BIOIMPEDANCE SPECTROSCOPY (BIS) IN KIDNEY DISEASES

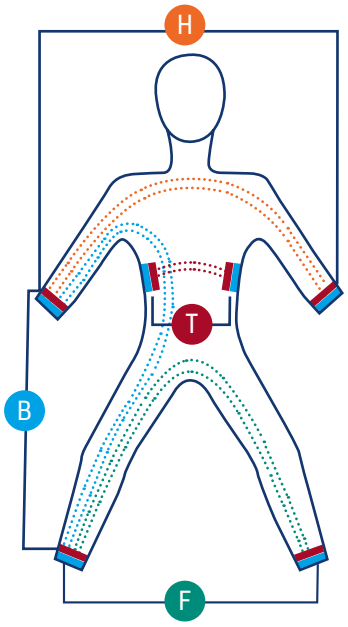
Monitoring fluid status in hospitalised patients with renal impairment is crucial, especially for those at risk of fluid overload or dehydration.

The ESPEN guidelines recommend regular assessment of fluid balance, particularly in patients undergoing kidney replacement therapy (KRT) or those suffering from acute kidney injury (AKI). Accurate monitoring helps prevent complications such as fluid overload, which can negatively affect kidney function, or dehydration, which can impair recovery and overall health outcomes [1].

Moreover, maintenance of residual kidney function (RKF) in patients commencing dialysis has been linked to notable benefits, including improved survival, better quality of life and lower risk of intradialytic hypotension, cardiac stunning and death due to removal of high fluid volumes [2,3]. The integration of bioimpedance technology in hemodialysis can enhance patient outcomes by improving fluid status management. This technology can enable clinicians to determine more accurate post-dialysis target weights, thereby reducing the risks of fluid overload and dehydration. Consequently, patients may experience improved quality of life and a decrease in dialysis-related complications [4].

BIS can be applied as an early warning system and a monitoring tool with the potential to improve patient care and outcomes.





- **B - Electrodes placed on foot and hand:** Measures whole body.
- **T - Electrodes placed on ribs:** Transthoracic measurement (central oedema).
- **F - Electrodes placed on two legs:** Measures lower limbs only.
- **H - Electrodes placed on two hands:** Measures upper limbs.

The Prediction Marker, Phase Angle, and Characteristic Frequency are highly reliable indicators of fluid overload and should function effectively even in the context of segmental measurements.

HOW FLUID BALANCE IS CURRENTLY MEASURED IN CLINICAL SETTINGS



FLUID BALANCE CHARTS



PHYSICAL ASSESSMENT OF FLUID BALANCE

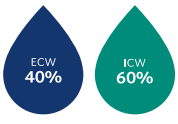


MONITORING OF BLOOD RESULTS

HOW CAN CLINICIANS ENHANCE FLUID BALANCE MONITORING WITH MULTISCAN 5000?



TBW



ICW ECW



OHY



PREDICTION MARKER INFINITY



NUTRITIONAL INDEX

Bodystat®
BODY COMPOSITION TECHNOLOGY

THE MULTISCAN 5000 IS NON-INVASIVE, PORTABLE, HANDHELD AND CAN PROVIDE FREQUENT MONITORING.

The Multiscan 5000 distinguishes ICW (Intracellular Water) and ECW (extracellular Water) separately, helping to build an accurate Total Body Water (TBW). Monitoring TBW is essential for assessing overall hydration status. The analyser is capable of detecting fluid shifts between these compartments (e.g., from ICW to ECW) and evaluating the equilibrium between fluid intake and output.

The OHY (Overhydration) parameter is a critical measure used to assess and quantify the excess fluid in the body, beyond what is physiologically necessary. This parameter plays a significant role in evaluating fluid balance in clinical settings where fluid overload can be a concern. The OHY parameter estimates the volume of excess fluid retained in the body by comparing the measured Total Body Water (TBW) with the expected normal hydration level for an individual, based on their body composition. The bioimpedance spectroscopy (BIS) device is a non-invasive, economical, and highly reproducible method that rapidly provides information on the fluid status of patients undergoing haemodialysis (HD) [10].

Bodystat's BIS Multiscan 5000 can assist the adjustment of nutritional, physical and medical intervention. This approach can aid in preventing complications such as oedema, fluid overload and malnutrition, thereby enhancing overall patient outcomes in renal settings.

IMPORTANT PARAMETERS

PHASE ANGLE

Phase angle, which is directly measured correlates significantly with overhydrated status, serving as an indicator of cell membrane integrity and hydration levels [5]. Excessive fluid overload may further decrease phase angle [6].

Evidence shows PhA can be used for monitoring treatment of patients with disease-related fluid imbalance and malnutrition.

Inflammation with potential oxidative damage is a common mechanism affecting PhA in health and pathology [7].

BIVA

BIVA is an accurate, non-invasive, accessible and cost-effective tool that assesses fluid balance.

BIVA is a rapid, noninvasive, and cost-effective method for assessing hydration status at the bedside, and BIVA-guided ultrafiltration (UF) prescriptions during continuous renal replacement therapy (CRRT) are seen to improved control over lean body mass water content [8].

BIVA provides detailed insights into both fluid balance and nutritional status, which are critical in managing renal patients who often struggle with fluid overload and malnutrition.

OHY

The OHY parameter estimates the volume of excess fluid retained in the body by processing the ECW, ICW and other body parameters by special algorithm.

Fluid overload is highly prevalent among patients undergoing hemodialysis (HD) and is strongly associated with poor outcomes, including systemic hypertension, pulmonary hypertension, left ventricular hypertrophy, and mortality[9].

The OHY parameter is critical to assess and quantify the excess fluid in the body, beyond what is physiologically necessary. Making OHY a valuable prognostic marker for assessing the severity of the disease and the likelihood of complications.

PREDICTION MARKER INFINITY (TBW/ECW)

PM∞ allows the monitoring of the TBW and ECW ratio, based off raw data.

Excess Extracellular Water (ECW) volume is a common characteristic of patients with advanced chronic kidney disease (CKD),which leads to oedema in the lower limbs, hypertension, heart failure, pulmonary vascular congestion[11,12].

Elevated ECW levels have been associated with poor outcomes in patients. Higher ECW/TBW ratio is associated with Chronic Kidney Disease (CKD) progression [11].

Malnutrition is common in patients with chronic kidney disease (CKD) due to factors such as dietary restrictions and inflammation. To effectively assess and monitor nutritional status, various parameters can be utilised. Total Body Water (TBW) helps evaluate hydration, Fat-Free Mass (FFM) provides insights into overall nutritional status, and Skeletal Muscle Mass (SMM) is crucial for preventing sarcopenia. Additionally, Lean Body Mass (LBM), Phase Angle (PA), Body Mass Index (BMI), and the differentiation of extracellular and intracellular water offer a comprehensive view of health. These parameters are instrumental in tailoring interventions to address malnutrition and enhance health outcomes in CKD patients.

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