



A Hemolysis Event at the Dialysis Unit

Dealing with a hemolytic event can be one of the most stress producing situations that physicians and nurses can have to face in dialysis. Because there are so many possible causes of hemolysis, even excellent dialysis units may have an event.

The purpose of this resource is to provide information from a variety of sources to assist the personnel who are investigating an event and are attempting to uncover the root cause of the hemolysis.

Setting Priorities: The Acute Phase

1. Safety of Patients

Assuring the safety of the other patients is paramount. Take time to do the following:

- Look around the room and do a quick but intense visual assessment of the patients currently dialyzing
- Determine if any patient is currently dialyzing on the same machine which the affected patient was using
- Take vital signs on every patient
- Be alert for signs and symptoms especially hypertension and shortness of breath (but any symptom should not be overlooked at this point)

2. Save Supplies/Items Used

Be sure to immediately remove the involved dialysis machine from the patient treatment area and label it prominently so that it will not be used on other patients until its safety is assured. Keep the dialysis tubing, dialyzer, packaging and product lot numbers, saline bag, tubing, syringes, etc. that were used for the treatment in a safe place and label "do not destroy." These items may need to be tested.

3. Support Staff Members

An emergency such as this will no doubt cause worry and concern among the staff members. They may second-guess their actions or doubt their own abilities to provide quality dialysis care. Managers need to be aware of the effects a hemolytic event could have on the staff members and provide supportive communication to them. Keep staff members informed of investigative findings as appropriate.

4. Searching for the Cause

Enlist and accept the assistance of experts to help you search for the cause of the event. Such experts might be:

- The local water department
- Vendors of dialysis machinery and related products such as tubing
- Recognized leaders in water treatment for dialysis
- The Heartland Kidney Network
- The State Survey agency
- Corporate resources
- Etc.

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Hemolysis: A Laboratory Data Review

Haptoglobin

Independent of other laboratory markers cannot along identify hemolysis in an ESRD patient. During the hemodialysis treatment, some damage to the red blood cell membrane occurs. Additionally, the life cycle of an ESRD patient's red blood cells is greatly diminished when compared to the general population, therefore, additional laboratory data must be evaluated in conjunction with signs and symptomology prior to the assumption of a hemolytic event. Haptoglobin values are directly influenced by other comorbid disease processes, including: cardiac, hepatic, spleen and respiratory. As many ESRD patients have several comorbidities, again, haptoglobin is only one of several markers. Note: Haptoglobin is a very expensive test that is not covered by Medicare.

LDH (Lactate dehydrogenase)

In a true hemolytic event, LDH values would be expected in the thousands, not hundreds. LDH values are not an independent tool for hemolysis evaluation. As in haptoglobin evaluation, the multiple comorbidities observed in ESRD patients directly influences LDH values. LDH is not an independent laboratory value for hemolysis evaluation.

Hemoglobin (Hgb)

In a true hemolytic event, hemoglobin levels would drop abruptly and dependent upon the patient's baseline hemoglobin prior to the event would vary. As with LDH and haptoglobin, hemoglobin is not an independent marker for hemolysis.

Reticulocyte counts

With the administration of erythropoietin and evaluation of hemoglobin, transferrin and ferritin levels, reticulocyte levels are anticipated to increase during red blood cell synthesis. An increased reticulocyte count does not necessarily indicate hemolysis, rather, when evaluating the patient's anemia trend, iron storage and availability, reticulocyte counts vary by the patient, their comorbidities, nutritional status, dialysis adequacy and mineral metabolism.

Source: This information was reviewed by the Medical Review Board

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Hemolysis Event Check List

Discussion: Sometimes the underlying cause of hemolysis is found to be from chemicals, mechanical trauma, and/or water treatment. Occasionally, the root cause of a hemolytic event may never be discovered.

Directions: In the event of a suspected hemolytic event, utilize the checklist below to plan facility strategies, actions, interventions, and the promotion of safety for all patients.

Have You...

General (To Insure the safety of the other patients.)

- Assessed all other patients immediately for signs and symptoms of hemolysis and if necessary, provided treatment as indicated?
- Removed the involved machine from the treatment area and tagged it "Do not use" and also kept the dialysis tubing, lot number, dialyzer, etc. from the machine?
- Assembled a team of experts to assist in the investigation for the cause? (For example, possible members of the investigation team might include the local water department, corporate water treatment personnel, Health Department personnel, dialysis tubing/machinery vendors, CDC, ESRD Network, etc.)
- Kept the other patients informed and made arrangements for alternative dialysis treatments?
- Reviewed records to determine if any other patients used the same machine of the patient with suspected hemolysis?
- In-serviced all staff members about hemolysis signs, symptoms, and treatment?
- Documented the In-service training all staff members?
- Alerted the ESRD Network of the problem? (The Network can help the unit determine if this is a local issue or more widespread across states or the nation.)

Chemical

- Reviewed the patient's medical record for the presence of comorbid medical conditions and medications that could predispose the patient to the development of hemolysis?
- Reviewed machine cleaning and maintenance logs?
- Performed cultures from every possible water valve?
- Performed cultures of all dialysis machines?
- Reviewed cultures of machines and valves?
- Reviewed machine maintenance records?
- Reviewed Actril or other chemical disinfection test strips inserts?
- Pulled Actril or other chemical disinfection test strips w/ affected lot number out of service?

Mechanical

- Removed the involved machine from service?
- Contacted suppliers of dialyzer tubing and machines?
- Pulled tubing of same lot number from use?
- Instructed all sister units to remove tubing having the same lot number from service as a precautionary measure?
- Reviewed the maintenance history of the involved machine?
- Performed an internal & external evaluation of machine?

Water

- Reviewed all water testing scores?
- Contacted the local water company to determine if any unusual treatment to the incoming water supply was present?
- Reviewed water system cultures?
- Conducted additional water testing – LAL and mineral analysis?
- Reviewed Actril or other chemical disinfection test strips inserts?
- Pulled Actril or other chemical disinfection test strips w/ affected lot number out of service?

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Helpful Information

Differentiating the Diagnosis of Hemolysis

Patients Affected	Slow Onset	Sudden Cause
Single patient	<ul style="list-style-type: none"> Hyperspleism Medication Under dialysis 	<ul style="list-style-type: none"> Microangiopathy Medication Hypotonic Dialysis Hyperthermic/hypothermic dialysis solution
Most Patients dialyzing at once	Waterborne toxin	Waterborne toxin
Sporadic Episodes	Disinfectants	<ul style="list-style-type: none"> Disinfectants Hyperoccluded blood pump Defective dialysis machine Hyperthermic/hypothermic dialysis solution

Source: *Assessing Anemia Secondary to Hemolysis in Hemodialysis Patients* by Jamie Behrens. Nephrology Nursing Journal, April 2001.

Chemical Agents Associated with Hemolytic Events

Oxidizing Agents	Reducing Agents	Osmolar Insults
<ul style="list-style-type: none"> Copper Zinc Nitrate Ozone Paracetic acid 	<ul style="list-style-type: none"> Formaldehyde 	<ul style="list-style-type: none"> Hyperosmolar Hypo-osmolar Hyperthermia

Source: *The Diagnosis of Hemolysis During Dialysis* by Dr. Leslie Spry, Lincoln, NE. Seminars in Dialysis.

Some Possible Signs and Symptoms of Hemolysis

*Acute hypertension (Systolic blood pressure rising more than 30 mm Hg)	Nausea	Abdominal pain	Chest pain
* Shortness of breath	Cyanosis	Back pain	Headache
Generalized erythema ("turning red")	Vomiting	Chills	Diarrhea

* Pay particular attention to these unexpected symptoms during dialysis

Source: *The Diagnosis of Hemolysis During Dialysis* by Dr. Leslie Spry, Lincoln, NE. Seminars in Dialysis.



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Additional Suggested Reading

Blood Tubing Defect Linked to Four Dialysis Deaths by Mark E. Neumann. Nephrology News & Issues, July 1998 pages 9-11

The Diagnosis of Hemolysis During Dialysis by Dr. Leslie Spry, Lincoln, NE. Seminars in Dialysis.

Assessing Anemia Secondary to Hemolysis in Hemodialysis Patients by Jamie Behrens. Nephrology Nursing Journal, April 2001.

Hemolysis: Crisis Intervention by Elisabeth Harman. <http://nephrologynursing.net>

Multistate Outbreak of Hemolysis in Hemodialysis Patients – Nebraska and Maryland, 199. JAMA. 1998; 280: 1299-1300.

Prolonged Hemolysis from Overheated Dialysate by Berkes et al. Annals of Internal Medicine 83:363-364, 1975.

Hot Topics and Heads Up: Fall 2006 – Hemolysis 101. www.HeartlandKidney.org

Dealing with the Unexpected. <http://www.ultracare-dialysis.com>

Hidden Hemolysis by P. Dutka. Nephrology Nursing Journal, 2007 Mar-Apr; 34(2):223-4.

Formaldehyde-induced hemolysis during chronic hemodialysis by Orringer and Mattern. New England Journal of Medicine. Volume 294:1416-1420, June 24, 1976.

Blood Flow, Negative Pressure, and Hemolysis During Hemodialysis by Twardowski et al. <http://www.multi-med.com>

KDOQI Guidelines - Anemia

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