11.1: Therapeutic plasma exchange (TPE)

TPE removes large-molecular-weight substances such as harmful antibodies from the plasma. It is usually carried out using an automated blood cell separator to ensure fluid balance and maintain a normal plasma volume. This may require the insertion of a femoral or jugular line to allow adequate blood flow. Typically, 30–40 mL/kg of plasma (1–1.5 plasma volumes) are removed at each procedure and replaced with isotonic 4.5 or 5.0% human albumin solution (some services substitute 25–50% of replacement volume with 0.9% saline). Exchange with fresh frozen plasma (FFP) is reserved for the replacement of ADAMTS13 in thrombotic thrombocytopenic purpura (see below) or to replace clotting factors. A one plasma volume exchange removes about 66% of an intravascular constituent and a two plasma volume exchange approximately 85%. TPE is normally combined with disease modifying treatment, such as immunosuppressive drugs, for the underlying condition.

11.1.1: Indications for therapeutic plasma exchange

TPE should only be carried out in conditions where there is good evidence of its effectiveness. The American Society for Apheresis (ASFA – http://www.apheresis.org) produces regularly updated evidence-based guidelines (last updated in 2010). Table 11.1 shows the 2010 category I ASFA indications for TPE (recommended as first-line therapy). Category II indications (TPE is an established second-line therapy) are shown in Table 11.2. The evidence base is constantly developing and the decision to implement a course of TPE will usually involve discussion with a transfusion medicine specialist or other expert from the team providing the therapy.

Table 11.1 ASFA Category I indications for therapeutic plasma exchange (first-line therapy based on strong research evidence)
<table>
<thead>
<tr>
<th>Speciality</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurology</td>
<td>Acute Guillain–Barré syndrome</td>
</tr>
<tr>
<td></td>
<td>Chronic inflammatory demyelinating polyneuropathy</td>
</tr>
<tr>
<td></td>
<td>Myasthenia gravis</td>
</tr>
<tr>
<td></td>
<td>Polyneuropathy associated with paraproteinaemias</td>
</tr>
<tr>
<td></td>
<td>PANDAS&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>Haematology</td>
<td>Thrombotic thrombocytopenic purpura</td>
</tr>
<tr>
<td></td>
<td>Atypical haemolytic uraemic syndrome (autoantibody to factor H)</td>
</tr>
<tr>
<td></td>
<td>Hyperviscosity syndromes (paraproteinaemias)</td>
</tr>
<tr>
<td></td>
<td>Severe/symptomatic cryoglobulinaemia</td>
</tr>
<tr>
<td>Renal</td>
<td>Goodpasture’s syndrome (anti-glomerular basement membrane antibodies)</td>
</tr>
<tr>
<td></td>
<td>Antineutrophil cytoplasmic antibody (ANCA)-associated rapidly progressive glomerulonephritis</td>
</tr>
<tr>
<td></td>
<td>Recurrent focal segmental glomerular sclerosis</td>
</tr>
<tr>
<td></td>
<td>Antibody-mediated renal transplant rejection</td>
</tr>
<tr>
<td>Metabolic</td>
<td>Familial hypercholesterolaemia (homozygous)</td>
</tr>
<tr>
<td></td>
<td>Fulminant Wilson’s disease</td>
</tr>
</tbody>
</table>

<sup>a</sup> Paediatric autoimmune neuropsychiatric disorders associated with streptococcal infection.
Table 11.2 ASFA Category II indications for therapeutic plasma exchange (established second-line therapy)

<table>
<thead>
<tr>
<th>Speciality</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neurology</td>
<td>Lambert–Eaton myasthenic syndrome</td>
</tr>
<tr>
<td></td>
<td>Acute exacerbation of multiple sclerosis</td>
</tr>
<tr>
<td></td>
<td>Chronic focal encephalitis</td>
</tr>
<tr>
<td></td>
<td>Neuromyelitis optica</td>
</tr>
<tr>
<td>Haematology</td>
<td>ABO-incompatible haemopoietic stem cell transplantation</td>
</tr>
<tr>
<td></td>
<td>Pure red cell aplasia</td>
</tr>
<tr>
<td></td>
<td>Life-threatening cold agglutinin disease</td>
</tr>
<tr>
<td></td>
<td>Atypical haemolytic uraemic syndrome (complement factor gene mutations)</td>
</tr>
<tr>
<td></td>
<td>Myeloma with cast nephropathy</td>
</tr>
<tr>
<td></td>
<td>Red cell alloimmunisation in pregnancy</td>
</tr>
<tr>
<td>Immunological</td>
<td>Catastrophic antiphospholipid syndrome</td>
</tr>
<tr>
<td></td>
<td>Cerebral systemic lupus erythematosus (SLE)</td>
</tr>
<tr>
<td>Metabolic</td>
<td>Refsum’s disease</td>
</tr>
</tbody>
</table>

11.1.2: Risks associated with therapeutic plasma exchange

Plasma exchange with albumin or saline causes a transient fall in blood-clotting factors and mild prolongation of prothrombin and activated partial thromboplastin times recovering in 4 to 24 hours. Clinically
significant bleeding is rare but a coagulation screen should be undertaken before surgery or organ biopsy is performed. Other risks include haematomas at venepuncture/line insertion sites, vasovagal episodes with fainting, fluid overload or under-replacement, and allergic or anaphylactic reactions due to plasma infusion.

11.1.3: Thrombotic thrombocytopenic purpura (TTP)

This rare condition is a medical emergency with a mortality of 90% if untreated. It is caused by an acquired (autoimmune) or congenital deficiency of von Willebrand factor cleaving protein (ADAMTS13). TPE, using FFP to replace ADAMTS13, is the treatment of choice and should be started as soon as possible after the diagnosis is suspected, ideally within 4–8 hours. The 2012 British Committee for Standards in Haematology (BCSH) Guidelines on the Diagnosis and Management of Thrombocytopenic Purpura and other Thrombotic Microangiopathies (http://www.bcshguidelines.com) recommend solvent detergent treated FFP (SD-FFP) as the replacement fluid. TPE is more effective than FFP transfusion alone. Platelet transfusions are contraindicated in TTP unless there is life-threatening haemorrhage. Thromboprophylaxis with low molecular weight heparin is recommended once the platelet count is >50×10^9/L. Daily TPE is continued until the platelet count has been >150×10^9/L for 2 days.