



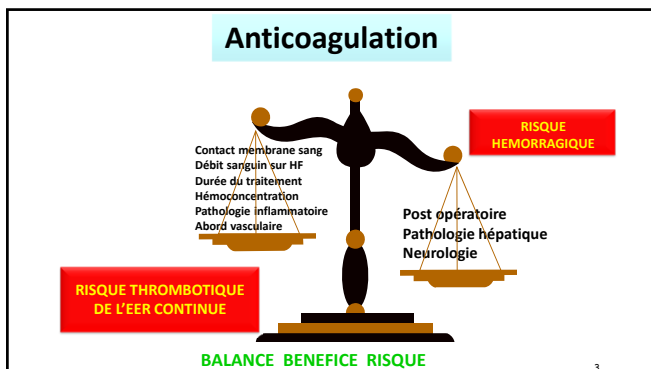
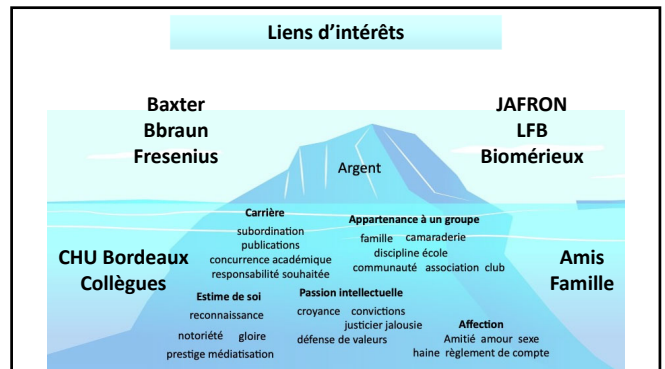
Anticoagulation et EER






CHU BORDEAUX
CENTRE HOSPITALIER
UNIVERSITAIRE
BORDEAUX

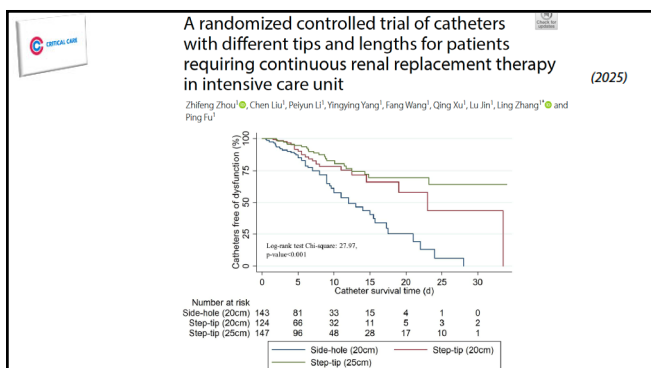
Pr Olivier JOANNES-BOYAU
Pôle Anesthésie-Réanimation, CHU Bordeaux
Olivier.joannes-boyau@chu-bordeaux.fr



Coagulation

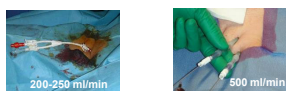
Origine des thromboses de filtres:

- 50% – KT (insertion, nursing, cause locale...)
- 37% = Coagulopathie
- 13% = Technique

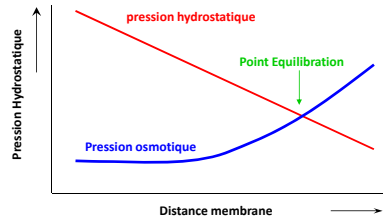



Catheters

- Type:**
 - Trous latéraux
 - Baïonnette
 - Canon de fusil
- Structure interne:**
 - Double ou deux catheters simples

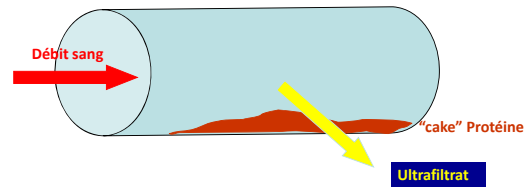
Convection



7

Fraction Filtration

$$FF = \frac{\text{Pre} + \text{Post} + \text{Perte patient}}{\text{Débit Sg} + \text{Pre}}$$



Quel Anticoagulant ?

HEPARINE voie générale

Héparine

Héparine non fractionnée

- Dose ajustée
 - Plaquettes > or < 50.000
 - APTT (TCA) ou héparinémie
 - risque hémorragique
 - Poids corporel
- Co-enzyme : AT souvent diminué chez les patients de réanimation
- Doses = Bolus 15-30 UI/kg puis 5-15 UI/kg/h

Héparine : Risques ?

Thrombopénie induite par l'héparine

Après 1 semaine.
Thrombocytopénie isolée
Ou associée à des phénomènes de thrombose

Morinière P et al. Blood Purif..

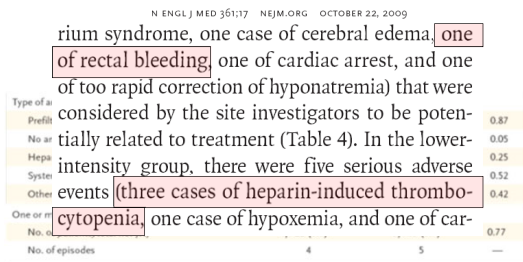
Héparine : les risques ?

N ENGL J MED 359:1 WWW.NEJM.ORG JULY 3, 2008
Intensity of Renal Support in Critically Ill Patients
with Acute Kidney Injury

The VA/NIH Acute Renal Failure Trial Network*

Event	Intensive Management Strategy (n=563)		Less-Intensive Management Strategy (n=561)		P-Value
	number	percent	number	percent	
Study days	7572		7227		
Reported serious adverse events (SAEs)	6681		4921		
Bleeding	7 (1.2)	9 (0.1)	6 (1.1)	4 (0.3)	0.79

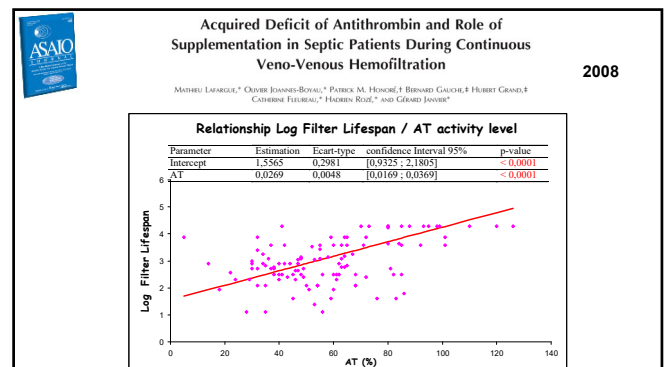
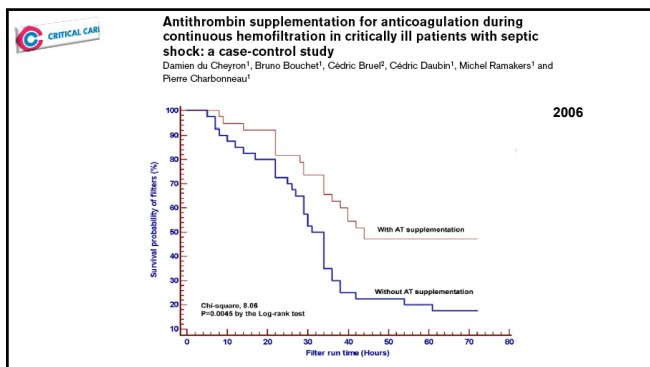
Héparine : les risques ?



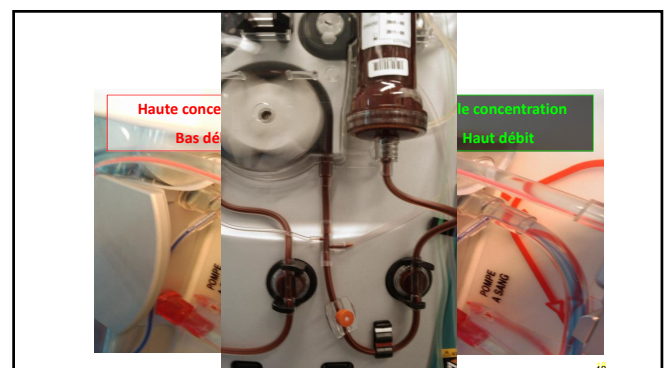
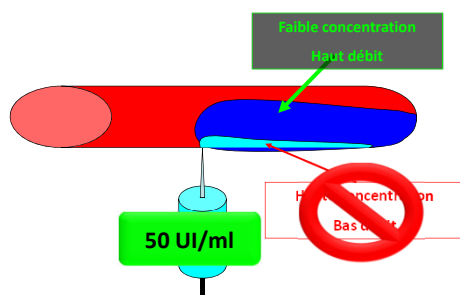
Héparine

Héparine non fractionnée

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- Doses = Bolus 15-30 UI/kg puis 5-15 UI/kg/h



Héparine



Quel anticoagulant ?

HEPARINE voie générale ↔ Risque élevé de saignement

HEPARINISATION régionale ?

Quel anticoagulant ?

HEPARINE voie générale ↔ SAFE

HEPARINISATION régionale ↔ Difficultés techniques

HBPM ?

HBPM

- Action anti Xa et moindre action antithrombine
- Réduit le risque hémorragique
- Très utilisées chez l'IRC
- Moins maniables en réanimation
 - surveillance difficile.
 - Accumulation chez l'insuffisant rénal
 - Antagonisation partielle par la protamine

De Pont AC, et al. *Crit Care Med.* 2000
Joannidis M, et al. *Int Care Med.* 2007

Quel anticoagulant ?

HEPARINE voie générale ↔ SAFE

HEPARINISATION régionale ↔ Difficultés techniques

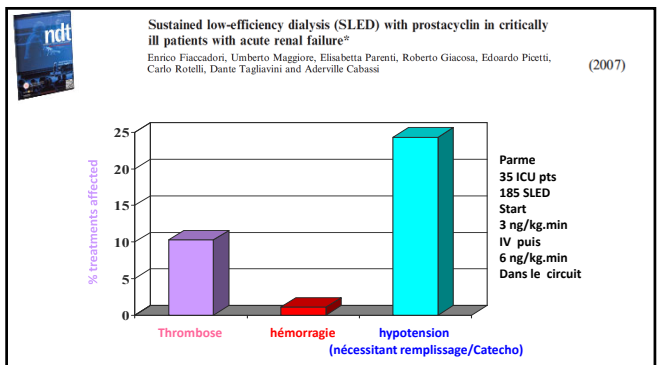
HBPM ↔ Peu maniable en réa

PROSTACYCLINE ?

Prostaglandines

Prostacycline (PGI₂)

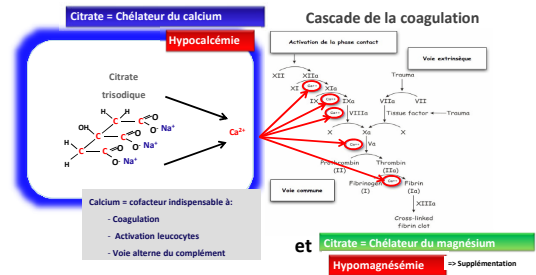
- Antiagrégant.
- Puissante action vasodilatatrice.
- En association avec HBPM ou HNF
- Coût



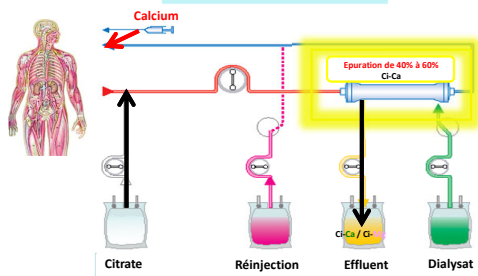
Quel anticoagulant ?

HEPARINE voie générale	↔	SAFE
HEPARINISATION régionale	↔	Difficultés techniques
HBPM	↔	Peu maniable en réa
PROSTACYCLINE	↔	Risque hémorragique ⚠
CITRATE ?		Effets secondaires ⚠

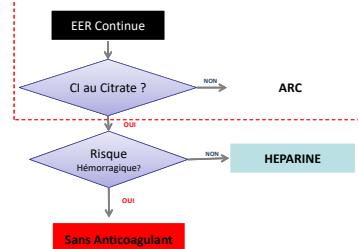
Citrate & Coagulation



Citrate



KDIGO : Kidney Disease Improving Global Outcomes



Épuration extrarénale en réanimation adulte et pédiatrique.

2014

Champs 2.3 : Anticoagulation

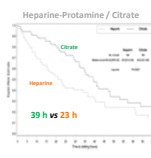
- 2.3.1 Chez le patient à haut risque hémorragique ou présentant une coagulopathie
- 2.3.2 Chez le patient à faible risque hémorragique ne nécessitant pas d'anticoagulation systémique
- 2.3.3 Chez le patient nécessitant une anticoagulation systémique

- 2.3.1.1 En épuration intermittente, il faut probablement ne pas faire d'anticoagulation systémique. Accord faible
- 2.3.1.2 En épuration continue, il faut probablement privilégier, sauf contre-indication, le recours à l'anticoagulation régionale au citrate par rapport à l'absence d'anticoagulation. Accord fort
- 2.3.2.1 En épuration intermittente, il faut probablement privilégier l'héparine non fractionnée ou de bas poids moléculaire par rapport à d'autres anticoagulants systémiques. (Avis d'experts) Accord fort
- 2.3.2.2 En épuration continue, chez l'adulte, il faut probablement privilégier, sauf contre-indication, l'anticoagulation régionale au citrate, dans le but de prolonger la durée de vie du circuit. Accord faible

Gattas et al. trial

212 patients

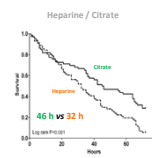
Moniteur : 5 Primaflex (CVVHD) 2 Aquarius Solutions : Primaflex 300 Personal



CASH trial

139 patients

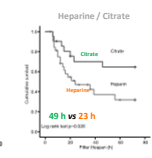
Moniteur : Dileco (CVVH) Solutions : HF Citrate HF3206

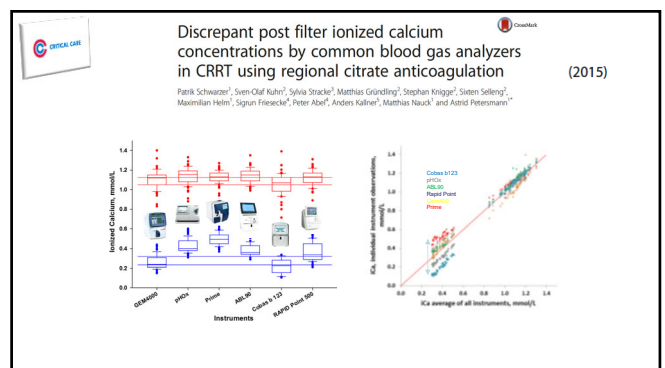
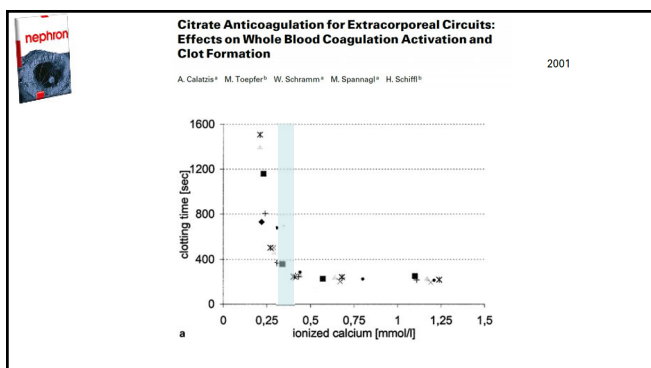
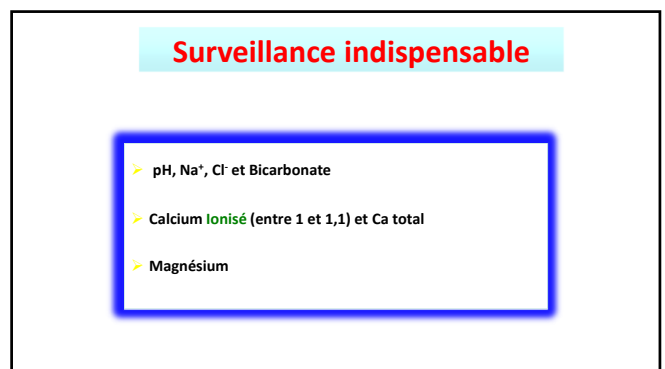
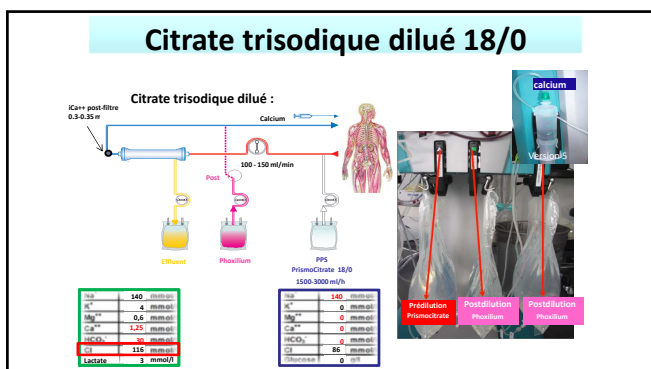
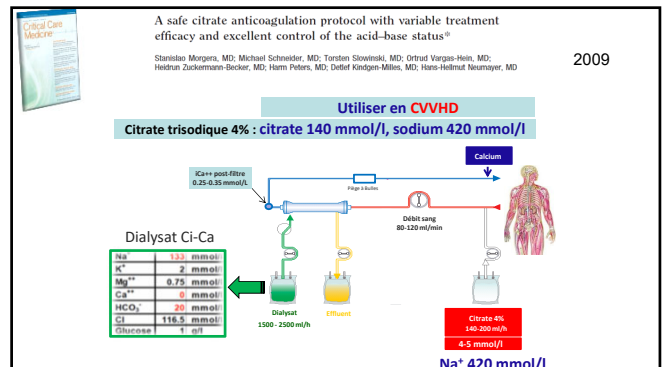
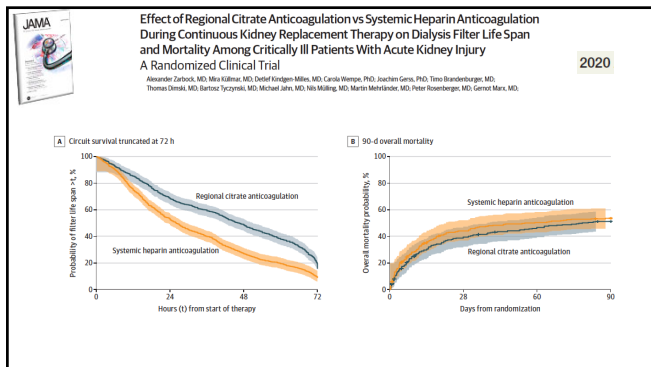


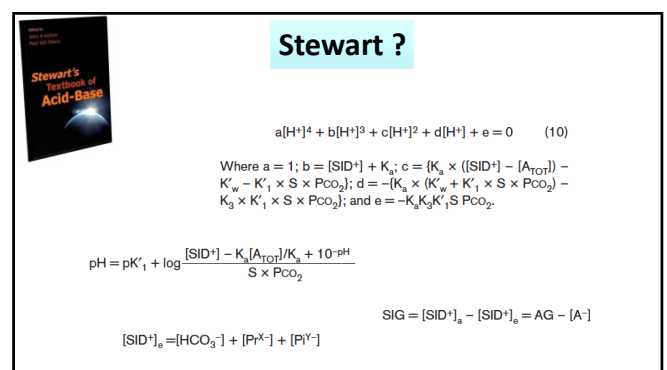
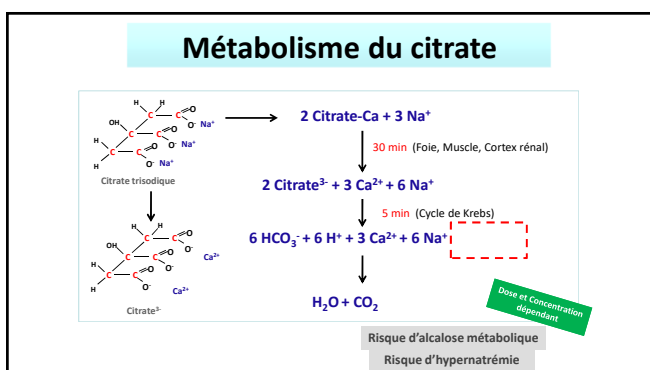
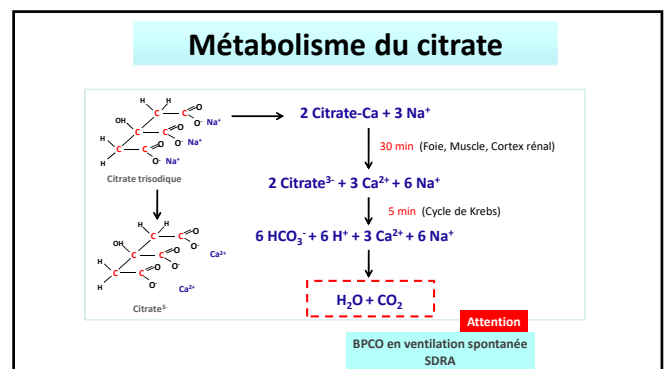
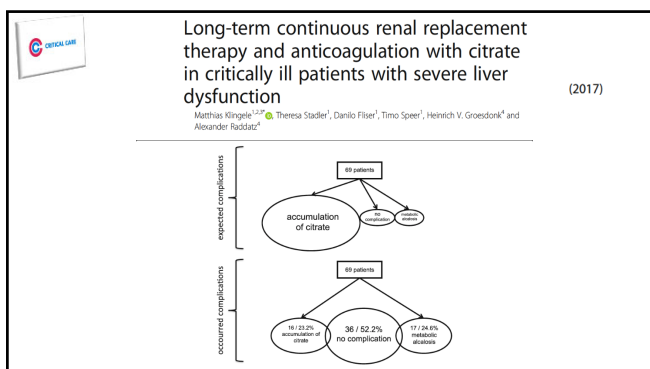
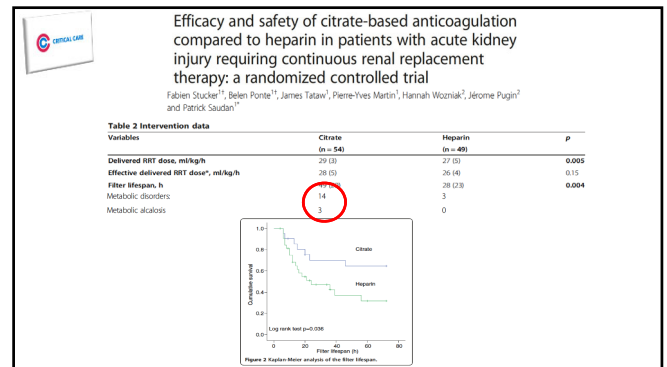
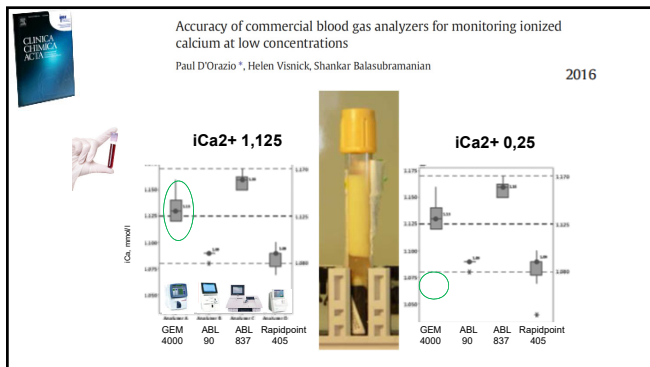
Stucker et al. trial

103 patients

Moniteur : Primaflex (CVVHD) Solutions : Primaflex 300 Personal







Stewart ?

Peut-on faire plus simple ?

Stewart

CATIONS	ANIONS
Na ⁺ 140	Cl ⁻ 105
	HCO ₃ ⁻ 25
	Alb
	anions indosés (XA- lactate)
K ⁺	
Ca ⁺⁺	
Mg ⁺⁺	

SIDe

SIG

SIDa

Stewart PA, Resp Physiol 1978; Fencl V, Resp Physiol 1993

Acide / Base

Na⁺

Cl⁻

HCO₃⁻

Prot

Group UA (lact)

OH⁻

Le bicarbonate de sodium alcalinise

Na⁺ HCO₃⁻

HCO₃⁻ + H⁺

H₂CO₃

CO₂ + H₂O

Effet alcalinisant ddp de capacité à épurer CO₂

Na⁺

Cl⁻

HCO₃⁻

Prot

Phosph UA (lact)

OH⁻

SID

SID

Acide / Base

Na⁺

Cl⁻

HCO₃⁻

Prot

Phosph UA (lact)

OH⁻

Le lactate de sodium acidifie

L'acétate de sodium acidifie

Le citrate de sodium acidifie

lactate⁻ Na⁺

= anions organiques

Na⁺

Cl⁻

HCO₃⁻

Prot

Phosph UA (lact)

OH⁻

SID

SIG

Acide / Base

Na⁺

Cl⁻

HCO₃⁻

Prot

Phosph UA (lact)

OH⁻

Le lactate de sodium alcalinise

L'acétate de sodium alcalinise

Le citrate de sodium alcalinise

= anions métabolisables

CO₂ + H₂O

lactate⁻

lactate⁻

Effet alcalinisant ddp de la capacité à métaboliser l'anion

Na⁺

Cl⁻

HCO₃⁻

Prot

Phosph UA (lact)

OH⁻

SID

SID

Substitution Calcique

Asservi : Qs / Dose Citrate / Dose épuration

Présence Ca⁺ dans substitution

CaCl₂ >>> Gluconate de Ca

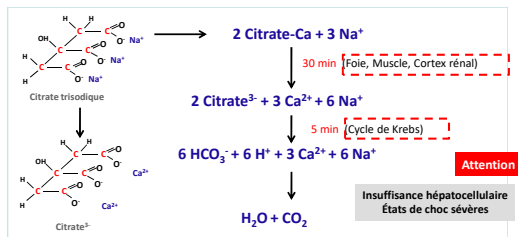
Si CaCl₂ : Sur circuit (le plus proximal du patient)

ou sur VVC

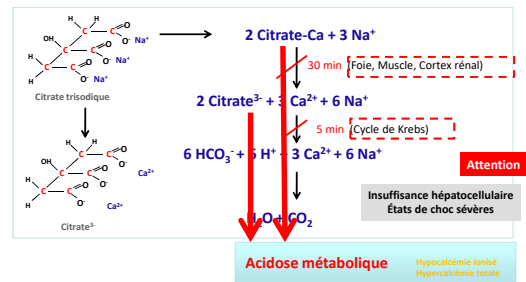
pas sur VVP...

Il faut disposer de Ca⁺⁺ patients avant mise en route de l'AR Ca/Cl

Métabolisme du citrate



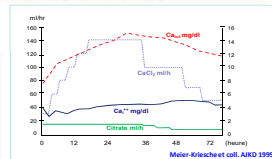
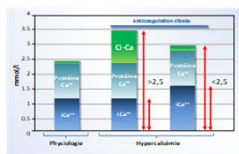
Métabolisme du citrate



Syndrome d'accumulation de citrate

Ca total > 2,5
Ca ionisé

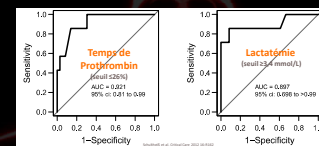
Il est conseillé d'arrêter l'anticoagulation régionale citrate si :
Calcium total > 3 mmol/l
Ratio Calcium total / Calcium ionisé > 2,5



Toute hypo iCa résistante à l'ajout de la supplémentation calcique
 $\Rightarrow$ Dosage Ca Tot/ iCa

Le côté obscur du citrate ..

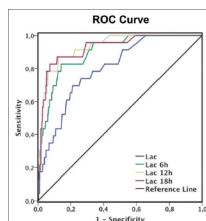
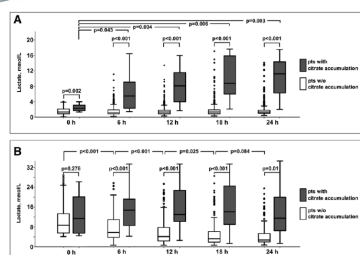
Le syndrome d'accumulation



hépatique

Hyperlactatémie, Lactate Kinetics and Prediction of Citrate Accumulation in Critically Ill Patients Undergoing Continuous Renal Replacement Therapy With Regional Citrate Anticoagulation

2017



Prescription ?

Je sais pas si c'est la couleur...

... mais je me sens pas bien!

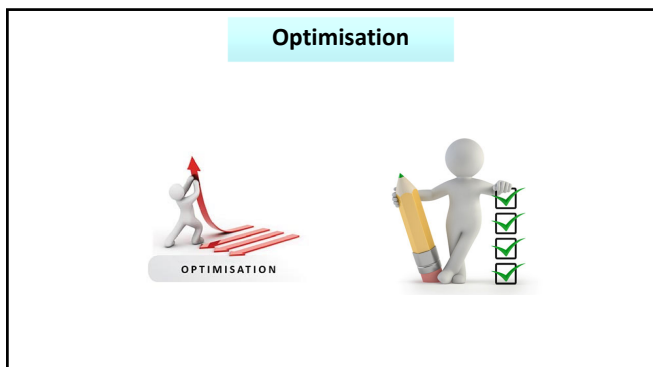




61



62



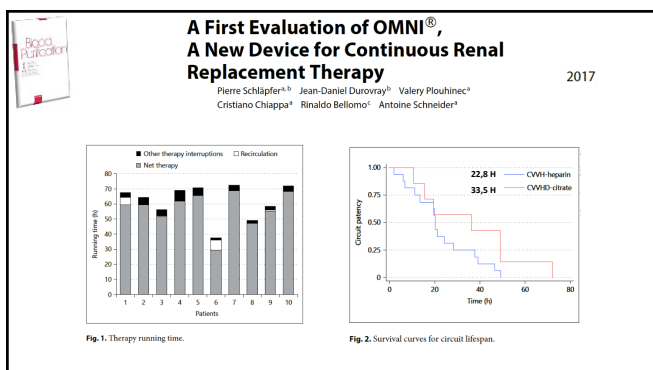
Optimizing continuous renal replacement therapy in the ICU: a team strategy

Olivier Joannes-Boyau^a, Lionel Velly^b, and Carole Icha^a

2018,

KEY POINTS

- The successful completion of a RRT session is extremely dependent on the team's experience and the involvement of physicians and nurses.
- Organization, training, evaluation and protocols are the key points of the team's efficiency.
- The training should be repeated, including basic principles and more advanced concepts. Simulation will probably become the cornerstone of the training program in the future, especially in ICUs with high nurse's turnover.
- RRT experts and champions should be identified and trained to write protocols, provide hands-on training and evaluate the team's performance.
- This complex approach is now encouraged and facilitated by the implementation of platforms addressing the problem of data collection and management with current machines.



The Novel PrisMax Continuous Renal Replacement Therapy System in a Multinational, Multicentre Pilot Setting

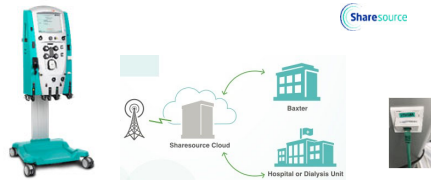
Marcus Broman^a, Max Bell^{b,c}, Olivier Joannes-Boyau^d, Claudio Ronco^{a,f}

2018,

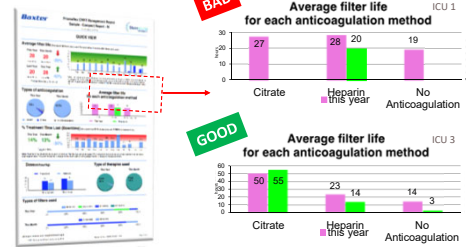
Table 1. Comparison of key parameters between the previous Prismaflex system and the novel PrisMax system

	Prismaflex	PrisMax	Significance level, p value
Priming time, min	35.27±119.58	24.07±43.03	0.4156
Mean ± SD per filter	n = 4,230	n = 305	
Filter life span, h	25.76±22.51	32.12±29.83	0.0007
Mean ± SD per filter	n = 4,181	n = 305	
Blood pump stops, min	34.12±254.37	6.56±9.54	<0.0001
Mean ± SD per filter	n = 4,181	n = 283	
Bag time change, min	1.66±1.17	0.82±0.31	<0.0001
Mean ± SD per filter	n = 3,640	n = 283	
Alarms informational, n	15,62±22.64	11,97±8.64	<0.0001
Mean ± SD per filter	n = 4,181	n = 305	
Alarms malfunction, n	0.90±2.11	0.22±0.70	<0.0001
Mean ± SD per filter	n = 4,181	n = 305	

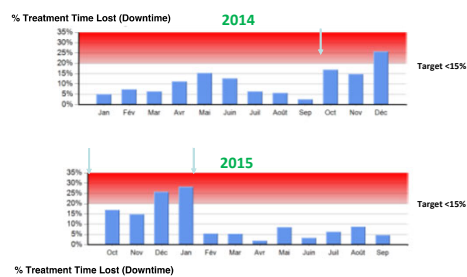
DOWNTIME



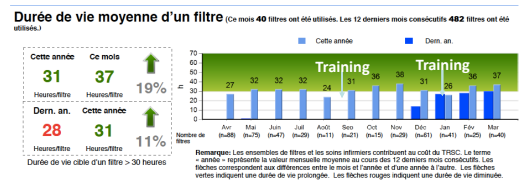
BAD



Marseille



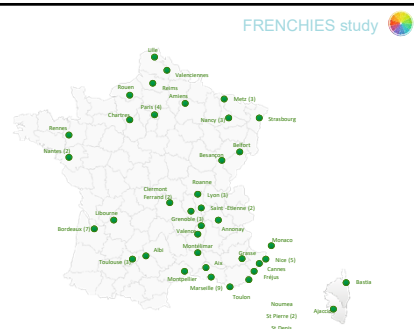
Bordeaux

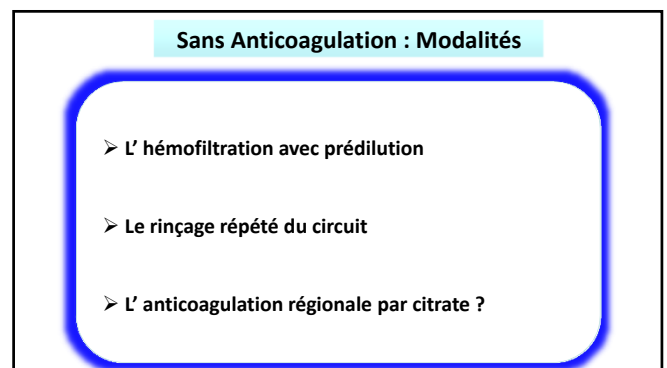
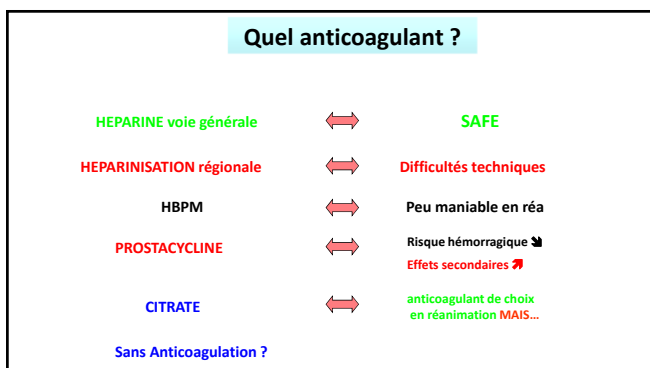
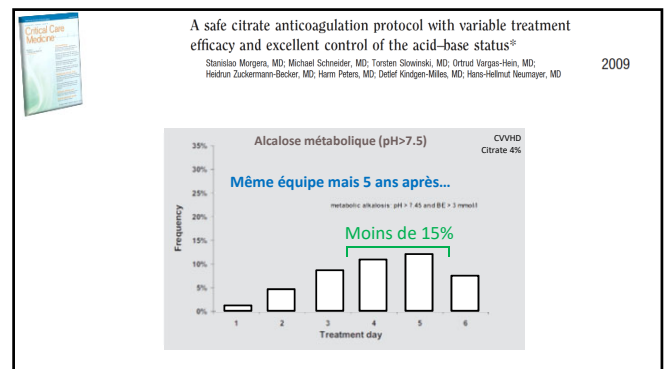
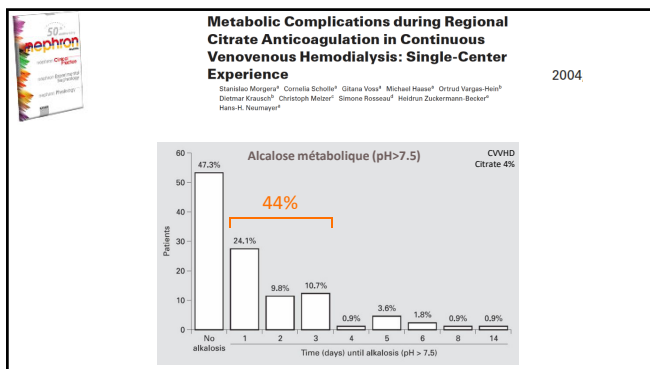
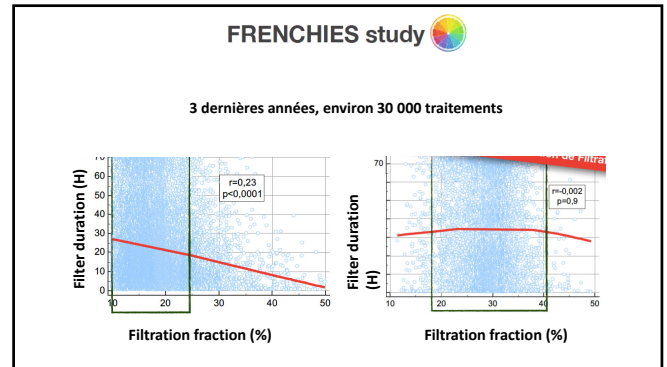
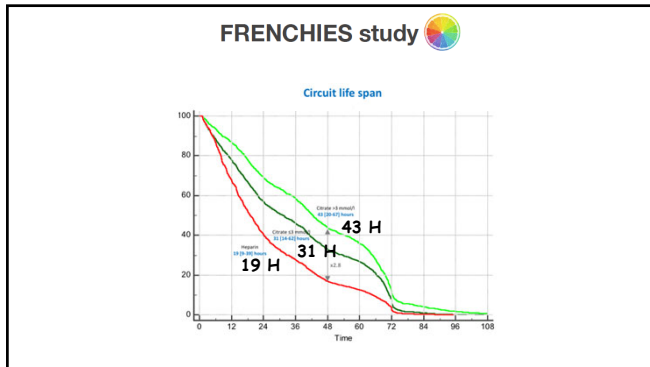


FRENCHIES study
FRENch Citrate and Heparin In Extra-renal Support
 Lionel Velly, Carole Ichai, Olivier Joannes-Boyau, Julien Pottecher, Thomas Rimmelé, Romain Deraroy, Olivier Langeron



78 Réas

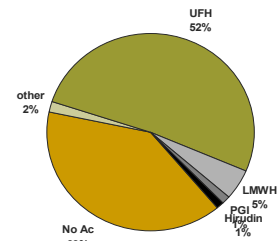




Quel anticoagulant ?

HEPARINE voie générale	↔	SAFE
HEPARINISATION régionale	↔	Difficultés techniques
HBPM	↔	Peu maniable en réa
PROSTACYCLINE	↔	Risque hémorragique 🩸 Effets secondaires 🦋
CITRATE	↔	anticoagulant de choix en réanimation MAIS...
Sans Anticoagulation	↔	Si risque hémorragique

Continuous renal replacement therapy: A worldwide practice survey (B.E.S.T. Kidney)



Uchino S, *Intensive Care Med* 2007

CONCLUSION

- Ne représente qu' 1/3 des causes de thromboses
- Gestion optimale des autres facteurs
- Difficulté accrue dans le sepsis
- Surveiller l'AT et le fibrinogène
- Privilégier l' anticoagulation:
 - A demi-vie courte
 - Antagonisable
 - Fonction des habitudes de service

Conclusion

- Le citrate une anticoagulation « métabolique »

➤ **Le citrate est une anticoagulation régionale...aux conséquences métaboliques générales**

- FORMATION +++