# Hemodialysis: Initiating and Discontinuing Therapeutic Plasma Exchange

## Site Applicability

SPH In-center hemodialysis unit

## Practice Level

Specialized: Registered Nurses who have at least two years' experience in hemodialysis and/or one year experience on 6D, who have completed the required education and training and provide care in a Providence Health Care Renal Program Hemodialysis unit

## Need to Know

1. A powerplan order for isolated therapeutic plasma exchange (TPE) must be entered by nephrologist in Cerner
2. Prior to initiating therapeutic plasma exchange, RNs must ensure that patient's informed consent for the procedure/treatment (Form ID 2745) and consent for transfusion of blood products (Form ID 2750) has been obtained and signed. Both consents should be available inside patient's chartlet
3. 5% albumin and fresh frozen plasma (FFP) may be combined as treatment plan during TPE. When fibrinogen level of patient is low (less than 100 mg/dL) FFP can be ordered as another source of coagulation factor. It is usually given during the last part of the procedure to prevent further bleeding tendency.
4. Plasma exchange is performed using a blood cell separator (apheresis system). The system uses centrifugal force to separate plasma from other blood components (red cells, white cells, platelets)
5. In-centre HD uses the Spectra Optia ® Apheresis system in performing TPE. It has a unique automated interface management (AIM) system and a graphical user interface (GUI)
6. TPE requires one to one nursing care, therefore must be coordinated by the Clinical Nurse Leader (CNL) of the hemodialysis unit (6D) or delegate.
7. RNs should follow safe cytotoxic practices when performing this procedure if the patient is on Cytotoxic Precautions (see Occupational Health and Safety)
8. Systemic anticoagulation is required to prevent thrombus formation, platelet deposition and clotting in the blood circuit of the Optia® machine. To perform plasma exchange, ACD-A (Anticoagulant Citrate Dextrose Solution – USP fomula A) is the anticoagulant of choice.
9. During the procedure, hypocalcemia can further occur due to the effect of the ACD-A. The citrate in ACD-A binds calcium resulting to a decrease in patient's ionized calcium levels.
10. Common signs and symptoms of mild hypocalcemia are: tingling of lips; tongue and fingertips, shivering, light-headedness, twitching and tremors, and rarely muscle cramps (particularly from back and legs)

11. For severe hypocalcemia, symptoms can develop into frank tetany with spasms in other muscle groups including life threatening laryngospasm, generalized seizures and cardiac arrest.
12. Hypocalcemia event during TPE can be prevented and/or treated by infusing a 10% calcium gluconate 1 to 2 g/hour IV as ordered (see Powerplan or PPO PH190, PH643, PH644). Calcium Gluconate should be given through the venous return line of the vascular access to optimize its efficacy.
13. Hematocrit (Hct) level entered in the patient data section is used by the Spectra Optia® system to calculate the limits for plasma volume and the initial plasma flow rate. If the entered Hct is higher or lower than the actual or current patient's Hct value, the system cannot correctly position the interface, thus causing alarms. (See Appendix A – Trouble shooting common machine alarms)

## Equipment and Supplies

1. HD CVC Scrub/Off tray
2. HD On/Off tray
3. Fistula Needles (2)
4. 18 guage needles
5. 50 mL Normal Saline
6. "Y" Adapter with Male L.L./with clamps
7. Spectra Optia® Apheresis System machine
8. Spectra Optia® exchange disposable set
9. Normal Saline 1 liter bag
10. 2% Chlorhexidine gluconate/70% Isopropyl Alcohol Swabs (10)
11. Anticoagulant connection Adapter
12. Anticoagulant Citrate Dextrose Solution (ACD) formula A bag (500 mL)
13. Replacement Fluids (albumin, Fresh Frozen Plasma, Solvent Detergent Plasma)
14. Calcium Gluconate 10% 1g/10 mL vials

## Procedures

| Steps | Rationale |
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| **Pre Treatment** | |
| 1. Check Powerplan order in Cerner | |
| 2. Check for consent to the procedure and blood/blood product transfusion | See: B-00-12-10065 – Blood/Blood Products: Administration. See: PHC Consent for Transfusion of Blood and /or Blood Products (Form ID 2750) |
| 3. Check bloodwork to collect from order menu and powerplan view; and from laboratory orders in Cerner | |
| 4. Check transfusion history rom ambulatory workflow | To know if group and screen is done and blood product availability |

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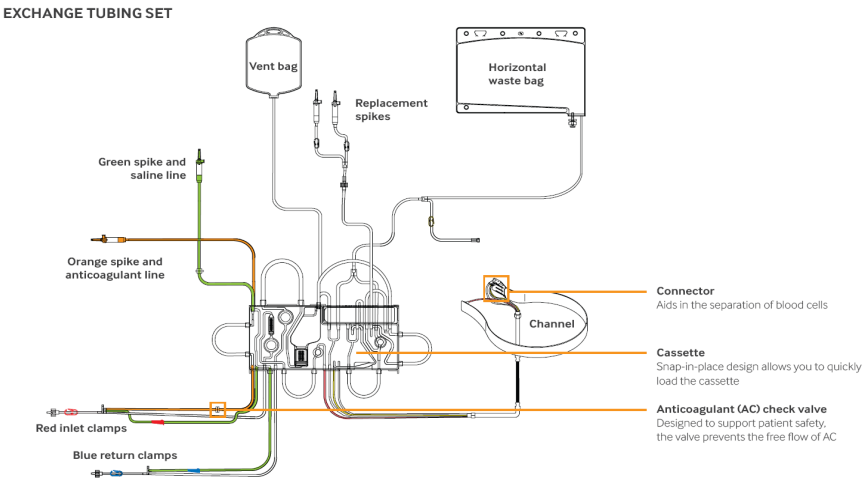
| 5. Request ordered blood products (replacement fluids) from Transfusion Medicine. Give the completed request form to the ward aide/porter | |
| 6. Set up Spectra Optia ® machine:<br>a. Select TPE procedure<br>b. Load the exchange set | |

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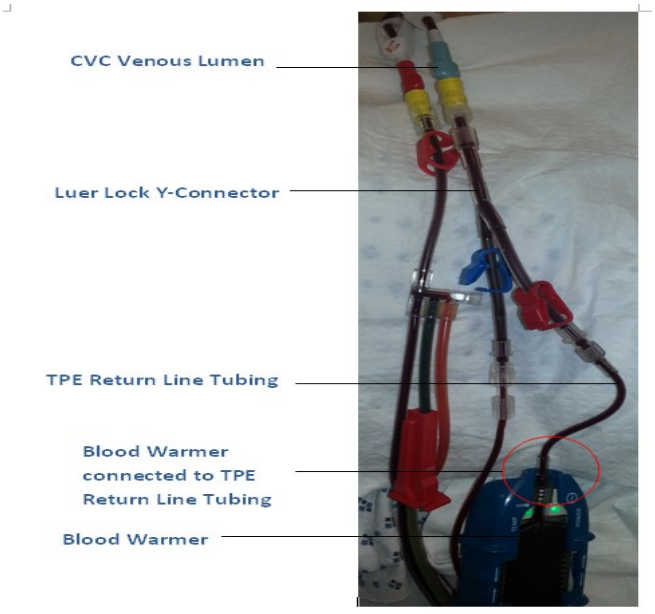
| c. Spike correct fluids and connect to correct lines<br>d. Make sure fluid flows into drip chamber<br>e. Load channel and tubing set in the centrifuge<br>f. Load the collar in the centrifuge collar holder and ensure the notch in the locking pin is visible<br>g. Test and prime tubing set when prompted<br>h. Perform visual inspection<br>i. Obtain patients vital signs, weight and height; record on iView apheresis management pre treatment<br>j. Enter and confirm accurate patient data when prompted<br>i. Type of procedure<br>ii. Patient sex<br>iii. Height (cm)<br>iv. Weight (Kg)<br>v. Latest hematocrit (Hct)<br>vi. Type of replacement fluid<br>vii. Fluid balance desired (%)<br>viii. Replacement Volume<br>ix. A/C ratio and AC rate as ordered<br>k. Prepare replacement fluid after performing a double check | Following each step carefully prevents incorrect or missed data entry<br><br>This prevents the possibility of air entering the tubing<br><br>  |

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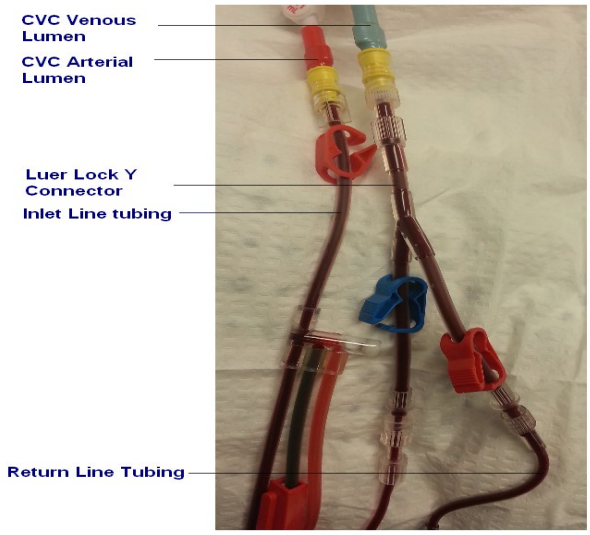
| l. Enter pre and post blood work in SCM if not done yet<br>m. Set up IV calcium infusion as ordered<br>n. Check most current results of hematocrit, RBC and ionized calcium | Hematocrit is one of the required parameters to determine the accurate total blood volume of the patient. The best value to enter is the day-of-procedure value.<br><br>See: B-00-12-10065 – Blood/Blood Products: Administration |
| **Starting the Treatment** | |
| 1. Connect both the **inlet** (arterial access) and return lines to the patients access (direct hook up)<br>a. If CVC, attach return line to one of the ports of the Y leur lock adaptor connected to the venous limb of CVC and attach inlet line to the arterial limb of the CVC<br>b. For AVF/AVG follow the same procedures as connecting to CVC<br>  <br><br>2. Unclamp both the TPE inlet and the return lines<br>3. Touch Start Run<br>4. **If using Albumin,** start inlet flow rate is 50 mL/min and record immediately on the intra apheresis management iView in Cerner the required parameters<br>**5. If using fresh frozen plasma (FFP),** start inlet flow rate as **auto calculated** by machine. May increase gradually the inlet flow rate up to maximum | * See B-00-12-10152 - HD: Accessing a CVC with and without Tego connectors and B-00-12- 10101 Attaching or Changing TEGO Connectors if using Central Access to initiate TPE procedure *<br><br>* See Cannulation of an Arteriovenous Fistula or Graft if using AVF or Graft to initiate TPE procedure.<br><br>The system primes the replace line with replacement fluid, and begins drawing the patient's blood into the tubing set.<br><br>Main screen appears and is the default run screen that displays access to the information. |

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| ordered plasma removal rate and if not restricted by the machine system | |
| **Monitoring the Treatment** | |
| 1. Touch the Run menu button then select the run or current screen to view:<br>a. Clock time or hourglass icon<br>b. Packing factor<br>c. Current/target flow rate (mL/min) and volume (mL)<br>d. AC infusion rate<br>e. Inlet :AC ratio<br>f. AC to patient<br>g. Exchange status<br>h. Fluid Balance<br>i. Type of replacement fluid<br>j. Bolus volume<br>k. AIM graphics (ideal interface, buffy coat accumulation, plasma, black, aim message) | The clock time is the run time graph that indicates starting time, current time, and the ending time; while hourglass icon indicates the elapsed run time, the remaining run time, and the total run time.<br><br>Packing factor shows the relationship between the inlet pump flow rate and the centrifuge speed indicating how tightly the cells are packed in the channel. **Optimal packing factor is 20**<br><br>Exchange status provides information about the volumes of plasma that have been currently removed and replaced<br>Automated Interface Management (AIM) system displays various graphics to communicate its interpretation of the interface position. This **does not require** operator intervention |
| 2. Assess progress of patients condition, response to treatment, and any signs and symptoms of hypocalcemia, hypotension, hemorrhage, vasovagal syncope or transfusion reactions | |
| 3. Inform most responsible nephrologist and other health care team members as appropriate if any complications or adverse reactions occur | |
| 4. Check the centrifuge through the view port and interface graphics on the main run screen to visualize the separation of the plasma, Buffy coat and RBCs | |
| **Ending Treatment** | |
| 1. Procedure is complete when removal equals ordered amount.<br>a. Press RINSEBACK.<br>b. Open Arterial side of NaCl (green), clamp<br>c. Press CONTINUE. Rinseback begins. Takes about 6 minutes<br>d. Disconnect the bloodlines using sterile technique | The time of the treatment can be extended or the target value can be increased to use up any plasma that is left so that none is wasted. |

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| e. If using CVC access. Lock catheter using either Heparin or Na Citrate 4% depending on doctor's order<br>f. If using AV Fistula or graft, disconnect the bloodlines and remove the fistula needles as per unit protocol<br>g. Continue to Final Values.<br>h. Calculate ACDA to patient.<br>i. Take post treatment blood work if required<br>j. Weigh patient, take vital signs and record in log<br>k. Disconnect remove line and remove bag by using<br>l. the seal safe system | * See B-00-12-10144. Flushing and Capping CVC<br><br>*See B-00-12-10029. Post dialysis hemostasis for AVF and arteriovenous graft (AVG).<br><br>To obtain the total ACDA to the patient, subtract the ACDA plasma value from the final ACDA value infused. This number equals the total ACDA to the patient.<br><br>Seal safe system is a device use in the Spectra Optia system by sealing the tubing before being removed from the tubing set thereby decreasing risk of exposure to patient's blood. |
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| 2. Remove used tubings from the centrifuge and the disposable exchange set from the front panel. Leave on top of the machine for technician to dispose and to clean the machine | |
| 3. Ensure that the patient can be safely discharged post treatment | |
| 4. Prior to transferring inpatient, give handover report using hand off tool in Cerner to the receiving unit/RN including telephone verbal report. Print transfer ticket and attach to patient chartlet | |

## Documentation

1. Interactive View (iView) Apheresis Management in Cerner
   - Preprocedure - type, weight, height/length measured, vital signs, cycle number, total blood volume and machine set up preparation verified with independent double check (IDC)
   - Intraprocedure (Run Status) – type, anticoagulant type/volume, plasma removal rate/volume, replace rate/volume, A/C flow rate/volume, Inlet flow rate/volume, inlet access/return pressure, run time, packing factor, vein check, vital signs (BP)
   - Transfusion Data – Albumin 5%/Plasma unit number/volume transfused
   - Postprocedure - type, run status, complications, run values (run time, inlet final volume, plasma removed final volume, ACD-A bag/to patient, rinse back, replace final volume, total out including ACDA in bag, calcium gluconate, total apheresis volume in/out), vital signs
2. Medication Administration Record (MAR)

- IV Calcium gluconate titratable infusion in the continuous infusion section. Post Plex, change rate to **"Zero" (0g/hr)** in the administration information section of the MAR

3. Canadian Apheresis Group (CAG) Database
   - Post TPE information for core data collection and tracking
4. Nursing Narrative Notes

## Patient and Family Education

1. Patient receiving TPE should be aware of signs and symptoms of mild hypocalcemia. These can include tingling of lips, tongue and fingertips, muscle cramps particularly back and legs, restlessness, BP may drop, shivering, light-headedness, twitching, and tremors.
2. Patient receiving TPE should also be aware of the treatment for hypocalcaemia. For mild Symptoms, patient receives titrated IV Calcium infusion.
3. Patient receiving TPE should also be aware of possible blood product reactions which may include rash, itchiness, back pain or fever.
4. Before discharge, patient should be aware and instructed of any changes in medications, condition and care of access site, and/or TPE treatment schedule

## Related Documents

1. Occupational Health and Safety – Cytotoxic Handling
2. Parenteral Drug Therapy Manual – Calcium Gluconate Monograph
3. B-00-13-10130 – Hemodialysis: Anaphylaxis Treatment
4. B-00-12-10152 - HD: Accessing a CVC with and without Tego connectors
5. B-00-12-10101 - Hemodialysis: Attaching or Changing Tego Connectors on Central Venous Catheters (CVC)
6. B-00-12-10065 – Blood/Blood Products: Administration
7. B-00-13-10068 – Blood/Blood Products: Transfusion Reaction Identification and Management
8. B-00-12-10144 - Hemodialysis: Flushing and Capping Off Central Venous Catheter (CVC)
9. B-00-12-10095 – Hemodialysis: Initiating & Discontinuing Therapeutic Plasma Exchange (TPE) Hemodialysis Combo
10. CST Cerner Help at http://cstcernerhelp.healthcarebc.ca/#t=Whats_New%2FWhat_s_New.htm
11. Form ID 2745 (PHC-MR002) – Consent to Treatment
12. Form ID 2750 (PHC-MR030) – PHC Consent for Transfusion of Blood and/or Blood products

## References

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6. Winters, J. & et al. Editors. (2008). Therapeutic Apheresis: A Physician's handbook, 2nd edition. Bethesda, Maryland: AABB
7. Terumo BCT, Inc. (2012). Spectra Optia® Apheresis System Therapeutic Plasma Exchange (TPE) Procedure Guide
8. Terumo BCT, Inc (2010). Spectra Optia® Apheresis System Essentials Guide.
9. Terumo BCT, Inc (2015). Spectra Optia® Operators Manual.
10. Madore, F. (2002). Plasmapheresis. Technical aspects and indications. *Critical Care Clinics*. 18: 375-392.
11. McLeod, B.C. (2000). Introduction to the Third Special issue: Clinical Applications of Therapeutic Apheresis, *Journal of Clinical Apheresis* 15:1-5. Wiley –Liss Inc

## Appendices

a. Appendix A – Troubleshooting Common Machine Alarms
b. Appendix B - Patient Adverse Events and Interventions during PLEX

Persons/Groups Consulted: Renal Practice Committee

Developed By: Nurse Educator Hemodialysis

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|---|---|
| **First Released Date:** | MAY-2006 |
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| **Last Revised:** | 15-JUL-2021 |
| **Last Reviewed:** | |
| **Approved By:** *(committee or position)* | PHC |
| | |
| **Owners:** *(optional)* | PHC |
| | Renal Program |

## Appendix A: Troubleshooting Common Machine Alarms

a. Read the alarm name that appears on the red bar of the active alarm screen

b. Review and consider all possible causes for the alarm

c. Touch the button for the possible cause to display the troubleshooting information and action steps; if action does not resolve condition review a different possible cause

| Alarm | Suggested actions |
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| **Inlet pressure too low**<br><br>This is a common alarm that is often solved by continuing the procedure at a slower inlet flow rate | • Consider repositioning the needle if using AVF/AVG. Check for kinks or an obstruction in the tubing.<br>• Consider reducing inlet pump flow rate |
| **Return pressure too high**<br><br>System pauses and remains paused until corrected. Usually the return pump flow rate is faster than the inlet pump flow rate Alarm | • Consider repositioning the needle if using AVF/AVG. Check for kinks or obstruction in the tubing,<br>• Consider reducing the inlet pump flow rate |
| **Low level reservoir sensor detected excess fluid** | • Modify AC-Inlet ratio from 15:1 to 10:1 |
| **Low level reservoir sensor detected air**<br><br>This can happen if the system detects foam or excess fluid at the low-level sensor that possible cause is reservoir filter is obstructed due to inadequate anticoagulation. It is important to correct this alarm or the procedure cannot be completed | |
| **Air detected in return line**<br><br>AIM system detected RBC interface near top of channel. If not corrected there will be an increase in platelet loss | • Touch Remove Air in the screen and follow the air removal process as prompted by the machine |
| **High Interface AIM system alarm** | • Look through the view port to verify the position of the interface and verify entered hematocrit.<br>• If entered hematocrit is incorrect lower the interface by increasing the hematocrit by 3% up to 3 times.<br>• If the hematocrit value is correct, touch retry to resume procedure |

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| **Clumping**<br><br>Inadequate anticoagulation can lead to clot formation and likelihood for platelet clumping to occur, Clumping can affect plasma removal efficiency by interfering with separation in the connector, keeping the ratio at 10: 1 minimizes the impact on the procedure | • Decrease the inlet ratio to 8: 1 until clump disappears.<br>• Consider increasing the inlet: AC ratio to 10: 1 if resolved |
| **Replacement fluid not detected**<br><br>Usually happens when replacement fluid runs out and tubing set fills with air during the procedure This alarm can also be due to the replacement line tubing being pulled out of the detector when changing the replacement fluid container | • Manually prime the replace line and blood warmer set again; replace the replacement line tubing behind the IV pole when connecting the replacement fluid containers, Reconnect the replacement line tubing to the replace fluid detector |
| **AIM System cannot establish target interface** | |
| **Turbulence**<br><br>Turbulence may be due to high inlet pump flow rate; low packing factor; platelet swirling; hyperviscosity or mild lipemia.<br><br>An inlet pump flow rate at 62 mL/min will give a packing factor of 20 which may provide for optimal separation of cells and possibly decrease turbulence in the connector | • Look though the view port to verify if it is present in the connector.<br>• Decrease the inlet pump flow rate to increase the packing factor<br>• Do nothing<br>• Enter semi-Automatic mode |
| **Hemolysis**<br><br>May be due to certain patient conditions that may cause alarms involving the RBC detector of the machine | • Verify if presence of hemolysis in the blood is due to certain patient condition prior to disabling the RBC detector<br>• Monitor the remove line when RBC detector is disabled<br>• Consult physician to determine if procedure should be continued<br>• Re-enable the RBC detector if hemolysis has cleared |

## Appendix B: Patient Adverse Events and Interventions during Plex

| Adverse Events | Interventions |
|---|---|
| **Cramps and Hypotension**<br><br>This may happen in relation to the patient's target fluid balance during the procedure (e.g. hypovolemia). | • See Hemodialysis: Intradialytic Hypotension<br><br>• See Spectra Optia® Operator's manual in giving fluid bolus if ordered. |
| **Blood product reactions**<br><br>A possible response to transfused blood products | • See B-00-13-10068 - Blood/Blood Products: Transfusion Reaction Identification and Management<br>• See B-00-13-10130 – Hemodialysis: Anaphylaxis Treatment |
| **Hypocalcemia**<br><br>Possible side effect of citrate toxicity resulting to a low level of ionized calcium. This may also happen if AC infusion rate is more than the recommended maximum limit of 1.2 mL/min/L TBV | • Decrease the AC infusion rate to a desired rate (0.8 mL/min/L TBV). Fluctuating average rate may occur and is acceptable (e.g. 0.4 mL/min/l TBV – 0.5 mL/min/L TBV)<br>• Give electrolyte supplement (e.g. Calcium gluconate 1 to 2 g/hour as ordered)<br>• Decrease the inlet pump flow rate to maintain optimal AC infusion rate at 0.8 mL/min/L TBV (refer to powerplan order in Cerner) |