

Best Practice: Cardiac Function

Forestall ESRD patients' cardiovascular complications by routine clinical exams supported by hemodialysis cardiac function screening

Cardiovascular disease (CVD) is the leading cause of morbidity and mortality in patients with End-Stage Renal Disease (ESRD). Transonic Cardiac Function Monitoring provides a way to integrate cardiac function studies into a hemodialysis clinic's treatment protocol to forestall the devastating effects of CVD. Transonic proprietary ultrasound indicator dilution technology measures Cardiac Output and reports the following derived cardiac function parameters:

- Cardiac Output (CO);
- Cardiac Index (CI);
- Peripheral Resistance (PR);
- Central Blood Volume (CBV);
- Central Blood Volume Index (CBVI);
- Ratio of Access Flow to Cardiac Output (AF/CO).

Monitoring of these parameters identifies:

- 1) Dangerously high and prolonged levels of access flow (>1,600-2,000 mL/min) stress the heart causing cardiomegaly and heart failure. This can be identified by an access flow to cardiac output ratio (AVF/CO) exceeding 25-30%.
- 2) Dangerously low cardiac output ($CI < 2 \text{ L/min/m}^2$) which places patients at high risk for cardiovascular complications and failure.
- 3) Dramatic 20 - 30% decreases of Cardiac Index during hemodialysis to dangerously low levels due to inaccurate dry weight estimation and/or inadequate medication that places patients at high risk for cardiovascular complications and sudden death following a dialysis session.
- 4) Dangerous decreases in Central Blood Volume during dialysis that may portend hypotensive episodes.

Central Hemodynamic Profiling (CHP)

CHP is the periodic assessment of cardiac function during the hemodialysis session in order to track the heart's response to the stress of a dialysis treatment (Fig. 2). CHP identifies patients who leave hemodialysis sessions with dangerously low cardiac indices ($CI \leq 2.0$), that increases their risk for death, stroke or myocardial infarction.



Fig. 1: When you measure vascular access flow, you can save an access; when you measure cardiac output, you can save a life!

Cardiovascular mortality in ESRD patients, depending on age, is 10 - 500 times greater than the general population.
NKF Task Force on Cardiovascular Disease, AJKD 1999; 32(5)

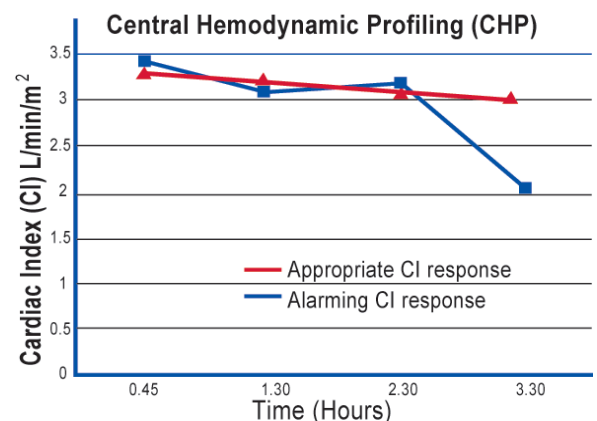


Fig. 2: Central Hemodynamic Profiling (CHP): four measurements taken during a single hemodialysis session shows Cardiac Index responses to the hemodialysis treatment. Acceptable CI results range between 2.5 - 4.2 L/min/m².
Courtesy of Dr. T. Tucker

transonic
THE MEASURE OF BETTER RESULTS.

Best Practice: Cardiac Function Cont.

HOW IT WORKS: CARDIAC OUTPUT VIA ULTRASOUND INDICATOR DILUTION

With blood lines in the normal line position and no direct recirculation present, cardiopulmonary recirculation represents a measure of cardiac output (Fig. 3). The complete bolus of saline indicator travels into the heart where it is mixed (diluted) into the full cardiac output. Part of this diluted indicator then reappears at the Transonic® arterial sensor. Cardiac output and Cardiac Index are calculated using conventional Stewart-Hamilton analysis.

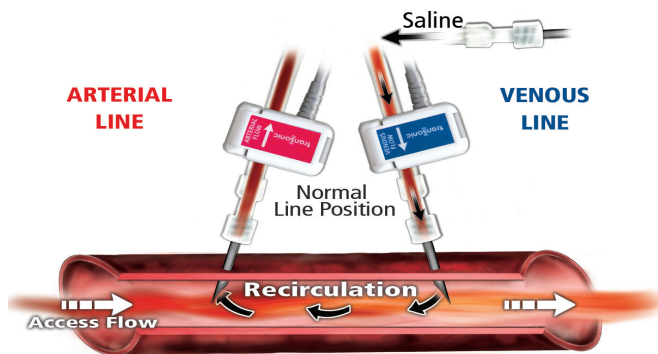


Fig. 3: Recirculation Measurement. Saline is introduced into the venous sensor with the dialysis lines in normal position. The arterial sensor measures the diluted concentration of blood from which recirculation is calculated.

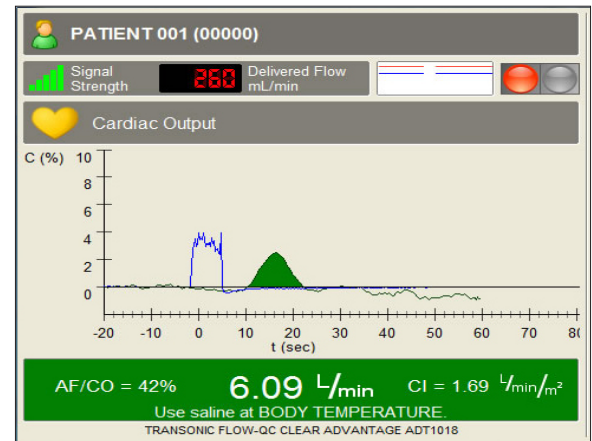


Fig. 4: Flow-QC screen reports Cardiac Output, Cardiac Index (CI) and Central Blood Volume (CBV). Software also displays Height, Weight, Heart Rate, Blood Pressure, Peripheral Resistance, Central Blood Volume Index, Systemic Cardiac Index and Stroke Volume.

"The ability to monitor cardiac output is one of the important cornerstones of hemodynamic assessment ...in particular in patients with pre-existing cardiovascular comorbidities." Tucker T et al,¹¹

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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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