Perioperative Management of Cardiac Implantable Electronic Devices

Introduction

The advent of new healthcare technology paired with the reduction in the severity of infectious diseases, has reduced mortality and morbidity rates over several decades. With Ischemic Heart Disease being one of the largest contributors to mortality in the United States, it is prudent for healthcare providers to understand the prevention, treatment, and management of this deadly phenomenon.

Cardiac Implantable Electronic Devices (CIEDs) is an encompassing term that includes any device used for permanent cardiac rhythm management and can be divided into pacemakers and Automatic Implantable Cardioverter-Defibrillators (AICD). With the application of these devices and Guideline Directed Medical Therapy (GDMT), overall rates of Sudden Cardiac Death (SCD) have declined over the years (DeFilippis et. al, 2017). Although promising results ensue after intervention with CIED insertion, the efficacy of the current guidelines for perioperative management of patients with these devices needs to be established.

Preoperative Management

According to the American Society of Anesthesiology (ASA), adequate preoperative management of CIED patients includes a thorough interview and evaluation. The preoperative period interview consists of a focused preoperative evaluation includes the following factors: determining what type of CIED the patient has, either from their manufacturer's card or chest X-ray, what mode the patient is programmed in, the last instance of device interrogation, whether the patient is pacer-dependent, whether antitachyarrhythmia therapies need to be turned off, and if the surgery requires some form of Electromagnetic Interference (EMI). The most common culprit of EMI is the use of electrocautery, through the means of the Bovie surgical tool (Mulpuru et. al, 2017). Preoperative magnet application reprograms the CIED mode and can avoid malignant EMI interference with the device.

Intraoperative Management

The focus of intraoperative management relies on understanding the influence of EMI on patients CIED function and how to troubleshoot any impending issues. The ASA practice advisory (2020) states that use of peripheral pulse monitoring (blood pressure, palpitation, arterial line waveform analysis), and plethysmography waveform analysis are useful in determining if the extent of the EKG abnormalities is strictly due to the EMI or if is patient-caused.

High risk of EMI come from procedures based above the umbilicus (head, neck, thoracic, etc.) and the path of current travel should be away from the CIED and its lead wires (Barash et. al, 2017). The use of bipolar electrocautery should be considered over monopolar to reduce the instance of EMI and the concomitant risk of CIED compromise

In the instance of cardiac compromise, the ASA practice advisory suggests that all sources of EMI be terminated if an emergency occurs, and the magnet should be removed in the case of AICD patients to restore the antitachyarrhythmia therapies. If no restoration of therapies commences then emergency cardioversion or external defibrillation should be considered

Postoperative Management

Postoperative management of CIED devices include close-monitoring and reinterrogation of the device (Barash et. al, 2017). Emergency defibrillator/cardioversion equipment should be available at any instance of CIED and patient compromise. Discussion of the postoperative programmed CIED mode, between the patient's electrophysiologist and CIED team is required before discharge. CIED patients can be kept in the original programmed mode before surgery, or reprogrammed into another mode to maintain hemodynamic and cardiovascular stability. Device interrogations should be performed per standard, due to the many instances that could cause CIED malfunction during surgery.

According to the ASA practice advisory: any instance of EMI interference, malfunction with reenabling antitachyarrhythmia therapies, and suspicion of the accidental disabling of the therapies from magnet use rather than short-term suspension are important concerns to reinterrogate the device.

Pacemaker and AICD Code

Table 3-2 Generic Pacemaker Code: NASPE/BPEG Revised (2002)

Position I, Pacing Chamber(s)	Position II, Sensing Chamber(s)	Position III, Response(s) to Sensing	Position IV, Programmability	Position V, Multisite Pacing
O = none	O = none	O = none	O = none	O = none
A = atrium	A = atrium	I = inhibited	R = rate modulation	A = atrium
V = ventricle	V = ventricle	T = triggered		V = ventricle
D = dual (A + V)	D = dual (A + V)	D = dual (T + I)		D = dual (A + V)

NBG: N refers to North American Society of Pacing and Electrophysiology (NASPE), now called the Heart Rhythm Society (HRS); B refers to British Pacing and Electrophysiology Group (BPEG); and G refers to generic.
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Table 3-3 Generic Defibrillator Code (NBG): NASPE/BPEG

Position I, Shock Chamber(s)	Position II, Antitachycardia Pacing Chamber(s)	Position III, Tachycardia Detection	Position IV,[a] Antibradycardia Pacing Chamber(s)
O = none	O = none	E = electrogram	O = none
A = atrium	A = atrium	H = hemodynamic	A = atrium
V = ventricle	V = ventricle		V = ventricle
D = dual (A + V)	D = dual (A + V)		D = dual (A + V)

[a]For robust identification, position IV is expanded into its complete NBG code. For example, a biventricular pacing defibrillator with ventricular shock and antitachycardia pacing functionality would be identified as VVE-DDDRV, assuming that the pacing section was programmed DDDRV. Currently, no hemodynamic sensors have been approved for tachycardia detection (position III).
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Discussion

This clinical review was performed to inform the patients and healthcare providers about CIED technology, and their subsequent uses and risks associated with them. With both parties understanding the purposes and reasons for CIED therapy, a better relationship between the patient and provider forms. The discussions between patient and providers could entail that CIED therapy may be a suitable adjunct to other forms of therapy if the patient suffers from risk of SCD. Although the literature and evidence have proven benefits in the clinical outcomes of patients with CIEDs, risks still exist with their insertion and maintenance. Additionally, some patients may not meet the criteria of having symptomatic bradyarrhytmias, or life-threatening tachyarrhytmias.

Conclusion

CIED integration into the treatment options for patients has overall improved clinical outcomes in patients at risk for cardiac arrest or SCD. With most of the future population shifting towards the elderly, the need for CIED therapy may become a mainstay treatment option. This shift in the trend of the population demographics, justifies the reason why it is important for healthcare providers to understand how to perioperatively manage these devices. Effective communication between members of the CIED team ensures that proper care is delivered to the patient from the preoperative, intraoperative, and postoperative phases. Additionally, healthcare providers and patients alike should be kept up with newer technology trends to allow the most optimal clinical outcomes.

References

Barash, P. G., Cullen, B. F., Stoelting, R. K., Cahalan, M., & Stock, M. C. (2017). *Clinical anesthesia* (8th ed.) "Appendix 3 Pacemakers and Implantable Cardioverter Defibrillator Protocols" pgs 4295-4306

DeFilippis, E. M., Butler, J., & Vaduganathan, M. (2017). Waiting period before Implantable cardioverter-defibrillator implantation in newly diagnosed heart failure with reduced ejection fraction. *Circulation: Heart Failure*

Mulpuru, S. K., Madhavan, M., McLeod, C. J., Cha, Y., & Friedman, P. A. (2017). Cardiac pacemakers: Function, troubleshooting, and management. *Journal of the American College of Cardiology*, *69*(2), 189-210. doi: 10.1016/j.jacc.2016.10.061

Practice advisory for the perioperative management of patients with cardiac Implantable electronic devices: Pacemakers and Implantable cardioverter–defibrillators (2020). *Anesthesiology*, *132*(2), 225-252. doi:10.1097/aln.0000000000002821

Vaidya, V. R., Asirvatham, R., Kowlgi, G. N., Dai, M. Y., Cochuyt, J. J., Hodge, D. O., Deshmukh, A. J., & Cha, Y. M. (2021). Trends in Cardiovascular Implantable Electronic Device Insertion Between 1988 and 2018 in Olmsted County. *JACC: Clinical Electrophysiology*. Published. https://doi.org/10.1016/j.jacep.2021.06.006