Assessment of dialysis dry weight in pediatric hemodialysis patients

Thesis

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List of Abbreviations

$\chi^{٢}$	: Chi-square
ACT	: Activated Clotting Time
ADMA	: Asymmetric dimethylarginine
ANP	: Atrial natriuretic peptide
ATM	: Adipose tissue mass
AVF	: Arteriovenous fistula
AVG	: Arteriovenous graft
AVS	: Arteriovenous shunt
BCM	: Body composition monitor
BCM	: Body cell mass
BI	: Bioelectrical impedance
BIA	: Bioimpedance analysis
BIS	: Bioimpedance spectroscopy
BMI	: Body mass index
BNP	: Brain natriuretic peptide
BP	: Blood pressure
BW	: Body weight
BVM	: Blood volume monitoring
c-BIS	: Calf bioimpedance spectroscopy
cfu	: Colony forming unit
cGMP	: Cyclic guanosine monophosphate
CI	: Collapse index
cIMT	: Carotid intimamedia thickness
CKD	: Chronic kidney disease
cm	: Centimeters
CMax	: maximal calf circumference
CRF	: Chronic renal failure
CVC	: Central venous catheters
CVD	: Cardiovascular Disease
d	: Daltons
DRA	: Dialysis-related amyloidosis
DW	: Dry weight

ECV	: Extracellular volume
ERBP	: European renal best practice
ES	: Sensing electrode
ESRD	: End stage renal disease
FMT	: Fluid management tool
Fr	: French size
FTI	: Fat tissue index
GFR	: Glomerular filtration rate
HD	: Hemodialysis
HDF	: Hemodiafiltration
HF	: Hemofiltration
ICV	: Intracellular volume
IDH	: Intradialytic hypotension
IDWG	: Interdialytic weight gain
IU	: International units
IVC	: Inferior vena cava
IVCD	: Inferior vena cava diameter
JVP	: Jugular venous pressure
K	: Urea clearance of dialyzer
K_{UF}	: Ultrafiltration coefficient
K_x	: Convective clearance of solute "x"
LMWH	: Low molecular weight heparins
LTI	: Lean tissue index
LTM	: Lean tissue mass
LVH	: Left ventricular hypertrophy
MAP	: Mean arterial pressure
MF-BIS	: Multi-frequency bioimpedance spectroscopy
NHDW	: Normohydrated dry weight
OH	: Overhydration
PD	: Peritoneal dialysis
PDU	: Pediatric dialysis unit
PRR	: Plasma refilling rate
PTH	: Parathyroid hormone
QB	: Extracorporeal blood flow rate
Q_{UF}	: Ultrafiltration flow across membrane

RBV : Relative blood volume
SF-BIA : Single frequency bioimpedance analysis
SHV : Hypervolemia slope
SNV : Normovolemia slope
S_x : Membrane sieving coefficient for solute "x"
TMP : Transmembrane pressure
t : Dialysis time
TBV : Total body volume
TBW : Total body water
UF : Ultrafiltration
UFH : Unfractionated heparin
UFR : Ultrafiltration rate
URR : Urea reduction ratio
V : Volume of distribution of urea

List of contents

List of Figures

List of Tables

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Introduction

In end-stage renal failure, regulation of extracellular fluid volume (ECV) is impaired because of reduced urinary output **(Dietel et al, ١٩٩٩).** An accurate assessment of hydration in hemodialysis patients presents a significant challenge especially in growing children **(Krause et al, ٢٠٠١).** Patient's dry weight is considered to be the ideal weight at the end of regular hemodialysis treatment where this weight is at normal or close to normal extracellular fluid volume ECV **(Dietel et al, ١٩٩٩; Krause et al, ٢٠٠١).** Underestimation of dry weight may lead to hypovolemia followed by hypotension, nausea, headache and muscle cramps, while overestimation may result in chronic fluid overload, edema, hypertension and cardiac failure **(Krause et al, ٢٠٠١).**

Clinically, assessment of dry body weight is used to develop a dialysis prescription or to determine the amount of ultrafiltration required **(Dietel et al, ١٩٩٩).** Clinical parameters (blood pressure, heart rate, presence of edema and venous congestion) are also influenced by factors other than hydration and are not always reliable **(Krause et al, ٢٠٠١).** However, these clinical markers alone do not suffice to assess dry body weight secondary to changes in lean body mass and body fat, particularly in children **(Dietel et al, ١٩٩٩).**

Invasive methods for evaluation of fluid status such as measurement of central venous pressure cannot be used routinely **(Krause et al, ٢٠٠١).** Bioimpedance analysis (BIA) and inferior vena cava diameter (IVCD) have been introduced as non-invasive means of assessing dry weight, but further clinical evaluation is required to establish their practicality **(Dietel et al, ١٩٩٩).**

BIA as a means to determine extracellular volume (ECV) or/and intracellular volume (ICV) has been validated by applying dilution methods as the gold standard **(Kotanko et al, ٢٠٠٨).** The high technical precision, lack of invasiveness and low cost of the method, together with its minimal requirements concerning observer experience and patient cooperation, make it a very attractive tool for the routine assessment of the state of hydration and fat/FFM distribution in clinical practice **(Schaefer et al, ٢٠٠٠).**

Significant correlation was found between IVCD and mean atrial pressure, total body volume as determined by radioiodinated serum albumin method and electrical bioimpedance **(Krause et al, ٢٠٠١).** We therefore embarked upon a prospective study to establish reference intervals for children and adolescents and to assess the practicality for pediatric dialysis patients **(Dietel et al, ١٩٩٩).**