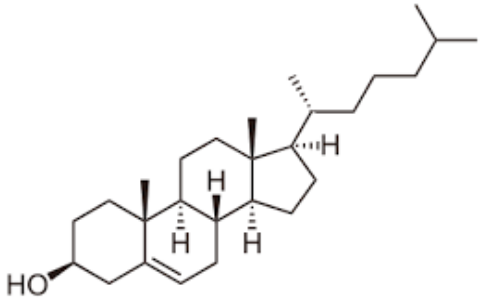
15 ΠΕΡΙΦΕΡΕΙΑΚΗ ΔΙΗΜΕΡΙΔΑ
ΕΛΛΗΝΙΚΗΣ ΕΤΑΙΡΕΙΑΣ ΑΙΜΑΦΑΙΡΕΣΗΣ



LDL αφαίρεση και FSGS

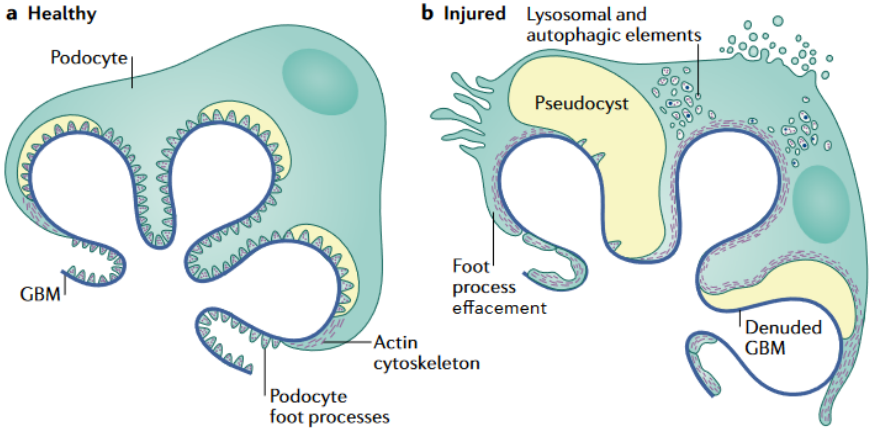
Μέμμος Βαγγέλης
Νεφρολόγος
Γ.Ν. «Παπαγεωργίου» Θεσσαλονίκης

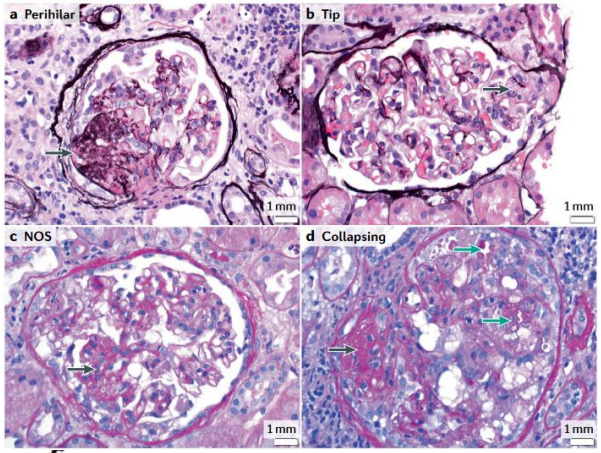
ΝΟΣΟΚΟΜΕΙΟ ΠΑΠΑΓΕΩΡΓΙΟΥ

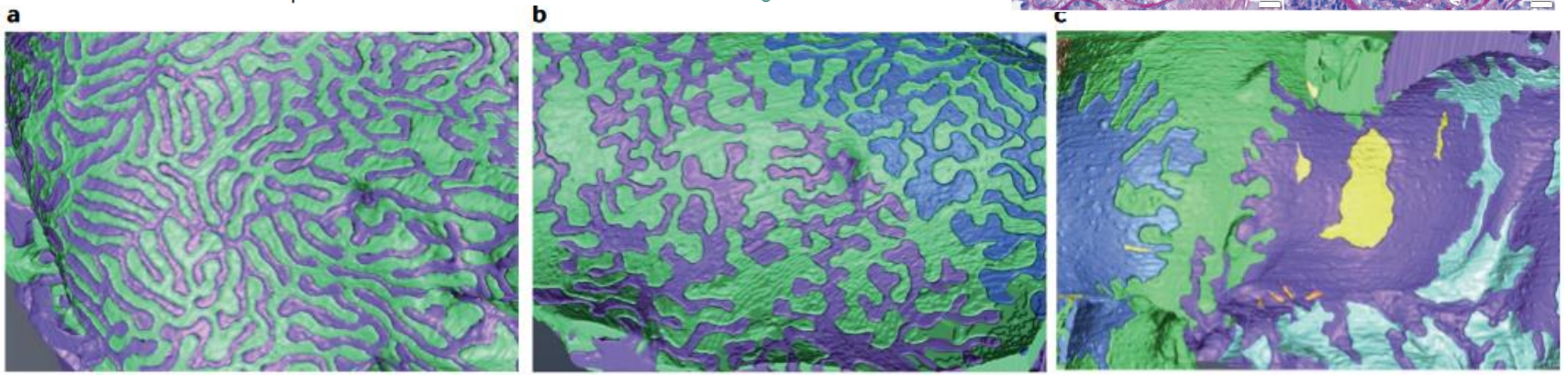
FSGS

Focal → Segmental → Glomerulo → Sclerosis

some sections of the filtering units are scarred

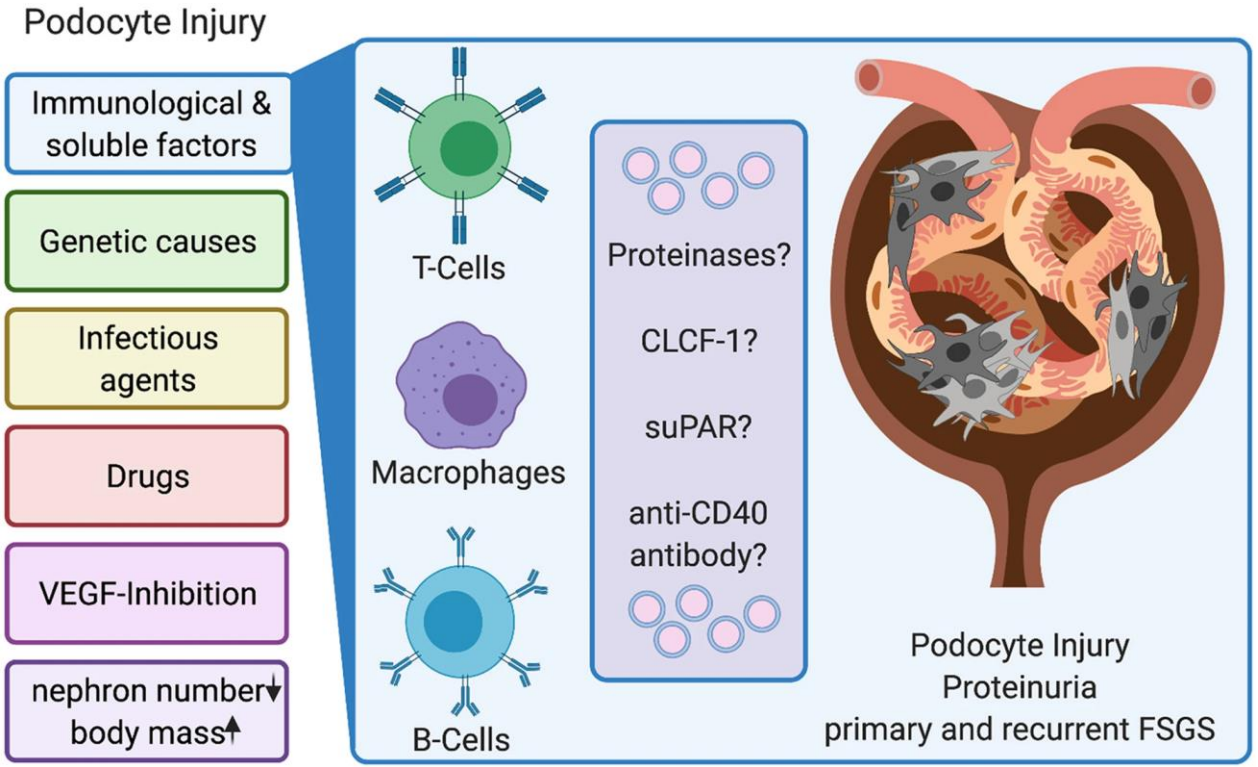






An De Vriese et al. Nat Rev Nephrol. 2018

Permeability factor related FSGS

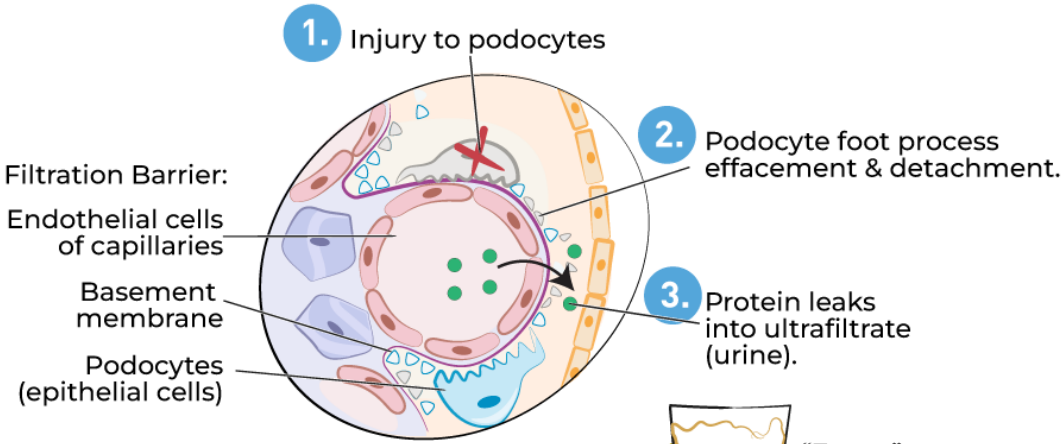


- Ίδιο φάσμα με MCD
- Κακή απάντηση σε RASi
- **40–70%** απάντηση σε κορτικοειδή και CNIs
- Μπορεί να απαντήσει σε PLEX ή ανοσοπροσρόφηση
- **70-80%** υποτροπή στο μόσχευμα

F Braun et al. Cell Tissue Res. 2021

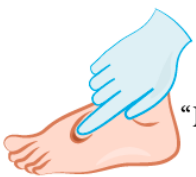
Nephrotic Syndrome

PATHOPHYSIOLOGY



4. SIGNS/SYMPTOMS

- High proteinuria > 3.5 g/day
  - → Hypoalbuminemia
    - → Water & Na+ retention
      - → Edema
- Hyperlipidemia/lipiduria
- Loss of Immunoglobulins & anticoagulants in urine.
  - → Infections, thrombotic complications



"Pitting" edema

https://ditki.com/course/pathology/glossary/term/nephrotic-syndrome-key-pathologies

Τάξεις λιποπρωτεϊνών

ApoB-48

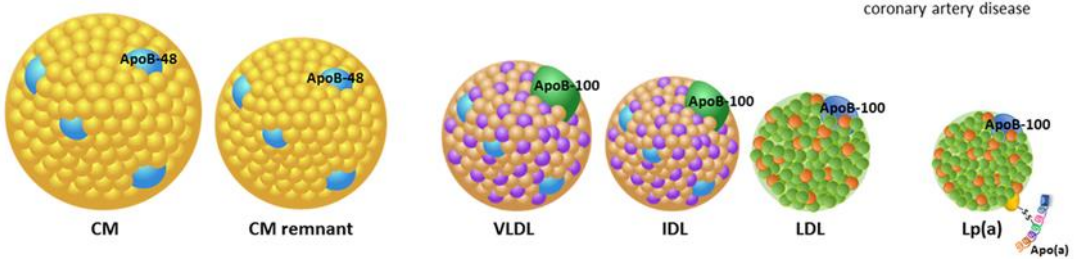
- MW: 264,000 daltons
- Metabolic function: assembly and secretion of CMs from the small intestine; structural protein of CMs and CM remnants

ApoB-100

- MW: 540,000 daltons
- Metabolic function: assembly and secretion of VLDL from the liver; structural protein of VLDL, IDL, LDL and Lp(a); ligand for LDL receptor

Apo(a)

- MW: 250,000-800,000 daltons
- Metabolic function: not completely defined, but it is an independent predictor of coronary artery disease

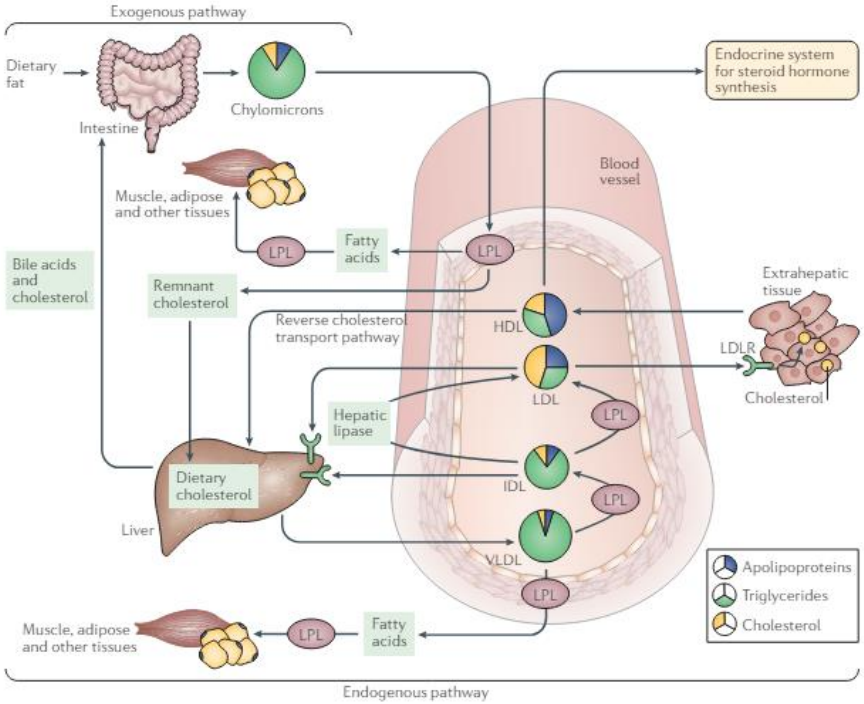


	CM	CM remnant	VLDL	IDL	LDL	Lp(a)
Source	intestine	CM	liver (intestine)	VLDL	VLDL	liver
Density (g/dl)	< 0.95	< 1.006	0.95-1.006	1.006-1.019	1.019-1.063	1.05-1.12
Diameter (nm)	75-1200	45-150	30-80	25-35	18-25	about 25
Molecular weight (daltons)	400×10^6	unknown	$10\text{-}80 \times 10^6$	$5\text{-}10 \times 10^6$	2.3×10^6	about 4×10^6
Structural components	99-98% total lipid and 1-2% total protein	94-92% total lipid and 6-8% total protein	93% total lipid and 7% total protein	85% total lipid and 15% total protein	80% total lipid and 20% total protein	80% total lipid and 20% total protein
Apolipoprotein composition	A-I, A-II, A-IV, B-48, C-I, C-II, C-III, E	B-48, E	B-100, C-I, C-II, C-III, E	B-100, C-I, C-II, C-III, E	B-100	B-100, Apo(a)

- ✓ ApoB: μια μεγάλη πρωτεΐνη που περιβάλλει την επιφάνεια των λιποπρωτεϊνών
- ✓ Μόριο ApoB: συνδέτης του υποδοχέα LDL (LDLR) για την κάθαρση των λιποπρωτεϊνών
- ✓ *Οι όροι VLDL, υπολειπόμενο CM και LDL είναι απλώς διαφορετικά ονόματα για την ίδια κυκλοφορούσα λιποπρωτεΐνη που περιέχει apoB, σε διαφορετικά στάδια του κύκλου ζωής της*

E Gianazza et al. Mass Spectrom Rev. 2023

Μεταβολισμός λιπιδίων



Εξωγενής οδός: λιπίδια της τροφής (TRGs κ.α.)

➔ Μετατρέπονται σε χυλομικρά από τον εντερικό βλενογόννο

➔ Εισέρχονται στην κυκλοφορία μέσω της λέμφου

➔ Προσλαμβάνονται από τους μύες, το λιπώδη και άλλους ιστούς ως ελεύθερα λιπαρά οξέα

Ενδογενής οδός: το ήπαρ παράγει VLDL

➔ στην κυκλοφορία σχηματίζει IDL

➔ απομακρύνεται από το ήπαρ

➔ σχηματίζεται LDL

➔ απομακρύνεται από το ήπαρ κ.α. μέσω του LDLR

Οδός της ανάστροφης μεταφοράς χοληστερόλης:

η HDL συνδέεται με τη Chol από περιφερικούς ιστούς

➔μεταφέρει τη Chol πίσω στο ήπαρ

S Agarwal et al. Nat Rev Nephrol. 2017

Υπερλιπιδαιμία στο νεφρωσικό σύνδρομο

Αύξηση IDL, VLDL, LDL, Chol λόγω:

- Ελαττωμένης κάθαρσης (↓LPL, ↓ ηπατικής λιπάσης)
- Αυξημένης σύνθεσης

Αύξηση PCSK9 (αποδομεί τον LDLR)

Μεταβολή στη σύνθεση και τη λειτουργία των λιποπρωτεϊνών

Αύξησης της πρόδρομης HDL

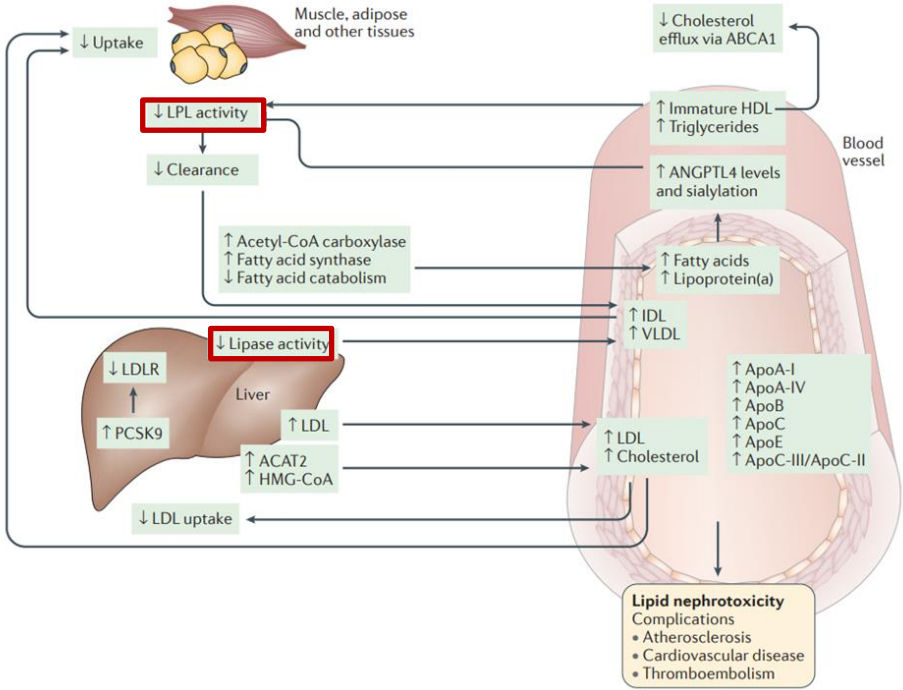
Υπερτριγλυκεριδαιμία

Αύξηση ANGPTL4 (καταστέλλει την LPL)

Διέγερση της ηπατικής ACAT2 (ελάττωση της ενδοκυττάριας ελεύθερης Chol)

Αύξηση της HMG-CoA αναγωγάσης

Αύξηση της οξείδωσης της LDL από την Lp(α)



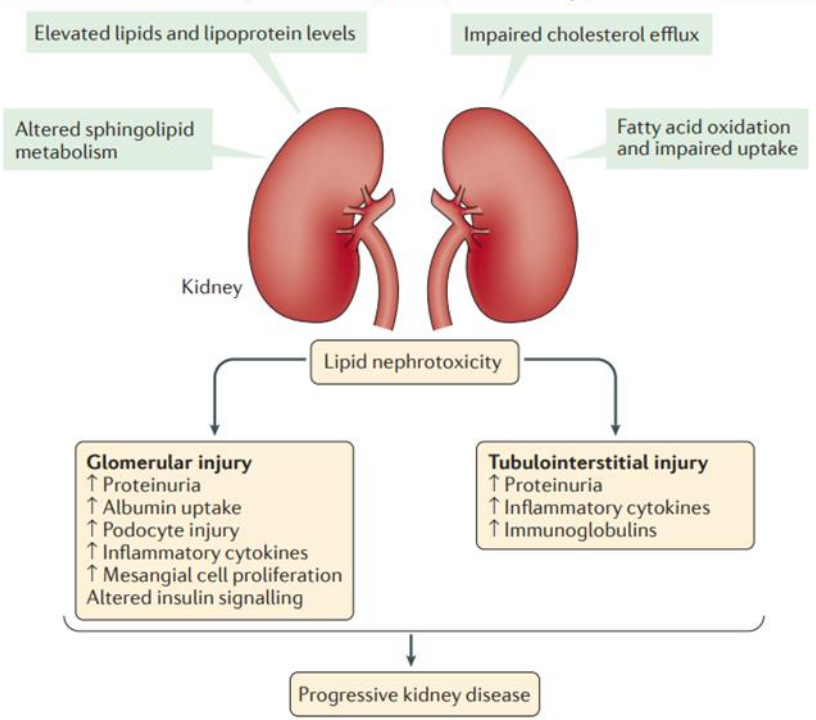
S Agarwal et al. Nat Rev Nephrol. 2017

Νεφροτοξικότητα λιπιδίων

Consequences of dyslipidaemia in nephrotic syndrome or CKD

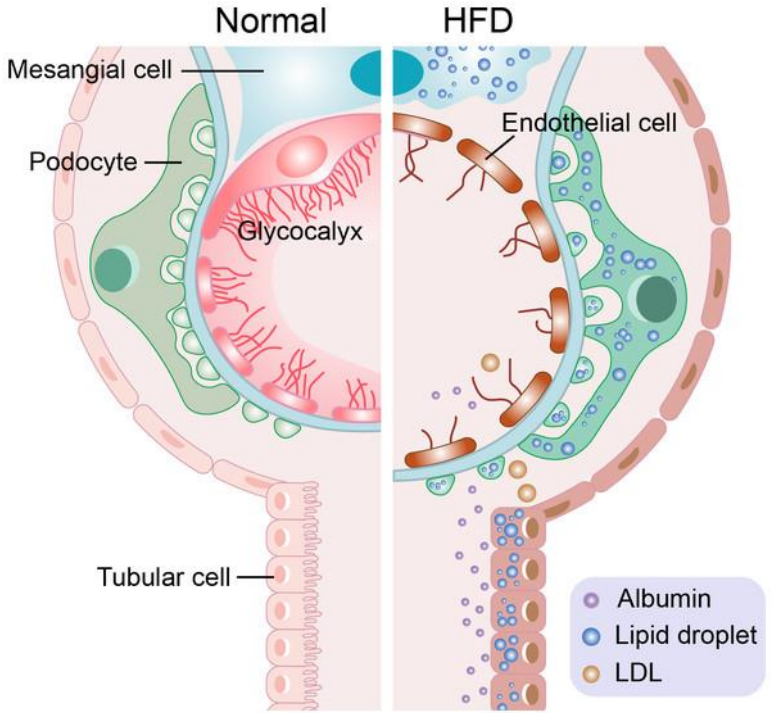
Complications associated with dyslipidaemia in nephrotic syndrome	Estimates of individual and additive risk for complications occurring in different disease states		
	Nephrotic syndrome	CKD	Nephrotic syndrome and CKD
Cardiovascular disease			
Atherosclerosis	++	+	+++
Myocardial infarction	++	+	+++
Cerebrovascular accident (stroke)	++	+	+++
Progressive kidney disease			
Glomerulosclerosis	++	+	+++
• Mesangial cell proliferation	+	±	+
• Podocyte injury	+	+	++
Tubulointerstitial disease	++	+	+++
• Proximal tubular cell injury	+	+	++
Other			
Thromboembolism	++	±	++

Mechanisms and consequences of lipid nephrotoxicity.

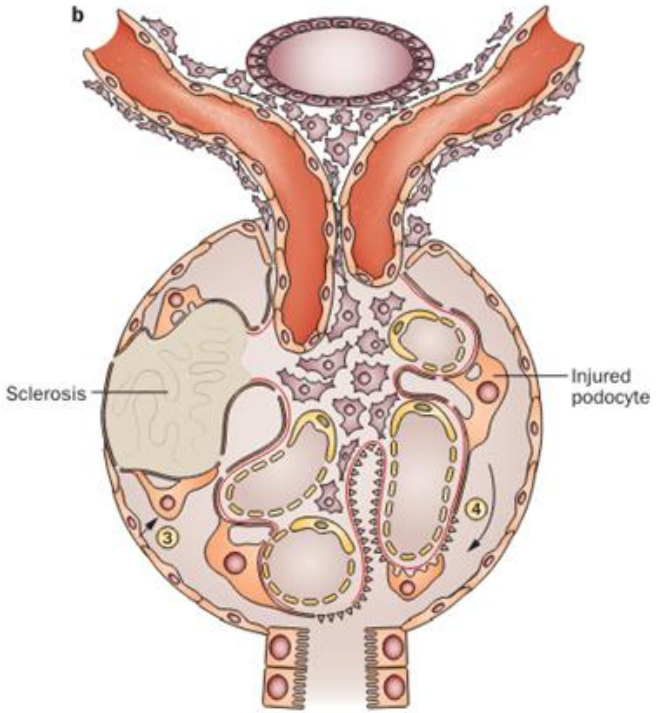


S Agarwal et al. Nat Rev Nephrol. 2017

Νεφροτοξικότητα λιπιδίων



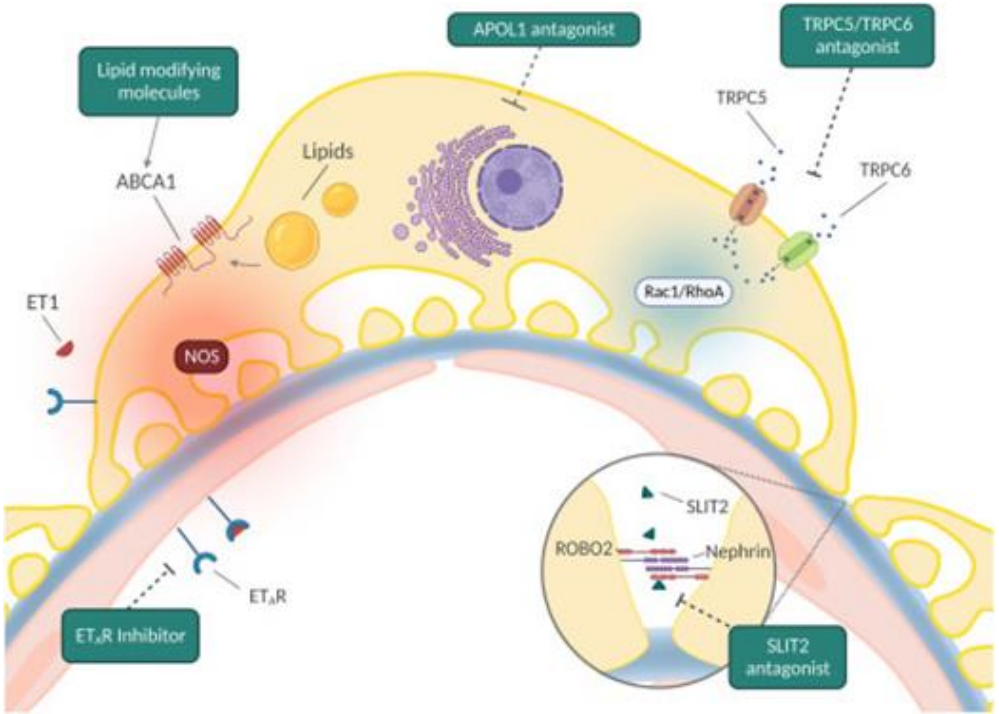
Υπερλιπιδαιμία + πρωτεϊνουρία + υποαλβουμιναιμία ➔ σπειραματοσκλήρυνση



Περίσσεια LDL παγιδεύεται στο μεσάγγειο

Chen et al. PeerJ.2023

Νεφροτοξικότητα λιπιδίων



Η έκθεση των ποδοκυττάρων σε αλβουμίνη + λιπαρά οξέα, προκαλεί κυτταρικό θάνατο

Η αντίδραση αυτή ΔΕΝ παρατηρείται κατά την έκθεση των ποδοκυττάρων ΜΟΝΟ σε αλβουμίνη

S Agarwal et al. Nat Rev Nephrol. 2017

Θεραπεία δυσλιπιδαιμίας σε νεφρωσικό σύνδρομο

Υγιεινοδιαιτητικές οδηγίες
Στατίνες
Δεσμευτικοί παράγοντες χολικού οξέος
Φιμπράτες
Νικοτινικό οξύ
Εζετιμίμπη
Anti-PCSK9 αντισώματα
LDL αφαίρεση (LDLA)

S Agarwal et al. Nat Rev Nephrol. 2017

Treatment	Action	Outcomes	Limitations
Conservative lifestyle changes (diet, weight, exercise)	• ↓ Cholesterol • ↓ Apolipoproteins (small reduction) • ↓ Triglycerides	• ↓ Hyperlipidaemia • ↓ Proteinuria	Implementation and patient compliance
Statins	• ↓ HMG-CoA	• ↓ LDL • ↓ Cholesterol • ↓ Triglycerides • ↑ HDL • Few adverse effects • Improved cardiovascular outcome in CKD	Limited number of studies
Bile acid sequestrants	• ↓ Enterohepatic bile acid circulation	• ↓ LDL	• Gastrointestinal adverse effects • Less effective than statins
Fibrates	• ↑ Lipoprotein lipase activity	• ↓ Triglycerides • ↓ LDL • ↓ Cholesterol	Meta-analysis found a lack of support for fibrate efficacy
LDL-apheresis	• ↓ LDL • ↓ Cholesterol • ↓ Triglycerides • ↑ Response to immunosuppressants	• Complete or partial remission of nephrotic syndrome • Few adverse effects	Requires central venous access
• Anti-PCSK9 antibodies • *PCSK9* RNA interference	• Inactivation of PCSK9 • Degradation of *PCSK9* mRNA • ↑ Hepatic LDLR	• ↓ LDL	Very expensive

S Agarwal et al. Nat Rev Nephrol. 2017

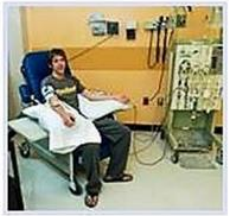
LDL αφαίρεση

Δρ Gil Thompson, Hammersmith, 1975

Δρ Paul Lupien, Quebec, 1976

Homozygous Familial Hypercholesterolemia
Standard Treatment Approach: LDL Apheresis

A Novel Way to Get Lipids Down



July 21, 2010

The patient, a 19-year-old from Ellicott City, Md., had levels of LDL (low density lipoprotein) – the so-called "bad" cholesterol – so high that he had to undergo coronary artery bypass at 15 years of age. Following the surgery, doctors used medications to lower his LDL cholesterol from 600-700 mg/dL to 300 mg/dL, but that

KDIGO 2021 Clinical Practice Guideline for the Management of Glomerular Diseases

Management of hyperlipidemia in glomerular disease

"Lipid apheresis, approved to treat ***familial hyperlipidemia***, has also been used to ***treat hyperlipidemia in patients with steroid-resistant NS*** (***SRNS***). In treated patients with NS, cholesterol and triglyceride levels were reduced, and in some, remission of NS was observed."

Nephrotic syndrome in children

Steroid Resistant Nephrotic Syndrome

"A phase 3 multicenter trial is in progress. Post-approval studies for LDL apheresis are ongoing and provide additional clinical trial options for children with ***CNI-resistant SRNS***."

Focal segmental glomerulosclerosis (FSGS) in adults

Research recommendations

"RCTs are needed: To examine the role of plasmapheresis and LDL apheresis in the treatment of ***primary FSGS*** and in the prevention of ***recurrent FSGS after kidney transplantation."***

FOCAL SEGMENTAL GLOMERULOSCLEROSIS (FSGS)

Incidence: 7/1,000,000		**Indication**	**Procedure**	**Recommendation**	**Category**
		Recurrent in kidney transplant	TPE/IA	Grade 1B	I
		Recurrent in kidney transplant/ Steroid resistant in native kidney	LA	Grade 2C	II
		Steroid resistant in native kidney	TPE	Grade 2C	III
# reported patients: >300		**RCT**	**CT**	**CS**	**CR**
Recurrent in transplanted kidney	TPE	0	4(68)	50(628)	NA
	IA	0	0	8(56)	6(6)
Recurrent in transplanted kidney/ Steroid resistant in native kidney	LA	0	1(23)	6(112)	NA
Steroid resistant in native kidney	TPE	0	0	3(26)	4(4)

"The successful use of immunoadsorption techniques with various ligands demonstrates that putative circulating factors have immunoglobulin-like binding characteristics."

"Therapeutic apheresis may be considered if prior therapies have failed."

"TPE/IA is first line therapy for recurrent FSGS."

"Patients with recurrent FSGS appear to have a circulating factor that increases glomerular permeability."

FOCAL SEGMENTAL GLOMERULOSCLEROSIS (FSGS)

Incidence: 7/1,000,000		**Indication**	**Procedure**	**Recommendation**	**Category**
		Recurrent in kidney transplant	TPE/IA	Grade 1B	I
		Recurrent in kidney transplant/ Steroid resistant in native kidney	LA	Grade 2C	II
		Steroid resistant in native kidney	TPE	Grade 2C	III
# reported patients: >300		**RCT**	**CT**	**CS**	**CR**
Recurrent in transplanted kidney	TPE	0	4(68)	50(628)	NA
	IA	0	0	8(56)	6(6)
Recurrent in transplanted kidney/ Steroid resistant in native kidney	LA	0	1(23)	6(112)	NA
Steroid resistant in native kidney	TPE	0	0	3(26)	4(4)

"The rationale for use of LA in FSGS is based on the hypothesis that altered lipid metabolism in nephrotic syndrome resulting in hypercholesterolemia creates a lipotoxic environment affecting podocyte function."

"In the US, LA is FDA approved for use in the treatment of adult and pediatric FSGS patients with nephrotic syndrome when standard treatment options, including corticosteroid and/or calcineurin inhibitors treatments, are unsuccessful or not well tolerated or in the post-transplant setting."

Μέθοδοι LDL αφαίρεσης

Μετά από διαχωρισμό πλάσματος

Ανοσοπροσρόφηση με anti-LDL Ab
Προσρόφηση με θειική δεξτράνη
Εξωσωματική καθίζηση LDL με ηπαρίνη (HELP)

Σε ολικό αίμα

Άμεση προσρόφηση λιποπρωτεΐνης χρησιμοποιώντας διάχυση (DALI)

R Raina V Krishnapppa. Pediatr Nephrol. 2018

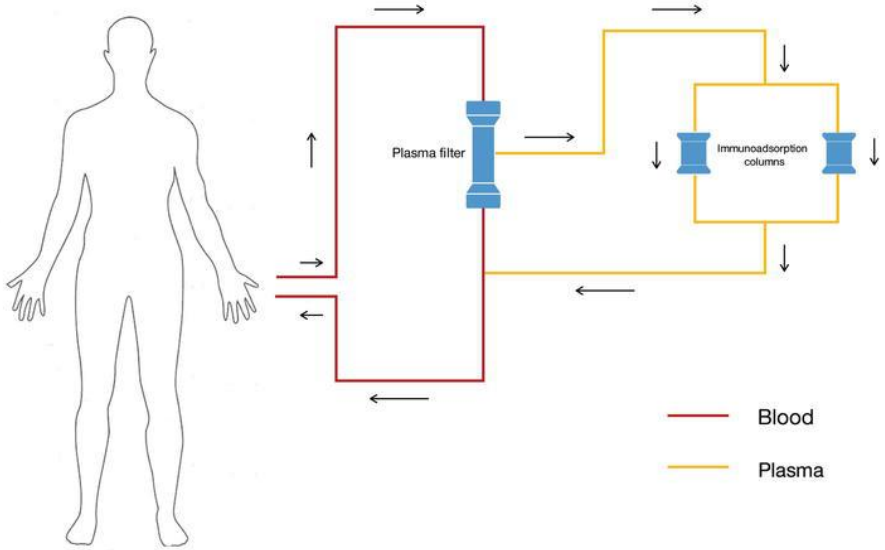
Τεχνικές LDL αφαίρεσης

Technique	Description and application	Lipids removed (%)
IAS	Selective LDL removal through anti-LDL antibody (polyclonal sheep antibodies to human apoB_{100}). Glycine buffer used for column regeneration. Used mainly for management of FH	Each session removes up to 55% of LDL and Lp (a)
Dextran sulfate cellulose adsorption	Removal of both LDL and VLDL using negatively charged dextran sulfate covalently bounded to cellulose beads. Five percent sodium chloride is used to regenerate the columns. Widely used for managment of drug-resistant NS and FH	Decrease in Lp (a) levels by 65–68% and LDL levels by 76–81%
HELP	Removal of LDL via precipitation. Plasma is treated with low pH (4.85) heparin and precipitated LDL is removed by filtration. Used mainly for management of FH and also reduces hepatitis C RNA and CRP level	Decrease in Lp (a) by 62%, LDL by 50%, and fibrinogen levels by 50%
DALI using hemoperfusion	Removal of LDL and La (a) using negatively charged polyacrylate-coated polyacrylamide absorber. Used mainly for management of FH	Decrease in LDL and Lp (a) levels by 40–45%

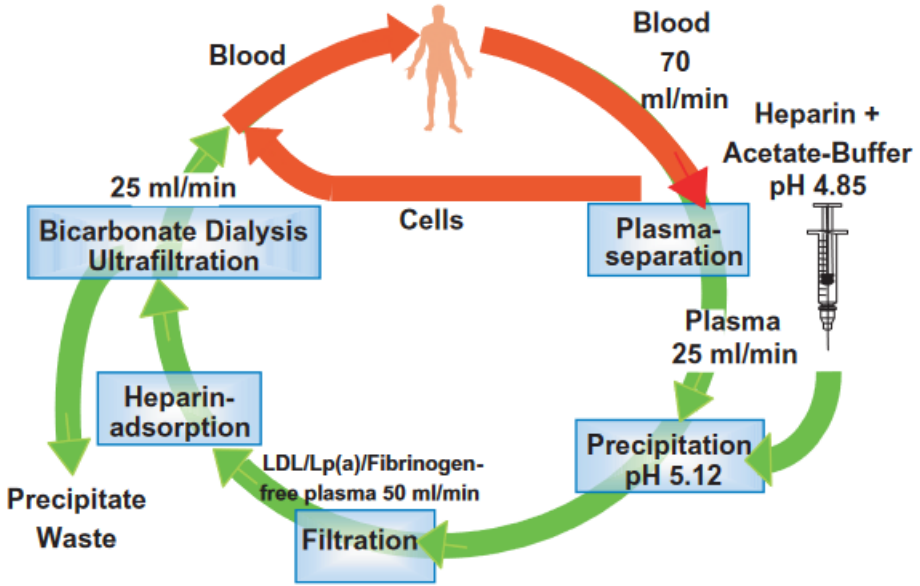
LDL-A, low-density lipoprotein-apheresis; IAS, immunoadsorption; FH, familial hypercholestrolemia; Lp (a), lipoprotein (a); NS, nephrotic syndrome; VLDL, very low-density lipoprotein; HELP, heparin extracorporeal LDL precipitation; DALI, direct absorption of lipoprotien; CRP, C-reactive protein.

R Raina V Krishnapppa. Pediatr Nephrol. 2018

Τεχνικές LDL αφαίρεσης



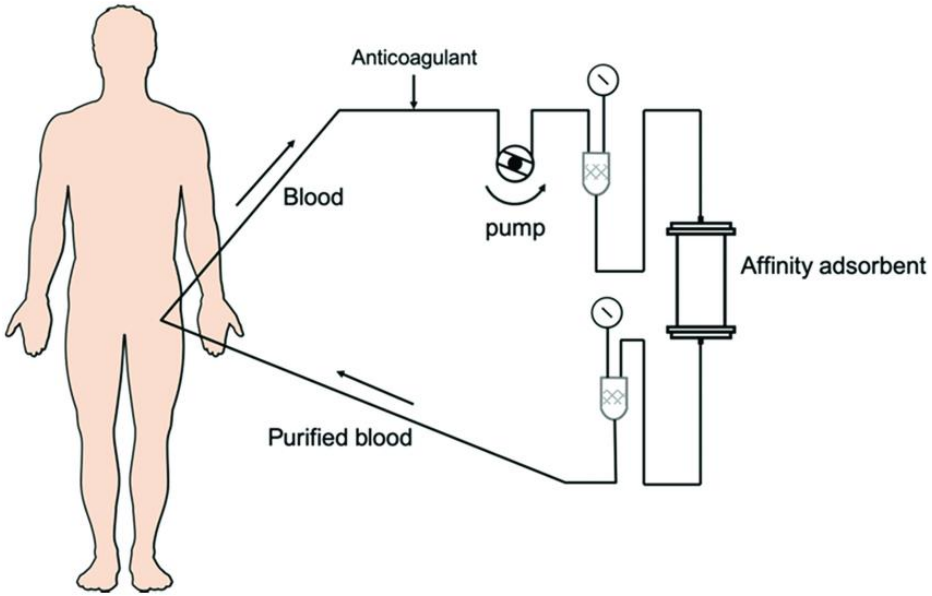
Ανοσοπροσρόφηση

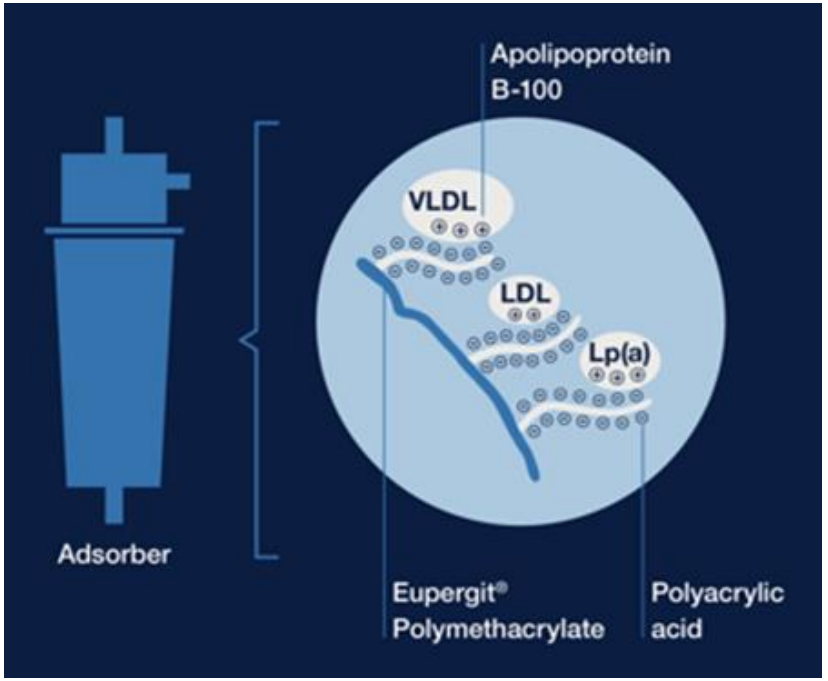


Εξωσωματική καθίζηση LDL με ηπαρίνη

F Blessing. Trans Apher Sci. 2008

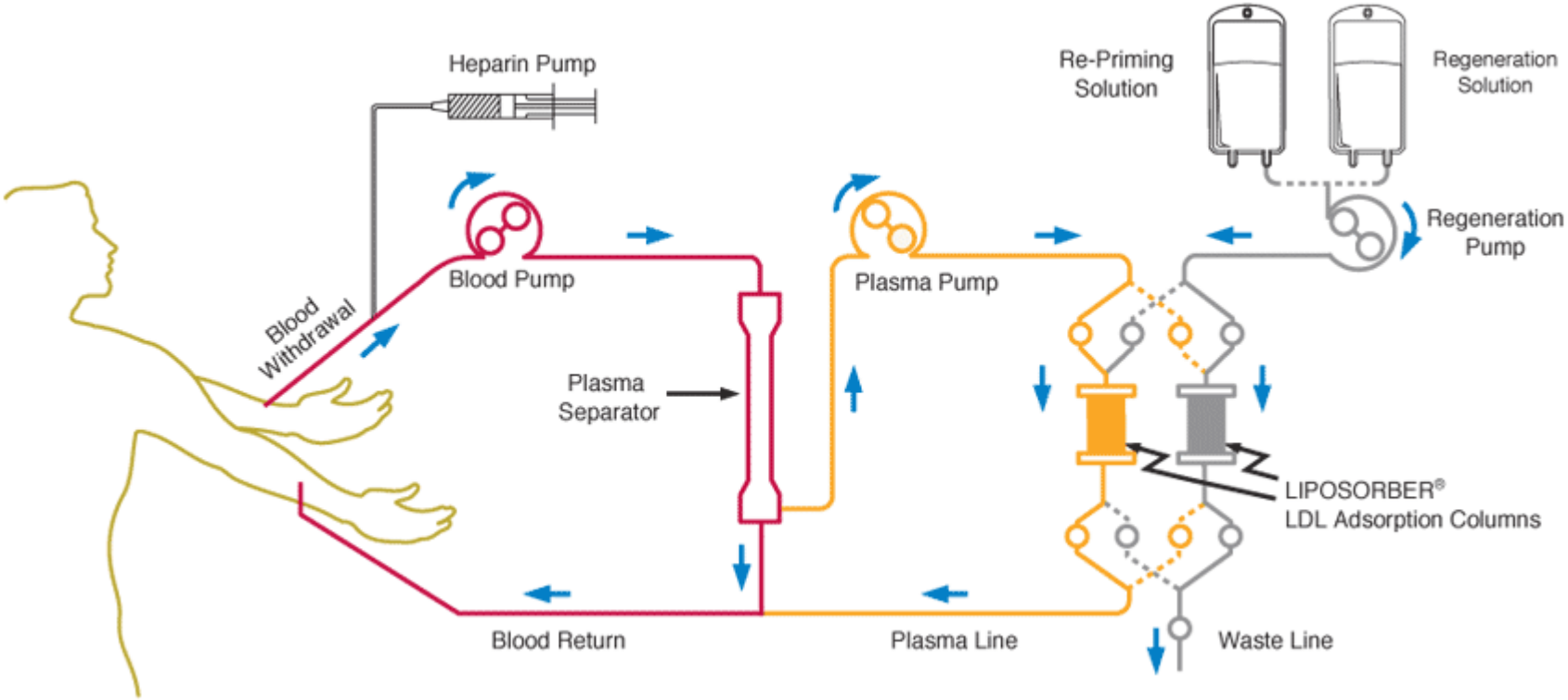
Τεχνικές LDL αφαίρεσης





Άμεση προσρόφηση λιποπρωτεΐνης χρησιμοποιώντας διάχυση (DALI)

Liposorber LA-15



<u>Προσρόφηση με θειική δεξτράνη</u>

https://www.kaneka-med.jp/english/products/apheresis/liposorber_la_15/

Liposorber LA-15 system

Performed 2–3× a week for 4 weeks then 1× a week for 6 weeks
Plasma volume (mL) to be treated = Patient weight (kg) × 60 (round to the nearest hundreth)
Heparin anticoagulation – Priming solution: 2,000–3,000 USP units of heparin in 1 L Ringer's lactate – Loading dose: heparin 25 USP units/kg (reduced if abnormal PT/PTT) – Continuous infusion: heparin 25 USP units/kg/h – Monitor PT, PTT, ACT – ACT should be 1.5–3× normal range – Typically, 1,000–3,000 USP units of heparin/h is adequate

ACT, activated clotting time; PT, prothrombin time; PTT, partial thromboplastin time.

Use of the device requires a central venous access (catheter).

The procedure takes approximately three hours to perform.

R Raina et al. Blood Purif. 2020

Benefits of LDL apheresis	Mechanism
Recovery of macrophage function	Reduced macrophage stimulation by oxidized LDL and reduction of inflammatory cytokines improves macrophage function.
Prevention of proximal tubular injury and tubulointerstitial disease	Lowering lipid levels reduces direct lipotoxicity to the glomeruli or interstitium.
Enhancement of response to immunosuppressant and steroids	Lowering lipid levels improves response to steroids and CsA due to improvement in intracellular drug transport.
Prevention of vascular endothelial injury	Reduction in VCAM-1 leads to improvement in endothelial dysfunction.
	Removal of fibrinogen and other anticoagulants improves blood flow.
	Increase in the levels of VEGF, nitric oxide, bradykinin, endothelium-derived growth factor or decrease in thromboxane A2 causes vasodilation.
	Lowering levels of vascular permeability factor or VEGF.
Anti-inflammatory effects	Lowering LDL oxidation, C-reactive protein, ICAM-1, and P-selectin.
	Restoration of interferon-γ production and interleukin-12 stimulation.

R Raina V Krishnapppa. Pediatr Nephrol. 2018

Ανεπιθύμητες ενέργειες

Side effects	Incidence (%)
Nausea and vomiting	0.3–2.5
Hypotension	2–2.5
Angina	0.2–0.3
Shock	NA
Allergic reactions	0.06
Circuit clotting	NA
Bleeding due to anticoagulation	NA
Infection of vascular access	10
Fever	NA
Headache	0–0.5
Lightheadedness/dizziness	NA
Malaise	NA
Leg cramps	NA
Anemia	NA
Vertigo	0–0.3

R Raina et al. Blood Purif. 2020

LDL-A και ανοσοκαταστολή

Έχουν παρατηρηθεί ευεργετικές επιδράσεις στην αποτελεσματικότητα των γλυκοκορτικοειδών και CNIs σε ασθενείς με ανθεκτικό ΝΣ

Η VLDL ελαττώνει τις θέσεις δέσμευσης της δεξαμεθαζόνης σε μυοκύτταρα

Η υπερέκφραση του LDLR από τα κύτταρα οδηγεί σε αυξημένη πρόσληψη της

Η σοβαρή υπερχοληστερολαιμία αναστέλλει τη δραστικότητα της CyA σε παιδιά με ΝΣ

Η LDL αφαίρεση βελτιώνει τη βιοδιαθεσιμότητα των γλυκοκορτικοειδών και της CyA μέσω ομαλοποίησης των αυξημένων επιπέδων λιπιδίων στον ορό

I Petrichenko et al. Biochim Biophys Acta. 1993
C Leon. J Pharm Sci. 2008
A Ingulli. J Am Soc Nephrol. 1992

Table 4. Studies of LDL-A for FSGS in pediatric patients

Study	Number	Age, years	Primary disease	LDL-A technique	Apheresis treatment	Outcome
Hattori et al. [40], 2003, retrospective	11	7–14.4 (10.9 ± 2.7)	FSGS (resistant to steroids, CPM and CSA)	Dextran sulfate cellulose adsorption	6 sessions (2× week for 3 weeks) followed by 1× week for 6 weeks. Total of 12 sessions	CR: 5 patients, PR: 2 patients. Efficacy rate of 76%. Effective in PSL resistant patients
Muso et al. [41], 2001, prospective	17	15–65	FSGS (14) or MCNS (3) (resistant to steroids)	Dextran sulfate cellulose adsorption	6 sessions (2× week for 3 weeks) followed by 1× week for 6 weeks. Total of 12 sessions	CR: 9 patients, PR: 4 patients and no effect in 4 patients. Efficacy rate of 76%
Yokoyama et al. [44], 1998, retrospective	14	N/A	FSGS (resistant to steroids)	N/A	Total of 6 sessions (2× week for 3 weeks)	8 responded while 6 had no effect. Efficacy rate of 57%. Increased serum albumin
Muso et al. [43] 1994, retrospective	8	16–56	Steroid resistant FSGS (6), MCNS (1) MN + FSGS (1)	Dextran sulfate cellulose adsorption	2–13 sessions (average of 7.3 sessions)	CR: 4 patients, PR: 1 patient and no effect in 3 patients. Efficacy rate of 63%
Tojo et al. [42], 1988, prospective	5	15–58	Drug resistant FSGS	Polyanionic dextran sulfate	Alternating 6–8 sessions of LDL-A and double filtration PP	Reduction in proteinuria with partial remission in 4 patients
Oto et al. [45], 2009, case report	1	8	FSGS (resistant to steroids, CPM, and CSA)	Dextran sulfate cellulose adsorption	5 session over 3 weeks plus CSA (65 mg/days), prednisolone (5 mg/kg/days) and methylprednisolone (800 mg/days) pulse therapy for 5 weeks before and 1 week after LDL-A treatment	Reduction in proteinuria to 0.5–1 g/day and hyperlipidemia
Shah et al. [1], 2019, prospective	7	19 months to 7 years	FSGS (recurrent)	Dextran sulfate cellulose adsorption	2–3 sessions per week for 3 weeks followed by weekly sessions for at least 6 weeks. Some patients received therapy for longer durations	All patients attained at least a 10-fold reduction in proteinuria (less than nephrotic range – 2.0 g.g). CR was achieved in 4 patients
Raina et al. [35], 2019, prospective	17	6–20	FSGS (recurrent or resistant to steroids)	Dextran sulfate cellulose adsorption	6 sessions (2× week for 3 weeks) followed by 1× week for 6 weeks. Total of 12 sessions	10 patients lost due to protocol deviation or to follow-up. 1/7 patients attained PR, 2/4 patients had CR/PR and 2/3 patients had CR/PR at 1, 3, and 6 month follow-up. All patients had improved or stable GFR

R Raina et al. Blood Purif. 2020

Preoperative Low-Density Lipoprotein Apheresis for Preventing Recurrence of Focal Segmental Glomerulosclerosis after Kidney Transplantation

Akihito Sannomiya,[1] Toru Murakami,[1] Ichiro Koyama,[1] Kosaku Nitta,[2] Ichiro Nakajima,[1] and Shohei Fuchinoue[1]

Background. Focal segmental glomerulosclerosis (FSGS) often develops rapidly and frequently progresses to renal failure, while the recurrence rate after kidney transplantation is 20–50%. We performed low-density lipoprotein (LDL) apheresis before kidney transplantation in FSGS patients to prevent recurrence. *Methods*. Five adult patients with chronic renal failure due to FSGS undergoing living related donor kidney transplantation were investigated retrospectively. LDL apheresis was done 1-2 times before transplantation. Postoperative renal function and recurrence of FSGS were assessed. *Results*. The patients were two men and three women aged 24 to 41 years. The observation period ranged from 60 days to 22 months. Preoperative LDL apheresis was performed once in one patient and twice in four patients. Blood LDL cholesterol levels were normal before LDL apheresis and remained normal both after LDL apheresis and after kidney transplantation. Additional LDL apheresis was performed once in one patient with mild proteinuria after transplantation. The renal graft survived in all patients and there was no evidence of recurrent FSGS. *Conclusions*. Although the observation period was short, FSGS did not recur in all 5 patients receiving preoperative LDL apheresis. These results suggest that LDL apheresis can be effective in preventing recurrence of FSGS after kidney transplantation.

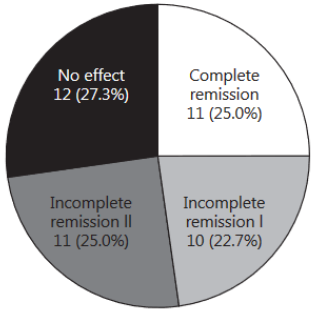
A Prospective Observational Survey on the Long-Term Effect of LDL Apheresis on Drug-Resistant Nephrotic Syndrome

Eri Muso[a] Masatoshi Mune[d] Tsutomu Hirano[e] Motoshi Hattori[g] Kenjiro Kimura[k]
Tsuyoshi Watanabe[l] Hitoshi Yokoyama[m] Hiroshi Sato[n] Shunya Uchida[h]
Takashi Wada[o] Tetsuo Shoji[b] Tsukasa Takemura[c] Yukio Yuzawa[p] Satoru Ogahara[q]
Satoshi Sugiyama[s] Yasuhiko Iino[i] Soichi Sakai[j] Yousuke Ogura[f] Susumu Yukawa[u]
Yoshiki Nishizawa[b] Noriaki Yorioka[v] Enyu Imai[w] Seiichi Matsuo[t] Takao Saito[r]

POLARIS (Prospective Observational Survey on the Long-Term Effects of LDL Apheresis on Drug-Resistant Nephrotic Syndrome)

N=44 refractory NS patients followed for 2 years

Results: 21 (47.7%) showed remission of NS based on a urinary protein level <1.0 g/day.



Clinical parameter	Favorable outcome	n	Poor outcome	n	p value
Serum total protein, g/dl	4.9±0.7	21	4.6±0.8	23	0.230
Serum albumin, g/dl	2.9±0.8	21	2.5±0.7	23	0.061
Serum creatinine, mg/dl	1.2±0.7	21	2.0±2.0	23	0.092
eGFR, ml/min/m^2	61.0±27.2	21	46.6±28.2	22	0.095
UP, g/day	1.7±1.8	20	6.2±3.5	22	<0.0001
Triglycerides, mg/dl	240.2±156.3	19	241.6±214.0	19	0.981
Total cholesterol, mg/dl	194.3±65.6	20	253.1±157.0	22	0.128
LDL cholesterol, mg/dl	83.1±60.4	18	115.1±58.9	21	0.103
HDL cholesterol, mg/dl	66.5±18.3	18	78.1±28.7	17	0.162
Fibrinogen, mg/dl	271.1±77.2	15	354.8±130.7	10	0.055
Thrombin-antithrombin III complex, ng/ml	14.7±38.6	14	3.3±3.1	6	0.488

LDL-A: προβληματισμοί

Αυξημένο κόστος (2500$/συνεδρία στις Η.Π.Α.)

Λίγες και μικρές μελέτες

Έχουν γίνει μικρές μελέτες και σε ασθενείς με νεφρωσικό σύνδρομο που οφείλεται σε MCD και MN με καλά αποτελέσματα

Ίσως να απομακρύνει και κυκλοφορούντες παράγοντες διαπερατότητας(!)