

# Best Practice: Dialysis Adequacy

Optimize efficient dialysis delivery and assess measurement of delivered pump blood flow and recirculation

## DELIVERED BLOOD FLOW

Pump (delivered blood) flow errors and recirculation compromise dialysis delivery of a KT/V prescription. The Transonic® Hemodialysis Monitor measures true delivered blood flow through dialysis tubing using Gold Standard transit-time ultrasound technology. By comparing actual delivered blood flow to the pump's reading, any flow limiting cause such as small needle diameter or incorrect needle placement can be identified and corrected.<sup>2,3</sup>

Delivered Blood Flow-QC® is used to:

- Test blood pump calibration and its "effective flow" algorithm;
- Find the cause of excessive negative arterial pressure;
- Determine the most appropriate blood pump setting for a low flow access when it is not feasible to increase access flow;
- Diagnose tubing set flow restrictions that might cause hemolysis.

## CASE REPORT: INADVERTENT REVERSAL OF BLOOD LINES

A routine Transonic® hemodialysis screening of a 41 year-old female ESRD patient reported a vascular access recirculation of 22%. The nurse reversed the blood lines and performed a second recirculation measurement. 0% recirculation registered. This demonstrated that the hemodialysis lines had been inadvertently reversed when they were initially connected for hemodialysis. The lines were left in the correct position for the duration of the dialysis session and the patient received her prescribed dialysis prescription unimpeded by inadvertent reversal of the blood lines.

## KDOQI GUIDELINES

*"Any access recirculation is abnormal. Recirculation ... should have prompt investigation of its cause. ... If access recirculation values exceed 20%, correct placement of needles should be confirmed before conducting further studies."*

<http://www.kidney.org/professional/KDOQI/guideline-upHD-VA/index.htm>

## AV ACCESS RECIRCULATION

With a single infusion of saline, the Transonic® Hemodialysis Monitor detects and quantifies access recirculation, a late indicator of a failing access. Because Transonic® ultrasound dilution technology can separate cardiovascular recirculation from cardiopulmonary recirculation, 0% Recirculation can be quantified.

Measurement of recirculation will:

- Identify inadvertent reversal of blood lines;
- Confirm proper needle placement;
- Confirm 0% recirculation.

## CATHETER ADEQUACY

Central venous catheters often under deliver dialysis due to a discrepancy between a pump's setting and its actual delivered flow and/or the presence of recirculation. The Transonic® Hemodialysis Monitor optimizes dialysis catheter delivery by:

- Establishing a maximum dialysis pump setting before recirculation occurs;
- Using known values for flow and recirculation to adjust the length of dialysis;
- Identifying flow restrictions;
- Finding the best connections between a catheter and blood lines;
- Identify failing catheters through high recirculation rates.

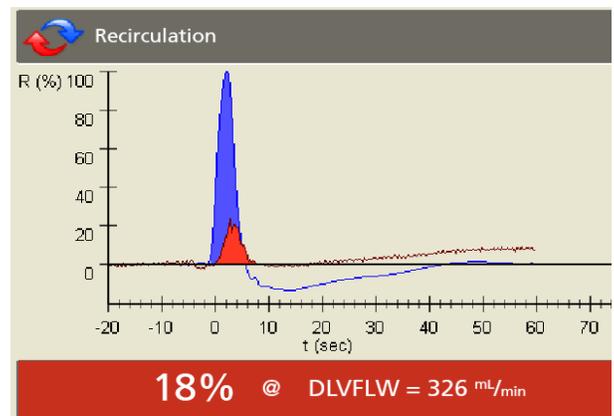
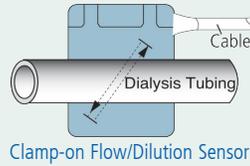


Fig. 1: Typical indicator concentration curves showing 18% access recirculation.

# Best Practice: Dialysis Adequacy Cont.

## HOW IT WORKS: DIFFERENTIAL TRANSIT-TIME ULTRASOUND

A clip-on sensor transmits a beam of ultrasound through the blood line. Two transducers pass ultrasonic signals back and forth, alternately intersecting the flowing blood in upstream and downstream directions. The Transonic® Hemodialysis Monitor derives an accurate measure of the changes in the time it takes for the wave of ultrasound to travel from one transducer to the other ("transit time") resulting from the flow of blood in the vessel. The difference between the upstream and downstream transit times is a measure of volume flow.



## HOW IT WORKS: ULTRASOUND INDICATOR DILUTION (Patient Blood Flows & Recirculation)

The velocity of ultrasound in blood (1560-1590 m/sec) is determined primarily by its blood protein concentration. The Transonic® Hemodialysis Monitor and Flow/dilution Sensors measure ultrasound velocity. A bolus of isotonic saline (ultrasound velocity: 1533 m/sec) introduced into the blood stream dilutes the blood and reduces the ultrasound velocity. The sensor records this saline bolus as a conventional indicator dilution curve.

When a bolus of saline indicator is introduced into the blood line, the arterial and venous sensors each register an indicator dilution curve (Fig. 1).

The Hemodialysis Monitor identifies the direct reflux of the venous saline indicator bolus into the arterial line (Fig. 2). The ratio of indicator concentrations equals access recirculation. High timing resolution enables identification of zero access recirculation (Fig. 3).

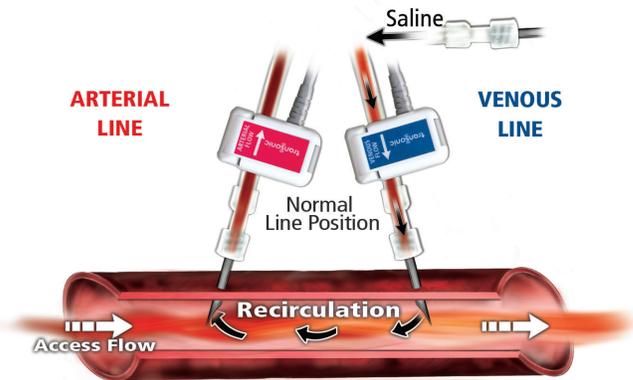


Fig. 2: Recirculation Measurement. Saline is introduced into the venous sensor with the dialysis lines in normal position. The arterial sensor measures the diluted concentration of blood from which recirculation is calculated.

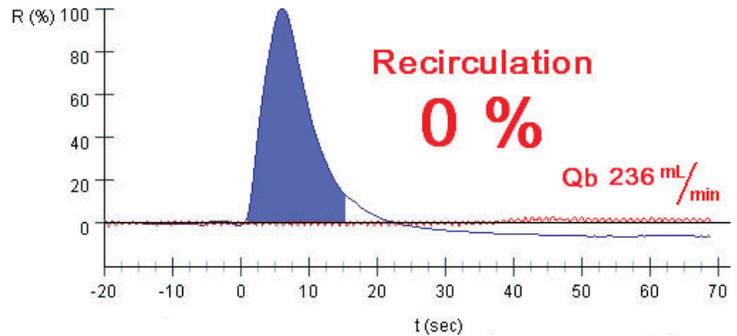


Fig. 3: Example of 0% Recirculation Measurement made possible due to the high timing resolution of the Transonic® Hemodialysis Monitor.

## SELECT REFERENCES

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- 6 Kelber J et al, Factors Affecting Delivery of High-Efficiency Dialysis Using Temporary Vascular Access," Am J Kid Dis 1993; 22(1): 24-29.



Transonic Systems Inc. is a global manufacturer of innovative biomedical measurement equipment. Founded in 1983, Transonic sells "gold standard" transit-time ultrasound flowmeters and monitors for surgical, hemodialysis, pediatric critical care, perfusion, interventional radiology and research applications. In addition, Transonic provides pressure and pressure volume systems, laser Doppler flowmeters and telemetry systems.

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