

Acute Dialysis Quality Initiative

Workgroup 1

Definitions and Nomenclature

Reporting of CRRT Techniques

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Definitions and Nomenclature

After nearly a quarter century of clinical use CRRT techniques and nomenclature have been well accepted and widely used.¹⁻¹² Current nomenclature depends on duration, continuity and operational characteristics of the treatment system. Present nomenclature allows for further evolution for the description of future techniques. These definitions are based on duration, continuity and operational characteristics.

Given the development of new techniques, what definitions are currently accepted?

Adsorption: An extracorporeal purification process where solute in plasma or blood binds to membranes or substances such as charcoal, resins, gels, proteins or monoclonal antibodies.

Continuous renal replacement therapy (CRRT) is any extracorporeal blood purification therapy intended to substitute for impaired renal function over an extended period of time and applied for, or aimed at being applied for, 24 hours per day.

Convection: Bulk-flow of solute across a semi-permeable membrane together with a solvent in a manner that is dependent on transmembrane pressure and membrane characteristics.

Dialysate: A solution of variable composition designed to facilitate diffusion of solutes into the ultrafiltrate-dialysate compartment of the hemofilter or hemodialyzer.

Diffusion: Describes solute transport across a semi-permeable membrane generated by a concentration gradient.

Hemodiafiltration (HDF): A technique associated with high ultrafiltration rates and diffusion across a highly permeable membrane. Blood and dialysate are circulated as in hemodialysis, but in addition, ultrafiltration, in excess of the scheduled weight loss, is provided. Replacement fluid is used to achieve fluid balance.

Hemodialysis (HD): An extracorporeal, primarily diffusive therapy, where solute and water are transported across a semi-permeable membrane into dialysate.

Hemofiltration (HF): An extracorporeal, primarily convective therapy, where solute and water are transferred across a semi-permeable membrane. Replacement fluid is used to achieve fluid balance.

High flux: A dialysis membrane designed to provide high water permeability, thereby increasing solute clearance especially large solutes such as beta-2 microglobulin.

Intermittent therapies are those usually prescribed for a period of 12 hours or less. These include Extended Daily Dialysis (EDD) and Slow Low-Efficiency Dialysis (SLED).

Peritoneal dialysis: An intracorporeal therapy where solute and water are transported across the peritoneal membrane based on osmotic and concentration gradients.

Postdilution fluid: is infused distal to the hemofilter/dialyzer.

Predilution fluid: is infused proximal to the hemofilter/dialyzer.

Replacement (substitution) fluid: A solution of variable composition, often physiologic, used to replace large volumes of ultrafiltrate during hemofiltration or hemodiafiltration. Replacement fluid may be given as predilution or postdilution.

Transmembrane pressure: The hydrostatic pressure gradient across the membrane. This is the driving force that causes ultrafiltration.

The current definitions of AVSCUF, VVSCUF, CAVH, CVVH, CAVHDF, CVVHDF, CAVHD and CVVHD are appropriately defined and generally accepted.¹

What new definitions are required for current therapies?

Continuous High Flux Dialysis (CAVHFD/CVVHFD) uses a highly permeable dialyzer with blood and dialysate flowing countercurrent. Ultrafiltrate production is controlled by blood pumps and there is a balance of filtration and backfiltration with ultrafiltrate produced in the proximal portion of the fibers and reinfused by backfiltration in the distal portion of the fibers so that replacement fluid is not required.^{13,14}

Continuous High Volume Hemofiltration is a variant of CVVH, which requires higher surface area hemofilters and employs ultrafiltration volumes >35 ml/h/kg. Studies have demonstrated a benefit from increasing the volume of ultrafiltration and replacement fluid during CRRT.¹⁴⁻¹⁶

What definitions should be used for other extracorporeal blood purification therapies?

Plasma therapies: Treatments that use specialized equipment which allows the separation of plasma from the formed elements of blood. This may be achieved with differential centrifugation or plasmafilters. Replacement may be by plasma derivatives such as fresh frozen plasma, albumin or other appropriate fluids.^{17,18}

Hemoperfusion: A treatment in which blood or plasma is exposed to an adsorptive substance (charcoal, protein A, synthetic materials, monoclonal antibodies etc.) to remove toxins, solutes or other materials. Fluid balance is not altered so that replacement fluid is not required.¹⁸

Combination therapies: Present nomenclature allows for definition of various combinations of the above therapies.¹⁹

Other potential therapies might include combinations of synthetic, bioengineered materials and cell culture systems.

Reporting of CRRT in the Literature

What should the criteria be for distinguishing, including and reporting new methods from modifications of existing techniques?

New methods should be substantially different from existing modalities. Otherwise they should be considered as subgroup of an existing modality and classified as such.

What should the criteria be for reporting studies involving CRRT?

The following are the minimal acceptable parameters for reporting studies involving CRRT and are critical for evaluation of studies using CRRT and comparisons between CRRT and intermittent therapy. It is recognized that technical reports describing technique modifications without outcome data may only report operational characteristics.

Table 1. Minimal Reporting Criteria for CRRT Studies

Define operational characteristics of treatments.	Report patient characteristics
Membrane/Dialyzer/Filter	Measure of time actually spent on therapy.
Delivery device	Surgical/Trauma/Medical/Other
Anticoagulation and monitoring	Co-interventions
Access and blood flow	Measure of severity of illness (e.g. APACHE II, SOFA, Liano, CCF Score) at start of therapy*
Replacement fluid composition and administration	Reporting of integrated hemodynamic status and vasopressor treatment.
Dialysate fluid composition and administration	Outcomes, especially: survival, short and long term, morbidity and return of renal function

*The most appropriate score remains to be determined.

References

1. Bellomo R, Ronco C and Mehta R. Nomenclature for continuous renal replacement therapies. *Am J Kidney Dis* 1996;28:S2-S7.
2. Ronco C, Bellomo R. Basic mechanisms and definitions for continuous renal replacement therapies. *Int J Artificial Organs* 1996; 19: 95-99.
3. Lauer A, Saccaggi A, Ronco C et al. Continuous arteriovenous hemofiltration in the critically ill patient: clinical use and operational characteristics. *Ann Int Med* 1983; 99: 455-460.
4. Colton CK, Henderson LW, Ford CA et al. Kinetics of hemodiafiltration: I. In vitro transport characteristics of a hollow fiber ultrafilter. *J Lab Clin Med.* 1975; 85: 355-371.
5. Henderson LW, Colton CK, Ford CA. Kinetics of hemodiafiltration: II. Clinical characteristics of a new blood cleansing modality. *J Lab Clin Med.* 1975; 85: 372-391.
6. Kramer P, Wigger W, Rieger J et al. Arteriovenous haemofiltration: a new and simple method for the treatment of over-hydrated patients resistant to diuretics. *Klinische Wochen-schrift.* 1977;55:1121-1122.
7. Kramer P, Schrader J, Bohnsack W. Continuous arteriovenous hemofiltration: a new kidney replacement therapy. *Proc EDTA.* 1981; 18: 743-749.
8. Ronco C, Bellomo R. Basic mechanisms and definitions for continuous renal replacement therapies. *Int J Artif Organs* 1996; 19:95-99.
9. Golper TA, Ronco C, Kaplan AA. Continuous arteriovenous hemofiltration: improvements, modifications and future directions. *Semin Dial* 1988; 1: 50-54.
10. Ronco C. Continuous renal replacement therapies for the treatment of acute renal failure in intensive care patients. *Clin Nephrol* 1993; 40: 187-198.
11. Kaplan AA. Continuous renal replacement therapy (CRRT) in the intensive care unit. *J Intensive Care Med* 1998; 13: 85-105.
12. Paganini EP. Continuous replacement modalities in acute renal dysfunction. In: Paganini EP, ed. *Acute continuous renal replacement therapy.* Boston: Martinus Nijhoff, 1986: 7-42.
13. Civati G, Guastoni C, Teatini U, Perego A, Perrino ML, Benazzi E, Minetti L. High-flux acetate haemodialysis: a single-centre experience. *Nephrol Dial Transplant.* 1991;6 Suppl 2:75-81.
14. Locatelli F, Di Filippo S, Manzoni C. Removal of small and middle molecules by convective techniques. *Nephrol Dial Transplant* 2000;15 Suppl 2:37-44.
15. Grootendorst AF, van Bommel EFH, van der Hoven B et al. High-volume hemofiltration improves hemodynamics of endotoxin-induced shock in the pig. *Intensive Care Med* 1992;18:235-240.

16. Ronco C, Bellomo R, Homel P et al. Effects of different doses in continuous veno-venous haemofiltration on outcomes of acute renal failure: a prospective randomised trial. *Lancet* 2000; 355: 26-30.
17. Reeves JH, Butt WW, Shann F, Layton JE, Stewart A, Waring PM, Presneill JJ. Continuous plasmafiltration in sepsis syndrome. Plasmafiltration in Sepsis Study Group. *Crit Care Med.* 1999;27:2096-2104.
18. Tetta C, Cavaillon JM, Schultzw M, Ronco C, Ghezzi PM, Camuzzi G, Serra AM, Curti F, Lonnemann G. Removal of cytokines and activated complement components in an experimental model continuous plasma filtration coupled with sorbent adsorption. *Nephrol Dial Transplant.* 1998;13:1458-1464.
19. Schlaefer C, Amerling R, Manns M, Levin NW. High clearance continuous replacement with a modified dialysis machine. *Kidney Int.* 1999; 56 Suppl:S20-S23.

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