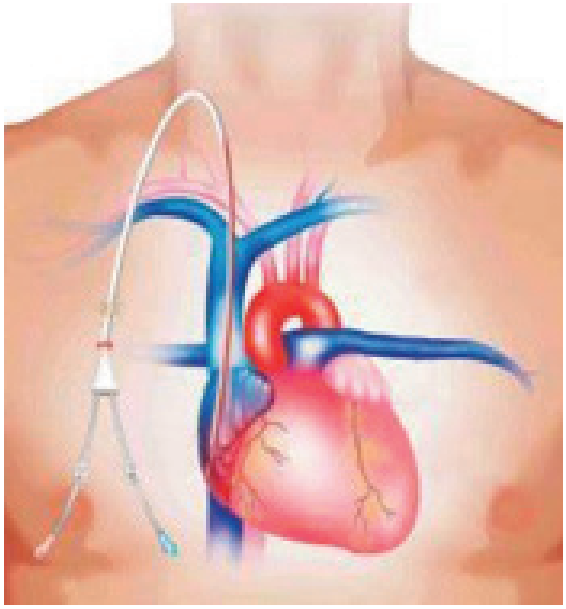
Optimizing Dialysis Adequacy In Dialysis Patients with Central Venous Catheters

Even though central venous catheters (CVCs) are prone to thrombosis and infection, 80.9% of patients use a catheter at initiation of HD, and 21.1% of prevalent patients continue that use.[1] (Note the 2019 KDOQI updated definition of CVC dysfunction: failure to maintain the prescribed extracorporeal blood flow required for adequate hemodialysis without lengthening the prescribed HD treatment.) Yet, catheter dysfunction remains a serious cause for concern for hemodialysis providers. Two potential pitfalls to achieving adequate catheter dose delivery include:

- A fibrin sheath can block the catheter's lumen, thus impeding flow and causing a severe drop in dialysis dose delivery.
- The close proximity of the catheter's arterial entry and venous return ports make recirculation and underdialysis likely.

Note: if any intervention occurs, such as the use of a thrombotic agent, the Delivered Flow and Recirculation measurements can be repeated to determine the effectiveness of the intervention.



Central venous catheter inserted via the jugular vein into the right atrium of the heart to serve as a vascular access for hemodialysis.

Delivered Blood Flow and Recirculation to Optimize Catheter Dialysis Measurements

Compare Transonic Delivered Blood Flow reading with the hemodialysis machine's pump setting. If the disparity is more than 10%, check for kinked tubing. A fibrin sheath might be restricting inflow and reducing dose delivery. The optimization of hemodialysis for cathether connection configuation with the Transonic Hemodialysis Monitor can be used to then check for recirculation. If the connection is then reversed, the Delivered Flow and Recirculation measurements should then be repeated to determine the best catheter configuration.

- The nurse can adjust the dialysis delivery parameters (time, pump setting etc.) to compensate for recirculation and deliver the prescribed dose of dialysis to the patient.
- Dialysis lines may be reversed. Reversing the lines might also correct high recirculation.

The nurse should report unusual delivered blood flow and recirculation readings to the Patient Care Team and/or nephrologist to ensure optimum short- and long-term management of the patient's hemodialysis treatment.

1. United State Renal Data System. 2022 USRDS Annual Data Report: Epidemeology of kidney disease in the United States. National Institute of Health, National Institute of Diabetes and Digestive and Kidney Diseases. Bethesda, MD, 2022.

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Optimizing HD Adequacy in Catheters

Catheter Configuration with the Transonic HD Monitor

Step 1:

MEASURE DELIVERED BLOOD FLOW RATE

With the bloodlines configured as normally used (document configuration), measure flow. Transonic Delivered Blood Flow Rate (Qb) is within 0-10% of the hemodialysis machine's set blood pump speed or delivery flow rate.*

YES

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS WITHIN 0-10% OF HEMODIALYSIS MACHINE'S SET, OR DELIVERY FLOW READING*

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration.

PROCEED TO RECIRCULATION MEASUREMENT

NO

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS >10% LOWER THAN THE HEMODIALYSIS MACHINE'S SET BLOOD PUMP SPEED OR DELIVERY FLOW READING*

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing the bloodlines to the opposite lumens of the catheter used for the initial measurement. Document configuration.

Repeat the blood flow measurement.

YES

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS WITHIN 0-10% OF THE HEMODIALYSIS MACHINE'S SET OR DELIVERY FLOW READING*

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration.

PROCEED TO RECIRCULATION MEASUREMENT

NO

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS 10% LOWER THAN THE HEMODIALYSIS MACHINE'S SET BLOOD PUMP SPEED

Carefully document measurement and catheter configurations.

Proceed to recirculation measurements with both catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

*Some Hemodialysis machines display both a Set Blood Pump Speed and Delivery Flow Reading. If both readings are displayed on your Hemodialysis machine, use the Delivery Flow Reading.

Catheter Configurations:

- Normal Configuration: Arterial Catheter Hub to Arterial Bloodline + Venous Catheter Hub to Venous Bloodline
- Reverse Configuration: Arterial Catheter Hub to Venous Bloodline + Venous Catheter Hub to Arterial Catheter Hub

Reference: Hemodialysis Catheter Optimization (HD-150-tn) Rev A 2017

Optimizing HD Adequacy in Catheters

Catheter Configuration with the Transonic HD Monitor

Step 2:

CHECK RECIRCULATION

With the bloodlines configured from Step One with maximized Delivered Blood Flow Rate,

MEASURE RECIRCULATION

Recirculation is within 0 - 10%

YES

RECIRCULATION IS WITHIN 0-10%

Current blood pump setting is maximizing Delivered Blood Flow with the current catheter to bloodline configuration.

NO

RECIRCULATION IS GREATER THAN 10%

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing bloodlines to the opposite lumens of the catheter used for the initial measurement.

REPEAT RECIRCULATION MEASUREMENT

YES

RECIRCULATION IS WITHIN 0-10%

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration.

NO

RECIRCULATION IS GREATER THAN 10%

Carefully document measurement and catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

Reference: Hemodialysis Catheter Optimization (HD-150-tn) Rev A 2017

Optimizing HD Adequacy in Catheters cont.

Catheter Configuration with the Transonic HD Monitor

For Use with Fresenius 5008 or other Hemodialysis machines that have Compensated Blood Flow Rate Capabilities

Step 1:

MEASURE DELIVERED BLOOD FLOW RATE

With the bloodlines configured as normally used (document configuration), measure flow.

Transonic Delivered Blood Flow Rate (Qb) is higher than the Fresenius 5008 set blood pump speed or within 0-10% lower than the set blood pump speed.

NOTE: Both higher and lower differences are displayed in RED on the Transonic screen.

YES

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS HIGHER THAN THE FRESENIUS 5008 SET BLOOD PUMP SPEED OR IS WITHIN 0-10% LOWER THAN THE SET BLOOD PUMP SPEED.

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration.

PROCEED TO RECIRCULATION MEASUREMENT

YES

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS HIGHER THAN THE FRESENIUS 5008 SET BLOOD PUMP SPEED OR IS WITHIN 0-10% LOWER THAN THE SET BLOOD PUMP SPEED.

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration.

PROCEED TO RECIRCULATION MEASUREMENT

This protocol only applies when using Fresenius 5008 Hemodialysis Machines.

Catheter Configurations:

- Normal Configuration: Arterial Catheter Hub to Arterial Bloodline + Venous Catheter Hub to Venous Bloodline
- Reverse Configuration: Arterial Catheter Hub to Venous Bloodline + Venous Catheter Hub to Arterial Catheter Hub

NO

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS >10% LOWER THAN THE FRESENIUS 5008 SET BLOOD PUMP SPEED.

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing bloodlines to the opposite lumens of the catheter used for the initial measurement. Document configuration.

Repeat the blood flow measurement.

NO

TRANSONIC DELIVERED BLOOD FLOW RATE (QB) IS 10% LOWER THAN THE FRESENIUS 5008 SET BLOOD PUMP SPEED

Carefully document measurement and catheter configurations.

Proceed to recirculation measurements with both catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

Optimizing HD Adequacy in Catheters cont.

Catheter Configuration with the Transonic HD Monitor

For Use with Fresenius 5008 or other Hemodialysis machines that have Compensated Blood Flow Rate Capabilities cont.

Step 2:

CHECK RECIRCULATION

With the bloodlines configured from Step One with maximized Delivered Blood Flow Rate,

MEASURE RECIRCULATION

Recirculation is within 0 - 10%

NO

RECIRCULATION IS GREATER THAN 10%

Only proceed if both catheter lumens had blood return with treatment initiation.

Using aseptic technique, reverse the catheter configuration by reversing bloodlines to the opposite lumens of the catheter used for the initial measurement.

REPEAT RECIRCULATION MEASUREMENT

YES

RECIRCULATION IS WITHIN 0-10%

Current blood pump setting is maximizing the Delivered Blood Flow with the current catheter to bloodline configuration.

NO

RECIRCULATION IS GREATER THAN 10%

Carefully document measurement and catheter configurations.

Escalate the results of the findings to the nephrologist for possible catheter evaluation or prescription adjustment to address catheter dysfunction.

YES

RECIRCULATION IS WITHIN 0-10%

Current blood pump setting is maximizing Delivered Blood Flow with the current catheter to bloodline configuration.

Reference: Hemodialysis Catheter Optimization (HD-152-tn) Rev A 2017

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Link to the 2019 KDOQI Vascular Access Guidelines
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Guideline Implementation Toolkit for Monitoring and Prevention of CVC Dysfunction
https://www.kidney.org/sites/default/files/vait-20_cvc_complications-monitoring_detection_cvc_dysfunction.pdf

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