Apheresis in Children: Assisting with

What is Involved in Assisting with Apheresis in Children?

› Apheresis is a general term describing multiple different procedures in which blood is removed from the body, separated into various components and manipulated in some way, and then returned to the patient. It is generally performed to remove harmful substances from the blood or from a component of the blood. A wide variety of diseases seen by different medical specialists can be treated with apheresis, including acute conditions in which apheresis acutely lowers the amount of circulating pathogenic substances, and chronic diseases, in which apheresis counteracts the ongoing production of pathogenic autoantibodies

• What: Assisting with apheresis in children involves directly supporting an apheresis specialist in providing safe and effective apheresis therapy to a pediatric patient. The registered nurse must assess patient vital signs and overall patient stability, provide significant emotional support, collect laboratory tests, and be knowledgeable about how to recognize and respond to patient safety concerns and possible emergencies

• How: Assisting with apheresis in children requires the nurse to utilize aseptic technique while handling apheresis instrumentation/equipment, use standard precautions unless patient case necessitates a higher level of asepsis, use developmentally appropriate communication, involve parents and family members productively in patient care, and collaborate with a multidisciplinary healthcare team

• Where: Apheresis in children is commonly performed in inpatient pediatric settings. Facility protocols vary; some require that patients undergoing apheresis be admitted to the pediatric intensive care unit (PICU). At other institutions, apheresis procedures can be performed at the bedside in a pediatric medical/surgical unit. Stable, chronic outpatients can undergo apheresis at a blood bank equipped with transfusion and apheresis services

• Who: Registered nurses, primary and specialty care physicians, and apheresis specialists (e.g., a nurse, physician, or licensed transfusion medicine staff member specifically trained in apheresis/transfusion medicine) provide care for the pediatric patient undergoing apheresis. The apheresis specialist sets up the apheresis instrumentation, initiates, maintains, and discontinues apheresis therapy, while the registered nurse provides support for the patient and assistance to the apheresis specialist. In nearly all situations, the parent(s) and family members are able and encouraged to be present while a child is undergoing therapeutic apheresis

What is the Desired Outcome of Assisting with Apheresis in Children?

› Desired outcomes of assisting with apheresis in children are as follows:

• Patient vital signs (including pain level and anxiety) remain stable and well controlled through the apheresis procedure

• Patient achieves desired improvement in the underlying medical condition requiring therapeutic apheresis

• Complications will be minimized by thorough verification/safety checks and vigilant nursing care
Why is Assisting with Apheresis in Children Important?
› Assisting with apheresis in children is important because
  • children can be especially sensitive to the experience/stimuli of undergoing apheresis and require age-appropriate explanations and comfort measures
  • children are at higher risk for complications from apheresis procedures, due to smaller blood volume, limited vascular access, slower hepatic metabolism, and body surface area factors
  • apheresis has a limited history/record of therapeutic use in pediatric populations. Procedures are often performed using evidence or experience extrapolated from adult clinical practice. Unexpected side effects, complications, or negative outcomes related to hemodynamics, electrolyte imbalance, and coagulation parameters can be minimized by proper prompt intervention of the registered nurse and apheresis specialist

Facts and Figures
› Investigators reported that all of 35 children and adolescents who underwent therapeutic plasma apheresis as treatment for autoimmune neuropsychiatric disorders secondary to streptococcal infection experienced at least some benefit from treatment. Participating parents reported average improvement of 65% at 6 months and 78% at longer-term follow-up, in symptoms including anxiety, tics, obsessive-compulsive disorder, and somatic complaints (e.g., sleep difficulty, urinary frequency); (Latimer et al., 2015)
› The reported rate of adverse effects in children undergoing therapeutic apheresis ranges from 4% to 55% (Hans et al., 2016)

What You Need to Know Before Assisting with Apheresis in Children
› The nurse clinician should have knowledge of the basic principles of apheresis
  • In apheresis therapy, blood is drawn from the patient through a large-bore peripheral I.V. or central venous access device (CVAD) and collected in the apheresis machine in a spinning centrifuge bowl
  • Blood components separate; more dense elements (e.g., RBCs) settle to the bottom, with less dense elements such as WBCs and platelets overlying the RBC layer, and plasma on the top
  • The type of apheresis performed depends on which blood component layer is removed; however, it is possible to collect any of the separated blood components. Once removed, the blood component can be filtered and returned to the patient or replaced with an appropriate blood product or colloid solution (e.g., albumin)
› The nurse clinician should be familiar with the basic types of apheresis and examples of conditions treated by that procedure
  • Therapeutic plasma exchange (TPE): The most frequently performed therapeutic apheresis across all populations and the type with the best evidence-based support for use in pediatric patients
    – Plasma is separated out, removed, and replaced with replacement solutions
    – Because many abnormal substances can reside in plasma—including paraproteins, autoantibodies, lipids, toxins or drugs bound to albumin, circulating immune complexes, and soluble mediators of inflammatory response—many different conditions can be treated by removal of plasma
    – Pediatric uses supported by the American Society for Apheresis include thrombotic thrombocytopenic purpura (TTP), atypical hemolytic uremic syndrome (HUS), Goodpasture syndrome, rapidly progressing glomerulonephritis with antibodies, systemic lupus erythematosus, recurrent focal segmental glomerulosclerosis, pediatric autoimmune neuropsychiatric disorders associated with streptococcal infections (PANDAS), solid organ allograft rejection, and thrombocytopenia-associated multiorgan failure (Schwartz et al., 2016)
  • Other types of therapeutic apheresis used less commonly in pediatrics include the following:
    – Leukocytopheresis – filtration and removal of WBCs (e.g., leukemic blasts or granulocytes), with or without replacement fluids. Used in hyperleukocytosis and inclusion body myositis
    – RBC exchange – filtration and removal of RBCs, with replacement donor RBCs/colloid solution. Used in severe malaria, babesiosis, and patients with sickle cell disease for acute stroke, acute chest syndrome, or multiorgan failure
    – LDL apheresis – filtration and removal of LDL cholesterol only. Used in familial hypercholesterolemia
    – Immunoabsorption – plasma is separated from blood and filtered to bind and remove specific immunoglobulins. Used in chronic focal encephalitis, cryoglobulinemia secondary to hepatitis C, and paraproteinemic polineuropathies
    – Extracorporeal photopheresis – buffy coat (e.g., layer containing most of the WBCs and platelets) is separated from blood, treated with photoactive compound, exposed to ultraviolet light, and returned to patient. Used in scleroderma, lung allograft rejection, and graft-versus-host disease
  • Pediatric indications for therapeutic apheresis are constantly and rapidly evolving
The nurse clinician should have a basic knowledge of unique safety concerns and technical modifications necessary for the pediatric patient undergoing apheresis

• Transfusion
  – Many apheresis machines have long tubing systems that can hold significant extracorporeal volumes (ECVs; e.g., blood supply removed from patient’s systemic circulation at any given time). When ECV is greater than 15% of total blood, there is a risk of symptomatic hypotension and impaired oxygen delivery
  – To prevent these effects, if ECV is > 15% of total blood, donor RBCs can be used to prime the tubing and prevent hypotension/impaired oxygenation. If donor RBCs are used, the registered nurse and apheresis specialist must additionally monitor for standard blood transfusion complications
  – Accurate patient weight is important for calculating need for priming substitute

• Vascular access
  – While peripheral vascular access in adults can be obtained using a 16-gauge steel needle, peripheral veins in children weighing < 30 kg can rarely accommodate minimal needle gauge and flow rates required for apheresis
  - Vascular access in children normally requires dual lumen CVADs, specialized tunneled ports, or the use of a peripheral vein for removal and a port/single lumen catheter for return
  - Advance communication with the service that will place the patient’s catheter is essential to avoid access problems

• Anticoagulation
  – Apheresis most often utilizes citrate for regional anticoagulation. Because citrate is primarily metabolized in the liver and hepatic metabolism is lower in children, pediatric patients are at increased risk of citrate toxicity, which manifests as hypocalcemia, hypokalemia, hypomagnesemia, and metabolic alkalosis. Monitoring for citrate toxicity in incapacitated or nonconversant children can be additionally problematic
  - The physician might order a continuous calcium chloride or calcium gluconate infusion to mitigate citrate toxicity
  - Systemic ionized calcium levels can be monitored during the treatment
  – Heparin anticoagulation has been used, but involves an increased risk for bleeding and complex coagulopathies. If heparin is used for anticoagulation, it is critical that the patient’s starting platelet count be > 50,000/μL

• Hypothermia
  – Both children and adults experience some degree of hypothermia during apheresis because of cooling of the blood in the extracorporeal circuit
  – This is more pronounced in younger children, as the flow rate per kg and ECV/body-surface-area ratio is higher than in adults
  – A blood warmer is commonly used in the return line for pediatric patients

• Psychological concerns
  – Anxiety is a significant concern for children who do not fully understand why they are undergoing apheresis. Children should be engaged according to their developmental stage in order to decrease anxiety (Wong et al., 2012):
    - Infants (newborn–12 months): Address parental anxiety by explaining the need, benefits, and risks of the procedure. Ask parents to provide familiar comfort item from home. Use restraints only as a last resort to avoid self-induced injury or trauma to access site
    - Toddler (1–3 years): Address parental and child anxiety. Use a doll for teaching to depersonalize the illness. Reassure the child if necessary that the procedure is not a punishment. Describe the procedure just before beginning, with a focus on the desired outcome of procedure
    - Preschool (3–6 years): Address parental and child anxiety. Use concrete terms with the child. Describe objects/instruments in terms of function, use body image outline and dolls if appropriate. Teach the child signs of possible reaction and when to call nurse/apheresis specialist (e.g., “I feel funny”, “I feel cold”)
    - School age (7–10 years): Use body outlines, technical names for body parts and equipment, inform the child of benefits and hazards of procedure, teach signs and symptoms of reaction, and emphasize the need to notify nurse/apheresis specialist for symptoms
    - Preadolescent (10–13 years): Same as school age children. Allow time for questions and clarify any misconceptions
    - Adolescent (> 13 years): Same as preadolescent. Use scientific terms, as appropriate. Include the adolescent in all discussions, including the need for the procedure. As appropriate, discuss perceived threats to body image

The nurse clinician should have the ability to recognize and promptly respond to complications of apheresis in children

• In addition to the pediatric-specific complications noted previously, children are also at risk for the same general complications of apheresis seen in adults, including hemodynamic instability, hypovolemia, hypocalcemia, vasovagal responses, hypothermia, citrate toxicity, allergic reactions, catheter-related thrombosis, catheter-related infection, and anxiety
Severe complications requiring immediate intervention, medication, and interruption of the apheresis treatment are most often due to hypotension and cardiac arrhythmia, and are most often reported in patients undergoing apheresis for TTP, HUS, leukostasis syndrome, and septic shock.

The nurse clinician should have the following additional knowledge, competencies, and abilities prior to assisting with apheresis in children:

- Competence in adhering to standard healthcare precautions, knowledge of aseptic technique, and use of personal protective equipment (PPE). For details, see Nursing Practice & Skill ... Standard Precautions: Following and Nursing Practice & Skill ... Aseptic Technique and Infection Prevention: Applying Principles at the Bedside.
- Knowledge of and certification in advanced cardiac life support (ACLS)/pediatric advanced life support (PALS) protocols.
- Competence in cardiopulmonary, neurologic, skin, and pain assessment skills. For details, see Nursing Practice & Skill ... Physical Assessment: Head-to-Toe --Performing and Nursing Practice & Skill ... Physical Assessment in Children: Performing.
- Knowledge of state nursing practice act and facility guidelines pertaining to skills which the RN can perform independently and skills with which the RN can assist.

Preliminary steps that should be performed before assisting with apheresis in children include the following:

- Review the facility/unit-specific protocol for assisting with apheresis in children, if one is available.
- Review the treating clinician’s orders for patient-specific nursing tasks to be completed before or after apheresis procedure.
- Review the manufacturer’s instructions for all equipment to be used and verify that the equipment is in good working order.
- Verify completion of facility informed consent documents.
  - If care is performed under emergency conditions and it is not possible to obtain written consent, the universally accepted standards of care offer implied consent.
- Review the patient’s medical history/medical record for:
  - Medical and surgical history.
  - History of present illness.
  - Indication for apheresis procedure.
  - Information on patient hemodynamic and fluid balance status.
  - Any allergies (e.g., to latex, medications, or other substances); use alternative materials, as appropriate.
- Gather supplies needed to assist with apheresis in children, which can include the following:
  - Appropriate PPE (e.g., nonsterile gloves, gown, face mask, eye protection).
  - Facility-approved, developmentally appropriate pain assessment tool.
  - Appropriately sized vital sign monitoring equipment.
  - Supplies for large-bore I.V. cannulation and laboratory test collection.
  - Medications, fluid solutions, and blood products, as ordered.
  - Padded or toothless clamp.
  - Paper or electronic copy of the patient's medical record.
  - Comfort items for distracting child and providing psychological/emotional support.

How to Assist with Performing Apheresis in Children:

- Perform hand hygiene and don any necessary PPE.
- Identify the patient according to facility protocol.
- Establish privacy by closing the door to the patient’s room and/or drawing the curtain surrounding the patient’s bed.
- Introduce yourself to the patient and family member(s), if present; explain your clinical role in providing care using age-appropriate language; assess the coping ability of the patient and family and for knowledge deficits and anxiety regarding apheresis and related procedures.
- Determine if the patient/family requires special considerations regarding communication (e.g., due to illiteracy, language barriers, or deafness); make arrangements to meet these needs if they are present.
  - Follow facility protocols for using professional certified medical interpreters, either in person or via phone, when language barriers exist.
- Assist apheresis specialist in explaining procedures involved in apheresis; answer any questions and provide emotional support as needed.
- Position the patient for comfort and accessibility; raise the bed to a height that is optimal for patient access.
- Verify that apheresis specialist has enough space in the patient’s room for the apheresis equipment and instrumentation.
Assess the patient’s hemodynamic/cardiac/pulmonary stability, vital signs, and pain level using a facility-approved, developmentally appropriate pain assessment tool

Verify presence of patent vascular access sites. Obtain any required laboratory samples. Administer any prescribed preprocedural medications, as ordered

Verify that apheresis specialist has any necessary laboratory results (e.g., Hct) prior to start of apheresis

Educate patient and family using age-appropriate communication about when to alert nurse or apheresis specialist about side effects (e.g., perioral tingling, dizziness, coldness)

Assist apheresis specialist as needed during apheresis procedure
  • Monitor vital signs during apheresis procedure according to standard facility/unit protocol; if donor blood products are used, follow standard transfusion vital sign monitoring protocols
  • Monitor for adverse effects of therapeutic apheresis or blood transfusions
  • Assist in obtaining necessary fluids, blood products, and medications for the apheresis specialist, as necessary
  • Notify the apheresis specialist if complications (e.g., access site leak, return site hematoma) are observed that might not trigger instrumentation alarms

Obtain postprocedural vital signs and assess patient for general stability

Collect postprocedural laboratory specimens as ordered; consult with apheresis specialist and treating clinician regarding abnormal values

Verify hemostasis at venipuncture site or antisepsis and patency at catheter access site

If patient is to maintain a CVAD due to multiple scheduled apheresis sessions, provide routine care for the catheter and observe for any complications, such as occlusion, air embolism, thrombosis, and infection
  • Keep all lumens clamped when not in use
  • Maintain clean, dry, and adherent catheter site dressings
  • Keep a padded or toothless clamp in the patient room, so that in the event of catheter damage the clamp can be used to prevent hemorrhage or air embolism

Dispose of used materials in proper receptacles and perform hand hygiene

Update the patient’s plan of care, as appropriate, and document apheresis-related care in the patient’s medical record, including the following information:
  • Date and time of patient care
  • Description of the care provided, including
    – assessments performed
    – medications or blood products administered
    – dressing changes or CVAD care
    – any additional care provided
  • Patient assessment findings, such as
    – vital signs
    – pain level, patient comfort
    – status of venous access sites
    – general hemodynamic stability
  • Coordination of care among multidisciplinary team members
  • Any laboratory specimens collected before, during, or after the procedure and sent for analysis
  • Any unexpected patient events or outcomes, interventions performed, and whether or not the treating clinician was notified
  • Patient/family education, including topics presented, response to education provided/discussed, plan for follow-up education, and details regarding any barriers to communication and/or techniques that promoted successful communication

Other Tests, Treatments, or Procedures That May be Necessary Before or After Assisting with Apheresis in Children

Patients with inadequate venous access can require sedation and placement of a CVAD prior to apheresis therapy, particularly if the course of therapy requires multiple treatments over time

Patients with more acute and multiple concomitant medical conditions are likely to require many lab tests both before and after apheresis treatments

Laboratory tests that can be ordered by the treating clinician prior to apheresis include CBC, Hgb, Hct, electrolytes, PT, PTT, additional coagulation/clotting studies, ionized Ca++, and a type/cross specimen for blood bank
• Laboratory tests that can be ordered by the treating clinician after apheresis include CBC, ionized Ca++, and magnesium and phosphate values obtained 2 hours post-treatment

**What to Expect After Assisting with Apheresis in Children**

› Patient vital signs, including pain level, and anxiety will have remained stable and well controlled through the apheresis procedure
› Patient will achieve desired improvement in medical condition
› Complications will have been minimized by thorough verification/safety checks and vigilant nursing care

**Red Flags**

› Angiotensin-converting enzyme (ACE) inhibitors should be discontinued at least 24 hours prior to undergoing apheresis to avoid serious complications, including profound hypotension and anaphylaxis
› In patients undergoing plasma exchange, the removal of plasma-circulating factors and antibodies can result in false negative tests for infectious diseases, autoantibodies, alloantibodies, and enzyme and coagulation factor activity. Samples for such testing should be collected prior to therapeutic apheresis

**What Do I Need to Tell the Patient/Patient’s Family?**

› Maintain open lines of communication with patient’s family before, during, and after apheresis procedure, as involving parent(s) and family in the child’s care can relieve patient/family anxiety and emotional distress
› Educate parent(s) or family to alert RN or apheresis specialist immediately if significant changes in patient status (e.g., altered mentation, sudden unexpected disposition changes) are noted
› Educate outpatients to remain in sitting/reclined position until deemed stable by nurse or apheresis specialist. Once stable, the patient should change position slowly
› Provide patient with reminders for any remaining apheresis treatments, clarify purpose/need for multiple treatments if the patient/family is unclear of the treatment plan

**References**