

A close-up photograph of several lemons. The lemons are bright yellow with some green at the stems. The stems are green and have a small brown circular mark, resembling a navel. The text is overlaid in the center of the image.

Citraat als
regionale
anticoagulans

Growing scientific interest

Clear benefits described

Medline Research: 997 applications on 5 pages

Date	Number Publications per year
März 1961	1
März 1965	2
März 1967	2
März 1969	3
März 1971	2
März 1973	2
März 1975	1
März 1977	1
März 1979	2
März 1981	2
März 1983	1
März 1985	1
März 1987	2
März 1989	2
März 1991	2
März 1993	3
März 1995	2
März 1997	3
März 1999	1
März 2000	3
März 2002	5
März 2004	10
März 2006	7

regional citrate anticoagulation

Number Publications per year

82: [Hocken AG, Hurst PL.](#)
Citrate regional anticoagulation in h
Nephron. 1987;46(1):7-10.
PMID: 3600914 [PubMed - indexed for

83: [Boyd LM, Felton SE.](#)
Regional citrate anticoagulation: a v
ANNA J. 1986 Oct;13(5):267-8. No abstr
PMID: 3640602 [PubMed - indexed for

84: [Corattivi V, Eekstein EC.](#)
Regional platelet concentration in b
Microvasc Res. 1986 Sep;32(2):261-70.
PMID: 3762431 [PubMed - indexed for

85: [von Brecht JH, Flanigan MJ, Freeman F](#)
Regional anticoagulation: hemodial
Am J Kidney Dis. 1986 Sep;8(3):196-201
PMID: 3752075 [PubMed - indexed for

86: [Boyd LM, Felton SE, Highfill BK, Unde](#)
Regional citrate anticoagulation: a r
J Nephrol Nurs. 1985 Jul-Aug;2(4):162-
PMID: 3849581 [PubMed - indexed for

87: [Ashouri OS.](#)
Regional sodium citrate anticoagula
Uremia Invest. 1985-1986;9(1):45-51.
PMID: 3835743 [PubMed - indexed for MEDLINE]

88: [Pinnick RV, Wiegmann TB, Diederich DA.](#)
Regional citrate anticoagulation for hemodialysis in the patient at high risk for bleeding.
N Engl J Med. 1983 Feb 3;308(5):258-61. No abstract available.
PMID: 6848936 [PubMed - indexed for MEDLINE]

89: [Seaton RD, Duncan KA, Pinnick RV, Diederich DA, Wiegmann TB.](#)
Regional citrate anticoagulation in chronic hemodialysis patients.
Trans Am Soc Artif Intern Organs. 1983;29:414-8.
PMID: 6673262 [PubMed - indexed for MEDLINE]

90: [MORITA Y, JOHNSON RW, DORN RE, HALL DS.](#)
Regional anticoagulation during hemodialysis using citrate.
Am J Med Sci. 1961 Jul;242:32-43. No abstract available.
PMID: 13772690 [PubMed - indexed for MEDLINE]

Items 81 - 90 of 90

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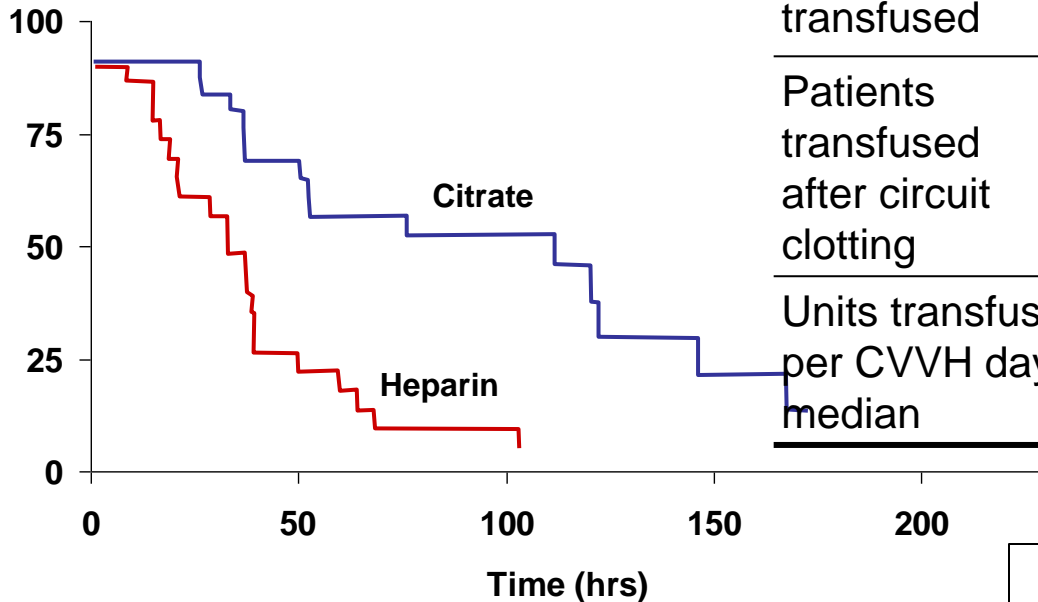
Citrate protocols

(Review of the literature)

	Citric Acid mmol/L	Sodium Citrate mmol/L	Complementary solution	Therapy	BFR mL/min	Citrate dose (mmol/L blood)	Country
Aperner	5	10	-	CWH	100	3.7	Austria
Dorval / Leblanc	5	15	Dia: 0.9% Saline (if needed)	CWH(DF)	125	3.7	Canada
Hiles	-	13.3	-	CWH	180	2.0	USA
Gabutti	-	13.3	Dialysate same as citrate	CWH(DF)	125	2.66	Switzerland
Tolwani	-	2%	0.9% Saline	CWHD	150	2.0	USA
Sramek	-	2.2%	Na=120, Bicar=22	CWHD(F)	100	3.6 - 6.3	Czech Republic
Bunchman	ACD-A		Dia: Normocarb	CWHD(F)	150	2.6	USA
Chadha	ACD-A		Pre: Na=140, Bicar=20	CWH	50 - 150	1.9 - 4.2	USA
Mitchell / Heemann	ACD-A		Calcium in dialysate	CWHD	75	5.7 - 6.5	Germany
Gupta	ACD-A		Calcium in dialysate	CWHD(F)	150	1.9	USA
Cointault	ACD-A		Calcium in dialysate & pre	CWHD(F)	125	3.9	France
Kustogiannis / Gibney	-	3.9%	Dia: Na=110, Bicar=variable	CWHD(F)	125	3.6	Canada
Mehta	-	4%	Dia: Na=117, Bicar=0	CWHD(F)	100	3.7 - 5.9	USA
Hoffmann	-	4%	Pre: 0.9% Saline	CWH	125	3.1	USA
Monchi	-	1000	Post: Na=120, Bicar=0	CWH	150	4.3	France
Evenepoel	-	1035	Calcium in dialysate	IHD	300	4.3	Belgium
Melar-Kriesche		46.7%	Dia: Na=110	CWHD	150		USA

Citraat vs. heparin for anticoagulation in CVVH
M. Monchi et.al. Intensive Care Med, Published online:

5 November 2003

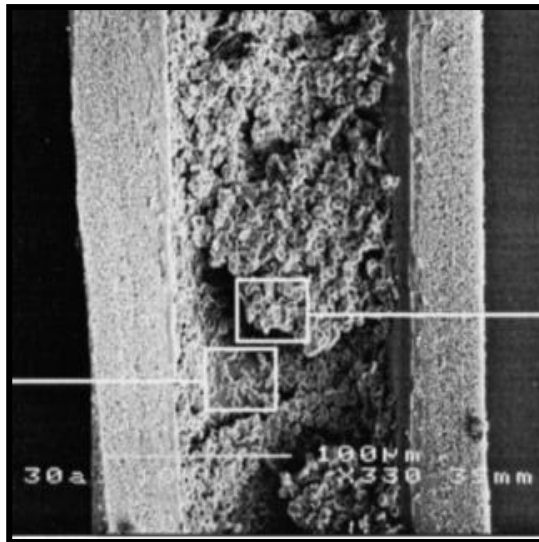


	Heparin (n=23)	Citrate (n=26)	<i>p</i>
Patients transfused	15 (63%)	9 (38%)	0.03
Patients transfused after circuit clotting	10 (44%)	5 (19%)	0.06
Units transfused per CVVH day, median	1.0 (0-2.0)	0.2 (0-0.4)	0.0008

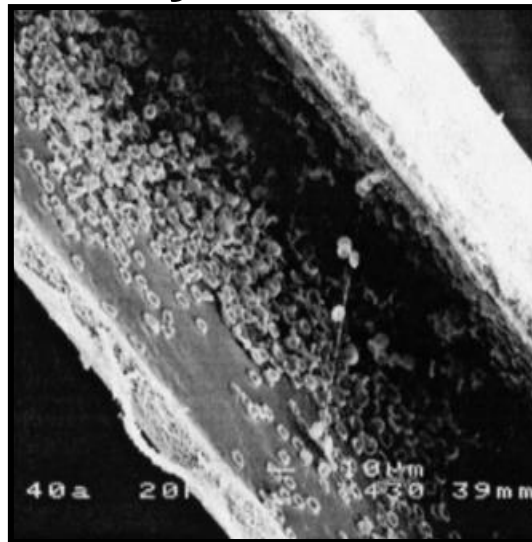
Median circuit lifetime
 Heparin 40 h (17–48)
 Citrate 70 h (44–140)
 (*p* = 0.0007)

Citrate provides optimal anticoagulation

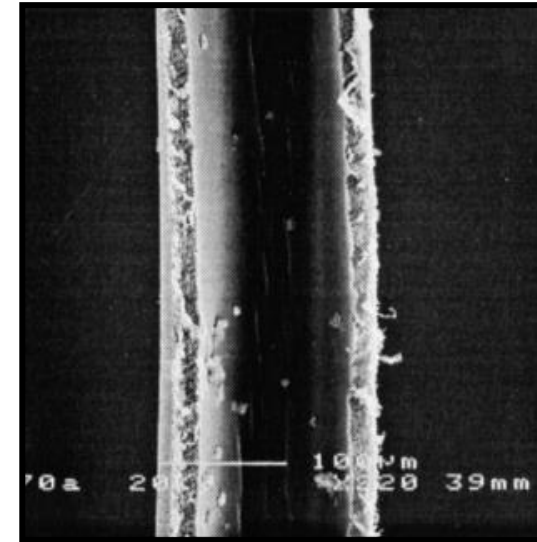
Hofbauer, Kidney Int 1999;56:1578-1583



5 pats heparin



5 pats dalteparin (Fragmin®)



5 pats citrate 50 mmol/hr

→ Citrate negligible thrombus formation and lowest dialyzer clotting score

Mogelijke voordelen

- Minder bloedingen bij post-ok patienten
- Langere filterduur
- Geen HIT mogelijk

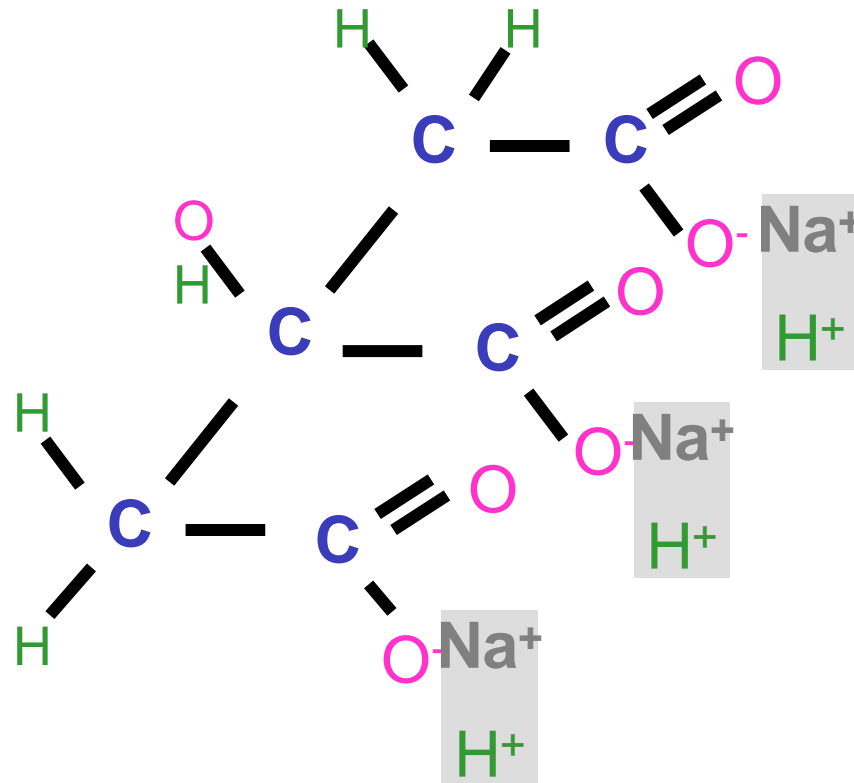
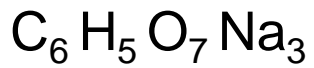


Wat & Hoe met regionale citraat antistolling

Citraat

- Antistolling
- Buffer

Citraat



Ca²⁺

Mg²⁺

Ligand Na⁺:

Sodium-Citrate

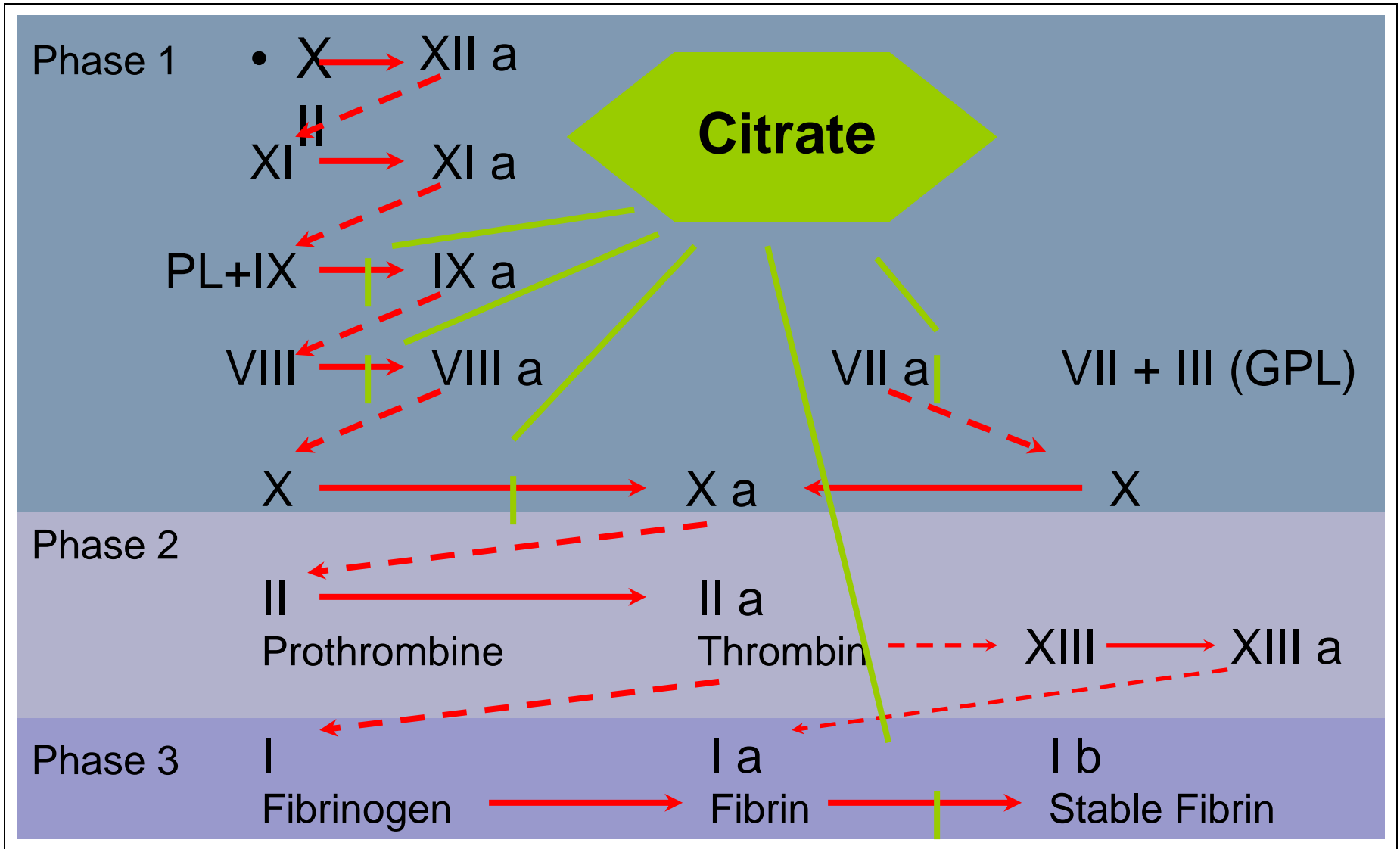
Ligand H⁺:

Citric acid

Citraat als anstistolling

Intrinsic (Vessel)

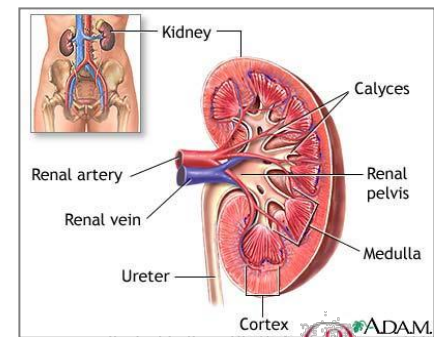
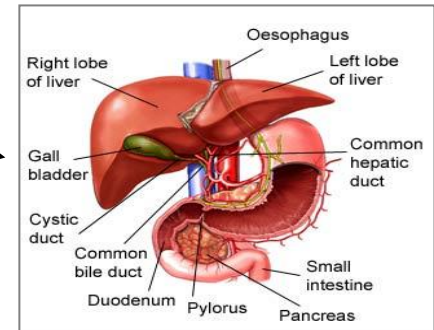
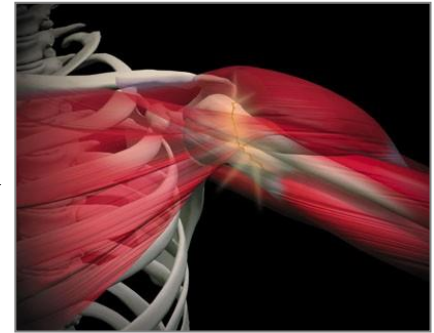
Extrinsic (Tissue)



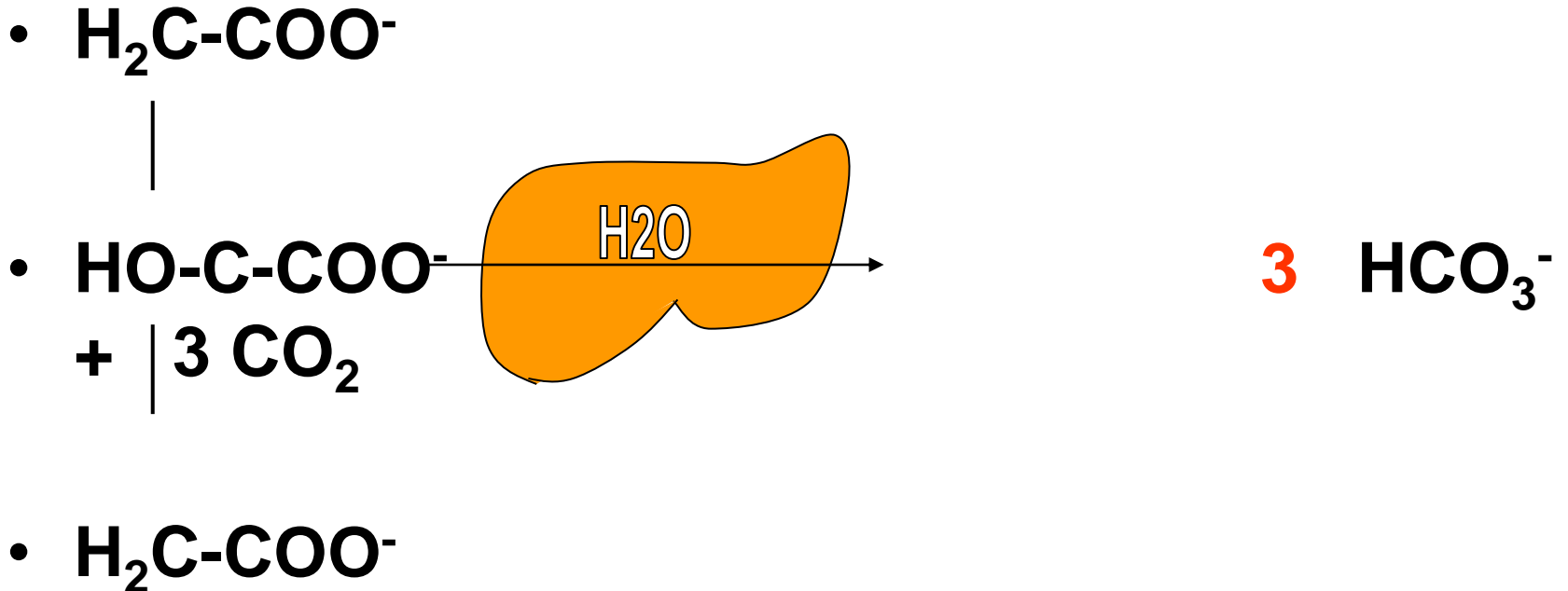
METABOLISME

Omzetting van citraatcomplex gebeurt in:

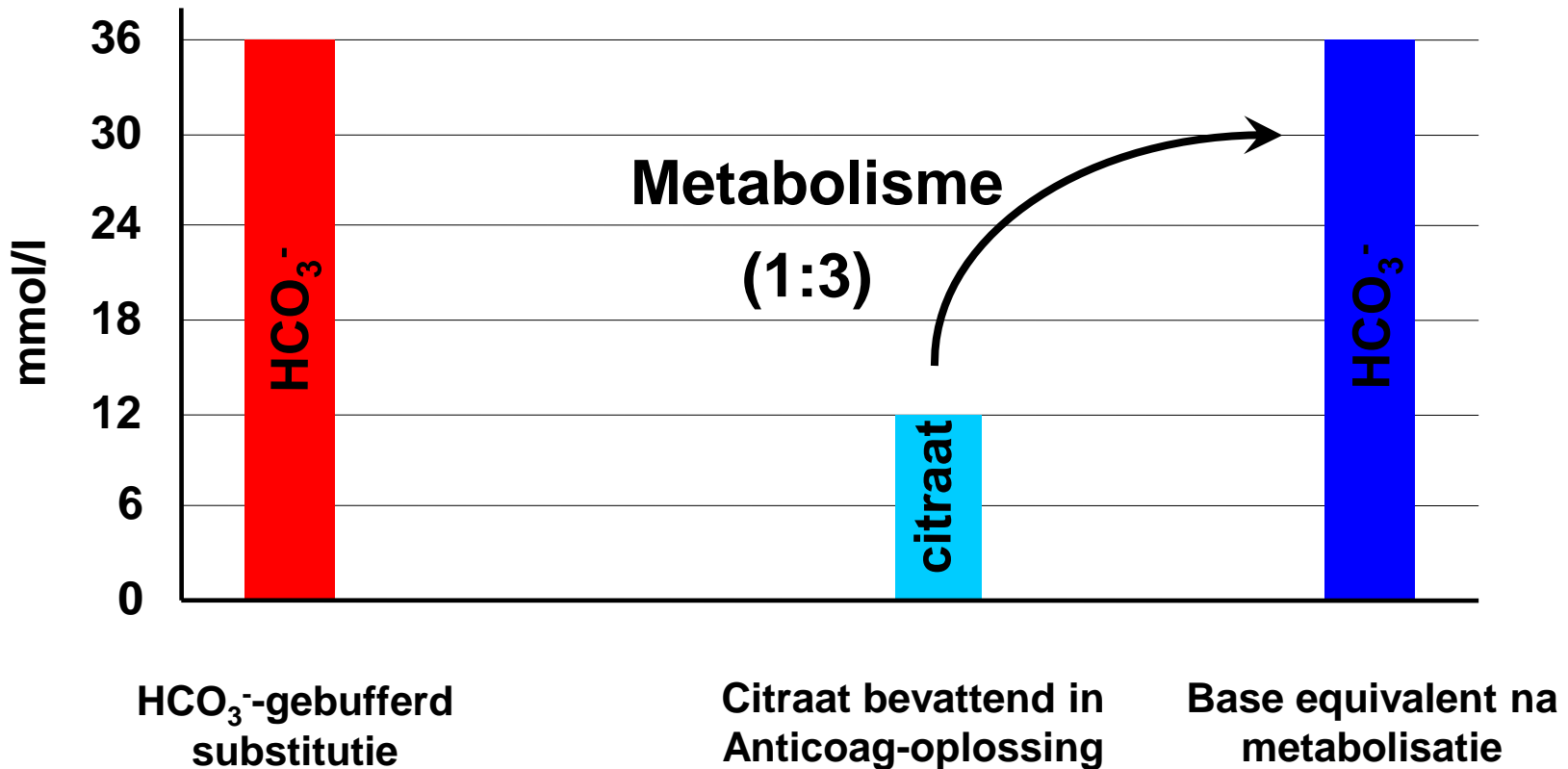
- **Spierweefsel**
- **Lever**
- **Nierschors**



Metabolisme van Citraat: citraat als buffer



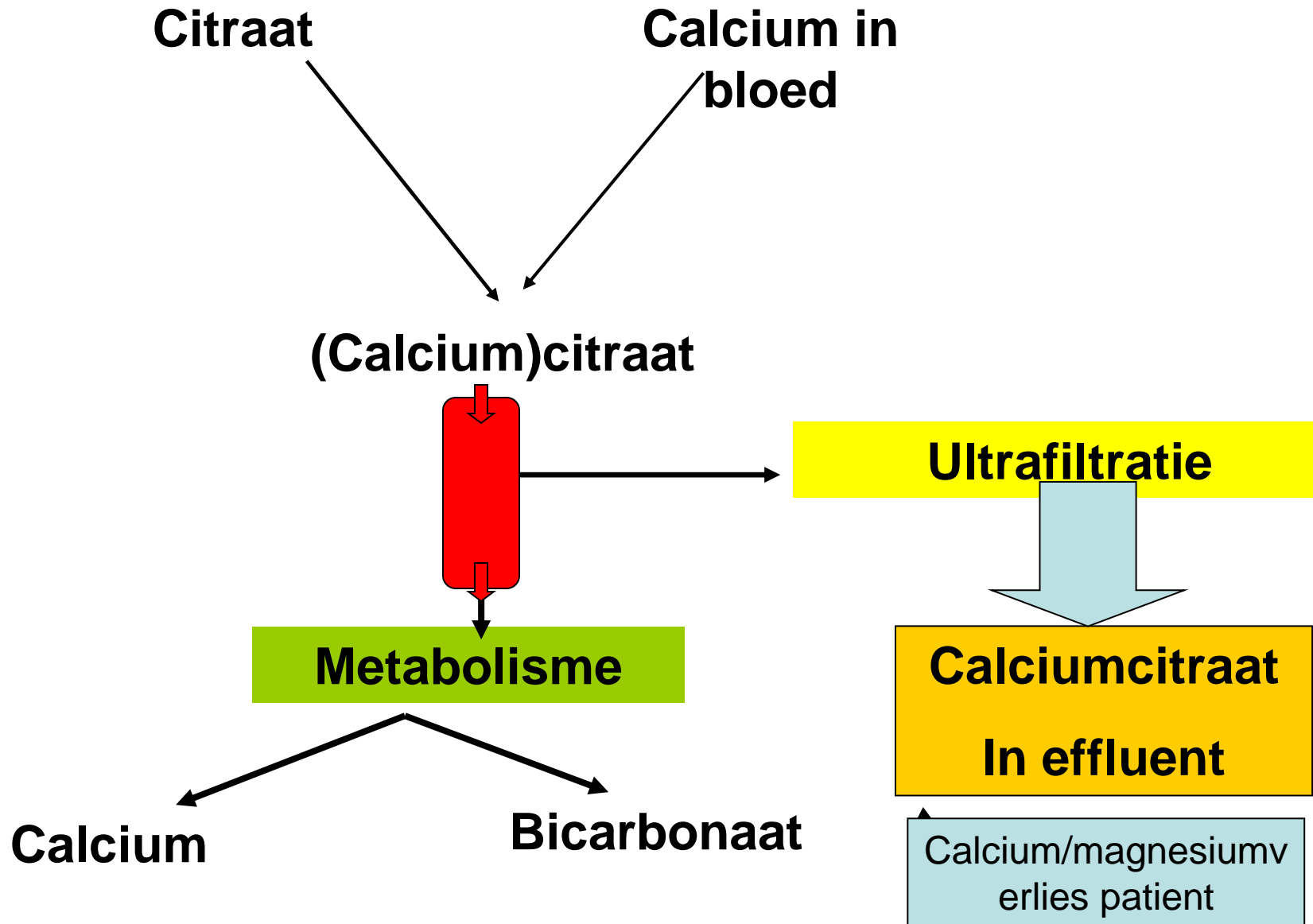
Citraat als buffer



Prismocitraat 10/2

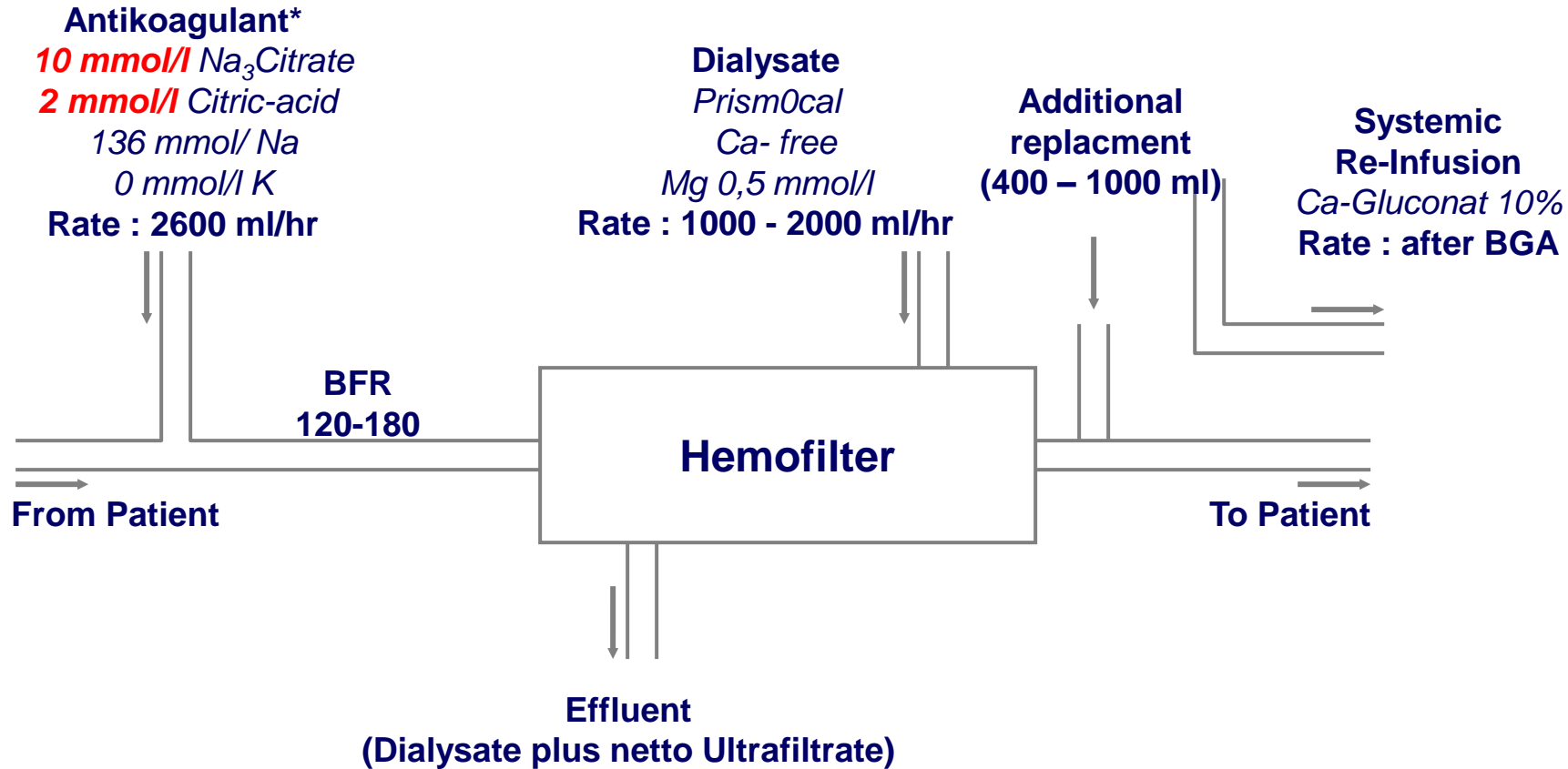
- Prismocitraat bevat **10** mmol citraat/l > 30 mmol/l bicarbonaat.
- Prismocitraat bevat **2** mmol citroenzuur > 0 mmol/l bicarbonaat.

Overzicht



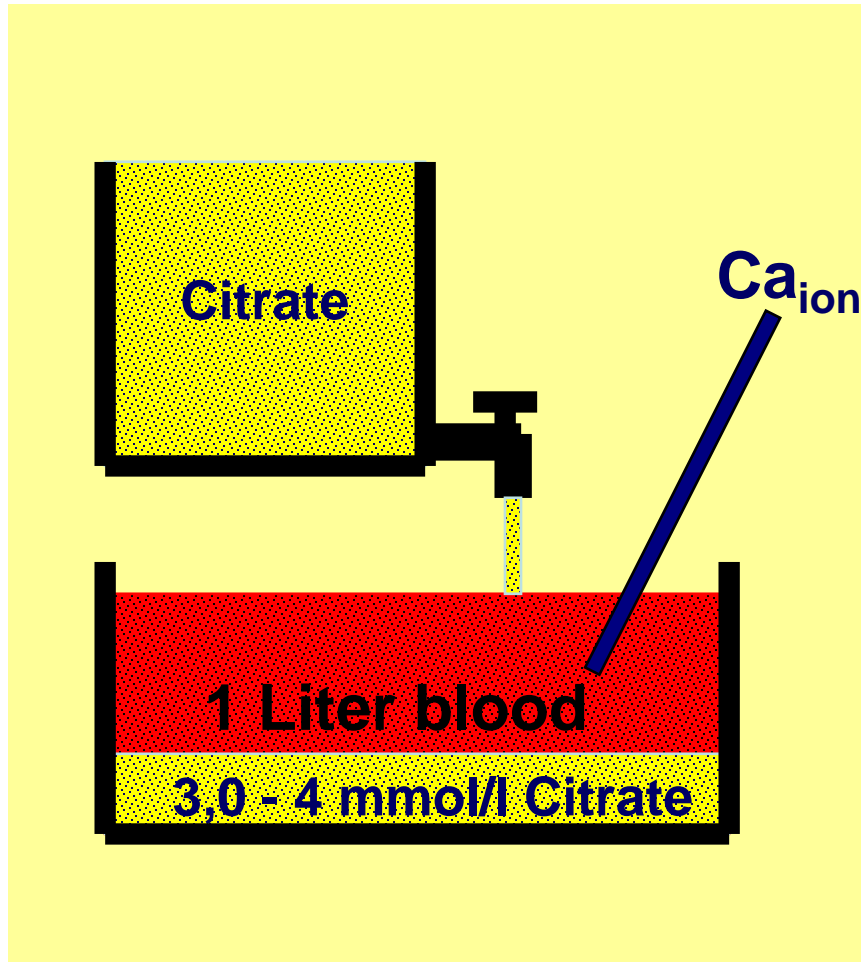
Modern Concepts use isotonic Citrate-Solutions

Gambro Citrate- CVVHD(F)



* PrismoCitratee 10/2

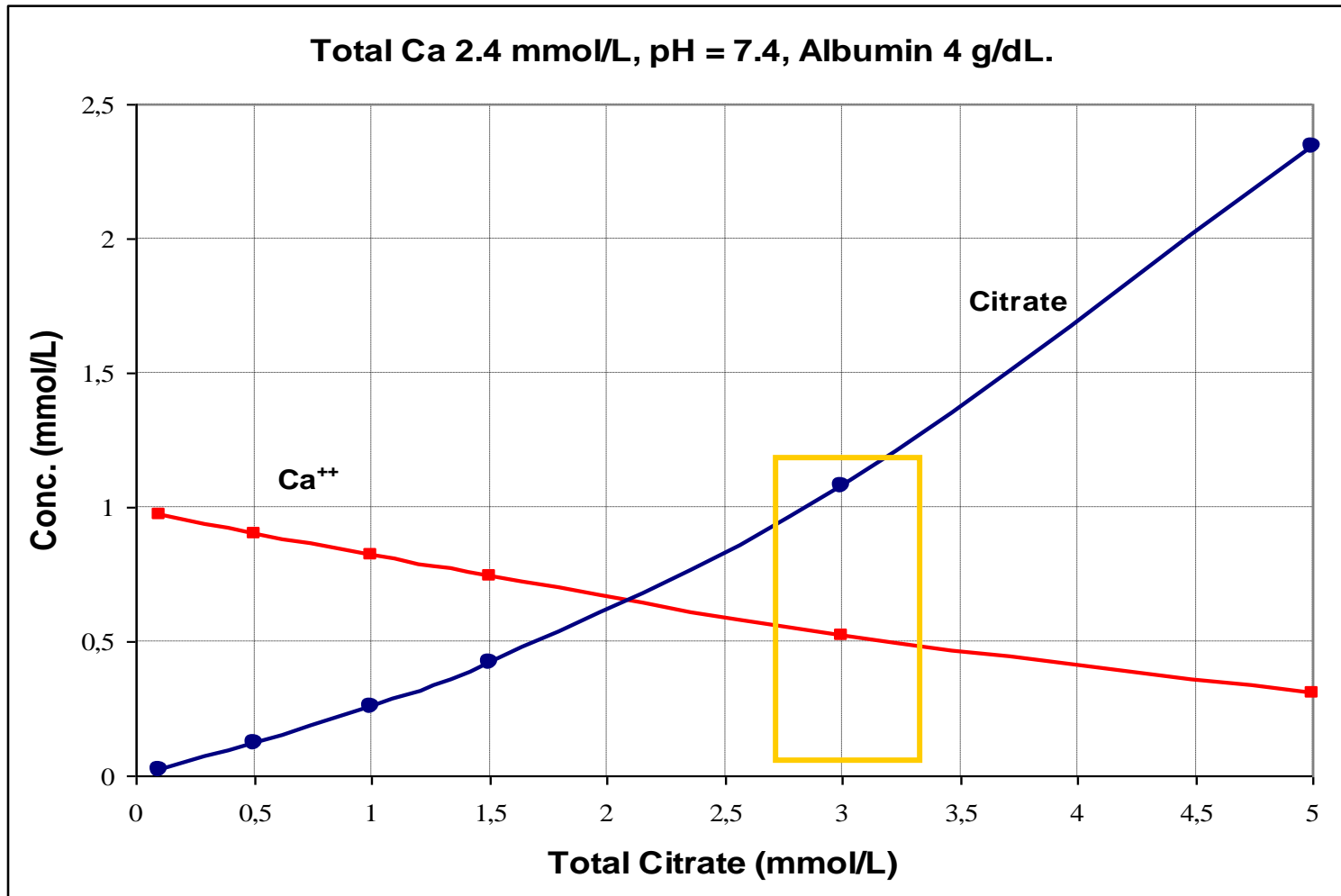
Citraat-Dosering



*Te behalen Post-filter
concentratie voor optimale
antistolling*

Ca_{ion}: 0,2 - 0,5 mmol/l

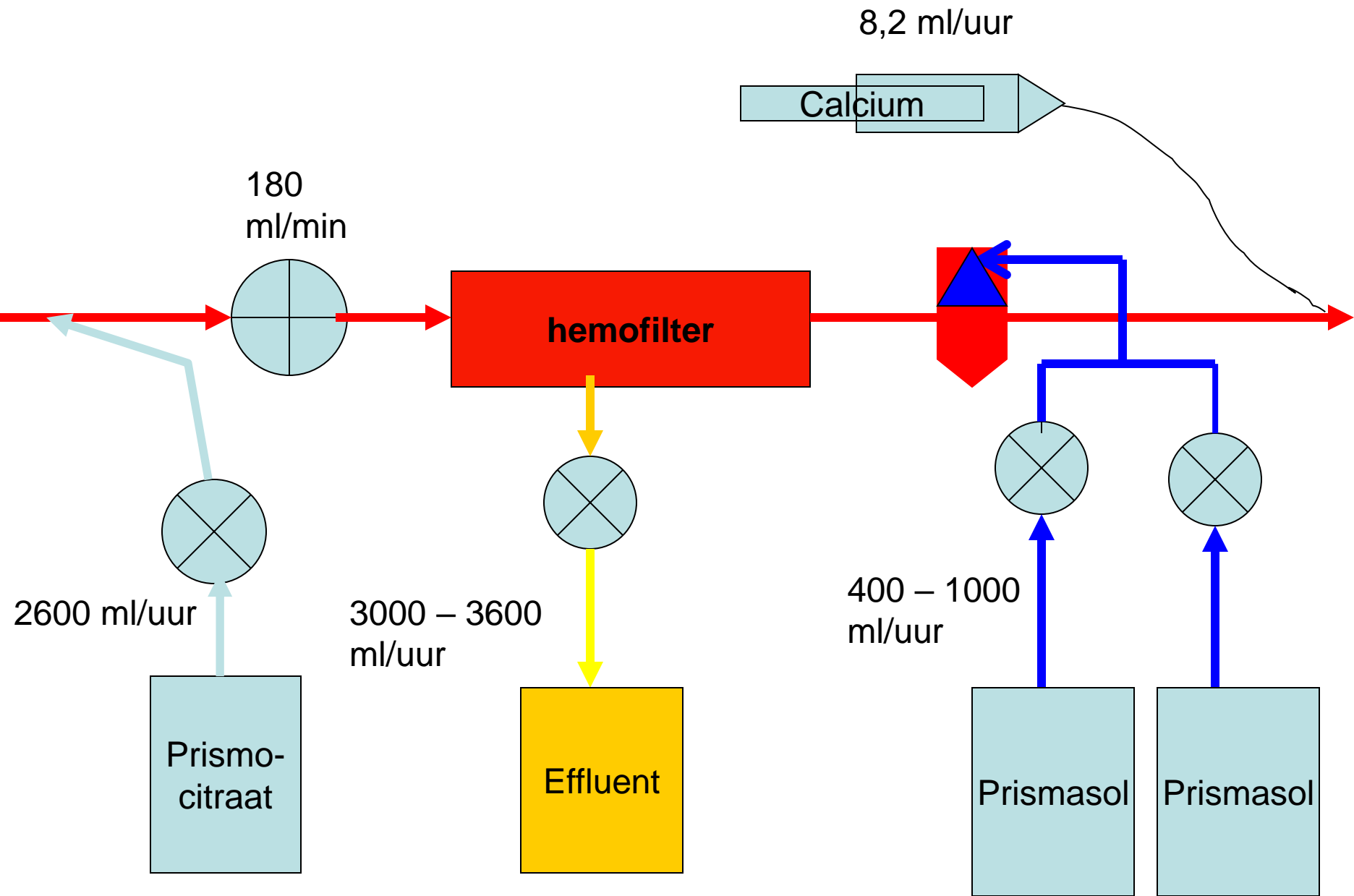
Geïoniseerd Ca⁺⁺ and Citraat toediening



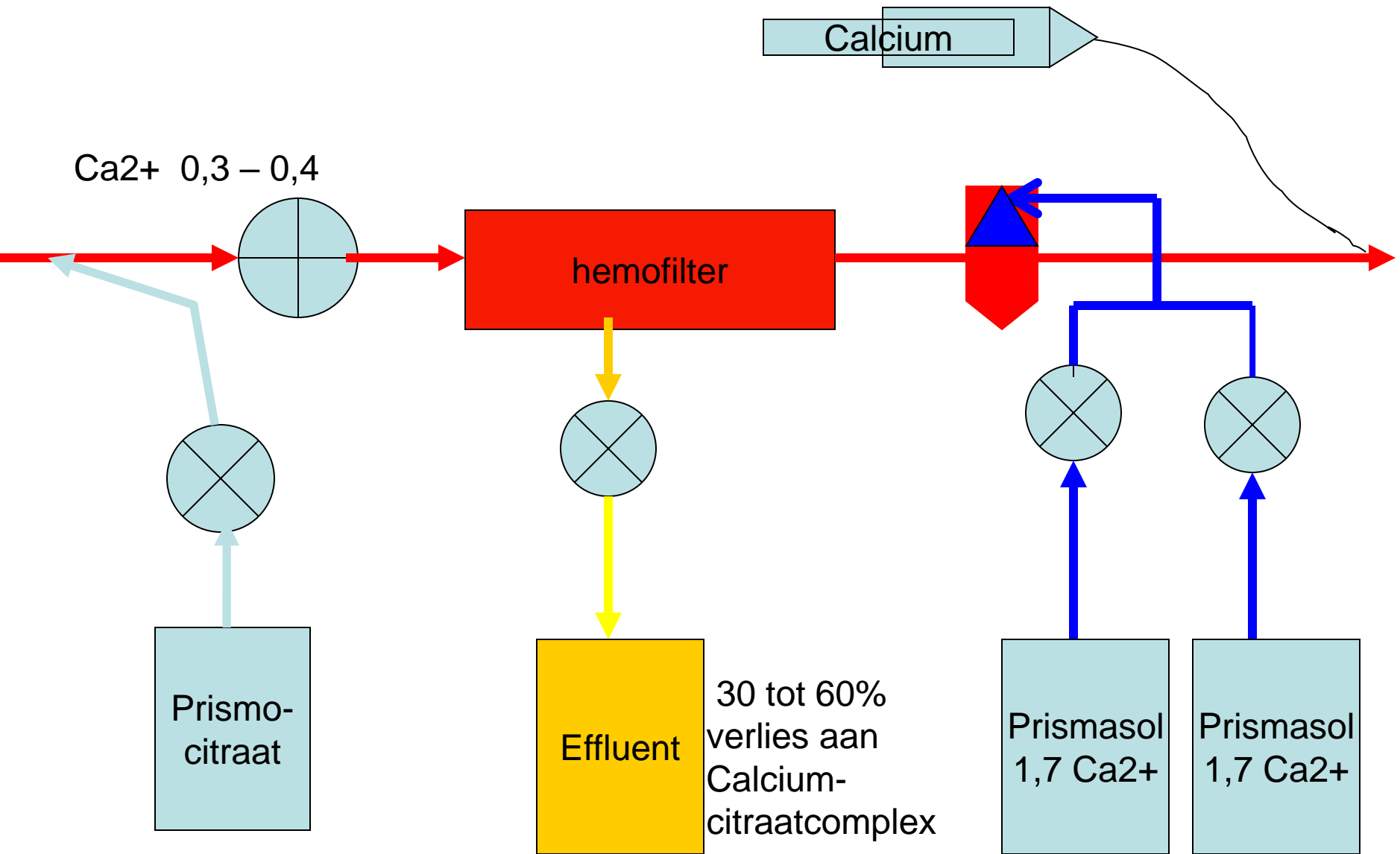
Data Gambro Research, Lyon, 2001

Flowsnelheden citraat

- Citraatdosis: 3,0 mmol citraat per liter bloed
- Prismocitraat bevat 12 mmol citraat per liter
- Bloedflow 150 ml/uur > 9 L/uur > 27 mmol citraat nodig
- Citraatflow gewenst $27/12 = 2,250$ L/uur predilutie

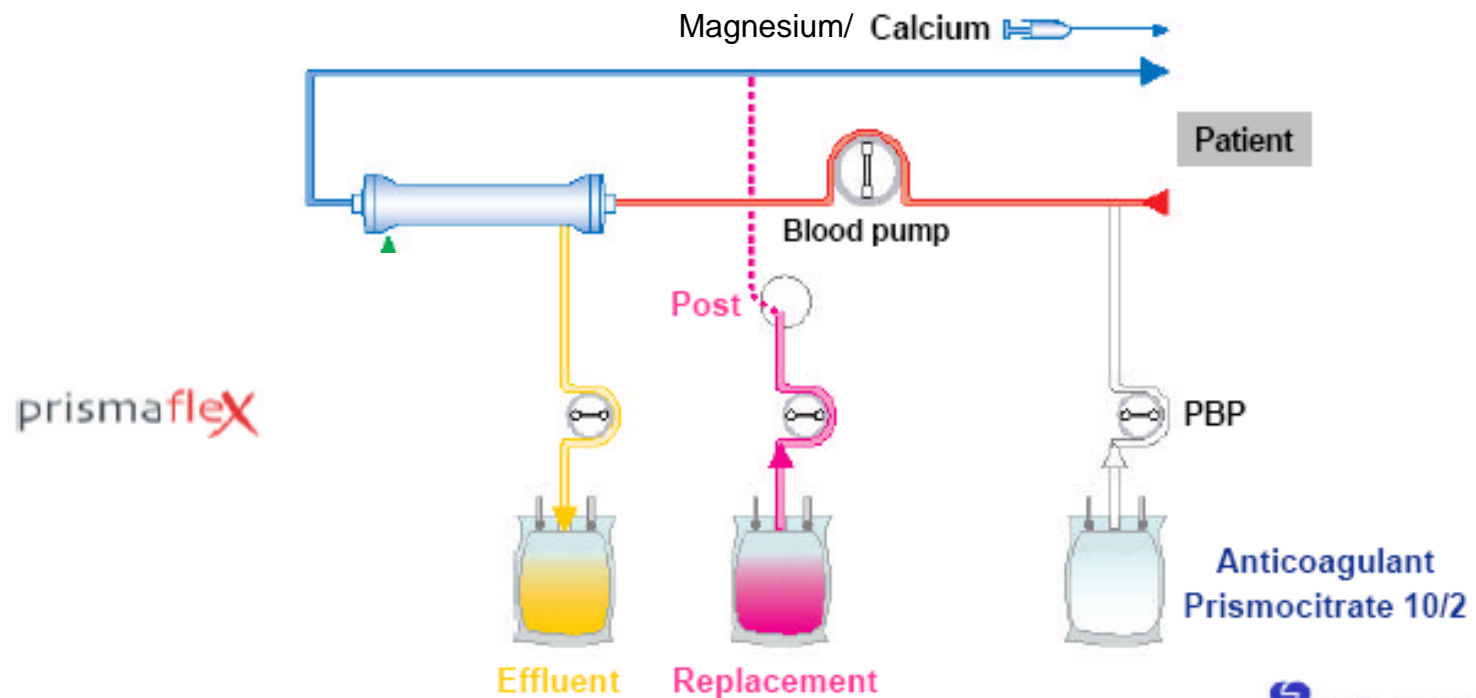


Normaal vrij Ca^{2+} = 1,0 – 1,2



How to use Prismocitrate 10/2?

- CRRT machine: Prismaflex
- Preferred therapy: CVVH



Maximale Flowsnelheden

- Prismocitraat tot 4000 ml per uur > prebloedpomp
- Priskasol 400 tot 1500 ml per uur > 100% postdilutie
- Prismocal dialysaat tot 2000 ml/uur
- Bloedflow 180 tot 250 ml/min
- CVVHDF en CVVH toepasbaar met citraat
- Hoogvolume: Effluentdosis tot 8000 ml per uur mogelijk (!)

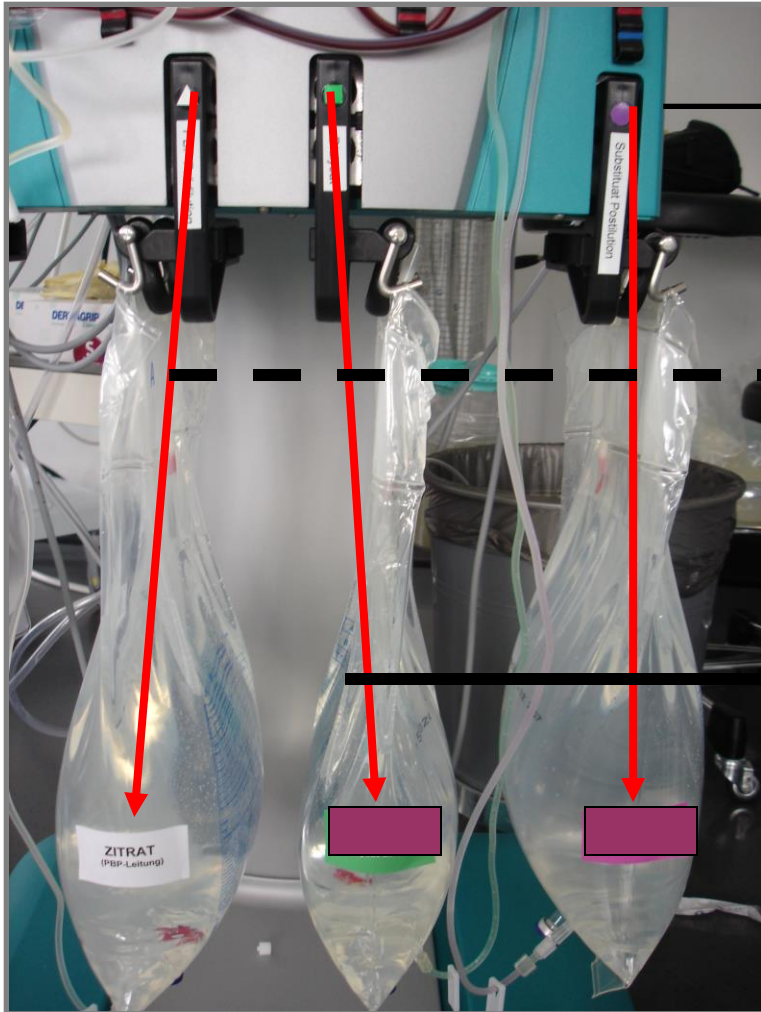
Flowsnelheden bij cvvh

Bloedflow (ml/min)	Citraat Prismocitraat mmol/u ml/uur	Prismosol Post- dillutie ml/uur	Totaal Effluent ml/uur	Ca- doserin g ml/u	Mg- doserin ml/uur
250	41 3500	400 - 1000	3900 – 4400	8,8	5
200	34 2800	400 - 1000	3200 - 3800	8,6	4,8
180	31 2600	400 - 1000	3000 - 3600	8,4	4,7
160	24 2100	400 - 1000	2500 - 3100	8,1	4,5

Controles

- Totaal Calcium, geïoniseerd calcium (4 – 6 uur)
- Magnesium (12 uur)
- Bicarbonaat (4 – 6 uur)
- Ph (4 – 6 uur)
- Controle totaal Ca/geïoniseerd Calcium = calciumratio

Rca op de Prismaflex



**Prismocitraat/
witte weegschaal**

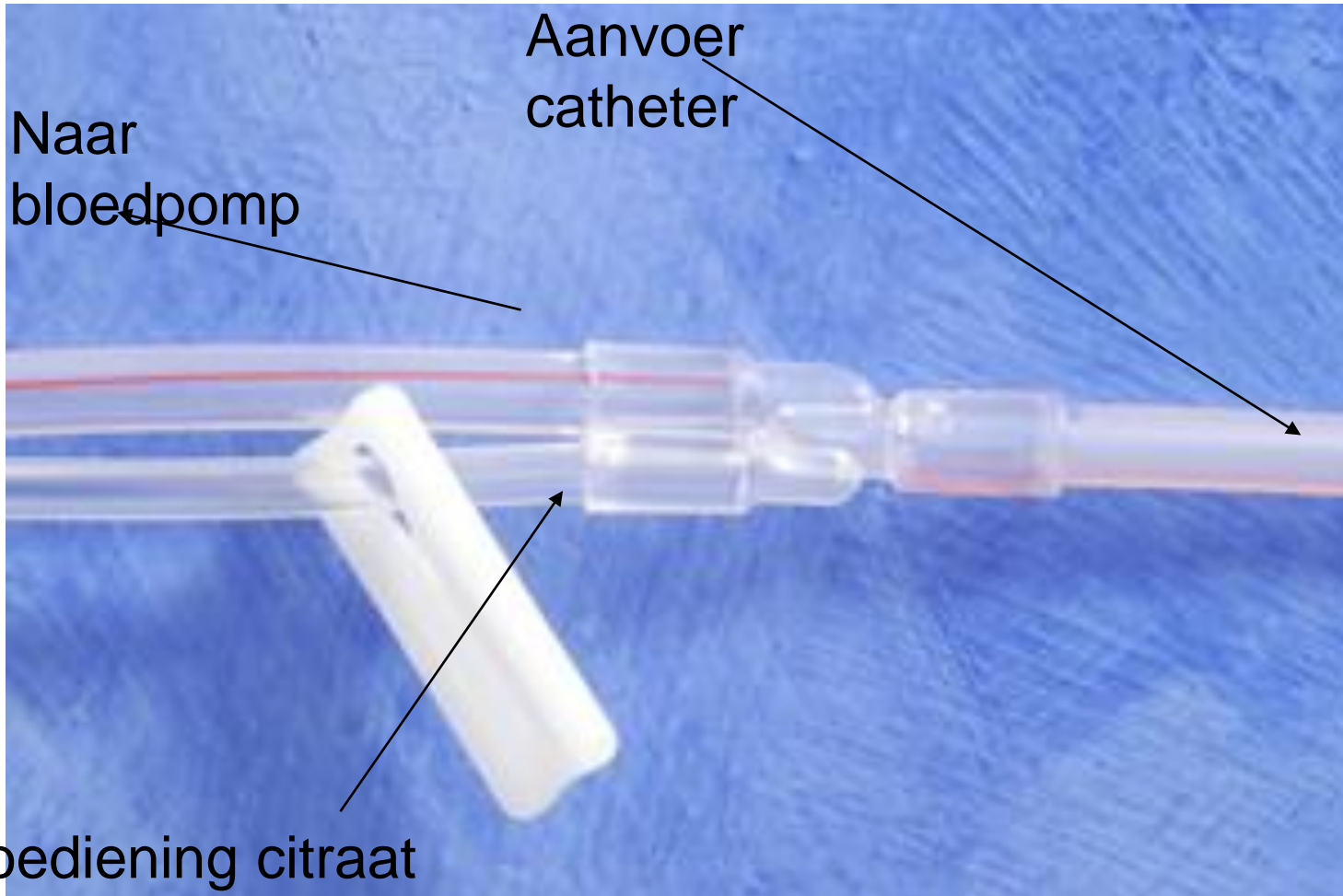
**Prismasol/
paarse en groene
weegschaal**



**Spuit van de prismaflex
vullen met CaCl_2**

**Aansluiting op veneuze
lijn van de patient met y-
stuk**

Plaats van antistolling afgifte

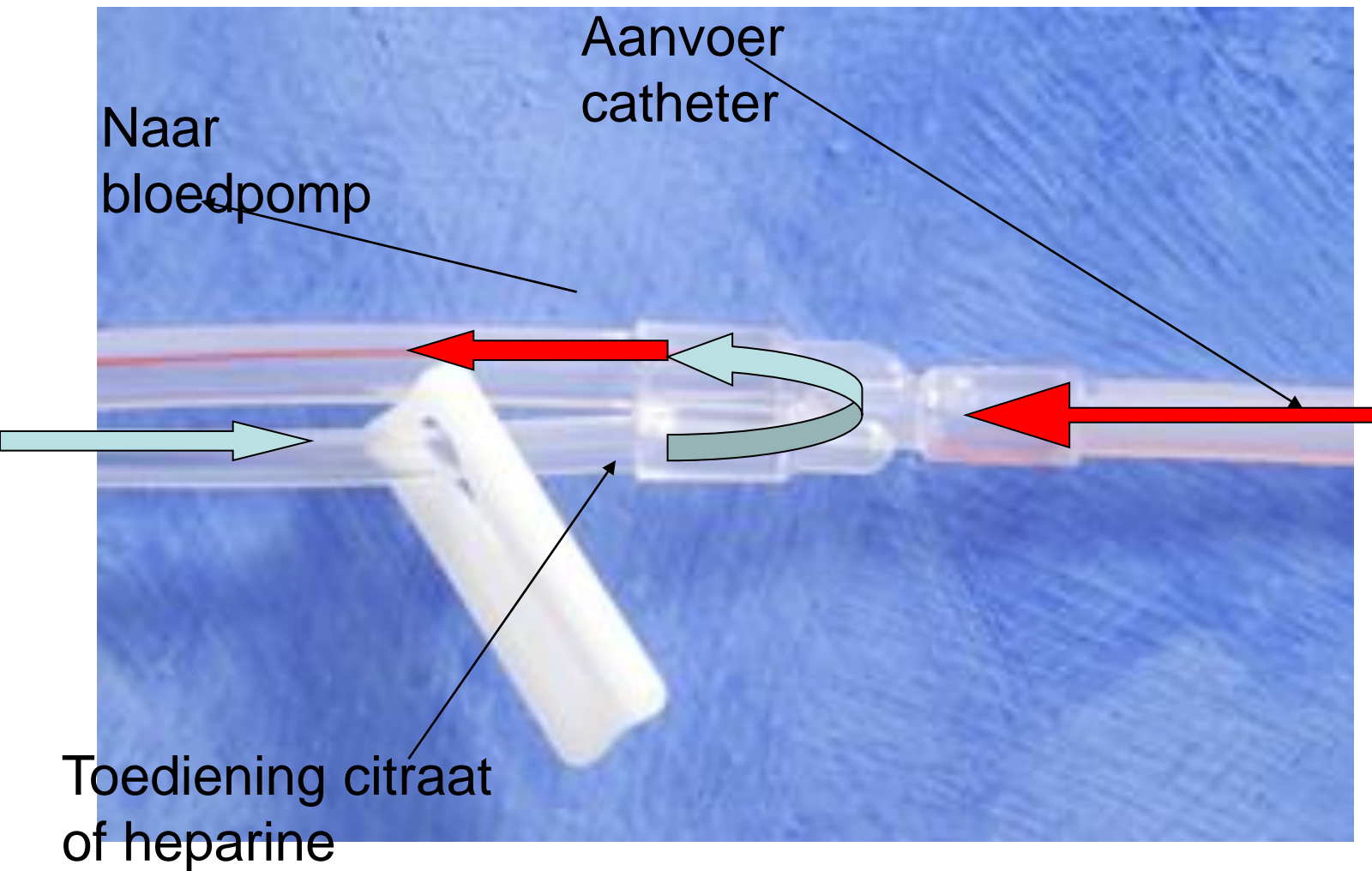


Naar
bloedpomp

Aanvoer
catheter

Toediening citraat
of heparine

Plaats van antistolling afgifte



Veiligheid

of 'Better safe than sorry..'

- Lage concentratie citraat (0,2%), lage foutgevoeligheid.
- Geïntegreerde citraat toediening, calcium toediening is gekoppeld aan teruggave lijn.
- Gebruik van kleurgecodeerde zakken
- Uitgebreide educatie en training door Gambro IC-groep voor verplegend personeel
- Beschikbaarheid bewezen protocollen

Prismaflex met 4.0

- Koppeling bloedflow en citraatflow adh van ingestelde citraatdosis
- Instelbaar antistollingscontrole alarm
- weergave citraat filtratie
- koppeling calcium/bloedflow/citraatflow volgt in later stadium.

Vragen?