

***Apply kinetic knowledge into
clinical practice***

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Clinical problems

- Anuric low transporter has good volume control while developing uremic symptoms
- Anuric high transporter has good solute removal but poor volume control
- Hypokalemia is common in PD while we always said low molecular weight solute removal is inadequate
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- Fluid kinetics
- Solute
- Sodium
- Potassium
- Phosphorous
- Middle and large molecular weight solutes

Membrane Model

■ . Membrane



Pathways for Peritoneal Transport

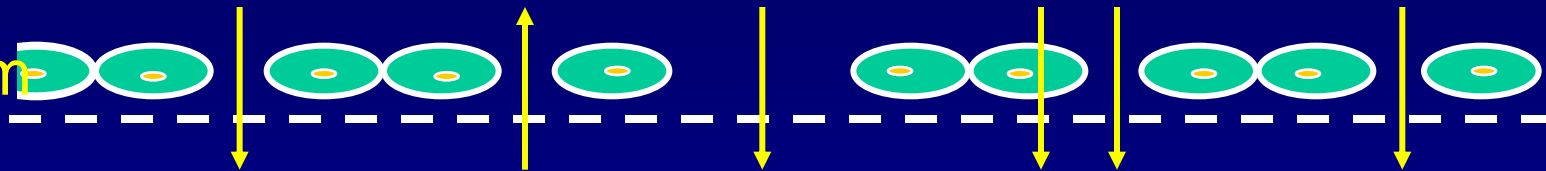
Capillaries (Blood)

Small solutes

Macro molecules

Water

Endothelium



Interstitium

Glucose

Crystalloid
osmosis

Colloid
osmosis

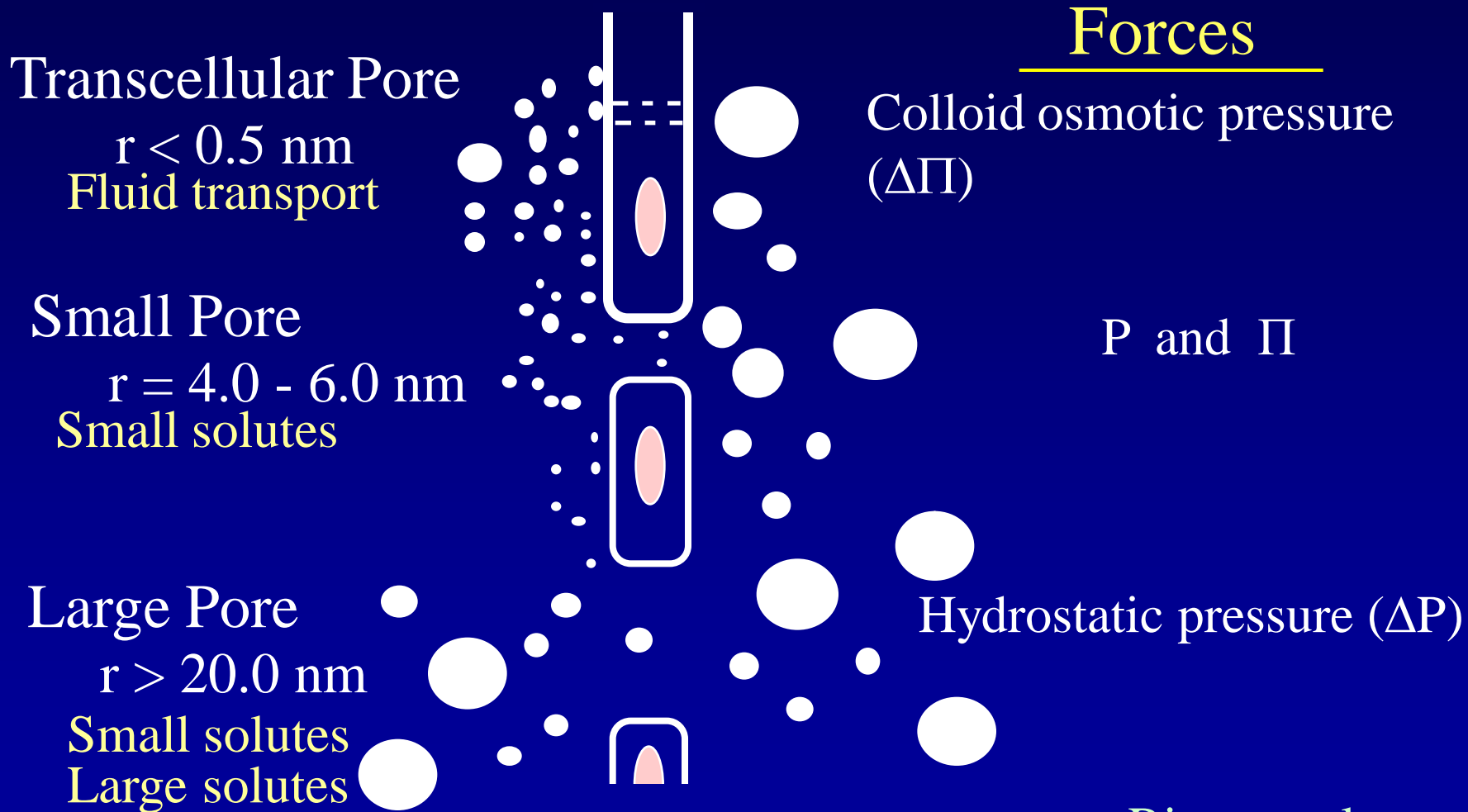
Mesothelium



Peritoneal tissue layer

Peritoneal Cavity (Dialysate)

Three Pore Model of Peritoneal Transport



Rippe et al.

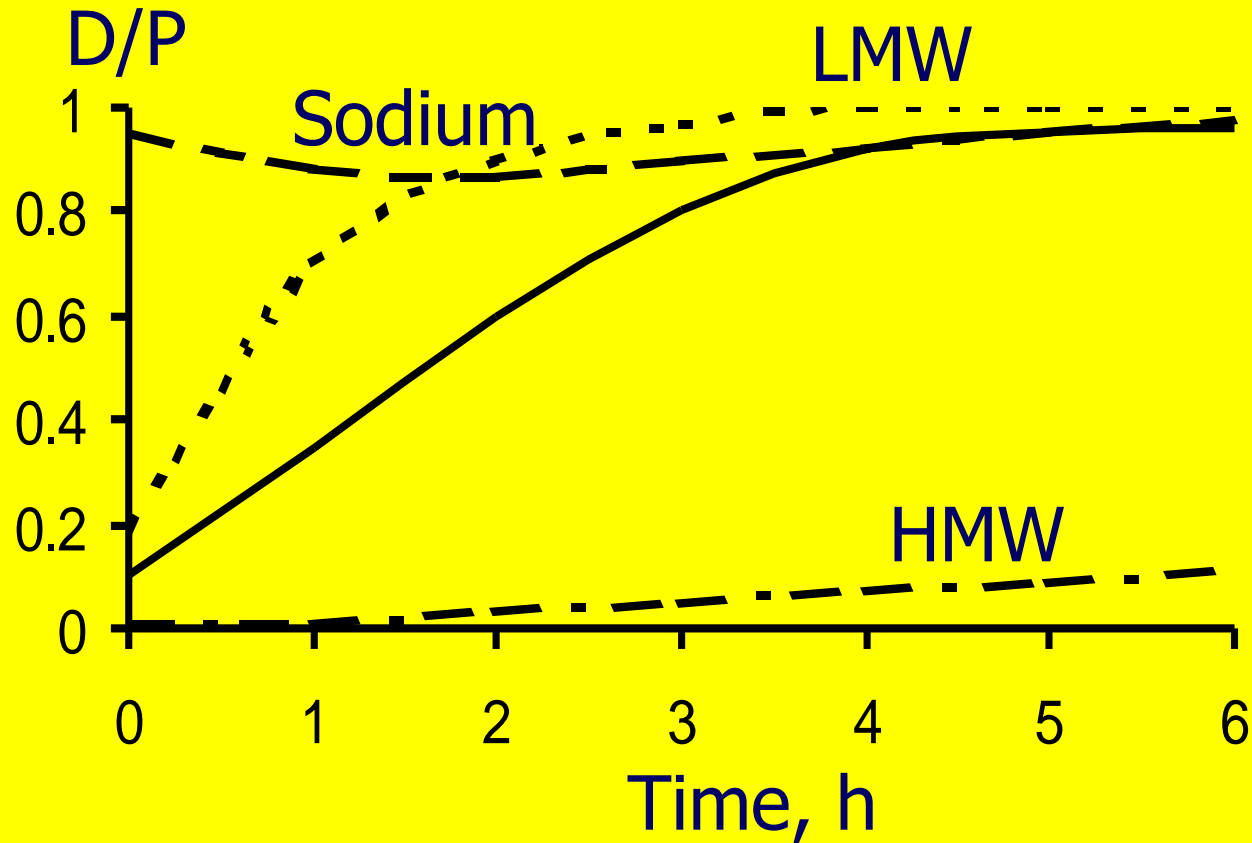
Uremic toxins

- Large molecular weight
- Middle molecular weight
- Small molecular weight
 - Potassium
 - Sodium
 - Ions
 - Urea

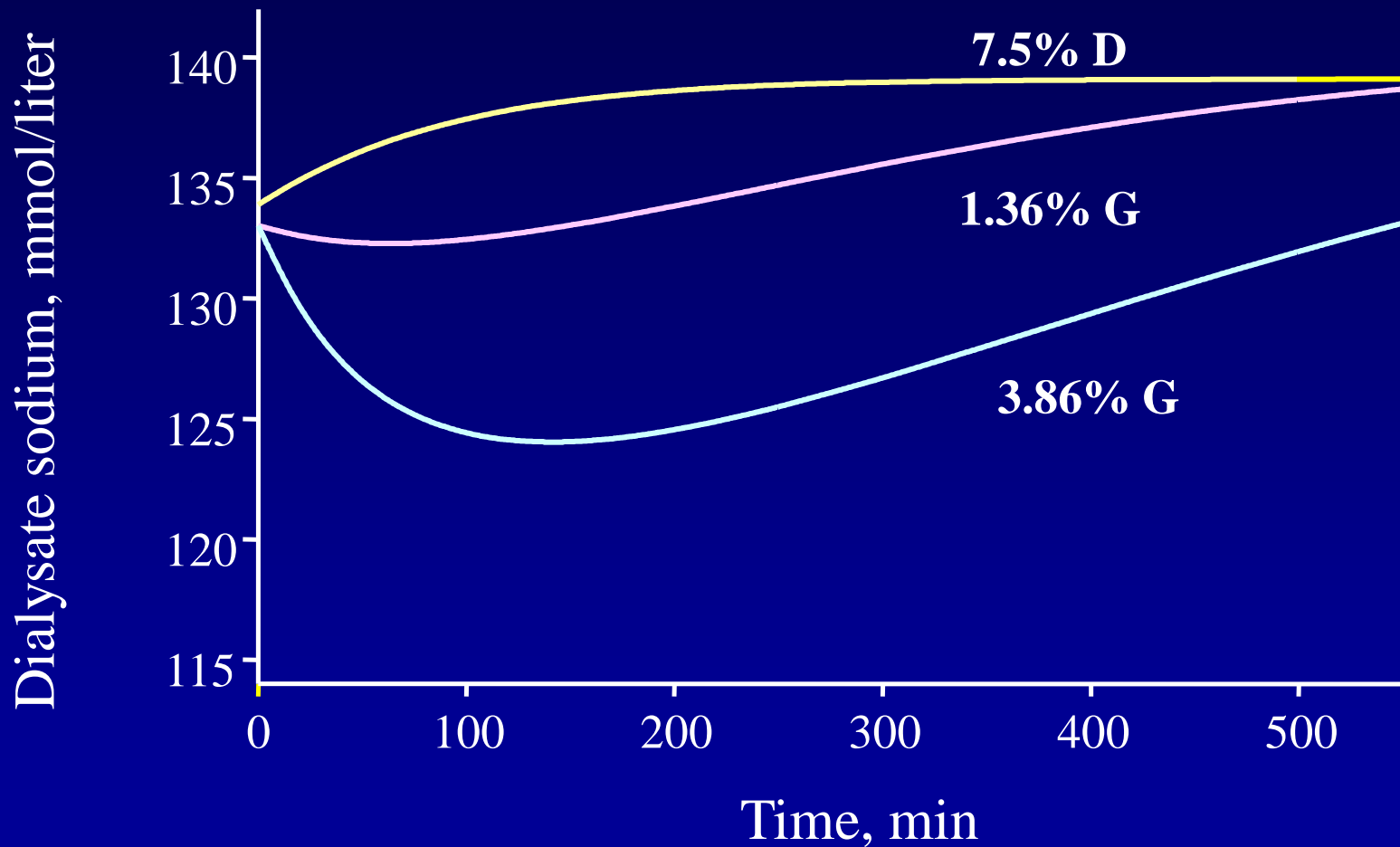
Factors that affect solute transport

- Solute concentration gradient (diffusive transport)
- Membrane permeability
 - Surface area
 - Hydraulic permeability
- Ultrafiltration (convective transport)
- Absorption

Membrane permeability and solute equilibration



Computer Simulations of Dialysate Sodium Profiles



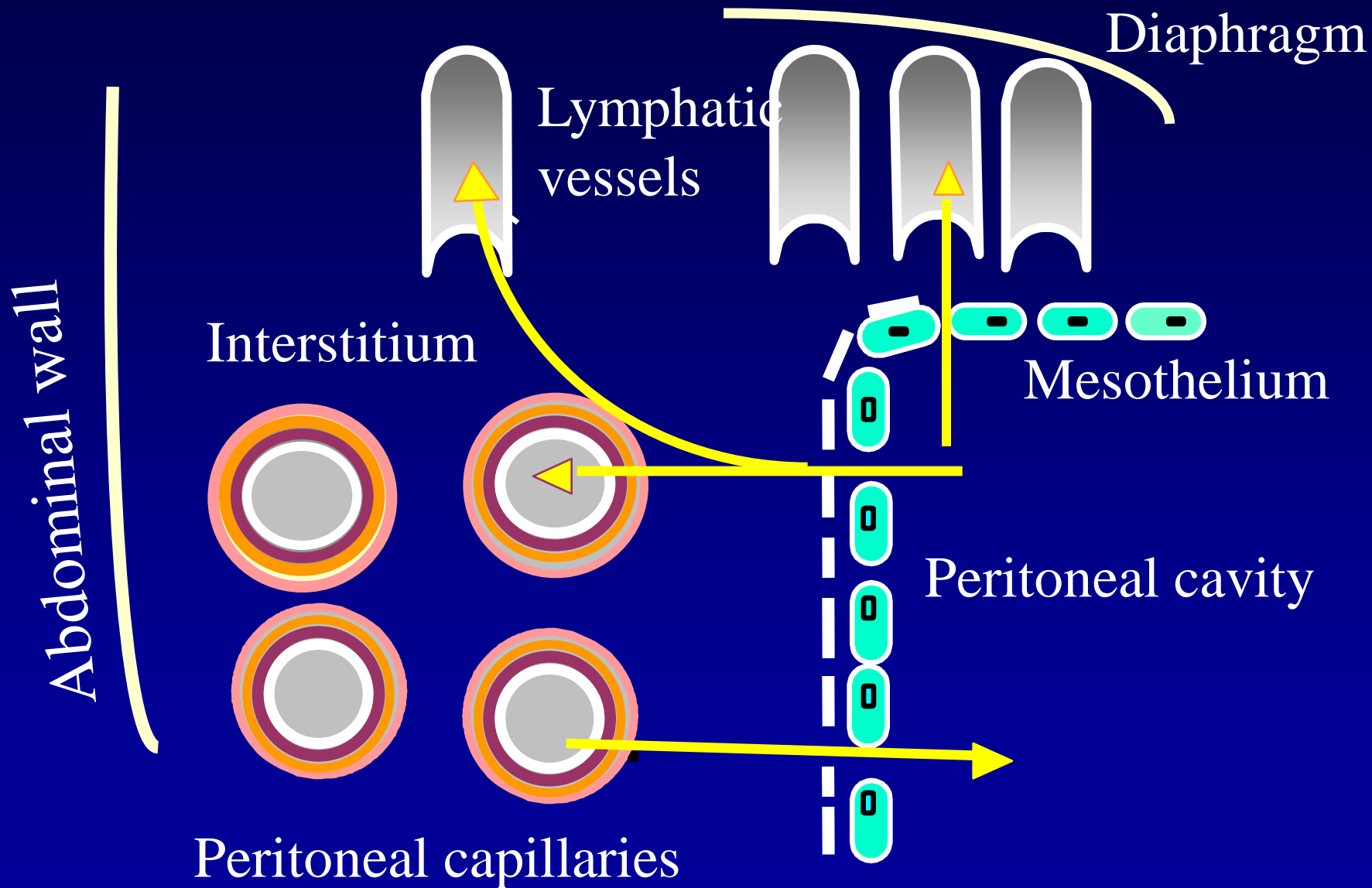
Why we use Kt/V ?

- Urea is supposed to be a surrogate for other small solute!
- It may be true in non-dialysis patient
- It is not true in PD patients
- Kt/V can not reflect sodium removal, middle and large molecular weight solute removal in PD

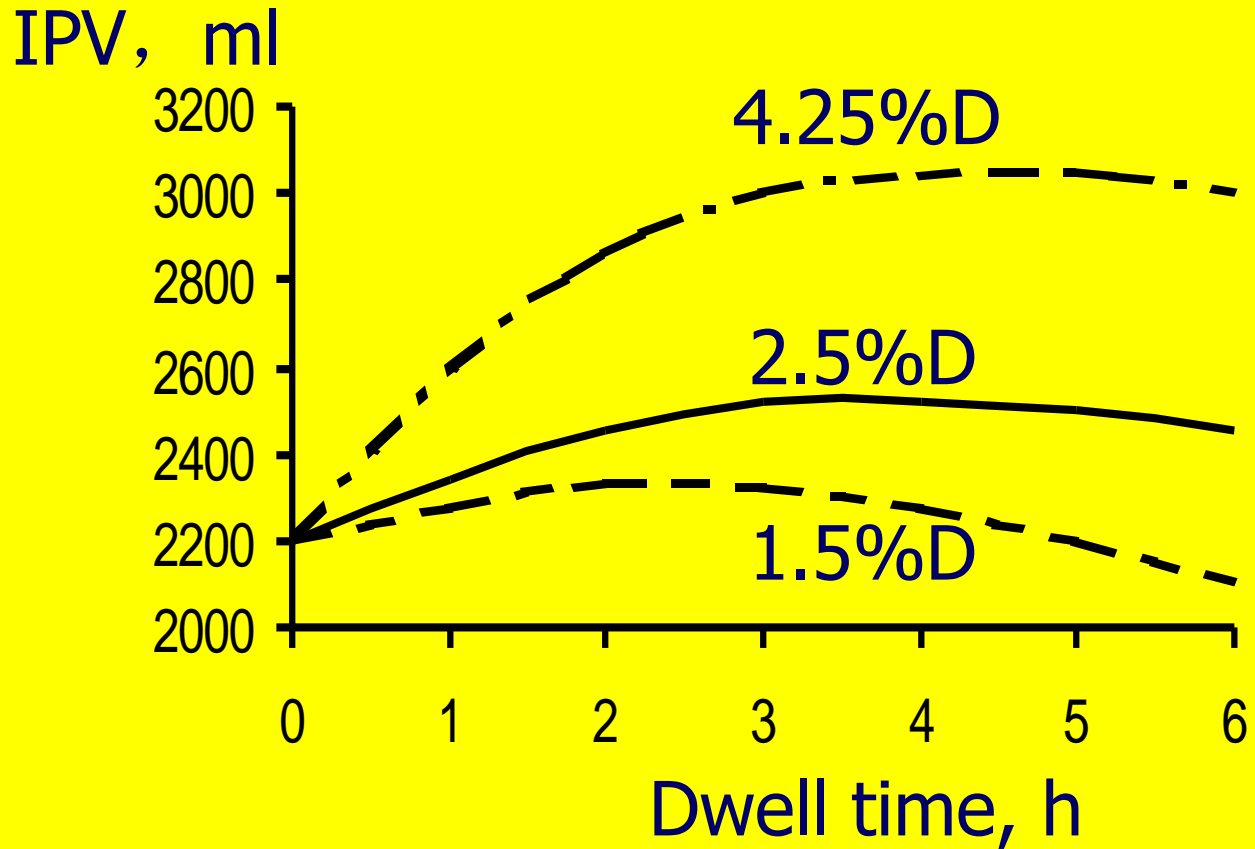
Mechanisms of Fluid Transport

- *Osmotic pressure difference* between dialysate and blood plasma
- *Hydrostatic pressure difference* between dialysate and blood plasma
- *Absorption of dialysate* to the submesothelial tissue and lymphatic vessels

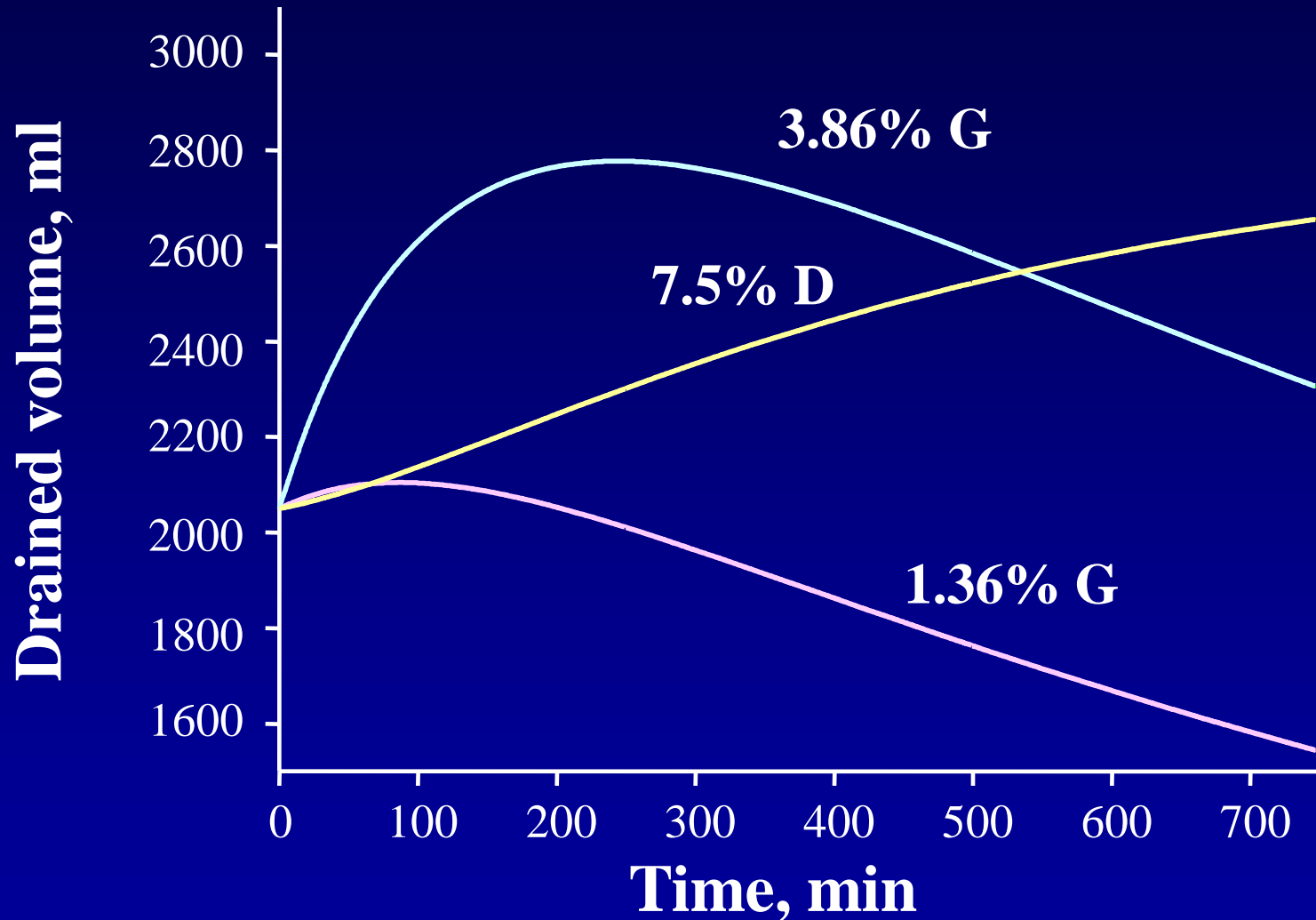
Peritoneal Fluid Transport



Peritoneal fluid transport



Computer Simulations of Ultrafiltration Profiles



Rippe and Levin. *Kidney Int* 57(6): 2546-56, 2000

Net Ultrafiltration (UF) is also dependent on fluid absorption

Net UF = Transcapillary UF – **Fluid absorption**

0-25 ml/min

1-2 ml/min

Peritoneal Fluid Absorption

- Bulk flow (small and large molecules are absorbed)
- Driven mainly by the intraperitoneal hydrostatic pressure
- Mainly absorbed to peritoneal interstitium and then to blood (directly or through lymph flow)
- Direct lymphatic flow accounts for only 10-30%
- Can be estimated with intraperitoneal volume marker

Factors Affecting Peritoneal Fluid Absorption Rate

- Intraperitoneal hydrostatic pressure
 - Dialysate fill volume
 - Residual volume
 - Body position
- Peritoneal hydraulic permeability: tissue hydraulic conductivity, surface area and fluid viscosity
 - Peritoneal tissue layer
 - Hyaluronan
- Direct lymphatic absorption

Impact of Peritoneal Fluid Absorption

- About 1-2 ml/min, i.e. 1440-2880 ml per 24 h !
- An important contributor to low peritoneal dialysis efficiency
- May decrease peritoneal fluid removal by 50-200% depending on the solution used
- Decreases peritoneal small solute clearance by 20-30%
- Neglected as cause of impaired net UF