



# Physiology of Renal Support

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Acute Kidney Injury and Renal Support

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**I have no actual or potential conflict of interest in relation to this program or presentation.**

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## Objectives

- Understand the role of renal support modalities in replacing several renal functions
- Understand the different ways in which these modalities achieve these goals
  - Hemodialysis
  - Hemofiltration
- Decipher the nomenclature of the different modalities

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## Renal Functions

- Complicated organ that plays an integral role in many physiologic processes
  - Acid-base regulation
  - Fluid and electrolyte homeostasis
  - Endocrine pathways
- Renal support may partially replace 3 main functions
  - Fluid balance
  - Solute removal
  - Replenishment of bicarbonate buffer

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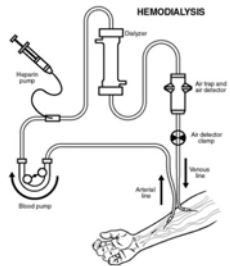
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## Renal Support setup

- All modalities in the ICU entail a similar setup
  - Blood leaves the body through a venous access
  - Passes through a filter
  - Returns to the body via venous access



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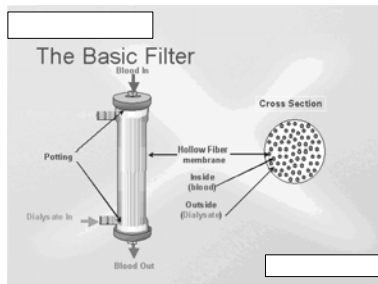
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## Renal Support setup



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## Fluid Removal (Ultrafiltration)

- Negative pressure applied to the outside of the fibers
- This creates a pressure gradient for the movement of fluid out of the hollow fibers
- Results in fluid removal from the blood compartment
- This fluid contains small solutes in the same concentration as plasma
  - Therefore no net change in solute concentration

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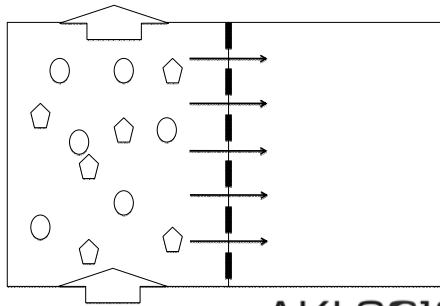
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## Fluid Removal (Ultrafiltration)



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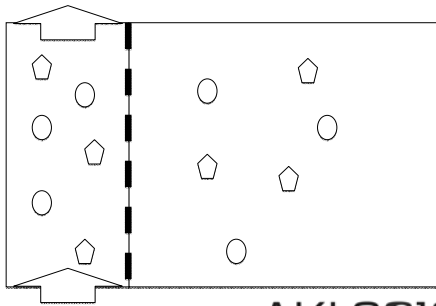
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## Fluid Removal (Ultrafiltration)



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### Solute Removal and Replenishment of buffer

- 2 different techniques to removal solute and replenish bicarbonate buffer
  - Hemodialysis
  - Hemofiltration

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### Hemodialysis

- Hollow fibers are bathed in an electrolyte solution (dialysate)
- Solutes move down there concentration gradient from blood to dialysate
- Bicarbonate moves from dialysate to blood
- Result is net removal of accumulated solute and gain of bicarbonate

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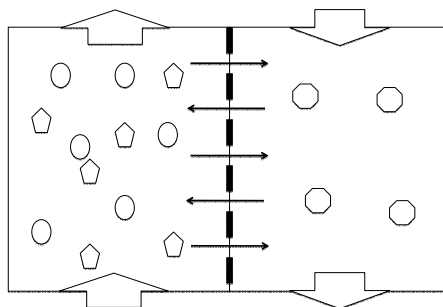
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### Hemodialysis



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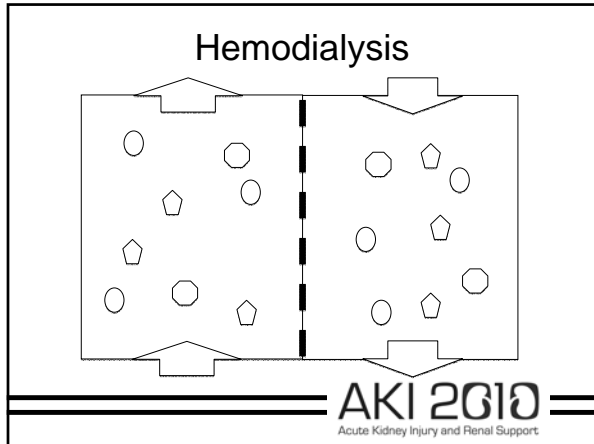
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### Hemodialysis

- Blood and dialysate move in a countercurrent fashion to maximize concentration gradient
- Net solute removal depends on solute, membrane, and technical factors
- Usually combined with ultrafiltration to remove excess fluid

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### Hemofiltration

- Large amounts of isotonic plasma are removed by ultrafiltration
- Net change in solute concentration is accomplished by replacing removed fluid with a 'normal' physiologic fluid
- Rate of solute removal less dependent on size
  - Higher molecular weight substances removed
  - Clinical relevance unclear

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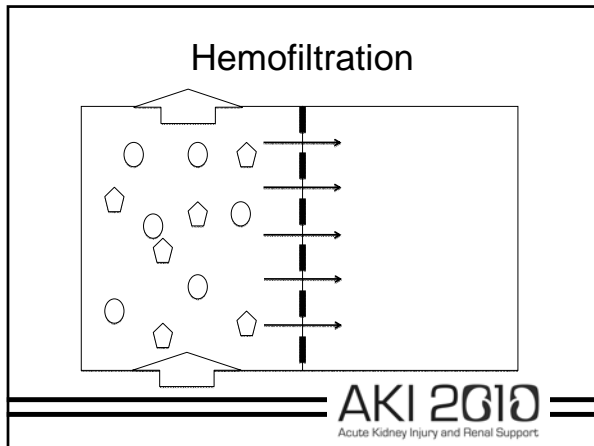
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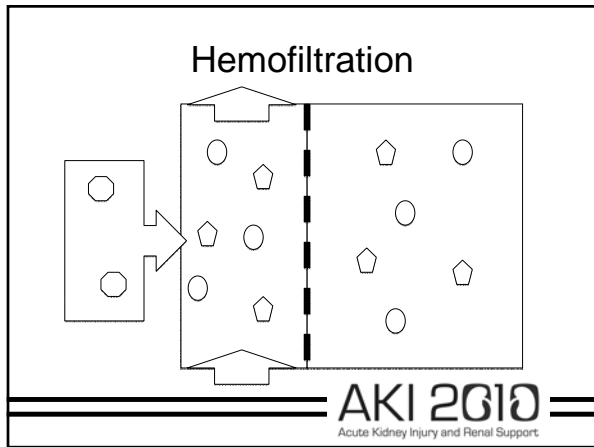
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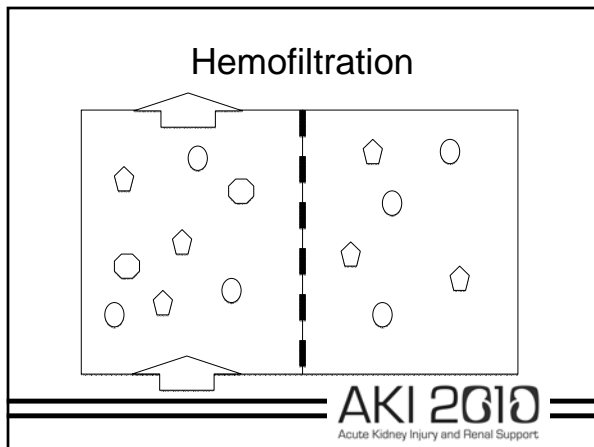
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## Modality Nomenclature

- Confusing nomenclature can be clarified by understanding that any modality can be prescribed for a variable length of time
- Hemodialysis usually combined with ultrafiltration
- Hemodialysis and hemofiltration can be performed together

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## Common terms

### Intermittent

- IHD
  - Hemodialysis performed for 4-6 hours
- SLED
  - Hemodialysis performed for 6-12 hours

### Continuous

- CRRT
  - Any renal support therapy applied continuously
- CVVH
  - Continuous hemofiltration
- CVVHD
  - Continuous hemodialysis
- CVVHDF
  - Continuous application of hemodialysis and hemofiltration

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## Summary

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