

# Routine Ultrasonography Use in Cardiopulmonary Resuscitation

Opposing authors provide succinct, authoritative discussions of controversial issues in emergency medicine. Authors are provided the opportunity to review and comment on opposing presentations. Each topic is accompanied by an Editor's Note that summarizes important concepts. Participation as an authoritative discussant is by invitation only, but suggestions for topics and potential authors can be submitted to the section editors.

**Editor's Note:** *Transthoracic ultrasonography has been promoted as a valuable tool for optimizing care of patients who have experienced cardiac arrest. However, it is unclear whether routine ultrasonography provides benefit or leads to improved patient outcomes. In this Clinical Controversies series, our discussants present pro and con views of using routine transthoracic ultrasonography in managing cardiopulmonary resuscitations.*

## ULTRASONOGRAPHY: A USEFUL ADJUNCT IN CARDIAC ARREST



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Cardiac arrest is a frequent presentation encountered by emergency physicians, with the majority of these patients experiencing poor outcomes. The goals of resuscitation are high-quality chest compressions and rapid identification of potentially reversible causes. There is an increasing body of evidence showing that point-of-care ultrasonography can improve the management of cardiac arrest. It can rapidly identify treatable causes, such as pulmonary embolism and cardiac tamponade, as well as determine the presence or absence of organized cardiac activity, which can help determine prognosis.<sup>1,2</sup> Point-of-care ultrasonography can also reliably identify esophageal intubation and pneumothorax.<sup>3,4</sup> Therefore, we believe it should be incorporated routinely into the management of cardiopulmonary arrest by appropriately trained physicians.

To begin with, point-of-care ultrasonography can rapidly and accurately identify pericardial tamponade and guide the drainage procedure, theoretically reducing the risk of complications.<sup>1,2</sup> It can also identify right ventricular enlargement, which is suggestive of pulmonary embolism,

and guide the decision to begin thrombolytic therapy in select cases.<sup>1</sup> Moreover, it can be used to identify pneumothorax both more quickly and more reliably than chest radiography.<sup>4</sup>

Additionally, pulse determination by health care providers may be inaccurate. A study with providers blinded to the presence or absence of aortic cross clamping found that the pulse was unrecognized by provider palpation in up to 45% of cases.<sup>5</sup> Physicians can use point-of-care ultrasonography in these cases to identify the presence of cardiac activity when no pulse is palpable (ie, pseudo-pulseless electrical activity). Hyperdynamic cardiac activity can suggest hypovolemia and the need for aggressive fluid repletion. The presence and cause of obstructive shock can also be uncovered, which may be less likely to be identified without point-of-care ultrasonography.<sup>6</sup> Furthermore, hypodynamic cardiac activity may suggest an alternate cause (eg, hyperkalemia, hypothermia) that would benefit from medical therapy while avoiding the complications associated with an unnecessarily invasive intervention (eg, needle decompression, blind pericardiocentesis). Finally, the absence of cardiac activity on point-of-care ultrasonography is associated with lower survival rates.<sup>1</sup> This could be used with other clinical information to stratify a cohort of patients in whom the outcome may be extraordinarily poor and aid in the decision to terminate resuscitation.<sup>1</sup>

In addition to evaluation of the heart and lungs, point-of-care ultrasonography is also a potentially valuable adjunct for airway assessment and management. Esophageal intubation has been demonstrated to occur in approximately 3.3% of all emergency intubations.<sup>7</sup> Complicating matters further, colorimetric end-tidal capnography may fail to identify intubation in up to one third of cases and is particularly problematic in cardiac arrest because of reduced pulmonary blood flow.<sup>8</sup> Point-of-care ultrasonography is able to rapidly and reliably identify endotracheal tube placement, with a mean confirmation time of 13 seconds.<sup>3</sup>

The potential for point-of-care ultrasonography to prolong pauses between periods of chest compressions is a

valid concern. However, a recent study of the Ultrasound for Circulation, Airway, and Breathing protocol in 177 cardiac arrest patients reported a mean duration of point-of-care ultrasonography assessment of only 9 seconds, which is shorter than the recommended 10-second pause for pulse checks.<sup>6</sup> An intervenable cause was identified by point-of-care ultrasonography in 18% of these patients.<sup>6</sup> Another study demonstrated that ultrasonographic acquisition time could be reduced with the use of a highly structured Cardiac Arrest Sonographic Assessment protocol.<sup>9</sup> Additional steps that have been shown to minimize pause duration with point-of-care ultrasonography include having the most experienced sonographer operate the transducer, placing the transducer in the subxiphoid location before the anticipated pulse check, having a code team member count down from 10 seconds during the pulse check, and saving clips during image acquisition, with assessment of the videos once compressions resume.<sup>9</sup> Newer literature has suggested that focused transesophageal echocardiography is feasible in the emergency department (ED) and allows assessment of the heart without significant pauses in compressions, although further studies are needed.<sup>10</sup>

According to the information discussed earlier, point-of-care ultrasonography likely has the greatest benefit in the assessment of pseudo-pulseless electrical activity, whereas it may have lower utility in pulseless ventricular tachycardia or ventricular fibrillation. Given the relatively low survival rates in patients with pulseless electrical activity, most studies were underpowered to assess differences in this outcome as a result of point-of-care ultrasonography.<sup>6,9</sup> However, research has consistently found that point-of-care ultrasonography identifies a number of intervenable causes,<sup>1,2,6</sup> although further studies are needed to determine the effect on survival rates.

The sickest patients in the ED deserve the highest level of care. In the case of cardiac arrest, this includes properly implemented point-of-care ultrasonography. Although further studies are needed to determine the optimal application of point-of-care ultrasonography in cardiac arrest, providers with adequate training should strongly consider incorporating it into their cardiac arrest algorithms.

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## ULTRASOUND SHOULD NOT BE ROUTINELY USED DURING CARDIOPULMONARY RESUSCITATION FOR SHOCKABLE RHYTHMS



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Cardiac arrest affects greater than 350,000 patients annually in the United States, with most patients experiencing poor outcomes.<sup>1,2</sup> Current American Heart Association guidelines recommend management focus on continuous, high-quality chest compressions, defibrillation in shockable rhythms, and identification of reversible causes of cardiac arrest in nonshockable rhythms.<sup>1-4</sup> Ultrasonography has received significant attention as a potential adjunct in the treatment of these patients.<sup>5,6</sup> However, much of this literature fails to explore the potential harms of using it during cardiac arrest,