THERAPEUTIC PLASMAPHERESIS IN NEPHROLOGY DIALYSIS DEPARTMENT

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NECKER 2026

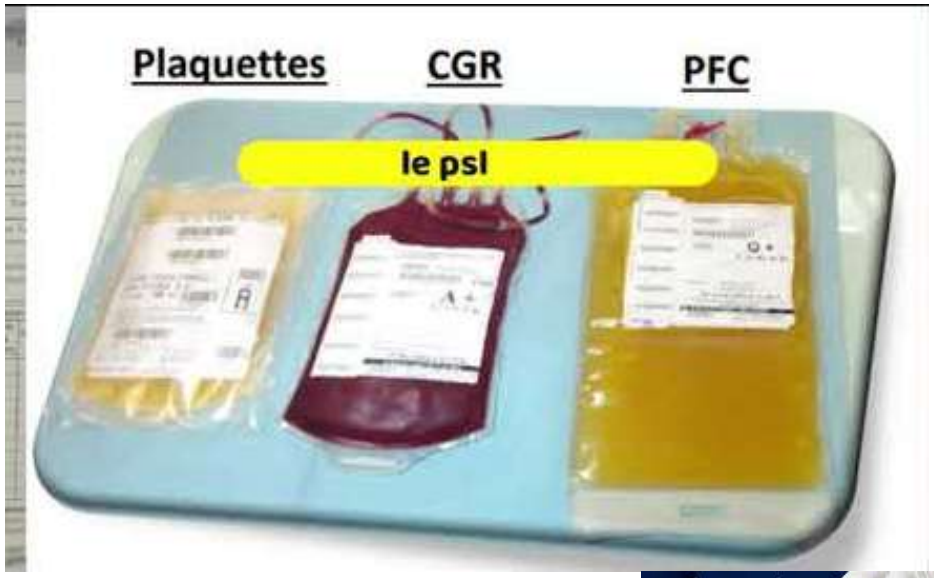
Disclosure

- During the last 3 years the presenter have received honoraria from the companies listed below for congress invitation, lectures, consultancy:

Sanofi, Boerhinger, GSK, Astra-Zeneca, Astellas, Infomed, Fresenius, Baxter, Vantive

- No writing fees, stock royalties endowed chair, gifts or other compensations.


EN 1 HEURE,
VOUS POUVEZ SAUVER 3 VIES !
Globules rouges
Hémorragies, accouchements difficiles...
Plaquettes
Cancers (Leucémie, Lymphome...)
Plasma
Maladies génétiques, déficits immunitaires...
EFS
Du donneur aux patients
PARTAGEZ VOTRE POUVOIR, DONNEZ VOTRE SANG !


Plaquettes
CGR
PFC
le psl

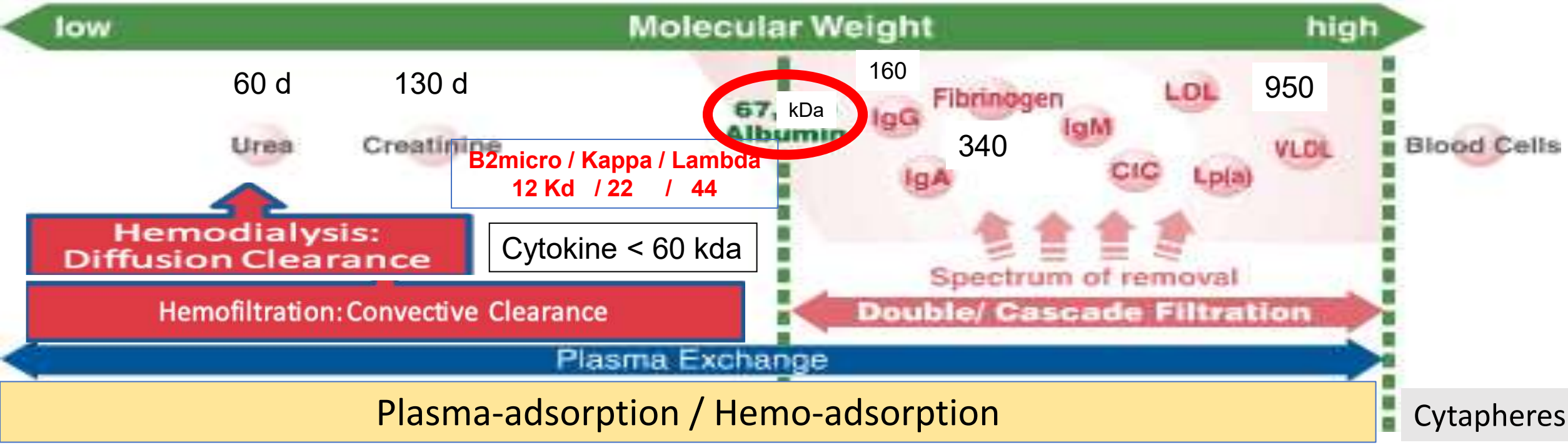

Albumin (Human) 5%, USP


Don de plasma par aphérèse
45 minutes environ
SÉPARATION DES COMPOSANTS DU SANG
PLASMA
GLOBULES ROUGES
PLAQUETTES
Prélèvement de sang
Les globules rouges et les plaquettes sont restitués
GLOBULES ROUGES
PLAQUETTES
Seul le PLASMA est collecté

OUTLINE

- **THERAPEUTIC APHERESIS AND BLOOD PURIFICATION**
- METHODS OF THERAPEUTIC APHERESIS
- PRESCRIPTION
- MECHANISM & GUIDELINES

BLOOD PURIFICATION CONCEPT BASED ON MOLECULAR SIZE/WEIGHT



Plasma-adsorption / Hemo-adsorption

Cytapheresis

- **SUBSTANCES TO REMOVE**
- **METHODS BLOOD PURIFICATION**

With Single Plasma Exchange, a Better Understanding of the Potential Clinical Effects of Albumin Replacement Is Required

Olivier Moranne[a, b] Jean-Paul Cristol[c, d]

Blood Purif
DOI: 10.1159/000531186

THERAPEUTIC PLASMAPHERESIS

➢ **Extracorporeal blood purification= removal of substances with spec characteristics**

- A large molecular weight (>100 kDa)
- A prolonged half life with slow rate of formation and low volume of distribution
- Acute toxic effect with resistance to conventionnal therapy

➢ **Action:** immunomodulator, rheological, « Removal Toxic»

➢ **Substances**: antibody, immune complexes, paraproteins, lipoproteins, toxins, substances (sflt1; CRP..), macromolécules…

➢ **Technics:** classification

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DOI: 10.1111/1744-9987.13567

REVIEW

Therapeutic Apheresis and Dialysis
WILEY

Physiological role of plasma and its components and the clinical implications of different methods of apheresis: A narrative review

Pedram Ahmadpoor[1] | Cedric Aglae[1] | Sylvain Cariou[1] | Emilie Pambrun[1] | Sophie Renaud[1] | Florian Garo[1] | Ruben Darmon[1] | Celine Schultz[1] | Camelia Prelipcean[1] | Pascal Reboul[1] | Olivier Moranne[1,2]

TABLE 1 Formulas for calculating plasma volume

Population	Formula	References
Overall patients According to weight	PV = 35-40 mL /kg (40 mL/kg in case of anemia)	15
General formula Based on hematocrit (HCT)	PV = 0.065 body weight (BW) (1-HCT)	15,16,17,18
Obese patients	1-estimation of plasma volume by using Ideal body weight (IBW) in: PV = 0.065 body weight (BW) (1-HCT) Or alternatively: 2-estimation of blood volume (eBV) in mL/kg eBV = 70/ √ BMI patient / 22 Then use general formula with calculated eBV instead of 0.065 in: PV = eBV BW (1-HCT)	17,18,19
Thin women	PV = 0.060 BW (1-HCT)	18
Muscular individuals	Men: PV = 0.075 BW (1-HCT) Women: PV = 0.070 BW (1-HCT)	18
BMI = (BW)/T^2 IBW in Men = 50 + 2.3 kg for each inch >5 ft (5 ft =152 cm or 1 ft = 152/5) Women 45.5 + 2.3 kg for each inch >5 in. (1 in. =2.54 cm)		86

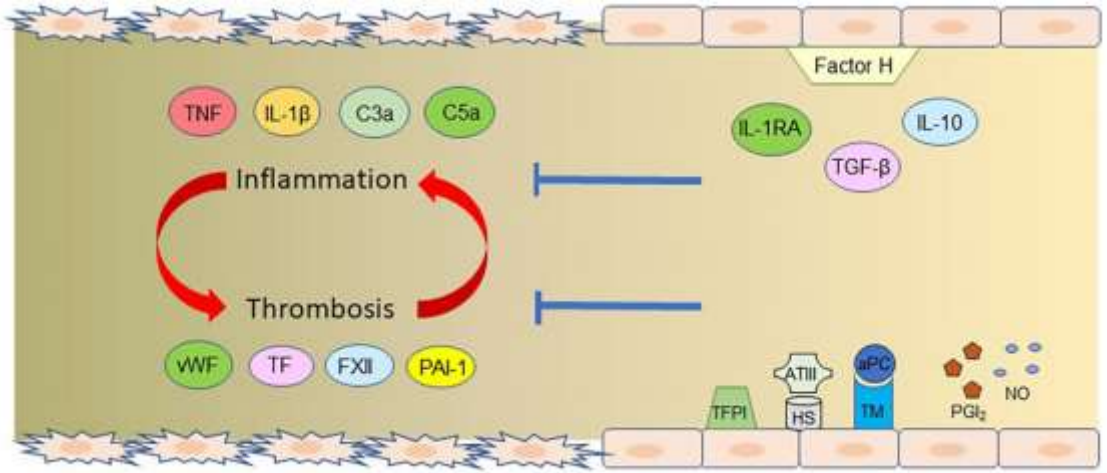
Plasma protein	Plasma concentration	Mol. weight (KDa)	Half-life	Description
ALBUMIN	35-55 g/L	69	21 days	Oncotic pressure, buffer, toxin/drug transport, production 10-15 g/d by liver.
C5 component	70 mg/L	190		Divided by C5 convertase to C5a (anaphylatoxin) & C5b (participates in MAC)
C1 component	C1q: 0.18 g/L	C1q: 440		Classic complement pathway, apoptotic cell clearance
Properdin	4–25 mg/L	53		Stabilizing alternative pathway C3 and C5 convertase by increasing their half-lives
Factor B	0.2 mg/L	90		Part of alternative pathway complement C3 convertase, serine protease
Gamma globulins	8-18 g/L			Polyclonal increase in infections and inflammation. Monoclonal increase in plasma cell disorders
IgG	6.5-16.5 g/L			Most efficient antibody mediated defense, intravascular to extravascular percentage: 50%
IgG1	3.7-8 g/L	146	21 days	High complement binding
IgG2	1.2-4 g/L	146	21 days	Weak complement binding
IgG3	0.4-1 g/L	170	5-7.5 days	High complement binding
IgG4	0.07-0.57 g/L	146	21 days	No complement binding, high levels(1.35 g/L) suggestive of IgG4 related disease

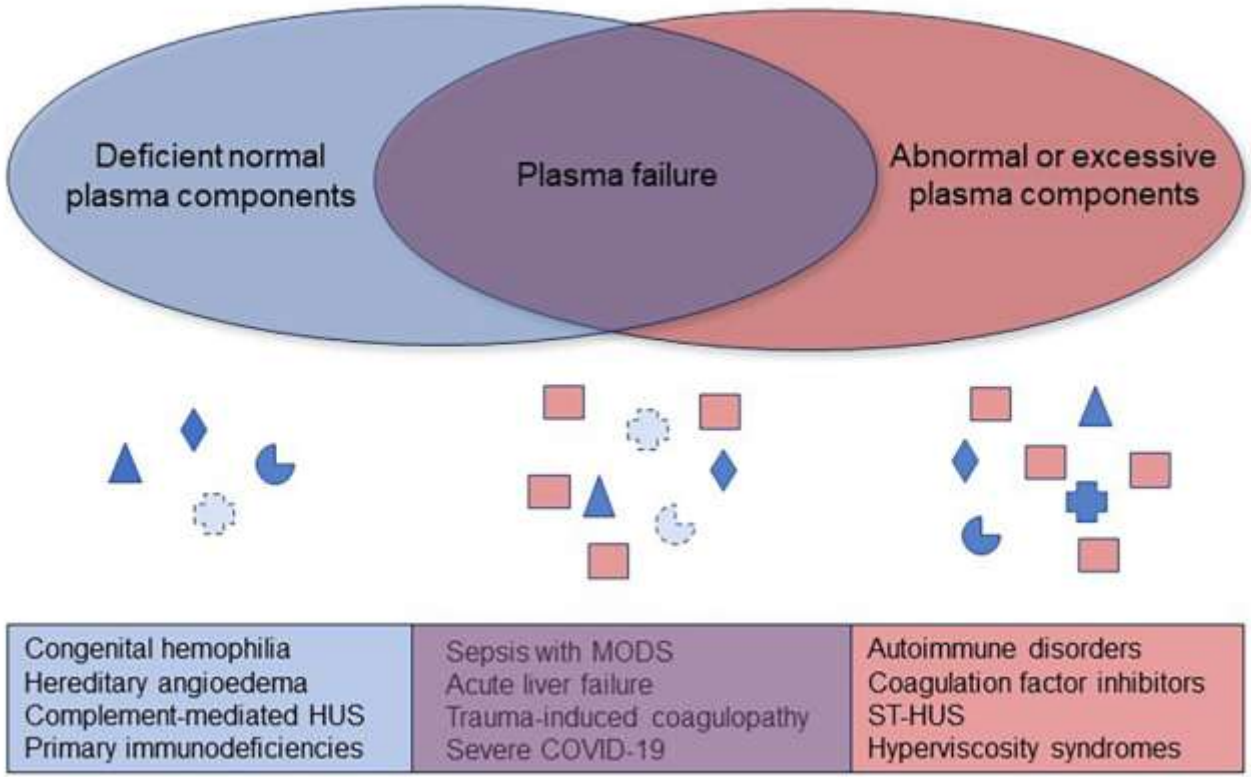
Myasthenia: IgG1,3,4
GBS: IgG1,IgG3
AMR: IgG1,3-Cplt; IgG2,4

Therapeutic Plasma Exchange to Reverse Plasma Failure in Multiple Organ Dysfunction Syndrome

Matthew J. Foglia[1,2] | Jay S. Raval[3] | Jan C. Hofmann[4] | Joseph A. Carcillo[1]

Journal of Clinical Apheresis ASFA





OUTLINE

- THERAPEUTIC APHERESIS AND BLOOD PURIFICATION
- **METHODS OF THERAPEUTIC APHERESIS**
- PRESCRIPTION
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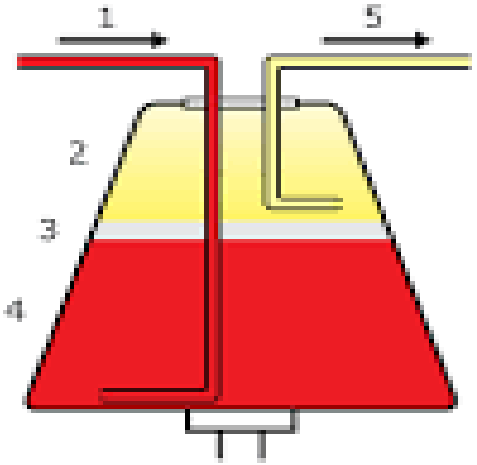
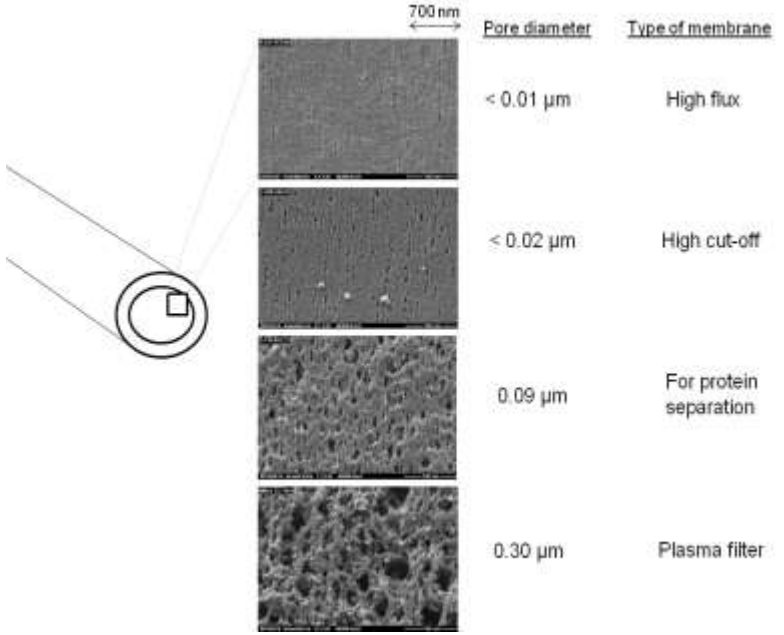
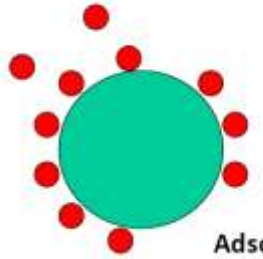
TECHNICS OF THERAPEUTIC PLASMAPHERESIS

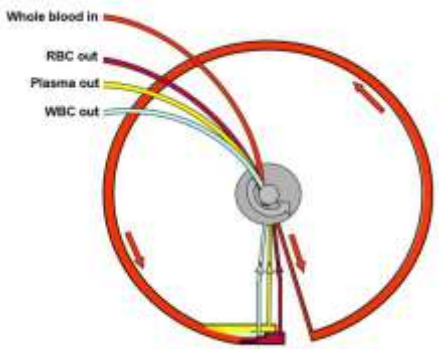
Centrifugation or Filtration or Adsorption







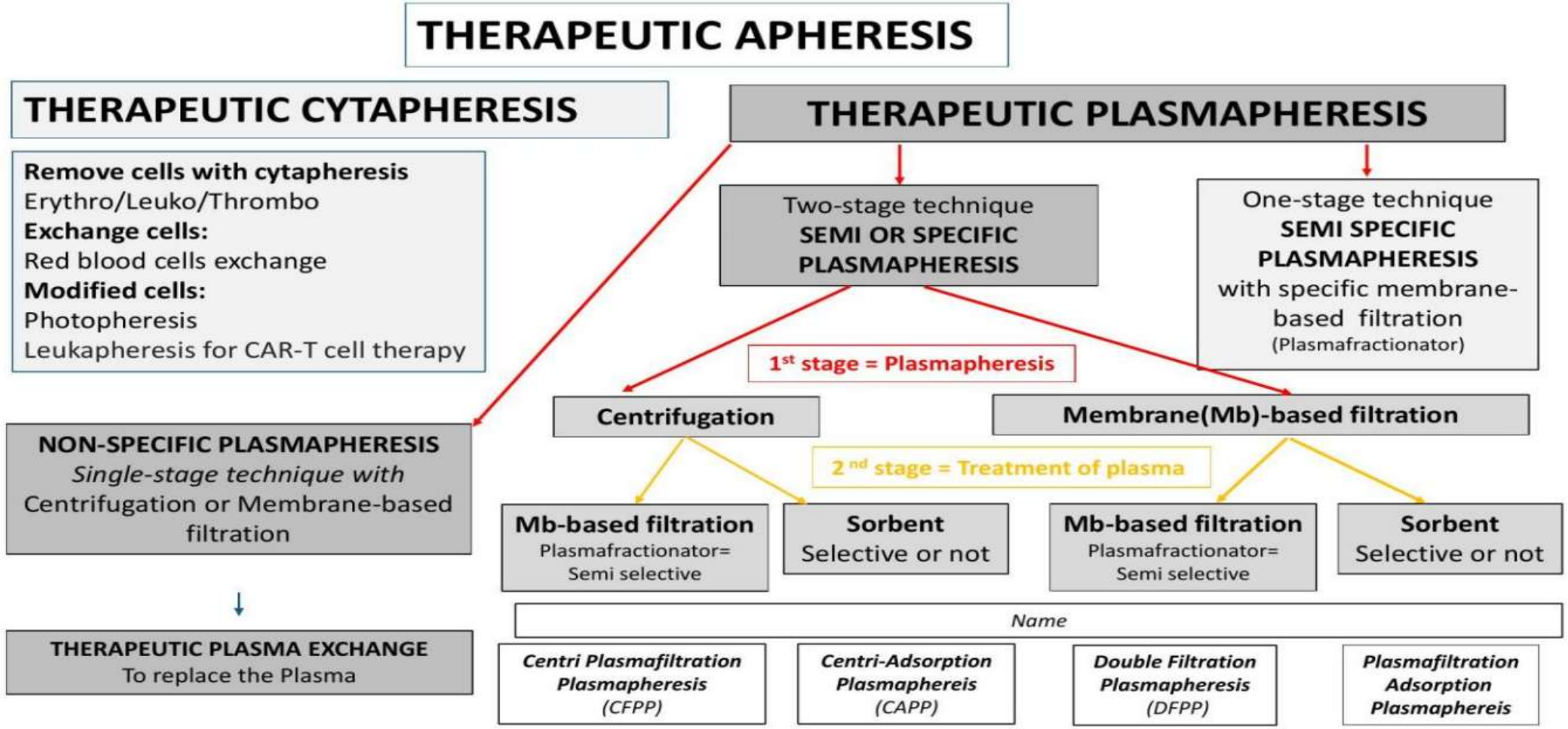
Adsorption



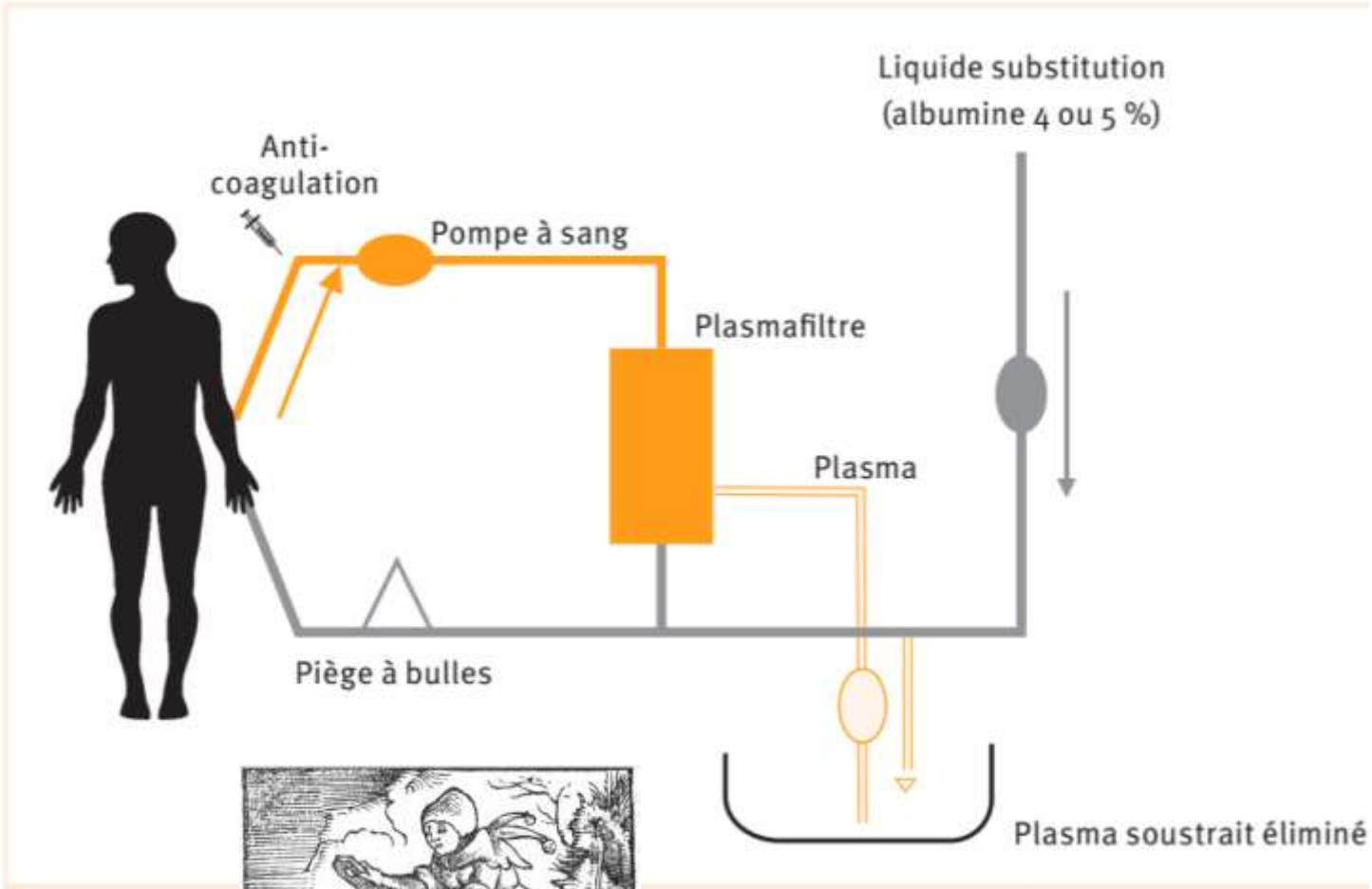
DESCRIPTION AND DISCUSSION OF TERMINOLOGY FOR THERAPEUTIC APHERESIS METHODS INCLUDING THERAPEUTIC CYTAPHERESIS AND THERAPEUTIC PLASMAPHERESIS

Moranne O

Blood Purification



NON SELECTIVE THERAPEUTIC PLASMAPHERESIS (TP)



	ALBUMIN Iso osmotic/ionic	Fresh frozen plama Single donor
	Human Albumin	Solvent or detergent
Volume	4-5 % 500mls + cristalloid NS	Iso HSA isoosmolar
Clotting factor	No clotting factor	Clotting factor: iso except lowFVIII
Gammaglobulin	No	yes
Utilization	Room temp, no blood compatible, rapid	Frozen storage / Blood group compatible
Complications	Allergies Infection Hypotension <2%	Citrate 7 meq/l Allergies /Trali Infection 5-20%

RESEARCH ARTICLE OPEN ACCESS

Journal of Clinical Apheresis ASFA

Hemodynamic Effect of Different Replacement Fluid Protocols During Therapeutic Apheresis Evaluated With CRIT-LINE

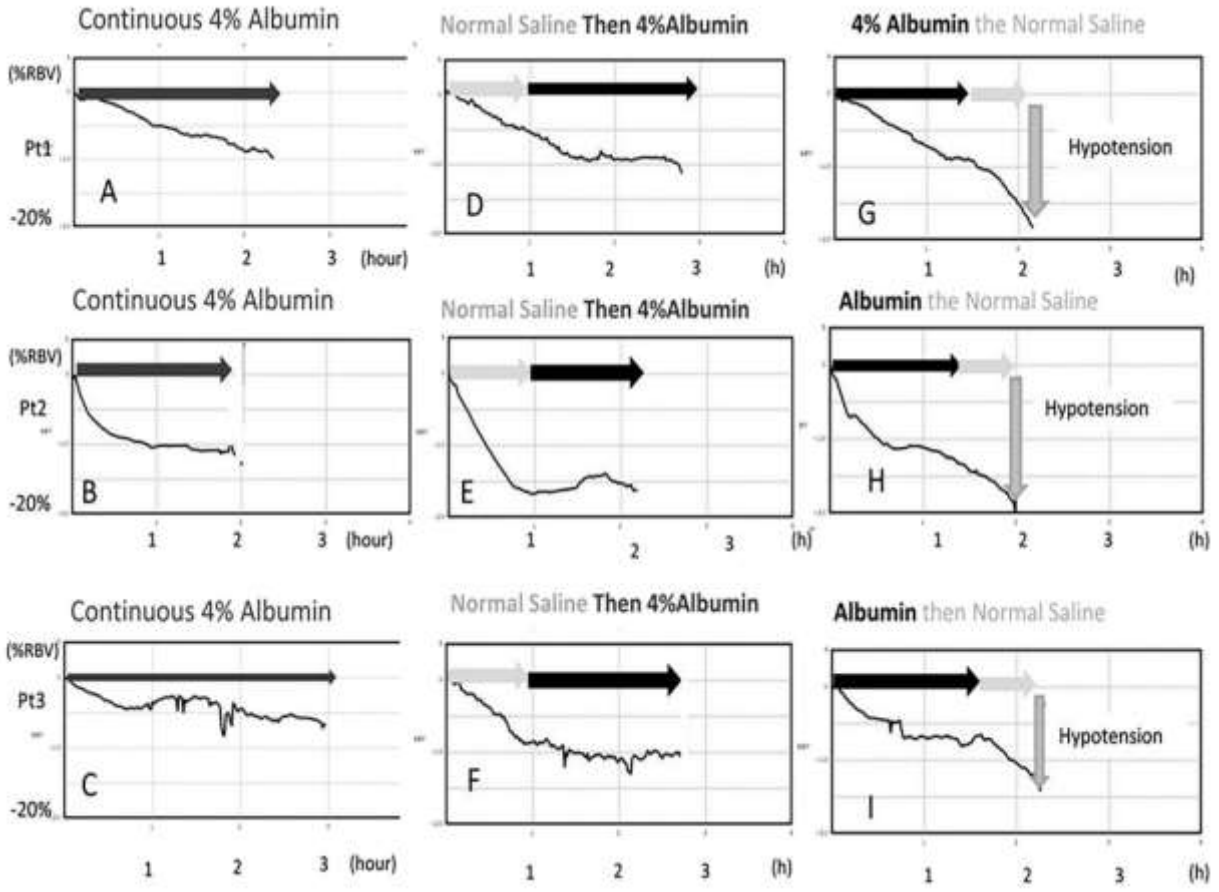
Hajar Elassas[1] | Olivier Moranne[1,2]

- 3 patients treated with **TPE** for CIDP with Device HF440®/Membran Granopen60® *(Infomed, Switzerland)*

- Monitoring Relativ Blood Volume (RBV) with Critline® *(FMC,Germany)* to evaluate 3 protocol of HSA infusion:

- Continous infusion HSA4% (500mls=40g/l)
- Or Infusion normal saline 25% of TPV

→ at the beginning or at the end of the session



RBV curves using CRIT-LINE IV during TPE treatment.

CASE REPORT OPEN ACCESS

Journal of Clinical Apheresis ASFA

Therapeutic Plasma Exchange Shows Greater Efficacy Than DFPP in Reducing FT3 and FT4 Levels in Thyrotoxicosis due to Amiodarone-Induced Thyrotoxicosis Type 2

Marion Gerbal[1] | Olivier Gilly[2] | Marie-Alix Joyeux[2] | Olivier Moranne[1,3]

[1]Service Néphrologie-Dialyse-Aphérèse, Hôpital Universitaire de Nîmes, Nîmes, France | [2]Service Endocrinologie, Hôpital Universitaire de Nîmes, Nîmes, France | [3]IDESP, Université de Montpellier, Montpellier, France

TPE WITH INDICATION OF FFP INFUSION

TTPai
ALF
SEVERE SEPSIS ?

COMPARISON OF PLASMA EXCHANGE WITH PLASMA INFUSION IN THE TREATMENT OF THROMBOTIC THROMBOCYTOPENIC PURPURA

GAIL A. ROCK, PH.D., M.D., KENNETH H. SHUMAK, M.D., NOEL A. BUSKARD, M.D., VICTOR S. BLANCHETTE, M.D., JOHN G. KELTON, M.D., RAMA C. NAIR, PH.D., ROBERT A. SPASOFF, M.D., AND THE CANADIAN APHERESIS STUDY GROUP*

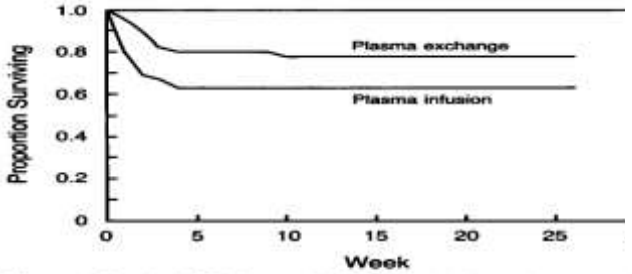
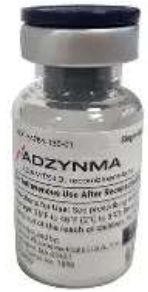


Figure 1. Survival of Patients with Thrombotic Thrombocytopenic Purpura.
The survival curves differ significantly (P = 0.036 by the Breslow–Gehan test).



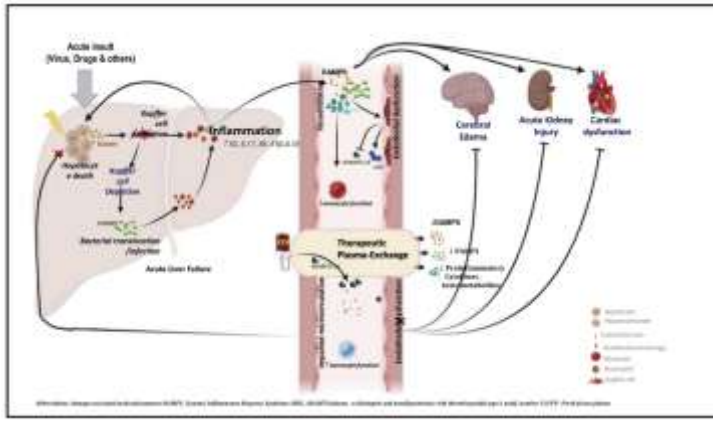
Research Article

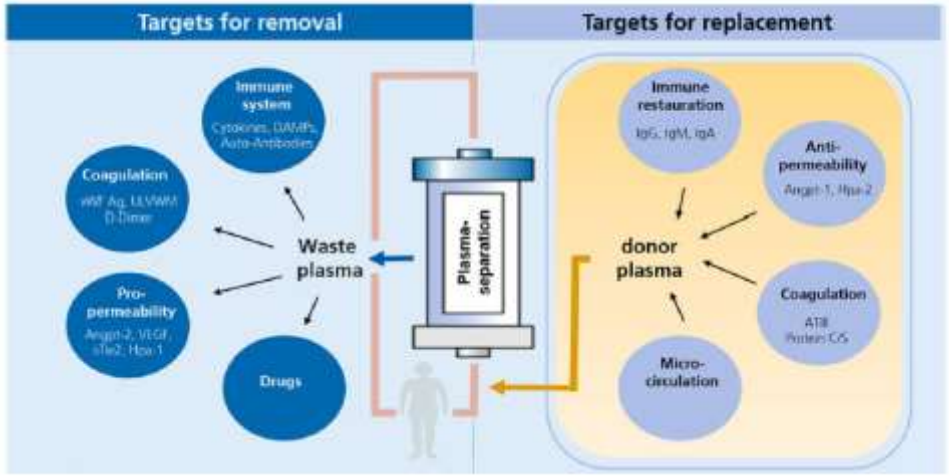
EASL | JOURNAL OF HEPATOLOGY

High-volume plasma exchange in patients with acute liver failure: An open randomised controlled trial

Fin Stolze Larsen[1,*], Lars Ebbe Schmidt[1], Christine Bernsmeier[2], Allan Rasmussen[3], Helena Isoniemi[4], Vishal C. Patel[2], Evangelos Triantafyllou[2], William Bernal[2], Georg Auzinger[2], Debbie Shawcross[2], Martin Eefsen[1], Peter Nissen Bjerring[1], Jens Otto Clemmesen[1], Krister Hockerstedt[4], Hans-Jørgen Frederiksen[5], Bent Adel Hansen[1], Charalambos G. Antoniades[2,6], Julia Wendon[2,*]

[1]Department of Hepatology, Rigshospitalet, Copenhagen, Denmark; [2]Institute of Liver Studies, King's College Hospital, London, United Kingdom; [3]Department of Surgery and Liver Transplantation C, Rigshospitalet, Copenhagen, Denmark; [4]Transplantation and Liver Surgery Clinic, Helsinki University Hospital, Finland; [5]Department of Anaesthesia AN-2041, Rigshospitalet, Copenhagen, Denmark; [6]Section of Hepatology, St. Mary's Hospital, Imperial College London, London, UK





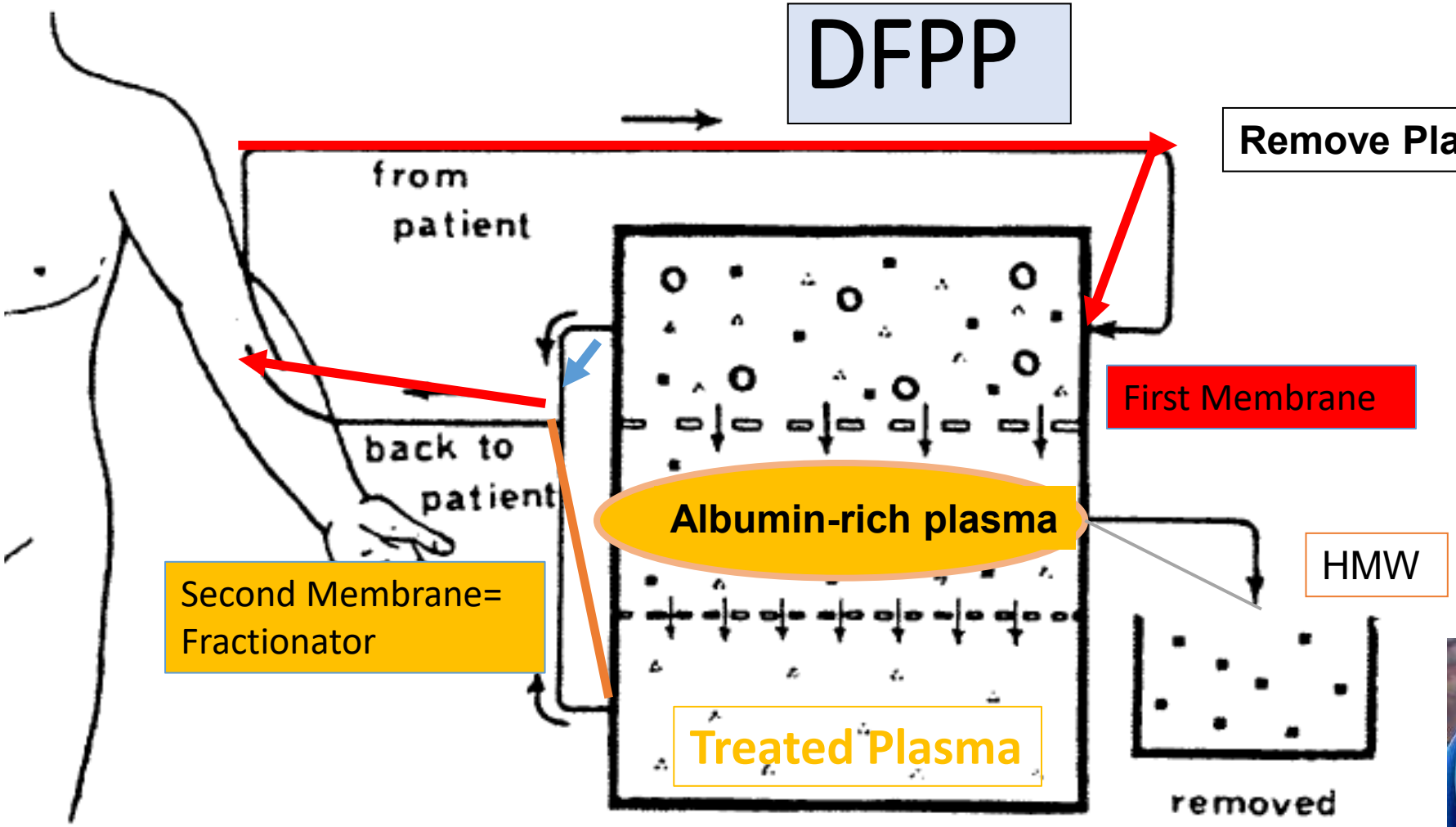
David *et al. Intensive Care Medicine Experimental* (2023) 11:26

STUDY PROTOCOL Open Access

EXCHANGE-2: investigating the efficacy of add-on plasma exchange as an adjunctive strategy against septic shock—a study protocol for a randomized, prospective, multicenter, open-label, controlled, parallel-group trial

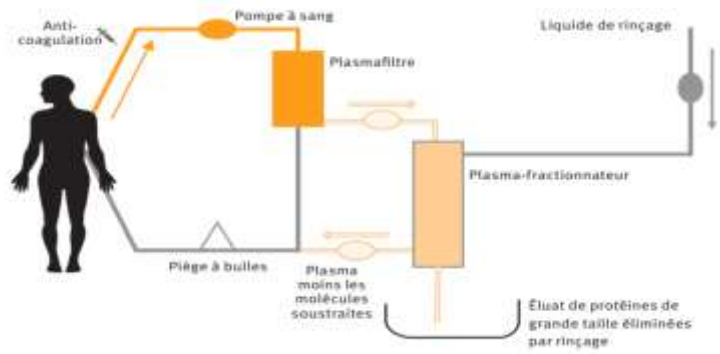
Sascha David[1,2*], Christian Bode[3], Klaus Stahl[4] and for the EXCHANGE-2 Study group

DFPP



Remove Plasma

First Membrane



HMW

Second Membrane= Fractionator

Remove protein

Double Filtration Plasmapheresis

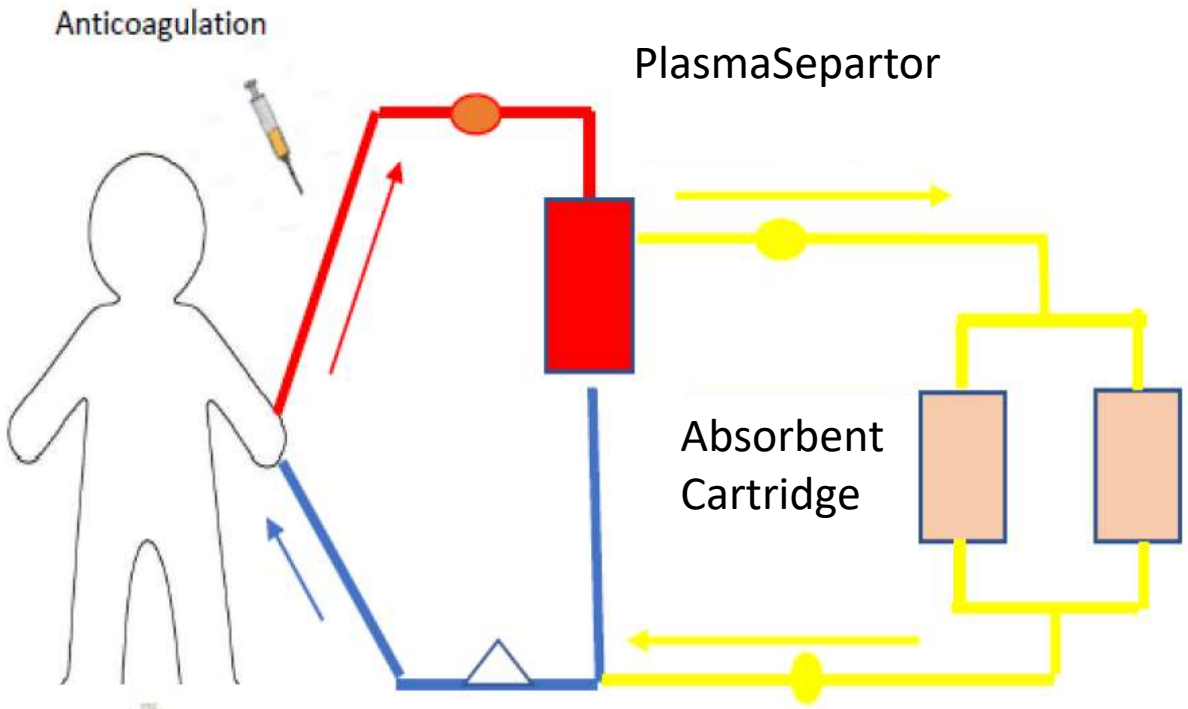
*T. Agishi, *l. Kaneko, *Y. Hasuo. *Y. Hayasaka, *T. Sanaka, *K. Ota, *H. Amemiya, *N. Sugino, S. Kawai, and Yamanc

•*Kidney Center, Tokyo Women's Medical Co/lege; tKawasumi Lt,boratories, Inc.; and ;/:Kuraray Co., Ltd.,* ***Tokyo, Japan.***

Protein removal with size > Albumin

No substitution fluid but some albumin

PLASMA-ADSORPTION



- **Specific substance removed with absorbent**
- **No substitution fluid but some albumin**

Sorbent
regenerable
or for single use.

Clinical idto	Products
Dyslipidemia	Kaneka / Liposorber Therasorb / LDL-Therasorb
Immune diseases	Asahi / Immusorba PH-350 Fresenius / Globaffin Therasorb / Ig- Therasorb
Liver support	Teraklin / MARS Fresenius Prometheus Asahi / Plasorba BR-350
Transplantation	Glycorex / Glycosorb ABO Vitrosorb / Secorim

LDL

Glycosorb: IgG specific Anti A/B

IA Semi-selectif:
Immunosorba: IgG1,IgG2,IgG4
Therasorb Ig Omni 5: IgG, IgM, IgA, IgE, K,L
Globafin: IgG1,2,4 lower IgG 3 & IgM,IgA
Glycorex (ProteineA): peu IgG3

Journal of *Clinical Medicine*

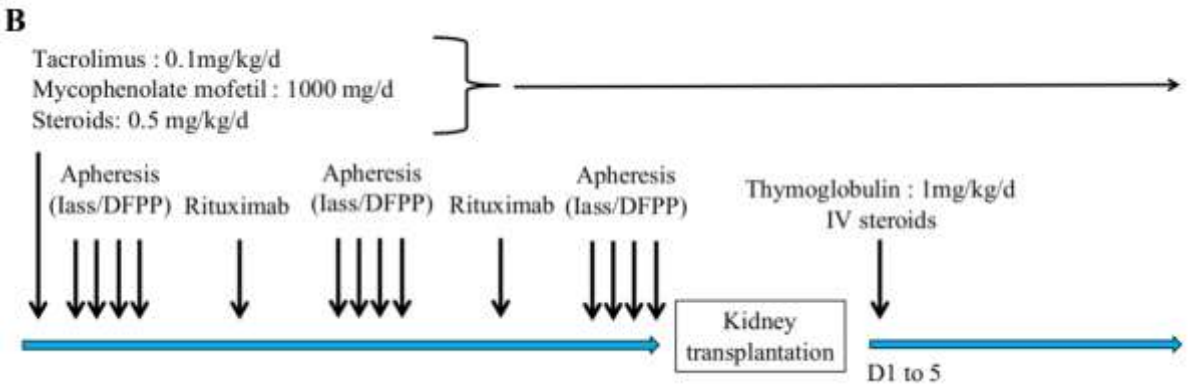
MDPI

Article

Apheresis Efficacy and Tolerance in the Setting of HLA-Incompatible Kidney Transplantation

2021

Johan Noble [1,2,†], Antoine Metzger [1,†], Hamza Naciri Bennani [1], Melanie Daligault [1], Dominique Masson [3], Florian Terrec [1], Farida Imerzoukene [1], Beatrice Bardy [3], Gaelle Fiard [4,5], Raphael Marlu [6], Eloi Chevallier [1], Benedicte Janbon [1], Paolo Malvezzi [1], Lionel Rostaing [1,2,*] and Thomas Jouve [1,2]



Immunoadsorption-Based HLA Desensitization in Patients Awaiting Deceased Donor Kidney Transplantation: An Interventional, Non-Randomised, Single Cohort Study

2023

Côme Bureau [1†], Cédric Rafat [1†], Jean Luc Taupin [2], Stéphanie Malard [2], Laurent Mesnard [1,3], Hélène François [1,3], Camille Petit-Hoang [1], Nacera Ouali [1], Alexandre Hertig [1,3], Matthieu Jamme [1], David Buob [3,4], Eric Rondeau [1,3], Pierre Galichon [1,3] and Yosu Luque [1,3]*

Clin Kidney J (2012) 5: 545–548
doi: 10.1093/ckj/sfs087
Advance Access publication 18 October 2012

Exceptional Case

CKJ

IgA-mediated anti-glomerular basement membrane disease: an uncommon mechanism of Goodpasture's syndrome

Guillaume Moulis[1,2,3], Antoine Huart[1,2,3,4], Joëlle Guitard[1,2,3], Françoise Fortenfant[2,5] and Dominique Chauveau[1,2,3,4]

COMPARISON TECHNICS

	cTPE	mTPE	DFPP	IA
Usage	Common in USA	Asia & CEE	Asian and CEE	Asia & CEE Germany++
Action	Non selective	Non selective	Semi selective	± Specific
Vascular Access	Peripheral veins	Central access	CVA / PVA	CVA / PVA
Treated Plasma Volume	1-1.2 PV	1-1.2 PV	1-1.2 PV	2-2.5 PV
Plasma extraction	80%	30-35%	30-35%	
Blood flows (VA++)	50-70 mls	100-200ml/min	90-150ml/min	100ml
Anticoagulant	Citrate	Heparin	Heparin/citrate	Heparin/citrate
Treatment time*	Shorter (54-128 min)	Longer (82-150 min)	Idem TPE	360- 480 mns
IgG/IgM reduction*	Equivalent*	Equivalent*	IgG / Fractionator	Higher for IgG

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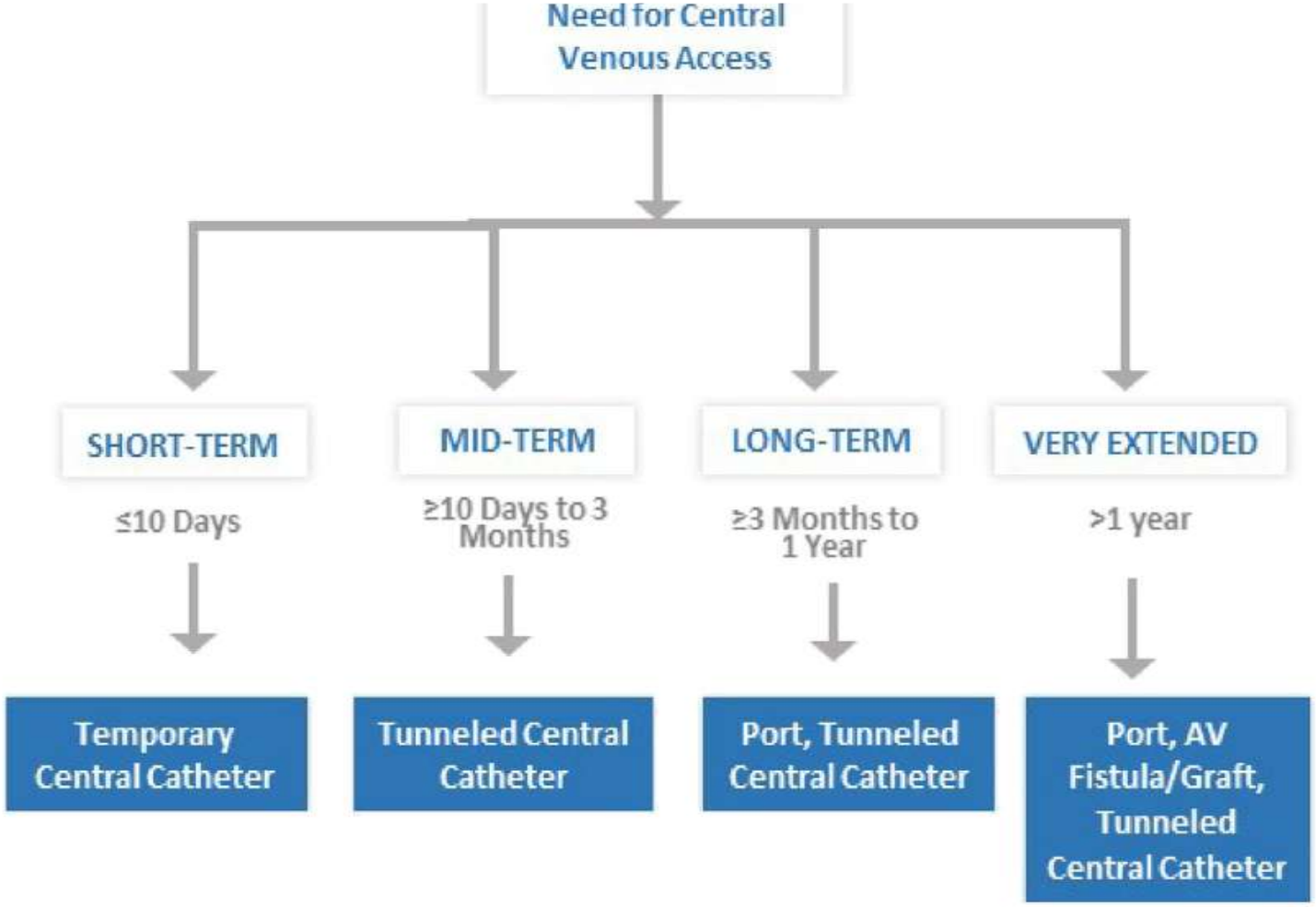
- **PRESCRIPTION**
- MECHANISM & GUIDELINES

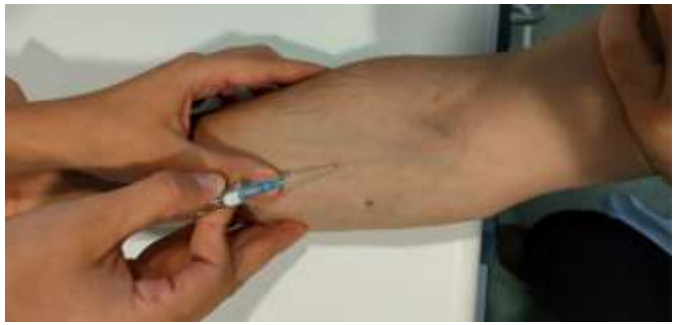
Peripheral vascular access for therapeutic plasma exchange: A practical approach to increased utilization and selecting the most appropriate vascular access

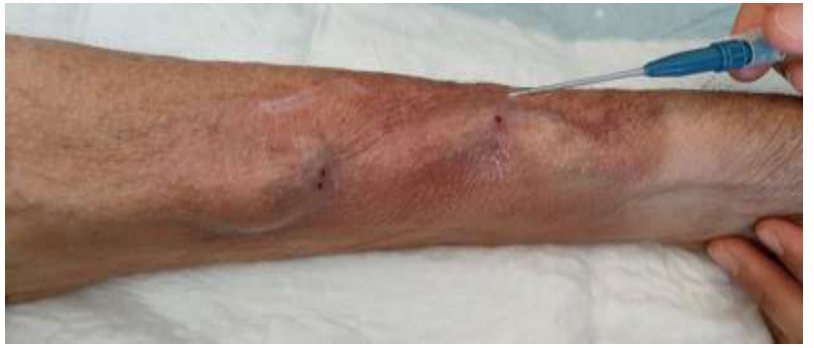
J Clin Apher. 2020;1–10.

David Barth[1] | Amber Sanchez[2] | Anna-Marie Thomsen[3] | Alicia Garcia[4] | Roman Malachowski[5] | Rebecca Weldon[6] | Michaela Mayhew[7] | Kari Mudie[8] | Dawn Faller[9] | Joseph Schwartz[10]



➢ Peripheral venous access **FIRST**





Blood Purification

Clinical Engineering - Research Article

Blood Purif
DOI: 10.1159/000531688

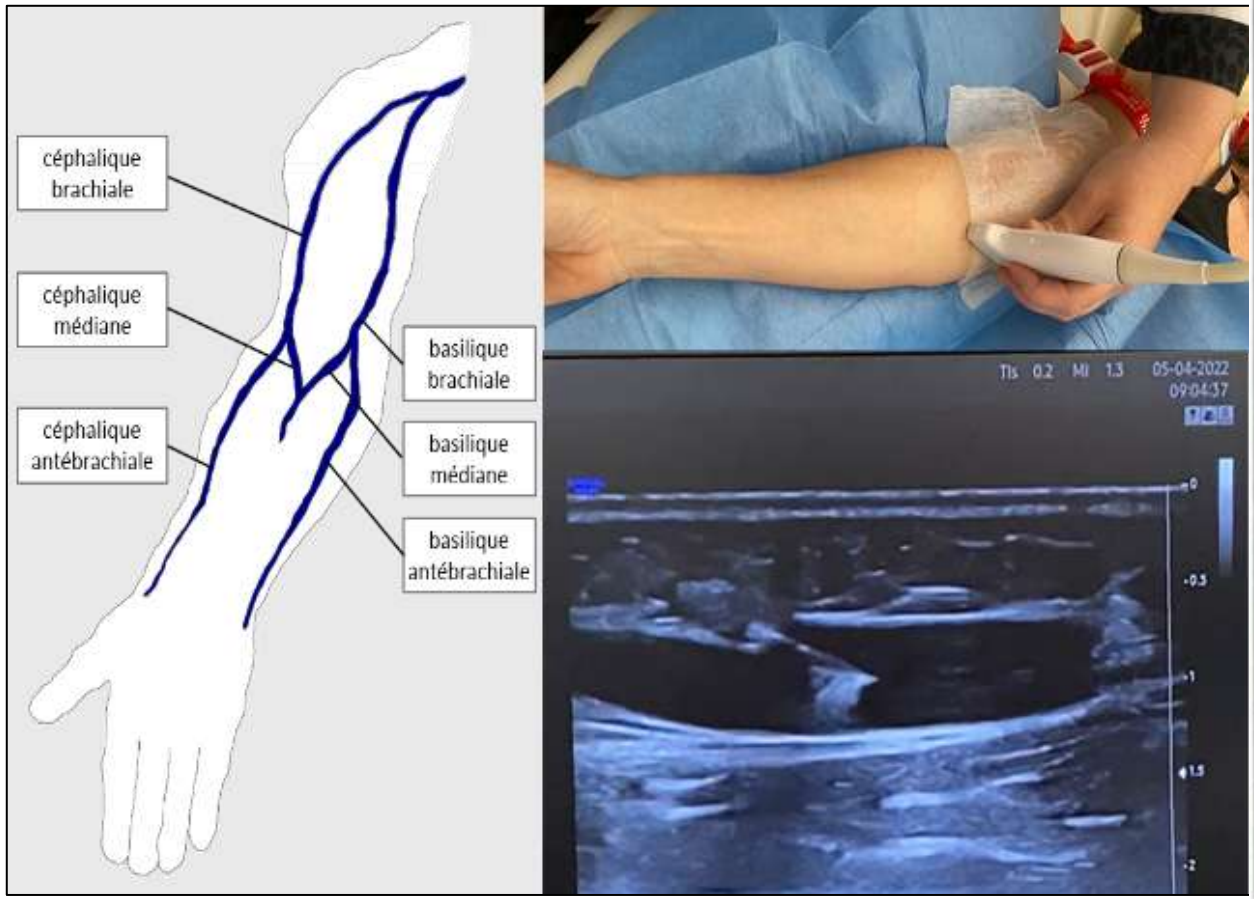
Received: March 3, 2023
Accepted: June 9, 2023
Published online: July ••, 2023

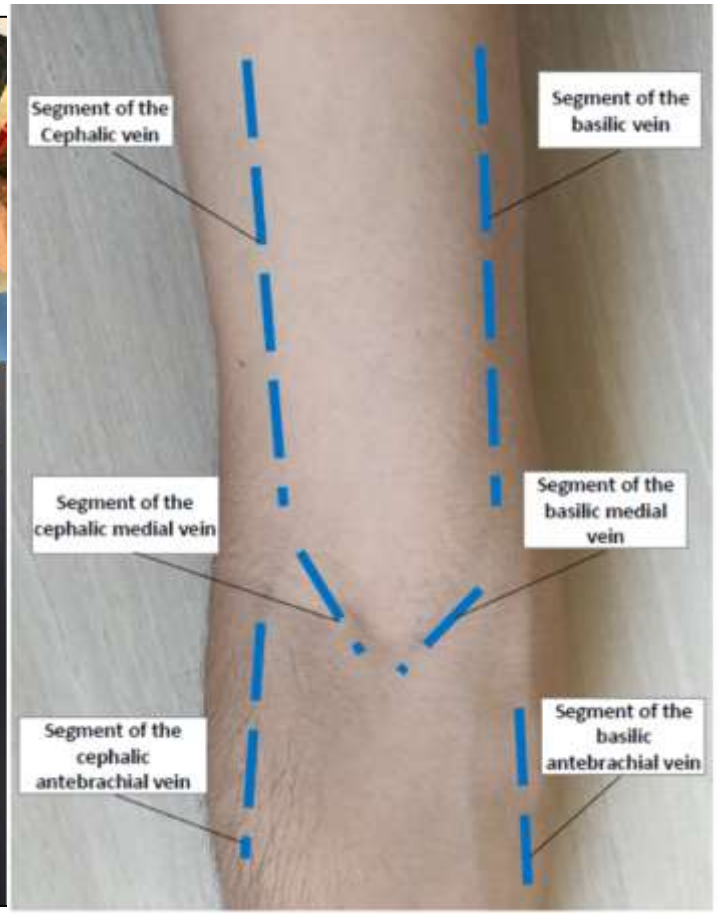
Feasibility, Efficacy, and Safety of Peripheral Venous Access for Chronic Double-Filtration Plasmapheresis with Regional Citrate Anticoagulation

Antoine Cardinale[a] Emilie Pambrun[a] Camelia Prelipcean[a] Ziyad Messikh[a]
Olivier Moranne[a, b]

[a]Service Néphrologie-Dialyse-Aphérèse, CHU Nîmes (France), Nîmes, France; [b]IDESP UMR Montpellier, •••, France

- **Doppler ultrasound venous mapping**
- **Ultrasound guidance for canulation**





Mean Blood Flow: 90 mL/mn

PATIENT'S COAGULATION STATE WITH THERAPEUTIC APHERESIS

➢ Coagulation activation

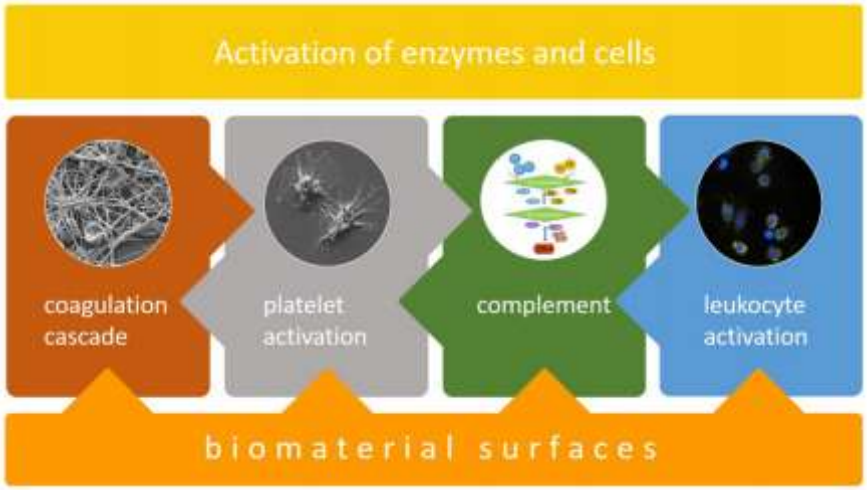
- Interaction with biomaterial (FXII)
- Clinical condition (inflammation…)

➢ Bleeding risk

- Anticoagulation's use (Heparin/RCA)
- Removal of clotting factors and fibrinogen

The blood compatibility challenge. Part 3: Material associated activation of blood cascades and cells

Maud Gorbet [1], Claudia Sperling [2], Manfred F Maitz [2], Christopher A Siedlecki [3], Carsten Werner [2], Michael V Sefton [4]



➢ **ONGOING STUDY** APHERCOAG STUDY NCT 06571552

➢ **Evolution clotting factors & Time Thrombin Generation**

ANTICOAGULATION FOR TPE

➢ **Unfractionated Heparin**

- Systemic anticoagulation
- Prescribed units/kg
- Bleeding risk and heparin induced thrombopenia

➢ **Citrate Anticoagulation**

- Regional circuit anticoagulation
- Prescribed with ratio of whole blood 12:1 ACD-A
- Infusion of gluconate/chlorure Ca2+
- Risk hypocalcemia, HypoMg2+, metabolic Alcalosis/acidosis

Jing Jiao et al Renal Failure 2023

Received: 18 May 2020 | Revised: 11 September 2020 | Accepted: 27 October 2020
DOI: 10.1002/jca.21854

CASE REPORT

Journal of Clinical Apheresis ...ASFA WILEY

Description of parallel and sequential configurations for concurrent therapeutic plasma exchange and continuous kidney replacement therapy in adults

Manish Kaushik[1] | Zhong Hong Liew[1] | Duu-Wen Sewa[2] | Ghee Chee Phua[2] | Ling Cao[3] | Thinesh Lee Krishnamoorthy[4] | Shin Yi Ng[5] | Amy Ee Lin Lim[1] | Li Choo Ng[1] | Riece Koniman[1] | Su Hooi Teo[1] | Han Khim Tan[1] | for the S.I.N:G.A.P.O.R.E Initiative (Science In Nephrology: Growth And Progress Of Research & Education Initiative)

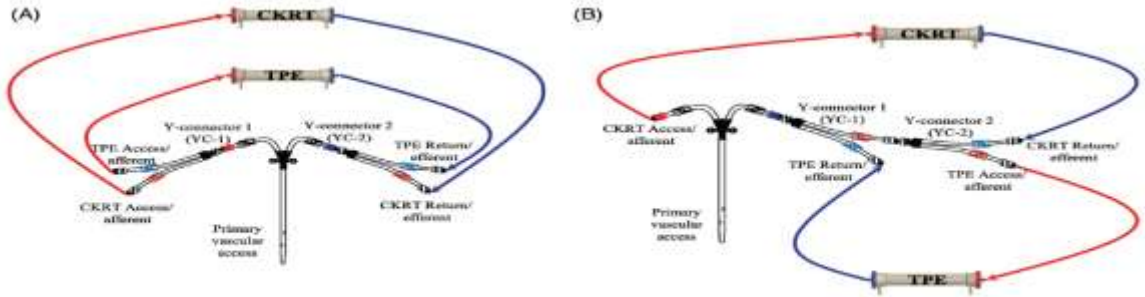


FIGURE 1 TPE-CKRT: Therapeutic plasma exchange (TPE) concurrent with Continuous Kidney Replacement Therapy (CKRT): A, in parallel configuration; B, in sequential configuration

Interest of therapeutic plasmapheresis in a chronic hemodialysis patient with severe bullous pemphigoid

Pedram Ahmadpoor[1] | Mathilde Beck[2] | Moise Michel[3] | Emilie Pambrun[1] | Pierre Stoebner[2,4] | Olivier Moranne[1,5]

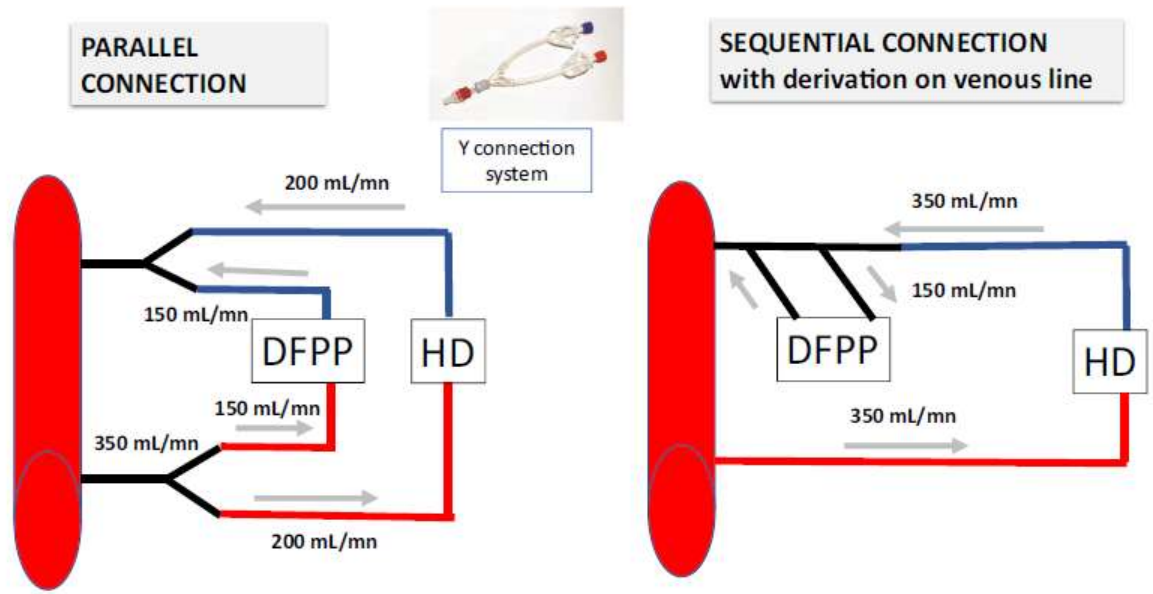
Journal of Clinical Apheresis ...ASFA

RESEARCH ARTICLE

Journal of Clinical Apheresis ...ASFA

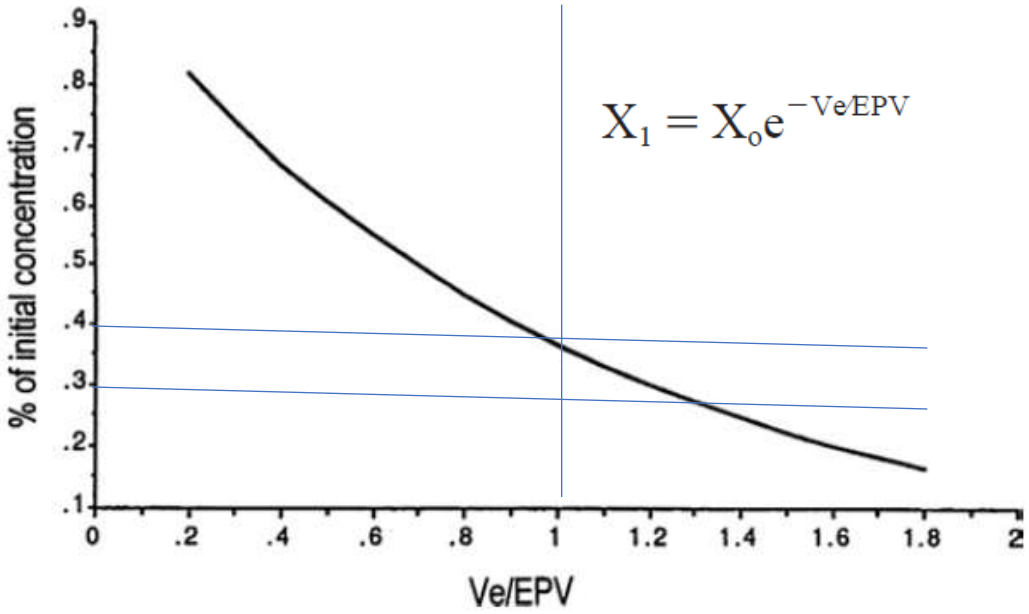
Tandem hemodialysis and DFPP: Procedure, safety and cost-effectiveness in patients requiring chronic hemodialysis and lipid apheresis

O Moranne[1,2] | F Chauvel[1] | E Pambrun[1] | P Ahmadpoor[1] | C Prelipcean[1] | A Wuillai[3] | S Chkair[2,4] | Z Messikh[1]



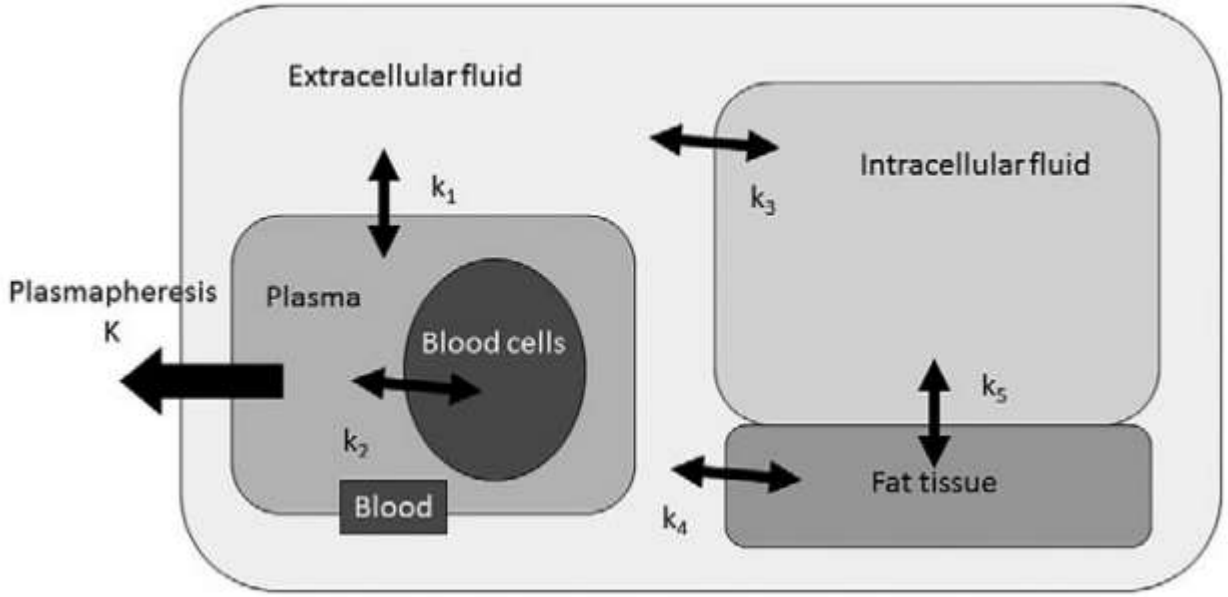
Theoretical removal of substance with TPE

1 PV exchange = 60% reduction



First order kinetic model without refilling

VP= 6.5% Weight x (1 –Hc) or 40 mL/kg

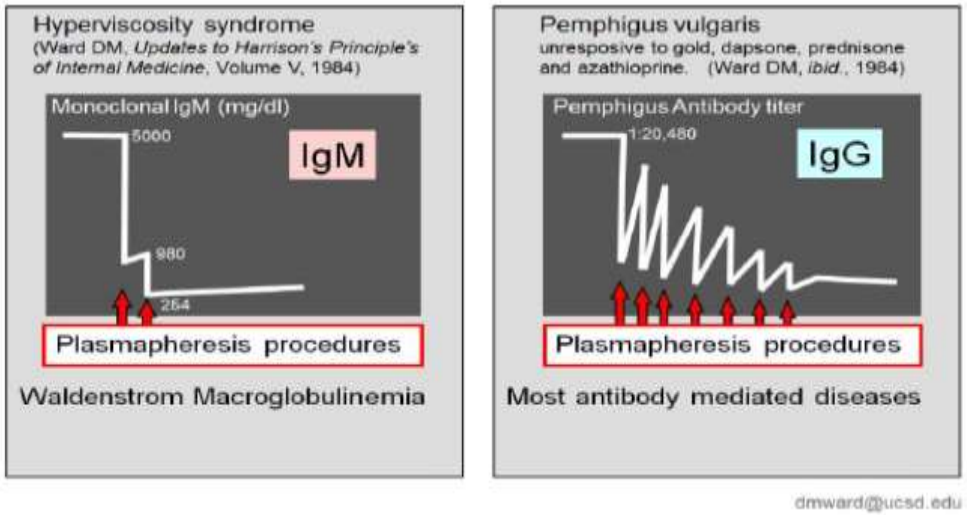


1 EVP = 63% soustraction; 1,4 EPV= 74%
Treatment: 1 to 1.5 EVP

Theoretical Basis of Pathogenic Substance Removal During Plasmapheresis

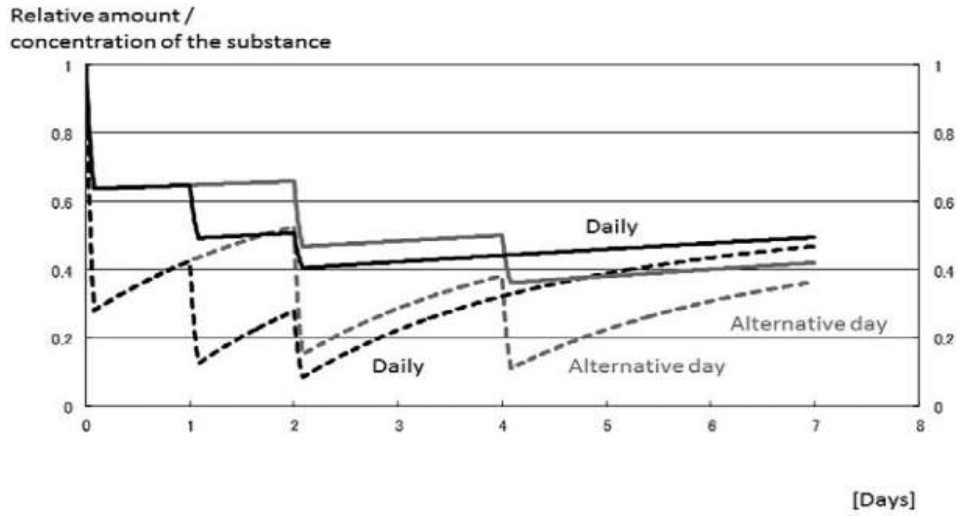
Norio Hanafusa

Therapeutic Apheresis and Dialysis 15(5):421–430
doi: 10.1111/j.1744-9987.2011.00930.x



- **Characteristics substances for prescription:**

- Molecular weight or size
- Distribution volume
- Transfer between compartments
- Production rate



OUTLINE

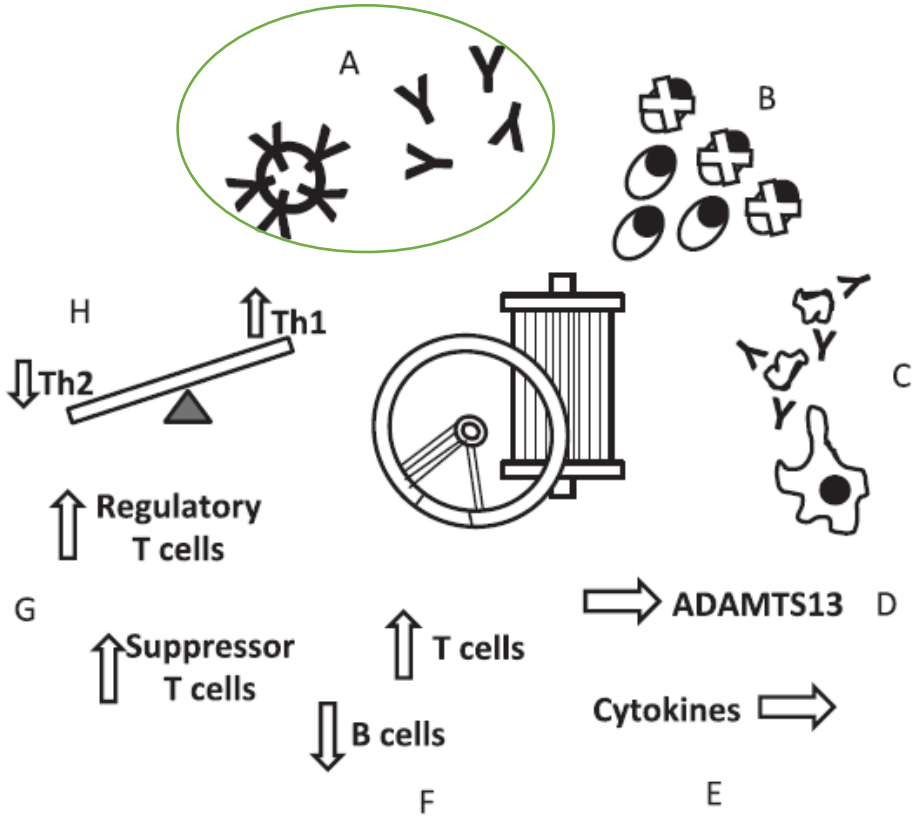
- THERAPEUTIC APHERESIS AND BLOOD PURIFICATION
- METHODS OF THERAPEUTIC APHERESIS
- PRESCRIPTION
- **MECHANISM & GUIDELINES**

PLASMA EXCHANGE IN AUTO IMMUN DISORDER

The mechanisms of action of plasma exchange

Hollie M. Reeves[1] and Jeffrey L. Winters[2]

[1]Department of Pathology – Clinical, University Hospitals Case Medical Center, Cleveland, OH, and [2]Division of Transfusion Medicine, Department of Laboratory Medicine and Pathology, Mayo Clinic, Rochester, MN, USA



A Removal of pathological antibodies.

B **Stimulates the proliferation of B cells and plasma cells**
D Removal of immune complex
E Removal of cytokines
F **Changes in lymphocytes number**
G **Increased T regulatory cells and T suppressor activity**
H **Correction of altered T helper cell type Th1/Th2 ratio favoring Th1 predominance**

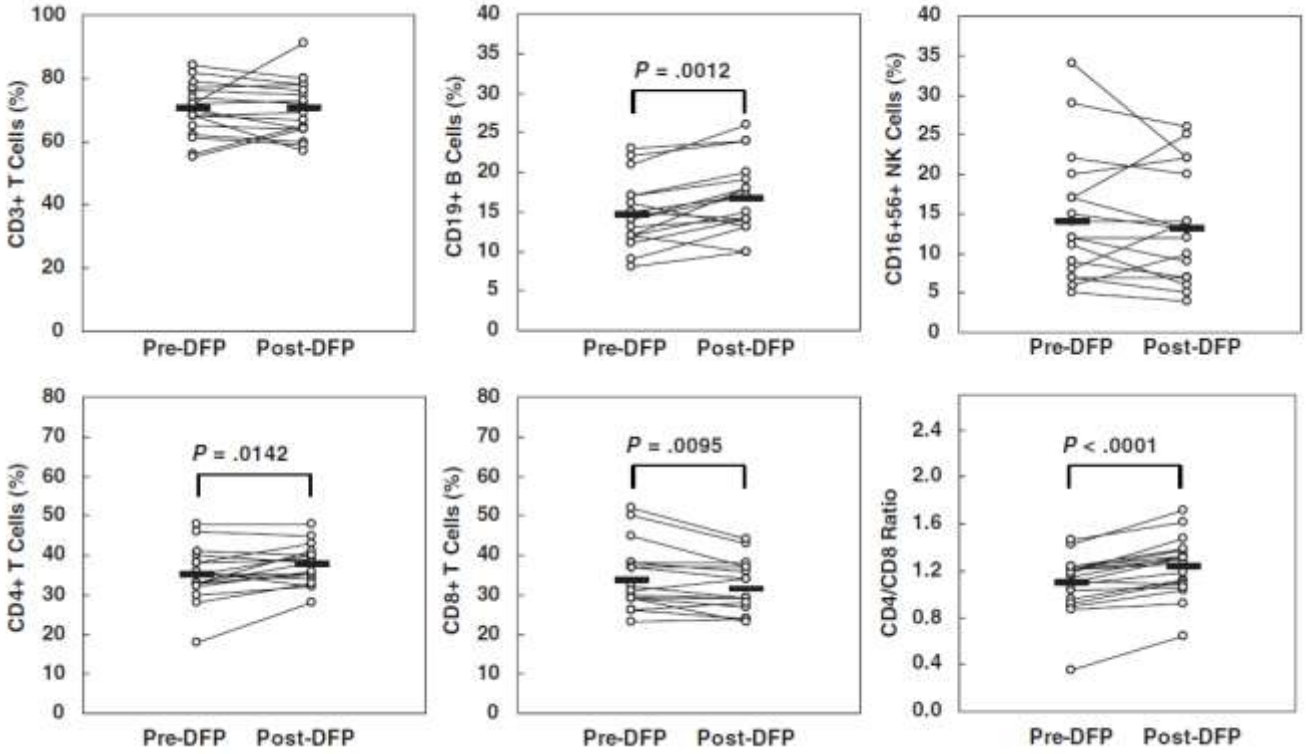
➢ **Modulation of cellular immunity** ?

Changes in the Lymphocyte Subset After Double-Filtration Plasmapheresis

Jiann-Horng Yeh, MD,[1,2] Pei-Ju Chien, MSc,[3] Yu-Mei Hsueh, PhD,[4] Chwen-Ming Shih, PhD,[5] and Hou-Chang Chiu, MD[1,2]

Am J Clin Pathol 2007;128:940-944

- Evaluation before and after DFPP on 18 healthy volonteers (Membrane Fractionator 4A)



- **Modification of immune system**
- **Decreased:**
  T Cells suppressor
- **Increased:**
  T cells helper and B cells
- Inchanged:
  Total T cells / Natural killer

THERAPEUTIC APHERESIS = MODULATION OF CELLULAR IMMUNITY ?

Transfus. Sci. Vol. 19, No. 1, pp. 27–33, 1998

Printed in Great Britain
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0955-3886/98 $19.00 + 0.00

Synchronization of Plasma Exchange and Adjuvant Treatments

Loïc Guillevin*

CLINICAL RESEARCH www.jasn.org

Randomized Trial of Plasma Exchange or High-Dosage Methylprednisolone as Adjunctive Therapy for Severe Renal Vasculitis

David R.W. Jayne,* Gill Gaskin,† Niels Rasmussen,‡ Daniel Abramowicz,§ Franco Ferrario,‖ Loic Guillevin,¶ Eduardo Mirapeix,** Caroline O.S. Savage,†† Renato A. Sinico,‖ Coen A. Stegeman,‡‡ Kerstin W. Westman,§§ Fokko J. van der Woude,‖‖ Robert A.F. de Lind van Wijngaarden,¶¶ and Charles D. Pusey; on behalf of the European Vasculitis Study Group†

BJCP British Journal of Clinical Pharmacology

DOI:10.1111/bcp.12167

Letter to the Editors

Influence of plasma exchange on rituximab pharmacokinetics

Nicolas Azzopardi,[1,2] Maud François,[3] Émeline Laurent,[4] Gilles Paintaud[1,2,4] & Béatrice Birmelé[3]

[1]CNRS, UMR 7292, France, [2]Université François-Rabelais de Tours, PRES Centre-Val de Loire Université, GICC, Tours, France and CHRU de Tours, Departments of [3]Haemodialysis and [4]Pharmacology-Toxicology, Tours, France

METABOLIC AND VASCULAR EFFECTS

Effects of LDL Apheresis on Blood Rheology in Two Patients with Homozygous Familial Hypercholesterolaemia

Blood Purif 1997;15:182–187

Effects of lipidapehresis for 2 patients
Results: ↘ LDLc: 60% & Fibrinogen: 22%,
↘ **Viscosity plasma et sang 12% et 17%**

Table 2. Immediate effect of LDL apheresis on blood rheological and lipid variables (sessions 1, 5 and 12)

Variables	Before treatment	After treatment	Change %	p value
Plasma fibrinogen, g/l	3.8 ± 0.9	1.9 ± 0.6	−50	<0.05
Plasma viscosity, mPa·s	1.31 ± 0.1	1.16 ± 0.07	−12	<0.05
Whole blood viscosity, mPa·s	4.6 ± 0.4	3.8 ± 0.3	−17	<0.05
Haematocrit, %	41 ± 2.6	43 ± 2.6	+5	NS
Total cholesterol, mmol/l	9.1 ± 3.8	3.8 ± 1.0	−58	<0.05
LDL cholesterol, mmol/l	8.2 ± 3.9	2.9 ± 1.2	−65	<0.05
HDL cholesterol, mmol/l	0.9 ± 0.2	0.8 ± 0.1	+11	NS

Circulation *Vol 81, No 2, February 1990*

Hemodynamic Changes in the Peripheral Circulation After Repeat Low Density Lipoprotein Apheresis in Familial Hypercholesterolemia

P. Rubba, MD, A. Iannuzzi, MD, A. Postiglione, MD, N. Scarpato, MD, S. Montefusco, MD, A. Gnasso, MD, G. Nappi, MD, C. Cortese, MD, and M. Mancini, MD

↑ **Max Blood flow +34%**
↓ **peripheral vasc Resit**
↓ **Blood viscosity**

LIPIDAPHERESIS = RHEOPHERESIS

PERIPHERAL VASCULAR DISEASES

Prevalence: 3-10% of population (US)	Procedure	Recommendation	Category
	LA	Grade 1B	II

Volume treated: 3000-5000 mL of plasma

Frequency: Once or twice per week

Replacement fluid: NA

Duration and discontinuation/number of procedures

Ten treatments in less than an 8-week period have been used.

Journal of *Clinical Medicine*

MDPI

Article

Rheopheresis Performed in Hemodialysis Patients Targets Endothelium and Has an Acute Anti-Inflammatory Effect

Justine Solignac [1,2,*], Romaric Lacroix [2,3], Laurent Arnaud [3], Evelyne Abdili [3], Dammar Bouchouareb [1], Stéphane Burtey [1,2], Philippe Brunet [1,2], Françoise Dignat-George [2,3] and Thomas Robert [1,2]

RESEARCH ARTICLE

Journal of Clinical Apheresis ASFA WIL

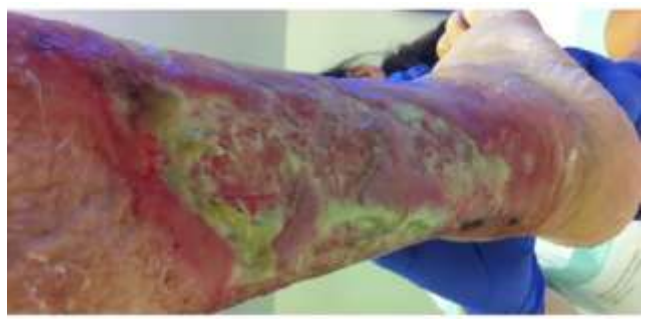
Study Protocol: A Randomized Controlled Prospective Single-Center Feasibility Study of Rheopheresis for Raynaud's Syndrome and Digital Ulcers in Systemic Sclerosis (RHEACT Study)

Jan-Gerd Rademacher[1†], Björn Tampe[1†], Angela Borisch[1], Rosa Marie Buschfort[1], Andrea von Figura[1], Thomas Asendorf[2] and Peter Korsten[1]*

[1] Department of Nephrology and Rheumatology, University Medical Center Göttingen, Göttingen, Germany, [2] Department of Medical Statistics, University Medical Center Göttingen, Göttingen, Germany

Rheopheresis: A new therapeutic approach in severe calciphylaxis

Thomas Robert[1] | Arnaud Lionet[2] | Stanislas Bataille[3,4] | Guillaume Seret[5]



Guidelines on the Use of Therapeutic Apheresis in Clinical Practice – Evidence-Based Approach from the Writing Committee of the American Society for Apheresis: The Eighth Special Issue

Journal of Clinical Apheresis ... ASFA WILEY

Anand Padmanabhan[1] | Laura Connelly-Smith[2] | Nicole Aqui[3] | Rasheed A. Balogun[4] | Reinhard Klingel[5] | Erin Meyer[6] | Huy P. Pham[7] | Jennifer Schneiderman[8] | Volker Witt[9] | Yanyun Wu[10] | Nicole D. Zantek[11] | Nancy M. Dunbar[12] |

DOI: 10.1111/1744-9987.13749

GUIDELINES

Therapeutic Apheresis and Dialysis WILEY

2021

The Japanese Society for Apheresis clinical practice guideline for therapeutic apheresis

Takaya Abe[1] | Hidenori Matsuo[1,2] | Ryuzo Abe[1] | Shinji Abe[1] |

FDA authorization=
TPE, DFPP no, LDLapheresis

JAPAN= TPE, DFPP, PA

- No Guidelines in Europe !!

Guidelines on the Use of Therapeutic Apheresis in Clinical Practice – Evidence-Based Approach from the Writing Committee of the American Society for Apheresis: The Eighth Special Issue

Anand Padmanabhan[1] | Laura Connelly-Smith[2] | Nicole Aqui[3] | Rasheed A. Balogun[4] | Reinhard Klingel[5] | Erin Meyer[6] | Huy P. Pham[7] | Jennifer Schneiderman[8] | Volker Witt[9] | Yanyun Wu[10] | Nicole D. Zantek[11] | Nancy M. Dunbar[12] |

Updating every 3 yrs

Selection of clinical Indication (91)
With Evidence Based Medicine

CATEGORY: I first line, **II** second line therapy

GRADE 1-2: strong recommandation with H/moderate quality evidence

Category	Description
I	Disorders for which apheresis is accepted as first-line therapy, either as a primary standalone treatment or in conjunction with other modes of treatment.
II	Disorders for which apheresis is accepted as second-line therapy, either as a standalone treatment or in conjunction with other modes of treatment.
III	Optimum role of apheresis therapy is not established. Decision making should be individualized.
IV	Disorders in which published evidence demonstrates or suggests apheresis to be ineffective or harmful. IRB approval is desirable if apheresis treatment is undertaken in these circumstances.

Recommendation	Description	Methodological quality of supporting evidence
Grade 1A	Strong recommendation, high-quality evidence	RCTs without important limitations or overwhelming evidence from observational studies
Grade 1B	Strong recommendation, moderate quality evidence	RCTs with important limitations (inconsistent results, methodological flaws, indirect, or imprecise) or exceptionally strong evidence from observational studies
Grade 1C	Strong recommendation, low-quality or very low-quality evidence	Observational studies or case series
Grade 2A	Weak recommendation, high-quality evidence	RCTs without important limitations or overwhelming evidence from observational studies
Grade 2B	Weak recommendation, moderate-quality evidence	RCTs with important limitations (inconsistent results, methodological flaws, indirect, or imprecise) or exceptionally strong evidence from observational studies
Grade 2C	Weak recommendation, low-quality or very low-quality evidence	Observational studies or case series

Journal of Clinical Apheresis ASFA WILEY

JCA 2026
Grade III ↗ II

Disease of interest →

Literature available →

Disease description →

Current management →

Rationale for apheresis →

Typical apheresis prescription →

Guidelines on the Use of Therapeutic Apheresis in Clinical Practice – Evidence-Based Approach from the Writing Committee of the American Society for Apheresis: The Ninth Special Issue

Laura Connelly-Smith[1] | Caroline R. Alquist[2] | Nicole A. Aqui[3] | Jan C. Hofmann[4] | Reinhard Klingel[5,6] | Oluwatoyosi A. Onwuemene[7] | Christopher J. Patriquin[8] | Huy P. Pham[9] | Amber P. Sanchez[10] | Jennifer Schneiderman[11] | Volker Witt[12] | Nicole D. Zantek[13] | Nancy M. Dunbar[14]

VASCULITIS, ANCA-ASSOCIATED

Incidence: 1 to 3/100,000/year (geographical, age, and ethnic differences)

Indication	Procedure		Category	Grade
Microscopic polyangiitis	TPE		III	1B
Granulomatosis with polyangiitis				
Eosinophilic granulomatosis with polyangiitis	TPE		III	2C
# reported patients: >300	**RCT**	**CT**	**CS**	**CR**
	10 (1091)	5 (345)	NA	NA

Description

The antineutrophil cytoplasmic antibody (ANCA)-associated vasculitides (AAV) comprise granulomatosis with polyangiitis (GPA; 25%-40%), microscopic polyangiitis (MPA; 48%-65%), and eosinophilic granulomatosis with polyangiitis (EGPA; 10%-20%). These diseases affect small- and medium-sized vessels and are characterized by multisystem organ involvement, commonly impacting the kidneys (70%; typically exhibiting rapidly progressive glomerulonephritis (RPGN) with high risk of end stage kidney disease (ESKD)), lungs (>50% at onset; can range from asymptomatic pulmonary lesions to life-threatening diffuse alveolar hemorrhage (DAH)), ear-nose-throat, joints, skin and nerves. Overlapping features between AAV subtypes occur. GPA is characterized by necrotizing granulomatous inflammation and is typically associated with cytoplasmic ANCA and antibodies to proteinase 3. GPA carries a higher risk for relapsing disease. MPA is characterized by vasculitis without granulomatous inflammation, and is most commonly associated with perinuclear ANCA and antibodies to myeloperoxidase. EGPA is rarely associated with RPGN or DAH. The presentation of the pulmonary-renal syndrome associated with ANCA can be clinically similar to anti-glomerular basement membrane (GBM) disease. When ANCA and anti-GBM are both present, the disease should be considered to represent anti-GBM disease (*see separate fact sheet*).

Current management/treatment

The treatment of all AAV subtypes is divided into two phases: induction of remission and, maintenance therapy given risk for relapse. Urgent treatment is required to prevent irreversible organ damage. The current standard of care for the induction phase is a combination of high-dose glucocorticoids with either cyclophosphamide or rituximab, which induces remission in up to 90% of patients. TPE has been included as an adjunctive therapy during induction in patients with significant kidney involvement and/or DAH, though the benefit has been challenged by the PEXIVAS study (Walsh, 2020). The mortality of AAV approaches 20% at 1 year, and is largely infection-related supporting a reduced steroid dose (50% of previous standard) based on RCT data from PEXIVAS demonstrating non-inferiority. There remains much practice variation and uncertainty for ideal steroid dosing in both induction and maintenance phases. Avacopan (a C5a receptor inhibitor) has been shown to be noninferior to oral prednisone for remission at 26 weeks, and superior to prednisone for sustained remission at week 52 in an RCT (Jayne, 2021). Maintenance treatment usually entails a gradual taper of steroids plus an additional immunomodulatory agent (azathioprine, mycophenolate mofetil, or rituximab) for 12 to 18 months.

Rationale for therapeutic apheresis

The cytotoxic role for ANCAs underlies the scientific rationale for therapeutic apheresis in the treatment of AAV. For decades, TPE has been considered an appropriate adjunctive therapy. Use of TPE for induction therapy in AAV with severe kidney involvement was first described as improving kidney function/dialysis independence in a RCT of 48 anti-GBM negative cases of RPGN with creatinine (Cr) >500 µmol/L (5.7 mg/dL; Pusey, 1991) then later confirmed by the MEPEX RCT (Jayne, 2007). Long-term follow-up from MEPEX (median 4 years) failed to show a net benefit of TPE on the composite outcome of death and ESKD (Walsh, 2013). Additionally, in other subsequent non-randomized CTs or CSs, the benefit of TPE was not always confirmed despite its acceptance into common practice. The addition of TPE in patients with severe kidney involvement remained a mainstay of induction therapy until the results of PEXIVAS, the largest RCT of TPE in AAV, failed to demonstrate a benefit of TPE on the composite primary outcome of ESKD and mortality at 12 months (Walsh, 2020).

PEXIVAS was an international RCT that enrolled 704 patients and assessed the effect of TPE as well as a reduced dose steroid regimen on the primary composite outcome of ESKD or death in patients with AAV with an eGFR<50 ml/min or with DAH. After induction with pulse steroids (IV) and cyclophosphamide (oral or IV) or rituximab, randomization to receive 60 mL/kg volume TPE or no TPEs and standard dose or reduced dose steroid regimen, with follow up for 2 to 7 years (median 2.9 years). Subgroup analysis of patients with Cr ≥5.7 mg/dL or DAH also failed to show a statistically significant benefit of TPE. However, review of supplemental data suggested outcomes may favor the TPE groups with DAH and when Cr ≥5.7 mg/dL; confidence intervals were large (i.e., PEXIVAS may be underpowered to detect differences in these subgroups). An accompanying editorial pointed out several issues regarding the generalizability of results (Derebail, 2020).

A subsequent systematic review and meta-analysis including 1060 participants with AAV found no impact of TPE on all-cause mortality, and data from seven trials with 999 total participants demonstrated a reduced risk of ESKD at 12 months (20% risk reduction); however, TPE was also associated with an increased risk for serious infections (Walsh, 2022). In a retrospective study of 427 cases of AAV with biopsy proven severe kidney involvement, a model predicting patients most likely to benefit from TPE was developed and favors those with increasingly elevated creatinine levels, high Brix score and crescentic Berden score on biopsy (Nezam, 2022). Further validation studies are needed to use this scoring system in clinic practice. The 2021 KDIGO guidelines continue to recommend consideration for TPE in select cases. The American College of Rheumatology (ACR) has recommended against the routine use of TPE in all patients with active glomerulonephritis, but notes that TPE can be considered for patients at higher risk for progression to ESKD who accept a potential increased risk for infection (Chung, 2021). The ACR guideline panel also recommended against the use of routine plasma exchange for DAH as TPE has not been able to demonstrate an improvement in mortality.

Technical notes

Volume treated: 1 to 1.5 TPV **Frequency:** Daily in DAH, typically every other day in absence of DAH

Replacement fluid: Albumin; plasma when DAH present

Duration and discontinuation/number of procedures

Median number of TPE is 7 over a median period of 14 days, up to 12 have been reported to result in further improvement in patients with severe kidney failure (Cr ≥5.7 mg/dL or on dialysis) or DAH (deLuna, 2015). Daily therapy should be considered in patients with severe DAH, tapered to every other day as clinical situation improves.

Exemple d'un service
de Néphrologie
CHU Nimes

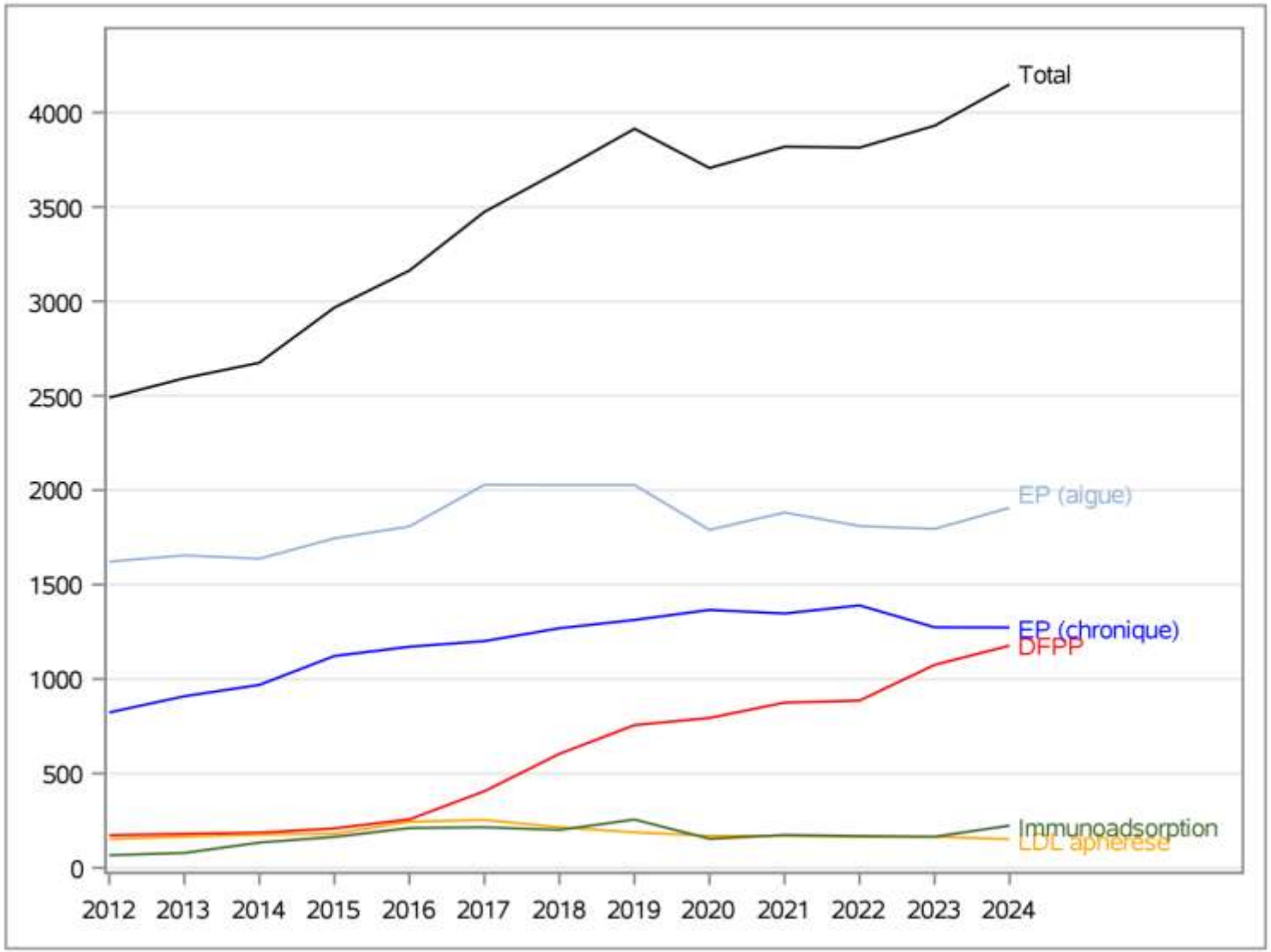
Nephrology ICU

Reanimation

- **Plasmapherese ≈ 900 sessions/an**
- **DFPP & TPE centri/filtration**
- VVP /VVC: Filtration/Centrif
- Heparine & Citrate
- Pas d indication chez greffe

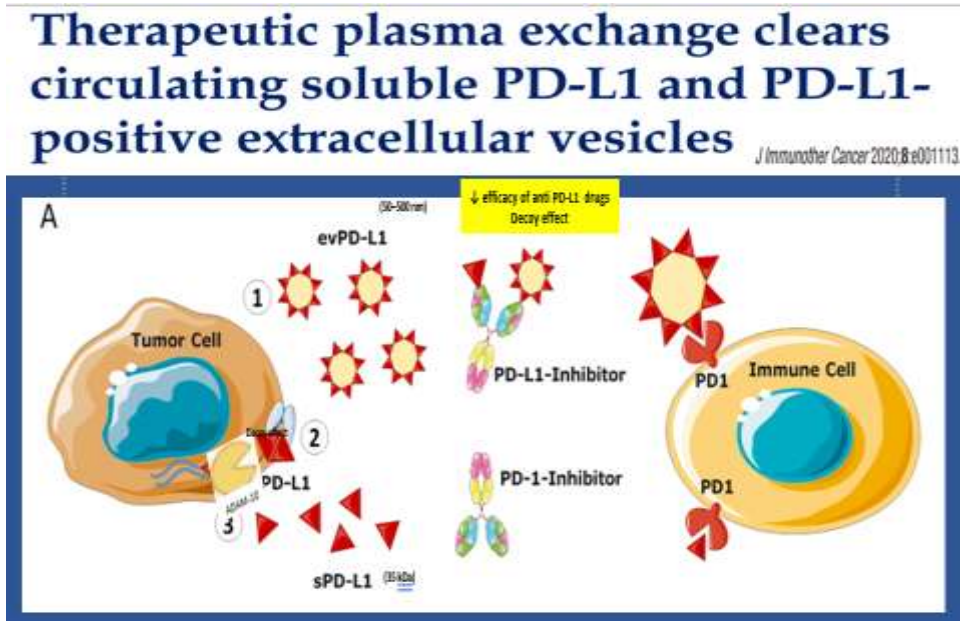
Chronic HDI & Therapeutic Apheresis

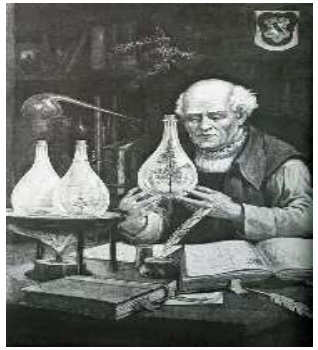
PATIENTS TREATED BY THERAPEUTIC PLASMAPHERESIS IN FRANCE (2012-2024)



CONCLUSION

- **Indications**: PTTai ↘ (PHRC PEXFREE), épuration vésicules extra-cellulaire, ischémie vasculaire?
- **Essai randomisé** Plasmaphérèse Thérapeutique vs médicaments ?





A Randomized Trial Comparing Imlifidase to Plasmapheresis in Kidney Transplant Recipients With Antibody-Mediated Rejection

Fabian Halleck[1,2] | Georg A. Böhmig[3] | Lionel Couzi[4,5] | Lionel Rostaing[6] | Gunilla Einecke[7,8] | Carmen Lefaucheur[9] | Christophe Legendre[10,11] | Robert Montgomery[12] | Peter Hughes[13,14] | Anil Chandraker[15] | Kate Wyburn[16] | Phil Halloran[17] | Angela Q. Maldonado[18] | Kristoffer Sjöholm[18] | Anna Runström[18] | Paola Lefèvre[18] | Jan Tollemar[18] | Stanley Jordan[19]

GOOD-IDES-02, a global pivotal Phase 3 trial in anti-GBM) disease, did not meet its primary endpoint

Renée Aguiar-Lucander, CEO, Hansa Biopharma said

"**We are disappointed not to be able to provide a new treatment option for this patient group**, who to date have experienced poor outcomes. Despite the deep and rapid reduction of anti-GBM antibodies following imlifidase treatment, it did not result in a statistically significant outcome in this setting

Arenesdelaplasma.org

THANK YOU

LES ARÈNES DE LA PLASMAPHÉRÈSE THÉRAPEUTIQUE

DU Aphérèse thérapeutique 2026-27 Université Montpellier-Nimes site de Nimes