



Ablation Success in Various Arrhythmias: When It Is Appropriate to Recommend Ablation?

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Abstract: Cardiac arrhythmia is an abnormal electrical activity of the heart. It can be divided into rhythms with increased electrical activity (tachyarrhythmia) and those with reduced electrical activity (bradyarrhythmia). Ablation therapy has a role in tachyarrhythmia, but this role varies from being limited in inappropriate sinus tachycardia to being a class 1 indication in typical atrial flutter. A balanced approach in recommendation for ablation therapy for the management of tachyarrhythmias involves knowledge of the interplay between the risk, benefit, success rate, and alternatives with advances in mapping and ablation therapy. (Curr Probl Cardiol 2021;46:100760.)

Introduction

Cardiac arrhythmia is defined as abnormal electrical activity of the heart. It can be broadly divided into rhythms with increased electrical activity with most leading to increase in the rate of mechanical contraction of the heart (tachyarrhythmias) vs those with decreased cardiac electrical activity which causes a reduced rate of mechanical contraction of the heart (bradyarrhythmia). Ablation, which traditionally is the use of radiofrequency, cryotherapy, laser and recently electroporation to interrupt either the initiation or propagation of cardiac electrical activity is currently used for treatment of tachyarrhythmias.

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Bradyarrhythmias are usually managed with identification and discontinuation of offending agents, medications, or device therapies.

These cardiac rhythms with increased electrical activity can be further classified into primary disorders of the sinoatrial (SA) node, atrial and atrioventricular (AV) node such as inappropriate sinus tachycardia (IST), sinoatrial node reentrant tachycardia, atrial premature complex (APC), atrial tachycardias (AT), atrial flutter (AFI), atrial fibrillation (Afib), atrioventricular nodal reentry tachycardia (AVNRT), junctional tachycardia, to those arrhythmias that involve an accessory pathway connecting the atrium with the ventricle giving rise to atrioventricular reentry rhythms and finally to primary disorders of the ventricles such as frequent premature ventricular contractions (PVC), ventricular tachycardia (VT), ventricular fibrillation (VF).

Advances in ablation techniques, making it safer and more accurate, and concomitant advances in the precise mapping of cardiac electrical pathways, have made location of triggers and reentry circuits of arrhythmia easier, providing substrates for ablation which can terminate a good percentage of these tachyarrhythmias.

Ablation which in layman terms is partial destruction of cardiac tissue is an invasive process with risk and should be attempted only in suitable individuals with a clear idea of the success rate of termination of various tachyarrhythmia types. We will discuss the indications, risks, and benefits of ablation for tachyarrhythmias. A summary of the recommendation and most common risk associated with ablation of various tachyarrhythmias is provided in [Table](#).

Supraventricular Tachycardia Ablation Recommendation

Inappropriate Sinus Tachycardia

IST occurs when there is a persistent atrial rate greater than 100 beats/min with sinus morphology on electrocardiogram (EKG) and which is not in keeping with the level of physiological, pharmacologic, or pathologic stress. Tachycardia usually begins and ends gradually. Etiology of IST is unclear and recommendation is seeking reversible causes then medication therapy with beta blocker or/and ivabradine as first-line therapy¹ with the use of calcium channel blockers as alternative agents. Sinoatrial node modification although effective is reserved as a salvage procedure when other measures fail and patient with intolerable symptoms or cardiomyopathy due to the risk of causing permanent SA node signal interruption far outweighs benefit of first-line ablation strategy.^{2,3}

TABLE. Various types of tachyarrhythmia ablation with recommendation and major risk.

Type of ablation	Recommendation	Major risk	Journal
Inappropriate sinus tachycardia	Medication therapy preferred; limited role of ablation especially in uncontrolled Sinoatrial node reentrant tachycardia	Permanent pacemaker	Page et al ¹ Rodríguez-Manero et al ³ Yamabe et al ⁴ Huang et al ⁵
Frequent atrial premature complex	Ablation may be considered when it is symptomatic or causes other atrial arrhythmia otherwise medication as initial choice	Pericardial effusion <1%	
Atrial tachycardia	1. Focal atrial tachycardia ablation class 1 for suitable candidates 2. Multifocal atrial tachycardia. Treatment of underlying condition and medication therapy is preferred	<1%-2% overall risk	Page et al ¹
Atrial flutter	Ablation is a class 1 indication for suitable candidates that are symptomatic or opts for rhythm control due to 97% success rate	1. Permanent pacemaker 0.2% 2. Pericardial effusion 0.3%	Page et al ¹
Atrial fibrillation	Pulmonary Vein Isolation by catheter ablation recommended for patients with symptoms	1. Permanent pacemaker 0.2% 2. Pericardial effusion 0.3% 3. Pulmonary vein stenosis 1%	Calkins et al ⁹ Page et al ¹
Atrioventricular nodal reentry tachycardia	Ablation with slow pathway modification is a class 1 indication for suitable candidates	Permanent Pacemaker 0.7%	Page et al ¹
Accessory pathway present in tachyarrhythmia	EP study and ablation class 1 indication for suitable candidates	1. Permanent pacemaker 0.3% 2. Death 0.1% 3. Tamponade 0.4%	Page et al ¹

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TABLE. (continued)

Type of ablation	Recommendation	Major risk	Journal
Junctional tachycardia	Medication therapy. Ablation a class IIb indication if medications not effective or contraindicated	Complete heart block 0%-18%	Page et al ¹
Frequent premature ventricular contractions	Varies with type, preferred to medications for symptomatic frequent episodes from RVOT	Varies. Use the PAINESD risk score 1. Stroke <1% 2. Pericardial effusion/myocardial puncture 1%-2%	Cronin et al ¹⁰ Tung et al ¹¹
Ventricular tachycardia	1. Idiopathic >90% success rate 2. Structural heart disease 50%-75% success rate	1. Stroke <1% 2. Pericardial effusion/myocardial puncture 1%-2%	Tung et al ¹¹
Ventricular fibrillation	Recommended when refractory to antiarrhythmic medications and triggered by PVCs from a potentially identifiable site	Varies. Use the PAINESD risk score 1. Stroke <1% 2. Pericardial effusion/myocardial puncture 1%-2%	Cronin et al ¹⁰ Anderson et al ¹²

All ablation types have an operator dependent risk from vascular access site.

Sinoatrial Node Reentrant Tachycardia

Sinoatrial node reentrant tachycardia is a differential of IST. It occurs when there is a clear reentrant rhythm within the SA node or pathway may include atrial tissue just outside the SA node. Ambulatory heart rhythm monitoring usually will show abrupt increases in atrial rates which occurs in paroxysm and an electrophysiology study will show reentry pathway. Medications and vagal maneuvers are tried initially with ablation reserved for refractory cases.⁴

Frequent Atrial Premature Complex

APCs, also called premature atrial contraction, are common arrhythmias of the heart which occurs when there are one or more foci in the atrium which intermittently initiates an atrial activity independent of the sinoatrial node. Conservative therapy with lifestyle modification is recommended when there are infrequent and only coincidentally noticed on EKGs. When they start producing symptoms such as palpitation, in addition to avoidance of triggers, medications such as a beta blocker, calcium channel blocker or less frequently antiarrhythmic medications are recommended. Ablation of APCs is recommended when these initial measures fail, and patient is still with symptoms or when the APCs are seen to induce other cardiac arrhythmias. Success of ablation could be as high as 88.9% in a study.⁵

Atrial Tachycardia

AT occurs when one or more foci in the atrium takes over the initiation of electrical activity of the heart with a frequency of 100b/min or greater. When there is one focus, catheter ablation is a class 1 indication if patient prefers it¹ with a high success rate. When there is more than one focus, the etiology is usually secondary to another pathology such as pulmonary abnormality, congenital heart disease, theophylline therapy, or hypomagnesemia with initial management of treating the underlying condition in addition to using av nodal blocking medications. AT ablation is reserved for those that have a good SA node function, have the underlying cardiac or pulmonary pathology under control, have symptoms, refractory to medication therapy and have distinct reproducible atrial foci whose site can be easily accessed.

Atrial Flutter

AFI occurs when there is a macroreentry circuit involving only the atrium. There are various types with the common variations being pathways that are dependent on the carotricuspid isthmus (CTI) for its propagation. AFI dependent on CTI are readily amenable to CTI ablation when there are no contraindications.⁶ Other types of AFI which results from congenital disorders of the heart, a prior ablation or surgery involving the atrium can also be ablated after mapping.^{7,8}

Atrial Fibrillation

Advances in the last 25 years showing atrial fibrillation is dependent on triggers from the pulmonary veins has made pulmonary vein isolation with ablation a class IIa recommendation for symptomatic paroxysmal atrial fibrillation⁹ with success rate approaching 80% for first-time ablations. Due to better techniques, short- and long-term complications are less common. AV node ablation with insertion of a permanent pacemaker is reserved for AFib patients with poorly controlled ventricular rates, refractory to drugs and not good candidates for AFib ablation.

Atrioventricular Nodal Reentry Tachycardia

AVNRT occurs when there is tachyarrhythmia dependent on an AV nodal reentrant rhythm. Due to its paroxysmal nature causing symptoms in most individuals, vagal maneuvers, and medications are tried initially but AVNRT ablation is also recommended as an initial therapy in suitable individuals. AVNRT ablation involves modification of the AV nodal slow pathway resulting in disruption of the re-entrant circuit in the AV node.

Junctional Tachycardia

This is a nonreentrant supraventricular rhythm that arises from the AV junction. Junctional tachycardia ablation can achieve an 82%-85% success rate but it is still a class 2b recommendation¹ due to the risk of complete heart block.

Accessory Pathway-Mediated Tachyarrhythmias

Accessory pathway-mediated tachyarrhythmias have almost a 100% cure rate once the accessory pathway is ablated. Ablation in these population is a class 1 recommendation and preferred over drug therapy especially when atrioventricular reentrant tachycardia is frequent or patient

has associated atrial fibrillation which can cause dangerous ventricular rates and rhythm when AV node is bypassed.¹

Ventricular Arrhythmia Ablation Recommendation

Frequent Premature Ventricular Contractions

PVCs, which are isolated early ventricular depolarizations, when frequent are usually seen in structural heart disease and electrolyte abnormalities. Correction of underlying abnormality with initiation of medications such as beta blocker is usually the first line of therapy. PVC ablation can be done when patient has persistent symptoms despite optimization of electrolytes and medication therapy, or when the etiology of cardiomyopathy is frequent PVCs. In specific types of PVCs such as that originating from the right or left ventricular outflow tract, ablation becomes a class 1 recommendation and preferred to medication therapy when it is frequent and symptomatic.¹⁰

Ventricular Tachycardia

There are diverse types of VT with various recommendations for management depending on the etiology. Idiopathic VT which occurs in patients without structural heart disease, long QT syndrome nor metabolic abnormality can be cured by ablation techniques with a success rate of greater than 90%.¹¹ Ablation is a class 1 recommendation for patients with arrhythmogenic right ventricular cardiomyopathy who experience recurrent sustained VT or frequent appropriate ICD interventions in whom antiarrhythmic drugs is ineffective or not tolerated.¹⁰ For structurally mediated VT, it is recommended that ablation should be offered when VT episodes are not controlled with antiarrhythmics. Implantable Cardioverter Defibrillator (ICD) is recommended in patients with structural heart disease and VT for prevention of sudden cardiac death, but catheter ablation can reduce episodes of shock as this portends overall poor prognosis.

Ventricular Fibrillation

Management of the known etiology of VF such as acute myocardial infarction with ICD implantation for those that still remain at high risk is the standard to abort further VF episodes; however, a careful observation of initiation of VF can be valuable to evaluate for VF substrates or triggers which can be ablated to prevent VF recurrence, with some studies showing greater than 90% success rate.¹²⁻¹⁵

Conclusion

With advances in mapping and ablation therapy, ablation has come to the fore front in the management of tachyarrhythmia and knowledge of its indications, alternatives, success rates, and major complication frequency provides a balanced approach in the management of tachyarrhythmias.

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