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When Managing Patients with Left Ventricular Assist Devices Undergoing Noncardiac Surgery, Less Is Not More

To the Editor:

We read with great interest the manuscript in the March 2017 issue of Anesthesiology by Mathis *et al.*[1] that provided an overview of the authors' experiences managing patients with left ventricular assist devices (LVADs) who were undergoing noncardiac surgery. We would propose that there are no straightforward anesthetics for LVAD patients and that all cases performed on LVAD patients should be considered higher risk. In this context, risk stratification is unnecessary and, if anything, may lead to an increased sense of complacency when managing a "low-risk" LVAD patient—there is no such thing.

Certain elements of the anesthetic planning should reflect this increased risk. For example, only 20.1% of the anesthetics described by Mathis *et al.* involved placement of an arterial line. Given their diminished pulsatile flow and the complex physiologic changes that may occur in the LVAD heart undergoing sedation and anesthesia, we would argue that this percentage should be much higher, even in cases not involving general anesthesia. Not only does the arterial line display an accurate reflection of blood pressure and pulsatility, the waveform itself can yield valuable information about volume status.[2] The authors' observation that 5.5% of cases were performed without any recorded blood pressure (invasive or noninvasive) further highlights the importance of having a low threshold to place a reliable intraarterial blood pressure monitor. Additionally, the fact that 55% of cases had a more than 20-min intraoperative gap without

recorded blood pressures is of particular concern, as duration of intraoperative hypotension has been shown to correlate with acute kidney injury, among other adverse outcomes.[3,4] Given the low incidence of complications associated with radial arterial line placement and the high incidence of intraoperative hypotension in this population, we would argue that arterial line placement is underutilized in the perioperative management of these patients.[5]

Competing Interests

The authors declare no competing interests.

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Noninvasive Blood Pressure Determination in Left Ventricular Assist Device Patients

To the Editor:

We read with great interest the intriguing study by Mathis *et al.*[1] involving 702 noncardiac procedures performed in patients with left ventricular assist devices (LVADs). We commend the authors for their work in this important area and share their passion and enthusiasm for caring for LVAD patients perioperatively.

Mathis *et al.* reported that arterial line blood pressure (BP) was utilized in 20% of cases, with the remaining relying on noninvasive BP monitoring modalities. Interestingly, they report that 55% of all anesthetics had a greater than 20-min gap intraoperatively without a documented BP reading. Even more alarming is that 48% of their anesthetics had BP monitoring for less than 20% of minutes intraoperatively, and 31 cases lacked any BP recordings entirely. Further, in cases where an arterial line was employed, they report a monitoring gap of greater than 20 min in 32% of anesthetics occurring primarily between induction of anesthesia and arterial line placement. It is not reported in the manuscript whether the placement of arterial access was necessitated by the inability to obtain noninvasive BP readings or whether it was anticipated based upon patient and/or surgical factors. Mathis *et al.* stated that when BP was not recorded, "measures approximating vital organ perfusion were documented, including patient responsiveness (*e.g.*, patient following commands, patient alert, *etc.*) in 11 cases and/or serial documentation of stable LVAD parameters (*i.e.*, flow, power, and pulsatility index) in 29 cases."

We previously reported that arterial line BP monitoring was used in 66% of LVAD patients undergoing general anesthesia for noncardiac surgery at our institution.[2] In LVAD patients undergoing exclusively gastrointestinal endoscopy principally without general anesthesia, we reported arterial line use in only 10% of procedures.[3] In 6% of these anesthetics, the BP was not charted or documented as inaccurate.

The American Society of Anesthesiologists Standards for Basic Anesthetic Monitoring state "every patient receiving anesthesia shall have arterial BP and heart rate determined and evaluated at least every five minutes," with exceptions permitted "under extenuating circumstances."[4] Continuous-flow LVAD patients present many perioperative challenges including BP monitoring. One study evaluated various noninvasive BP modalities in continuous-flow LVAD patients and found that the success rate of obtaining a BP reading with an automated BP cuff was 53%, Doppler BP 94%, auscultation 14%, and palpation 3%.[5] In our experience, although noninvasive BP determination (particularly with automated cuffs) may be initially possible in LVAD patients, preload and afterload can change markedly and rapidly intraoperatively. These fluctuations may result in a significant decrease in pulsatility with subsequent loss of reliable and accurate noninvasive BP readings. For this reason, we strongly believe that if noninvasive BP determination (especially an automated BP cuff) is utilized, then a more reliable modality to determine BP should be immediately available in the anesthetizing location such as Doppler BP or the ability to expeditiously place invasive arterial line BP monitoring. In teaching institutions such as ours, this often entails educational efforts in modalities such as Doppler BP determination and the limitations of automated BP cuffs that may be unfamiliar to the wide variety of noncardiac anesthesia providers who help care for LVAD patients perioperatively. When use of invasive arterial BP monitoring is planned intraoperatively, consideration should be made for placement before induction of anesthesia to avoid monitoring gaps postinduction should noninvasive BP determination attempts become unsuccessful. In cases where the functionality of noninvasive BP modalities