ReNews®

A publication on dialyzer reprocessing volume 16, 2009

Successful Heparin Strategies in Today's Economic Environment

Heparin may be the most important, and most frequently used, medication in hemodialysis. Most dialyzers currently in routine clinical use require anticoagulation to prevent the clotting that reduces blood compartment volume.[1] During the course of a dialysis treatment, a patient's blood will contact approximately 650m² of tubing and membrane material.[2] When blood comes into contact with foreign surfaces, the clotting mechanism is initiated. When the body has a need to clot blood, the protein prothrombin converts to thrombin, which in turn assembles other proteins to form a blood clot. "Heparin activates antithrombin which inhibits prothrombin to thrombin formation"[3] and so, inhibits the reactions that lead to the clotting of blood and the formation of fibrin clots. Heparin does not dissolve previously formed clots, but it does forestall their enlargement and prevent new clots from forming.

Originally, a typical heparin administration scheme was based on empirical evidence and was more art than science. In the late 1970's, Frank Gotch and others developed pharmacodynamic models for determining individual heparin doses, based on serial measurements of coagulation times over several dialysis treatments. Implementation of these models were time consuming and expensive, particularly after passage of the Clinical Laboratory Improvement Amendments (CLIA) of 1988 that requires that any laboratory testing of human specimens be performed in a certified laboratory that incorporates quality control, proficiency testing, and calibration verification in its testing program.[4] This effectively prohibited manual determination of coagulation times in dialysis facilities.

Alternative heparin administration models were subsequently implemented. One such method proposed by Lazurs, J.M, Denker, B., & Owen, W, in the 5th Edition of The Kidney (as cited in Contemporary Nephrology Nursing: Principles and Practices, Second Edition –

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Q&A ? ? ? ? ? ?

Pressure Failure

Q: I was calibrating the Renatron® station this morning and received a Pressure Fail alarm in Step 39. No dialyzer was attached, so what could be the cause of the alarm?

A: The Renatron II 100 Station will build at least -250 mmhg of vacuum in the Renatron during Step 38 and apply the vacuum to the dialysate circuit in Step 39. The pressure transducer will measure the pressure change in Step 39.

In Step 39 of the 00 and CH program, if the pressure in the dialysate circuit drops by more than 50 mmhg within 60 seconds, the Renatron Station will alarm and display Pressure Fail. In Step 39 of the HF program, if the pressure in the dialysate circuit drops by more than 50 mmhg within 45 seconds, the Renatron Station will alarm and display Pressure Fail.

<u>Troubleshooting</u>
Inspect Hansen connectors and Hansen o-rings:

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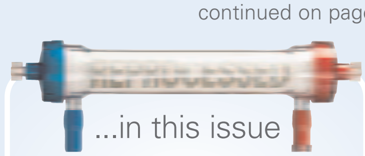

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Heparin Strategies

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American Nephrology Nurses' Association 2006), called for a pre-dialysis bolus (loading dose) of 50 – 100 units/kg of patient weight and a continuous maintenance dose of about 1000 units/hr.[5]

Before 2008, heparin was relatively inexpensive, ranging from approximately $0.03 – $0.08/1000 units. Typically, heparin for dialysis is supplied in a 1000 units/ml concentration. Heparin has been used in priming dialyzers, during patient treatments and in post-treatment rinsing of the dialyzer without incurring a major expense for dialysis clinics. In January 2008, a major recall of heparin was initiated because of contaminated raw stock imported from China. Baxter stopped manufacturing heparin in 2008, and APP Pharmaceuticals became the sole U.S. manufacturer of heparin. The cost of heparin increased six to seven fold, with prices ranging from approximately $0.19 – $0.56/1000 units. Facilities began decreasing heparin use for dialysis treatments soon after. While too much heparin can induce hemorrhage, too little heparin leads to resumption of the clotting mechanism, causing clots to form in the dialyzer. As fibers are lost due to clotting, the efficiency of the dialyzer decreases, and the reduced surface area translates to reduced clearances.

Although heparin management is often associated with reuse outcomes, the prudent management of heparin is not an issue of reuse versus single use. The outcomes of bad heparin practices have an equally damaging affect on the amount of therapy delivered by either single-use or multiple-use dialyzers.

Strategies have been developed to maximize the effectiveness of the prescribed heparin dose; the route and timing of delivering the loading dose plays a critical role. It is important to aspirate and flush the heparin loading dose or follow the loading dose with a saline flush to ensure delivery of the entire loading dose to the patient. Allow the loading dose to recirculate for 3 – 5 minutes before initiating dialysis.[6] It will take 3 – 5 minutes for a measurable portion of the heparin to recirculate back to the access. "It takes approximately 5 minutes for heparin to activate antithrombin."[7] If you do not wait 5 minutes before patient connection, part of the hemodialyzer clots at the very beginning of the treatment, and the entire treatment becomes suboptimal.[8]

The three principle methods of heparinization can be classified as: loading dose only, intermittent bolus and continuous heparinization. Loading dose only heparinization involves delivering a large enough dose of heparin at the initiation of dialysis to anticoagulate the patient for the entire treatment. Since the half-life of heparin is 90 – 110 minutes, the loading-dose only method is effective for treatments of short duration, but is much less effective as the length of treatment increases. In the intermittent bolus method of heparinization, the patient receives a loading dose followed by small boluses of heparin administered hourly. The intermittent method is associated with periods of under and over anticoagulation and requires an attentive caregiver to make sure the hourly bolus of heparin is given.

When monitoring the effectiveness of continuous heparinization, some important questions to ask are:

- ***Was the heparin line primed before the initiation of dialysis?***
- ***Was the heparin pump turned on at initiation of dialysis?***
- ***Was the heparin line unclamped?***
- ***Was the heparin pump calibrated and in working order?***
- ***Was the heparin pump shut off at the prescribed time?***

Continuous heparinization involves a continuous injection of heparin delivered via a heparin pump after the loading dose is administered, and this may be the most effective method of heparinization.

One element of heparin use that was eliminated after cost increases was using heparinized-saline to rinse the dialyzers. Theoretically, this change had little effect on outcomes since heparin is anionic (carries a negative charge) and will attach to positively charged membranes, but few membranes carry a positive charge, and heparin will not inhibit platelet attachment to the membrane. Also, "heparin is a medication and blood interaction, not a medication dialyzer membrane interaction."[9] Results of using heparinized-saline for priming the dialyzer have been mixed.

Proper priming and handling of the dialyzer and the bloodlines can help ensure that the full benefit of whatever amount of heparin is prescribed is realized. The impact of air in the extracorporeal circuit promotes clotting at the air/blood interface and a decrease in dialyzer efficiency. **AIR IS DEATH TO A DIALYZER!**

To minimize the impact of air on a dialyzer, eliminate ALL air from the arterial line before attaching it to the dialyzer. Prime the dialyzer from bottom to top. Recirculate at a speed that does not pull in air, and keep the arterial end of the dialyzer down until after recirculation of saline begins. Fully prime and then clamp the heparin maintenance line. If the line is not primed at the appropriate time, air may be infused into the dialyzer on blood lines that have the arterial drip bulb/chamber located pre-pump. Fully prime the arterial or venous bloodline before connecting it to the dialyzer to avoid infusing air into the dialyzer fibers. Air can become trapped in the blood pump header segment and then become lodged in the arterial header of the dialyzer. Not positioning the dialyzer vertically allows air to migrate to the highest point in the dialyzer header, occluding fibers and possibly reducing the membrane surface area. After the patient has been disconnected from the dialyzer, inject any remaining heparin into the extracorporeal circuit and recirculate at the maximum pump speed. If there is no heparin, recirculate anyway, since this may help prevent additional clotting before reprocessing.

Dialysis practices before the heparin recall and price increases of 2008 relied on heparin to compensate for bad practices. Current economics require close attention to best practices to maximize return on heparin investment. The effectiveness of heparin protocols is not dependent on any one factor, and anticoagulation strategies include effective delivery of heparin and the elimination of air from the extracorporeal circuit.

[1] American Journal of Kidney Diseases, Vol 35, No 1 (Jan), 2000: pp 89-94

[2] Dialysis and Transplantation, (April), 2001: pp 223-224

[3] Dialysis Technology, Third Edition National Association of Nephrology Technicians/Technologists 2003, p 80

[4] Ward, R, Aronoff, G,Anticoagulation Strategies During Hemodialysis Procedures, Principles and Practices of Dialysis (pp 70-78) Lippinicott, Williams & Wilkins 1994

[5] Contemporary Nephrology Nursing: Principles and Practices, Second Edition – American Nephrology Nurses' Association 2006, page 550

[6] Contemporary Nephrology Nursing: Principles and Practices, Second Edition – American Nephrology Nurses' Association 2006, page 550

[7] Dialysis Technology, Third Edition National Association of Nephrology Technicians/Technologists 2003, p 80

[8] Dialysis and Transplantation, (April), 2001: pp 223-224

[9] Dialysis Technology, Third Edition National Association of Nephrology Technicians/Technologists 2003, p 80

Heparin Strategic Summary Chart

ACTION	OUTCOME
Aspirate heparin bolus	Delivers prescribed heparin dose
3-5 minute dwell time	Achieves systemic heprinization
Continuous delivery of maintenance heparin dose	Avoids periods of under and over heparinization
Proper priming	Prevents air from entering the extracorporeal circuit
Vertical positioning of the dialyzer	Prevents air from accumulating in the arterial header

What are "Humectants" and Why Should I Care?

A "Humectant" is a substance that is added to a product to retain moisture. In products such as cosmetics and hair care products, the benefits of a substance such as a humectant are obvious; humectants help to retain moisture on your hair and skin. But what do humectants have to do with dialysis and the dialysis setting?

All surface disinfectants have an associated contact time. The contact time is the time that the surface must remain in contact with the disinfectant to assure efficacy. Many disinfectants have five-minute and ten-minute contact time. If you apply a disinfectant to a surface, chances are that the solution will evaporate well in advance of the stated contact time. This is where humectants come into play. Humectants allow for a thin layer of disinfectant to remain on the disinfected surface. Even though the surface looks dry, the humectant retains enough disinfectant to meet the stated contact time. Surface disinfectants, such as CleanCide® Ready To Use, contain humectants to achieve efficacy.

Humectant content should be considered when evaluating the effectiveness of a surface disinfectant. You should question how any disinfectant product meets the minimum surface contact time.

MINNTECH® renal systems

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Q&A

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- Make sure the Hansen o-rings are in good condition – no cuts or signs of wear.
- Make sure Hansen connectors are in good condition.

Inspect valve 4, 6, 9 and 11 plungers for:

- Complete circular imprint on the plunger head.
- The spring is on the plunger in the correct direction (small end toward the rubber head of the plunger).
- The plunger moves smoothly within the valve guide.
- No cracks or debris in the manifold.

Inspect the lower two Colder quick connects on the front of the manifold:

- Any imperfection in the o-ring or the connector can cause a pressure fail; replace the o-ring or connector if they are not in perfect condition.

Test the pressure transducer:

- Call Minntech Technical Services for instructions on testing the pressure transducer.

Note: Do not cut the tubing when removing the Hansen connector or Colder connectors. It is recommended that you heat the tubing with a heat gun or hot water to remove the fittings. A knife may score the fittings and create a leak path that will cause a pressure fail.

Note: Defective or worn fitting on the blood circuit will not cause a pressure fail in Step 39.

Calendar of Events

August 2009

17th World Transplant Games
(http://www.worldtranslantgames09.com)
August 22-30
Gold Coast, Australia

September 2009

American Association of Kidney Patients (AAKP) Annual Convention
(http://www.aakp.org)
September 3-5
Denver, CO

October 2009

American Kidney Fund (AKF) 2009 Conference
(http://www.kidneyfund.org)
October 1
Baltimore/Washington
(Laurel, MD)

ANNA Fall Meeting for Nephrology Nurses
(http://www.annanurse.org)
October 9-11
Lake Buena Vista, FL

21st Annual ESRD Network of New England Educational Meeting
(http://www.networkofnewengland.org/meetings.htm)
October 15
Sturbridge, MA

American Society of Nephrology (ASN) Renal Week
(http://www.asn-online.org/home.aspx)
October 27-November 1
San Diego, CA

Renatron® Service & Maintenance Seminars

Each two-day seminar covers:

- Renatron specifications and operational procedures
- Renalin® description, specification, dilution, handling instructions and testing
- Calibration and maintenance lab
- Performing calibration and maintenance procedures
- Hydraulic schematic and program outlines
- Hands-on troubleshooting using hydraulic schematics
- Troubleshooting techniques and repair lab

DATES	LOCATIONS
Sept. 22-23, 2009	Atlanta, GA
Sept. 24-25, 2009	Atlanta, GA
Nov. 17-19, 2009	Dallas, TX
Nov. 20-21, 2009	Dallas, TX

To request registration for Maintenance Seminars, email frankhouser@minntech.com

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