CORRESPONDENCE

Novel use of the NexfinTM HD monitor for real-time physiological assessment of blood flow during creation of an upper extremity arteriovenous fistula

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To the Editor,

Arteriovenous fistulas (AVFs) must meet certain criteria regarding diameter and flow rate (Qa) upon maturation to be considered adequate for use in hemodialysis as well as to reduce the risk of negative sequelae such as high-output cardiac failure.^{1–3} In spite of extensive preoperative vessel assessment, 20–50% of AVFs fail to meet these criteria and must undergo surgical revision.⁴ Intraoperative assessment of AVF patency often relies on clinical evaluation for the presence of a venous thrill post-anastomosis, but this method is highly operator-dependent and a poor predictor of long-term AVF outcomes.² While more objective devices exist to assess intraoperative flow (i.e., devices to measure transit time), they are invasive and require expert surgical skill to produce accurate and reliable readings.² In addition, there is poor evidence to correlate a specific range of measured transit times with improved rates of maturation.² Creation of an AVF results in a well-documented increase in cardiac output (CO) due to a rapid decrease in systemic vascular resistance (SVR) post-arteriovenous anastomosis.^{1,3} Continuous measurement of CO by noninvasive means may provide a more objective and reproducible intraoperative method of measuring AVF patency and predicting long-term outcomes.

We present the novel use of photoplethysmographic technology with the NexfinTM HD monitor (BMEYE, Amsterdam, The Netherlands). This device was used for intraoperative assessment of CO during creation of a

brachiocephalic AVF in a 60-yr-old male with end-stage renal disease (glomerular filtration rate 19 mL·min⁻¹) and type 2 diabetes mellitus. The patient gave his consent for publication of this report. Anesthesia options were discussed and we elected to proceed with the procedure under general anesthesia. The patient was placed in the supine position and, in addition to using standard hemodynamic monitors, a Nexfin cuff was placed on the index finger of the patient's non-operative arm. The Nexfin uses finger cuff-based photoplethysmography to provide noninvasive continuous blood pressure, CO, SVR, and heart rate monitoring.⁵ Induction of anesthesia was uneventful and surgical management of the case was routine. Clinically, the surgical team was satisfied with the newly created AVF. Hemodynamic monitoring by Nexfin showed a baseline CO pre-AVF that ranged from 5.4–5.8 L·min⁻¹ and increased to 7.0 L·min⁻¹ immediately after the fistula was established (Figure). Systemic vascular resistance dropped from 955 dyn·sec⁻¹·cm⁻⁵ pre-AVF to 916 dyn·sec⁻¹·cm⁻⁵ post-anastomosis. The patient tolerated the procedure well and remained hemodynamically stable during the surgery and postoperatively until discharge.

Current intraoperative methods to determine AVF adequacy are limited to subjective clinical assessments or invasive and operator-dependent Qa measurement devices.² These methods are poor predictors of long-term AVF adequacy and continue to result in high AVF failure rates, particularly in females, the elderly, and diabetics.^{2,4} Intraoperative continuous monitoring of CO may provide an additional means of assessing AVF patency. This method would have traditionally required invasive arterial pressure (IAP) monitoring.⁵ Nevertheless, newer noninvasive CO monitors such as Nexfin are comparable with IAP for hemodynamic monitoring in the majority of patients undergoing surgery, but they do not come with any

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Figure Cardiac output (CO) tracing from the Nexfin™ monitor during creation of an upper extremity arteriovenous fistula (AVF). Baseline CO ranged from 5.4 to 5.7 L·min⁻¹, was 5.8 L·min⁻¹ pre-AVF and increased to 7.0 L·min⁻¹ immediately post-AVF

establishment (black arrow).^{*} The transient increase in CO before creation of the AVF, at 12:10, was due to a decrease in the end-tidal sevoflurane concentration from 1.5% to 1.2%. It was subsequently kept at 1.5% until the end of the case

of the serious risk factors associated with IAP.⁵ Our case suggests that Nexfin may offer a novel alternative to the current monitoring modalities. As this is a unique case study investigating the use of Nexfin in this population, it constitutes limited evidence. Formal study using a robust randomized trial design will be required to determine its role, if any, in the intraoperative assessment of AVF blood flow, and in its ability to predict fistula maturation and reduce poor outcomes in patients with AVFs.

Conflicts of interest None declared.

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