

Advanced Dialysis Techniques

Acute Peritoneal Dialysis (APD)

Related terms: Peritoneal dialysis, CAPD, renal replacement therapy

A rapid-start modality that uses the peritoneum as a filter for patients with sudden kidney failure. APD typically employs automated cyclers to deliver multiple exchanges over 24 hours. Example: A critically ill postoperative patient receives 8-hour nocturnal cycles to manage fluid overload. Practical application includes use in intensive care units where vascular access is limited. Challenges involve maintaining sterile technique, controlling ultrafiltration volume, and monitoring for peritonitis, especially when exchanges are frequent.

Automated Peritoneal Dialysis (Automated PD)

Related terms: APD, cycler, nocturnal dialysis

A technology-driven form of peritoneal dialysis where a machine (cycler) performs fluid exchanges automatically, often during sleep. Example: A home-based patient sets the cycler for 5 L of dialysate over 8 hours, reducing daytime treatment burden. It improves patient autonomy and quality of life. Challenges include machine malfunction, power outages, and the need for patient education on troubleshooting and data interpretation.

Bioimpedance Spectroscopy (BIS)

Related terms: fluid status assessment, extracellular water, dialysis adequacy

A non-invasive technique that measures body composition by applying alternating currents at multiple frequencies. In dialysis, BIS guides ultrafiltration targets by quantifying fluid overload. Example: A patient with refractory hypertension uses BIS readings to adjust weekly ultrafiltration volume. Practical application extends to tailoring individualized dry weight. Limitations include variability due to electrode placement, patient movement, and the need for calibrated devices.

Continuous Renal Replacement Therapy (CRRT)

Related terms: hemofiltration, hemodiafiltration, intensive care dialysis

A set of extracorporeal therapies delivering slow, continuous solute and fluid removal over 24 hours, suited for hemodynamically unstable patients. Modalities include continuous venovenous hemofiltration (CVVH) and continuous venovenous hemodiafiltration (CVVHDF). Example: A septic shock patient receives CVVHDF at 30 mL/kg/h to maintain fluid balance and clear inflammatory mediators. Challenges involve anticoagulation management, circuit clotting, and high resource utilization.

Diffusive Clearance

Related terms: hemodialysis, solute transport, concentration gradient

The process by which solutes move across a semi-permeable membrane from higher to lower concentration, driven by diffusion. In high-flux hemodialysis, diffusive clearance efficiently removes small-molecule uremic toxins (Hemodiafiltration (HDF))

Related terms: convective clearance, diffusion, high-flux dialyzer

A hybrid modality combining diffusive and convective solute removal. Replacement fluid is infused either pre- or post-filter, augmenting ultrafiltration and enhancing middle-molecule clearance. Example: Online HDF delivers 20 L replacement fluid per session, improving β 2-microglobulin elimination. Practical applications include treatment of patients with amyloidosis or persistent pruritus. Challenges involve ensuring ultrapure replacement fluid, managing higher blood flow rates, and monitoring for albumin loss.

High-Flux Hemodialysis

Related terms: low-flux dialyzer, membrane permeability, middle-molecule clearance

Uses dialyzers with larger pore sizes (≥ 20 kDa) to increase removal of middle-size solutes while maintaining small-molecule clearance. Example: A patient on high-flux treatment experiences reduced β 2-microglobulin levels, decreasing dialysis-related amyloidosis risk. Practical benefits include better cardiovascular outcomes. Challenges comprise higher cost, need for careful ultrafiltration control to avoid excessive fluid removal, and potential loss of essential proteins if membrane integrity is compromised.

High-Volume Hemofiltration (HVHF)

Related terms: convective therapy, ultrafiltration rate, cytokine removal

An intensive convective technique delivering ultrafiltration rates > 35 mL/kg/h, often used in sepsis or severe inflammatory states. Example: A patient with septic shock undergoes HVHF for 6 hours, aiming to clear cytokines and stabilize hemodynamics. Practical application extends to research on modulating immune response. Challenges include rapid electrolyte shifts, albumin depletion, and the requirement for high-capacity replacement fluid supplies.

Integrated Dialysis Therapy (IDT)

Related terms: combined modality, hybrid treatment, patient-centered care

A coordinated approach that blends multiple dialysis techniques (e.g., Intermittent hemodialysis plus nightly peritoneal dialysis) to optimize solute control and fluid management. Example: A patient with residual renal function uses nocturnal home hemodialysis three times weekly and daytime CAPD exchanges, preserving kidney function longer. Practical applications focus on individualized treatment plans. Challenges involve scheduling, training for multiple modalities, and ensuring consistent vascular and peritoneal access care.

Kt/V

Related terms: dialysis adequacy, urea clearance, single-pool Kt/V

A dimensionless index representing the ratio of dialyzer clearance (K) multiplied by treatment time (t) to the volume of distribution of urea (V). Target values differ by modality (e.g., $Kt/V \geq 1.2$ Per session for thrice-weekly HD). Example: A patient's monthly Kt/V is calculated using online clearance monitoring, confirming adequacy. Practical use includes dose adjustment and quality benchmarking. Challenges arise in accurately estimating V in obese patients and accounting for residual renal function.

Low-Flux Hemodialysis

Related terms: high-flux dialyzer, membrane cut-off, small-molecule clearance

Employs membranes with smaller pore sizes (Middle-Molecule Clearance)

Related terms: β 2-microglobulin, HDF, high-flux dialyzer

The removal of solutes ranging from 500 Da to 60 kDa, which are implicated in dialysis-related amyloidosis and inflammation. Example: An HDF regimen achieving convective volume >20 L per session significantly lowers β_2 -microglobulin concentrations. Practical relevance includes improving patient symptomatology (e.g., Pruritus). Challenges include balancing convective volume with hemodynamic stability and preventing nutrient loss.

Nocturnal Hemodialysis (NHD)

Related terms: home hemodialysis, extended treatment, fluid management

A schedule where dialysis is performed overnight, typically 6-8 hours, allowing higher total weekly treatment time. Example: A patient conducts three nocturnal sessions at home, achieving superior phosphate control and reduced antihypertensive medication. Practical advantages include better quality of life and flexibility. Challenges comprise ensuring patient safety during sleep, reliable home water treatment, and managing vascular access integrity.

Online Hemofiltration (OHF)

Related terms: replacement fluid generation, ultrapure water, HDF

A technique where sterile, ultrapure replacement fluid is produced on-demand by the dialysis machine, eliminating the need for pre-packaged bags. Example: An OHF system delivers 25 L of replacement fluid during a single session, enhancing convective clearance. Practical use reduces logistical burden and storage requirements. Challenges involve strict water quality monitoring, maintenance of filtration membranes, and compliance with infection control standards.

Peritoneal Equilibration Test (PET)

Related terms: peritoneal transport status, D/P ratio, dialysis prescription

A diagnostic assessment measuring the rate of solute equilibration between dialysate and plasma over a 4-hour dwell, categorizing patients as high, high-average, low-average, or low transporters. Example: A PET result showing D/P creatinine = 0.78 Classifies the patient as a high transporter, prompting shorter dwells. Practical application guides prescription of exchange volumes and dwell times. Challenges include variability due to inflammation, glucose concentration, and patient adherence to test protocol.

Peritoneal Dialysis Fluid (PDF)

Related terms: dialysate, glucose concentration, icodextrin

A sterile solution containing electrolytes, buffer, and an osmotic agent (commonly glucose) used to instill into the peritoneal cavity for solute exchange. Example: A 2.5 % Glucose PDF is selected for a patient requiring higher ultrafiltration. Practical considerations involve selecting appropriate osmotic agents to minimize peritoneal membrane damage. Challenges include glucose-induced angiogenesis, metabolic derangements, and long-term membrane fibrosis.

Peritoneal Membrane Transport Characteristics

Related terms: high transporter, low transporter, PET, ultrafiltration capacity

The intrinsic ability of the peritoneal capillary network to allow solute and water movement, influencing dialysis efficiency. Example: A low-transport patient benefits from longer dwell times to achieve adequate solute clearance. Practical application includes tailoring exchange regimens. Challenges consist of transport status shifting over time, requiring periodic reassessment.

Renal Replacement Therapy (RRT) Modality Selection

Related terms: dialysis modality, patient-centered care, comorbidity profile

The process of choosing the optimal dialysis technique (hemodialysis, peritoneal dialysis, CRRT, hybrid) based on clinical, psychosocial, and logistical factors. Example: A young, employed patient with residual renal function may be steered toward home nocturnal hemodialysis. Practical impact includes improving adherence and outcomes. Challenges involve equitable access to technology, insurance coverage, and patient education.

Sorbent Dialysis (Hemodialysis with Sorbent Cartridge)

Related terms: renal assist device, toxin adsorption, portable dialysis

A modality that incorporates sorbent materials (e.G., Activated charcoal, resin) within the circuit to bind protein-bound and middle-size toxins beyond membrane filtration. Example: A portable sorbent-based system used in remote settings reduces uremic symptoms during travel. Practical benefits include reduced need for large dialyzers and water supply. Challenges encompass cartridge saturation, limited clearance of electrolytes, and cost of consumables.

Therapeutic Plasma Exchange (TPE)

Related terms: plasmapheresis, immunomodulation, acute renal failure

A procedure where plasma is removed and replaced with albumin or fresh frozen plasma, aiming to eliminate pathogenic substances. Example: A patient with anti-GBM disease undergoes daily TPE alongside dialysis to control antibody levels. Practical application includes treating severe autoimmune renal conditions. Challenges involve coagulation disturbances, volume overload, and need for vascular access capable of high flow rates.

Ultrafiltration Rate (UFR)

Related terms: fluid removal, dry weight, intradialytic hypotension

The volume of fluid removed per hour per kilogram of patient weight during hemodialysis, expressed as mL/kg/h. Example: A UFR of 10 mL/kg/h is targeted to avoid intradialytic hypotension in a frail elderly patient. Practical monitoring helps prevent cardiovascular stress. Challenges include balancing adequate fluid removal with hemodynamic tolerance, especially in patients with limited residual urine output.

Ultra-High-Flux Dialyzers

Related terms: medium cut-off membranes, albumin leakage, expanded clearance

Dialyzers engineered with pore sizes approaching 50-kDa, allowing removal of larger middle molecules while preserving albumin. Example: A patient with refractory pruritus benefits from an ultra-high-flux dialyzer achieving greater clearance of cytokines. Practical use is expanding in research on dialysis-related inflammation. Challenges involve strict monitoring for albumin loss, higher cost, and limited availability.

Vascular Access Surveillance

Related terms: AV fistula, catheter lock solution, access flow measurement

A systematic program to monitor and maintain patency of hemodialysis access points using clinical examination, ultrasound dilution, and flow measurements. Example: Quarterly access flow studies detect a 30% decline, prompting pre-emptive angioplasty. Practical impact includes reducing access-related hospitalizations. Challenges encompass resource allocation, patient compliance, and interpreting borderline

flow values.

Water Treatment in Dialysis

Related terms: reverse osmosis, ultrapure water, dialysate contamination

The multi-stage process (pretreatment, reverse osmosis, ultrafiltration) that ensures dialysate water meets strict microbiological and chemical standards. Example: A clinic installs a double-stage RO system to achieve

Extended-Hours Hemodialysis (EHD)

Related terms: short daily dialysis, nightly dialysis, treatment intensity

Dialysis sessions exceeding conventional 4-hour durations, often 6-8 hours, to increase weekly clearance and improve fluid control. Example: A thrice-weekly 6-hour regimen reduces phosphorus levels without phosphate binders. Practical benefits include better blood pressure control and reduced left-ventricular hypertrophy. Challenges involve patient fatigue, scheduling constraints, and increased resource utilization.

Hybrid Dialysis Programs

Related terms: combined modality, incremental dialysis, patient-tailored therapy

Structured treatment plans that integrate two or more dialysis techniques to exploit synergistic benefits. Example: A patient starts with conventional HD but transitions to supplemental peritoneal exchanges to preserve residual renal function. Practical application aims at extending time to full-scale dialysis. Challenges include coordinating multiple access sites, ensuring consistent prescription, and managing differing complication profiles.

Incremental Hemodialysis

Related terms: preserved residual renal function, reduced frequency, individualized dosing

A strategy that starts patients on fewer weekly sessions (e.g., Twice weekly) when residual kidney function contributes significantly to solute clearance. Example: A newly diagnosed ESRD patient with urine output > 1 L/day begins twice-weekly HD, adding sessions as function declines. Practical advantage is improved quality of life and slower loss of native kidney function. Challenges involve precise monitoring of residual clearance, patient education, and rapid escalation when needed.

Medium Cut-Off (MCO) Membranes

Related terms: ultra-high-flux, albumin-sparing, expanded toxin removal

Dialyzer membranes designed with a narrow pore size distribution that allows removal of molecules up to ~45 kDa while retaining albumin. Example: An MCO dialyzer reduces inflammatory cytokines in a patient with chronic inflammation, improving fatigue scores. Practical impact includes bridging the gap between conventional high-flux and sorbent therapies. Challenges encompass ensuring consistent manufacturing quality and monitoring for subtle albumin loss over long-term use.

Peritoneal Dialysis Prescription Software

Related terms: automated dosing, treatment simulation, patient education

Computer-based tools that calculate optimal exchange volumes, dwell times, and glucose concentrations based on patient parameters (weight, transport status, residual function). Example: A clinician inputs a patient's PET results, and the software generates a CAPD regimen with 4 exchanges of 2 L each. Practical benefits include standardized prescribing and reduced calculation errors. Challenges include software licensing costs, need for regular updates, and ensuring data security.

Dialysate Sodium Modeling

Related terms: individualized sodium set point, intradialytic hypertension, osmotic balance

A technique that varies dialysate sodium concentration during a session to minimize rapid serum sodium shifts, thereby reducing intradialytic hypertension and cramps. Example: A program starts with 140 mmol/L sodium and gradually reduces to 135 mmol/L over 4 hours. Practical application supports better blood pressure control. Challenges involve accurate serum sodium monitoring, patient variability, and potential for sodium loading if not individualized.

Remote Monitoring of Dialysis Machines

Related terms: telemedicine, data analytics, proactive maintenance

The use of internet-connected dialysis units that transmit treatment parameters (e.G., Kt/V, UF volume) to clinicians for real-time review. Example: A home hemodialysis patient's session data is automatically uploaded, allowing the nurse to adjust prescription before the next treatment. Practical benefits include early detection of inadequate dialysis and equipment faults. Challenges encompass data privacy, reliable connectivity, and the need for staff trained in interpreting remote metrics.

Biocompatible Dialysis Membranes

Related terms: synthetic polymers, complement activation, inflammatory response

Membranes engineered to minimize activation of blood components, reducing cytokine release and oxidative stress during treatment. Example: A patient switched from cellulose acetate to a synthetic polysulfone membrane experiences fewer post-dialysis fatigue episodes. Practical relevance includes improved tolerability and potentially better long-term outcomes. Challenges involve higher cost and varying degrees of biocompatibility among manufacturers.

Anticoagulation Strategies in CRRT

Related terms: heparin, citrate, regional anticoagulation

Protocols to prevent clotting of extracorporeal circuits while minimizing bleeding risk. Example: Regional citrate anticoagulation maintains circuit patency for up to 72 hours without systemic anticoagulation, suited for patients with coagulopathy. Practical application reduces filter changes and blood loss. Challenges include monitoring calcium levels, citrate toxicity, and need for specialized infusion pumps.

Patient-Reported Outcome Measures (PROMs) in Dialysis

Related terms: quality of life surveys, symptom burden, treatment satisfaction

Standardized questionnaires that capture patients' perspectives on health status, fatigue, pruritus, and daily functioning. Example: The KDQOL-36 is administered quarterly to assess the impact of switching from conventional HD to HDF. Practical use informs shared decision-making and individualized care plans. Challenges involve ensuring cultural relevance, literacy considerations, and integrating results into routine clinical workflow.

Thermal Balance in Hemodialysis

Related terms: dialysate temperature, patient comfort, cardiovascular stability

Adjustment of dialysate temperature (typically 35-36 °C) to reduce intradialytic hypotension and improve patient comfort. Example: A patient prone to cramps tolerates cooler dialysate (34 °C) without compromising solute clearance. Practical implication includes personalized temperature settings. Challenges

consist of potential for increased peripheral vasoconstriction, patient preference variability, and equipment limitations.

Dialysis-Induced Amyloidosis Management

Related terms: β 2-microglobulin, high-flux dialysis, sorbent therapy

Approaches to prevent or treat accumulation of amyloidogenic proteins in long-term dialysis patients.

Example: Transitioning a patient from low-flux to high-flux HDF reduces β 2-microglobulin levels and alleviates joint pain. Practical strategies also include use of MCO membranes and periodic monitoring. Challenges involve cost, patient adherence, and the irreversible nature of established amyloid deposits.

Glucose-Sparing Peritoneal Dialysis Regimens

Related terms: icodextrin, amino-acid solutions, metabolic control

Prescribing dialysate solutions with alternative osmotic agents to limit systemic glucose absorption.

Example: Using 7.5% Icodextrin for long-dwelling exchanges reduces hyperglycemia in diabetic patients. Practical benefit includes better glycemic control and fewer lipid abnormalities. Challenges comprise higher cost, potential for allergic reactions, and limited availability in some regions.

Clinical Decision Support Systems (CDSS) for Dialysis

Related terms: algorithmic dosing, alert generation, electronic health records

Software that integrates patient data to provide evidence-based recommendations for dialysis prescription, anticoagulation, and fluid management. Example: A CDSS alerts a clinician when a patient's Kt/V falls below target, suggesting an increase in treatment time. Practical advantage includes standardization and reduced cognitive load. Challenges involve integration with legacy systems, false-positive alerts, and ensuring clinician acceptance.

Phosphate Management in Advanced Dialysis

Related terms: dialysate phosphate concentration, binders, dietary counseling

Strategies to control serum phosphate through dialysate composition, frequency, and adjunctive medications. Example: Lowering dialysate phosphate to 0.8 mmol/L combined with sevelamer reduces hyperphosphatemia without increasing calcium load. Practical relevance includes reducing vascular calcification risk. Challenges include balancing phosphate removal with risk of hypophosphatemia and patient adherence to dietary restrictions.

Biomarker-Guided Dialysis Prescription

Related terms: inflammatory markers, IL-6, beta-trace protein

Utilizing laboratory biomarkers to tailor dialysis intensity and modality. Example: Elevated IL-6 levels prompt transition to high-volume HDF to enhance cytokine clearance. Practical application aims at personalized medicine. Challenges consist of assay availability, cost, and establishing clinically relevant thresholds.

Renal Replacement Therapy in Pregnancy

Related terms: maternal-fetal considerations, low-flux HD, peritoneal dialysis

Adapting dialysis modalities to meet the increased metabolic demands and volume changes of pregnancy. Example: Increasing HD frequency to five sessions per week maintains urea < 15 mg/dL, supporting fetal growth. Practical aspects include careful anticoagulation and close monitoring of blood pressure.

Challenges involve vascular access complications, medication safety, and coordinating multidisciplinary care.