TITLE

HYDRATION STATUS: NOT JUST A MATTER OF NUMBERS

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OBJECTIVES

The optimization of dry weight estimation with reliable tools in patients treated with hemodialysis is mandatory to reduce cardiovascular (CV) risk and increase survival (1). In the last decade, several studies underscored the importance of minimizing interdialytic weight gain (IWG) in order to reduce the occurrence of major CV events (2-4), as acute myocardial infarction and acute pulmonary edema as well as hospitalization rate (5). Several factors, including the different distribution of body water, make the estimation of hydration status only with IWG a partial view of the real situation. Since unrecognized hyperidration is potentially fatal, the identification of a reliable, simple and accurate clinical tool to quantify the hydration status is mandatory. The aims of this study were: to compare bioelectrical impedance vectorial analysis (BIVA), the assessment of B-lines by pulmonary ultrasonography (US) and US evaluation of inferior vena cava (IVC); to investigate the reliability of total body water estimation with BIA equations.

METHODS

Fifty-one patients referring to the Hemodialysis outpatient clinic at the Hospital of Perugia were enrolled. All patients were treated with thrice a week hemodialysis (4 hours each). Clinical, BIVA and US assessment of IVC and pulmonary B-lines were performed after the last hemodialysis of week 1 (final session, FS) and before the first hemodialysis of the subsequent week (initial session, IS). BIVA was performed with Akern Bia 101® bioimpedenziometer (Figure 1) and US scan with LogiQ, G&E Healthcare ® and 7.5MHz linear probe for detection of B-lines (Figure 2) and 3,5 mHz convex probe for IVC (Figure 3). According to BIVA, hyperhydration status was defined with values under the 50% tolerance ellipse plot. Concerning pulmonary US, hyperhydration status was defined by the presence of more than 15 B-lines in 28 intercostal spaces (4). Patients with IVCDmax > 11,5 mm/m^2 were defined hyperidrated (6). Data analysis was performed with SAS 9.4 software. The agreement (Gwen agreement coefficient, AC,1) and disagreement (Maxwell and McNemar chi square for disagreement homogeneity and simmetry) among the three procedures were calculated.

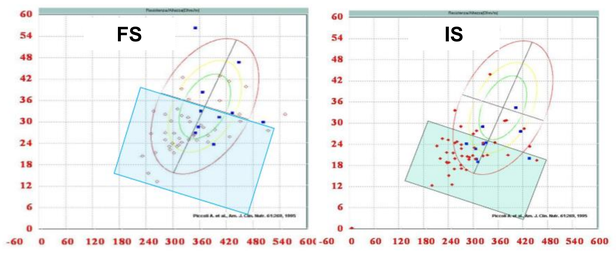


Figure 1

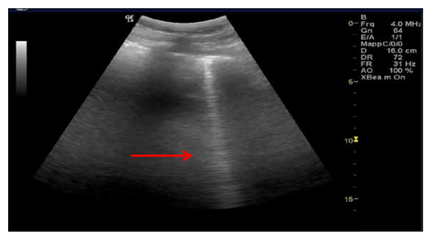


Figure 2

Figure 3

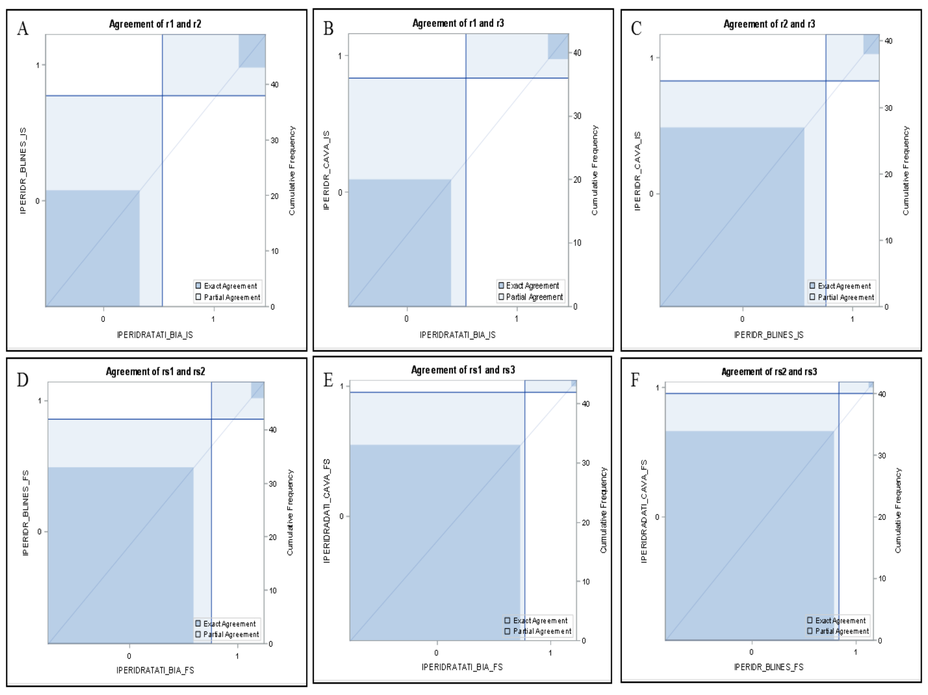
RESULTS

Patients (n°)	**51**
Female gender n° (%)	21 (41.2)
Age	67.7±2
Interdialytic weight gain*	2.8 ± 0.2

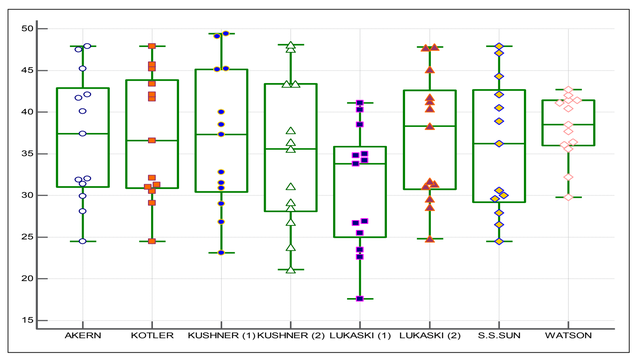
Category IS	AC1 statistic	Standard Error	Z	Prob>Z
Normal	0.49824	0.14966	3.32918	0.00044
Hyper	-0.16626	0.21378	-0.77773	0.78164
Overall	0.29835	0.08875	3.36153	0.00039

Category FS	AC1 statistic	Standard Error	Z	Prob>Z
Normal	0.82411	0.08907	9.2519	0.00000
Hyper	0.00947	0.23099	0.0410	0.48364
Overall	0.70127	0.06598	10.6288	0.00000

The table on the left shows main features of patient cohort. Tables in the middle and right display the global agreement of BIVA, B-lines and IVC in the identification of hyper and normohydrated patients at IS and FS. The agreement is higher for normohydrated vs hyperidrated and at FS compared to IS.



	IS		FS	
	Maxwell (p)	McNemar (p)	Maxwell (p)	McNemar (p)
BIA-B lines	0,01	0,01	0,16	0,16
BIA-IVC	0,003	0,003	0,01	0,01
IVC-B lines	0,36	0,36	0,06	0,06



Agreement charts (left) show the larger agreement between coupled procedures at FS compared to IS in identifying normohydrated patients. The table shows that disagreement is significant and asymmetric for BIVA and both B-lines and IVC at IS and for BIVA and IVC at IS. Asymmetry is due to BIVA for hyperidrated patients. To note, disagreement between IVC and B-lines is never significant. The box-plot on the right shows that despite high intraclass correlation among BIVA equations, patients over 65 years cannot be included due to software limitations and therefore Piccoli's nomogram has a larger applicability in clinical practice. In addition the nomogram provides information «at a glance».

CONCLUSIONS

Taken the good agreement among the 3 procedures in the identification of normohydrated patients and since BIVA is reliable, time-saving and easy to employ in clinical practice it should be recommended as first line approach to evaluate hydration status of hemodialysis patients. Conversely the lack of agreement for hyperhydrated patients may be explained by the fact that while BIVA ascertains systemic hyperhydration, B-lines and IVC reflect heart-related pulmonary congestion. BIVA graphical approach, rather than its quantitative value, is not misleading in the quantitative estimation of hydration status.

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