

# **Assessment of dialysis dry weight in pediatric hemodialysis patients**

*Thesis*

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## *List of Abbreviations*

$\chi^2$	: 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

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## *Introduction*

**I**n end-stage renal failure, regulation of extracellular fluid volume (ECV) is impaired because of reduced urinary output (**Dietel et al, 1999**). An accurate assessment of hydration in hemodialysis patients presents a significant challenge especially in growing children (**Krause et al, 2001**). 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, 1999; Krause et al, 2001**). 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, 2001**).

Clinically, assessment of dry body weight is used to develop a dialysis prescription or to determine the amount of ultrafiltration required (**Dietel et al, 1999**). 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, 2001**). 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, 1999**).

Invasive methods for evaluation of fluid status such as measurement of central venous pressure cannot be used routinely (**Krause et al, 2001**). 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, 1999**).

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, 2008**). 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, 2000**).

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, 2001**). 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, 1999**).