VIEWPOINT

Mechanical Medical Devices in Intensive Care and End-of-life: Unanswered Questions

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Received on: 02 May 2022; *Accepted on:* 17 December 2022; *Published on:* 22 February 2023

Abstract

End-of-life can be at different locations. Intensive care admission and progression to the terminal stage is one of these locations. The condition progresses to an unfortunate state where finally it is decided to initiate comfort care, terminal extubation, or change the status to no further therapy. Modern advancements in health care include the application of an extensive list of medical devices to continue functional life in an outpatient setting or support critical care conditions. Both of these situations can have periods where medical device function makes critical decisions difficult. Patients, families, and sometimes healthcare providers discuss and do their best what has to be done to deal with these devices as the end-of-life approaches. Here we bring up some questions, not clearly defined in medical practice and suggest some options. As medical care gets more complex, there will be newer editions to these devices and further questions will arise. To make the point more clear, the below-mentioned case may help with the questions to follow.

Keywords: Critical Care, Ethics, Medical device.

Journal of Medical Academics (2022): 10.5005/jp-journals-11003-0111

Introduction

End-of-life can be at different locations. Intensive care admission and progression to the terminal stage is one of these locations. The condition progresses to an unfortunate state where finally it is decided to initiate comfort care, terminal extubation, or change the status to no further therapy. Modern advancements in healthcare include the application of an extensive list of medical devices to continue functional life in an outpatient setting or support critical care conditions. Both of these situations can have periods where medical device function makes critical decisions difficult. Patients, families, and sometimes healthcare providers discuss and do their best what has to be done to deal with these devices as the end-of-life approaches. Here we bring up some questions, not clearly defined in medical practice and suggest some options. As medical care gets more complex, there will be newer editions to these devices and further questions will arise. To make the point more clear, the below-mentioned case may help with the questions to follow.

A 77-year-old female patient presented to a community hospital with severe chest pain. She was found to have significant acute myocardial infarction with a marked reduction in ejection fraction. She was transferred to a higher level of care for mechanical assist device insertion and an attempt for revascularization. On arrival at the tertiary care hospital, an emergent mechanical circulatory assist device (Impella) was placed. She underwent four-vessel coronary angiogram which showed extensive coronary artery disease, not amiable to endovascular or open revascularization. Her ejection fraction at the time of the angiogram was under 15%. She was admitted to the intensive care unit for medical treatment. After full medical care, she continued to require Impella. Her neurological examination was intact, she was on minimal nasal oxygen with normal renal functions. She was bedbound but able to eat full meals. After extensive discussion with her, the decision was made to proceed to inpatient hospice. The team was not clear on how to deal with the device which was keeping her circulation intact. It was the weekend and there was only emergent service available. Just turning off the device, which was transversing the aortic valve and placed in the middle of the left ventricle, would have led to clotting, reduced aortic flow, and possibly lead to her death. Explantation of the device was the only option. She underwent explantation and followed by transfer to home hospice.

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How to cite this article: Janjua T, Kisana M, Moscote-Salazar LR. Mechanical Medical Devices in Intensive Care and End-of-life: Unanswered Questions. J Med Acad 2022;5(1–2):34–36.

Source of support: Nil

Conflict of interest: None

Does the Pacemaker Need to be Turned off before Terminal Extubation or Left Running?

The presence of pacemakers in intensive care patients is very common. Most of these are a combination of defibrillator with pacing. At end-of-life decisions, it is usually not a part of this picture that the pacemaker will be running at the time of terminal extubation or comfort care.[1] The automatic defibrillation (AICD) function is turned off with a magnet when the status is changed to do not resuscitate (DNR). On the contrary, this aspect is usually not present on documents for DNR about the management of AICD. Cardiac death is confirmed with no pulse being felt with

continued pacer spikes. It is not clear if the rhythm is present with the paced activity to call it cardiac death. The only way to confirm is that it is pulseless electrical activity (PEA). This is an undefined aspect of medical care that PEA with the pacemaker capture of myocardium is considered to be the time of death. To overcome this, the pacemaker has to be turned off with the external programmer. There is always this issue of keeping the patient in the intensive care after the death is confirmed so that an external device can be brought in. Further research is needed to streamline these thoughts and set the standard for the AICD and pacemaker approach once the death is imminent or the patient is pronounced expired. These questions are asked by the family, hospital morgues, and funeral services.

Does the Mechanical Circulatory Device Need to be Explanted before Terminal Weaning and Extubation?

This question arises in cardiac care commonly due to a circulatory device being placed to assist with poor cardiac function. Due to varied reasons, the assist device is not enough to sustain life and other multiple end-organ failures are present. This becomes clear when a clinical confirmation of brain death is obtained. The devices used include extracorporeal membrane oxygenation (ECMO), left ventricular assist devices like Impella and left ventricular assist device (LVAD), intra-aortic balloon counterpulsation (IABP), and automatic cardiopulmonary compression device. The last one can be tricky as families might consider that it is providing circulation to the patient and they do not want it turned off. Continuous cardiopulmonary resuscitation (CPR) is sometimes used to bridge to ECMO initiation and during that process, it is not clear if the patient proceeded to brain death. This is brought up with the examination of fixed and dilated pupils. The amount of catecholamines used during resuscitation is usually the reason and in these situations, the CPR continues. The automatic CPR equipment duration limitation is not clear in the literature. How long to continue before stopping it and if ECMO is not available, the duration is the same as the CPR without the automatic device in place. ECMO circuit carries a significant amount of blood, especially with a venoarterial setup. Whether the blood return is done or not at end-of-life is a question asked by the staff. The decannulation and disconnection of the machine may not be an easy task at the terminal stage. This is usually done as the patient is not able to get circulatory support, there is a major complication leading to impending death or the patient is brain dead. The decision has to be made about whether to switch off the machine vs decannulation. Families might not want to see any hemorrhage. There are no clear answers and the best clinical judgment is used.[2] Further research is required to understand and create a system to handle this. The above example shows the complex nature of left ventricular support devices, especially in awake and decision-making patients. To turn off the device leading to cardiac decompensation seems like a straightforward approach, though the device in the left ventricular can lead to complications if not working and the ultimate demise of the patient.[3] For example, Impella can be pulled back into the aorta and left there rather than full explantation. The LVAD can be turned off but anticoagulation continues. These questions need further insight and the best medical judgment should be used with the comfort and dignity of the patient as the center point. IABP can be left there though the patient cannot sit up if it is in the femoral area. The axillary approach is much easier to take care of. Counterpulsation can be stopped and explantation delayed till arrangements can be made to take it out or the patient expires.

Is the External Ventricular Device (EVD) Taken out before Full Comfort Care?

An EVD and lumbar drain are used for cerebrospinal fluid (CSF) diversion. EVD can give intracranial pressure and adjustment of management is done based on the output of CSF and the pressure reading. Once comfort care is initiated, some steps are not clear. Whether the pressure monitoring is continued or disconnected from the monitor? Do we disconnect the EVD from the collection bag? Do we leave the EVD or take it out? In trauma patients and patients where there is a question for possible autopsy or legal review, EVD is left in. The best clinical reasoning is used and after discussion with the family, mostly this device is taken out.

What do We Do with the Intracranial Pressure Bolt Waveform for Brain-dead Patients?

Brain death is defined by clinical criteria and with confirmation testing like blood flow imaging. A nuclear blood flow study will show no flow to the brain. Transcranial Doppler for the major blood vessels will show only spikes but no systole and diastole changes. Minimal invasive placement of cranial pressure monitoring device will pick up these sharp spikes and there will be pressure reading rather a flat line as expected for no blood flow. This can confuse the staff. So it is not clear if the device is taken out at that stage vs left in as there is a waveform. Once a confirmation test is done and brain death is labeled, it is an easier decision to take the device out. It is before confirmation, and questions on the clinical examination, the waveform can be confusing.

With the Disconnection of the Ventilator, the Tracheostomy Stays or Comes Out?

Tracheostomy is placed for long-term airway. Unfortunately, the placement of tracheotomy does not confirm that patient will survive the illness and leave the hospital. Most of these patients are connected to ventilators and the end-of-life involves disconnection to room air. The tracheostomy is left in, there are no clear indications why it is left in. Upon discharge, it can be taken out at home as a terminal event.[4] In an intubated patient, the ventilator and endotracheal tube both are taken off for terminal extubation. Concerns for removal of the tracheostomy are the risk of bleeding, the collapse of the upper airway, and the presence of excessive secretions. Further research on these questions will help to answer the correct approach.

Is Continuous Use of Bilevel Pressure Support Considered to be a Full Support Measure or Part of Comfort Support?

Bilevel pressure support is provided with the nasal, partial facial, or full facial mask. The set pressure is titrated between inspiratory pressure and expiratory pressure. The difference between these gives the driving pressure to generate the tidal volume, hence reducing the work of breathing. This leads to a partial or full correction of hypoxemia and more importantly ventilation with correction of respiratory acidosis. By looking at this brief description of the bilevel positive airway pressure (BIPAP) mode of respiratory support, it can be deduced that it is full ventilatory support short of endotracheal intubation. Patients who are DNR or do not intubate are technically getting full ventilatory support, and the question is brought up about how to stop the support which is providing comfort to the patient, and also there is no intubation involved.[5] This can be avoided with earlier discussions with the patient and his family. Further education

of clinicians is required about the ventilatory support provided with bilevel pressure support and withdrawal leading to possible discomfort. The best clinical judgment is used with narcotics to reduce air hunger and to stop mask ventilation.

If Patients are Dependent upon Continuous Renal Support, Do We Stop the Support or Wean It during Terminal Care?

Intensive care patients who are in shock or have chronic renal failure presenting with shock or intracranial pathology require continuous renal replacement therapy (CRRT). This corrects the metabolic derangement and improves fluid balance. One key aspect is the correction of metabolic acidosis, which if not corrected will lead to respiratory demand and higher work of breathing. There is no clear data to confirm that a patient with severe acidosis on CRRT does not feel more air hunger with stoppage of CRRT at end-of-life. This needs to be validated in a proper control fashion as CRRT is a common modality used in intensive care units. Presently it is turned off and the patient is placed on a comfort care path.

Are the Pleural Drainage Tubes Taken out before Comfort Care or Left in Place?

Chest tubes are inserted for two main reasons: effusion/fluid and air evacuation. Fluid is usually not a major concern except for major active hemothorax, especially at the time of discontinuation of a chest tube for comfort care. It is the presence of active bronchopleural fistula and spontaneous breathing or ventilated patient where the removal can be questioned. If there is an air leak and the chest tube is removed, the process can lead to tension pneumothorax and hence the demise of the patient. There is no clear answer to this question. Leaving to underwater seal and extubation to room air is one option. In one particular situation, it can be a problem where patients cannot go to home hospice with a chest tube in place.

Are Lines Taken out or Left in during Comfort Care, that is, Central Lines, Urinary Catheter, and Feeding Tube?

This can be the most common situation that bedside staff will be asking about. The removal of the urinary catheter can lead to urine retention at end-of-life and can be an uncomfortable feeling. Other lines are the central line, arterial line, peripherally inserted central lines, dialysis lines, temporary pacer wires, and venous lines. There are no clear guidelines and clinicians have to deal with the individual needs of the patients.

Conclusion

In conclusion, there are multiple examples wherein intensivists deal with medical devices during end-of-life discussion. The above-mentioned are some key devices and questions for which clear answers are not present. Good training with experience is the best approach at this stage for the intensivist to deal with these. Future research in a controlled fashion is required to create clear guidelines and pathways to handle complex medical devices in the intensive care units for the transition to comfort care.

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References

1. Karches KE, Sulmasy DP. Ethical considerations for turning off pacemakers and defibrillators. Card Electrophysiol Clin 2015;7(3):547–555. DOI: 10.1016/j.ccep.2015.05.012
2. DeMartino ES, Braus NA, Sulmasy DP, et al. Decisions to withdraw extracorporeal membrane oxygenation support: patient characteristics and ethical considerations. Mayo Clin Proc 2019;94(4):620–627. DOI: 10.1016/j.mayocp.2018.09.020
3. McIlvennan CK, Wordingham SE, Allen LA, et al. Deactivation of left ventricular assist devices: differing perspectives of cardiology and hospice/palliative medicine clinicians. J Card Fail 2017;23(9):708–712. DOI: 10.1016/j.cardfail.2016.12.001
4. Taylor N, Christie J, Donna W. Head and neck cancer end of life care: complex challenges. BMJ Support Palliat Care 2022; bmjspcare-2022-003644. DOI: 10.1136/bmjspcare-2022-003644
5. Sellner-Pogány T, Lahrmann H. Die BIPAP-Maskenbeatmung in der Terminalphase der amyotrophen Lateralsklerose (ALS) – Wenn das Sterben zu Hause von einem medizinischen Gerät begleitet wird (BIPAP-mask-ventilation in terminal amyotrophic lateral sclerosis (ALS)). Wien Med Wochenschr 2009;159(23-24):604–607. DOI: 10.1136/bmjspcare-2022-003644