**Apheresis, Plasmapheresis and Plasma Exchange**

https://litfl.com/apheresis-plasmapheresis-and-plasma-exchange/

**Definitions**

* Apheresis is the general technique of extracorporeal blood purification whereby one constituent is removed and the remainder is returned to the patient
* removal may involve centrifugation or filtration
* Cytapheresis is removal of cellular components from the blood
* Plasmapheresis is a subset of apheresis whereby plasma is removed; this is termed ‘plasma exchange’ when host plasma discarded and replaced  by donor plasma or an alternative colloid

**RATIONALE FOR APHERESIS**

* substance must be present in the intravascular space
* substance must be so large it can’t be removed by haemofiltration or high-flux haemodialysis
* substance must have sufficiently long-half life
  + can be rapidly cleared by apheresis as compared to endogenous clearance
* substance removal by apheresis must be more rapid than renewal
* substance to be removed must be acutely toxic and resistant to conventional therapy
* untreated the disease must be sufficiently serious to warrant treatment, and there must be a reasonable chance of recovery

**PLASMAPHERESIS**

* extracorporeal blood purification technique designed for removal of large molecular weight substances from plasma
* separation of plasma from blood cells by centrifugation or by membrane filtration
* reinfusion of cells with:
  + ‘cleaned’ autologous plasma, or
  + donor plasma, or another replacement colloid solution (e.g. albumin, FFP or cryoprecipitate)(this is termed plasma exchange)

**SUBSTANCES REMOVED BY PLASMAPHERESIS**

* immunoglobulins
* immune complexes
* coagulation factors
* cytokines
* endotoxins
* protein-bound substances (e.g. drugs and toxicants)
* albumin
* triglycerides and other lipids
* myeloma light chains
* cryoglobulins
* auto-antibodies

**SPECIFIC INDICATIONS**

*\*\* = indicated with level 1 evidence (A CHIP O)*

Hyperviscosity syndromes

* \*\* hyperleucocytosis with leukostasis (ALL or AML) – start with hydroxyurea + induction chemotherapy
* \*\* monoclonal gammapathy – \*\* multiple myeloma (monoclonal immunoglobulins)
* \*\* sickle cell crisis – removal of sickled RBCs and replacement with functional RBCs

Immunoglobulins

* \*\* cryoglobulinaemia (cryoglobulins)
* \*\* paraproteinaemic polyneuropathies (IgG/IgA)
* Waldenstrom macroglobulinaemia (monoclonal immunoglobulins)

Autoantibodies

* \*\* AIDP (Guillian Barre Syndrome) – no difference compared to treatment with IV IgG
* \*\* CIDP (Chronic inflammatory demyelinating polyradiculopathy)
* \*\* Myasthenia gravis – use in myasthaenic crisis (Anti-ACh receptors)
* \*\* anti-GBM antibody disease (Goodpastures) – start early prior to Cr > 600
* SLE
* systemic vasculitis with pulmonary haemorrhage
* Hemophilia due to anti-FVIII inhibitors
* Anti-phospholipid antibody syndrome (APLS)
* TTP — plasmapheresis is the mainstay of treatment
* autoimmune haemolytic anaemia (e.g. cold agglutinins)

Circulating immune complexes

* immune complex glomerulonephritis
* SLE
* systemic vasculitis

Protein bound substances

* thyroid storm
* *Amanita phalloides* toxin (mushroom)
* familial hypercholesterolaemia
* paraquat
* digoxin
* envenomation

Others

* HELLP syndrome
* Multiple sclerosis
* HIV neuropathy
* pemphigus
* paraneoplastic syndrome
* renal transplant rejection
* DIC
* overwhelming sepsis syndromes (e.g. meningococcemia)
* Reye’s syndrome

**PRACTICAL ASPECTS**

Removal

* 1-1.5 plasma volumes (3-4 L) removed in one sitting (efficiency is less at >1.5 plasma volume exchanges)
* usually repeated daily or on alternate days
* removal of substance follows 1st order kinetics
* A single volume plasma exchange (40 mg/kg) will reduce the concentrations of immunoglobulins, complement proteins, fibrinogen, and other coagulation factors by 50-60% if the plasma is not replaced. Most constituents will return to normal levels within 24 to 48hours
* The efficiency of removal of antibody is often less than anticipated because of rapid resynthesis during an immune response

Replacement

* replacement fluid is typically 4% albumin, FFP or cryoprecipitate
* replacement fluid is given concurrently -> maintains haemodynamic stability

**ADVERSE EFFECTS**

**Vascular access**

* vascular access complications as for vascaths

Procedural problems

* hypocalcaemia (from citrate toxicity due to citrate anticoagulation in tubing)
* vasovagal, hypovolaemia, hypotension
* mechanical haemolysis
* air embolism

Replacement fluid effects

* transfusion reactions
* coagulopathy (dilutional from replacement of plasma with non-plasma fluid)
* pharmacological changes -> removal of drugs
* hypothermia
* pyrogenic reactions (fever, chills)
* anaemia
* hepatitis
* electrolyte imbalance
* suxamethonium apnea (due to depletion of plasma cholinesterase)
* sepsis
* hypoproteinemia