

CASE AND COMMENTARY

How Should a Surgeon and Anesthesiologist Cooperate During Intraoperative Cardiac Arrest?

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Abstract

Surgeons and anesthesiologists each have a unique sense of duty and responsibility to patients throughout all phases of perioperative care. Intraoperative cardiac arrest during elective, noncardiac surgery is rare, with an incidence between 0.8 to 4.3 per 10 000 cases. Fortunately, patients who suffer cardiac arrest during surgery are more likely to survive than patients who suffer cardiac arrest in other settings. This article considers factors that have been shown to influence outcomes after intraoperative cardiac arrest and offers a framework for analyzing and discussing these clinically, ethically, and emotionally complex cases.

Case

Ms D is a 43-year-old woman who consents to undergo an elective laparoscopic left nephrectomy to remove a renal cell carcinoma. The surgery team, led by Dr S, and the anesthesiology team, led by Dr A, agree that Ms D's risk for perioperative complications is low. Her surgery proceeds routinely, and she wakes from anesthesia in stable condition.

A few hours later, however, Ms D develops a tense, distended abdomen; her heart rate is elevated; and her blood pressure is low. Dr S evaluates Ms D and believes that she has internal bleeding and needs to be taken back to the operating room.

Back in the operating room, massive transfusion of blood products is begun. After induction of anesthesia, Ms D's blood pressure drops significantly. Dr A's team administers medications to try to raise her blood pressure. Dr S's team opens Ms D's abdomen, and it is clear that there is significant internal bleeding. Dr V, the on-call vascular surgeon, is paged to the room, and everyone works together to try to control of Ms D's bleeding. Dr A continues to deliver blood products and escalates doses of blood pressure-augmenting medications, but Ms D's condition declines, with ST elevations on her electrocardiogram indicating cardiac compromise. Dr A communicates this information to surgical team members, who continue to try to identify the source of bleeding. After 15

minutes, however, Dr A asks the surgical team to pause to allow the anesthesiology team to resuscitate the patient.¹

The surgery team stops, but only after applying packing and pressure to what they've now finally identified as the source of the bleeding, Ms D's inferior vena cava (IVC). Dr A administers more blood products.

The surgery team resumes operating, and Ms D sustains cardiac arrest. The surgical team stops operating and applies pressure to Ms D's IVC during resuscitation, led by Dr A for 10 minutes—and after administration of more than 100 units of blood products.

Spontaneous circulation is achieved, and Dr S's team resumes operating. Dr A now worries about Ms D's neurological status, as anesthetics have not been administered for several minutes, suggesting Ms D has had brain injury as a result of low blood pressure.

Ms D sustains a second cardiac arrest. Dr A's team resumes resuscitation, then requests resuscitation be stopped, believing Ms D is moribund. Dr S's team requests resuscitation be continued while they attempt to control the IVC bleeding.

Dr A wonders whether to insist on ceasing resuscitation.

Commentary

The case in question is rare, but it is one that most surgeons and anesthesiologists will experience during their careers. Here, we see an elective operation complicated by a devastating vascular injury resulting in hemorrhage and, ultimately, [intraoperative cardiac arrest](#) while an attempt was made to repair what was identified as an injury to the IVC. Dramatic attempts to rescue such patients are common. These patients not only are statistically more likely to survive cardiac arrest than the general population, but also have been documented to survive, if rarely, after prolonged resuscitation.¹ Moreover, while caught up in the chaos of a cardiac arrest, surgeons and anesthesiologists alike are united by at times overpowering hope—hope that their years of medical education and training will be substantiated, hope that they will not have to meet a patient's family in the waiting room and recount how this 43-year-old woman died during an elective procedure, and hope that the patient will survive.

In an era of meticulous internal auditing and continual emphasis on quality improvement, extensive research has been devoted to risk prediction and the subsequent mitigation of risk.^{2,3,4} As an example, early efforts to treat pancreatic cancer with the Whipple procedure (pancreaticoduodenectomy) carried a staggering in-hospital mortality rate of 25%, an unacceptable figure for any operation; the mortality rate for pancreaticoduodenectomy is now reported to

be less than 5% after years of procedural refinement and both retrospective and prospective critical study.^{5,6} Historical examples such as this one reflect the significant risks that patients will undertake in the search for a cure or an improved quality of life.

Surgeons, anesthesiologists, and patients alike would agree that a world without surgical site infections, aspiration pneumonias, and venous thromboembolic events would be ideal, although some complications are easier for all parties to navigate than others. For any clinician, intraoperative death is the apex of bad outcomes, the event that has caused some physicians to leave medicine entirely, and the memory of which often haunts those who continue to practice. This article considers factors that have been shown to influence outcomes after intraoperative cardiac arrest and offers a framework for analyzing and discussing these clinically, ethically, and emotionally complex cases.

Intraoperative Cardiac Arrest

Intraoperative cardiac arrest during elective, noncardiac surgery is a rare event, occurring with an incidence between 0.8 to 4.3 per 10 000 cases.^{7,8} Over time, this occurrence has become less common, with Sprung and colleagues' retrospective study reporting rates of cardiac arrest that fell from 5.1 to 4.6 per 10 000 anesthetics between 1990 and 1995 compared to a rate of 2.5 per 10 000 anesthetics in 2000, at the study's conclusion.⁸ Unfortunately, perioperative and in-hospital survival after intraoperative cardiac arrest has not appreciably improved.⁸ Reported immediate survival rates vary depending on the cause of arrest but ranged between 18% to 72% in one study⁸ and from 32% to 56% in a systematic review.⁹ Perhaps unsurprisingly, patients who sustain cardiac arrest during an elective operation have improved survival compared to those who sustain an arrest during an emergency operation or one for trauma (59.2% vs 30.6% in one series).⁸ These figures are comparatively optimistic when compared to the general population; among patients who suffer an out-of-hospital cardiac arrest and receive cardiopulmonary resuscitation, the expected hospital survival rate is approximately 14%.¹⁰

Probable causes of cardiac arrest in patients undergoing noncardiac surgery include primary cardiac dysfunction (eg, myocardial infarction), pulmonary embolism, electrolyte abnormalities, hemorrhage, and the anesthetic used at the time of arrest.^{8,11} A minority of cases are attributable solely to anesthesia management (ie, the anesthetic medication used or airway complications during surgery), and these patients have considerably higher rates of hospital survival than the overall rate of hospital survival (79% vs 35%).^{8,12}

Some risk factors for both immediate and in-hospital mortality among such patients have been elucidated. Indications for surgery, comorbidities, physical status, and type and duration of operation are all factors that ultimately influence the outcome.⁸ Other factors include documented hypotension, the requirement for vasopressors, intraoperative bleeding, and cardiac arrest during

nonstandard working hours.⁸ For example, Sprung and colleagues reported an 18% immediate and 10.3% in-hospital survival rate for cases in which bleeding was determined to be the cause of cardiac arrest.⁸ Unfortunately, there is a paucity of quality evidence in this area due to the rarity of intraoperative cardiac arrest. However, it is worth remembering that the cause of arrest may provide insight into survivability and futility.

Surgeons' and Anesthesiologists' Responsibility to Patients

Surgeons and anesthesiologists [share duties](#) and obligations as they work together to usher patients safely through the various phases of perioperative care.

Surgeons' responsibilities. Surgeons have a unique relationship with their patients and bear the onus of responsibility when choosing to operate for any indication. Often, the operation in question, the approach, and timing are recommended by the surgeon. Regardless of the operation's medical necessity or comparative technical difficulty, patients enter into a mutual contract with their surgeon. Patients trust that their ailment will be alleviated or that cancer will be resected through invasive means, and the surgeon, in turn, promises to guide the patient through both the operation and the subsequent recovery period.

Anesthesiologists' responsibilities. Similarly, anesthesiologists have complete physiological governance over each surgical patient throughout the duration of their operation. Once the decision to proceed with surgery has been made, the value of the anesthesiologist-patient relationship is as important as the anesthetic itself, with research as early as 1963 demonstrating both anxiolytic and analgesic effects of preoperative visits.^{13,14,15} The emotional and psychological effects of both the surgeon's and the anesthesiologist's [relationships with their patients](#) cannot be overstated, and teamwork between these individuals is critical in order to usher these patients through some of the most invasive and life-altering periods of their lives.

Desisting Resuscitative Efforts

Ms D is one of the patients who do gain a return of spontaneous circulation after heroic efforts. Nevertheless, she still likely suffers irreversible hypoxic brain injury and again suffers cardiac arrest, bringing to the forefront the potential futility of continued efforts at resuscitation. Many physicians would act similarly to Dr S and request continued resuscitation despite the already staggering use of resources due to a sense of responsibility, fear, anxiety, or any number of strong emotions. Given the lack of quality evidence on whether resuscitation is futile in these circumstances, there are no guidelines to aid in decision making. However, based on the available data, we can understand trends and make predictions that can help guide decision making. Patients' comorbid and functional status, along with the cause of and circumstances surrounding their arrest, should factor into decision making during the initial

resuscitation. Research on prognosticating meaningful neurological recovery after in-hospital cardiac arrest may not be directly applicable to patients who suffer an intraoperative cardiac arrest due to inherent differences in cause and patient demographics. However, there is evidence that older patients with multiple comorbidities or those who experience hypotension, asystole or pulseless electrical activity (as opposed to ventricular fibrillation or ventricular tachycardia), or sepsis prior to an arrest are less likely to survive in-hospital cardiac arrest with a favorable neurological status.^{16,17} After efforts to correct all underlying causes have been exhausted—particularly in the context of possible neurological injury—surgeons and anesthesiologists must also consider the utilitarian implications of continued resuscitation and utilization of limited resources such as blood products.

We do feel that the decision to cease resuscitative efforts during a cardiac arrest in the operating room must be one that is shared by all parties. All physicians, nurses, and staff in the room should feel that appropriate efforts have been made and that further efforts are futile. When a decision to cease resuscitative efforts is being considered, it should be voiced openly in the room and, if anyone disagrees, efforts should be resumed. Each member of the perioperative team brings a different skill set and viewpoint to these scenarios and all opinions must be respected and heard. Only through collaboration, open communication, trust, and teamwork can we continue to care for our patients in these most trying of circumstances.

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Editor's Note

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Conflict of Interest Disclosure

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