



Clinical Anesthesiology

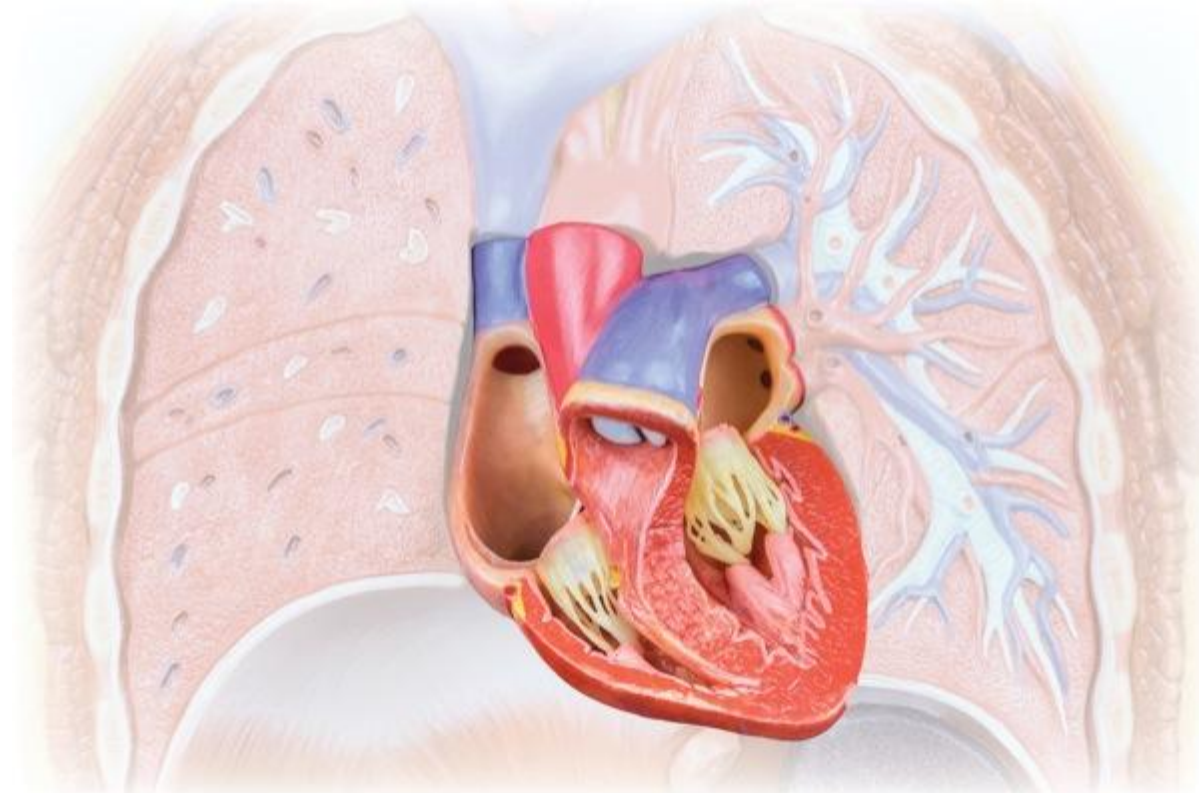
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Stroke Volume–Guided Resuscitation Improves Outcomes in Septic ICU Patients

San Antonio—Stroke volume–guided fluid resuscitation in severe sepsis and septic shock ICU patients may result in less fluid administered and improve patient outcomes that reduce cost of care, according to a new study.

Patients who underwent noninvasive cardiac output monitoring (NICOM) had improved outcomes of significantly shorter ICU stays, compared with patients undergoing a less specific approach of assessing fluid responsiveness. The NICOM patients also experienced reduced mechanical ventilation, shortened time on vasopressors and less hemodialysis, according to researchers at the University of Kansas Medical Center, in Kansas City.

According to Heath E. Latham, MD, FCCP, an associate professor of medicine in the Division of Pulmonary and Critical Care Medicine, the clinical benefits of using stroke volume–guided resuscitation through Cheetah Medical’s NICOM technology for a cohort of 100 ICU patients translated into a cost savings of nearly \$1.5 million—\$14,498 per patient—during the six-month study. The study was presented at the 2018 annual meeting of the Society of Critical Care Medicine (abstract 1451).



“There are multiple publications in the last decade that repeatedly show that only about 50% of patients with severe sepsis and septic shock are actually fluid responsive,” Dr. Latham said. In one analysis, only 40% to 72% of hemodynamically unstable patients benefited from IV fluids by increasing cardiac output and improving perfusion (*Expert Rev Anti Infect Ther* 2012;10[6]:701-706). In another, additional IV fluids did not improve perfusion in nearly half of hemodynamically unstable patients, and may instead have caused harm (*Crit Care Med* 2013;41[7]:1774-1781). “We know there is mounting evidence that potential harm is in place for patients who do have excess volume when we resuscitate them,” Dr. Latham said.

Recognizing this, the researchers wanted to investigate whether a difference would exist between patients treated with a stroke volume–guided resuscitation process versus those treated with usual care, which is when clinicians use vital signs, such as blood pressure and heart rate, to determine whether more IV fluids should be given to these patients.

The researchers conducted a retrospective chart review from April 2014 through September 2014 looking at patients in the ICU whose primary diagnosis on admission was severe sepsis or septic shock. “We chose this time frame because April of 2014 is when we acquired noninvasive cardiac output monitor technology to dynamically assess fluid responsiveness by measuring stroke volume in patients,” Dr. Latham said. Fluid volume would be administered only if the patient’s stroke volume was increased, he said. The study compared 100 patients in the stroke volume–guided group, with 91 patients during the same time frame who met the criteria for usual care.

Patients in the stroke volume–guided resuscitation group required 3.59 L less fluid, according to the study ($P=0.022$). “Our hypothesis was that stroke volume–guided resuscitation would result in less fluid administration, and that is, in fact, what we did show,” Dr. Latham said. “Within 24 hours there was a significantly less net fluid balance in those with stroke volume–guided resuscitation, and that difference persisted at 48 hours.”

ICU Stays Reduced, Too

The study also explored secondary outcomes. “Mortality was no different between the groups. However, ICU length of stay was significantly less in those with stroke volume–guided resuscitation,” Dr. Latham said. ICU length of stay was reduced by 2.89 days ($P=0.03$), he said.

The need for mechanical ventilation also was significantly less in those with stroke volume–guided resuscitation (29% vs. 57%), although “there was no difference in the time patients were on the ventilator between the two groups if they did require mechanical ventilation,” Dr. Latham said (relative risk [RR], 0.51; $P=0.0001$).

There was no difference in how many patients in each group required vasopressors, “but interestingly enough, in the stroke volume–guided group, patients required significantly less time (a 32.78-hour decrease) on vasopressors than those in the usual care group,” Dr. Latham said ($P=0.001$).

Patients required 13.25% less acute dialysis therapy in the stroke volume–guided group than in the usual care group (RR, 0.32; $P=0.01$), Dr. Latham said. The results of the study affected resuscitation strategies at the institution. “We only resuscitate with stroke volume–guided resuscitation,” Dr. Latham said. “Those that need it get it. Those that don’t, don’t.”

Paul E. Marik, MD, FCCP, FCCM, a professor of medicine and the chief of the Division of Pulmonary and Critical Care Medicine at the Eastern Virginia Medical School, in Norfolk, said the findings “are in line with a large body of recent scientific data, and what I have been preaching over the years.

“Excess fluid in patients with sepsis increases the risk of complications and death. It is absurd to postulate that a one-size-fits-all approach applies to fluid resuscitation in sepsis, that is, the Surviving Sepsis Campaign 30-mL/kg mandate,” Dr. Marik said. “Fluid, like any treatment, must be individualized according to each patient’s unique physiology.”

Dr. Latham said the cost savings of using stroke volume–guided resuscitation was based on a national data set that incorporates information from 17% of U.S. academic and community-based hospitals. The 2.89 days of reduced ICU length of stay saved \$8,953 per

treated patient; the risk of mechanical ventilation was reduced by 51%, saving \$1,940 per treated patient; and the risk of acute dialysis initiation was reduced by 32%, saving \$3,605 per treated patient. The study was published in the *Journal of Critical Care* before its presentation at the conference (2017;42:42-46).

The 100 patients underwent stroke volume–targeted fluid resuscitation guided by NICOM technology during the initial four hours of their ICU course. The technology determines stroke volume by continuously measuring the time delays between the voltage of pulsatile blood flow within the large thoracic arteries and the applied AC current. According to the Newton, Ma.–based Cheetah Medical, its NICOM technology uses four pads applied to the thorax that can tell whether additional IV fluids is likely to increase perfusion.

The dynamic assessment, such as the Passive Leg Raise, evokes a simple physiologic response by challenging the patient with a small volume of intravascular fluid and directly observing the heart’s ventricular response, the company said. If a patient’s stroke volume increases by at least 10%, this is highly predictive that the heart will benefit from the addition of IV fluids, according to the company. A response of less than 10% is predictive that the patient is unlikely to increase perfusion with additional fluid.

–*Thomas Rosenthal*

Dr. Latham received consulting fees from Cheetah Medical in 2016. None of the other authors of the study, as well as Dr. Marik, reported any relevant financial disclosures.