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The Role of Muscle Thickness Measurement in Frailty Assessment among CKD Patients: An Integrative Review

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ABSTRACT

Background: Frailty has been generally defined in association with advanced age. Chronic kidney disease (CKD) is one of the conditions that produce changes similar to aging lead to a frailty state at younger ages. Some studies have estimated frailty prevalence in hemodialysis patients between 21 up to 73% of cases. There are different measurement tools available to assess frailty in ESRD. The best measure of frailty has not yet been identified. Ultrasonography (US) has shown promise in assessing muscle size in frail older adults and in hemodialysis recipients, however consistency of BATT with different frailty measures in hemodialysis patients still under evaluated and require more investigation. Aim of the study to evaluate the application of ultrasound measurements of bilateral anterior thigh thickness (BATT) for screening of hemodialysis patients for Frailty. **Conclusion:** Ultrasound measurements of bilateral anterior thigh thickness (BATT) are a valuable, non-invasive tool for routine frailty screening in hemodialysis patients.

Keywords: Farlity, BATT, Dialysis ,ESRD

Introduction

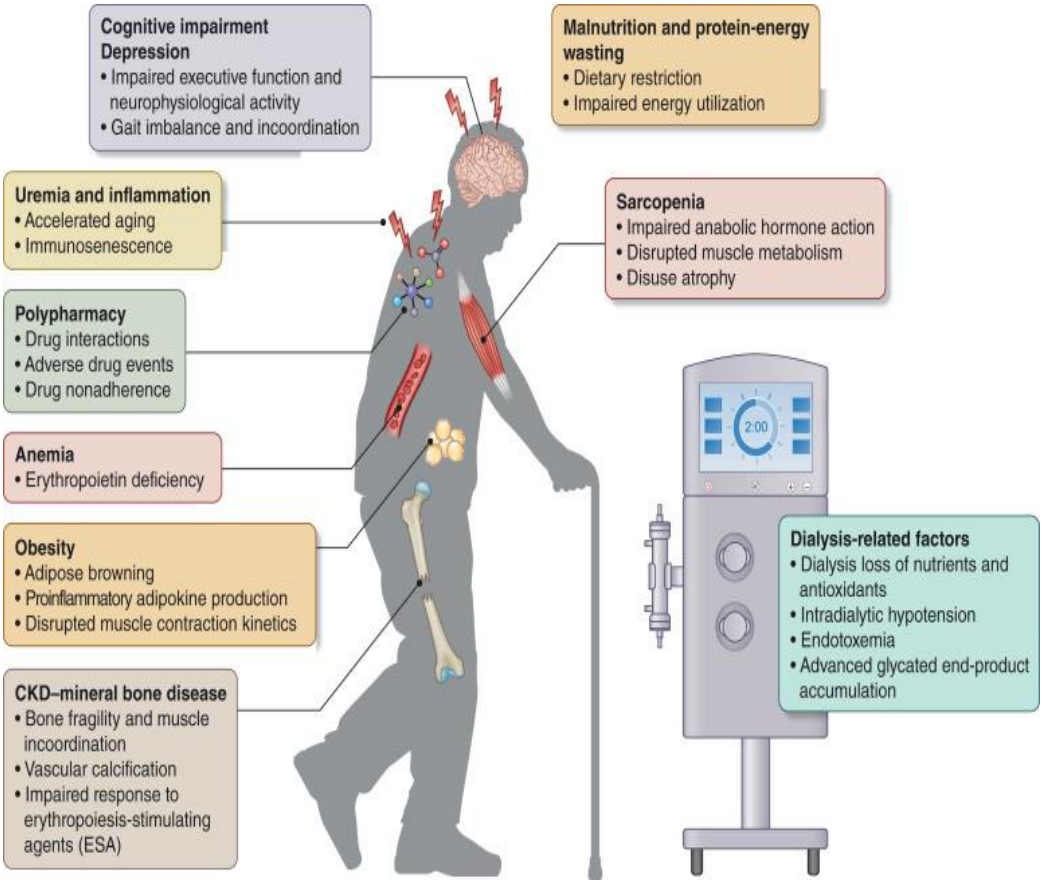
Frailty is an important geriatric syndrome (1) .Frailty is a multidimensional and dynamic condition, theoretically defined as a state of decreased physical function, reduced resilience and increased vulnerability to adverse health out-comes, resulting from age-associated declines in reserve and function across multiple physiologic systems, including decreased muscle mass and strength, reduced energy levels, and decreased physical activity levels, so the ability to cope with every day or acute stressors is compromised (**2)**This can lead to an increased risk of falls, fractures, and hospitalizations as well as to an increased risk of mortality. Frailty can be assessed by a variety of methods, including physical performance tests, laboratory tests, and questionnaires (3).

The most commonly utilized and well-regarded operational definition is the Fried frailty phenotype that defined frailty as a clinical syndrome in which three or more of the five following criteria are present: unintentional weight loss (≥10 lbs in the past year), self-reported exhaustion, weakness (grip strength), slow walking speed, and low physical activity (active kcals expended per week) (4).

The prevalence rates of frailty range from 30% to 80% and from 65% to 72% in patients receiving hemodialysis (HD) and peritoneal dialysis (PD), respectively (**5**), which are substantially higher than the rate of 12% in patients at earlier stages of kidney disease (**6**).

Patients with frailty incur a 22.0% higher healthcare-related expenditure, compared to others. Moreover, the expenses related to hospitalization and in-patient care for those patients who succumb to frailty are observed to be 60.3% higher (**7**).

Frailty can be caused by a variety of factors, including traditional factors that contribute to the development of frailty in the general population, such as accelerated aging, oxidative stress, inflammation, malnutrition, and protein-energy wasting. In addition, chronic kidney disease–specific factors, such as uremia, mineral bone disease, and dialysis treatment, also have been linked to the development of frailty (figure 1) (***8*).**



Diagnosis of frailty in hemodialysis patients

Several instruments have been developed to diagnose and evaluate the severity of frailty, yet debate is ongoing about the best methods and tools for objectively measuring the classical components of frailty. From a geriatric's perspective, comprehensive geriatric assessment that involves a multidimensional and multidisciplinary evaluation of a patient's physical, functional, cognitive and psychosocial capabilities, is the gold standard for diagnosing frailty **(9). C**omprehensive geriatric assessment covers areas such as functional capacity, fall risk, cognition, mood, polypharmacy, social support, financial matters, and care objectives **(9).**

Currently, no universal definition of frailty has been established for clinical and research purposes. Nevertheless, frailty can be conceptualized broadly through 2 different models—the "phenotypic frailty" model, which focuses on physical function, and the "cumulative deficits" model, which tallies up deficits across various domains, including disability, disease, and physical, cognitive, and psychological aspects (***8***). **The Fried phenotype of frailty** is the one most commonly cited and is a highly validated classification for phenotypic frailty. It has a high positive predictive value, but the process of classification is time-consuming; it also requires specific tools, such as a dynamometer, thereby limiting its practicality for use in a typical clinic setting (**10**). **The Short Physical Performance Battery (SPPB) test:** resembles frailty phenotype as a physical phenotype but it focuses on the lower-limb functions, yet SPPB is relatively simple and quicker to perform than the Fried phenotype classification.

However, the SPPB does not consider handgrip strength, a major determinant of frailty (**11**), or psychological aspects of a patient's condition (**12**).

The cumulative-deficits model, evaluated through either self-reporting or clinician assessment, offers an alternative way to categorize frailty (**13**).

Muscle ultrasound is a non-invasive, widely available, inexpensive, and painless method to evalutate various aspect of the muscle including : 1) Muscle volume estimated by measuring longitudinal or oblique diameters or muscular cross-sectional area (CSA) **(14)** and muscle structure represented by the echogenicity of the muscle. Dynamic muscle ultrasound can image muscle contractions or spontaneous activity such as fasciculations. Doppler imaging helps to evaluate muscle vascularization. Recent studies have suggested that muscle ultrasound is most suitable to reliably assess muscle wasting in older people **(15).** Muscle ultrasound is particularly effective for measuring muscle size in different body parts, with the quadriceps femoris muscle (MQ) being one of the most reliable muscle groups to evaluate **(16).** Moreover, it has been found to be useful in assessing muscle hypertrophy and atrophy by providing a direct insight into muscle size **(17).**

Assessment of sarcopenia by means of muscle ultrasound

Several investigations have revealed that specific ultrasound measurements of muscle tissue such muscle thickness and cross-sectional area can effectively identify sarcopenia in elderly people. with the rectus femoris or anterior thigh muscles being the muscles studied most often. By using bioelectrical impedance analysis as reference method to evaluate muscle mass, they concluded that ultrasound-derived rectus femoris cross-sectional area was significantly correlated with muscle mass parameters and knee extensor muscle strength (**18**). Recently, the Society of Physical and Rehabilitation Medicine special interest group on sarcopenia (ISarcoPRM) has adopted the measurement of quadriceps muscle thickness as a diagnostic criterion for assessing low muscular mass (**19**). Kara et al. defined sonographic thigh adjustment ratio cut-off values of 1.4 for males and 1.0 for females, which is two standard deviations below the mean values of healthy young adults. (**20**).

Another study was conducted in 223 haemodialysis patients to study the association between ultrasound-derived bilateral anterior thigh thickness (BATT), sarcopenia, and frailty by utilizing common frailty tools such as the Frailty Phenotype, Frailty Index, Edmonton Frailty, and Clinical Frailty Scale. Ultrasound measurements of quadriceps muscle thickness were found to be variably associated with frailty depending on the frailty tool used (**21**).

Conclusion

Ultrasound measurements of bilateral anterior thigh thickness (BATT) are a valuable, non-invasive tool for routine frailty screening in hemodialysis patients. Studies reported significant associations between low BATT and increased frailty prevelance .This approach could enhance early identification and management of frailty in hemodialysis patients, potentially improving clinical outcomes and patient care.

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