Apheresis Products—An Overview

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What is Apheresis

• Apheresis is derived from Greek word:
  – ‘Apo’ meaning ‘away’ and
  – ‘Heresis’, is the process which involves the removal of whole blood, separating and collecting any of the components, whilst returning remaining blood component to maintain haemodynamic status.

• Historical background:
  – B/W 1902-14, Plasmapheresis performed in France, Russia and USA.
  – In 1960, Solomen and Fahey used Manual Therapeutic Plasmapheresis to reduce elevated Ig levels in Hyperviscosity Syndrome.

• Now a days Automated cell separator machine is used to collect and/or treat blood components in apheresis.
Applications

I. Components Collection:
- PLT
  - Plateletpheresis (SDP)
- RBC
  - Erythrocytapheresis
- WBC
  - Leucocytapheresis
- PLASMA
  - Plasmapheresis

II. Therapeutic Procedures:
- PLT
  - Thrombocytosis
- RBC
  - Sickle Cell Disease
  - Malaria
- PBSC
  - Leukemias
  - Cell Therapies
- PLASMA
  - TPE

Guillain Barre Syn.
Myasthenia Gravis
Goodpasture’s Syn.
Waldenstrom’s
Principle of working

A. Centrifugation.
   I. IFC
   II. CFC

I. IFC
Adv:
- Smaller
- mobile
- Single Venipuncture

Disadv:
- Greater Extracorporeal volume.
- Procedure timer ↑
- Variable Volume of Collection.
- Red Cell Contamination.
- NOT a Leukocyte Depleted (LD) SDPs

II. CFC
Adv:
- Single/Double
- Hyper concentrated Platelets harvesting.
- In-process LD.
- No chance of Red Cell Contamination.
- Lesser Extracorporeal volume.
- Procedure timer ↓

Disadv:
- Larger

B. Membrane Filtration

Single filtration technique
By pore size and charge differentiate/filtrate plasma compounds from blood
1. SDP: Apheresis-PC

- **Plateletpheresis**: is the process of collecting required platelets and rest of the components are returned back to the donor.
- **Procedure Time**: 45-90 minutes.
- **Average**: > $3 \times 10^{11}$ Platelets (equivalent to 5-8 RDPs) in 200-300 ml plasma/PAS.
- **Can be stored for 5 days at 22±2ºC with continuous agitation.**
- **Can be prepared with/without plasma, can be used as FFP.**
- **Could boost Platelet Count by 30,000-60,000/ul.**

<table>
<thead>
<tr>
<th>Merits</th>
<th>Demerits</th>
</tr>
</thead>
<tbody>
<tr>
<td>➢ Reduced donor exposure: Full transfusion Dose</td>
<td>➢ Trained persons required</td>
</tr>
<tr>
<td>➢ High Quality Products: More QC per component collected</td>
<td>➢ Sophisticated equipment required</td>
</tr>
<tr>
<td>➢ Leukocytes &lt;$5.5 \times 10^6$/ unit</td>
<td>➢ Donation by Apheresis requires commitment</td>
</tr>
<tr>
<td>➢ Obviate the need of filtration</td>
<td></td>
</tr>
<tr>
<td>➢ Low risk to alloimmunization</td>
<td></td>
</tr>
<tr>
<td>➢ Red cells-Traces</td>
<td></td>
</tr>
<tr>
<td>➢ Matching donor to patient</td>
<td></td>
</tr>
<tr>
<td>➢ Less exposure to infection</td>
<td></td>
</tr>
<tr>
<td>➢ Decreased risk of bacterial contamination &amp; easy handling</td>
<td></td>
</tr>
<tr>
<td>➢ Consistent and standardized products (yields)</td>
<td></td>
</tr>
</tbody>
</table>
Indications for Platelet Transfusions

1. Bone marrow failure
   (Due to disease, cytotoxic therapy or irradiation)
   - Therapeutic platelet transfusion.
     • Equivocally indicated for patients with active bleeding associated with thrombocytopenia.
   - Prophylactic platelet transfusions.
     • Become standard practice for patients with bone marrow failure.
   - A threshold of $10 \times 10^9/L$ is safe for patients without risk factors.
   - Acute Promyelocytic leukemia a threshold should be kept >$20 \times 10^9/L$
   - Chronic stable thrombocytopenia e.g. MDS and Aplastic Anemia patients are best managed on an individual basis depending on the degree of hemorrhage.

2. Prophylaxis for Surgery/Massive Transfusion:
   - Bone marrow aspiration & biopsy:
     • Procedure can be performed without platelets tr.
   - Lumber puncture, epidural anesthesia, gastroscopy & biopsy, transbronchial biopsy, liver biopsy, laparotomy or similar procedure, and Acute Bleeding in Trauma.
     • >$50 \times 10^9/L$
   - Operations at critical sites (Brain or Eye)/Multi-trauma or CNS Injury:
     • >$100 \times 10^9/L$

3. DIC:
   - Platelet transfusion are a part of the management of acute DIC.
   - Recommendations:
     • Frequent estimation of the platelet count & coagulation screening tests should be carried out.
     • Aim to maintain the platelet count >$50 \times 10^9/L$.
     • In chronic DIC, or in the absence of bleeding, platelet transfusions should not be given merely to correct a low platelet count.

4. Platelet function disorder:
   - Patients rarely need platelet transfusions.
   - Recommendations:
     • Withdraw drugs known to have antiplatelet activity &Correct any underlying condition.
     • Correct the HCT to > 30, Consider use of Desmopressin in patients with inherited dysfunction defect &/or Cryo in patient with Uremia.
     • Use platelets where the above methods are not appropriate or are ineffective.
Contraindications

• Thrombotic Thrombocytopenic Purpura (TTP):
  – Platelet transfusions are contraindicated unless there is life threatening hemorrhage.

• Heparin induced thrombocytopenia (HIT):
  – Platelet transfusions should not be administered as acute arterial thrombosis can result.
Response to Platelet Transfusion

- **Monitoring of response:**
  - If platelet transfusion was given to bleeding patient i.e., *Therapeutic Transfusion*, the **CLINICAL RESPONSE** is the most important indication of effectiveness of the transfusion.
  - Responses to a *Prophylactic Transfusion* should be assessed by measuring the increase in platelet count following transfusion.

- **Percentage Platelet Recovery (PPR):**
  \[
  PPR (%) = \frac{\text{Platelet increment } 10^9/L \times \text{blood volume (BV)}}{10^{11} \text{ transfused platelet}} \times 100
  \]

- **Corrected Count Increment (CCI):**
  \[
  CCI = \frac{\text{Platelet increment/µl } \times \text{BSA (m}^2\text{)}}{\text{Number of platelets transfused } (x10^{11})} \times 10^{11}
  \]

- A successful transfusion may produce a platelet recovery of about 67% in a stable patient, But the minimum platelet recovery to define a successful transfusion is considered as:
  - PPR >30% at 1 h post transfusion and >20% at 20-24 h.
  - or a CCI of >7.5x10^9 platelets/µl/m² at 1 hr and >4.5x10^9 platelets/µl/m² at 20-24 h.

- In practice, a poor response to a prophylactic platelet transfusion can be defined as:
  - Failure to raise the platelet count above the ‘trigger’ platelet count for two consecutive transfusions.

**Platelet Transfusion Refractoriness**

**1. Platelet quality**
- Amount of platelets transfused
- Leukocyte contamination
- Storage duration
- Type of storage bag
- Temperature

**2. Non-immune factors**
- Fever/infection
- Disseminated Intravascular Coagulation (DIC)
- Splenomegaly
- Drugs

**3. Alloimmune factors**
- HLA antibodies
- HPA antibodies
- ABH antibodies

**4. Auto antibodies**
2. Leukapheresis (Granulocytapheresis)

Role of granulocytes for sepsis in neonates is unclear. However there are certain clinical situations where they may be considered as adjunct therapy to antibiotics.

- **Factors to be considered:**
  - Strong evidence of bacterial or fungal septicemia.
  - Absolute neutrophil count < 3000/ul.
  - Diminished storage pool.

- **Indications and Guidelines:**
  - Neonates & Older Children:
    - Neutropenia or granulocyte dysfunction with bacterial infection and lack of responsiveness to standard therapy.
    - Fungal disease not responding to standard therapy.
    - post BMT fungal infections resistant to treatment

- **Dose:**
  - A typical dose for neonates is 10-15 ml/kg body weight, which is approx. $1-2 \times 10^9$ PMN/Kg.
  - Older children and adult dose is $1 \times 10^{10}$ cells/kg.
  - Treatment should be administered daily until an adequate neutrophil count is achieved &/or patient shows clinical improvement.

- **Sources:**
  - Granulocytapheresis.
  - Buffy coats (about 10 BC ABO matched)

- **Complications:**
  - Transfusion reactions
  - TA-GvHD

- **Precautions:**
  - ABO & Cross Match Compatible with the patient.
  - Irradiated to prevent TA GVHD.
  - CMV Negative
3. Erythrocytapheresis

- Erythrocytapheresis is an apheresis procedure by which erythrocytes are separated from whole blood.

- On-line separation of RBCs and Plasma.

- Donor Selection Criteria:
  - Same as W.B. Donor, except:
    - Hb >14 gm/dl
    - Donation Interval 6 months.

- Advantages:
  - Standardized absolute up to 2 units of RBCs mass collection.
  - Greater volume of RBCs without hypervolemia.
  - Possible to collect Rare antigen Matched pRBCs in adequate doses for multi transfused patients:
    - Thalassemia.
    - Dialysis.
    - Cancer.

<table>
<thead>
<tr>
<th></th>
<th>Donor</th>
<th>Donor</th>
<th>Donor</th>
<th>Maximum Absolute</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Weight (lb)</td>
<td>Height (in)</td>
<td>Hematocrit (%)</td>
<td>Red Cell Volume (mL)</td>
</tr>
<tr>
<td><strong>Men</strong></td>
<td>130-149</td>
<td>≥61</td>
<td>≥40</td>
<td>180 × 2</td>
</tr>
<tr>
<td></td>
<td>150-174</td>
<td>≥61</td>
<td>≥40</td>
<td>200 × 2</td>
</tr>
<tr>
<td></td>
<td>≥175</td>
<td>≥61</td>
<td>≥40</td>
<td>210 × 2</td>
</tr>
<tr>
<td><strong>Women</strong></td>
<td>150-174</td>
<td>≥65</td>
<td>≥40</td>
<td>180 × 2</td>
</tr>
<tr>
<td></td>
<td>≥175</td>
<td>≥65</td>
<td>≥40</td>
<td>200 × 2</td>
</tr>
</tbody>
</table>
4. Plasmapheresis / Plasma Exchange:

The American Society for Apheresis (ASFA) definitions for these procedures are as follows:

**Plasmapheresis:** A procedure in which blood of a patient or the donor is passed through a medical device which separates out plasma from the other components of blood and the plasma is removed (i.e., less than 15% of total plasma volume/ Aprox 500 ml) without the use of replacement solution.

**Plasma Exchange:** Therapeutic procedure in which blood of the patient is passed through a medical device which separates out plasma from other components of blood, the plasma is removed and replaced with a replacement solution such as colloid solution (e.g., albumin and/ or plasma) or combination of crystalloid/colloid solution.

<table>
<thead>
<tr>
<th>Level</th>
<th>Schedule</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aggressive (A)</td>
<td>Daily</td>
<td>3 treatments to indefinite</td>
</tr>
<tr>
<td>Routine (R)</td>
<td>3 times a week</td>
<td>5-7 treatments</td>
</tr>
<tr>
<td>Prolonged (P)</td>
<td>1-2 times a week</td>
<td>3-8 weeks</td>
</tr>
<tr>
<td>Chronic (C)</td>
<td>Every 1-4 weeks</td>
<td>Indefinite</td>
</tr>
</tbody>
</table>

TPE = therapeutic plasma exchange.
Molecular weight of removed substances by blood purification therapy

Molecular weight

- Hemodialysis
- Hemoperfusion
- Hemofiltration
- Plasma exchange
- Double-filtration

Blood corpuscles

- $10^2$
- $10^4$
- $10^6$
Efficiency of TPE

- Volume of exchange
  - 1-1.5 plasma volume
  - Calculation depends on numerous factors
    - Frequency of procedures
    - Duration of therapy
- What is being removed?
  - IgG - mainly extravascular
  - IgM – mainly intravascular

**Table: Plasma Volumes Exchanged: Fraction Removed and Remaining**

<table>
<thead>
<tr>
<th>Plasma Volume Removed</th>
<th>Fraction Removed (%)</th>
<th>Fraction Remaining (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.5</td>
<td>40</td>
<td>60</td>
</tr>
<tr>
<td>1.0</td>
<td>62</td>
<td>38</td>
</tr>
<tr>
<td>1.5</td>
<td>78</td>
<td>22</td>
</tr>
<tr>
<td>2.0</td>
<td>85</td>
<td>15</td>
</tr>
<tr>
<td>2.5</td>
<td>91</td>
<td>9</td>
</tr>
<tr>
<td>3.0</td>
<td>94</td>
<td>6</td>
</tr>
</tbody>
</table>
TPE: Indications & Grading Recommendations

- **Category I:**
  Apheresis is standard and acceptable as a primary therapy or first line adjunct therapy. This does not mean that it is mandatory.

- **Category II:**
  Apheresis is accepted but as supportive to other treatment.

- **Category III:**
  Apheresis may be beneficial; however, there is insufficient evidence to establish the efficacy or risk or benefit.

- **Category IV:**
  Controlled trails have not shown benefits to be approved by Institutional review board.
## Indications for TPE

<table>
<thead>
<tr>
<th>Disease</th>
<th>Procedure</th>
<th>Indication category</th>
<th>Recommendation Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Renal and metabolic diseases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Focal Segmental Glomerulonephritis</td>
<td>TPE</td>
<td>I</td>
<td>1 C</td>
</tr>
<tr>
<td>RPGN</td>
<td>TPE</td>
<td>III</td>
<td>2 B</td>
</tr>
<tr>
<td>Familial hypercholesterolemia</td>
<td>Selective absorption, TPE</td>
<td>I</td>
<td>1 A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>II</td>
<td>1 C</td>
</tr>
<tr>
<td>Phytanic acid storage disease</td>
<td>TPE</td>
<td>II</td>
<td>2 C</td>
</tr>
<tr>
<td><strong>Autoimmune and rheumatic diseases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cryoglobulinemia</td>
<td>TPE</td>
<td>II</td>
<td>1 B</td>
</tr>
<tr>
<td>Thrombotic thrombocytopenic purpura (TTP)</td>
<td>TPE</td>
<td>I</td>
<td>1 A</td>
</tr>
<tr>
<td>Rheumatoid arthritis</td>
<td>Immuno-adsorption TPE</td>
<td>II</td>
<td>2 A</td>
</tr>
<tr>
<td></td>
<td>TPE</td>
<td>IV</td>
<td>1 B</td>
</tr>
<tr>
<td><strong>Hematologic diseases</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ABO incompatible marrow transplant</td>
<td>HPC (marrow) TPE</td>
<td>II</td>
<td>1 B</td>
</tr>
<tr>
<td></td>
<td>HPC (Apheresis)</td>
<td>II</td>
<td>2 B</td>
</tr>
<tr>
<td>Secondary Erythrocytosis polycythemia vera</td>
<td>Erythrocytapheresis</td>
<td>III</td>
<td>2 B</td>
</tr>
<tr>
<td></td>
<td>Erythrocytapheresis</td>
<td>III</td>
<td>2 B</td>
</tr>
<tr>
<td>Thrombocytosis</td>
<td>TPE</td>
<td>II</td>
<td>2 C</td>
</tr>
<tr>
<td>Sepsis with multi-organ failure</td>
<td>TPE</td>
<td>III</td>
<td>2 B</td>
</tr>
<tr>
<td>Post-transfusion purpura</td>
<td>TPE</td>
<td>III</td>
<td>2 C</td>
</tr>
<tr>
<td>Sickle cell diseases</td>
<td>RBC exchange</td>
<td>I</td>
<td>1 C</td>
</tr>
<tr>
<td>Myeloma or ARF</td>
<td>TPE</td>
<td>II</td>
<td>2 B</td>
</tr>
<tr>
<td>Coagulation factor inhibitors</td>
<td>TPE</td>
<td>III</td>
<td>2 B</td>
</tr>
<tr>
<td>Cutaneous T-cell lymphoma</td>
<td>Photopheresis</td>
<td>I</td>
<td>1 B</td>
</tr>
</tbody>
</table>
Replacement fluid

1. 5% Albumin
   1. Best choice
   2. Dilute only with saline

2. Combination of saline and albumin

3. FFP

4. Cryo poor plasma

<table>
<thead>
<tr>
<th>Replacement Solution</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystalloids</td>
<td>Low cost</td>
<td>2-3 volumes required</td>
</tr>
<tr>
<td></td>
<td>Nonallergenic</td>
<td>Hypo-oncotic</td>
</tr>
<tr>
<td></td>
<td>No viral risk</td>
<td>Lacks coagulation factors and immunoglobulins</td>
</tr>
<tr>
<td>Albin</td>
<td>Iso-oncotic</td>
<td>Higher cost</td>
</tr>
<tr>
<td></td>
<td>Low risk of reactions</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plasma</td>
<td>Iso-oncotic</td>
<td>Viral transmission risk</td>
</tr>
<tr>
<td></td>
<td>Normal levels of coagulation factors,</td>
<td>Citrate load</td>
</tr>
<tr>
<td></td>
<td>immunoglobulins and other plasma proteins</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ABO compatibility required</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Risk of allergic reactions</td>
</tr>
<tr>
<td>Cryoprecipitate-reduced</td>
<td>Iso-oncotic</td>
<td>Same as plasma</td>
</tr>
<tr>
<td>plasma</td>
<td>Reduced HMW vWF</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Normal levels of most other plasma proteins</td>
<td></td>
</tr>
</tbody>
</table>

HMW vWF = high-molecular-weight von Willebrand factor.
5. Selective Adsorption (Immuno-adsorption)

- **Principle:**
  
  \[ \text{WB} \rightarrow \text{Cell Separator(Plasma)} \rightarrow \text{Pump} \]
  
  ↑ ↓
  
  Rvr← Plasma ← Affinity column or Filter

### Types & Clinical Application

<table>
<thead>
<tr>
<th>Adsorbent</th>
<th>Sub.Removed</th>
<th>Application</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charcoal</td>
<td>Bile acids</td>
<td>Cholestatic priritus</td>
</tr>
<tr>
<td>A, B Antigen</td>
<td>Anti A, Anti B</td>
<td>Transplantation</td>
</tr>
<tr>
<td>Anti-LDL</td>
<td>Heparin,LDL</td>
<td>Hypercholesteri mia</td>
</tr>
<tr>
<td>DNA, ANA</td>
<td>Immune complexes</td>
<td>SLE</td>
</tr>
<tr>
<td>Protein A</td>
<td>IgG,Imm. Complexes</td>
<td>ITP, Cancer, HUS</td>
</tr>
</tbody>
</table>

### Clinical Indications

<table>
<thead>
<tr>
<th>Indication</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chronic focal encephalitis (Rasmussen encephalitis)</td>
<td>II</td>
</tr>
<tr>
<td>Coagulation factor inhibitors</td>
<td>III</td>
</tr>
<tr>
<td>Cryoglobulinemia Secondary to hepatitis C virus</td>
<td>II</td>
</tr>
<tr>
<td>Dilated cardiomyopathy New York Heart Association Class II-IV</td>
<td>III</td>
</tr>
<tr>
<td>Familial hypercholesterolemia Homozygous</td>
<td>I</td>
</tr>
<tr>
<td>Familial hypercholesterolemia Heterozygous</td>
<td>II</td>
</tr>
<tr>
<td>Paraneoplastic neurologic syndromes</td>
<td>III</td>
</tr>
<tr>
<td>Paraproteinemic polyneuropathies IgG/IgA or IgM</td>
<td>III</td>
</tr>
<tr>
<td>Rheumatoid arthritis, refractory</td>
<td>II</td>
</tr>
</tbody>
</table>
6. Photopheresis

Buffy Coat is separated from whole blood, chemically treated with Methoxalen (Uvadex) & exposed to ultraviolet light, and returned to the patient. Therakos Photopheresis System (J & J)

<table>
<thead>
<tr>
<th>Indication</th>
<th>Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cardiac allograft rejection</td>
<td>I</td>
</tr>
<tr>
<td>Prophylaxis</td>
<td></td>
</tr>
<tr>
<td>Treatment of rejection</td>
<td>II</td>
</tr>
<tr>
<td>Cutaneous T-cell lymphoma; mycosis fungoides; Sézary syndrome</td>
<td>I</td>
</tr>
<tr>
<td>Erythrodermic</td>
<td></td>
</tr>
<tr>
<td>Nonerythrodermic</td>
<td>II</td>
</tr>
<tr>
<td>Graft-vs-host disease</td>
<td>II</td>
</tr>
<tr>
<td>Skin (chronic)</td>
<td></td>
</tr>
<tr>
<td>Skin (acute)</td>
<td>II</td>
</tr>
<tr>
<td>Nonskin (acute/chronic)</td>
<td>III</td>
</tr>
<tr>
<td>Lung allograft rejection</td>
<td>II</td>
</tr>
<tr>
<td>Nephrogenic systemic fibrosis</td>
<td>III</td>
</tr>
<tr>
<td>Pemphigus vulgaris</td>
<td>III</td>
</tr>
<tr>
<td>Scleroderma (progressive systemic sclerosis)</td>
<td>IV</td>
</tr>
</tbody>
</table>

Photopheresis & Centrifugation

- Selection of cells granulocytes/lymphocytes
- Addition of psoralen
- UV irradiation
- Partial apoptosis
- Retransfusion

Centrifugation technique

UV-light

Leukocytes
7. Red Cell Exchange

• Sickle Cell Disease:
  • Clinical picture
    – Chronic genetic anemia
    – Hgb S instead of Hgb A alters the erythrocytes and their membranes (sickle red cells)
    – Increased blood viscosity
    – Microvascular occlusion
      • Infarcts in brain, lungs, retina
      • Pain crisis
      • Priapism
      • Acute chest syndrome
      • Stroke
  • Treatment
    • Red cell transfusions
    • Hydroxyurea
    • Red cell exchange (ASFA Category I)
      – Aims to maintain Hgb S <30

• Malaria/Babesiosis
  – Severe malaria or babesiosis with parasitic index >10%
8. Leukocytapheresis

- Leukocytosis
  - Acute Myelogenous Leukemia (AML)
  - Chronic Myelogenous Leukemia (CML)
  - Acute Lymphocytic Leukemia (ALL)
  - Chronic Lymphocytic Leukemia (CLL)

- Clinical picture
  - Hyperviscosity with microvascular occlusion: \( \text{WBC levels} > 100 \times 10^3 / \mu\text{L} \)
    - CNS symptoms
    - Hemorrhage
    - Pulmonary insufficiency

- Treatment
  - Combination chemotherapy (tumor cell lysis leads to metabolic imbalance and ARDS)
  - Leukapheresis (ASFA Category I)
    - The role of therapeutic leukapheresis is to initially and rapidly decrease the burden of leukocytosis on the body by 50-60% whilst chemotherapy is commenced.
      - Treatment of leukocytosis
      - Prevention of tumor cell lysis syndrome
9. Thrombocytapheresis

- Thrombocytosis (>1,000 x 10^9 /L)
  - Essential
  - Polycythemia vera

- Clinical picture:
  - Microvascular occlusion
    - CNS symptoms
    - Hemorrhage
    - Pulmonary insufficiency

- Treatment:
  - Chemotherapy
  - Plateletapheresis (ASFA Category I)

- Aim:
  - To prevent the development of thrombotic and hemorrhagic complications until conventional therapy can control platelet production.

Note:

It should be noted that in disease process, which result in thrombocytemia, the platelets are generally atypical and function poorly and therefore platelet transfusions post apheresis may be indicated (this is rare).
10. Peripheral Blood Stem Cell (PBSC) Harvesting by Apheresis

- **Background**
  - First successful transplants—late 1960s
  - 30,000-40,000 transplants performed yearly worldwide
  - >20,000 patients have survived >5 years
  - **Hematopoietic stem cell**
    - Responsible to maintaining marrow function throughout the life of individual.
    - Stem cells are undifferentiated cells with the capacity for unlimited or prolonged self-renewal & the ability to give rise to differentiated cells
      - Totipotent: give rise to entire organism
      - Pluripotent: give rise to most cells
    - Gives rise to (any) blood cells: RBC, PLT, WBC.
    - Re-establish hematopoietic function in patients with damaged/defective bone marrow or immune systems
    - Potentially curative for a wide variety of disorders

Complications of Apheresis

- **Apheresis/Plasma Exchange:**
  - Citrate toxicity
  - Vascular access complications (hematoma, sepsis, phlebitis, neuropathy)
  - Vasovagal reactions
  - Hypovolemia (more common with saline-albumin infusion)
  - Hemolysis
  - Air embolus
  - Depletion of clotting factors
  - Circulatory and respiratory distress
  - Transfusion-transmitted disease
  - Lymphocyte loss
  - Depletion of proteins and immunoglobulins

- **PBSC:**
  - Citrate Toxicity
  - Thrombocytopenia: 30-40% PLT loss.
  - G-CSF Related:
    - Flu like syndrome.
    - Bone pain.
    - Hypercoagulable state

Ref:


2. Denise M. Harmening, Modern blood banking and transfusion practices, Philadelphia : F.A. Davis, 2005
Thank you ?