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DNAR: More Than Code or No Code

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It has become standard medical practice to follow the evidence. Medical research helps us understand which therapies are appropriate for a particular disease state. In this article we will look at published data describing applications and efficacy of three "heroic medical measures": cardiopulmonary resuscitation (CPR), mechanical ventilation, and artificial nutrition and hydration.

Cardiopulmonary Resuscitation

Closed-chest massage was first described by surgeons at Johns Hopkins in 1959. It was originally performed only in operating and recovery rooms on patients who sustained cardiac arrest in those settings. At its inception, CPR was designed to resuscitate patients who had a sudden cardiac arrest but otherwise were in good physiologic condition.[1] The original article describing the use of CPR demonstrated a 70% return to spontaneous rhythm.[2] Until the 1990s reports of CPR statistics were characterized by variable endpoints that made it difficult to compare study outcomes. The Utstein consensus standardized the outcome measurements in the 1990s to include return of spontaneous circulation (ROSC), survival-to-hospital discharge, and survival to 30 days, 6 months, and 1 year from hospital discharge.[3] In 1999 the American Heart Association (AHA) formed a National Registry of Cardiopulmonary Resuscitation, which has provided consistent outcomes data. International research has recently focused on similar outcomes. A summary of representative studies and their outcomes appears in the table.

Cardiopulmonary Resuscitation Studies and Outcomes

Study Topic	Resuscitation	ROSC	Discharge
Predictors of survival after in-hospital CPR[4]	22%		16%
Survival after in-hospital CPR with and without other disease[5]			
without abnormal observations		18%	
with abnormal observations			9%
CPR in cancer patients: survival[6]		35%	7%
CPR in patients with terminal illness[7]	67.5%	42.2%	0%
CPR in cancer patients: survival (metaanalysis)[8]			6%
14,720 cardiac arrests. AHA National Registry.[9]		44%	17%
Factors influencing CPR survival in Iran[10]		19.9%	5.3%
A decade of CPR outcomes[11]		38.6%	15.9%
Predictive model after CPR in hospital[12]			15.1%
Efficacy of CPR in adult ICU (Athens)[13]		100%	9.2%
Long-term survival after in-hospital CPR (UK)[14]			16.5%
Predictors of survival after in-hospital CPR[15]		48.3%	22.4%
unwitnessed		21%	1%
Out-of-hospital cardiac arrest in Detroit (94% died before admission)[16]		4%	
Out-of-hospital cardiac arrest in Rochester, NY[17]		20%	

Despite the potential for international variability, the data are remarkably consistent. Although ROSC rates range between 20% and 50%, survival to hospital discharge hovers around 15% and rarely exceeds 20%. Studies reflecting higher rates of survival to hospital discharge usually imposed exclusionary criteria for CPR, limiting it to patients whose pathology was primarily cardiac and recoverable. These data do not reflect significant improvement in outcomes during the 47 years CPR has been available despite the multiple changes in technique AHA recommended during the intervening years.[12]

Other trends that have been observed are listed below.

General Population

- Patients younger than 70 years of age have significantly better survival rates than those 70 years or older.[1]
- Tachycardia, bradycardia, hypertension (systolic pressure higher than 200 mm Hg), hypotension (systolic pressure lower than 90 mm Hg), or hypoxia (saturation less than 90% with or without oxygen) decrease survival to hospital discharge from 18% to 9%.[5]
- The more comorbidities a patient has, the worse the outcome.[7]
- Witnessed arrests have significantly better outcomes than unwitnessed arrests; survival in unwitnessed arrests is at 1% compared with 22.4% for witnessed arrests.[15]
- In one study, survival varied by the shift during which the arrest occurred.[5]
- Ventricular fibrillation and ventricular tachycardia have better outcomes

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than asystole or pulseless electrical activity.[12]

- Out-of-hospital CPR has uniformly poor outcomes.[16]
- Among survivors, cognitive damage is relatively uncommon.[9]
- Factors associated with better outcomes include higher body mass index, respiratory versus cardiac arrest, ventricular tachycardia or ventricular fibrillation as initial rhythm, arrest early in a hospital stay as opposed to later in a hospital stay, short duration of resuscitation effort, and witnessed arrest.[12]

Nursing Home and Long-Term Acute Care (LTAC) Patients

One study showed ROSC of 20%, with no patient surviving to hospital discharge.[18]

Patients with Cancer or Other Terminal Illness

Survival to hospital discharge is similar to that reported for patients with hemodynamic abnormalities or hypoxia, with survival to discharge in the 5% to 9% range.[6,8] Other factors influence survival to discharge in cancer patients:

- Patients with solid tumors fare better than those with hematologic malignancy (12.5% vs 1.5%).[6]
- Those who arrest outside the intensive care unit (ICU) survive more often than those whose arrests occur in the ICU (13.7% vs 1.4%).[8]
- Victims of unexpected arrest have a better survival rate than those whose arrest is the endpoint of an unrelenting downhill course (21.9% vs 0%). This may explain decreased survival for patients in the ICU.[6]

Mechanical Ventilation

Although it is ranked 60th as a reason for hospitalization, mechanical ventilation in respiratory failure ranks third for total cost and first in terms of cost per patient. Mechanical ventilation is costly, exceeding $100,000 per quality-adjusted year of life gained in those older than 68 years and those with a predicted 1-year mortality higher than 50%. Quality-of-life studies show survivors of prolonged mechanical ventilation have uniformly low quality-of-life scores and difficulty with sleep, energy, and mobility.[19]

A study of acute respiratory failure in men found that 62% of participants were able to be weaned in the hospital, 46% were discharged alive from the ICU, 43% were discharged alive from the hospital, and 30% were alive at 1 year.[20]

A review of the outcomes of prolonged mechanical ventilation (more than 21 consecutive days of ventilation for at least 6 hours per day) published in 2006 reported hospital mortalities ranging from 22% to 61%, with 1-year mortality ranging between 58% and 71%.[21] A 2007 *Chest* review of prolonged ventilation in LTAC settings reported that 54% were weaned.[22] Other subjects were evenly divided between death and long-term ventilator dependency. Only 33% of participants were alive 1 year after intubation. When respiratory failure is due to the progression of a terminal illness, survival to hospital discharge after mechanical ventilation approaches zero.[19]

Artificial Nutrition and Hydration

Hydration and nutrition remain subjects of emotional discussions at many levels of society. Outside palliative care circles, physicians may be unaware that intravenous fluids do not relieve thirst, that anabolic steroids add fat rather than meaningful body mass, or that the absence of food in patients with anorexia does not cause pain.

In a review of nutritional support in various illnesses, recent literature was graded on strength of evidence as follows:[23]

- A—strong evidence in support of
- B—weak evidence in support of
- C—insufficient evidence to judge
- D—weak evidence of no benefit or harm
- E—strong evidence of no benefit or harm.

This review found no A-grade evidence for parenteral nutrition (PN), enteral nutrition (EN), or volitional nutrition support (VNS). There was B-grade evidence to support VNS for malnourished elderly patients, EN for critically ill patients, and PN for patients with head or neck cancers before surgery or for patients with chronic liver disease. There was D-grade evidence for PN and EN for patients with hip fracture, chronic obstructive pulmonary disease, and nonsurgical cancer treatment. E-grade evidence was found for any form of nutritional support in the first few days of dysphagia after stroke.

A study of nutritional support in cancer patients concluded that[24]

- only patients with head or neck and upper gastrointestinal (GI) malignancies who are candidates for definitive surgery will benefit from nutritional support
- enteral therapies offer no survival benefit for cancer patients
- parenteral nutrition for patients receiving chemotherapy is associated with shorter survival.

These impressions were supported by a study from Brown University in which PN for ovarian cancer patients was evaluated.[25] Overall survival was 23 months for the PN group and 35 months for the group that did not receive PN. Survival from the time of total intestinal obstruction was the same for both groups when adjusted for the presence or absence of chemotherapy, which, when present, clearly shortened survival, particularly in the group receiving PN.

Additional Data

One study triaged cancer patients according to their circumstances.[26] Patients who were confined to their beds or only receiving palliative care were denied access to an ICU. Those who were early in their treatment course and those for whom definitive therapy was likely to succeed were afforded unrestricted ICU access. The remaining patients were admitted to the ICU with full code status and reevaluated in 5 days. Within this third group for whom unlimited, potentially life-prolonging therapies were provided, the following results were observed: organ failure scores were more predictive of outcome on day 6 in the ICU than on day 1; 21.8% survived to hospital discharge; and all patients who required initiation of dialysis, pressors, or mechanical ventilation after the third day in the ICU died.

Discussion

Cardiopulmonary Resuscitation

The survival data for CPR in hospitals are clear and may be presented as bases for discussion with patients and families. Admittedly, we find it difficult to withhold heroics when the alternative is death, but the dismal outcomes associated with CPR in advanced illness (and the associated traumas) pose strong arguments against CPR under these circumstances. It is beyond the scope of this article to suggest a threshold level for potential success (with success defined as discharge alive from the hospital). Here are some points to consider when CPR is an option:

- Physicians should be trained to decide which procedures or treatments are appropriate based on an understanding of their likelihood of helping or harming a patient.
- For some populations, the potential to survive a CPR event and be discharged from a hospital is near or at zero. If we follow our evidence base, these patients should not receive treatment: for instance, those for whom CPR is initiated in nursing homes; those for whom cardiac arrest is the inevitable result of the progression of an irreversible illness; and, perhaps more arguably, those for whom CPR was initiated outside of a hospital.
- CPR statistics have not changed materially during the 40 years the intervention has been commonly used despite multiple revisions to CPR techniques. CPR success rates may remain poor because of patient selection, not technique.

Mechanical Ventilation

Survival data are better for prolonged mechanical ventilation than for CPR. It appears the best survival estimates can be made only after several days of ICU care, making up-front decisions difficult.[26] For patients with ventilatory failure as the inevitable result of a disease process that is not reversible, the likelihood of survival to hospital discharge is predictably dismal. These patients include those with progressive neuromuscular diseases such as multiple sclerosis and Parkinson's disease, refractory malignancy (which directly impairs respiratory function or produces weakness through cachexia), profound neurologic injury, and end-stage obstructive lung disease or pulmonary fibrosis. For these patients it may be wise to regard mechanical ventilation as a treatment which, at best, has no endpoint and a sole purpose to postpone death. If we define efficacy in terms of live discharge from the hospital, mechanical ventilation in the examples previously mentioned may be viewed as ineffective. However, some patients with high cervical spinal injuries or amyotrophic lateral sclerosis (Lou Gehrig's disease) may be viewed as having potential to benefit from mechanical ventilation.

The cost of mechanical ventilation is staggering in terms of meaningful years of life gained. Families, patients, and healthcare providers must closely examine the single most expensive item on the healthcare treatment list—prolonged mechanical ventilation. Each party must continue to address this difficult topic.

Artificial Nutrition and Hydration

The data surrounding artificial nutrition and hydration are perhaps the most clear in terms of failure to accomplish goals. No form of hydration or nutrition has been found to prolong survival in end-stage malignancy. Its application in this oncology setting is contrary to evidence-based medicine. In fact, parenteral nutrition, when combined with chemotherapy, has been shown to shorten survival. In addition, intravenous hydration does not relieve thirst and should not be offered to patients for that purpose. Use of these agents can only be palliative, except when used for patients with head or neck cancers or upper GI cancers who are being prepared for definitive surgery. Intravenous fluids may be used to relieve symptomatic volume depletion, for example, or parenteral nutrition may be given to maintain performance status in otherwise robust patients who develop total intestinal obstruction due to malignancy. We must help patients and their families understand that these treatments likely will not prolong survival.

For patients with dementia or frail elderly patients, there is weak evidence that some form of enteral support may prolong survival. However, the reasons behind failure to eat orally must be considered. Gastrostomy placement, for example, will not prevent patients from aspirating their oral or nasopharyngeal secretions, and tube feedings may provide opportunities for patients to reflux and aspirate.

Conclusion

More discussion is necessary to help determine the efficacy thresholds that should be applied to various heroic medical measures. That said, there are clear-cut situations in which CPR, mechanical ventilation, and artificial nutrition or hydration provide little or no survival benefit and should not be offered for the purpose of extending life. There is no sound ethical basis for providing treatment that has no benefit and carries significant risk.

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Although it is important to take into account the wishes of our patients and their families, decisions about which treatments are indicated, safe, and effective still lie with trained professionals. No medication, medical device, or surgical procedure can be approved unless it is both safe and effective. Why should we view heroics any differently? Even in consideration of patient autonomy, a patient is not entitled to demand and receive CPR if it cannot work any more than he or she is entitled to demand an appendectomy when it is not needed or chemotherapy when there is no malignancy.

Data should be introduced to help patients and families understand both the efficacy and burdens that CPR, ventilation, and artificial nutrition and hydration offer those with advanced illness. In addition, there must be professional discourse on reasonable thresholds of efficacy for treatments that are expensive and potentially injurious and on the necessity to practice evidence-based medicine when heroic medical measures present as options.

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Suggested Reading

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