Anesthesia in the Electrophysiology Laboratory

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KEYWORDS

• General anesthesia • Conscious sedation • High-frequent jet ventilation
• Catheter ablation • Programmed stimulation

KEY POINTS

- Sedation remains an important modality in the electrophysiology suite and monitoring for respiratory depression is an essential component.
- Scar-related ventricular tachycardia can typically be induced under general anesthesia; however, more aggressive programmed stimulation is often required.
- In contrast, automatic and triggered arrhythmias, as well as reentrant arrhythmias incorporating the atrioventricular node, are more sensitive to catecholamine state.
- General anesthesia and high-frequency jet ventilation decrease patient movement and thoracic excursion, enhancing contact between the ablation catheter and myocardium, resulting in more durable ablation lesions and improved outcomes.
- Use of mechanical hemodynamic support including percutaneous left ventricular assist devices and extracorporeal membrane oxygenation are increasing in ablation of scar-related ventricular tachycardia.

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INTRODUCTION

The electrophysiology (EP) suite is a foreign, and often foreboding location to many anesthesiologists. Like many non–operating room anesthesia areas, the initial experience in

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the EP suite was with shorter procedures performed under conscious sedation (CS), and the value of greater tailoring of the sedation/anesthesia by anesthesiologists was not perceived until practice patterns had already been established. It is not surprising, then, that the reference therapy for studies that assess the impact of anesthetic techniques is most frequently CS. This impact is not always positive; muscle relaxants may preclude identification of the course of the phrenic nerve, rendering it susceptible to ablation injury; anesthetics may suppress arrhythmias, preventing mapping. Anesthesia can also blunt the hemodynamic adaptation to induced arrhythmias, aggravating hypotension and at the same time impeding assessment of cerebral perfusion, factors that are used to guide the duration that an arrhythmia can be allowed to persist to allow mapping and ablation. Thus, it is important when approaching the EP suite to recognize that conventional anesthesia wisdom derived from experience with surgeons may not be optimal for collaborating with electrophysiologists. It is also important to understand that electrophysiologists follow a different path than surgeons during training, and are not inculcated with the culture of the operating room. It is easy for this difference in expectations to lead to arguments that do not serve the interest of the patient. We attempt to address several areas in which an understanding of the requirements of the procedure can enhance care.

PREPROCEDURAL PLANNING

Patients undergoing EP procedures span the gamut of possibilities, from a healthy child to a frail octogenarian. Although anesthesiologists are accustomed to tailoring the anesthetic plan to the level of pain anticipated for the procedure, many EP procedures are minimally invasive, and pain is not the primary reason for involvement of anesthesia providers. It is, therefore, important in planning the anesthetic management to understand the particular arrhythmia.

A commonly performed procedure in EP is placement of an implantable cardiac device (or pacemaker). Many patients can tolerate placement of transvenous devices with minimal sedation, and many centers no longer routinely perform defibrillation threshold testing. When this is needed, a period of sedation or general anesthesia is typically used for cardioversion/defibrillation. More recently, subcutaneous defibrillators have become available, requiring more extensive dissection and tunneling, and general anesthesia is required in most cases. Regional anesthesia may be a useful adjunct during device implantation.

Catheter ablation is the other major category of procedures. Achieving the procedural goal of identifying and ablating the arrhythmia requires consideration of factors that may influence its inducibility and procedural tolerance. Arrhythmias typically originate either from a small focus or larger reentry circuits. Focal arrhythmias are usually due to abnormal automaticity (although small reentry circuits are sometimes encountered) and are more commonly seen in structurally normal hearts. These are referred to as idiopathic; ectopic atrial tachycardia, idiopathic premature ventricular beats, and idiopathic ventricular tachycardia (VT) are common examples. Focal atrial tachycardias may occur after catheter ablation for atrial fibrillation, and focal VTs can arise from diseased Purkinje tissue (fascicular automatic tachycardia). Focal arrhythmias are targeted for ablation by identifying the site of earliest activation during the arrhythmia by moving a catheter across the cardiac chamber of origin during the arrhythmia and plotting the activation time on a 3-dimensional reconstruction of the chamber in an electroanatomic mapping system. Successful ablation of these arrhythmias requires that the arrhythmia be provoked and allowed to persist long enough to be mapped; once mapped, the focus can often be ablated anatomically. Most idiopathic arrhythmias are well-tolerated hemodynamically and rarely require