



Bio-impedance in Dry Weight Estimation in Pediatric Patients

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Abstract

Volume status assessment in pediatric patients on maintenance hemodialysis before and after hemodialysis sessions using bio-impedance and integrated lung and inferior vena cava ultrasonography in correlation with clinical status of the patients.

Key Words: Hemodialysis, Bio-impedance, Dry Weight.

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Introduction

Dry Weight

Dry weight is a crucial and often challenging component of hemodialysis (HD) to prevent volume overload or depletion. Both hypovolemia and hypervolemia can have adverse effects on quality of life and can lead to long-term cardiovascular complications. (1)

Volume overload is a very important prognostic factor, associated with impaired oxygenation (2), end-organ damage (3), prolonged hospital stay (4), morbidity (3), and mortality (5), perhaps being one of the most insidious and common risk factor for mortality (6,7)

Dry weight of chronic kidney disease (CKD) patients, which is usually assessed by clinical judgment (trial and error method), can be defined as the lowest tolerated postdialysis weight at which there are minimal symptoms or signs of either hypovolemia or hypervolemia.(8) This clinical estimation of dry weight is subjective and can often be inaccurate.(8) Different novel techniques such as bioimpedance spectroscopy, B-natriureti peptide levels, inferior vena cava (IVC) measurements and lung ultrasonography (LUS) have been evaluated for dry weight estimation, but these methods are not used routinely in clinical practice.(9,10).

Bio Impedance

Bio impedance spectroscopy is the use of electrical bioimpedance to assess hydration status is an up-and-coming method that has been increasingly used due to its alluring features as being simple, inexpensive, and noninvasive (10). Bioelectrical impedance analysis (BIA) actually came to light in the mid-1980s with commercial availability of impedance analyzers (11) BIA is thought to be an objective fluid status assessment method, which is shown superior to classical methods such as BP monitoring and weight control in many studies.(12) Brain natriuretic peptide (BNP), was proposed to assess the volume status.BNP was first identified in the brain but is primarily released from the heart, particularly by the ventricles BNP is produced by the cleavage of the prohormone pro-BNP. As already mentioned, BNP and ANP levels are increased in heart failure particularly in response to high ventricular filling pressures (13). but even in the absence of a clinically diagnosed heart failure, both ANP and BNP levels are increased in patients with renal insufficiency. (14)

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In these patients, an increase in natriuretic peptides levels was suggested to be a result of either volume expansion or left ventricular hypertrophy (14). Although the use of natriuretic peptides for fluid status assessment is under debate (15), numerous studies show a direct association between these biomarkers and overhydration (16), and more importantly with adverse outcomes in ESRD patients. (16).

Methods

Recently, LUS has been gaining attention as a method of dry weight estimation as it accurately estimates lung congestion by measuring extravascular lung water (EVLW).(17)

IVC measurements using ultrasonography (USG) is a reliable noninvasive technique. Central venous pressure (CVP) has a positive correlation with IVC size and negative correlation with IVC collapsibility index (IVCCI). (18)

New dry weight was defined as the weight of the patient at which the number of B-lines was <4 on eight site lung USG and IVC collapsibility index was between 50% and 75% (Integrated lung-IVC USG will be done immediately before and 45 minutes after the HD session. For both lung and IVC imaging, curvilinear 3–5 MHz ultrasound probe will be used.)

Breathlessness and orthostatic giddiness were scored and documented for another 2 weeks after redefining dry weight using body composition monitor (BCM) which is one of bio impedance devices.

Lastly selected patients are assessed both pre and post dialysis for serum levels of BNP by immunofluorescence assay.

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