noninvasive clinical methods such as the standard clinical
examination, measurement of interdialytic weight gains,
and relative plasma volume monitoring (14). With advance-
ments in chest ultrasonography, it should be possible to
routinely screen for pulmonary congestion with greater pre-
cision before dialysis treatment. This critical piece of inform-
ation is likely to be more important to clinical decision
making than measurement of interdialytic weight gains.
Indeed, the authors found little correlation between pulmonary
congestion using chest ultrasonography and interdialytic
weight gain, suggesting that interdialytic weight gain is a
poor substitute for central volume assessment.

Going forward, it will be important to explore whether
the application of chest ultrasonography in routine clinical
practice will alter our decision-making capacity and lead to
improved volume control among hemodialysis patients. At
the very least, it should stimulate an amplified response to
tackle the high rates of pulmonary congestion as suggested
in this study, especially if the findings are confirmed in
demographically and racially diverse populations. Increases
in the frequency of hemodialysis or/and the duration of
settings were shown to be beneficial in improving patient
outcomes (15). Volume assessment and its man-
agement among patients undergoing hemodialysis may be
viewed by some as the Achilles heel of dialysis practice.
Excessive volume gains during the interdialytic period pre-
dict increased mortality risk and now reduced physical
functioning. The advent of chest ultrasonography may
herald a new approach to volume assessment and control.
Earlier recognition, detection, and quantification of extra-
vascular lung water should provide the nephrology team
with new practical information to inform decision making
and guide prescribing practices, with the potential to affect
major clinical outcomes. Randomized controlled trials are
now required to test whether screening for pulmonary con-
gestion in hemodialysis patients leads to better volume con-
tral, reduced cardiovascular events, and improved patient
survival and quality of life. This approach may herald the
dawn of a new era and a paradigm shift in managing central
fluid overload in hemodialysis.

Disclosures
None.

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