Sarcopenia Screening Among Patients Undergoing Peritoneal Dialysis

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Sarcopenia, characterized by an aging-related progressive decline of skeletal muscle mass, strength, and physical performance, is frequently encountered in patients undergoing peritoneal dialysis (PD) and is associated with adverse clinical outcomes. However, the best screening tools facilitating the rapid detection of sarcopenia among patients undergoing PD remain unknown.

SARC-F SARC-CalF calf circumference sarcopenia peritoneal dialysis

1. Introduction

Sarcopenia, characterized by an aging-related progressive decline of skeletal muscle mass, strength, and physical performance, is associated with adverse clinical outcomes [1][2][3]. As chronic kidney disease progresses, the accelerated muscle wasting resulting from multifactorial and intricate pathogenesis accounts for the considerably high prevalence of sarcopenia when patients reach end-stage renal disease (ESRD) [4]. In particular, patients undergoing peritoneal dialysis (PD) have substantial daily losses of protein during the process of dialysis [5]. Therefore, it is crucial to develop feasible and easy-to-use screening tools facilitating the rapid detection of sarcopenia among patients undergoing PD in an attempt to provide timely therapeutic intervention.

The strength, assistance walking, rise from a chair, climb stairs, and falls (SARC-F), a five-item self-reported questionnaire first developed in 2013 [6], is a well-established and widely used initial screening tool for geriatric sarcopenia and has been recently recommended by the Asian Working Group for Sarcopenia (AWGS) 2019 and the revised European Working Group on Sarcopenia in Older People (EWGSOP2) [7][8]. Moreover, calf circumference (CC) has been used to screen geriatric sarcopenia, which provided moderate-to-high sensitivity and specificity in the Asian population [9][10][11]. Accordingly, the AWGS 2019 also recommends screening sarcopenia using CC and SARC-F combined with calf circumference (SARC-CalF) [8], the latter of which adds CC item into the original SARC-F scale [12].

There is increasing evidence suggesting an improved diagnostic accuracy and sensitivity of SARC-CalF compared with the original SARC-F version in the geriatric and cancer population [12][13][14][15]. However, only a few studies have addressed the clinical utility of SARC-F, CC, and SARC-CalF among the dialysis population. Although the use of SARC-F among patients undergoing PD has been recently reported [16], whether CC and SARC-CalF are superior to SARC-F in the diagnostic performance of sarcopenia in this vulnerable population remains unexplored.

2. Sarcopenia Screening among Patients Undergoing Peritoneal Dialysis

Although sarcopenia is highly prevalent among patients with ESRD, ranging from 11% to 40% , there has been no consensus regarding the definition and working diagnosis of sarcopenia in patients undergoing dialysis. In an attempt to better characterize the performance of these screening tools, four different operational diagnoses derived from the agreements of geriatric experts, including the AWGS 2019 [8], EWGSOP2 [7], Foundation for the National Institutes of Health (FNIH) [17], and International Working Group on Sarcopenia (IWGS) [18], were used simultaneously here. The prevalence of sarcopenia among 186 participants undergoing PD ranged between 25.8% and 38.2% (**Figure 1**).

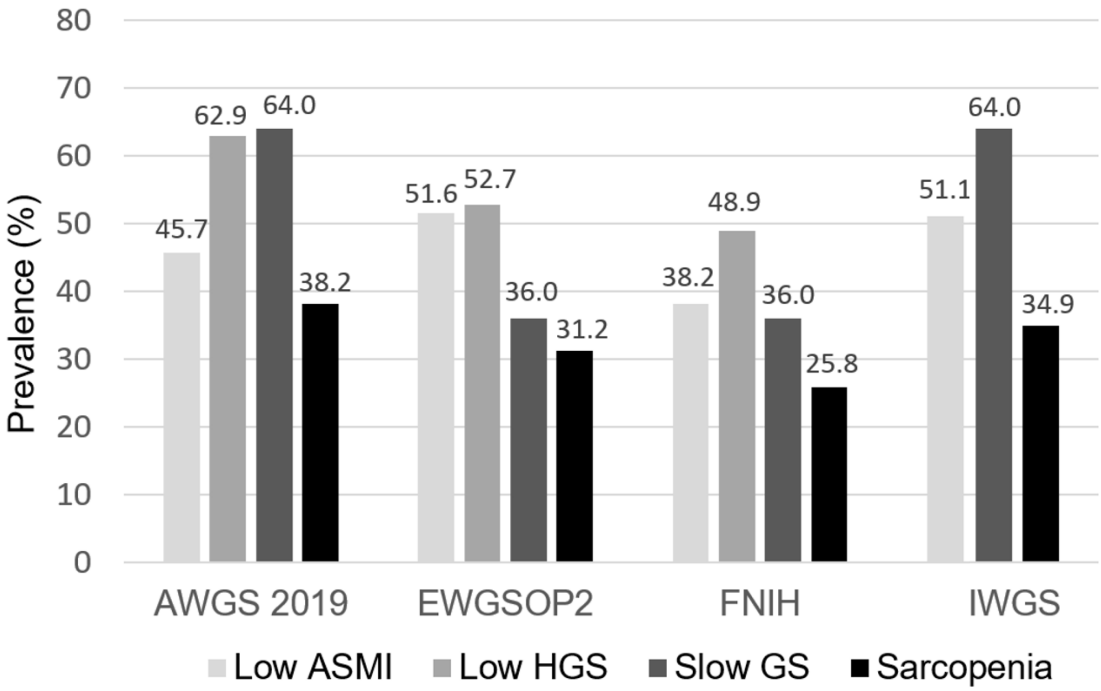

Figure 1. The prevalence of low ASMI, low HGS, slow GS, and sarcopenia across four sarcopenia criteria among patients undergoing PD. ASMI, appendicular skeletal muscle index; HGS, handgrip strength; GS, gait speed; AWGS, Asian Working Group for Sarcopenia; EWGSOP, European Working Group on Sarcopenia in Older People; FNIH, Foundation for the National Institutes of Health; IWGS, International Working Group on Sarcopenia.

The correlations of SARC-F, SARC-CalF, and CC with anthropometric and skeletal muscle measurements are shown in **Table 1**. SARC-F correlated significantly with HGS (r = −0.363, p < 0.001) and GS (r = −0.452, p < 0.001) but not with ASMI (r = −0.125, p = 0.090) and anthropometric measurements. In contrast, SARC-CalF and CC correlated not only with HGS (r = −0.445, p < 0.001 for SARC-CalF; r = 0.522, p < 0.001 for CC) and GS (r = −0.293, p < 0.001 for SARC-CalF; r = 0.181, p = 0.019 for CC) but also with ASMI (r = −0.421, p < 0.001 for SARC-CalF; r = 0.683, p < 0.001 for CC).

Table 1. The correlations of SARC-F, SARC-CalF, and CC with anthropometric and skeletal muscle measurements.

Variables	SARC-F		SARC-CalF		CC	
	r	*p*	*r*	*p*	*r*	*p*
Anthropometric measures						
Weight (kg)	−0.029	0.692	−0.435	<0.001*	0.721	<0.001*
BMI (kg/m^2)	−0.009	0.900	−0.382	<0.001*	0.625	<0.001*
WC (cm)	0.120	0.104	−0.224	0.002*	0.436	<0.001*
MAMC (cm)	−0.056	0.451	−0.395	<0.001*	0.617	<0.001*
FTI (kg/m^2)	0.136	0.067	−0.146	0.050*	0.298	<0.001*
Skeletal muscle measures						
ASMI (kg/m^2)	−0.125	0.090	−0.421	<0.001*	0.683	<0.001*
HGS (kg)	−0.363	<0.001*	−0.445	<0.001*	0.522	<0.001*
GS (m/s)[a]	−0.452	<0.001*	−0.293	<0.001*	0.181	0.019*

[a] *n* = 168, CC, calf circumference; BMI, body mass index; WC, waist circumference; MAMC, mid-arm muscular circumference; FTI, fat tissue index; ASMI, appendicular skeletal muscle index; HGS, handgrip strength; GS, gait speed. *$p < 0.05$ was considered to be statistically significant.

The diagnostic performance of SARC-F, SARC-CalF, and CC against the four different definitions is shown in **Table 2**. In general, the AUCs of CC (range 0.652–0.813) and SARC-CalF (range 0.648–0.748) were significantly higher

than those of SARC-F (range 0.587–0.625) across the different definitions, except when applying FNIH. Furthermore, CC significantly outperformed SARC-CalF when AWGS 2019 was adopted.

Table 2. The diagnostic performance of SARC-F, SARC-CalF, and CC on sarcopenia based on four operational definitions in the overall study population.

Definitions	AUC (95% CI)	*p*
AWGS 2019		
CC	0.813 (0.749–0.866)[a,b]	<0.001*
SARC-CalF	0.739 (0.670–0.801)[a,c]	<0.001*
SARC-F	0.587 (0.513–0.659)[b,c]	0.033*
EWGSOP2		
CC	0.776 (0.709–0.834)[b]	<0.001*
SARC-CalF	0.748 (0.679–0.809)[c]	<0.001*
SARC-F	0.625 (0.551–0.695)[b,c]	0.003*
FNIH		
CC	0.652 (0.579–0.721)	<0.001*
SARC-CalF	0.648 (0.575–0.717)	0.002*
SARC-F	0.587 (0.513–0.659)	0.063

IWGS		
CC	0.750 (0.682–0.811)[b]	<0.001*
SARC-CalF	0.710 (0.639–0.774)[c]	<0.001*
SARC-F	0.621 (0.547–0.691)[b,c]	0.004*

AUC, area under curve; CI, confidence interval; AWGS, Asian Working Group for Sarcopenia; CC, calf circumference; EWGSOP, European Working Group on Sarcopenia in Older People; FNIH, Foundation for the National Institutes of Health; IWGS, International Working Group on Sarcopenia. [a] $p < 0.05$ indicates significant difference of AUCs between CC and SARC-CalF. [b] $p < 0.05$ indicates significant difference of AUCs between CC and SARC-F. [c] $p < 0.05$ indicates significant difference of AUCs between SARC-CalF and SARC-F. *The AUC was significantly different from 0.5.

In patients undergoing HD, Yamamoto et al. have reported that the AUCs of the SARC-F questionnaire for muscle weakness and poor physical performance range from 0.76 to 0.87, indicating its good diagnostic performance for identifying patients undergoing HD with physical disability [19]. Furthermore, a close relationship between SARC-F scores and overall mortality in patients undergoing HD has been demonstrated in previous study [20]. Unfortunately, the AUCs of SARC-F for sarcopenia, defined as both low muscle mass and strength, were less satisfactory in geriatric and dialysis populations [20][21]. Similarly, in PD cohort, the diagnostic performance of SARC-F on sarcopenia was generally poor across the four different criteria.

In patients undergoing HD, Marini et al. have reported that SARC-F is more closely associated with muscle functionality than muscle mass [22]; similarly, disclosed a poor correlation of SARC-F with skeletal muscle mass, including MAMC and ASMI, in patients undergoing PD. These findings suggest that the score of SARC-F primarily reflected the status of skeletal muscle strength and physical performance rather than muscle mass, the latter of which is considered as an essential criterion for sarcopenia diagnosis. In contrast, CC yielded the highest correlation with ASMI in analysis. In this regard, SARC-CalF, which adds the CC item into SARC-F, could improve the weakness of SARC-F in the aspect of skeletal muscle mass assessment. Not surprisingly, the improved performance of SARC-CalF over SARC-F exhibited in PD cohort had been consistently reported in the geriatric and cancer population [12][13][14][15].

In particular, CC is considered a strong and reliable marker for skeletal muscle mass in the general population, which exhibited a high correlation with appendicular lean mass in a large-scale NHANES 1999–2006 cohort [23]. The good diagnostic performance of CC for detecting sarcopenia was affirmed in middle-aged and older adults [9][10][11][24] and in patients with chronic liver disease [25] and stroke [26]. In patients undergoing PD, CC yielded the

best correlation not only with ASMI but also with HGS among the three screening tools. The discriminative power of CC was even significantly better than that of SARC-CalF when adopted the AWGS 2019—the criteria that may be most suitable for Taiwanese population over the other three definitions. These findings emphasize that CC could be a simple-to-measure and valuable tool for the initial screening of sarcopenia among patients undergoing PD.

3. Implications for Clinical Practice

Among the widely used screening tools for sarcopenia, CC and SARC-CalF outperformed SARC-F in the diagnostic accuracy of sarcopenia among patients undergoing PD, and both could serve as optimal screening tools for sarcopenia in clinical settings.

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