

# Hemodialysis Guideline

## Nursing Management of Complications during Hemodialysis

FINAL Feb 20, 2021



## Contents

1.0	Scope of Guideline .....	2
2.0	Recommendations .....	2
2.1	Air in Bloodline.....	3
2.2	Air Embolus .....	3
2.3	Anaphylaxis .....	4
2.4	Blood in Dialysate .....	6
2.5	Cardiac Arrest (Intradialytic) with Resuscitation .....	7
2.6	Chest Pain (Intradialytic).....	8
2.7	Clotted Extracorporeal Circuit. ....	9
2.8	Dialyzer Reaction / Membrane Incompatibility.....	10
2.9	Disequilibrium Syndrome .....	12
2.10	Hemolysis.....	13
2.11	Intradialytic Hypotension.....	14
2.12	Muscle Cramps.....	17
2.13	Nausea / Vomiting .....	19
2.14	Pyrogenic Reaction .....	20
2.15	Seizure.....	21
2.16	Vascular Access Complications .....	22
2.16.1	VA Disconnection/Needle Dislodgement (Arterial or Venous).....	22
2.16.2	Acute VA Rupture/Hemorrhage (AVFs/AVGs) .....	23
2.16.3	Infiltrated Needle while on Dialysis .....	25
3.0	Sponsors.....	27
4.0	References .....	27

## 1.0 Scope of Guideline

This guideline makes recommendations on the nursing management of complications during hemodialysis. An attempt is made to list the steps in sequential order; however, in reality, many of these steps are performed simultaneously depending on the clinical situation.

Applicability: In centre and community hemodialysis (HD) units

## 2.0 Recommendations

**Recommendation #1: Implement the recommendations on the next set of tables for the nursing management of complications during hemodialysis.**

## 2.1 Air in Bloodline

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
Air in bloodline <sup>2,3,4</sup>	<ul style="list-style-type: none"> <li>• Connections and caps loose within the extracorporeal circuit</li> <li>• Improper priming of dialyzer and bloodlines</li> <li>• Incorrect system settings</li> <li>• Clamp to the medication line left open upon accessing</li> <li>• Cracked catheter</li> <li>• Empty air vented IV bottle (e.g., albumin)</li> <li>• Defective manufactured product (e.g., small hole or puncture in the bloodline; flaw in dialysis needle/angiocath)</li> <li>• Low levels of blood in arterial or venous drip chambers</li> </ul>	<ul style="list-style-type: none"> <li>• Visible air in lines</li> <li>• Air detector alarm</li> </ul> <p>If not remedied, potential to cause <a href="#">air embolism</a> and <a href="#">circuit clotting</a>.</p>	<ul style="list-style-type: none"> <li>• Turn blood pump off</li> <li>• Immediately clamp patient’s access and machine bloodlines</li> <li>• Investigate cause and magnitude of air in circuit</li> <li>• Secure any loose connections and clamp vented IVs</li> <li>• If air is noted after venous sensor, attach empty sterile syringe to patient’s access and aspirate any air, if possible. Clamp</li> <li>• Keep access patent while troubleshooting as per HA protocol</li> <li>• If unable to clear or remove air from bloodline, do not return blood and use a new set up</li> <li>• Follow machine-specific guidelines as to how to remove the air from the circuit</li> </ul>

## 2.2 Air Embolus

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p><b>Air embolus</b> <sup>1-4</sup></p> <p><b>Definition:</b> An air embolism, also known as a gas embolism, is a blood vessel blockage caused by one or more bubbles of air or other</p>	<ul style="list-style-type: none"> <li>• Loose connection or leak in the extracorporeal circuit</li> <li>• Open clamp during catheter care</li> <li>• Accidental disconnection of vascular access</li> <li>• Air entrapment during CVC insertion or removal</li> <li>• Air infused during improper reinfusion</li> </ul>	<ul style="list-style-type: none"> <li>• Patient complains of hearing the sound of a train or rushing air</li> <li>• Visible air/foam in venous blood</li> <li>• Chest pain, dyspnea, coughing, cyanosis</li> <li>• Visual disturbances</li> <li>• Churning sound on auscultation of heart</li> </ul>	<p>Immediate management of patient:</p> <ol style="list-style-type: none"> <li>1. Turn off blood pump and DO NOT RETURN BLOOD</li> <li>2. Immediately clamp all lumens of patient’s access &amp; ALL bloodlines</li> <li>3. Place patient in a head down, feet up position on their LEFT side.</li> <li>4. Disconnect bloodlines &amp; aspirate any remaining air with a 10cc syringe from both lumens beginning with the VENOUS lumen</li> </ol>

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
gas in the circulatory system <sup>i</sup>	<ul style="list-style-type: none"> <li>Defective or faulty air detector on HD machine</li> <li>Faulty blood line</li> </ul>	<ul style="list-style-type: none"> <li>Neurologic deficits: confusion, coma, hemiparesis</li> <li>Loss of consciousness</li> <li>Cardiac/respiratory arrest</li> </ul>	<ol style="list-style-type: none"> <li>Check SpO<sub>2</sub>. As needed, place patient on high flow oxygen mask (100% oxygen). Monitor SpO<sub>2</sub></li> <li>Obtain assistance. Initiate resuscitation procedures, including calling Code Blue or 911, if indicated.</li> <li>Call MD/NP</li> </ol> <p>Explore possible causes of air embolus: Refer to column 2 (Possible Cause(s)).</p>

## 2.3 Anaphylaxis

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p><b>Anaphylaxis – non-dialyzer related cause<sup>5</sup></b></p> <p><b>Definitions:</b> Anaphylaxis is a potentially life-threatening allergic reaction that is rapid in onset. Anaphylaxis occurs with exposure to a trigger in a susceptible individual. Onset of symptoms usually occurs in minutes but can occur hours after exposure to a trigger. Death from anaphylaxis occurs as a result of severe respiratory complications,</p>	<p>May be allergic or non-allergic:</p> <ul style="list-style-type: none"> <li>Allergic causes include medications, iron, latex, food, etc</li> <li>Non-allergic causes include idiopathic anaphylaxis &amp; anaphylactoid reactions (e.g., response to opiates, NSAIDs &amp; radiocontrast dyes/agents)</li> </ul>	<p><b>Skin:</b></p> <ul style="list-style-type: none"> <li>Angioedema and tingling to face and mouth</li> <li>Hives – may be delayed</li> </ul> <p><b>Anaphylaxis can occur without presence of hives</b></p> <ul style="list-style-type: none"> <li>Warm, itchy, red and blotchy</li> </ul> <p><b>Respiratory:</b></p> <ul style="list-style-type: none"> <li><b>Labored breathing</b> - Hoarse voice, throat tightness, rapid breathing, wheezing, coughing, nasal flaring, nasal and chest congestion</li> <li>Rhinitis (stuffy or runny nose, itchy watery eyes and sneezing)</li> <li>Dyspnea – difficulty filling lungs</li> </ul> <p><b>Cardiovascular:</b></p> <ul style="list-style-type: none"> <li>Weak and rapid pulse</li> </ul>	<ol style="list-style-type: none"> <li>Assess client for signs &amp; symptoms of anaphylaxis: <ul style="list-style-type: none"> <li>Circulation, airway, breathing (CAB)</li> <li>Skin, mental status and GI</li> </ul> </li> <li>Remove/stop offending agent/drug (if possible)</li> <li>Stop dialysis. Return the patient's blood to the patient. Maintain HD access until an adequate alternative is available</li> <li>Promptly perform <b>simultaneously</b> the following actions: <ul style="list-style-type: none"> <li>Administer Epinephrine intramuscular (IM) as per MD/NP order/HA protocol <ul style="list-style-type: none"> <li>Adults (14 yrs and older): 0.5 mg (of 1 mg/ML) IM mid lateral thigh</li> <li>Children (under 14 yrs): 0.01 mg/kg of 1 mg/mL to max 0.5 mg/dose IM mid lateral thigh</li> </ul> </li> <li>Call Code Blue or 911</li> <li>Reassess Circulation, Airway, Breathing (CAB)</li> <li>Administer oxygen for hypoxia if available.</li> </ul> </li> </ol>

<sup>i</sup> [https://en.wikipedia.org/wiki/Air\\_embolism](https://en.wikipedia.org/wiki/Air_embolism)

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>cardiovascular collapse, or both<sup>ii</sup></p> <p><i>Anaphylactoid reactions</i> produce a clinical presentation similar to anaphylaxis but are not IgE mediated and occur through a direct nonimmune-mediated release of mediators from mast cells or direct complement activation</p> <p>If dialyzer is the suspected cause, refer to "Dialyzer reaction/membrane incompatibility"</p>		<ul style="list-style-type: none"> <li>• <b>Hypotension is less common in children</b></li> <li>• <b>Hypotension alone after an exposure can represent anaphylaxis</b></li> <li>• Shock</li> </ul> <p><b>Gastrointestinal:</b></p> <ul style="list-style-type: none"> <li>• Nausea, vomiting, abdominal pain or cramping and diarrhea</li> <li>• Dysphagia (difficulty swallowing) and drooling in children</li> </ul> <p><b>Other:</b></p> <ul style="list-style-type: none"> <li>• Sudden lack of energy (lethargy), quietness or sleepiness in children</li> <li>• Headache, dizziness or light-headedness, decreased level of consciousness. Anxious or feeling of "impending doom". Uterine cramps</li> </ul>	<p>Goal: SpO<sub>2</sub> above 92%</p> <ul style="list-style-type: none"> <li>• Place in recumbent position / elevate legs if possible</li> <li>• Call MD/NP</li> </ul> <ol style="list-style-type: none"> <li>5. Continuous observation: Vital Signs Q5 minutes until transfer of care</li> <li>6. Repeat Epinephrine (IM) Q5 minutes PRN x 2 doses as per MD/NP order/HA protocol for ongoing signs and symptoms of anaphylaxis</li> <li>7. Connect IV line with attached bag of normal saline to venous needle/lumen</li> <li>8. Provide handover to Code Team or Paramedics: Time of onset and nature of symptoms                             <ul style="list-style-type: none"> <li>• Interventions provided including timing and amount of epinephrine</li> <li>• Response to treatment</li> </ul> </li> </ol>

<sup>ii</sup> Anaphylaxis: Initial emergency treatment by nurses (adult and pediatric) Clinical Decision Support Tool; [http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Immunization/Vaccine%20Info/Anaphylaxis-Provincial\\_DST.pdf](http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Immunization/Vaccine%20Info/Anaphylaxis-Provincial_DST.pdf)

## 2.4 Blood in Dialysate

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<b>Blood in dialysate</b> <sup>2,6-8</sup>	<ul style="list-style-type: none"> <li>Fractured dialyzer membranes</li> <li>Cracked or faulty dialyzer headers</li> <li>Hemolysis</li> </ul> <p>May also be a false alarm which might have been caused by a faulty blood leak detector</p>	<ul style="list-style-type: none"> <li>“Blood in dialysate” alarm (HD machine)</li> <li>Visible blood in outflow dialysate hose</li> <li>Positive chemstrip</li> </ul>	<ol style="list-style-type: none"> <li>Stop dialysis and clamp bloodlines and patient access</li> <li>Check vital signs</li> <li>Inspect the dialyzer and outflow dialysate hose for blood leak</li> <li>If no visible blood leak, remove dialysate hose from the connector port &amp; test dialysate outflow fluid with test strip (e.g., Chemstrip, Hemastix®)</li> <li>If test strip negative, restart dialysis and increase blood pump slowly. If alarm reoccurs, test again with test strip</li> <li>If chemstrip tests positive OR blood is visible, treat as blood leak:             <ol style="list-style-type: none"> <li>Do not return patient’s blood</li> <li>Contact MD/NP re: recommencing dialysis with new dialyzer and new machine and possible bloodwork (e.g., potassium) and prophylactic antibiotics</li> <li>Monitor vital signs</li> <li>Review recent bloodwork and notify MD/NP of blood loss as patient may require complete CBC to be drawn at next HD treatment</li> <li>Do heat and chemical disinfection on the original machine (do not run any other patients on this machine until disinfected)</li> <li>Record dialyzer lot number &amp; retain dialyzer for post-investigation by the vendor</li> <li>Inform MD/NP, charge nurse &amp; biomed of all blood leaks</li> </ol> </li> </ol>

## 2.5 Cardiac Arrest (Intradialytic) with Resuscitation

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p><b>Cardiac arrest (intradialytic) with resuscitation</b> <sup>9,10</sup></p> <p><b>Definition:</b> Sudden cardiac arrest is the sudden, unexpected loss of heart function, breathing and consciousness. Sudden cardiac arrest usually results from an electrical disturbance in your heart that disrupts its pumping action, stopping blood flow to the rest of your body<sup>iii</sup></p>	<ul style="list-style-type: none"> <li>• Electrolyte/acid-base imbalance</li> <li>• Dysrhythmias</li> <li>• Myocardial infarction</li> <li>• Hypoxemia</li> <li>• Large air embolus</li> <li>• Pulmonary embolus</li> <li>• Hemolysis</li> <li>• Exsanguination</li> <li>• Hypotension</li> <li>• Hypovolemia</li> <li>• Hypoxia</li> <li>• Acidosis</li> <li>• Hypoglycemia</li> <li>• Hypothermia</li> <li>• Hyperthermia/overheated dialysate</li> <li>• Tension pneumothorax</li> <li>• Tamponade</li> </ul>	<ul style="list-style-type: none"> <li>• Absence of apical/carotid or femoral pulse</li> <li>• Lack of spontaneous respiratory effort</li> <li>• Unresponsive to stimuli</li> <li>• Asystole or ventricular fibrillation on cardiac monitor</li> </ul>	<p>Promptly perform <b>simultaneously</b> the following actions:</p> <ul style="list-style-type: none"> <li>• Shout for help from other staff members – do not leave the patient</li> <li>• Review MOST if available</li> <li>• Notify MD/NP.</li> <li>• Call CODE BLUE/911: <ul style="list-style-type: none"> <li>• In-centre units: Call CODE BLUE</li> <li>• Community Dialysis Units (CDUs): Call 911 or CODE BLUE as per unit policy</li> </ul> </li> <li>• Commence CPR &amp; activate the emergency resources used for cardiac arrest</li> <li>• Stop dialysis. Return blood to patient if safe to do so &amp; bolus of 0.9% NaCl PRN. Disconnect bloodlines from patient’s access. Connect IV line with attached bag of NS to venous needle/lumen</li> <li>• Flush with normal saline. Cap off other needles/lumens</li> <li>• Move dialysis machine away from area if possible.</li> <li>• Secure access until transfer of care per CODE or 911 team, then remove needles/cap CVC (once alternate access established)</li> <li>• Patient's assigned nurse to provide handover</li> <li>• Delegate nurse to record CODE events</li> <li>• Follow health authority protocol for follow-up of patient</li> </ul>

<sup>iii</sup> Mayo Clinic, <https://www.mayoclinic.org/diseases-conditions/sudden-cardiac-arrest/symptoms-causes/syc-20350634>

## 2.6 Chest Pain (Intradialytic)

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
Chest pain (intradialytic) <sup>2,4,11,12</sup>	<p>Cardiac causes:</p> <ul style="list-style-type: none"> <li>• Underlying coronary artery disease with demand ischemia from low BP, high ultrafiltration rate, anemia</li> <li>• Myocardial infarction</li> <li>• Angina</li> <li>• Arrhythmia</li> </ul> <p>Differential diagnosis:</p> <ul style="list-style-type: none"> <li>• Pulmonary embolus</li> <li>• Air embolism</li> <li>• Hemolysis</li> <li>• Pericarditis</li> <li>• Dialyzer reaction</li> <li>• Fluid overload</li> <li>• Infection</li> <li>• Disequilibrium syndrome</li> <li>• Musculoskeletal</li> <li>• GERD</li> </ul>	General: pain or tightness in the chest, back, arm or jaw which may be accompanied by nausea, dyspnea and diaphoresis	<p><i>Management:</i></p> <ul style="list-style-type: none"> <li>• Place machine in minimum ultrafiltration rate (UFR)</li> <li>• Decrease pump speed to 250 ml/min</li> <li>• Assess vital signs</li> <li>• Assess nature of chest pain, including location, radiation, character, severity, exacerbating or relieving factors, duration and frequency and associated symptoms (e.g., syncope)</li> <li>• If chest pain accompanied by hypotension &amp;/or hemodynamically unstable: <ul style="list-style-type: none"> <li>• Position in supine with raised legs as tolerated, or lay flat if respiratory status allows</li> <li>• Return patient's blood and administer 0.9% NaCl 250 mL.</li> <li>• Call MD/NP.</li> </ul> </li> <li>• If hypoxemic (SpO<sub>2</sub> &lt;92% on room air), administer oxygen at 1-5L/min via nasal prongs or simple mask at 6-10L/min.</li> <li>• Titrate oxygen to achieve SpO<sub>2</sub> ≥92%</li> <li>• If blood pressure is not substantively reduced when chest pain manifests: <ul style="list-style-type: none"> <li>• If ordered, administer 1 - 2 sprays nitroglycerin (NTG) SL</li> <li>• If not resolved in 5 min and upon MD/NP order, repeat NTG SL Q5 min as necessary for a maximum of 3 doses. If still not resolved, call MD/NP and prepare patient for transfer of care/specialty consultation</li> </ul> </li> <li>• Arrange investigations as ordered by MD/NP. e.g., troponin and STAT ECG, Hgb level</li> <li>• If chest pain resolves or a non-cardiac cause established, proceed with UFR and dialysis as directed by MD/NP</li> </ul> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>• Assess UF goal and ultrafiltration rate, and estimated dry weight</li> <li>• Avoid high UF rates</li> </ul>



## 2.7 Clotted Extracorporeal Circuit.

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
Clotted extracorporeal circuit <sup>2,13,14</sup>	<ul style="list-style-type: none"> <li>• Inadequate heparin</li> <li>• Changes to systemic anticoagulation therapy (e.g., warfarin)</li> <li>• Inadequate blood flow/blood pump speed during dialysis</li> <li>• Single needle dialysis</li> <li>• Kinked tubing, line clamps, infiltrated needle, etc</li> <li>• Hemoconcentration due to excess fluid loss</li> <li>• Elevated hemoglobin (high hematocrit)</li> <li>• Transfusion of PRBCs or parenteral nutrition with lipids</li> <li>• Change in dialyzer type (dialyzer new to patient)</li> <li>• Incomplete priming of dialyzer</li> <li>• Air in bloodline</li> <li>• Frequent pump stops during run</li> </ul>	<ul style="list-style-type: none"> <li>• Rising venous/arterial pressures</li> <li>• Dropping venous pressure</li> <li>• Change to transmembrane pressure (TMP)</li> <li>• Decrease in dialysis clearance</li> <li>• Upon flushing circuit, visible streaking in dialyzer or clot/dark red blood in the circuit</li> <li>• Transducer monitors filling rapidly with blood (older machines)</li> </ul>	<ul style="list-style-type: none"> <li>• If anticoagulant-free HD, intermittently flush circuit to visualize presence of clot(s) in chamber or dialyzer as per HA protocol.</li> <li>• Rule out causes such as kinked/occluded tubing, infiltrated needle, etc.</li> <li>• Flush circuit to determine extent of clotting as per Health Authority protocol.</li> <li>• If signs of clotted circuit are worsening, consider returning patient's blood. DO NOT <u>manually</u> (hand crank) return blood.</li> <li>• If circuit completely clotted, stop dialysis and discard the circuit. DO NOT RETURN BLOOD. Recommence HD with a new circuit as per HA protocol. Check hemoglobin next HD run or with resumption of HD.</li> <li>• Inform MD/NP to review heparin dose or follow HA protocol.</li> </ul>

## 2.8 Dialyzer Reaction / Membrane Incompatibility

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Dialyzer reaction/membrane incompatibility 1,2,8,15,16</p> <p>Response may be anaphylaxis or anaphylactoid</p>	<p>Immediate/delayed reaction:</p> <ul style="list-style-type: none"> <li>Hypersensitivity to dialyzer membrane or sterilant, especially ethylene oxide (ETO)</li> <li>Contamination by bacterial peptides</li> </ul> <p>Old/expired dialyzer reaction</p> <ul style="list-style-type: none"> <li>Caused by exposure to degraded products, usually associated with cellulose-based membranes</li> </ul> <p>Risk factor: Use of ACE inhibitors in patients using AN69 dialyzer (Nephral)</p>	<p><b>Immediate (onset within 1<sup>st</sup> 10 min)</b></p> <ul style="list-style-type: none"> <li>Symptoms may be mild to severe:                             <ul style="list-style-type: none"> <li>Skin: Pruritus, urticaria, angioedema</li> <li>Respiratory: Cough, sneezing, wheezing, SOB, laryngeal edema</li> <li>GI: Abdominal cramps, diarrhea, vomiting</li> <li>Other: Fever, chills, “impending sense of doom,” chest pain/back pain</li> </ul> </li> <li><b>Anaphylactic shock:</b> Hypotension, rash, wheeze → cardiac arrest</li> </ul> <p><b>Delayed (onset after 1<sup>st</sup> 10 min)</b></p> <ul style="list-style-type: none"> <li>More common and less severe symptoms</li> <li>Symptoms generally <u>improve</u> with continuation of dialysis treatment. Symptoms include:                             <ul style="list-style-type: none"> <li>Chest pain</li> <li>Back pain</li> <li>Dyspnea</li> <li>Nausea/vomiting</li> <li>Hypotension</li> </ul> </li> </ul> <p>Note: Blood and dialyzer membrane interaction can cause significant thrombocytopenia</p> <p><b>Old/Expired Dialyzer Reaction (onset within 7 – 24 hrs post-treatment):</b></p> <ul style="list-style-type: none"> <li>Rare, especially with newer synthetic membranes.</li> <li>Variable symptoms including decreased hearing and vision, conjunctivitis, headache, confusion, corneal opacification, and cardiac arrest</li> </ul>	<p><b>Immediate (onset within 1<sup>st</sup> 10 min):</b></p> <ul style="list-style-type: none"> <li><b>STOP treatment and DO NOT return blood.</b> Keep access open</li> <li>Consider calling <b>CODE BLUE</b></li> <li>Administer the following medications as per unit protocol:                             <ul style="list-style-type: none"> <li>Epinephrine, if anaphylaxis</li> <li>Antihistamine (e.g., diphenhydramine)</li> <li>Steroids (e.g., hydrocortisone, methylprednisolone)</li> <li>Bronchodilators. (e.g., salbutamol nebulizer)</li> </ul> </li> </ul> <p><b>Delayed (onset after 1<sup>st</sup> 10 min):</b></p> <p><b>If mild:</b></p> <ul style="list-style-type: none"> <li>Check vitals frequently</li> <li>Monitor symptoms</li> <li>Consider differential diagnosis (see below)</li> <li>Consider stopping treatment if symptoms progress</li> <li>Call MD/NP. If ordered:                             <ul style="list-style-type: none"> <li>Administer PRN medications e.g., antihistamine – diphenhydramine</li> <li>Administer extra volume prime dialyzer in subsequent runs</li> </ul> </li> </ul> <p><b>If severe:</b></p> <ul style="list-style-type: none"> <li><b>STOP Treatment and DO NOT return blood.</b> Keep access open</li> <li>Consider calling <b>CODE BLUE</b></li> <li>Administer the following medications as per unit protocol:</li> </ul>

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
			<ul style="list-style-type: none"> <li>• Epinephrine, if anaphylaxis</li> <li>• Antihistamine (e.g., diphenhydramine)</li> <li>• Steroids (e.g., hydrocortisone, methylprednisolone)</li> <li>• Bronchodilators. (e.g., salbutamol nebulizer)</li> </ul> <p><b>Differential Diagnosis:</b></p> <ul style="list-style-type: none"> <li>• <a href="#">Air embolism</a></li> <li>• <a href="#">Disequilibrium syndrome</a></li> <li>• <a href="#">Hemolysis</a></li> <li>• <a href="#">Intradialytic hypotension</a></li> <li>• Allergic reaction to medication</li> <li>• Vasovagal response</li> </ul> <p><b>Follow up:</b></p> <ul style="list-style-type: none"> <li>• Update patient’s allergy status as per HA protocol</li> <li>• MD/NP to order different type of dialyzer membrane &amp; blood work to rule out thrombocytopenia</li> </ul>

## 2.9 Disequilibrium Syndrome

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Dialysis disequilibrium syndrome (DDS) <sup>2,4,17-21</sup></p> <p>Many believe DDS is related to an acute increase in brain water content due to the rapid lowering of the plasma solute level during dialysis. This causes the plasma to become hypotonic with respect to the brain cells. This results in water shifting from the plasma into the brain tissue (urea concentration in blood declines faster than in brain → water shifts from blood into brain)</p>	<p>Patient risk factors:</p> <ul style="list-style-type: none"> <li>• Advanced age</li> <li>• Pre-existing neurological condition</li> <li>• Other conditions that could cause cerebral edema (hyponatremia, hepatic encephalopathy, hypertensive emergency, etc)</li> <li>• Concomitant conditions with increased blood brain barrier permeability (sepsis, vasculitis, TTP/HUS, meningitis, encephalitic, etc)</li> <li>• Very high serum urea. e.g., patients who have missed several HD runs in a row</li> </ul> <p>Treatment risk factors:</p> <ul style="list-style-type: none"> <li>• Full clearance dialysis (e.g., high QB; longer dialysis duration; high dialysate flow). Highest risk is in first 3 dialysis runs</li> <li>• Significant change in dialysis prescription which increases the clearance rate (e.g., change in treatment setting from regular to hemodiafiltration (HDF) or expanded dialysis)</li> </ul>	<ul style="list-style-type: none"> <li>• Mild confusion</li> <li>• Dizziness</li> <li>• Headache</li> <li>• Restlessness</li> <li>• Seizures</li> <li>• Nausea and vomiting</li> <li>• Hypertension</li> <li>• Somnolence</li> <li>• Occasional muscle twitching</li> <li>• Blurred vision</li> <li>• If untreated, may lead to coma and death</li> </ul>	<p><i>Management:</i></p> <ul style="list-style-type: none"> <li>• Monitor closely for symptoms</li> <li>• Notify MD/NP if symptoms occur</li> <li>• Reduce pump speed or discontinue treatment depending on the severity of the symptoms (based on consultation with MD/NP)</li> <li>• Provide nursing interventions specific to symptom(s) (e.g., seizure)</li> </ul> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>• Identify at risk patients and review with MD/NP</li> <li>• MD/NP may modify the dialysis prescription to mitigate risk (e.g., reduce pump speed for first few runs, low flux dialyzer, reduce treatment duration, lower dialysate flow rate, connect dialysate flow concurrent to blood flow, sodium modelling).</li> </ul>

## 2.10 Hemolysis

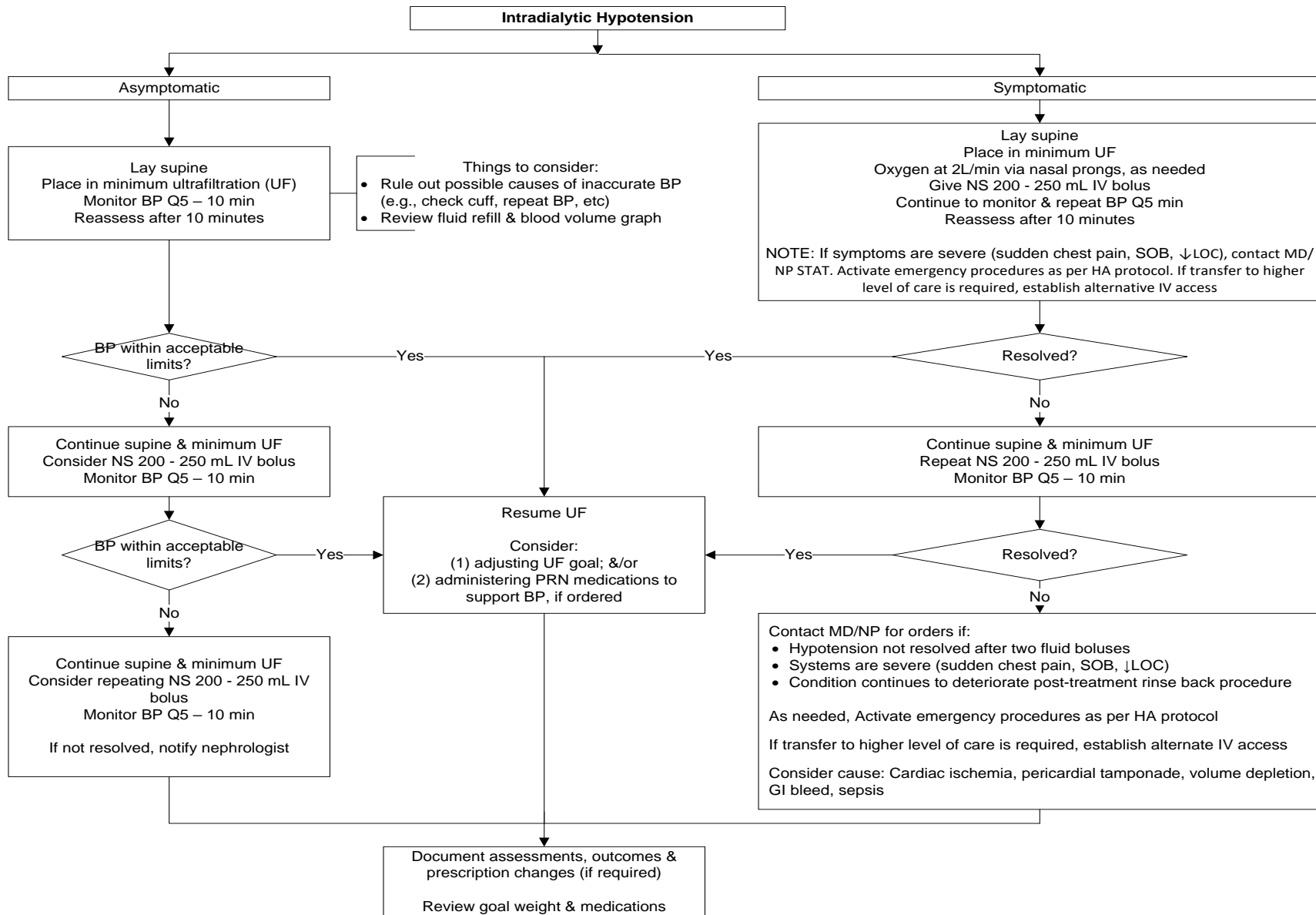
Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Hemolysis <sup>1,4,12,14,22-24</sup></p> <p><b>Definition:</b> Rupture of erythrocytes with release of hemoglobin and potassium into the plasma. If not detected early can result in death</p>	<p><b>Elevated extracorporeal circuit pressures:</b></p> <ul style="list-style-type: none"> <li>Blood pump malocclusion</li> <li>Single-needle high flow HD</li> <li>High QB with small needle gauge</li> <li>High access pressure +/- 250 mm Hg</li> <li>Partial occlusion of HD catheter or malposition of needle that restricts flow.</li> <li>Kinked or faulty tubing</li> <li>Access flow rate lower than pump speed</li> </ul> <p><b>Dialysate related:</b></p> <ul style="list-style-type: none"> <li>Chemicals in dialysate from contaminated water</li> <li>Blood exposure to cleansing agents</li> <li>Hypotonic or hypertonic (less common) dialysate/IV solutions</li> <li>High dialysate temperature</li> </ul>	<ul style="list-style-type: none"> <li>Sudden more positive blood volume detected by HD machine</li> <li>Blood leak alarms or pink discoloration of dialysate</li> <li>Blood appears translucent, deep burgundy or cherry-red in colour post dialyzer</li> <li>Rapid onset of pallor &amp;/or anemia</li> <li>Symptoms associated with hyperkalemia (e.g., dysrhythmias, tachycardia, chest pain, muscle weakness)</li> <li>Abdominal pain, back pain, chest pain/tightness</li> <li>Nausea/vomiting/diarrhea</li> <li>Dyspnea, shortness of breath, hypoxemia</li> <li>Hypotension (can be initially hypertension)</li> <li>Fever/diaphoresis/chills</li> <li>Localized pain/burning at access site</li> <li>Malaise</li> <li>Deepening skin pigment/jaundice</li> </ul>	<ul style="list-style-type: none"> <li>Immediately STOP dialysis</li> <li>Immediately clamp venous line</li> <li>Visually inspect dialysate fluid for changes in color – test for contamination</li> <li>Do NOT return (hemolyzed) blood</li> <li>Monitor vital signs, notify MD/NP stat</li> <li>Observe for dysrhythmias, hypotension and shortness of breath</li> <li>Maintain vascular access (i.e., leave needles in situ or catheter ready for access)</li> <li>Administer oxygen</li> <li>If necessary, replace volume with NS</li> <li>Contact MD/NP to obtain order for:                             <ul style="list-style-type: none"> <li>Bloodwork (e.g., anticipate CBC, electrolytes, cross match STAT - LDH, peripheral blood smear, haptoglobin reticulocyte count, hematocrit and bilirubin)</li> <li>ECG (to determine hyperkalemic changes and assess for acute cardiac ischemia)</li> </ul> </li> <li>Obtain pre- and post-dialyzer samples of dialysate for testing</li> <li>If MD/NP says safe to proceed with HD, set up new machine with new dialyzer</li> <li>Inform biomedical engineering. Sequester machine, tubing and dialyzer</li> <li>Watch for other patients with similar signs and symptoms (if problem was in the water/centre dialysate system).</li> </ul> <p>Note: If &gt;1 patient develops hemolysis within the same unit, contamination of the dialysate should be suspected.</p>

## 2.11 Intradialytic Hypotension

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Intradialytic hypotension <sup>2,25-27</sup></p> <p><b>Definition:</b> Decrease in systolic blood pressure (BP) <math>\geq 20</math>mmHg or a decrease in mean arterial pressure by 10 mmHg, provided that the decrease in BP is associated with clinical events and need for nursing interventions<sup>28</sup></p> <p>Hypotension may be minor or severe, asymptomatic, or symptomatic</p>	<p>Excessive or rapid decreases in blood volume with insufficient hemodynamic compensation.</p> <p>Possible causes:</p> <ul style="list-style-type: none"> <li>Excessive ultrafiltration which exceeds the plasma refilling rate</li> <li>Rapid reduction in plasma osmolality which causes extracellular water to move into the cells</li> <li>Active bleeding</li> </ul> <p>Fluid volume excess/overload: Patient unable to tolerate high fluid removal due to large interdialytic weight gain</p> <p>Miscalculated target weight</p> <p>Lack of vasoconstriction due to:</p> <ul style="list-style-type: none"> <li>Sepsis</li> <li>Eating a large meal before or during dialysis</li> <li>Autonomic neuropathy (e.g., diabetes)</li> <li>Intake of antihypertensive medications</li> <li>Reactions to the dialyzer membrane</li> </ul>	<ul style="list-style-type: none"> <li>Low blood pressure</li> <li>Weakness</li> <li>Dizzy or light-headed</li> <li>Nausea, vomiting, abdominal pain</li> <li>Yawning/sighing</li> <li>Muscle cramps</li> <li>Restless &amp; anxious</li> <li>Pale, diaphoretic &amp;/or cold clammy skin</li> <li>Tachycardia</li> <li>HD machine shows blood volume trending low &amp; not refilling; triggers arterial pressure alarm</li> </ul> <p>If hypotension not addressed, further symptoms may include:</p> <ul style="list-style-type: none"> <li>Chest pain</li> <li>Loss of consciousness</li> <li>Cardiac decompensation leading to coronary and/or cerebral ischemic events if untreated</li> </ul>	<p><i>Management</i> – Refer to attached algorithm (Table 1).</p> <ul style="list-style-type: none"> <li>Place patient in supine position</li> <li>Place in minimum ultrafiltration (UF)</li> <li>Administer oxygen @ 2L/min via nasal prongs, as needed</li> <li>Administer fluid bolus(es) as per algorithm</li> <li>Contact MD/NP for orders if: <ul style="list-style-type: none"> <li>Hypotension not resolved after two fluid boluses</li> <li>Symptoms are severe (sudden chest pain, SOB, reduced LOC)</li> <li>Condition continues to deteriorate post-treatment rinse back procedure</li> </ul> </li> <li>As needed, activate emergency procedures as per HA protocol</li> <li>If transfer to higher level of care is required, establish alternate IV access</li> <li>See below for prevention strategies for recurring hypotension</li> </ul> <p><i>Prevention</i> (may require MD/NP order as per site protocol):</p> <ul style="list-style-type: none"> <li>Accurate dry weight assessment</li> <li>Dialysate sodium modeling/UF modeling (profiling) – separate or in combination</li> <li>Isolated UF followed by either a reduced UF or isovolemic (no UF) dialysis</li> <li>Lower dialysate temperature</li> <li>Use of hematocrit, blood volume monitoring, or hemoScan monitoring with an UF feedback control mechanism</li> <li>Review of prescribed anti-hypertensive medications and dose timing related to dialysis (may need to be taken post)</li> <li>Alpha adrenergic agonists –midodrine or pseudoephedrine</li> <li>Avoid food during dialysis</li> </ul>

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
	<ul style="list-style-type: none"> <li>• Increased synthesis of endogenous vasodilators, such as nitric oxide</li> <li>• Allergic reaction to intradialytic medications</li> </ul> <p>Insufficient cardiac function related to:</p> <ul style="list-style-type: none"> <li>• Diminished cardiac filling and cardiac reserve</li> <li>• Sudden release of adenosine during organ ischemia</li> <li>• Arrhythmias or pericardial effusion with tamponade</li> <li>• High magnesium concentrations in the dialysate</li> </ul> <p>Underlying serious medical conditions (e.g., infection, arrhythmias, tamponade, MI, hemolysis, dialyzer reaction)</p>		<ul style="list-style-type: none"> <li>• Limit interdialytic salt intake</li> <li>• Extend length of dialysis time or increase dialysis frequency</li> <li>• Review dialysate composition (e.g., Ca, Mg)</li> <li>• Consider medications for hypotension (occasionally)</li> <li>• Consider use of intradialytic exercise program if available and patient is agreeable</li> <li>• Patient teaching re: salt intake, fluid restrictions, medications, recognizing and reporting symptoms</li> </ul>

**Table 1: Management of Intradialytic Hypotension**





## 2.12 Muscle Cramps

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
Muscle cramps <sup>2,4</sup>	<ul style="list-style-type: none"> <li>• Hyponatremia (most common)</li> <li>• Plasma volume contraction (2<sup>nd</sup> most common)</li> <li>• Poor plasma refilling due to (1) autonomic dysfunction or (2) cardiomyopathy</li> <li>• High volume removal in relation to dry weight</li> <li>• Low sodium dialysate</li> <li>• Incorrect dry weight</li> <li>• Intradialytic hypotension</li> <li>• Mineral and electrolyte imbalances (e.g., hypokalemia, hypocalcemia, hypomagnesemia, elevated leptin levels)</li> <li>• Vitamin deficiencies (B1 Thiamine, B5 Pantothenic acid, B6 Pyridoxine, Vitamins C &amp; E)</li> <li>• Medications. e.g., IV iron sucrose, oral contraceptive, nifedipine, pyrazinamide, statins, long-acting <math>\beta</math>-agonists, diuretics (especially</li> </ul>	<ul style="list-style-type: none"> <li>• Involuntary &amp; sustained contraction of muscle without relaxation, lasting from seconds to minutes</li> <li>• Pain/discomfort: hands, legs, feet</li> <li>• Restlessness, agitation, anxiety</li> <li>• Muscular firmness, tenderness, bulging, soreness</li> </ul>	<p><i>Management</i></p> <ul style="list-style-type: none"> <li>• Reduce UFR to minimum and decrease total UF target</li> <li>• Massage and stretch the cramped muscle, as appropriate</li> <li>• Apply hot or cold to the tight muscle (e.g., warm towel or massage muscle with ice)</li> <li>• Suggest low intensity exercise (e.g., stationary bike) during dialysis</li> <li>• Reinfuse normal saline IV as per unit protocol</li> <li>• Consider obtaining order or carry out prescribed order:                             <ul style="list-style-type: none"> <li>• Sodium profiling</li> <li>• Higher sodium dialysate</li> <li>• 50% dextrose infusion</li> <li>• Dialysate thermal control</li> <li>• Hypertonic saline IV</li> </ul> </li> <li>• Other management:                             <ul style="list-style-type: none"> <li>• Reversal of low blood pressure, if present</li> <li>• Stop or decrease ultrafiltration</li> <li>• Review causes of interdialytic hypotension</li> </ul> </li> </ul> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>• Regularly &amp; systematically assess the:                             <ul style="list-style-type: none"> <li>• <i>Ideal weight/trend in weight:</i> recent illness/ hospitalization, appetite (stress/holiday-related) nausea, vomiting, diarrhea</li> <li>• <i>Co-morbidities:</i> cardiac failure leading to hypotension</li> <li>• <i>Hydration status:</i> minimal or absence of residual renal function, edema, blood pressure<sup>iv1</sup>, engorged IJ veins, dyspnea; hematocrit; RBV<sup>v</sup>.</li> <li>• <i>Fluid removal/UF goal:</i> UF tolerance, headaches, washed-out feelings, thirsty/ croaky voice.</li> </ul> </li> <li>• Sequential UF/dialysis</li> </ul>

<sup>iv</sup> Preferably measured with patient sitting & standing

<sup>v</sup> Poor refilling may be present in spite of an expanded volume (in patients with diabetes and autonomic dysfunction or in patients with cardiomyopathy)

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
	potassium-sparing and thiazide-like diuretics), $\beta$ -blocker intrinsic sympathomimetic, benzodiazepines <ul style="list-style-type: none"> <li>• Tissue hypoxia</li> </ul>		<ul style="list-style-type: none"> <li>• UF profiling; minimize excessive UF; avert dialysis hypotension</li> <li>• Consider blood volume monitoring (BVM) ultrafiltration (UF) control with hematocrit monitoring</li> <li>• Minimize/substitute medications associated with leg cramps. Consider vitamin E, carnitine. If not effective, try Gabapentin. Refer to BCR pamphlet at: <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/Management%20of%20Muscle%20Cramps%20in%20Patients%20with%20Chronic%20Kidney%20Disease.pdf">www.bcrenalagency.ca/resource-gallery/Documents/Management%20of%20Muscle%20Cramps%20in%20Patients%20with%20Chronic%20Kidney%20Disease.pdf</a></li> <li>• Consider referral to dietitian</li> <li>• Patient education:                             <ul style="list-style-type: none"> <li>• Minimize interdialytic weight gain</li> <li>• Review fluid &amp; sodium restriction<sup>vi</sup></li> <li>• Exercise before bed</li> </ul> </li> <li>• Refer to BCR patient pamphlet <a href="http://www.bcrenalagency.ca/our-research-site/Documents/Symptom%20Management%20Patient%20Teaching%20Tool-Muscle%20Cramps.pdf">www.bcrenalagency.ca/our-research-site/Documents/Symptom%20Management%20Patient%20Teaching%20Tool-Muscle%20Cramps.pdf</a></li> </ul>

<sup>vi</sup> Fluid: 1L/day plus estimated urine output; Sodium: 4 – 6 g/day

## 2.13 Nausea / Vomiting

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
Nausea/vomiting <sup>2,4,29,30</sup>	<p><b>Dialysis-related:</b></p> <ul style="list-style-type: none"> <li>Excessive fluid removal (hypotension) – most common cause</li> <li>Hemolysis</li> <li>Dialyzer reaction</li> <li>Can be an early manifestation of disequilibrium syndrome</li> <li>Contaminated or incorrectly formulated dialysis solution (high sodium, calcium)</li> <li>Exposure to water contaminants</li> <li>Dialysis inadequacy</li> </ul> <p><b>Patient-related:</b></p> <ul style="list-style-type: none"> <li>Eating during dialysis - some patients</li> <li>Uremia</li> <li>Hypercalcemia</li> <li>Diabetic gastroparesis<sup>1</sup></li> <li>Nephrotic syndrome<sup>2</sup></li> <li>AKI rhabdomyolysis<sup>2</sup></li> <li>Concurrent medication/ treatment side effect</li> </ul>	Nausea &/or vomiting	<ul style="list-style-type: none"> <li>Rule out possible dialysis-related and patient-related causes and treat underlying issue (treatment dependent on suspected cause)                             <ul style="list-style-type: none"> <li>As hypotension is most frequently the cause, check BP for all new-onset nausea/vomiting</li> <li>Treat hypotension</li> </ul> </li> <li>Administer anti-emetics if ordered &amp; BP allows</li> <li>Elevate head of bed</li> <li>Patient teaching (depending on suspected cause) could include: (1) Interdialytic fluid gain; (2) eating during treatment; and (3) dietary counselling (limiting salt and fluid intake)</li> <li>Assess patient’s HD adequacy (clearance, PRU)</li> <li>Access flow, recirculation, HD schedule and frequency, dialyzer size, Qb and Qd</li> <li>If history of nausea/vomiting &gt; 3 days, contact MD/NP:                             <ul style="list-style-type: none"> <li>MD/NP may wish to check electrolytes</li> <li>As per MD/NP order, implement HD techniques that may help relieve symptoms (isolated UF, sodium profiles/modeling)</li> </ul> </li> </ul>

## 2.14 Pyrogenic Reaction

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Pyrogenic reaction 12,14,31-33</p> <p><b>Definition:</b> A febrile phenomenon caused by infusion of contaminated solution, and commonly manifested by cold, chill and fever</p>	<p>Dialysis-related:</p> <ul style="list-style-type: none"> <li>Pyrogens or endotoxins in the dialyzer or bloodlines, HD machine, water system &amp;/or bicarbonate containers/system</li> <li>Contaminated medication administered through the dialysis circuit</li> </ul> <p>Patient related:</p> <ul style="list-style-type: none"> <li>Bacteremia (access site or non-access related)</li> <li>Break in aseptic practices (may cause bacteremia which may lead to a pyrogenic reaction)</li> </ul> <p><b>Differential diagnosis:</b> Blood transfusion reaction (oral temperature <math>\geq 38^{\circ}\text{C}</math>; <math>\geq 1^{\circ}\text{C}</math> higher than baseline; or presence of chills/rigors)</p>	<p>Most common:</p> <ul style="list-style-type: none"> <li>Patient feels cold soon after initiation of dialysis, accompanied by chills and fever, often within the first 45 – 75 min of treatment</li> <li>Hypotension</li> <li>Nausea and vomiting</li> </ul> <p>Less common:</p> <ul style="list-style-type: none"> <li>Headache</li> <li>Myalgia (muscle pain)</li> <li>Hemodynamically unstable</li> </ul>	<p><i>Management:</i></p> <ul style="list-style-type: none"> <li>Assess for signs and sources of infection such as: vascular access, foot ulcer, pressure ulcer, respiratory or urinary tract</li> <li>Take vital signs, including pre-dialysis temperature</li> <li>Notify MD/NP. If ordered:                             <ul style="list-style-type: none"> <li>Obtain blood cultures from patient</li> <li>Administer antibiotics until culture results are known</li> <li>Administer antipyretics</li> <li>Discontinue HD without returning blood if pyrogen or endotoxin is suspected</li> </ul> </li> <li>Obtain water (system) and inlet/outlet samples of dialysate to culture for bacterial endotoxins</li> </ul> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>Strict adherence to guidelines for the chemical and bacteriologic quality of water used to prepare dialysis fluid and circuit</li> <li>Ensure dialysis equipment and water system are carefully and properly disinfected</li> <li>Ensure concentrate containers are not reused to prevent growth of bacteria</li> <li>Minimize the length of time supplies &amp; extracorporeal system are prepared before treatment initiation</li> <li>Maintain aseptic technique throughout dialyzer preparation and HD</li> <li>Best practices such as good hand hygiene and aseptic techniques for accessing the vascular access</li> </ul>

## 2.15 Seizure

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Seizure <sup>2,4</sup></p> <p>A seizure is a sudden, uncontrolled electrical disturbance in the brain. It can cause changes in your behavior, movements or feelings, and in levels of consciousness. There are many types of seizures, which range in severity. Seizure types vary by where and how they begin in the brain. Most seizures last from 30 seconds to two minutes. A seizure that lasts longer than five minutes is a medical emergency. (Mayo Clinic; <a href="http://www.mayoclinic.org/disease-s-conditions/seizure/symptoms-causes/syc-20365711">www.mayoclinic.org/disease-s-conditions/seizure/symptoms-causes/syc-20365711</a>)</p>	<p><i>Dialysis-related:</i></p> <ul style="list-style-type: none"> <li>• Acute renal failure</li> <li>• Hypotension</li> <li>• Electrolyte imbalance</li> <li>• Disequilibrium syndrome</li> <li>• Severe hypertension</li> <li>• Dialysate composition errors</li> <li>• Anticonvulsant /seizure medications is dialyzed out</li> </ul> <p><i>Patient-related:</i></p> <ul style="list-style-type: none"> <li>• Seizure disorder</li> <li>• Hypertensive encephalopathy</li> <li>• Intracranial hemorrhage (e.g., post-fall), intracranial mass, intracranial infection and large ischemia stroke</li> <li>• Medications (i.e., narcotics).</li> <li>• Alcohol withdrawal</li> <li>• Toxins</li> <li>• Metabolic:                             <ul style="list-style-type: none"> <li>• Hypocalcemia</li> <li>• Hypernatremia (accidental due to hemodialysis machine malfunction) or hyponatremia</li> <li>• Hypoglycemia</li> </ul> </li> <li>• Anoxia secondary to:                             <ul style="list-style-type: none"> <li>• Cardiac abnormalities</li> <li>• Severe hypotension</li> <li>• Air embolism</li> <li>• Allergic reaction</li> </ul> </li> </ul>	<p>Depends upon type of seizure (focal vs generalized)</p> <p>Common symptoms include:</p> <ul style="list-style-type: none"> <li>• Aura</li> <li>• Loss of consciousness</li> <li>• Seizure activity</li> </ul>	<p>These activities may happen concurrently</p> <ul style="list-style-type: none"> <li>• Ask for help</li> <li>• Note time, type and duration of seizure</li> <li>• Discontinue dialysis – return blood if safe to do so</li> <li>• If hypotension/hypovolemia/hypoglycemia present, treat as per HA protocol</li> <li>• Maintain airway                             <ul style="list-style-type: none"> <li>• Apply oxygen, if indicated</li> <li>• Set up suction</li> </ul> </li> <li>• Protect patient from injury                             <ul style="list-style-type: none"> <li>• Turn patient to side to prevent aspiration (recovery position)</li> <li>• Protect patient’s access site from separation/dislodgement</li> </ul> </li> <li>• Call MD/NP STAT</li> <li>• Call Code BLUE if seizures persist</li> <li>• As ordered by MD/NP:                             <ul style="list-style-type: none"> <li>• Administer medications (e.g., IV diazepam or lorazepam, and phenytoin if required)</li> <li>• Treat metabolic disturbance(s), if present</li> </ul> </li> <li>• Obtain blood samples for electrolytes and serum calcium</li> <li>• If hypoglycemia suspected, follow HA hypoglycemia protocol</li> <li>• After care:                             <ul style="list-style-type: none"> <li>• Offer reassurance</li> <li>• Provide for safety</li> <li>• Remain with patient until fully conscious and reoriented</li> <li>• Discuss resumption of dialysis with MD/NP</li> </ul> </li> </ul>

## 2.16 Vascular Access Complications

### 2.16.1 VA Disconnection/Needle Dislodgement (Arterial or Venous)

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>VA disconnection/ needle dislodgement (arterial or venous) 2,35,36</p> <p><b>Definitions:</b> Dislodgement = Fistula/graft needle or catheter falls out.</p> <p>Disconnection = Separation of vascular access line(s)</p>	<ul style="list-style-type: none"> <li>Poorly secured access. e.g., improper taping of access tubing to skin, loose luer lock tubing connection, bloodlines not looped loosely enough, needles <math>\leq 2.5</math> cm (<math>\leq 1</math> in)</li> <li>Patient factors. e.g., confused, restless, agitated, cognitively impaired &amp;/or sedated, frequent manipulation of lines and connections, excessive movement of arm or body, hypotension or muscle cramps during treatment, diaphoresis or pruritus, non-adherent skin (e.g., excess body hair, waxy skin), unwilling to keep access areas &amp; bloodlines uncovered, on nocturnal &amp;/or home HD</li> </ul>	<ul style="list-style-type: none"> <li>Blood circuit pressure alarm (venous or arterial) BE AWARE: Pressure alarms are not always reliable &amp; may not provide an alert</li> <li>Patient reports moisture in area of access</li> <li>Visible blood leakage or spray</li> <li>Hypotension with alteration in level of consciousness</li> </ul>	<p><i>Management:</i></p> <ul style="list-style-type: none"> <li>Don Personal Protective Equipment (PPE)</li> <li>Stop blood pump</li> <li>Call for help</li> <li>Secure access (CVC: clamp; Fistula/graft: apply pressure)</li> <li>Check vitals</li> <li>If excessive blood loss, give NS bolus into an available access</li> <li>If circuit is contaminated, do not return blood</li> <li>Obtain STAT CBC &amp; cross match orders; inform MD/NP</li> </ul> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>Proper securing of access, blood lines and caps. Refer to Staff Guide at <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/VA-Prevention_of_VA_Disconnection_Needle_Dislodgement-Staff_Guide.pdf">www.bcrenalagency.ca/resource-gallery/Documents/VA-Prevention_of_VA_Disconnection_Needle_Dislodgement-Staff_Guide.pdf</a></li> <li>Visibly check the access, needle sites, blood line positions &amp; all luer connections as part of routine monitoring &amp; each time an alarm is activated. Document checks on HD run log</li> <li>Set the lower limit of the venous pressure alarm as close as possible to the current venous pressure, as allowed by the dialysis equipment</li> <li>For patients at higher risk for needle dislodgement (see signs and symptoms under patient factors), consider using a device intended to detect moisture (blood loss)</li> <li>Patient teaching: Keep access area &amp; bloodlines visible at all times, check access frequently during dialysis, do not touch needles/catheter, connection or tape holding the access in during dialysis, be aware of access when moving (move slowly). Refer to Patient Teaching sheet at <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/VA_Disconnection-Needle_Dislodgement_Patient_Teaching_Handout.pdf">www.bcrenalagency.ca/resource-gallery/Documents/VA_Disconnection-Needle_Dislodgement_Patient_Teaching_Handout.pdf</a></li> </ul>

## 2.16.2 Acute VA Rupture/Hemorrhage (AVFs/AVGs)

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Acute VA rupture/hemorrhage<sup>1,37-41</sup> while in dialysis unit (AVF/AVG)</p> <p>Although thrombosis and stenosis are more frequently seen, hemorrhage from a VA can result in life-threatening blood loss. Rupture may occur underneath the skin, or it can break through the skin.</p>	<p>VA-related:</p> <ul style="list-style-type: none"> <li>Rupture of vascular access (e.g., aneurysm/pseudoaneurysm)</li> </ul> <p>HD-related:</p> <ul style="list-style-type: none"> <li>Too much heparin in the HD machine (over-anticoagulation)</li> </ul> <p>Patient-related:</p> <ul style="list-style-type: none"> <li>On anticoagulants (e.g., warfarin or clopidogrel)</li> <li>Coagulopathy disorder e.g., platelet dysfunction; uremia</li> </ul>	<p>Massive bleeding from access site</p>	<p><i>Management of major VA hemorrhage:</i></p> <ul style="list-style-type: none"> <li>Don PPE</li> <li>Stop the bleeding:                             <ul style="list-style-type: none"> <li>If bleeding is life threatening, apply tourniquet or strong manual pressure proximal to the puncture site (extreme measure as this will result in thrombosis formation within the AVF/AVG and make it nonfunctional)</li> <li>If bleeding is not life threatening, apply firm direct pressure to access at the site of bleeding using a 2-handed technique: Use dominant hand to put pressure in the bleeding point and non-dominant hand to put pressure proximal to the bleeding point (from Mayo Clinic article). Do not apply adhesive bandages until hemostasis is achieved</li> </ul> </li> <li>Call MD/NP immediately</li> <li>As per MD/NP orders:                             <ul style="list-style-type: none"> <li>Adjust patient/HD factors contributing to hemorrhage (e.g., heparin dosage)</li> <li>Refer to vascular surgeon/radiologist (ligation, repair &amp;/or reconstruction of access, etc)</li> </ul> </li> </ul> <p>Note: For management of VA bleeding after leaving the HD unit, refer to BCR patient handout: <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/VA%20for%20Hemo%20-%20Bleeding%20Fistula%20or%20Graft.pdf">www.bcrenalagency.ca/resource-gallery/Documents/VA%20for%20Hemo%20-%20Bleeding%20Fistula%20or%20Graft.pdf</a></p> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>Proactively manage warning signs of VA rupture/hemorrhage (rapid increase in size, pain, thinning &amp; degeneration of the overlying skin of the skin, shiny &amp; pulsating and infection)</li> <li>Refer to BCR documents:                             <ul style="list-style-type: none"> <li>Prevention of aneurysms (patient handout): <a href="http://www.bcrenalagency.ca/resource-">http://www.bcrenalagency.ca/resource-</a></li> </ul> </li> </ul>

## Nursing Management of Complications during Hemodialysis

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
			<p><a href="#">gallery/Documents/VA-Ways to Prevent Aneurysms in Fistulas and Grafts.pdf</a></p> <ul style="list-style-type: none"> <li>Prevention of VA disconnection/needle dislodgement (staff &amp; patient handout) <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/VA-Prevention of VA Disconnection Needle Dislodgement-Staff_Guide.pdf">www.bcrenalagency.ca/resource-gallery/Documents/VA-Prevention of VA Disconnection Needle Dislodgement-Staff_Guide.pdf</a></li> <li>Careful removal of needles post-HD (guideline): <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/Care%20of%20Needling%20Sites%20Post%20Hemodialysis%20for%20Fistulas%20%20Grafts%20(Hemostasis).pdf">www.bcrenalagency.ca/resource-gallery/Documents/Care%20of%20Needling%20Sites%20Post%20Hemodialysis%20for%20Fistulas%20%20Grafts%20(Hemostasis).pdf</a></li> </ul>



## 2.16.3 Infiltrated Needle while on Dialysis

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
<p>Infiltrated needle while on dialysis</p> <p><b>Definition:</b> Needle dislodges from inside the vein (fistula) or graft during needle insertion or during dialysis treatment. Blood leaks out of the vein into the surrounding tissues.</p>	<p>Cannulation-related:</p> <ul style="list-style-type: none"> <li>• Fragile or new access (higher risk)</li> <li>• Accidental “back or side wall” puncture</li> <li>• Needle malposition</li> <li>• Not enough of the needle in the vessel</li> <li>• Vessel spasm</li> </ul> <p>Other reasons:</p> <ul style="list-style-type: none"> <li>• Poorly secured access</li> <li>• Patient factors (refer to section on VA disconnection/needle dislodgement guideline)</li> </ul>	<ul style="list-style-type: none"> <li>• Sudden onset of pain &amp;/or discomfort in the access area</li> <li>• Feeling of warmth/moisture &amp;/or pressure near the cannulation site</li> <li>• Swelling at cannulation site</li> <li>• Arterial or venous pressure alarms</li> </ul>	<p><i>Management:</i></p> <p>When two needles are in-situ:</p> <ol style="list-style-type: none"> <li>1. Ask for assistance</li> <li>2. Consider returning blood or putting HD circuit on “circle”</li> <li>3. If patient has not received heparin:                             <ul style="list-style-type: none"> <li>• Shut off the pump</li> <li>• Remove the needle</li> <li>• Apply digital pressure to the exit site by placing two fingers along the access for at least one inch in the area of the infiltration</li> <li>• If a back or side infiltration is suspected, use two fingers along the access and a thumb on the backside of the arm to apply posterior pressure (“C-clamp” method). It can be difficult to control back or side wall bleeding because it is not possible to place direct pressure on the puncture site</li> </ul> </li> <li>4. If patient has received heparin:                             <ul style="list-style-type: none"> <li>• Assess the infiltration site to see if the needle should be pulled out or left in place with ice applied over the site until the dialysis treatment is complete</li> <li>• If the hematoma is increasing in size during the treatment, shut off the pump, remove the needle and apply digital pressure as described above</li> <li>• If the hematoma size is stable, it is acceptable to leave the needle in until the end of the treatment</li> </ul> </li> <li>5. Apply ice as soon as able to the infiltrated access for 20 minutes. Instruct the patient to apply ice another six to eight times for the next 24 hours to reduce pain and swelling. After 24 hours, instruct the</li> </ol>

Complication	Possible Cause(s)	Signs & Symptoms	Nursing Management
			<p>patient to apply warm (not hot) compresses (e.g., warm wash cloth) on the area for 20 minutes several times a day to promote healing</p> <p>6. In the meantime, revert back to using the CVC (if present) for dialysis. If there is no CVC, consult the nephrologist and VA Nurse (they may suggest single needle dialysis, temporarily needling above or below the infiltrated area, giving the patient the day off of dialysis to rest the access or inserting a CVC)</p> <p>7. Assess infiltration at each dialysis treatment and resume use once the majority of swelling/bruising has subsided and the AVF/AVG can be easily palpated (usually takes one to two weeks). When the AVF/AVG is ready for use again, reinstitute the sequence at the last successful level (i.e., level reached prior to “blow”). If the access appears to be compromised, consider using a smaller gauge needle</p> <p><i>Prevention:</i></p> <ul style="list-style-type: none"> <li>• Use ultrasound to guide cannulation</li> <li>• Consider angiocaths, especially if patient has limited capacity to keep limb immobilized</li> <li>• Avoid repeated attempts at cannulation</li> <li>• Cannulate slowly and with care, stop with any resistance</li> <li>• Ask for guidance on cannulating an unfamiliar access</li> <li>• Secure the access as per BC Renal guideline:  <a href="http://www.bcrenalagency.ca/resource-gallery/Documents/VA-Prevention_of_VA_Disconnection_Needle_Dislodgement-Staff_Guide.pdf">http://www.bcrenalagency.ca/resource-gallery/Documents/VA-Prevention_of_VA_Disconnection_Needle_Dislodgement-Staff_Guide.pdf</a> (Appendix 1)</li> <li>• Remind patient to immobilize limb with needles</li> <li>• Keep needled access exposed throughout treatment</li> </ul>

## 3.0 Sponsors

Developed by:

- BCR Renal Educators Group (REG)

Reviewed by:

- Nephrologists practicing in Interior Health, Fraser Health & Vancouver Island Health

Approved by:

- BC R Hemodialysis Committee (January 13, 2021)

## 4.0 References

1. Saha M, Allon M. Diagnosis, treatment, and prevention of hemodialysis emergencies. *CJASN*. 2017;12(2):357-369. <https://cjasn.asnjournals.org/content/12/2/357>. Accessed May 18, 2020.
2. Vancouver General Hospital. Guideline: Management of complications during dialysis. 2018:1-10.
3. Interior Health Authority. Guideline: Intradialytic air embolus. 2015:1-4.
4. Soldier's Memorial Hospital, Regional Kidney Care Program. Guideline: Management of complications during hemodialysis self-learning package. 2009:1-18.
5. BCCDC. Anaphylaxis: Initial emergency treatment by nurses (adult & pediatric) clinical decision support tool. [http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Immunization/Vaccine%20Info/Anaphylaxis-Provincial\\_DST.pdf](http://www.bccdc.ca/resource-gallery/Documents/Guidelines%20and%20Forms/Guidelines%20and%20Manuals/Immunization/Vaccine%20Info/Anaphylaxis-Provincial_DST.pdf). Updated 2019. Accessed Aug 25, 2020.
6. Alberta Health Services. Guideline: Blood in dialysate. 2015:1-4.
7. Interior Health Authority. Guideline: Blood in dialysate alarm: Responding to. 2017:1-5.
8. Soldiers' Memorial Hospital. Guideline: Dialyzer blood leak. 2017:1-3.
9. Alberta Health Services. Staff education: Intradialytic cardiac arrest scenario database #5. 2016:1-6.
10. Interior Health Authority. Guideline: Intradialytic cardiopulmonary arrest. 2013:1-4.
11. Interior Health Authority. Guideline: Chest pain in the hemodialysis unit: Treatment of. 2014:1-8.
12. Counts CS, American Nephrology Nurses' Association. *Core curriculum for nephrology nursing, 6th ed. module 3: Treatment options for patients with chronic kidney failure*. 6th ed. ; 2015:136-139.

13. Interior Health Authority. Guideline: Clotting of the extracorporeal circuit on hemodialysis: Treatment of. 2014:1-3.
14. Levy J et al. *Oxford handbook of dialysis*. Oxford Handbook of Dialysis; 2001.
15. Bellucci, A. Reactions to the hemodialysis membrane. *UpToDate*.  
<https://www.uptodate.com/contents/reactions-to-the-hemodialysis-membrane#H1453243052>. Accessed May 18, 2020.
16. Olafirany Fea. Resolution of dialyzer membrane-associated thrombocytopenia with use of cellulose triacetate membrane: A case report. *Case Reports in Medicine*. 2011;2011(134295):1-3.  
<https://refworks.proquest.com/library/search/resolution%2520of%2520dialyzer/>. Accessed May 18, 2020.
17. Alberta Health Services. Guideline: Dialysis disequilibrium syndrome (DDS). 2017:1-2.
18. Fujisaki K, Nakagawa K, Nagae H, et al. Asymptomatic brain edema after hemodialysis initiation in a patient with severe uremia. *Case reports in medicine*. 2017;2017.
19. Richey SN. Dialysis disequilibrium syndrome: Treatment leading to fatality. *American Society for Clinical Laboratory Science*. 2015;28(1):15-18.
20. Steward C. Dialysis disequilibrium syndrome in the neurointensive care unit: A case study. *Nephrology Nursing Journal*. 2019;46(6).
21. Zepeda-Orozco D, Quigley R. Dialysis disequilibrium syndrome. *Pediatric nephrology*. 2012;27(12):2205-2211.
22. Alberta Health Services. Guideline: Hemolysis. 2015:1-2.
23. Daugirdas, J., Blake P., Ing, T. *Handbook of dialysis, 5th ed.*; <http://www.hdcn.com/misc/hbook5.ht>. Wolters Kluwer; 2015:231-232.
24. Tharmaraj D, Kerr PG. Haemolysis in haemodialysis. *Nephrology*. 2017;22(11):838-847.
25. Dheen S, Henrich WL. Preventing dialysis hypotension: A comparison of usual protective maneuvers. *Kidney International*. 2001;59(3):1175-1181.  
<http://www.sciencedirect.com/science/article/pii/S0085253815475830>. doi:  
<https://doi.org/10.1046/j.1523-1755.2001.0590031175.x>.
26. Agarwal R. How can we prevent intradialytic hypotension? *Curr Opin Nephrol Hypertens*. 2012;21(6):593-599.
27. Alberta Health Services. Guideline: Intradialytic hypotension. 2016:1-3.

28. Henrich W FJ. Intradialytic hypotension in an otherwise stable patient; . *UpToDate*. 2020. [https://www.uptodate.com/contents/intradialytic-hypotension-in-an-otherwise-stable-patient?search=intradialytic%20hypotension&source=search\\_result&selectedTitle=1~150&usage\\_type=default&display\\_rank=1](https://www.uptodate.com/contents/intradialytic-hypotension-in-an-otherwise-stable-patient?search=intradialytic%20hypotension&source=search_result&selectedTitle=1~150&usage_type=default&display_rank=1).
29. Camilleri M. Treatment of gastroparesis. *Literature review. Up to date*. 2016.
30. Thomas N. *Renal nursing: Care and management of people with kidney disease*. Wiley Online Library; 2019.
31. Fenves AZ. Medical management of the dialysis patient: Infectious complications. *Renal & Urology News*. 2020. <https://www.renalandurologynews.com/home/decision-support-in-medicine/nephrology-hypertension/medical-management-of-the-dialysis-patient-infectious-complications/>. Accessed August 25, 2020.
32. Bodin S. *Contemporary nephrology nursing, 3rd ed*. American Nephrology Nurses Association; 2017.
33. PHC P, VCH. Guideline: Blood and blood products: Transfusion reaction identification & management. Protocol-document #B-00-13-10068. 2018.
34. Interior Health. Guideline: Air in blood alarm. 2014:1-3.
35. BC Renal. Staff guide: Prevention of vascular access disconnection/needle dislodgement; [http://www.bcrenalagency.ca/resource-gallery/documents/VA-Prevention\\_of\\_VA\\_Disconnection\\_Needle\\_Dislodgement-Staff\\_Guide.pdf](http://www.bcrenalagency.ca/resource-gallery/documents/VA-Prevention_of_VA_Disconnection_Needle_Dislodgement-Staff_Guide.pdf). 2019:1-4.
36. Axley B, Speranza-Reid J, Williams H. Venous needle dislodgement in patients on hemodialysis. <https://www.annanurse.org/download/reference/journal/vndArticle.pdf>. *Nephrology Nursing Journal*. 2012;39(6):435-445.
37. BC Renal. Patient teaching tool: What to do. <http://www.bcrenalagency.ca/resource-gallery/documents/VA%20for%20Hemo%20-%20Bleeding%20Fistula%20or%20Graft.pdf>. 2016:1.
38. BC Renal. Care of needling sites post-hemodialysis for fistulas and grafts (hemostasis); [http://www.bcrenalagency.ca/resource-gallery/documents/Care%20of%20Needling%20Sites%20Post%20Hemodialysis%20for%20Fistulas%20%20Grafts%20\(hemostasis\).pdf](http://www.bcrenalagency.ca/resource-gallery/documents/Care%20of%20Needling%20Sites%20Post%20Hemodialysis%20for%20Fistulas%20%20Grafts%20(hemostasis).pdf). 2015:1-6.
39. Mudoni A, Cornacchiari M, Gallieni M, et al. Aneurysms and pseudoaneurysms in dialysis access. *Clinical Kidney Journal*. 2015;8(4):363-367. <https://search.datacite.org/works/10.1093/ckj/sfv042>. doi: 10.1093/ckj/sfv042.

40. Jose MD, Marshall MR, Read G, et al. Fatal dialysis vascular access hemorrhage. *American Journal of Kidney Diseases*. 2017;70(4):570-575. <http://dx.doi.org/10.1053/j.ajkd.2017.05.014>. doi: 10.1053/j.ajkd.2017.05.014.

41. Wangsgard, C and Cabrera, D. How to stop a post-dialysis site bleeding. <https://emblog.mayo.edu/> Web site. <https://emblog.mayo.edu/2015/04/27/how-to-stop-a-post-dialysis-site-bleeding/>. Updated 2015. Accessed Jul 11, 2020.