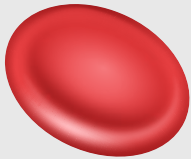


PLASMAPHERESIS

A GUIDE TO THE THERAPEUTIC APPLICATIONS



BY DR RASHMI SOOD
SENIOR CONSULTANT & INCHARGE
MANIPAL HOSPITAL, GURUGRAM,
HARYANA, INDIA.



Apheresis

we all know, is a word of “Greek Derivation”, meaning “separation or taking away.

Apheresis can be done on :

1. blood donors, for collecting blood components, as well as
2. on patients, in a number of clinical diagnosis

and is called donor apheresis and therapeutic apheresis accordingly. One of the important therapeutic apheresis is therapeutic plasmapheresis and the others being various types of cytappheresis.

Therapeutic Plasmapheresis

It removes various plasma components. Conventional Therapeutic Plasma Exchange (TPE) is categorized as non-selective, as now a days new therapeutic apheresis procedures have been developed that are more selective, targeting a specific molecule, antibody or cellular element. But higher cost may be involved. Plus the limited availability of the required columns, to perform the selective procedures, is currently the biggest hurdle in popularizing them.

Therapeutic Plasma Exchange (TPE) / PLEX Treatment remains the gold standard among all therapeutic plasmapheresis.

What does TPE Remove?

It removes from the plasma:

- Various antibodies (auto-allo)
- Antigen-antibody complexes
- Monoclonal proteins
- Cryoprecipitates
- Circulating immune complexes
- Injurious and noxious large Nolecular weight substances
- Toxins
- Protein-bound drugs
- Myeloma light chains
- Endotoxins
- Cryoglobulins
- Lipids such as LDL, cholesterol & Triglycerides
- Some poisons & metals in plasma.



Procedures Involving Plasma

01

Plasmapheresis:

Done on blood donors. Removal of plasma from donor, with no replacement given with crystalloid/colloid or new plasma.

02

Therapeutic Plasma Exchange / TPE / PLEX Treatment:

A procedure where the blood of the patient is passed through a cell separator machine and then the plasma is removed from the patients' blood and the red cells of the patient are reinfused to the patient along with new replacement fluid - which could be new plasma from the blood center or albumin 5% or a combination of crystalloid, colloid & plasma.

NP: TPE is not plasmapheresis – whereas plasmapheresis is a donor apheresis and here the donor plasma is taken out (less than 15% of the total plasma volume) but without any replacement fluid being given back to the donor, TPE is a different procedure.

Selective Therapeutic Plasmapheresis: Selective removal of plasma is involved in double filtration plasmapheresis (DFPP) and cryofiltration.

03

Double Filtration Plasmapheresis (DFPP) / Cascade Filtration / Rheopheresis :

Process involves a primary membrane plasma separation, to isolate the plasma and then a secondary plasma fractionator (PF), to remove target solutes (based on molecular size and weight).

Uses: Treatment of Hypercholesterolemia, Cryoglobulinemia and Waldenstrom's Macroglobulinemia. DFPP can reduce blood viscosity in diseases with impaired microcirculation, such as age-related macular degeneration, diabetes, coronary heart disease, peripheral arterial occlusive disease, cerebrovascular stroke and sudden deafness.

04 Cryofiltration

Two methods of performing cryofiltration:

i) Plasma is separated, pumped , cooled in a thermoregulatory unit, water bath or cooling coils at 4°C and passed through a cryofilter to collect the precipitated cryoproteins/cryoglobulins. Cryoprotein depleted plasma is then warmed at 37°C, mixed with the cells and returned to the patient.

ii) Second technique involves cryogel removal. Cryogel is precipitated fibrinogen, extradomain A fibronectin, fibrin split products and fibronectin. Heparin bolus (2000U) with a continuous infusion at 1000 – 2000 U/h forms the core of the cryogel upon which other proteins aggregate.

Uses: Treatment of rheumatoid arthritis, Cryoglobulinemia, Cold hemagglutinin disease, Ulcerative colitis, in Kidney transplantation to treat HLA Antibody and ABO Incompatibility

05 LDL Apheresis

Performed as TPE/DFPP/LDL Antibody Immunoabsorption /Thermofiltration /Hemoperfusion Uses :

1. Indicated for patients with homozygous form of familial hypercholesterolemia.
2. If LDL $\geq$ 200 mg/dl and there is documented coronary heart disease.
3. If LDL $\geq$ 300 mg/dl despite medical therapy or for those intolerant to medical therapy such as statins.

06 Immunoabsorption (IA)

A blood purification technique that enables the selective removal of Immunoglobulins from separated plasma through high-affinity adsorbers.

Immunoabsorption is especially effective in autoimmune diseases where TPE failed to be effective. Limitation in its use is cost and lack of many controlled trials for Immunoabsorption.

Devices available in the market



Non-selective Adsorbers
Selesorb: Dextran Sulphate Column



Semi-selective Prosorba,
Immunosorba: with Staphylococcal Protein A-agarose column



Selective Therasorb: with antihuman Ig Adsorber column

Indian Experience

Evaflex columns 2A: Pretransplant and Post-Transplant

Evaflex column 5A: LDL Apheresis.

To Evaluate the Appropriateness of Therapeutic Apheresis :

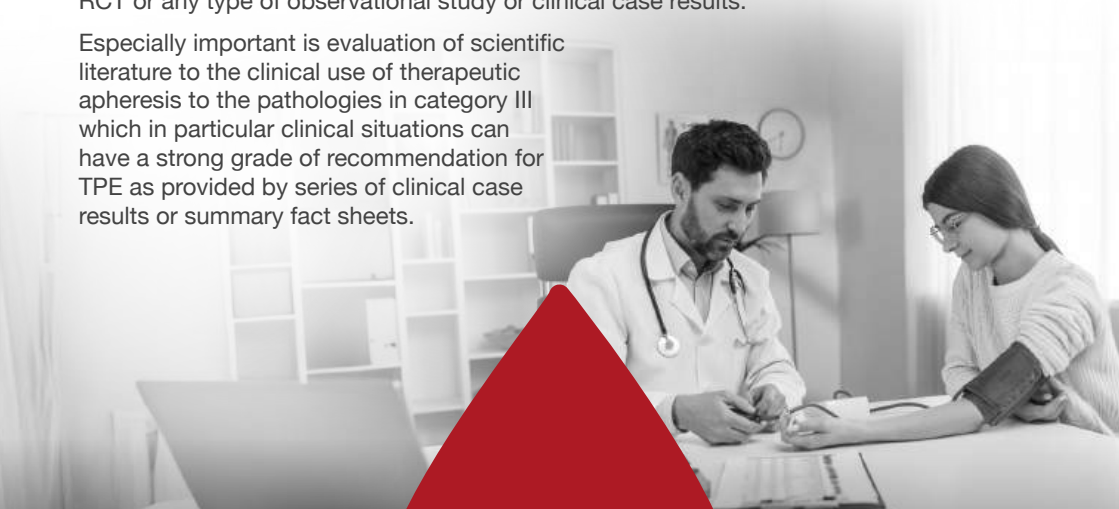
Guidelines of the American Society for Apheresis (ASFA) were first drawn up in 2007 and are revised and updated every 3 years, looking into the criteria of evidence -based medicine. The latest guidelines came in 2023.

Many clinical trials continue to clarify the appropriate use of therapeutic plasma exchange (TPE) in various diseases.

Indication for TPE is divided into categories and grades

Grading depends on the quality of evidence available in favor, e.g., whether it is RCT or any type of observational study or clinical case results.

Especially important is evaluation of scientific literature to the clinical use of therapeutic apheresis to the pathologies in category III which in particular clinical situations can have a strong grade of recommendation for TPE as provided by series of clinical case results or summary fact sheets.



**Another criteria
plasma exchange
includes the
intensity of the
treatment:**

Aggressive A:
Daily treatment:
3 to Indefinite

Prolonged P:
1-2 times/week:
3-8 weeks

Routine R:
3 times a week:
5-7 treatments

Chronic C:
Every 1-4 weeks:
Indefinite

Various categories of disorders, as per the evaluation of the efficacy for therapeutic plasma exchange, include:

Category 1 Disorders

Category I disorders	Where TPE (or a particular apheresis) is accepted as first line therapy : either primary standalone treatment or in conjunction with other modes of treatment
Category II disorders	Where TPE is accepted as second line therapy : either as a standalone treatment or in conjunction with other modes of treatment
Category III disorders	Optimum role of TPE is not established ,decision making should be individualized
Category IV disorders	Where published evidence suggests TPE to be ineffective

Clinical trials continue to clarify the appropriate use of TPE in various diseases.

Enumerating the category, I disorder and specifying how TPE helps in each disorder:

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
1	Acute Inflammatory Demyelinating Polyradiculoneuropathy	GB Syndrome (Gullian Barre Syndrome)	Circulating Myelin Antibodies	TPE / Immunoabsorption	Evidence suggests: 1) Improvement in clinical grade 2) Shortening of recovery time 3) Improvement even in mildly affected patients as well	1A/1B

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
2	Acute Liver Failure	TPE for Hepatitis Virus-induced Acute Liver Failure	Rapid removal of aromatic amino acids, ammonia, endotoxins, Mercaptans, Activated coagulation factors, FDPs, TPAs, Phenols, Cytokines, DAMPs	TPE		1A
3	Acute Glomerular Basement Membrane Disease	Good Pastures Syndrome	Antibodies attacking the basement membrane of blood vessels in kidneys and lungs.	TPE	1) In case of diffuse alveolar hemorrhage 2) Dialysis Independence 3) To initiate initial treatment as early as possible, this is crucial to prevent renal failure and pulmonary damage.	1C/1B
4	Catastrophic Antiphospholipid Syndrome	CAPS	1) Removal of antiphospholipid antibodies such as lupus anticoagulants, anticardiolipin, anti beta2 glycoprotein. 2) Especially valuable treatment option when multiple organs are affected by thrombosis.	TPE		2C

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
5	Chronic Acquired Demyelinating Polyneuropathies		IgG / IgA / IgM related	TPE		1B
6	Chronic Inflammatory Demyelinating Polyradiculoneuropathy	CIDP	Removal of Antibodies to Myelin Protein Antigen	TPE / IA (Immunoadsorption)	1) Especially in patients not responding to or tolerating steroids 4) Proven to be more effective than IVIG in GB syndrome.	1A
7	Familial Hypercholesterolemia	Homozygotes (HoFH)	1) Removal of large amounts of LDL and cholesterol from blood, typically required on regular schedule as per the severity of the patients condition. 2) Especially useful in homozygote patient aged less than < 10 years, they cannot be treated with selective DFPP etc due to small extracorporeal circulation.	TPE/DFPP/LDL Antibody Immunoabsorption /Therapeutic plasma exchange /Hemoperfusion		1A
8	Focal Segmental Glomerulosclerosis	FSGS	Removal of circulating antibodies that damage the glomeruli in the kidneys	TPE / Immunoabsorption	In recurrent FSGS especially after kidney transplants	1B

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
9	Hyperviscosity in Hypergammaglobulinemia		1) Hyperviscosity: When serum viscosity > 3 centipoise greater than water esp. with neurological signs 2) Cellular causes of Hyperviscosity (Hyperleucocytosis, Thrombocytosis) 3) Effectively reduces the high level of abnormal immunoglobulin in blood.	TPE	1) Single session reduces plasma viscosity by 20-30% 2) Rapid recovery of renal functions	1B
			Symptomatic	TPE		1B
			Prophylaxis for rituximab	TPE		1C
10	Myasthenia Gravis	1) Acute short term treatment with TPE / DFPP / IA - Category I indication 2) Long term treatment with TPE / DFPP / IA - Category II indication	1) Especially useful for rapid symptomatic improvement, esp. those with breathing, swallowing, walking compromise 2) Useful for those intolerant or unresponsive to other therapies 3) Useful for patients who are negative for the antibody 4) Useful to optimize muscle function before thymectomy or other surgery 5) In comparison with IVIG, median response time is significantly shorter	TPE		

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
11	N-Methyl-D-Aspartate Receptor Antibody Encephalitis	Is a commonly identified cause of autoimmune encephalitis	1)Increases the removal of autoantibodies 2) Decreases the inflammatory	TPE /IA		1A
12	Thrombotic Microangiopathy - Drug Induced - Ticlopidine		To remove excessively thrombogenic and antifibrinolytic molecules To replenish the deficient anticoagulants and profibrinolytic molecules	TPE		
13	Thrombotic Microangiopathy - Thrombotic Thrombocytopenic Purpura		To remove excessively thrombogenic and antifibrinolytic molecules To replenish the deficient anticoagulants and profibrinolytic molecules	TPE		

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
14	Transplantation - Kidney - ABO Compatible		1)Pre transplant: Aim is to avoid delayed engraftment. TPE removes ABO antibodies, anti HLA antibodies, and DSA antibodies, so that these cannot damage the donated kidney. 2) Post transplant : Aim is to correct engraftment and to prevent rejection. TPE prevents antibodies from rebounding and causing rejection.	TPE /IA		1B
15	Transplantation - Kidney - ABO Incompatible		1)Pre transplant: Aim is to avoid delayed engraftment. Desensitization – of Living Donor TPE removes ABO antibodies, anti HLA antibodies, and DSA antibodies, so that these cannot damage the donated kidney. 2) Post transplant : Aim is to correct engraftment and to prevent rejection. TPE prevents antibodies from rebounding and causing rejection.	TPE / IA		1B

S No	Disease Where TPE in the First Line Indication	Synonym	Rationale	Procedure	Comments	Grade
16	Transplantation - Liver		Desensitization - ABO Incompatible - Living Donor	TPE		1C
17	Wilson's Disease - Fulminant		Rapid reduction of elevated serum copper levels occurring due to acute hepatocellular necrosis. Ameliorates hemolytic anemia. Serves as bridge to liver transplant.	TPE		1C

The category II disorders where TPE is accepted as second line therapy : either as a standalone treatment or in conjunction with other modes of treatment, include:

S No	Disease Where TPE Is The Second Line Indication	Synonym	Rationale	Procedure	Comments	Grade
1	ACUTE DISSEMINATED ENCEPHALOMYELITIS		STEROID REFRACTORY	TPE		2C
2	ACUTE TOXINS - VENOMS AND POISONS		MUSHROOM POISONING	TPE		2C
3	AMYLOIDOSIS - SYSTEMIC - DIALYSIS RELATED		BETA2 MICROGLOBULIN ADSORPTION	TPE		2B

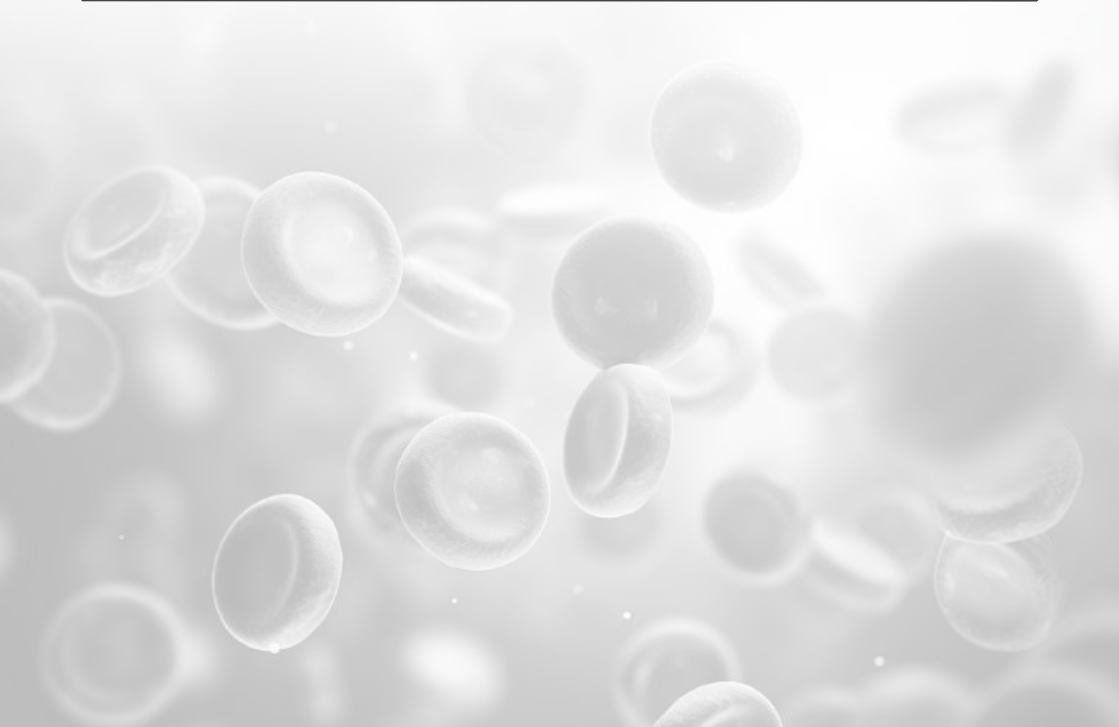
S No	Disease Where TPE Is The Second Line Indication	Synonym	Rationale	Procedure	Comments	Grade
4	AUTOIMMUNE HEMOLYTIC ANEMIA -SEVERE SEVERE COLD AGGLUTININ DISEASE		1)Removes cold agglutinins, primarily IgM, that bind to red blood cells at cooler temperatures, leading to RBC destruction 2) Reduces rate of hemolysis esp when hemolysis is severe and rapid - Stabilize the patient during acute hemolytic crisis 3) Acts as a bridging therapy, allowing time for other treatments to become effective			
	SEVERE COLD AGGLUTININ DISEASE			TPE		2C
5	CRYOGLOBULIN EMIA		To remove circulating cryoglobulins	TPE/DFPP	SEVERE /SYMPTOMATIC	2A
6	DILATED CARDIOMYOPATHY - IDIOPATHIC		Particularly for refractory heart failure, by removing autoantibodies against cardiac cell proteins	IA	NYHA FUNCTIONAL CLASSIFICATION II-IV	1B
				TPE -111		2C
7	Erythropoietic Protoporphyria -Liver Disease		Rare inherited metabolic disorder caused by deficiency of enzyme ferrochelatase ,leading to protoporphyrin accumulation in red blood cells ,skin and liver .RBC exchange helps by reducing protoporphyrin levels in blood,thus improving liver function .	TPE/RBC Exchange		2C
8	FAMILIAL HYPERCHOLESTEROLEMIA		An established treatment that removes LDL cholesterol from blood,improving biochemical abnormality and reversing physical manifestations			
	HOMOZYGOTES		Selectively removes LDL cholesterol from blood	LA -1		1A
	HETERZYGOTES			LA -11		1A
	ALL PATIENTS			TPE -11		1B

S No	Disease Where TPE Is The Second Line Indication	Synonym	Rationale	Procedure	Comments	Grade
9	LAMBORT -EATON MYASTHENIC SYNDROME		An autoimmune disorder where body's immune system attacks neuromuscular junction ,TPE works by removing harmful antibodies that attack the neuromuscular junction	TPE		2C
10	MULTIPLE SCLEROSIS		Removal of harmful plasma containing antibodies ,interrupting autoimmune attack and reducing inflammation	TPE/IA	Acute attack /Severe Relapse unresponsive to standard treatment	1A/1B
11	MYASTHENIA GRAVIS			TPE/DFPP/ IA : 1	ACUTE SHORT TERM TREATMENT	1B
			TPE in combination with immunosuppressants prevents antibody production and maintains long term control of the disease	TPE/DFPP/ IA : 11	LONG TERM TREATMENT	2B
12	MYELOMA CAST NEPHROPATHY		Is a type of kidney damage that occurs in people with multiple myeloma , is caused by toxic effects of free light chains in blood which can precipitate in kidney tubules	TPE		2B
13	NEUROMYELITIS OPTICAL SPECTRUM DISORDER	NMOSD	NMOSD an autoimmune inflammatory disorder primarily affecting optic nerves and spinal cord.TPE is esp useful during acute attacks or when high dose steroids are not effective	TPE : 11	Acute attack /Relapse /Steroid refractory	1B
				IA : 11		1C
				TPE : 111	Maintenance	2C
14	Pediatric Autoimmune Neuropsychiatric Disorders	PANDAS/ PANS Exacerbation	For acutely and severely affected patients of PANDAS , aim is to remove antibodies from blood	TPE: II		1B

S No	Disease Where TPE Is The Second Line Indication	Synonym	Rationale	Procedure	Comments	Grade
15	PHYTANIC ACID STORAGE DISEASE			TPE/LA : II		2C
16	Steroid Responsive Encephalopathy Associated With Autoimmune Thyroiditis			TPE :II		2C
17	Systemic Lupus Erythromatosus		Removes harmful autoantibodies and immune complexes ,improving disease activity esp in refractory or severe cases .	TPE	SEVERE/REF RACTORY	2C
18	THYROID STORM		Is a SALVAGE THERAPY for thyroid storm when conventional treatments are ineffective / contraindicated /cause severe adverse effects .It rapidly removes circulating thyroid hormones (T3 T4) both free and protein bound ,TBG , Throid auto antibodies ,Cytokines and other contributing substances ,also help to create a WINDOW for definitive treatments like surgery and radioactive iodine .	TPE : II		2C
19	Transplantation - Heart		1) Increased survival 2) Improved graft function 3) Facilitating transplantation - removing recipient antibodies against donors blood in case of positive crossmatch ,treating antibody mediated rejection caused by antibodies attacking transplanted heart ,treating primary graft dysfunction reducing donor specific human leukocyte antigen antibody titers (DSA) ,decreasing panel reactive antibody (PRA) titer	TPE	Desensitization	2C
				TPE	Polyarteritis Nodosa	2C

S No	Disease Where TPE Is The Second Line Indication	Synonym	Rationale	Procedure	Comments	Grade
20	Transplantation -Hematopoietic Stem Cell- Abo Incompatible	HSCT	Type of ABO Incompatibility : 1) Major : Recipient has antibody against donor blood type (eg Type A receiving transplant from Type B) ; 2) Minor : Donor has antibody against recipient blood type (eg Type O donor to Type A,B ,AB; 3)Bidirectional IC : Both major and minor IC are present . ROLE of TPE : TPE removes plasma which contains antibodies from recipient blood ,reducing levels of incompatible antibodies .a) Reduces antibody titers b) Improves erythroid recovery c) Successful treatment of pure red cell aplasia HOW IS TPE UTILIZED : TPE can be used before ,during or after HSCT depending on specific case and specific incompatibility	TPE	Major Abo Incompatible -Hpc (M)	1B
21	Transplantation -Kidney - Abo Incompatible		ABO incompatible kidney transplantation where donors blood type doesn't match the recipient .It requires medical treatment like desensitization to reduce antibodies ,before transplant ,to reduce or eliminate antibodies against donors blood type and immunosuppression by taking immunosuppressants .	TPE : I	Desensitization : Living Donor	
				TPE /IA : II	ANTIBODY MEDIATED REJECTION	1B

S No	Disease Where TPE Is The Second Line Indication	Synonym	Rationale	Procedure	Comments	Grade
22	VASCULITIS -OTHER		An adjunctive intervention to immunosuppression(raidl y removes harmful antibodies and inflammatory mediators) for treatment of severe renal involvement or lung hemorrhage in patients with ANCA associated vasculitis	TPE :II	HEPATITIS B	2C
					POLYARTERITI S NODOSA	2C
23	Transplantation -Kidney - Abo Incompatible		These antibodies target proteins associated with voltage gated potassium channels ,which are crucial for nerve and muscle function,TPE removes antibodies from blood causing clinical improvement esp when combined with immunosuppressive therapies .	TPE/IA : II		1B



Diseases where selective plasmapheresis is indicated, include :

S No	Disease/ Condition	Synonym	Rationale	Procedure	Category Of Indication	Grade Of Indication (Acc To Type Of Evidence)
1	Amyloidosis, Systemic, Dialysis Related	Beta2 Microglobulin Adsorption		Beta2 Microglobuli n Adsorption	2	2B
2	Age Related Macular Degeneration	DRY, HIGH RISK		DFPP	3	2B
3	Atopic Dermatitis, Recalcitrant			ECP/IA/TPE/ DFPP	3	2B
4	BABESIOSIS	SEVERE		RBC EXCHANGE	3	2C
5	CHRONIC FOCAL ENCEPHALITIS			TPE/IA	3	2C
6	CUTANEOUS T-CELL LYMPHOMA	ERYTHRODE RMIC MYCOSIS FUNGOIDES /SEZARY SYNDROME		ECP	1	1B
		NON ERYTHRODE RMIC MYCOSIS FUNGOIDES		ECP	111	2B
7	Erythrocytosis	Polycythemia Vera		Erythrocytap heresis	1	1B
		Secondary Erythrocytosis		Erythrocytap heresis	3	1C

S No	Disease/ Condition	Synonym	Rationale	Procedure	Category Of Indication	Grade Of Indication (Acc To Type Of Evidence)
8	Heparin Induced Thrombocytope nia and Thrombosis	Pre - Procedure		TPE/IA	3	2C
		Refractory Or With Thrombosis		TPE	3	2C
9	Hereditary Hemochro- matis			Erythrocytap heresis	1	1B
10	HYPERLEU- KOCYTOSIS			LEUKOCYTA PHERESIS	111	2B
11	Inflammatory Bowel Disease	Ulcerative Colitis		Adsorptive Cytapheresis	11	1B
		Crohns Disease		Adsorptive Cytapheresis	111	1B
12	Lipoprotein(a) Hyperlipopro- teinemia	Progressive Atherosclerotic Cardiovascular Disease		LA	11	1B
13	MALARIA	SEVERE		RBC EXCHANGE	111	2B
14	MULTIPLE SCLEROSIS		Acute Attack/ Relapse	TPE	11	1A
			Chronic Primary Or Secondary Progressive	IA	11	1B
15	MYASTHENIA GRAVIS		ACUTE,SHOR T-TERM TREATMENT	TPE/DFPP/IA	1	1B

S No	Disease/ Condition	Synonym	Rationale	Procedure	Category Of Indication	Grade Of Indication (Acc To Type Of Evidence)
			LONG-TERM TREATMENT	TPE/DFPP/IA	11	2B
16	Neuromyelitis Optical Spectrum Disorder		ACUTE ATTACK/RELA PSE	TPE	11	1B
				IA	11	1C
			Maintenance	TPE	111	2C
17	N-Methyl-D-Asp artate Receptor Antibody Encephalitis			TPE/IA	1	1C
18	Peripheral Vascular Diseases			LA	11	1B
19	Phytanic Acid Storage Disease			TPE/LA	11	2C
20	Sickle Cell Disease, Acute		ACUTE STROKE	RBC EXCHANGE	1	1C
			Acute Chest Syndrome, Severe	RBC EXCHANGE	11	1C
			Other Complications	RBC EXCHANGE /TPE	111	2C
21	Sickle Cell Disease, Non Acute		Stroke Prophylaxis	RBC EXCHANGE	1	1A
			PREGNANCY	RBC EXCHANGE	11	2B

S No	Disease/ Condition	Synonym	Rationale	Procedure	Category Of Indication	Grade Of Indication (Acc To Type Of Evidence)
			Recurrent Vaso-Occlusive Crises	RBC EXCHANGE	11	2B
			Preoperative Management	RBC EXCHANGE	111	2A
22	Thrombocytosis		symptomatic	Thrombocyta pheresis	11	2C
			Prophylactic	Thrombocyta pheresis	111	2C
23	Transplantation, Heart		Cellular Rejection	ECP	11	1B
			Recurrent Rejection	ECP	11	1B
			Rejection Prophylaxis	ECP	11	2A
24	Transplantation, Kidney, Abo Compatible		Antibody Mediated Rejection	TPE/IA	1	1B
			Desensitization /Prophylaxis, Living Donor	TPE/IA	1	1B
25	Transplantation, Kidney, Abo Incompatible		Desensitization, Living Donor	TPE/IA	1	1B
			Antibody Mediated Rejection	TPE/IA	11	1B

S No	Disease/ Condition	Synonym	Rationale	Procedure	Category Of Indication	Grade Of Indication (Acc To Type Of Evidence)
26	Transplantation, Lung		Chronic Lung Allograft Dysfunction	ECP	11	1C
			Bronchiolitis Obliterans Syndrome	ECP	11	1C
27	Voltage Gated Potassium Channel, Antibody Related Diseases			TPE/IA	11	1B

Author's Experience: The cases were I had the chance to perform the therapeutic plasmapheresis, non selective and/or selective, till date, include :

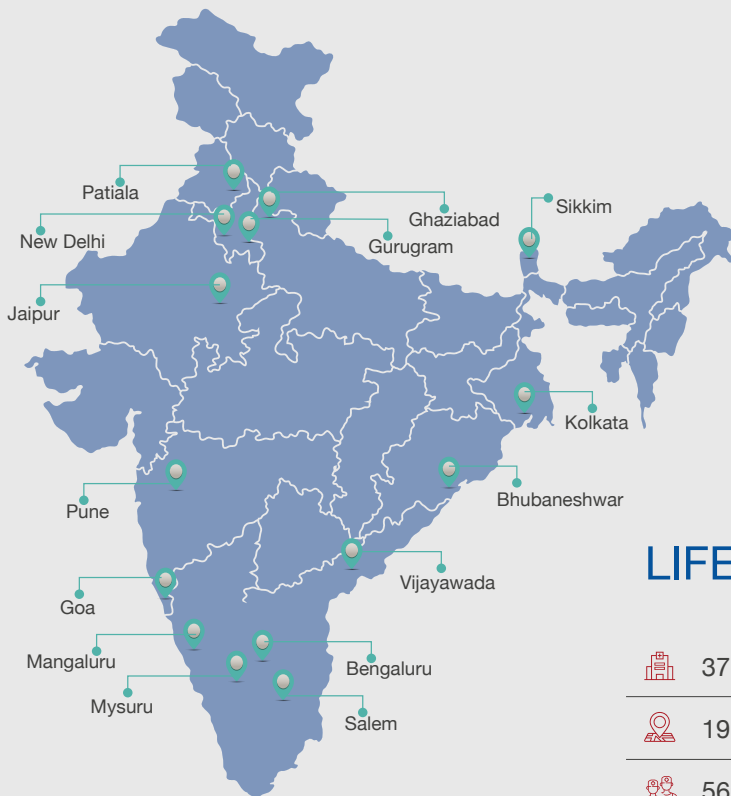
DISEASE	
• GBS • GBS Axonal • Acute Transverse Myelitis • Miller Fisher Syndrome • Demyelination • Wegner's Granulomatosis, Systemic Vasculitis C ANCA Pos • Myasthenia Gravis	• Anti GBM disease (Good Pastures Syndrome) • CIDP Chronic Inflammatory Demyelinating • Polyradiculoneuropathy • SLE • Hepatitis A virus induced acute liver failure

Ref : 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

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Notes

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