# Epuration extra-rénale aux soins intensifs: Indications, méthodes et complications

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# PLAN

- Introduction à l'IRA
- Méthodes d'épuration extra-rénale
- Complications de l'épuration extra-rénale
- Quelques controverses

# Introduction IRA

JAMA®

N= 29 269

**Acute Renal Failure in Critically Ill Patients: A Multinational, Multicenter Study**

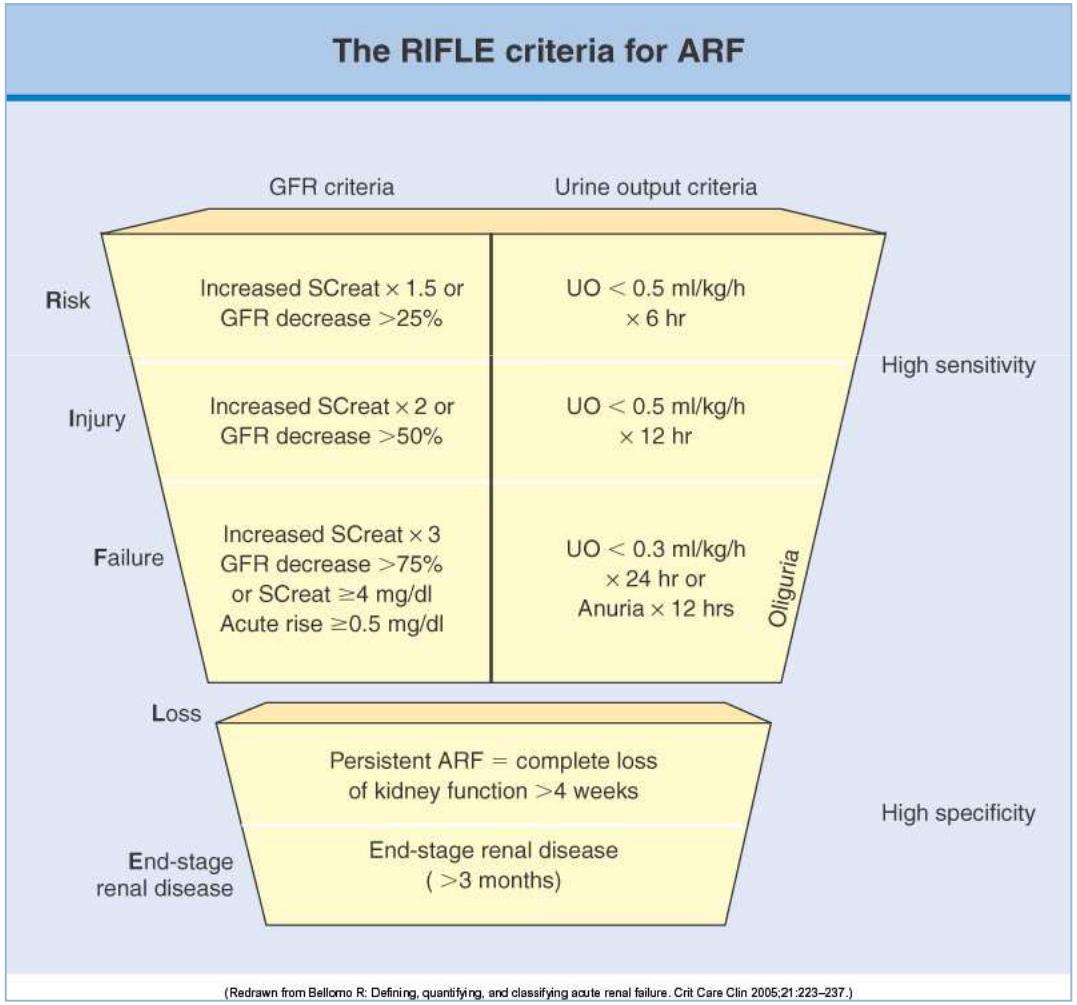
Shigehiko Uchino; John A. Kellum; Rinaldo Bellomo; et al.

- Incidence ARF: 5.5-6%; > 70% nécessitent dialyse.
- Hospital mortality: > 60%
- Most contributing factor: septic shock (47.5%)
- 80% treated with CRRT

**Superimposed renal impairment : 5-fold mortality increase in patients matched for sex, age and severity index scores.**

*Levy et al. JAMA 1996*

# Définition

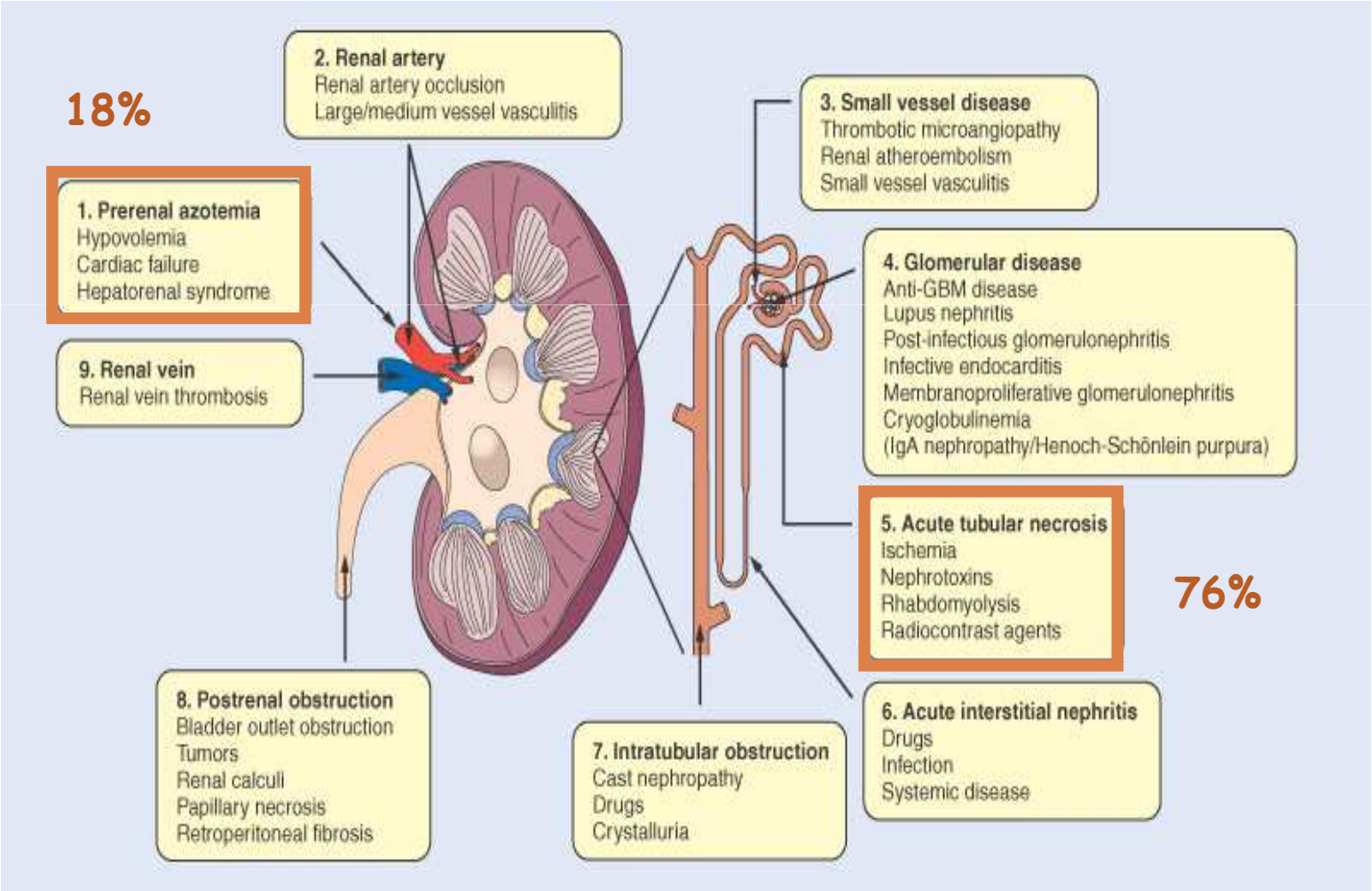



| Stade (% tous patients) | Mortalité |
|---|---|
| Risk (9.1%) | 15.1% |
| Injury (5.2%) | 29.2% |
| Failure (3.7%) | 41.1% |

Uchino S. Crit Care Med 2006

Bellomo R. Crit Care Clin 2005

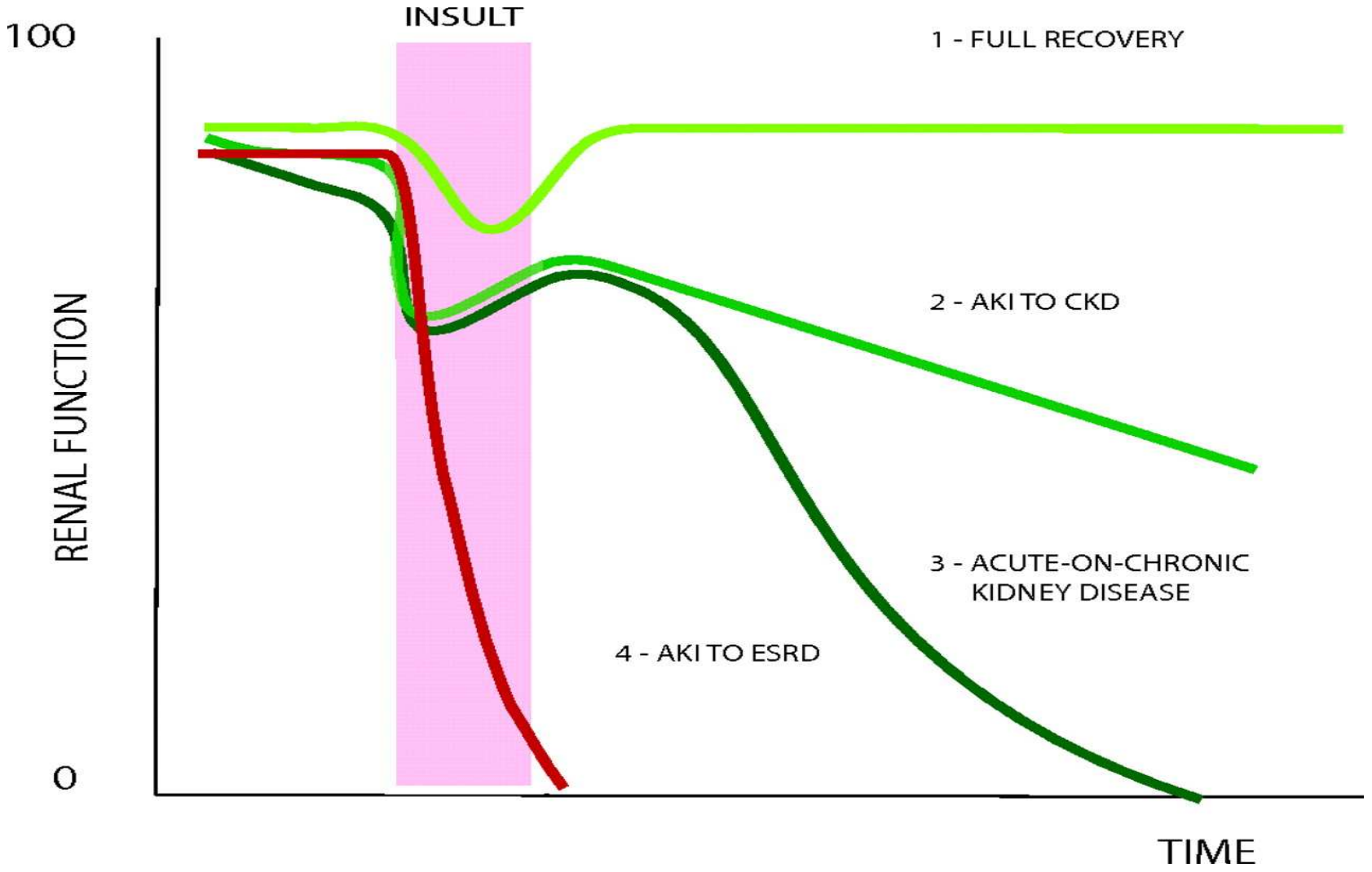
# Causes IRA


18%
2. Renal artery
Renal artery occlusion
Large/medium vessel vasculitis
3. Small vessel disease
Thrombotic microangiopathy
Renal atheroembolism
Small vessel vasculitis
1. Prerenal azotemia
Hypovolemia
Cardiac failure
Hepatorenal syndrome
4. Glomerular disease
Anti-GBM disease
Lupus nephritis
Post-infectious glomerulonephritis
Infective endocarditis
Membranoproliferative glomerulonephritis
Cryoglobulinemia
(IgA nephropathy/Henoch-Schönlein purpura)
9. Renal vein
Renal vein thrombosis
5. Acute tubular necrosis
Ischemia
Nephrotoxins
Rhabdomyolysis
Radiocontrast agents
76%
8. Postrenal obstruction
Bladder outlet obstruction
Tumors
Renal calculi
Papillary necrosis
Retroperitoneal fibrosis
7. Intratubular obstruction
Cast nephropathy
Drugs
Crystalluria
6. Acute interstitial nephritis
Drugs
Infection
Systemic disease

# Complications IRA

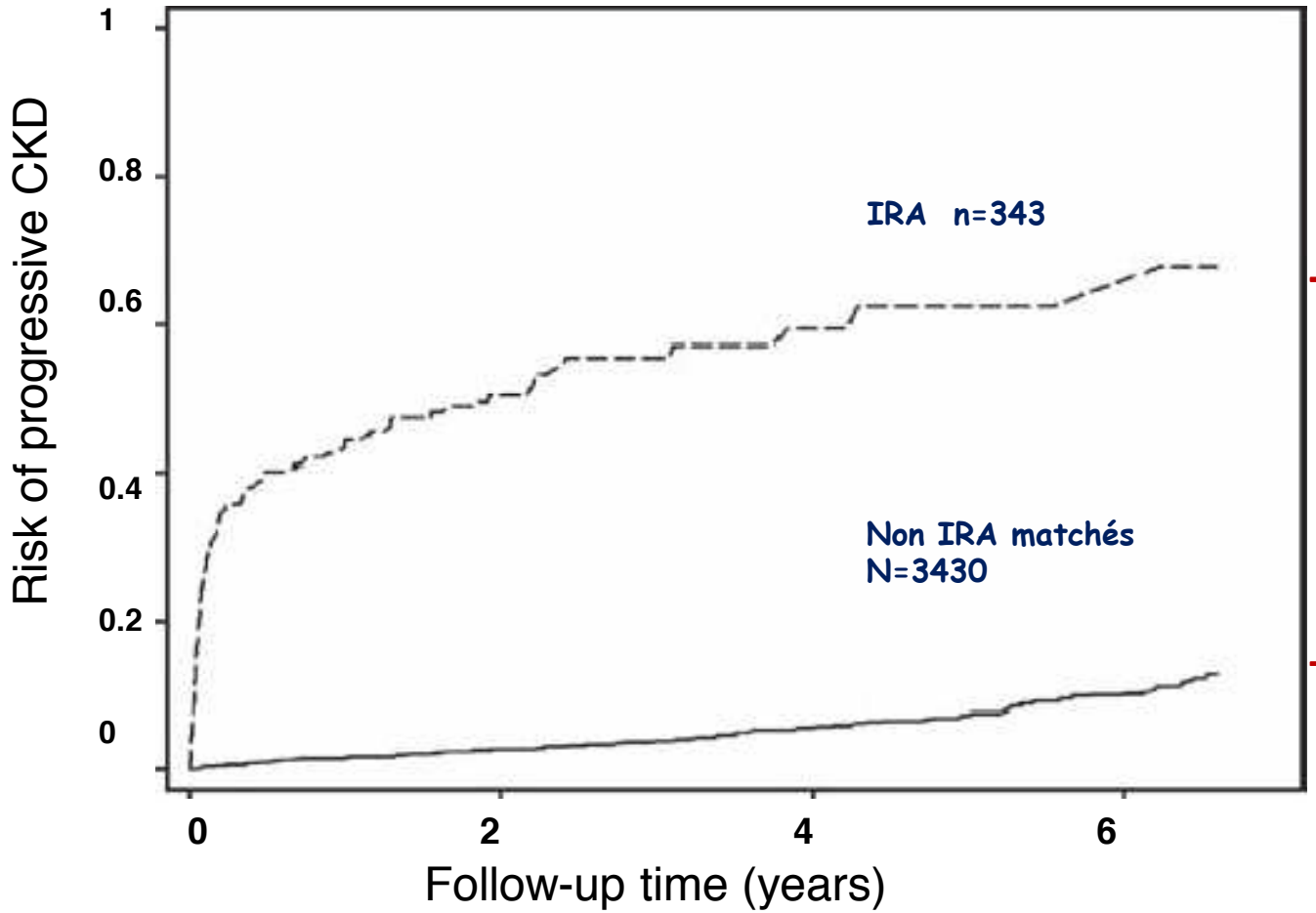
| Complications of ARF | | | | | |
|---|---|---|---|---|---|
| **Metabolic** | **Cardiovascular** | **Gastrointestinal** | **Neurologic** | **Hematologic** | **Infectious** |
| Hyperkalemia | Pulmonary edema | Nausea | Neuromuscular | Anemia | Pneumonia |
| Metabolic acidosis | Arrhythmias | Vomiting | Irritability | Bleeding | Wound infections |
| Hyponatremia | Pericarditis | Malnutrition | Asterixis | | Intravenous line infections |
| Hypocalcemia | Pericardial effusion | Gastritis | Seizures | | Septicemia |
| Hyperphosphatemia | Hypertension | Gastrointestinal ulcers | Mental status changes | | Urinary tract infection |
| Hypermagnesemia | Myocardial infarction | Gastrointestinal bleeding | Somnolence | | |
| Hyperuricemia | Pulmonary embolism | Stomatitis or gingivitis | Coma | | |
| | Pneumonitis | Parotitis or pancreatitis | | | |

# Complications à long terme: fonction rénale



# Complications à long terme: fonction rénale

Kaiser permanente. N= 556090 adultes dont **703 IRA+dialyse (343 non dépendant dialyse à 30j)**

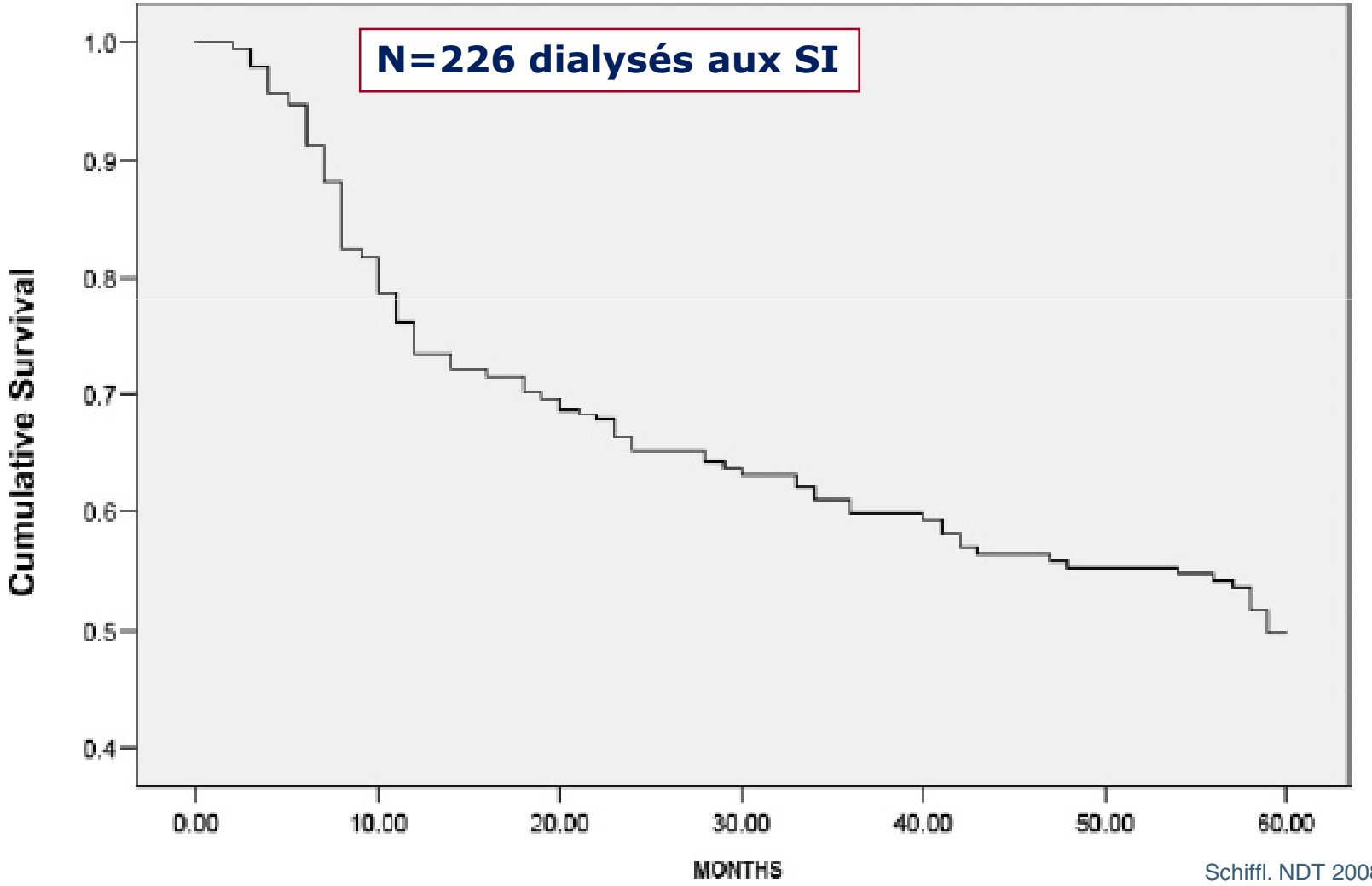



→ **47.9/100 pers-an**

→ **1.7 pers-an**

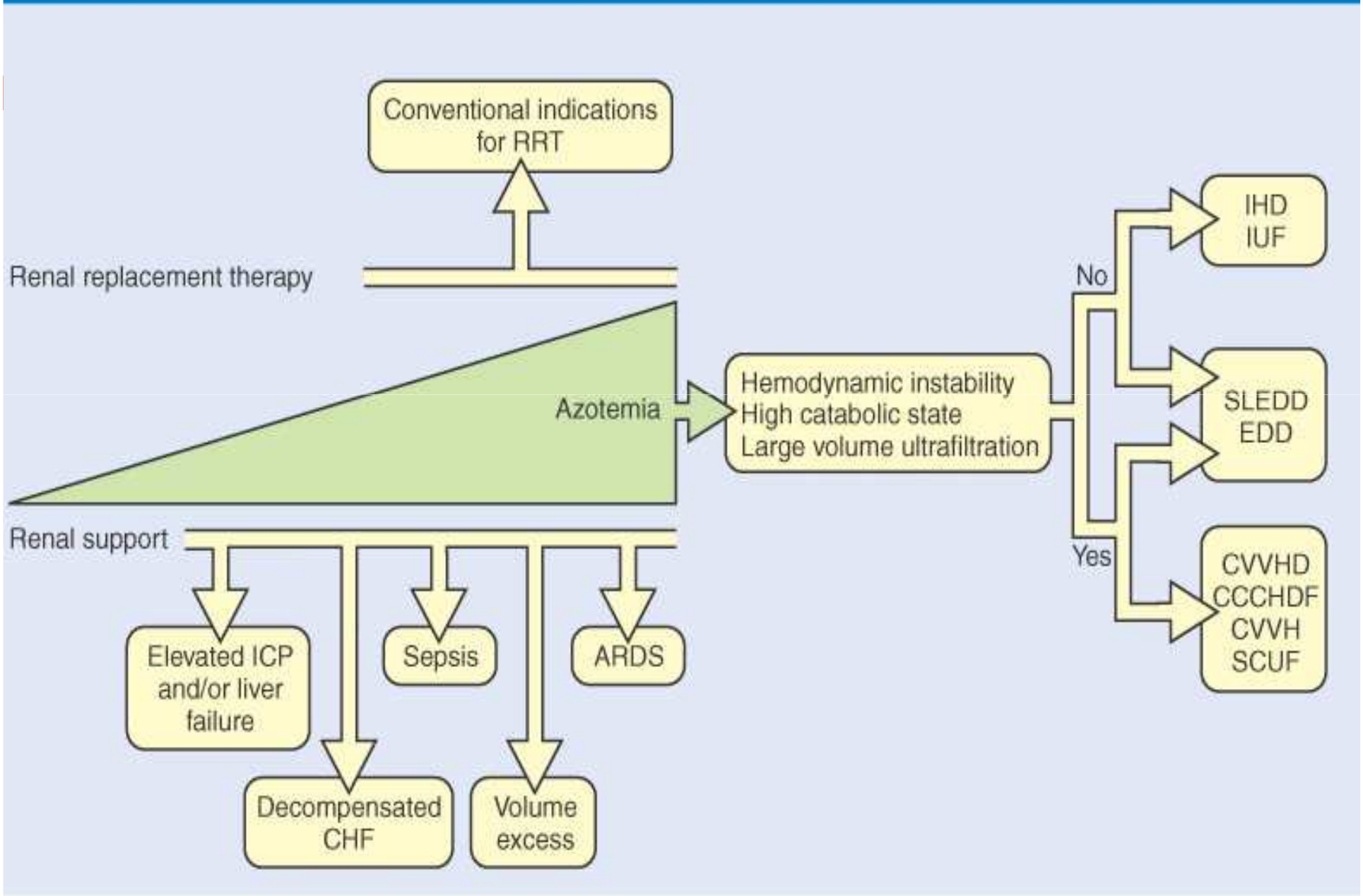
Lowell JL. KI2009

# Complications à long terme : mortalité




Schiffl. NDT 2008

# Méthodes d'épuration extra-rénale



# Indications

| Indications | Description |
|---|---|
| Renal | |
| Uremia | Azotemia |
| | Neuropathy, myopathy |
| | Encephalopathy (unexplained decline in mental status) |
| | Pericarditis |
| Overload of fluids | Volume removal |
| | Pulmonary edema |
| | Oliguria with < 200 mL of urine output in 12 h |
| | Anuria with < 50 mL urine output in 12 h |
| Electrolytes | Hyperkalemia (K+ > 6.5 mmol/L) |
| | Sodium abnormalities |
| Acid-base | Metabolic acidosis (pH < 7.0) |
| Intoxications | With dialyzable toxin |
| Nonrenal | Allowing administration of fluids and nutrition |
| | Hyperthermia |
| | Severe hemodynamic instability in severe sepsis? |
| | Elimination of inflammatory mediators in sepsis? |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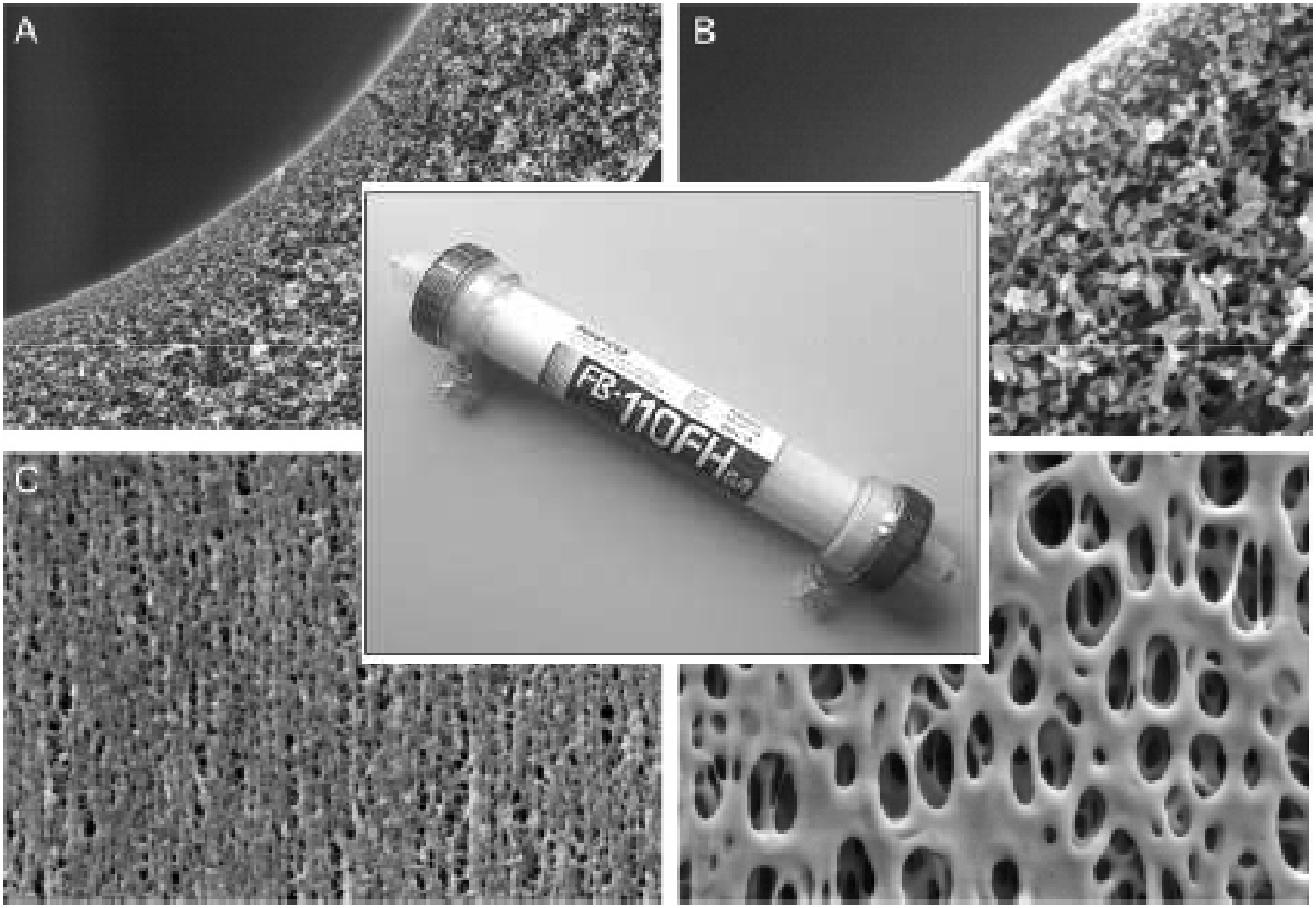
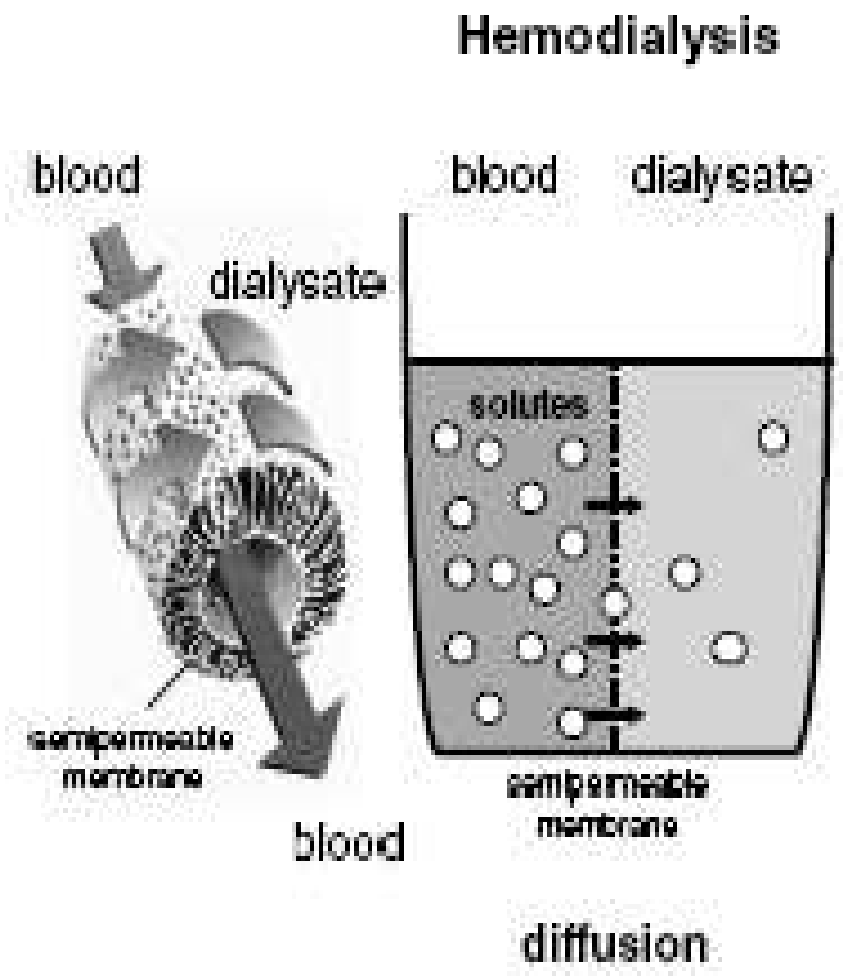
GAMBRO

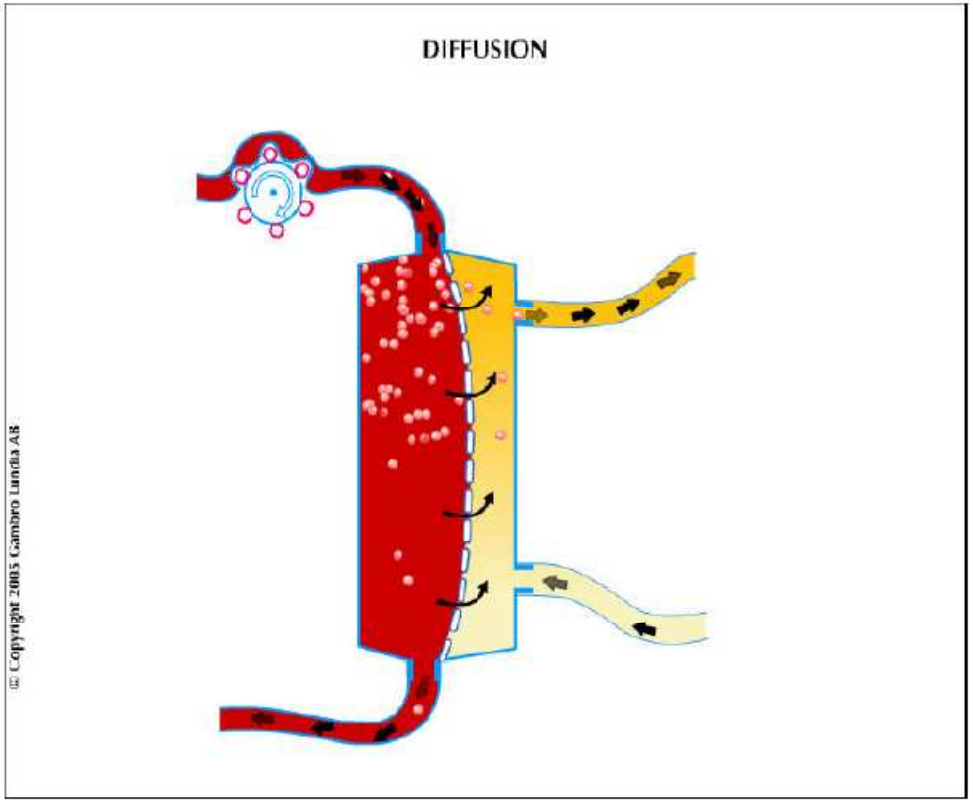
# Membranes




biocompatibles, 1.5m$^2$, haut flux

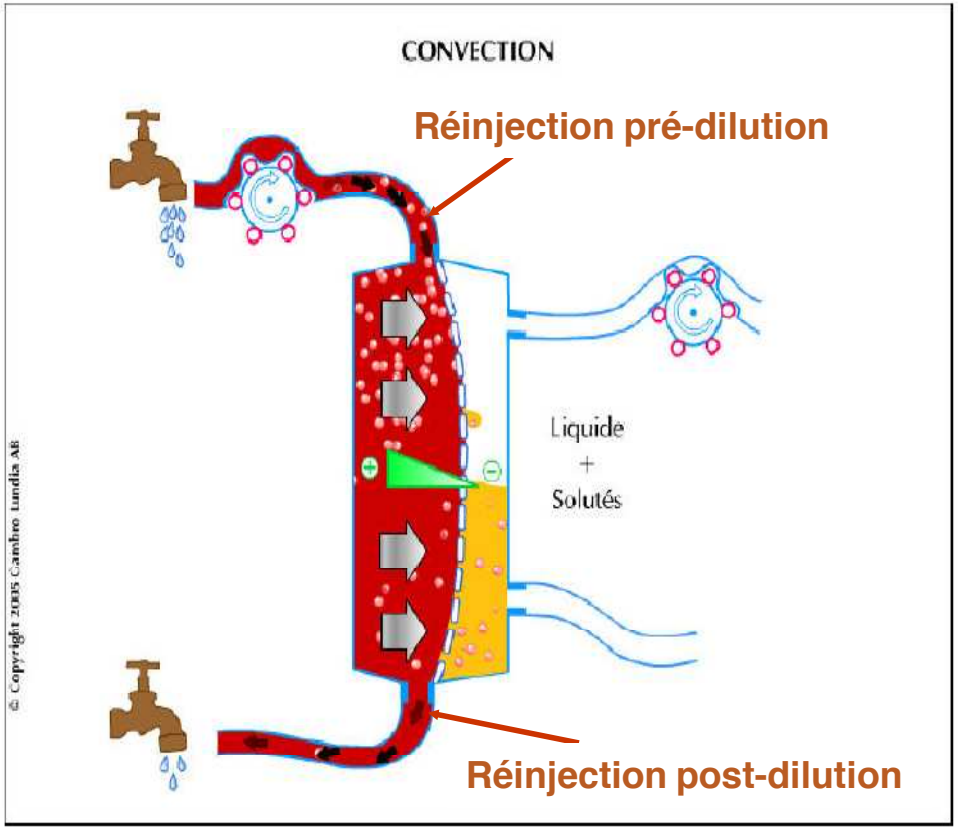
# Concepts de base



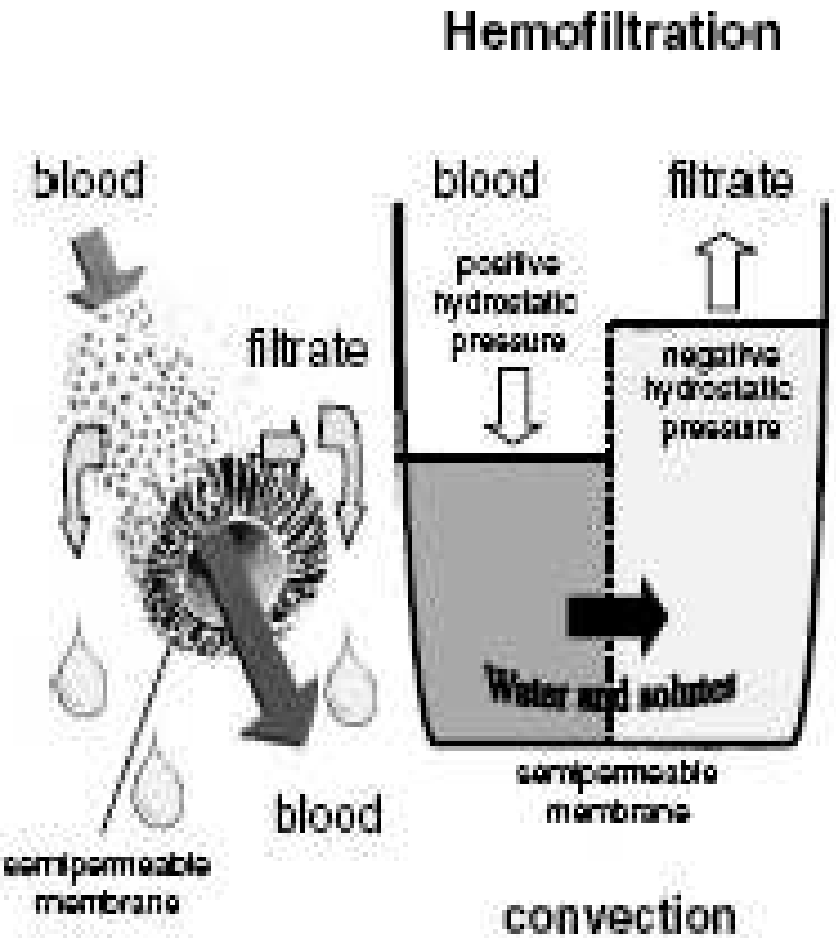




**Diffusion.** Les solutés indésirables, qui sont plus concentrés dans le sang du patient, se diffusent à travers la membrane semi-perméable d'une concentration supérieure à une concentration inférieure.

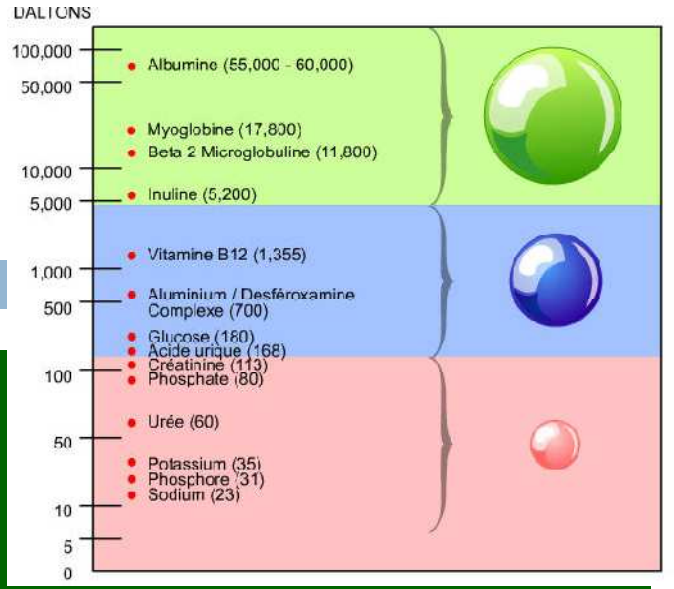
# Concepts de base

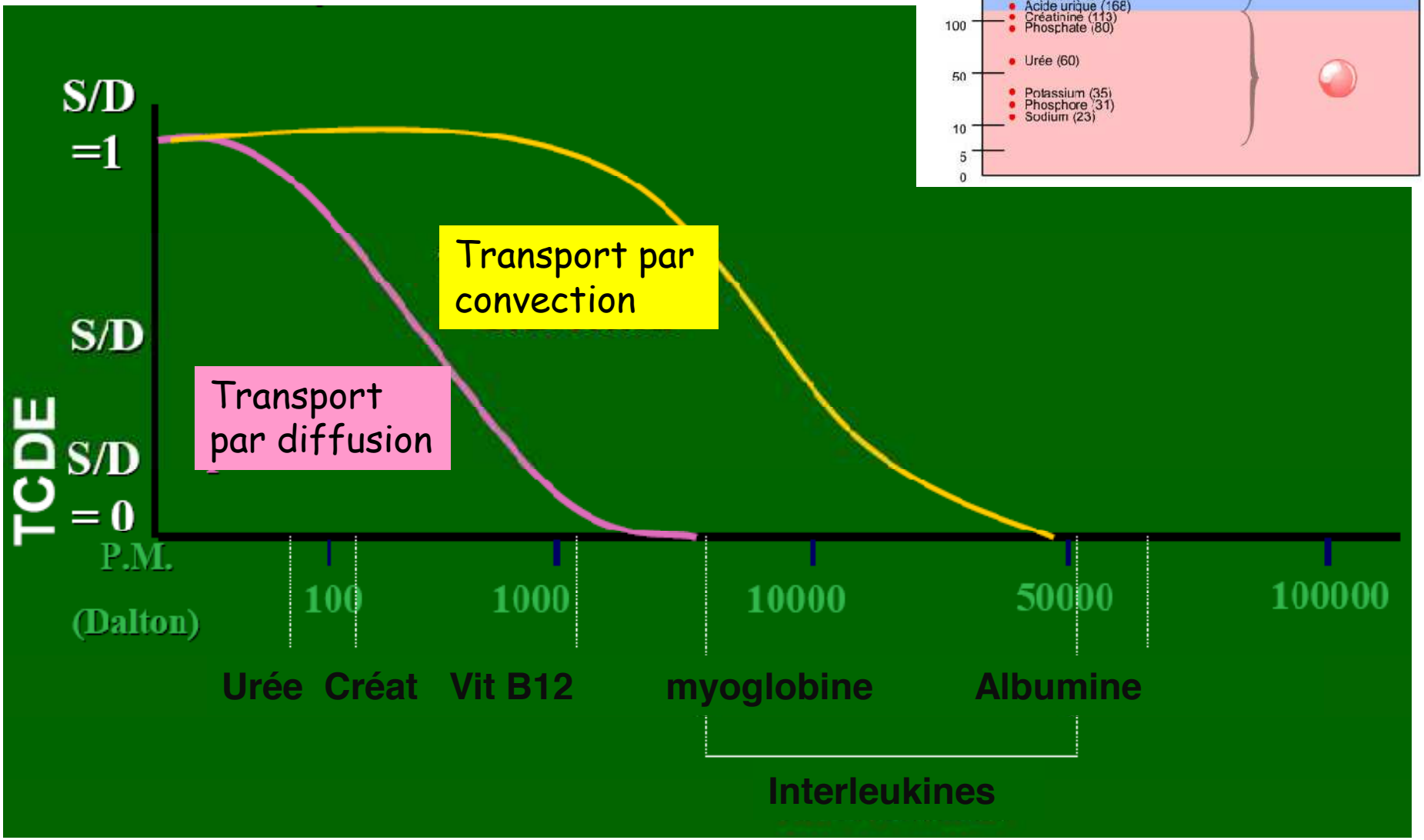



**Convection.** Les solutés sont poussés avec l'eau plasmatique à travers la membrane semi-perméable par ultrafiltration. Simultanément, un liquide de réinjection est injecté dans le sang à l'aide de pompes de réinjection.



# Transport moléculaire



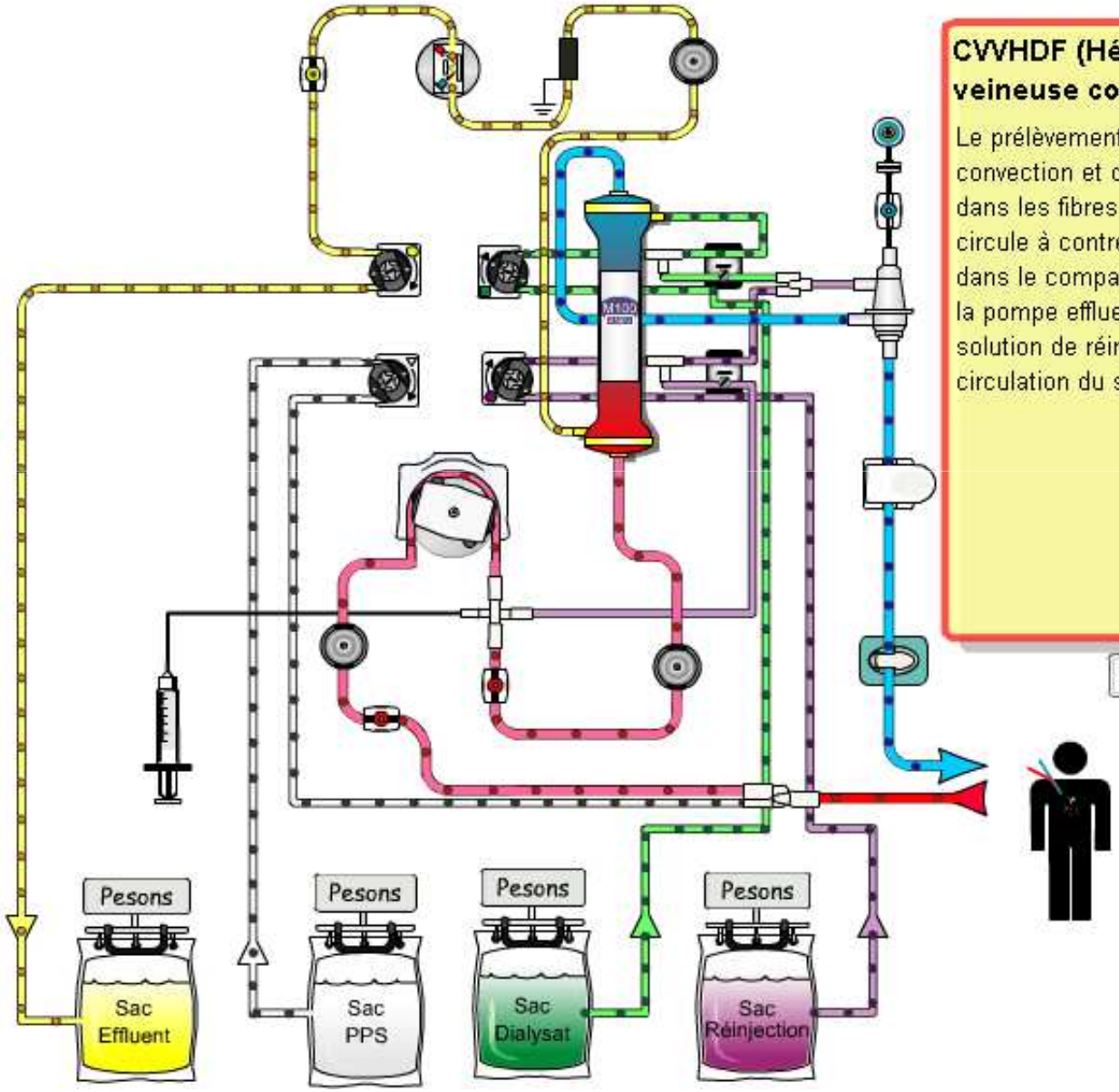
# Solutions utilisées

| | Solution 15 | Solution 8 | Solution Bicar |
|---|---|---|---|
| Na | 135 | 135 | 140 |
| K | 3 | 0 | 0 |
| Ca | 1.87 | 1.87 | 1.75 |
| Mg | 0.75 | 0.75 | 0. 5 |
| Cl | 108.5 | 108.5 | 108.5 |
| Lactate | 45 | 34 | 3 |
| Bic | 0 | 0 | 32 |
| Glu | 0 | 0 | 0 |

| | RRT Modality | Transport Principle | Comment |
|---|---|---|---|
| INTERMIT | IRRT | | All intermittent therapies |
| | IHD | Diffusion | "Classic" hemodialysis |
| | EDD | Diffusion | Longer dialysis times, slower blood and dialysate flows |
| | SLEDD | Diffusion | Longer dialysis times, slower blood and dialysate flows |
| | SCUF | Mainly convection | Only UF with conventional dialysis machines |
| CONTINUES | CVVHDF | Convection and diffusion | Hemofiltration combined with dialysis (low dialysate flow) |
| | EIHF | Convection | Early hemofiltration in septic shock with high UF rates (like HVHF) but without volume loss |
| | HVHF | Convection | Hemofiltration with high UF rates (equal to high RRT dose; allows intermittent therapy) |
| | CAVH | Convection | Without pumps, allows UF rates of only 10–15 L/d |
| | CVVH | Convection | "Classic" hemofiltration |
| | CRRT | | All continuous therapies |

Circulation totale | SCUF | CVVH | CVVHD | CVVHDF

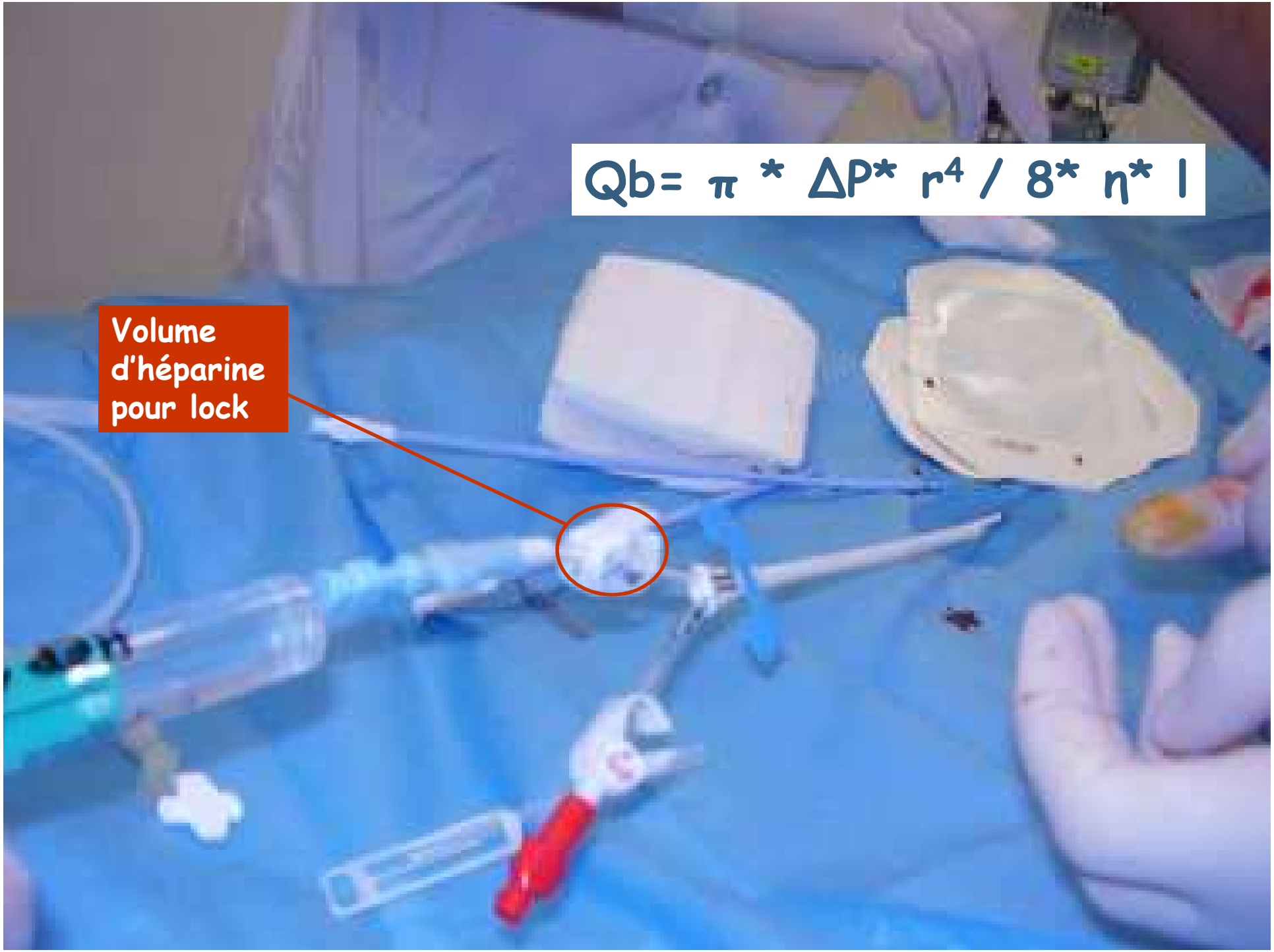
prismaflex

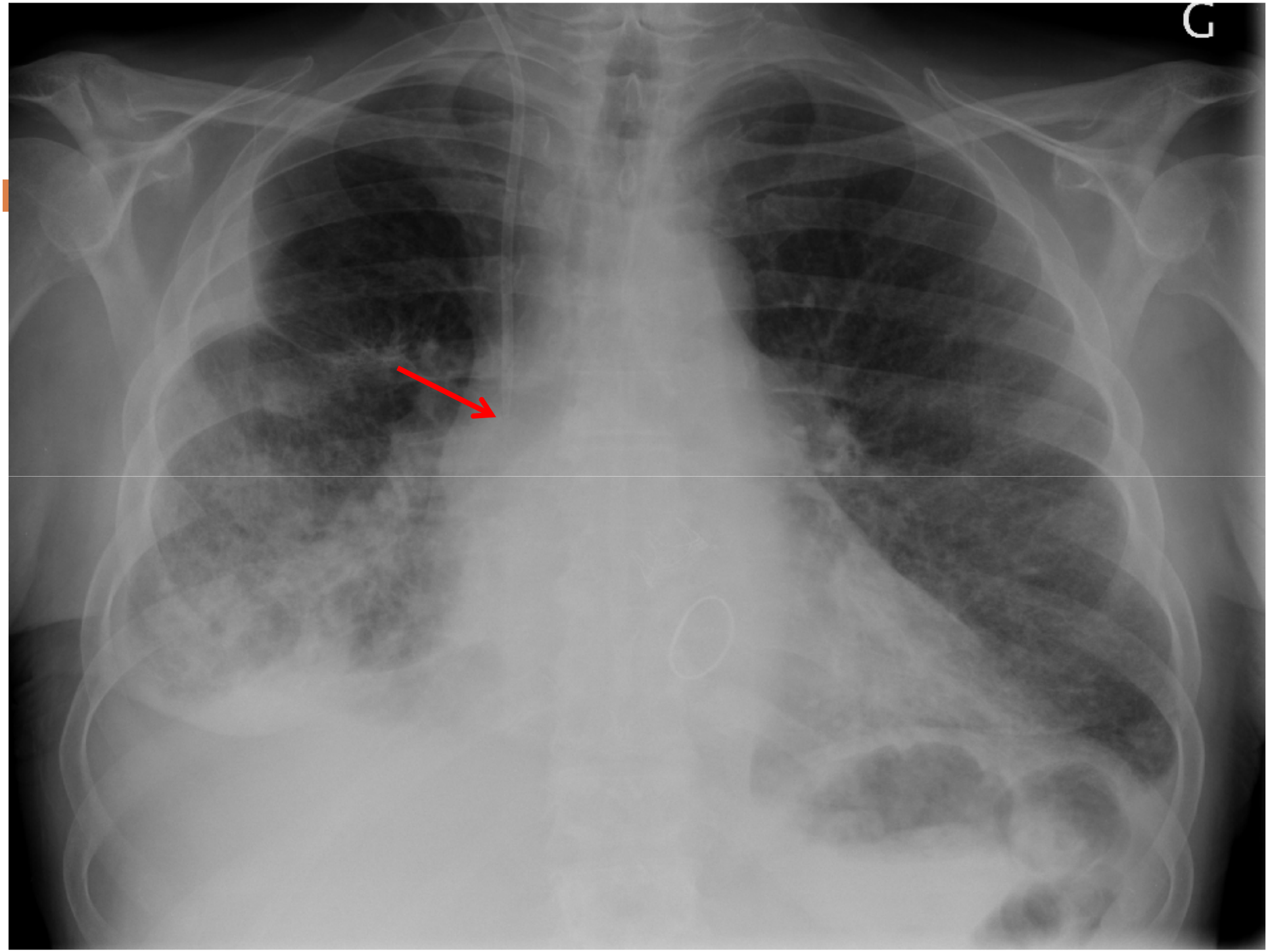



**CVVHDF (Hémodiafiltration veino-veineuse continue)**

Le prélèvement du soluté s'obtient à la fois par convection et diffusion. Lorsque le sang circule dans les fibres creuses du filtre, le dialysat circule à contre-courant par rapport au sang dans le compartiment du filtre. Simultanément, la pompe effluent contrôle l'ultrafiltration et une solution de réinjection est perfusée dans la circulation du sang.

**PPS Administration**


$Qb = \pi * \Delta P * r^4 / 8 * \eta * l$
Volume d'héparine pour lock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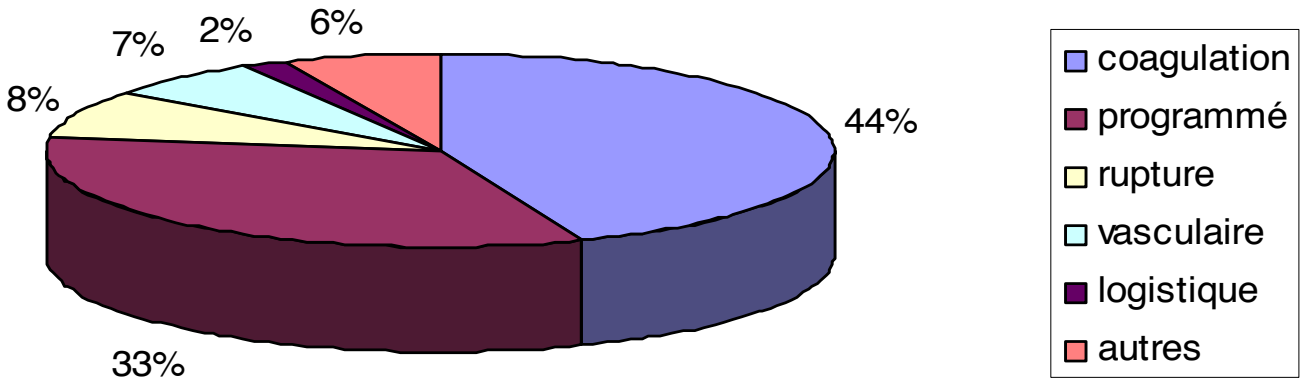
# Anticoagulation

**causes de changements de filtres**

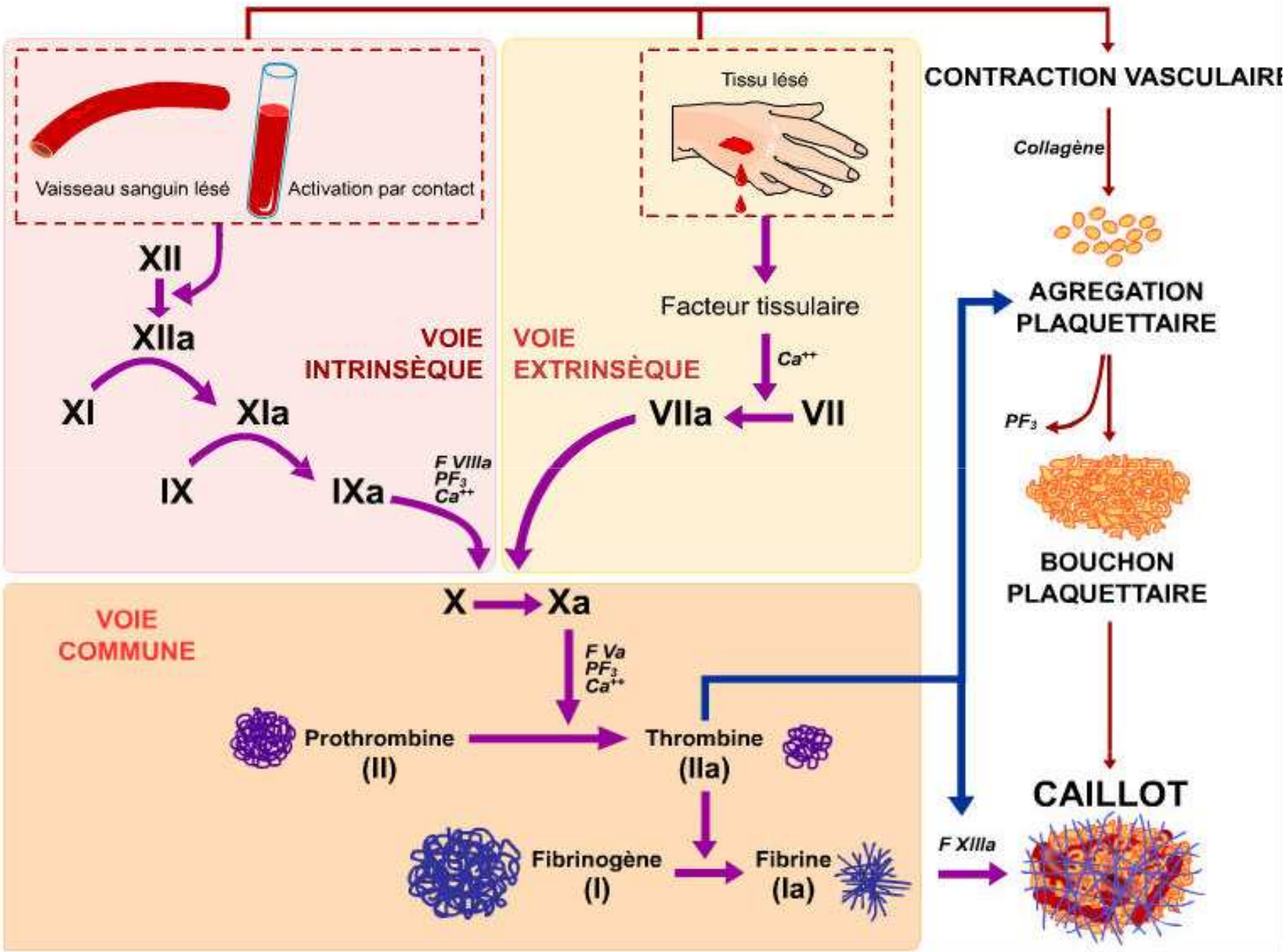
N=450 filtres
Durée moyenne=30.4±16h




**Si coagulation du circuit:**

- **Perte du filtre→ interruption du traitement**
- **Perte de sang (env 200ml)**
- **Diminution efficacité du traitement**

Gainza FJ. Kidney Int 1999


Vaisseau sanguin lésé
Activation par contact
XII
XIIa
XI
XIa
IX
IXa
F VIIIa
PF3
Ca++
VOIE INTRINSÈQUE
Tissu lésé
Facteur tissulaire
Ca++
VOIE EXTRINSÈQUE
VIIa
VII
CONTRACTION VASCULAIRE
Collagène
AGREGATION PLAQUETTAIRE
PF3
BOUCHON PLAQUETTAIRE
VOIE COMMUNE
X
Xa
F Va
PF3
Ca++
Prothrombine
(II)
Thrombine
(IIa)
Fibrinogène
(I)
Fibrine
(Ia)
F XIIIa
CAILLOT

# Anticoagulation idéale

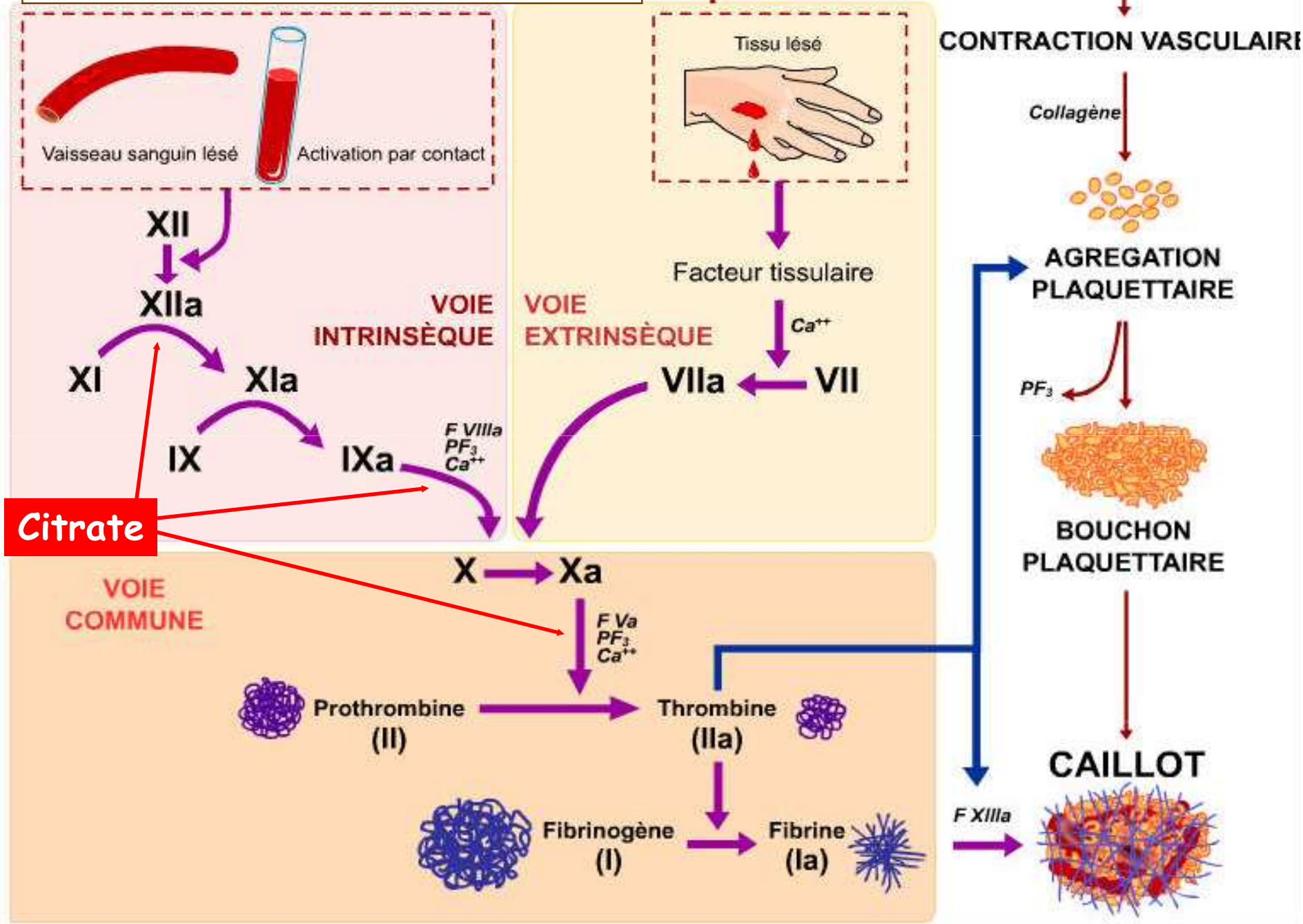
- ✓ Bas coût
- ✓ Facile à administrer
- ✓ Facile à monitorer
- ✓ Réversible
- ✓ Sans effet secondaires métaboliques

# Anticoagulation idéale

| Anticoagulation | |
|---|---|
| Unfractionated heparin | 429/1000 (42.9%) |
| Sodium citrate | 99/1000 (9.9%) |
| Nafamostat mesilate | 61/1000 (6.1%) |
| Low-molecular-weight heparin | 44/1000 (4.4%) |
| Prostacyclin | 11/1000 (1.1%) |
| Hirudin | 9/1000 (0.9%) |
| Heparin-protamine | 6/1000 (0.6%) |
| Others [b] | 3/1000 (0.3%) |
| Combination [c] | 7/1000 (0.7%) |
| No anticoagulation | 331/1000 (33.1%) |

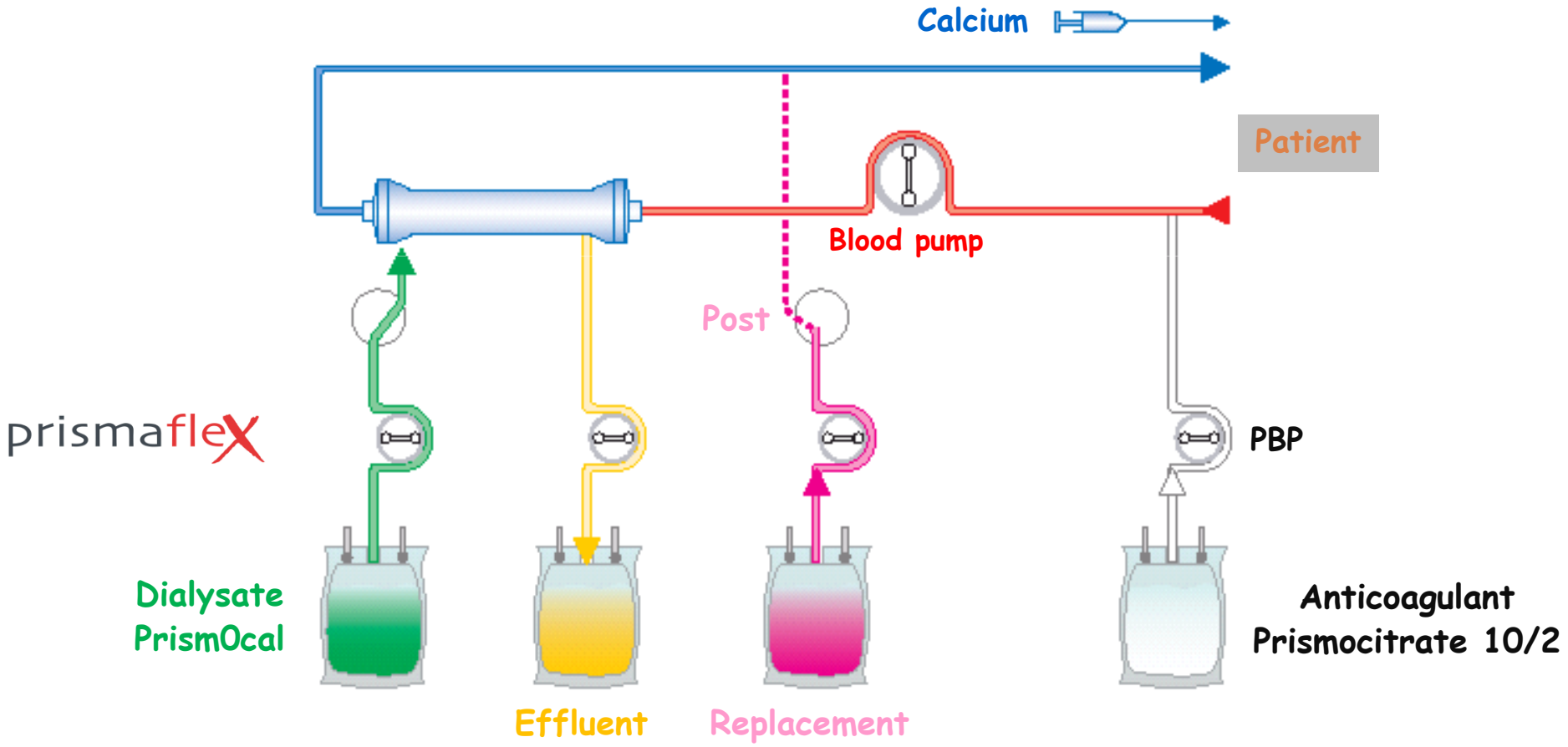
Best. Int Care Med 2007

# ANTICOAGULATION AU CITRATE



# Solutions utilisées avec citrate

## Anticoagulation régionale !



# Solutions utilisées avec citrate

**PRISMOCITRATE® 10/2 :** *pré-pompe sang (pré-dilution)*
Citrate : 10 mmol/L
Citric acid : 2 mmol/L
Sodium : 136 mmol/L
Chloride : 106 mmol/L
**PRISMOCAL® :** *dialysat*
Magnesium : 0.5 mmol/L
Sodium: 140 mmol/L
Lactate : 3 mmol/L
Bicarbonate : 32 mmol/L
Chloride : 106 mmol/L
**HEMOSOL BO® :** *réinjection (post-dilution)*
Calcium : 1.75 mmol/L
Magnesium : 0.5 mmol/L
Sodium: 140 mmol/L
Lactate : 3 mmol/L
Bicarbonate : 32 mmol/L
Chloride : 109.5 mmol/L

**+ gluconate de calcium**
*(post-filtre)*

# Métabolisme hépatique: 1 citrate→3 HCO3

| Tabelle 4 : Dose citrate pour 2,5 mmol citrate/L de Sang | | | | | | |
|---|---|---|---|---|---|---|
| **DEBIT POMPE SANG ml/Min** | **100** | **110** | **120** | **130** | **140** | **150** |
| **DEBIT PPS CITRATE ml/Hr** | **1250** | **1370** | **1500** | **1620** | **1750** | **1870** |
| **DEBIT Dialysat 0CAL ml/Hr** | **1000** | **1000** | **1000** | **1000** | **1000** | **1000** |
| **DEBIT REINJ POST Hemosol ml/Hr** | **600** | **650** | **750** | **800** | **850** | **900** |

Risque: hypocalcémie → doser calcium patient et post-filtre (0.2-0.4)

| **Injection de Gluconate CA 10% Débit initial** | | | | | |
|---|---|---|---|---|---|
| CA ionisé artériel patient (mmol/L) | <0'8 | 0,8<_<0,99 | **1,00<_<1,20** | 1,21<_<1,33 | >1,33 |
| **Débit initial (post-pompe)** | 20ml/Hr | 15ml/Hr | **10ml/Hr** | 5ml/Hr | 0ml/Hr |

Risque: hypercalcémie

| **BICARBONATE [mmol/l] Patient** | **< 20** | **20 – 21,9** | **22 - 26** | **26,1 - 30** | **> 30** |
|---|---|---|---|---|---|
| **Modification du débit dialysat** | **Dialysat↑ (+500ml)** | **Dialysat ↑ (+250ml)** | **Pas de modif** | **Dialysat ↓ (-250ml)** | **Dialysat ↓ (-500ml)** |

Risque: alcalose métabolique

# Citrate-based regional anticoagulation versus heparin for continuous renal replacement therapy in critically ill patients with acute renal failure: a randomized controlled trial

Prospective open-label randomized controlled trial (over 2 years)

**Inclusion criteria**

- Patients with acute kidney injury requiring renal replacement therapy (RIFLE criteria)
- Patients (males or females) > 18 yrs old
- Consent form signed (or in emergency investigator's statement form)

**Non-inclusion criteria**

- Patients with active bleeding disorders
- Patients with past history of heparin-induced thrombocytopenia (HIT)
- Patients with very severe liver disease ( patients awaiting liver

# Citrate-based regional anticoagulation versus heparin for continuous renal replacement therapy in critically ill patients with acute renal failure: a randomized controlled trial

**Primary Endpoint :**

- Mean daily delivered dose during intensive care stay
- Filter life span

**Secondary endpoints:**

- 28-day and 90-day patient survivals
- Length of ICU stay
- Bleeding episodes requiring tranfusions
- Heparin-induced thrombocytopenia (HIT) episodes
- Important metabolic disorders (metabolic alcalosis with pH>7.55, metabolic acidosis with pH< 7.25, hypocalcemia ( ionized calcium < 1)
- Global cost of disposables for CRRT (replacement fluids, filters)
- Safety (Adverse events considered to be RRT-related)

# Complications

- Cathéter
- Anticoagulation
- Electrolytes, acide-base
- Température
- Elimination substances non désirées

# Cathéter: insertion

TABLE 1 Incidence of complications during acute catheter insertion

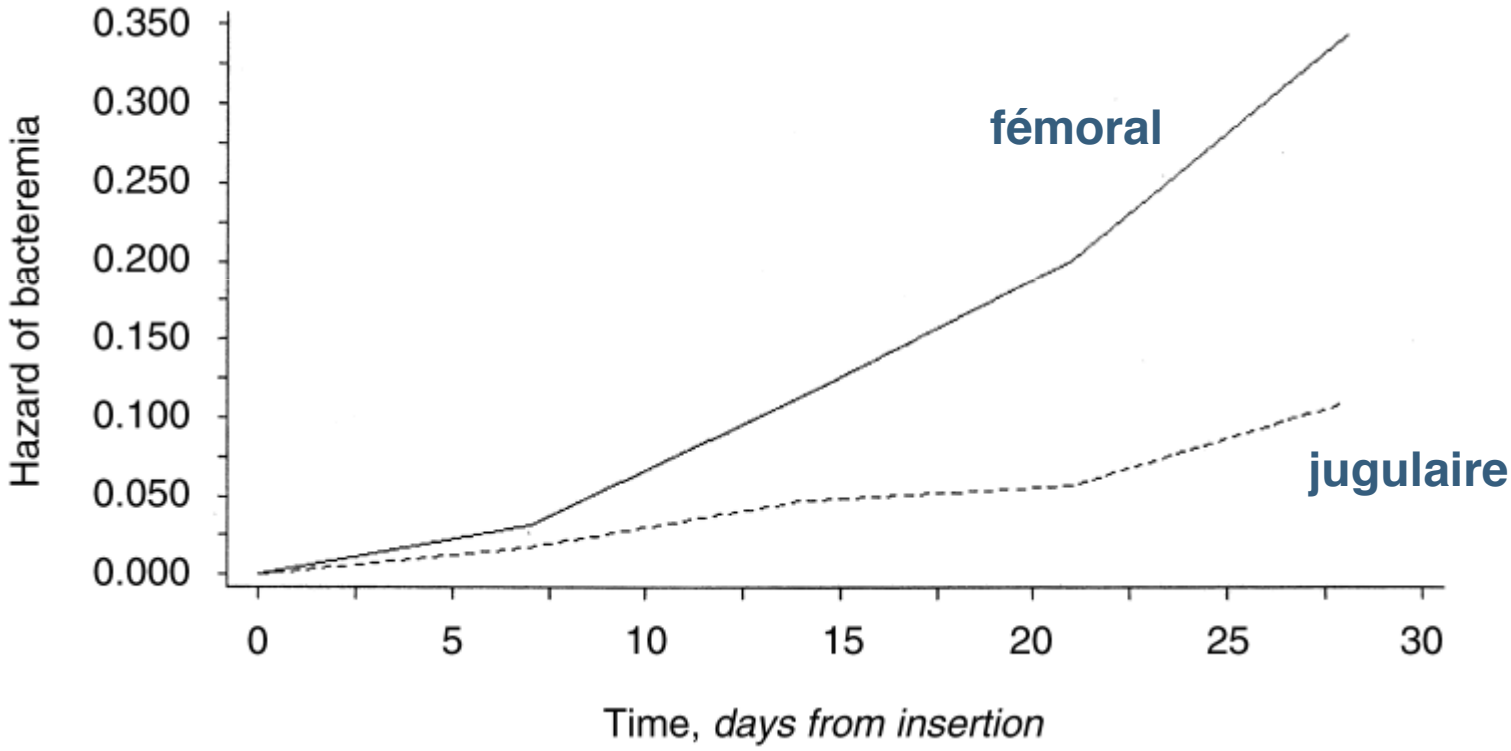
| Complication | Incidence (Range) |
|---|---|
| Arterial puncture | 4.4% (0–12%) |
| Local bleeding | 4.0% (0–16%) |
| Pneumo/Hemothorax[a] | 2.0% (1–3%) |
| Air embolism | 0.6% (1–1.3%) |
| Retroperitoneal bleeding[b] | 0.6% |

[a] Primarily reported for acute catheters inserted in subclavian vein. The incidence in studies including internal jugular catheters is ~0.6%.

[b] Acute dialysis catheters inserted in femoral vein.

Oliver MJ. Sem Dial 2001

# Cathéter: infection




Oliver MJ. Kidney Int 2000

# Anticoagulation

- Hémorragie (env 3.3%)
- TIH (caillotage filtre, thrombopénie)
- Hypocalcémie, alcalose métabolique (citrate)

# Problèmes acidobasiques / électrolytiques

- **Acide lactique / Hyperlactatémie:**

Dans l'EER clearance continue de 24 ml/mn
Soit environ 3% de la clearance totale de l'acide lactique !

Lactate dans solution de remplacement: dépression myocardique, augmentation catabolisme protéique

Lactate métabolisé en bicarbonate : 2000 mmol/j chez les patients en condition clinique stable.

→→ Remplacer par solutions bicarbonates si défaillance hépatique et/ou choc septique /circulatoire

*Levraut et al 1997*
*Heering et al, Kiendorf et al 1999*

# Problèmes acidobasiques / électrolytiques

- **Hypophosphatémie**

  Phosphate librement filtré (90% forme libre)

  **Pas** de phosphate dans liquide de réinjection/dialysat

  IRA accompagnée principalement d'hyperphosphatémie

**Si supplémentation nécessaire** :

- ✓ Dans liquide de réinjection/dialysat plutôt que apport phosphate parentéral (risque de calcifications vasculaires?)

***Since critically ill patients are prone to developing dialysis-induced hypophosphatemia, phosphorus must be monitored and supplemented if necessary. Since CRRT works continuously, serious derangement fluid and electrolyte homeostasis may occur in the absence of careful prescription and extremely vigilant monitoring.***

*Locatelli et al, Kidney Int 1998*

# Problèmes acidobasiques et électrolytiques

- Hypocalcémie (citrate)
- Hypokaliémie si non substitution
- Dysnatrémies
- Alcalose métabolique
- Production de $CO_2$ augmentée

# Température corporelle

- Liquide de réinjection préchauffé avant d'entrer dans le corps du patient
- Cave  température corporelle artificiellement normale !
- Si problème de régulation machine risque d'hypothermie!

# Elimination de substances: Nutrition

- **Pertes d'acide aminés** durant l'épuration extra-rénale continue conséquente: 0.2 g/L → 10-15g/j
- **Perte de protéines:** 5 g /j
- **Perte de glucose:** >25-50g/j
- **Perte vitamines hydrosolubles** (selenium, vitamine C…)

**Table 1** Nutritional requirements in patients with ARF (nonprotein calories).

| | |
|---|---|
| *Energy* | 20–30 kcal/kgBW/d* |
| Carbohydrates | 3–5 (max. 7) g/kgBW/d |
| Fat | 0.8–1.2 (max. 1.5) g/kgBW/d |
| *Protein (essential and non-essential amino acids)* | |
| Conservative therapy | 0.6–0.8 (max. 1.0) g/kgBW/d |
| Extracorporeal therapy | 1.0–1.5 g/kgBW/d |
| CCRT, in hypercatabolism | Up to maximum 1.7g/kgBW/d |

*Adapted to individual needs in case of underweight or obesity.

35kcal/kg/j?

Cano. ESPEN guidelines. Clin Nutrition 2006

# Elimination de substances:
# Antibiotiques

Lors de l'administration d'AB, il faut savoir:

- ✓ **Volume de distribution**
- ✓ **Liaison aux protéines**
- ✓ **Clearance totale**

  (Clearance de l'épuration extrarénale continue + clearance hépatique, pulmonaire, rénale résiduelle, etc..

# Elimination de substances:
# Adaptation de l'antibiothérapie

Aux soins intensifs:

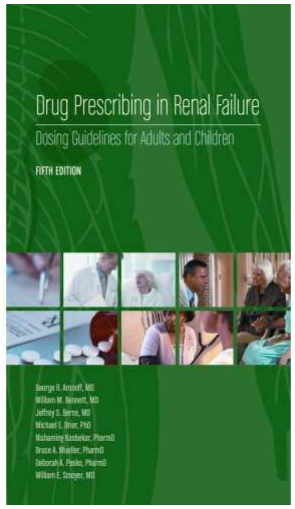
- **Volume de distribution erratique**
  (diminution liaison aux protéines, spoliation, surhydratation, capillary leak, défaillance circulatoire)

- **Liaison aux protéines erratique**
  ( diminution taux albumine, acidose, fièvre, urémie, acides organiques, autres médicaments)

- **Clearance non-rénale erratique**
  (flux sanguin hépatique diminué, activité enzymatique hépatique modifiée)

# Antibiotiques et épuration extra-rénale continue

Bennett, Standford guidelines




**Monitoring thérapeutique**
fréquent surtout si
marge thérapeutique étroite !

Trotman. Clin Inf Dis 2005
Bourquin. Nephrol Ther 2009

**Table 2. Antibiotic dosing in critically ill adult patients receiving continuous renal replacement therapy.**

| Drug | Dosage, by type of renal replacement therapy: CVVH | CVVHD or CVVHDF |
|---|---|---|
| Amphotericin B formulation | | |
| Deoxycholate | 0.4–1.0 mg/kg q24h | 0.4–1 mg/kg q24h |
| Lipid complex | 3–5 mg/kg q24h | 3–5 mg/kg q24h |
| Liposomal | 3–5 mg/kg q24h | 3–5 mg/kg q24h |
| Acyclovir | 5–7.5 mg/kg q24h | 5–7.5 mg/kg q24h |
| Ampicillin-sulbactam[a] | 3 g q12h | 3 g q8h |
| Aztreonam | 1–2 g q12h | 2 g q12h |
| Cefazolin | 1–2 g q12h | 2 g q12h |
| Cefepime | 1–2 g q12h | 2 g q12h |
| Cefotaxime | 1–2 g q12h | 2 g q12h |
| Ceftazidime | 1–2 g q12h | 2 g q12h |
| Ceftriaxone | 2 g q12–24h | 2 g q12–24h |
| Clindamycin | 600–900 mg q8h | 600–900 mg q8h |
| Ciprofloxacin[b] | 200 mg q12h | 200–400 mg q12h |
| Colistin | 2.5 mg/kg q48h | 2.5 mg/kg q48h |
| Daptomycin | 4 or 6 mg/kg q48h | 4 or 6 mg/kg q48h |
| Fluconazole[b] | 200–400 mg q24h | 400–800 mg q24h[c] |
| Imipenem-cilastatin[d] | 250 mg q6h or 500 mg q8h | 250 mg q6h, 500 mg q8h, or 500 mg q6h |
| Levofloxacin[b] | 250 mg q24h[e] | 250 mg q24h[e] |
| Linezolid[b] | 600 mg q12h | 600 mg q12h |
| Meropenem | 1 g q12h | 1 g q12h |
| Moxifloxacin | 400 mg q24h | 400 mg q24h |
| Nafcillin or oxacillin | 2 g q4–6h | 2 g q4–6h |
| Piperacillin-tazobactam[f] | 2.25 g q6h | 2.25–3.375 g q6h |
| Ticarcillin-clavulanate[g] | 2 g q6–8h | 3.1 g q6h |
| Vancomycin | 1 g q48h[e] | 1 g q24h[e] |
| Voriconazole[h] | 4 mg/kg po q12h | 4 mg/kg po q12h |

# Controverses

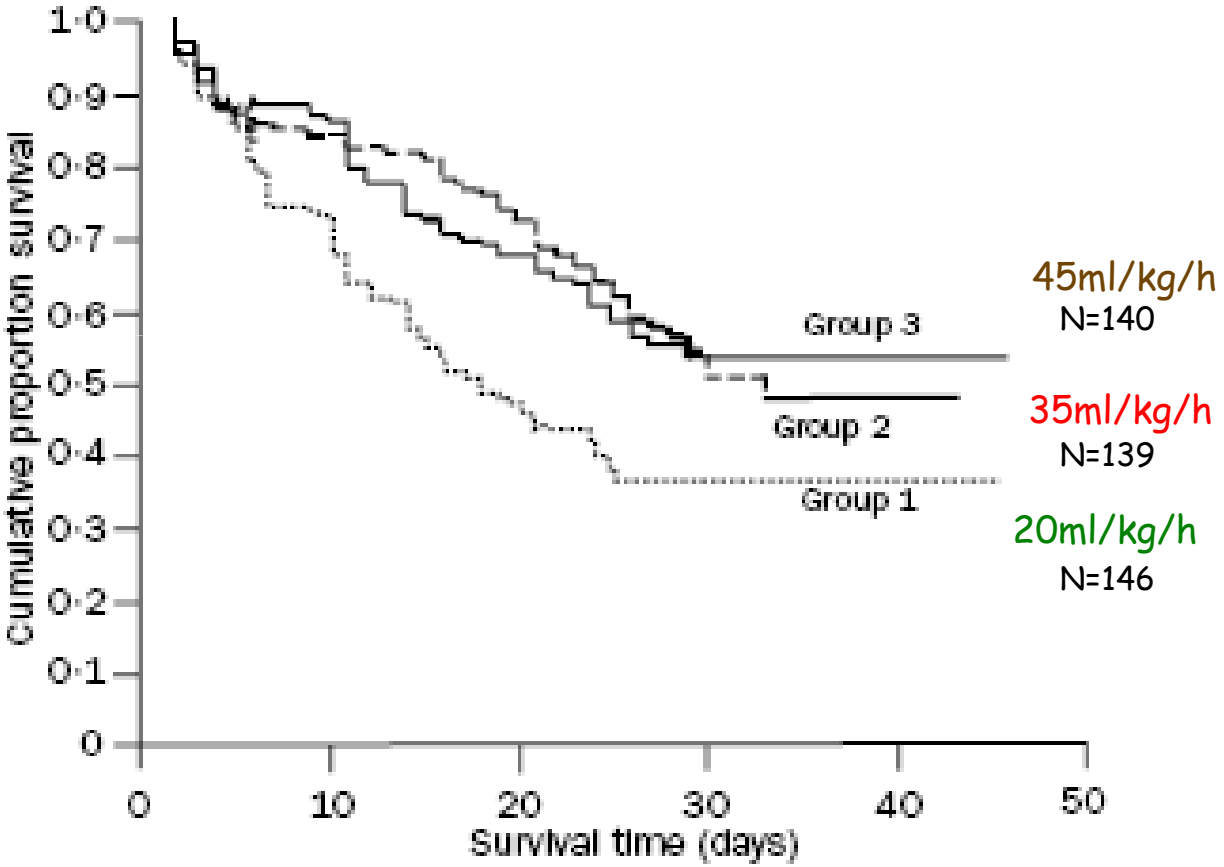
- **Dose** de dialyse
- Hémofiltration à **haut volume** dans le choc septique
- **Traitement continu versus hémodialyse intermittente**

# Dose dialyse

**Effects of different doses in continuous veno-venous haemofiltration on outcomes of acute renal failure: a prospective randomised trial**

Lancet 2000

*Claudio Ronco, Rinaldo Bellomo, Peter Homel, Alessandra Brendolan, Maurizio Dan, Pasquale Piccinni, Giuseppe La Greca*




45ml/kg/h
N=140

35ml/kg/h
N=139

20ml/kg/h
N=146

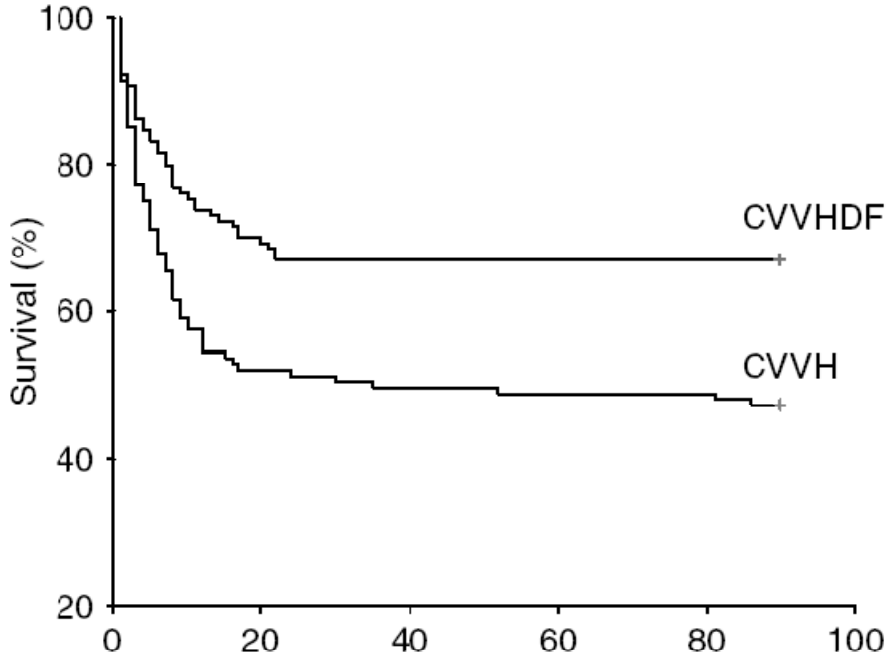
Figure 2: **Kaplan Meier estimation of survival rates in the three groups**

**CVVHF**
**Différents volume**

# Adding a dialysis dose to continuous hemofiltration increases survival in patients with acute renal failure

P Saudan[1], M Niederberger[2], S De Seigneux[1], J Romand[2], J Pugin[2], T Perneger[3] and PY Martin[1]

Kidney Int 2006




**CVVHDF vs CVVHF**

**= 42ml/kg/h**

| | CVVH group (*n*=102) | CVVHDF group (*n*=104) |
|---|---|---|
| Mean prescribed ultrafiltration dose (ml/kg/h) | 25±5 | 24±6 |
| Mean prescribed dialysis dose (ml/kg/h) | — | 18±5 |

ATN study

USA.
1124 patients.
NEJM 2008

Randomization (1:1)

**Intensive management strategy**

If hemodynamically stable (SOFA CVS score: 0–2), IHD 6 times/week (target Kt/V = 1.2–1.4/session)

If hemodynamically unstable (SOFA CVS score: 3–4), CVVHDF at 35 ml/kg/h or
SLED 6 times/week (target Kt/V = 1.2–1.4/session)

**Conventional management strategy**

If hemodynamically stable (SOFA CVS score: 0–2), IHD 3 times/week (target Kt/V = 1.2–1.4/session)

If hemodynamically unstable (SOFA CVS score: 3–4), CVVHDF at 20 ml/kg/h or
SLED 3 times/week (target Kt/V = 1.2–1.4/session)

**PAS de différences**

RENAL study

Australie.
1500 patients
NEJM 2009

Randomization (1:1)

**Normal-dose CRRT**

25 ml/kg/h of effluent generation in CVVHDF mode with post dilution replacement fluid

**Augmented-dose CRRT**

40 ml/kg/h of effluent generation in CVVHDF mode with post-dilution replacement fluid

# Habitudes locales : Doses d'épuration

| | IRA |
|---|---|
| Mode dialyse | CVVHDF |
| Cathéter | 11.5F |
| Débit pompe sang | 100-200ml/min |
| « Dose» | 30ml/kg/h |
| Dialysat | 1/3 |
| Réinjection | 2/3 |

# Prospective evaluation of short-term, high-volume isovolemic hemofiltration on the hemodynamic course and outcome in patients with intractable circulatory failure resulting from septic shock

Patrick M. Honore, MD; Jean Jamez, MD; Michel Wauthier, MD; Patrice A. Lee, PhD; Thierry Dugernier, MD; Bruno Pirenne, MD; Genevieve Hanique, MD; James R. Matson, MD

Crit Care Med 2000

Table 1. Characteristics at baseline of 20 patients with refractory septic shock treated with short-term high-volume hemofiltration (STHVH)

| No. | Age (Yrs) | Disease | Bacteria | Bilirubin (mmol/L) | APACHE II | Gender | Timing[a] (Hrs) | Weight (kg) | Dose[b] (L/kg) | Response[c] | Survival |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 73 | Peritonitis (diverticulitis) | *E. coli* | 93 | 30 | F | 3.25 | 60 | 0.58 | Y | Y |
| 2 | 70 | Community-acquired pneumonia | *Klebsiella* | 163 | 23 | F | 13.5 | 73 | 0.48 | Y | Y |
| 3 | 32 | Multiple trauma + septic shock (line sepsis) | *Serratia* | 143 | 35 | M | 1.5 | 66 | 0.53 | Y | Y |
| 4 | 35 | Multiple trauma + aspiration pneumonia | *S. aureus* | 111 | 25 | M | 6.75 | 75 | 0.46 | Y | Y |
| 5 | 32 | Community-acquired pneumonia | *S. aureus* | 45 | 37 | M | 2.75 | 65 | 0.53 | Y | Y |
| 6 | 48 | Septic shock + urinary tract infection | *E. coli* | 92 | 33 | M | 4 | 79 | 0.44 | Y | Y |
| 7 | 52 | Toxic strep syndrome | *Streptococcus* | 165 | 34 | F | 16.5 | 67 | 0.52 | Y | N |
| 8 | 66 | Pneumonia + pleural abscess | *Pseudomonas* | 85 | 31 | M | 12 | 63 | 0.55 | Y | N |
| 9 | 51 | Pneumonia | *Legionella* | 45 | 34 | M | 4.25 | 54 | 0.64 | Y | Y |
| 10 | 73 | Pneumonia + meningitis | Pneumococcus | 59 | 29 | F | 8.25 | 57 | 0.61 | Y | Y |
| 11 | 51 | Septic shock + urinary tract infection | *Enterococcus* | 68 | 30 | F | 6.5 | 67 | 0.52 | Y | Y |
| 12 | 69 | Peritonitis + diverticulitis | *E. coli* | 158 | 25 | M | 12.25 | 89 | 0.39 | N | N |
| 13 | 75 | Peritonitis (leaking anastomosis) | *E. coli* | 85 | 27 | F | 18 | 79 | 0.44 | N | N |
| 14 | 31 | Septicemia + pneumonia | Pneumococcus | 136 | 37 | M | 20.25 | 76 | 0.46 | N | N |
| 15 | 31 | Septicemia + pneumonia | Pneumococcus | 102 | 28 | F | 15 | 78 | 0.44 | N | N |
| 16 | 49 | Septicemia + meningitis | Pneumococcus | 49 | 35 | M | 9 | 81 | 0.43 | N | N |
| 17 | 71 | Community-acquired pneumonia | *E. coli* | 154 | 36 | M | 13.75 | 87 | 0.40 | N | N |
| 18 | 70 | Leaking anastomosis + peritonitis | *E. coli* | 89 | 31 | M | 7.25 | 91 | 0.38 | N | N |
| 19 | 74 | Nosocomial pneumonia | Pneumococcus | 67 | 28 | F | 17 | 85 | 0.41 | N | N |
| 20 | 68 | Leaking anastomosis + peritonitis | *Enterococcus* | 104 | 35 | F | 10.25 | 112 | 0.31 | N | N |

# Hémofiltration à haut débit (étude Ivoire)

## Impact of High-Volume Veno-Venous Continuous Hemofiltration in the Early Management of Septic Shock Patients With Acute Renal Failure

Open label randomized multicenter controlled trial on two parallel groups of patients with **septic shock and acute renal failure** admitted to ICU, treated **early either by high volume (70 ml/kg/h) or by standard volume (35 ml/kg/h) haemofiltration**.

**Intervention**

High volume (70 ml/kg/h) vs. standard volume (35 ml/kg/h) haemofiltration **during 96 hours**. Further renal replacement therapy (if haemofiltration, only standard volume is allowed) may be used according to investigator decision.

Primary endpoint

All cause 28-day mortality.

**Statistical aspects**

460 patients are planned to be included (230 in each group). A 15 % absolute reduction in 28-days all-cause mortality in the high volume group compared with the standard group is expected. Duration of the study: 3 years.

**PAS DE RESULTATS PUBLIES MORTALITE INFERIEURE A CELLE ATTENDUE**

Honoré. Clinical trials.com 2006

# Use of High Volume Hemofiltration in patients with refractory septic shock and acute kidney injury

**Choc septique réfractaire:** critères Bone, dose de noradrénaline > 0.2 µg/kg/min

**Insuffisance rénale aiguë:** selon classification RIFLE

**CRRT:** CVVHDF habituel

**Dose:** 70 ml/kg/h

**Accès:** cathéter 13 F

**Solution remplacement:** Hémosol®

**Timing:** dans les 24h du choc septique réfractaire et jusqu'à 96h ou résolution du choc

# Use of High Volume Hemofiltration in patients with refractory septic shock and acute kidney injury

**3 ans**
(juillet 2007-juillet 2010)
**55 patients**

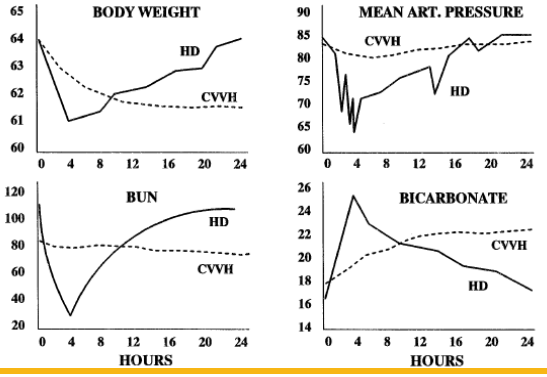
**Mortalité 63%**
APACHE II 60.5%
SAPS II 66%

**297** patients dialysés aux soins intensifs durant cette période dont **19 %** avec choc septique réfractaire

**pas de différence entre mortalité observée et mortalité attendue par ces 2 scores**

Bourquin. Nephrohug

# Continue vs intermittente

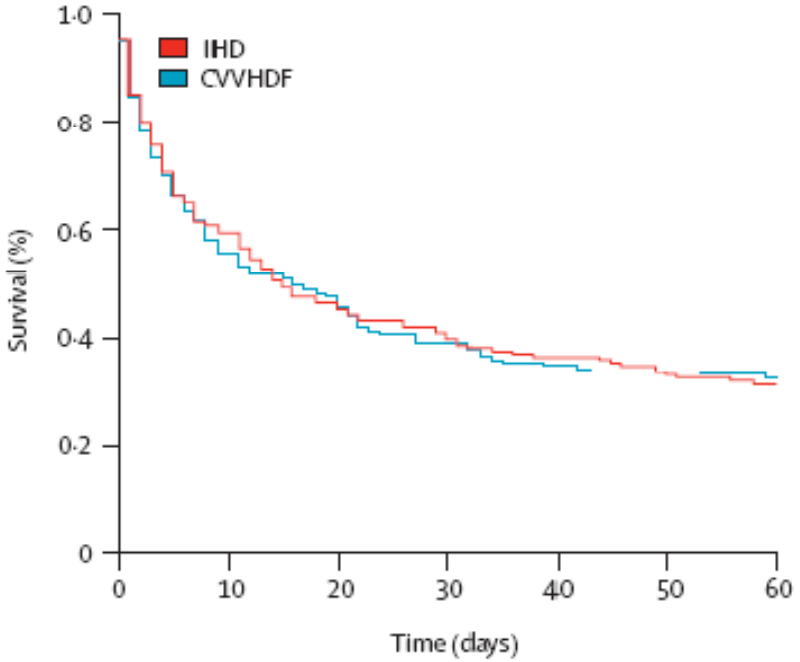



| | HD conventionelle (intermittente) | Techniques continues |
|---|---|---|
| « Shift » osmotique / oedème cérébral | — | + + |
| Tolérance hémodynamique | — | + + |
| Equilibration volume - électrolytes/24H | — | + + |
| Support nutritionnel | — | + |
| Elimination cytokines | — | + ? |
| Hyperkaliémie aigüe | + + | — |
| Dose / contrôle urémie | ++ *daily* | + *mais comment* |
| Anticoagulation /saignement | + + | — — |
| Coagulation filtre | + + | — — |
| Mobilité patient | + + | — — |
| Perte nutriments, vit, oligo-élements | – | — |
| Adaptation AB | + + | Guidelines? |
| Coût | + + | — — |
| Outcome rénal et mortalité | ????? | ????? |

# Continuous venovenous haemodiafiltration versus intermittent haemodialysis for acute renal failure in patients with multiple-organ dysfunction syndrome: a multicentre randomised trial

Christophe Vinsonneau, Christophe Camus, Alain Combes, Marie Alyette Costa de Beauregard, Kada Klouche, Thierry Boulain, Jean-Louis Pallot, Jean-Daniel Chiche, Pierre Taupin, Paul Landais, Jean-François Dhainaut, for the Hemodiafe Study Group*

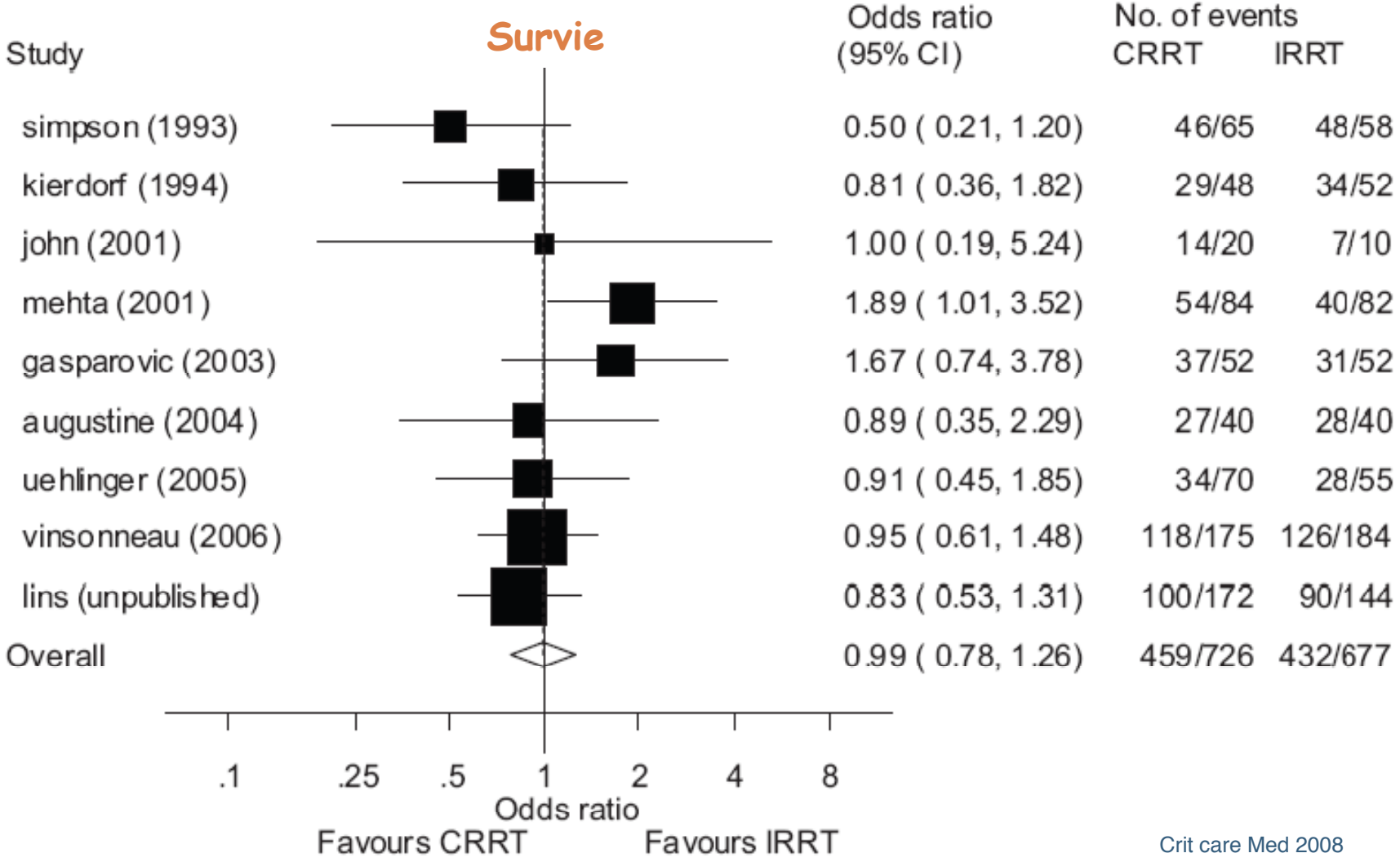
Lancet 2006




| | Intermittent haemodialysis (n=184) | Continuous venovenous haemofiltration (n=175) | p value |
|---|---|---|---|
| Hypotension* | 72 (39%) | 61 (35%) | 0·47 |
| Bleeding event† | 13 (7%) | 12 (7%) | 0·89 |
| Thrombocytopenia | 22 (12%) | 31 (18%) | 0·12 |
| Hypoglycaemia | 12 (7%) | 7 (4%) | 0·42 |
| Hypophosphataemia | 13 (7%) | 14 (8%) | 0·71 |
| Hypothermia | 10 (5%) | 31 (17%) | 0·0005 |
| Arrhythmia | 18 (10%) | 9 (5%) | 0·15 |
| Catheter infection | 2 (1%) | 3 (2%) | 0·95 |

# Continuous versus intermittent renal replacement therapy for critically ill patients with acute kidney injury: A meta-analysis*

Sean M. Bagshaw, MD, MSc; Luc R. Berthiaume, MD; Anthony Delaney, MBBS, MSc; Rinaldo Bellomo, MD




Crit care Med 2008

# Indications particulières

- Intoxications médicamenteuses
- Dysthermies
- Insuffisance cardiaque terminale
- Insuffisance hépatique terminale

**Souvent discutées au cas par cas**

# W. J Kolff. 1944

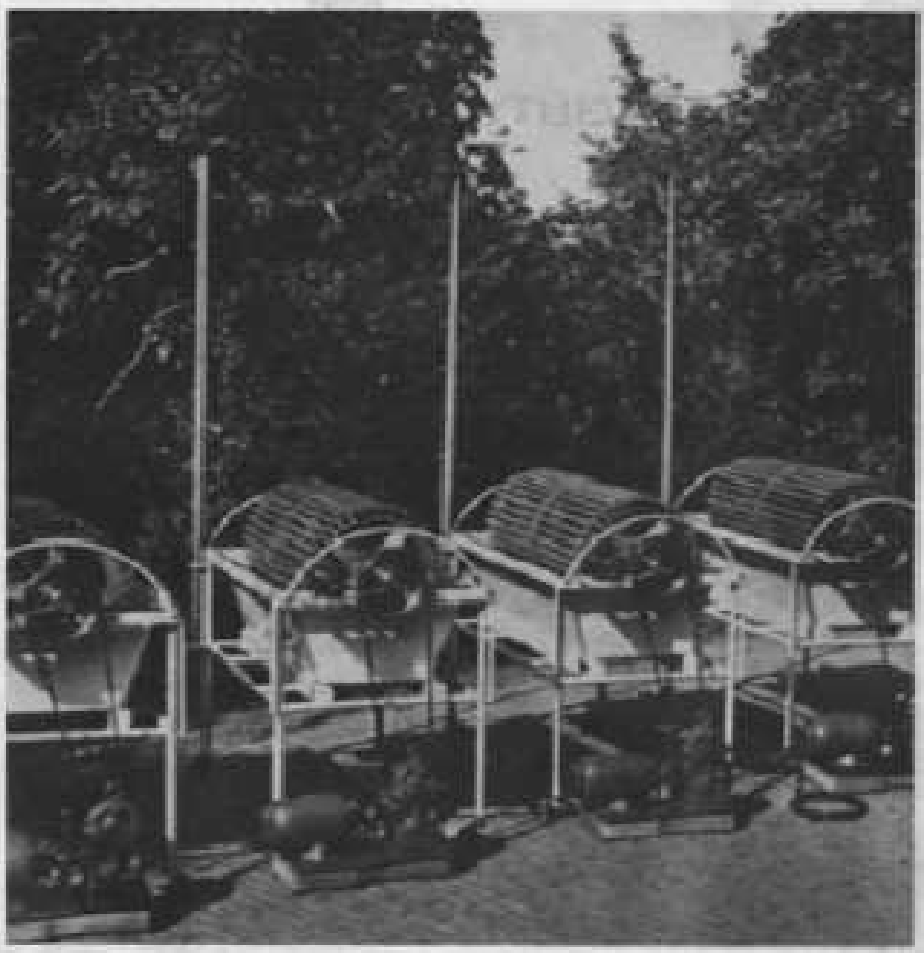


Figure 1. The first rotating artificial kidneys awaiting the end of the war to be sent to other countries. In the garden of the hospital at Kampen, September 1944.

# Prismaflex (Hospal-Gambro)

# Blog de néphrologie


**Pages** avec articles en français sur différents sujets néphrologiques & protocoles du service. **Billets** avec actualité néphrologique. Indexation par **mots-clefs** et **catégories**. **Liens** avec autres blogs et sites néphrologiques. Possibilité de laisser des **commentaires** et de **s'abonner.**

**http://nephrohug.com**

**MERCI DE VOTRE ATTENTION !**