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Short communication

Measuring body composition in hemodialysis patients: before or after hemodialysis?

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SUMMARY

Background & Aims: Body composition and clinical outcomes such as mortality and quality of life are strongly correlated in patients with chronic kidney disease. Since body weight and body mass index do not reflect body composition, measuring body composition is essential. In hemodialysis patients, there is an equipoise about the best moment to measure body composition; before or after hemodialysis. Our aim was to explore the agreement between bio-impedance spectroscopy (BIS) derived body composition indices before and after hemodialysis.
Methods: We performed BIS measurements in a cohort of hemodialysis patients. Patients were divided into group 1: measurements before and <30 min after the end of the hemodialysis session, and group 2: measurements before and ≥30 min after hemodialysis. Wilcoxon Signed Ranks Tests were performed to study differences. Bland–Altman procedure and two-way mixed intraclass correlation coefficients (single measures) were performed to study agreement.
Results: We included 37 hemodialysis patients, with a median age of 58 (28) years, and 51% was male. The analysis includes 78 hemodialysis sessions. Body weight, overhydration, total body water, extracellular water, phase angle, and resistance were significantly different between measurements in both groups. Adipose tissue mass was significantly different in group 1 ($P = 0.003$), but not in group 2. All variables had very good agreement in both groups (ICC > 0.810, $P < 0.001$).

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Conclusions: These results suggest that BIS-derived body composition measurements can be performed both before and after hemodialysis. If body composition is measured after hemodialysis, then measurements should be performed ≥30 min after the end of the session.

1. Introduction

In patients with chronic kidney disease (CKD) who undergo chronic hemodialysis, nutritional status, body composition, and especially muscle mass, and clinical outcomes such as mortality and quality of life are strongly correlated [1,2]. Since body weight and body mass index do not reflect body composition, measuring body composition is essential [3,4]. In hemodialysis patients, body composition is often determined by bio-impedance spectroscopy (BIS). The BIS method has the ability to differentiate between excess fluid and normally hydrated lean tissue mass (LTM) [5] and has been validated against gold-standard reference methods [6]. Despite validation of the BIS method, there is an equipoise about the best moment to measure body composition in hemodialysis patients. The KDOQI nutrition guideline 2020 states that body composition measurement with multi-frequency bio-electrical impedance analysis is preferably performed at ≥30 min after the end of a hemodialysis session to allow for fluid redistribution [7]. No recommendation has been made for BIS. In practice, however, measurements are performed both before dialysis, within 30 min after the end of a hemodialysis session and more than 30 min after the end of a hemodialysis session. Several studies measured body composition with BIS before hemodialysis sessions by using the Body Composition Monitor (BCM, Fresenius Medical Care) [3,4,8–10]. Measurements before hemodialysis have multiple advantages including being able to adjust the ultrafiltration rate to overhydration estimates and for patients not having to wait after ending a hemodialysis session. Our aim was to explore the agreement between BIS derived body composition indices before and after (<30 and ≥30 min) a hemodialysis session.

2. Methods

We performed BIS measurements by using the BCM in a cohort of patients with CKD treated with hemodialysis. For the analysis, patients were divided into group 1: measurements before and <30 min

Table 1
Results of body composition measurements performed before and after hemodialysis sessions.

	Group 1 (<30 min) (n = 39)			Group 2 (≥30 min) (n = 39)		
	Before	After	*P*-value[a]	Before	After	*P*-value[a]
Body weight (kg)	70.7 (14.5)	69.2 (17.2)	***<0.001***	80.3 (27.6)	77.9 (26.7)	***<0.001***
LTM (kg)	32.5 (18.9)	30.6 (18.7)	*0.080*	38.3 (14.4)	39.5 (17.9)	*0.094*
ATM (kg)	29.2 (22.5)	31.6 (23.3)	***0.003***	36.4 (23.6)	37.5 (23.9)	*0.334*
OH (L)	1.9 (2.2)	0.4 (1.9)	***<0.001***	1.5 (1.5)	-0.1 (1.0)	***<0.001***
TBW (L)	35.0 (9.6)	32.5 (10.8)	***<0.001***	37.4 (6.5)	34.6 (6.8)	***<0.001***
ICW (L)	17.9 (6.8)	17.3 (7.8)	*0.143*	19.4 (5.1)	19.0 (5.9)	*0.263*
ECW (L)	17.3 (3.5)	15.4 (3.4)	***<0.001***	18.0 (3.6)	16.3 (4.0)	***<0.001***
BCM (kg)	16.1 (12.7)	15.8 (13.1)	*0.092*	21.9 (9.3)	20.1 (8.4)	*0.161*
PA (°)	4.5 (2.2)	5.2 (2.3)	***<0.001***	5.1 (1.6)	5.6 (1.6)	***<0.001***
Re (Ω)	560 (145)	674 (150)	***<0.001***	573 (126)	691 (177)	***<0.001***
Ri (Ω)	1675 (881)	1724 (904)	*0.060*	1525 (553)	1598 (590)	*0.185*

Data presented in medians and interquartile ranges. Values in bold and italic represent statistically significant results.
Abbreviations: ATM: adipose tissue mass, BCM: body cell mass, OH: overhydration, LTM: lean tissue mass, PA: phase angle.
[a] Wilcoxon Signed Ranks tests were performed.

Table 2
Two-way mixed intraclass correlation coefficients (single measures) for body composition measurements performed before and after hemodialysis sessions.

	Group 1 (<30 min) (n = 39)	Group 2 (≥30 min) (n = 39)
	ICC[a]	ICC[a]
Body weight (kg)	0.998	0.997
LTM (kg)	0.972	0.958
ATM (kg)	0.990	0.985
OH (L)	0.906	0.810
TBW (L)	0.981	0.966
ICW (L)	0.972	0.966
ECW (L)	0.970	0.933
BCM (kg)	0.968	0.965
PA (°)	0.975	0.945
Re (Ω)	0.914	0.865
Ri (Ω)	0.962	0.966

Abbreviations: ATM: adipose tissue mass, BCM: body cell mass, OH: overhydration, LTM: lean tissue mass, PA: phase angle, ICC: intraclass correlation coefficients.
[a] All values had a *P*-value <0.001.

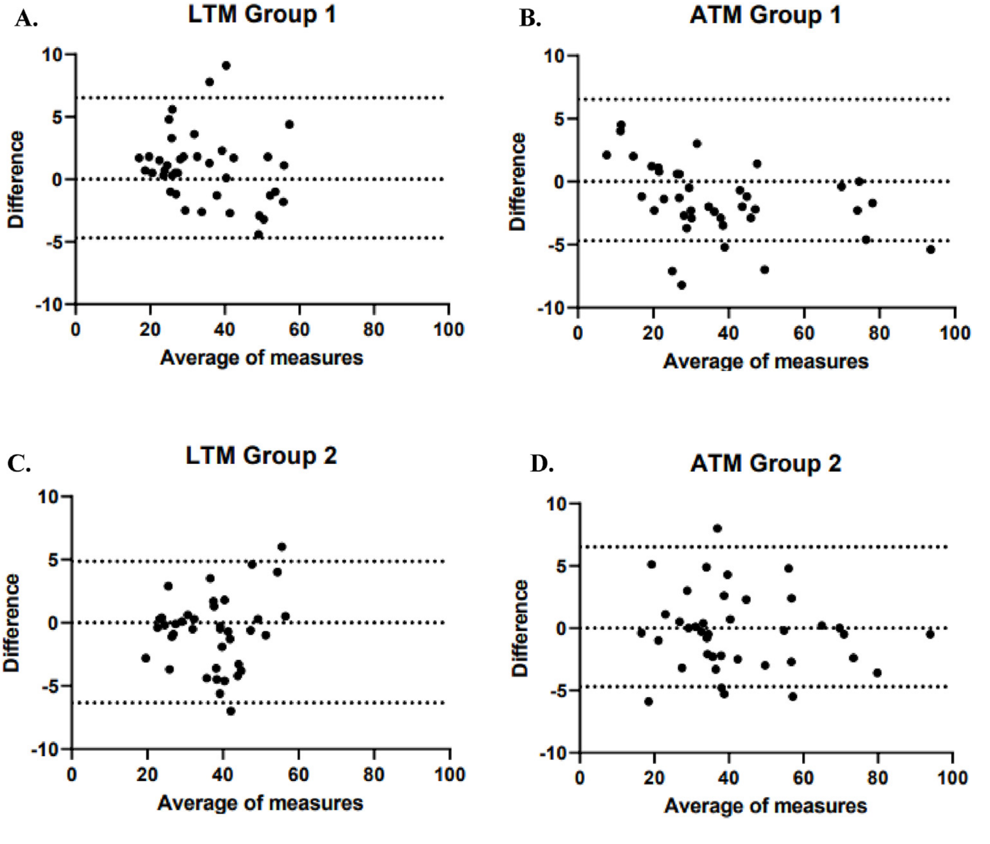

Figure 1. Bland–Altman plots of body composition parameters. **(A)** LTM Group 1. **(B)** ATM Group 1. **(C)** LTM Group 2. **(D)** ATM Group 2. Abbreviations: LTM: lean tissue mass, ATM: adipose tissue mass. Differences were calculated by subtracting before and after measurements.

after the end of the hemodialysis session, and group 2: measurements before and ≥30 min after the end of the hemodialysis session. The variables studied were body weight, LTM, adipose tissue mass (ATM), overhydration (OH), total body water (TBW), extracellular body water (ECW), intracellular body water (ICW), body cell mass (BCM), phase angle (PA), resistance (Re) and reactance (Ri) as displayed in the fluid management software. Wilcoxon Signed Ranks Tests were performed to study differences between before and after measurements. Additionally, we studied agreement by Bland–Altman procedure and two-way mixed intraclass correlation coefficients (single measures). Statistical significance was set at $P < 0.05$. The analyses were performed by using IBM SPSS Statistics version 28.

3. Results

We included 37 hemodialysis patients, with a median age of 58 (28) years and 51% males. Patients underwent measurements at multiple hemodialysis sessions, resulting in a total of 78 hemodialysis sessions, with both groups consisting of 39 sessions. We found significant differences between before and after measurements in both groups for body weight, OH, TBW, ECW, PA and Re. ATM was significantly different in group 1 ($P = 0.003$), but not in group 2. We found no significant differences in LTM between before and after measurements (Table 1). Agreement between measurements is shown in Table 2 and Fig. 1. In both groups, the intraclass correlation coefficients were ≥0.810 ($P < 0.001$) for all variables (Table 2). In group 1, for LTM, a mean difference of 0.9 kg (95% confidence interval (CI) 0.02–1.8) was demonstrated, with limits of agreement from −4.7 to 6.5 (Fig. 1A). The mean difference for ATM was −1.5 kg (95% CI −2.4 to −0.6), with limits of agreement from −7.2 to 4.2 (Fig. 1B). In group 2, for LTM, a mean difference of −0.7 kg (95% CI −1.6 to 0.2) was demonstrated, with limits of agreement from −6.4 to 4.9 (Fig. 1C). For ATM, a mean difference of −0.3 kg (95% CI −1.3 to 0.7) was apparent, with limits of agreement from −6.5 to 5.8 (Fig. 1D).

4. Discussion and conclusion

We found significant differences for body weight, OH, TBW, ECW, PA and Re between measurements taken before and both <30 and ≥30 min after hemodialysis. Nevertheless, all variables had very good agreement between body composition measurements taken before and both <30 and ≥30 min after hemodialysis. One parameter that was significantly different in group 1 but not in group 2, is ATM ($P = 0.003$).

To interpret the results, one should be aware that the explanation for the results is of a methodological nature rather than an actual occurred difference in body composition. With bioimpedance analysis, body composition is calculated by a device specific formula based on the measured resistance and reactance. An important factor in the measured resistance and reactance is the amount of fluid in the body. Since fluid is ultrafiltrated during dialysis and redistribution of fluid components takes place after dialysis, the formula will calculate body composition parameters with different values, which will produce different outcomes.

We conclude that BIS-derived body composition measurements can be performed before hemodialysis sessions. If body composition is measured after hemodialysis, then measurements should be performed ≥30 min after the end of the session. Given the intra-patient deviations between measurements, a standardized protocol should be used to best monitor changes in body composition. Considering the practical constraints, we thus suggest measurements to be taken before hemodialysis sessions.

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Author contributions

WJV and DS designed the research; IMR analyzed the data; WJV and IMR prepared the manuscript; All authors have critically reviewed and approved the manuscript.

Conflicts of interest

None.

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