PHYSIO CONTROL

Best Practice

Prolonging CPR with Mechanical Chest Compression: Buying Time to Improve Survival

Challenge

Provide high-quality, prolonged CPR while diagnosing and treating cardiac arrest patients who need percutaneous coronary intervention (PCI).

Like hospitals across the globe, the University of Chicago Medicine (UCM) struggled to improve survival of cardiac arrest patients. Too often, patients would die before they could receive the lifesaving treatment they need—often PCI to unblock constricted arteries. Even those who arrived at the hospital with a pulse might lose their pulse in the ED or on the way to the cardiac catheterization laboratory. Others arrested—or rearrested—on the cath lab table.

"Patients weren't surviving the procedure. Or even if they survived, they were brain dead. We had to try to change this."

Dr. Atman P Shah,
MD, FACC, FSCAI,
Associate Professor of Medicine
Clinical Director, Section of Cardiology
Co-Director, Cardiac Catheterization Laboratory at UCM

Dr. Shah, knew all too well the factors working against high-quality CPR in the cath lab:

- Fewer staff available to provide chest compressions, especially on overnight shifts
- Ergonomic injury as nurses and residents strained to do CPR while bending over a table or gurney
- Providers increasing radiation exposure and interfering with proper vessel imaging during CPR
- Inadequate chest compression rate and depth due to leaning and provider fatigue
- Loss of sterile field

"Patients weren't surviving the procedure," Shah recalls of the situation two years ago. "Or even if they survived they were brain dead. We had to try to change this."

What follows, describes how UCM's cath lab team worked to turn the situation around. Their success has inspired their ED and other hospital teams to follow their lead.

University of Chicago Medicine
Photo is from UC Medicine Locations page, http://www.uchospitals.edu/visitor/index.html

In 2014, survival of cardiac arrest patients at UCM was 15%, including those who arrested in-hospital and those who arrived via ambulance. To help more patients survive cardiac arrest, the solution had to include improving CPR quality.

"We know going to the cath lab improves survival, but it's hard enough to do high-quality chest compressions in the hospital. Trying to do compressions in the cath lab is a disaster," declares Dr. Shah.

Solution

LUCAS® 3 Chest Compression System to provide uninterrupted, high-quality chest compressions, freeing providers to treat the causes of a patient's cardiac arrest.

Shah was familiar with the LUCAS chest compression system from his previous resuscitation research with animals. He started using it on patients who arrested in the cath lab.

The LUCAS Chest Compression System includes a back plate which is positioned underneath the patient as a support for external chest compressions, an upper part which contains the compression mechanism and disposable suction cup, and the stabilization strap which helps secure the position of the device on the patient.

"Results were unbelievable," Shah recalls. "End-tidal CO_2s were through the roof. I did five patients and every single one got ROSC back. That compared to less than 10% previously."

It was not long before other interventional cardiologists started using the LUCAS device as a bridge technology to support their patients until the team could resolve the underlying problem.

"You can't argue with a pulse and with seeing a patient leave the hospital alive," Shah says. Getting his team's buy-in was not an issue. "Once people saw how amazing it is, that was it."

Soon, residents and nurses on cardiac units were calling for the LUCAS device if their patients arrested. "The best advertising is seeing what's happening with patients," Shah says. Next, he started hearing from colleagues in the ICU and ED. His team responded with the device before transporting patients to the cath lab. The ED recently bought its own LUCAS device.

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Dr. Atman P Shah, MD, FACC, FSCAI

Protocols and Practices

Shah and his UCM colleagues developed the following protocols and practices:

- For patients who arrest in the hospital or arrive in the ED having suffered cardiac arrest:
  - Patients are screened to include only those who are under 65, not nursing home residents, and have life expectancy greater than 12 months.
  - Manual CPR is done until team members attach the LUCAS device to the patient.
  - The patient is brought to the cath lab rather than waiting to stabilize them in the ED or hospital unit.
- If a patient previously arrested but has achieved ROSC and is conscious, the back plate is placed on the cath lab table under the patient to facilitate the LUCAS device use in the case of a re-arrest.
- For stable patients who are awake, oriented and with a good pulse when brought to the cath lab, the LUCAS device is not applied prophylactically.

For the most part, cath lab procedures are the same whether or not the LUCAS device is being used. One procedural change is that with the LUCAS device in place, the team relies on cranial views for imaging studies rather than lateral and caudal perspectives.

- All cath lab providers and staff are trained to use the LUCAS device. A quarterly in-service and mock code drill help keep skills high.
- The LUCAS device has inspired hospital teams to extend CPR time before ending a code. Historically a Code Blue would have ended after 30 minutes if ROSC wasn't achieved. "There's no responder fatigue, so CPR quality stays high," notes Shah. "With the LUCAS chest compression system, we have the ability to do interventions without the patient dying first."
- The LUCAS device is not generally used to support patients from the cath lab to the Critical Care Unit. One patient, however, continued receiving mechanical compressions from the LUCAS device for 22 hours—until he received a ventricular assist device. He was successfully discharged to long-term rehab.
- There are cases when patients leave the UCM cath lab on extracorporeal membrane oxygenation (ECMO), otherwise known as ECPR, an extracorporeal blood pump and membrane oxygenator that can support a patient's circulatory and / or pulmonary systems. The 2015 AHA Guidelines list CPR in the angiography suite and CPR during preparation for ECPR as scenarios where use of mechanical chest compression devices may be considered, provided that rescuers strictly limit interruptions in CPR during deployment and removal of the device.[1]

Clinical Study Findings

Much higher rates of ROSC (74% v. 42%) have been achieved in cardiac arrest patients who received mechanical chest compressions instead of manual CPR in the cath lab. A significantly greater proportion of those receiving compressions from the LUCAS device were successfully bridged to extracorporeal life support (ECLS) (45% v. 8%).[2]

The statistically significant improvement in rate of ROSC was achieved despite a smaller proportion of witnessed arrests and fewer cases amenable to PCI in the group that received mechanical chest compressions. The findings are based on a retrospective analysis of patients who received ACLS in the UCM cath lab between May 2011 and February 2016. 43 patients required CPR for cardiac arrest in the cath lab (12 manual and 31 treated with the LUCAS device). The UCM team presented their findings at TCT 2016, the Transcatheter Cardiovascular Therapeutics educational symposium.

A second presentation at TCT by the team concluded "Mechanical chest compression may help bridge patients to potentially life-saving percutaneous ECMO."[3] The authors noted that use of devices like LUCAS chest compression system "provide automated compressions that are independent of rescuer fatigue and do not interrupt transport to the cardiac catheterization lab."

"The LUCAS device is absolutely invaluable for the interventional cardiologist. Having the LUCAS device in the cath lab is as essential as having a balloon pump or a covered stent."

Dr. Atman P Shah, MD, FACC, FSCAI

Future improvements

Shah wants to keep the improvements going. "There's a lot we need to do better in terms of tracking and protocols," he says.

The LUCAS device use in other parts of the hospital is still a work in progress. "We'd love to have a *LUCAS* on every floor," Shah says. "But first we need more hospital buy-in. That's for the next phase."

Shah also aims to make data review a regular part of their process. Until recent staff turnover, the hospital reviewed cardiac arrest events on a quarterly basis.

He would also like to improve data tracking. Currently, he and a cath lab nurse do a manual process, using Excel spreadsheets.

Words of Advice

Shah has this encouragement for hospital teams looking to improve their patients' odds of surviving: "The LUCAS device is a very easy implementation to help improve patient survival. These are patients who could survive but don't because the quality of CPR drops after the first responders. Even if a patient gets a pulse back, there's a high chance they'll arrest again. The LUCAS device gets the patient through the procedure and lets them get the definitive care they need."

Saving a Life

Behind the patient survival statistics are real people. Like a 64-year-old man who walked out of UCM's hospital less than a week after receiving PCI while the LUCAS device kept blood flowing to his brain and other vital organs.

A customer service manager with a family history of heart disease came to the ED with chest pain and shortness of breath. Initially his EKG showed only subtle T-wave changes. The cath lab was not activated, but ED doctors were called for a consult. He deteriorated rapidly, developing ventricular fibrillation and suffering multiple episodes of cardiac arrest, defibrillation and resuscitation with manual chest compressions.

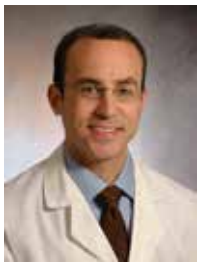
With refractory VF, the patient wasn't stable to transport. The cath lab team arrived with the LUCAS, attached it to the patient, and delivered high-quality mechanical compressions during the 10- or 15-minute journey through hallways and cramped elevators.

"We were able to transport him in a very controlled manner, without having to straddle the patient in an elevator giving inadequate chest compressions," recalls Dr. Jonathan Paul. Once in the cath lab, the interventional cardiologist performed PCI to clear an occlusion in the patient's left anterior descending artery (LAD).

"The device enabled us to do the PCI with high-quality CPR. It's hard to maneuver radiation equipment around a human being doing chest compressions. With the LUCAS device, it's easier to do the intervention without obstacles and interruptions."

"This patient almost certainly would not have survived if we didn't have a device like the LUCAS chest compression system."

Jonathan Paul, MD, interventional cardiologist
University of Chicago Medicine



"We felt comfortable that the patient was getting perfusion to the brain and heart," Paul adds. "Seeing mean arterial pressure at 50 to 60 millimeters of mercury makes you less concerned about possible neurological injury. It makes you push on a little further."

As soon as the occluded artery was opened, the patient's heart rhythm stabilized.

"Amazingly, he was able to leave the hospital in just a few days. His echo ejection fraction was normal at discharge. I saw him in follow-up clinic looking great," Paul reports. "This patient almost certainly would not have survived if we didn't have a device like *LUCAS*."

"The fact that he didn't have any neurological deficits on discharge despite needing 30 to 45 minutes of chest compressions speaks to the quality of the LUCAS device chest compressions," Paul continued. "I don't know if we would have achieved it with traditional chest compressions, but we did with this device."

About the University of Chicago Medicine

One of the nation's leading academic medical institutions, The University of Chicago Medicine comprises the Medical Center, Pritzker School of Medicine and the Biological Sciences Division. It is consistently ranked among the best hospitals in the nation by U.S. News & World Report. Last year the medical system reported 188,494 inpatient days, 90,736 ED visits and 760,201 outpatient encounters.

The Tools

The LUCAS Chest Compression System is designed to deliver effective, consistent and uninterrupted compressions according to current AHA guidelines to facilitate ROSC. It delivers automated compressions at a consistent rate and depth from first response in the field to patient transport and throughout the hospital. The LUCAS device facilitates consistent blood flow from the moment it is turned on, helping to improve a patient's chance for a successful outcome. The latest version, the LUCAS 3 device, collects data on compressions, pauses, user interaction, alarms and battery status. For easy review of device and user action, data can be downloaded via Bluetooth®.

LIFEPAK defibrillator/monitors have the power to escalate up to 360J for difficult-to-defibrillate patients. LIFEPAK 20e, 15 and 12 devices automatically capture continuous ECG waveforms and impedance data showing chest compressions and ventilations. Cardiac event data can be sent to CODE-STAT™ data review software wirelessly or using a gateway device, depending on the LIFEPAK model. The device also gathers $EtCO_2$ waveform, collects defibrillation information and records temperature and 10 parameters.

See the power and simplicity of LUCAS chest compression for yourself. Contact your Physio-Control sales representative or call 1.800.442.4412 to learn more.

REFERENCES

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For information about specific product claims and labeling, refer to the device operating instructions.

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