Nursing Practice

**Review**

**Haematology**

Apheresis is a vital but little-known procedure that can be undertaken by nurses who have the necessary skills to understand the process and how to perform it successfully.

# The nurse’s role in therapeutic apheresis

## In this article...

- How apheresis works
- Conditions treated using apheresis
- Knowledge and skills required by apheresis nurses

## Author

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## Abstract


Therapeutic apheresis is a relatively unfamiliar area of nursing practice. It involves the separation and removal of blood components and constituents for direct or indirect treatment of conditions spanning a wide range of clinical specialties; it requires a particular set of technical skills and specialised knowledge. This article summarises the procedure, when it is used, and the specialist skills needed to perform it and deal with any side-effects.

During the process of apheresis, blood components/constituents are separated or removed from a patient or donor in a continuous flow, with or without being replaced. Blood is drawn into a machine, usually via a vein in the cubital fossa of the arm, then returned to that or another vein minus the collected or removed components/constituents. Replacement fluid is added if required.

The term “apheresis” is derived from a Greek word meaning “to take away”. Schwartz and Padmanabhan (2011) described therapeutic apheresis as: “A technique in which whole blood is taken and separated extracorporeally, separating the portion desired from the remaining blood.”

## How does apheresis work?

Blood comprises red cells (erythrocytes), white cells (leucocytes) and platelets. These components are transported by plasma, which also contains dissolved substances and constituents, such as proteins, minerals, glucose, urea, amino acids, uric acid, hormones and antibodies (immunoglobulins). Each blood component or constituent has different physical properties – for example, size and weight – which allows apheresis to take place.

A number of methods are used to separate the blood components/constituents and several different types of machine are used (Table 1).

### When/for whom is apheresis used?

Apheresis is usually used:

- When a specific component or constituent of the blood has to be collected for transfusion/infusion at a later date, with or without further manipulation of the collected material;
- As a direct therapeutic treatment to immediately remove a harmful component or constituent of the blood, such as defective cells or antibodies. This may mean using replacement fluid, to replace volume or correct a deficiency with “normal” cells/constituents.

## Collection

This process involves the collection of:

- Blood components from unrelated donors for transfusion in the general population: collected and supplied by NHS Blood and Transplant (NHSBT);
- Other cells – mainly white cells (leucocytes) – for specific patients (directed), either from the patients themselves (autologous) or from a

Apheresis is carried out on patients with a range of acute and long-term conditions.

## 5 key points

1. Apheresis is a little-known specialty in nursing, requiring specific technical and knowledge competence.
2. Apheresis machines separate blood into components that are then removed, and replaced, if necessary.
3. Apheresis is used as a treatment in a wide range of clinical specialties.
4. There are different ways to perform apheresis using different types of equipment.
5. Apheresis is not universally available in NHS hospitals.
Apheresis treatment is often an adjunctive therapy, acting as a support in the acute stages of disease until other therapies take effect.

Evidence-based guidance categorising diseases and recommending apheresis are available from the American Society for Apheresis (ASFA) and British Committee for Standards in Haematology (BCSH) (Howell et al, 2015; Schwarz et al, 2013).

The main apheresis treatments include:
- Red cell exchange/depletion treatments;
- Plasma exchange/filtration/adsorption treatments;
- Extra corporeal photopheresis (ECP) treatment.

Red cell exchange/depletion treatments.
Removal, with or without replacement, of red blood cells is used to treat several red cell disorders, most commonly sickle cell disease. The patient’s “affected/defective” red cells are removed and simultaneously replaced with an equivalent or lesser amount of donated red cells. This relieves symptoms of painful “crises” and prevents stroke. The process can also be used as prophylactic treatment instead of more-frequent smaller transfusion episodes, or to reduce haemoglobin levels. Several other conditions, such as cerebral malaria, can be treated with red cell exchange apheresis where removal of the “affected” red cells reduces the parasite load, thereby relieving symptoms (McLeod et al, 2010).

Plasma exchange, filtration, adsorption treatments
Removal of the plasma or plasma constituents is used to treat several disorders across different specialties, including haematology, neurology, urology and rheumatology. It is used to treat conditions like thrombotic thrombocytopenic purpura (TTP), myeloma, vasculitis, Guillain-Barré syndrome, myasthenia gravis, hypercholesterolaemia, and for antibody removal before ABO-incompatible organ transplants, as well as many others (Schwartz et al, 2013).

The procedure removes disease-mediating components/constituents and replaces them as, or if, required. A plasma-exchange procedure will remove a large percentage, or most, of the circulating plasma (and its constituents), depending on the volume of blood processed. Plasma filtration and adsorption procedures can remove specific constituents from the plasma itself, reducing the need for replacement fluid and, in some cases (for example, as with cholesterol), the substance can be removed from the plasma or directly from the whole blood.

ECP treatment
White cells are separated, then collected and exposed to ultraviolet light, after the addition of a light-sensitising drug. The cells are then returned to the patient to obtain an immunomodulatory effect (Das-Gupta et al, 2014). This is used to treat chronic graft-versus-host disease after stem cell transplantation, in cutaneous T-cell lymphoma, and in various organ-transplant settings.

Considerations for nurses
Apheresis calls for competence in several technical skills, which include managing:
- An extracorporeal volume (ECV – blood outside the body) and fluid shifts during apheresis procedures;
- Anticoagulation in an ECV and side-effects of anticoagulants used in apheresis;
- Venous blood flow and venous access for apheresis procedures.

Managing ECV
Apheresis can involve the removal of a large volume of a blood cells or plasma, or result in a large ECV, which means replacement fluid must be given. The effect of the ECV and fluid shifts on the patient, and managing these, are major considerations for nurses undertaking apheresis procedures. They need to understand these issues, as well as having specialised knowledge of the function and operation of the apheresis equipment.

The type of replacement fluid used is determined by the procedure and condition being treated. These can be used alone or in combination and include:
- Blood components: red cells, plasma;
- Blood products: human albumin.

### TABLE 1. APHERESIS METHODS

<table>
<thead>
<tr>
<th>Method</th>
<th>Tool(s)</th>
<th>Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>Centrifugation</td>
<td>Centrifuge</td>
<td>A centrifuge spins the blood causing its components to separate into individual layers according to weight (specific gravity). The heaviest components are forced out farthest from the centre of the centrifuge, while the lightest remain closest to the centre. Red cells will form the outermost layer of the separated blood, followed by a layer of platelets, white cells and, finally, plasma and red cell membranes.</td>
</tr>
<tr>
<td>Filtration</td>
<td>Porous membrane</td>
<td>Blood is drawn through a porous membrane which, depending on the diameter of the pores, allows the smaller constituents of the blood to pass through, while blocking the larger constituents.</td>
</tr>
<tr>
<td>Adsorption</td>
<td>Adsorbent columns</td>
<td>Blood or components are drawn through a column containing a material with an affinity to specific constituents. The constituent(s) are adsorbed by the material out of the blood/component as it passes through the column.</td>
</tr>
</tbody>
</table>

Donor (allogeneic). The component most commonly collected in this way is stem cells;

Other cells (mainly leucocytes) for the production of advanced-therapy medicinal product treatments. These are based on gene therapy, somatic cell therapy or tissue engineering and used in an increasing number of diseases, including several cancers.

Directed collection procedures for specific patients are almost exclusively performed to support those undergoing stem cell transplants and will either be autologous or allogeneic. Collection from the peripheral blood has mainly replaced bone marrow collection as the preferred source of cells in haematopoietic stem cell transplantation (Mohty et al, 2014).

### Treatment

Treatment apheresis is broadly separated into three areas:

- Removal of a disease-mediating blood component or constituent;
- As above but with additional fluid to replace volume and, if necessary, add a missing or dysfunctional component;
- Removal and treatment of a blood component with subsequent reinfusion of the treated component to initiate a therapeutic effect.

Procedures may be carried out on patients with a range of conditions across different specialties – including neurology, oncology, haematology, rheumatology, dermatology and urology – and can be used to treat acute and long-term conditions.

Apheresis treatment is often an adjunctive therapy, acting as a support in the acute stages of disease until other therapies take effect.

Evidence-based guidance categorising diseases and recommending apheresis are available from the American Society for Apheresis (ASFA) and British Committee for Standards in Haematology (BCSH) (Howell et al, 2015; Schwarz et al, 2013).
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Managing anticoagulation
Nurses must also think about using anticoagulants to prevent clotting of the extra corporeal circuit and how these will affect patients and their treatment.

Two main anticoagulants are used in apheresis: heparin and acid citrate dextrose formula A (ACDA). Each works differently on the clotting mechanism and each calls for specific considerations about the patient.

Heparin is fairly standard for patients with some clotting disorders, such as deep vein thrombosis and pulmonary embolism. When heparinisation is not therapeutic but is used to maintain blood flow through the extracorporeal circuit, the considerations are different. Doses are different to those used in therapeutic procedures, as the aim is not anticoagulation of the patient, but only to prevent blood clotting as it passes through the apheresis machine.

ACDA, a calcium-chelating agent that binds free calcium ions to prevent clotting as the blood travels through the extracorporeal circuit, is not classified as a drug and is used almost exclusively in apheresis. Nurses using ACDA require special knowledge of its side-effects, such as hypocalcaemia and hypomagnesaemia, and management, both in the patient and in the machine.

Venous blood flow
Apheresis procedures rely on constant unimpeded venous blood flow through the machine; suboptimal blood flow can affect the overall procedure time and effectiveness of treatment. Management of venous access to ensure good flow is therefore a key part of the nurse’s role. Inadequate venous access can prevent the procedure from being undertaken or result in loss of blood volume if blood cannot be returned to the patient.

Apheresis machines create a negative pressure when drawing blood from the patient and a positive pressure when returning it; this pressure can take its toll on peripheral veins and central venous lines. A dual-lumen central venous catheter or arteriovenous fistula may be used where peripheral veins are not suitable/accessible. Treatment often occurs on a daily, or even twice-daily, basis so preserving the patency of established access is a vital part of maintaining the success of apheresis and a special element of the skillset of apheresis nurses.

Apheresis nursing
Apheresis is a fairly rare, little-known aspect of nursing. It is performed in a range of settings by nurses who may specialise solely in the procedure, or work in specific clinical areas with apheresis as an additional skill.

Those specialising solely in apheresis often carry out a wide range of apheresis procedures across different clinical specialities, using an extensive range of apheresis equipment and techniques.

They work across several environments, such as intensive care units, general wards, specialist wards, outpatient settings and specialist clinics; one example of such is therapeutic apheresis unit nurses working in NHSBT.

Nurses who perform apheresis as part of a wider role, such as in ICU, may perform only one type of apheresis procedure or a limited number of procedures, and remain in their specific clinical setting.

Apheresis is often confused with dialysis, but this is a separate and a specific form of apheresis. Dialysis is annexed into a separate specialty, catered for in the main by renal departments under specific renal guidelines.

References


Accessing apheresis services
Services are accessed via several routes and some trusts provide their own service within one or more particular specialty. Although many hospitals carry out some form of apheresis, it is often isolated within one clinical specialty – for example, haematology – and may be unknown and unavailable to those outside this area. Some larger trusts may offer a service locally, for example, as part of a cancer network for stem cell and bone marrow transplantation or on a less-formal referral basis for other apheresis treatments.

NHSBT’s Therapeutic Apheresis Services (TAS) provide regional 24/7 apheresis in many parts of England, supplying a range of apheresis procedures to large and small trusts; the largest individual provider of TTP is University College London Hospitals Foundation Trust. Details of how to find your nearest TAS are in Box 1. A range of apheresis services is also supplied to other parts of the UK by the national blood transfusion services of Northern Ireland, Scotland and Wales. Individual societies dedicated to the support of patients who have conditions treated by apheresis, such as sickle cell disease, may also be able to provide information about how and where to access services.

Further resources
- Locating therapeutic apheresis services
- Hospitals can find their nearest TAS service online via the NHS Blood and Transplant website: Bit.ly/NHSBTTAS
- In the North West of England and North Wales, an apheresis “roadmap” has been developed to help hospitals in the area locate and access various apheresis services: Bit.ly/NWTASRoadmap
- Advanced-therapy medicinal products
- For more information on ATMPs, visit: Bit.ly/EMAATMP

For more on this topic go online...
- Processing, testing and selecting blood components
- Bit.ly/NTBloodComponents