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Mini Review

# Prophylactic Temporary Pacing During Percutaneous Coronary Intervention: Indications, Strategies, and Clinical Implications

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## Abstract

Prophylactic temporary pacing is a critical consideration during percutaneous coronary intervention (PCI), particularly in scenarios where bradyarrhythmias or atrioventricular block are likely to complicate the procedure. This review examines the risk factors necessitating temporary pacing, evaluates different pacing techniques, and provides an overview of the associated clinical outcomes. We delve into specific interventions like rotational atherectomy and rheolytic thrombectomy, discussing their potential to induce transient cardiac rhythm disturbances and highlighting strategies to mitigate these risks. Evidence suggests diverse scenarios where prophylactic pacing may be beneficial, including coronary atherectomy and procedures involving severe coronary calcification. The efficacy of alternative pacing methods, such as transcoronary unipolar pacing and the use of specialized coronary guidewires, is also explored. This review underscores the importance of personalized pacing strategies tailored to patient-specific and procedural risk factors to optimize clinical outcomes during PCI.

**Keywords:** temporary cardiac pacing; percutaneous coronary intervention

## Introduction

Prophylactic temporary pacing during percutaneous coronary intervention (PCI) is employed to manage potential conduction disturbances that may arise during complex cardiac interventions. Temporary pacing is specifically indicated in procedures where there is an increased risk of bradyarrhythmias or atrioventricular block. These scenarios are notably observed in rotational atherectomy (RA) and other complex PCI techniques that can provoke cardiac rhythm disturbances. This review aims to consolidate current evidence on the indications and methodologies for temporary pacing during PCI, analyze different pacing strategies, and discuss their implications for clinical practice.

**The Role of Bradyarrhythmias in PCI:** Bradyarrhythmias are a common concern during PCI, especially during certain high-risk procedures. For instance, coronary atherectomy, known for its efficacy in managing severe coronary artery disease, can cause transient bradycardia due to the physiological response to rotational or orbital drilling of calcified plaques. Research associates these rhythm disturbances with the release of endogenous adenosine, advocating for the use of aminophylline as a preventative measure [1]. By antagonizing adenosine's effects, aminophylline has demonstrated efficacy in averting bradyarrhythmias during atherectomy, particularly in the Right Coronary Artery (RCA) or dominant circumflex artery.

**Understanding Risk in RA:** RA presents unique challenges due to the mechanical and hemodynamic effects of the procedure. Research indicates a variable need for temporary pacing based on the coronary artery involved. Findings suggest that heart blocks are more prevalent in lesions of the RCA and left-dominant circumflex artery compared to the left anterior descending artery, which frequently does not require prophylactic pacing [2]. Such insights highlight the necessity of

evaluating patient-specific factors and procedural risks before considering pacing interventions.

**Temporary Pacing in the Context of Coronary Calcification:** In scenarios of severe coronary calcification, where the risk of bradycardia is heightened, temporary pacing can play a crucial role. A case study illustrates the successful use of temporary trans-coronary pacing with a Rota wire to manage significant bradycardia during PCI in heavily calcified coronary arteries [3]. This approach is indicative of the broader application of prophylactic pacing in managing complex PCI cases, reaffirming its role in personalized treatment planning for patients with significant anatomical challenges.

**Alternative Pacing Techniques during PCI:** Given the limitations of traditional temporary pacing, alternative methods like transcoronary unipolar pacing present a viable solution, particularly when quick and reliable pacing is essential. Studies demonstrate its efficacy compared to conventional transvenous pacing, especially in critical anatomical locations such as the left main coronary artery bifurcation [4]. Additionally, specialized coronary guidewires like Vision Wire offer enhanced pacing capabilities, achieving high efficacy with lower thresholds, making them suitable for emergency and complex PCI scenarios where immediate pacing is necessary [5].

**Managing Rhythm Disturbances in PCI Interventions:** Transient cardiac rhythm disturbances frequently accompany interventions such as rheolytic thrombectomy. Evidence suggests temporary pacing as an essential strategy to manage these complications effectively [6]. Moreover, interventions such as RA are associated with complications like slow-flow or no-reflow phenomena, which warrant a comprehensive management approach, including prophylactic pacing alongside pharmacological and mechanical support [7].

## Indications for Prophylactic Pacing in PCI

Prophylactic pacing may be considered in PCI cases where the risk of transient or sustained conduction disturbances is high. The key indications include:

1. **Severe Baseline Conduction Disease**
   - Patients with pre-existing high-degree AV block (Mobitz II or complete heart block) or bifascicular/trifascicular block are at high risk of worsening conduction defects during PCI, particularly if the RCA or septal perforators are involved.
   - Literature suggests that PCI in such patients may lead to Permanent Pacemaker Implantation (PPI) in up to 10-20% of cases [8].
2. **Intervention on the RCA or Dominant Left Circumflex (LCx) Artery**
   - The RCA supplies the AV node in 90% of individuals, making it susceptible to ischemia-induced conduction disturbances during balloon inflation or stent deployment.
   - Temporary pacing is recommended in cases with a dominant RCA with pre-existing conduction delays (such as first-degree AV block or bundle branch block) [9].
3. **PCI in Acute Myocardial Infarction with High-Risk Features**
   - In inferior ST-Elevation Myocardial Infarction (STEMI), transient AV block occurs in 10–15% of cases, often resolving post-reperfusion but sometimes requiring pacing [10].
   - Anterior STEMI with proximal LAD occlusion can lead to Left Bundle Branch Block (LBBB) and subsequent AV block, warranting prophylactic pacing.
4. **No-Reflow or Slow Flow Situations**
   - PCI in patients with high thrombus burden, such as those undergoing intervention in the RCA or L Cx with heavy clot burden, is associated with a higher risk of complete AV block due to prolonged ischemia.
   - The slow flow/no-reflow phenomenon is reported in up to 30% of thrombotic STEMI PCIs and can result in transient bradyarrhythmias or Complete Heart Block (CHB) requiring temporary pacing [11].
5. **Complex PCI Cases (Left Main, Bifurcation, CTO, High-Risk Plaque Burden)**
   - Left main PCI, particularly in critical stenosis, poses a significant risk of transient hemodynamic collapse if severe flow compromise occurs during stenting.
   - Studies show that high-risk PCI (left main, bifurcation, or heavily calcified lesions) requiring atherectomy has a pacing requirement of 8–12% due to transient conduction disturbances [12].
   - CTO PCI, especially in RCA or septal collaterals, has a 3–8% risk of developing transient or persistent heart block, further necessitating prophylactic pacing in select patients [13].
6. **Balloon Occlusion in Aortic Stenosis or Pre-TAVR PCI**
   - PCI performed prior to Transcatheter Aortic Valve Replacement (TAVR) in patients with baseline conduction disturbances poses a risk of post-PCI CHB.
   - A study by Fadahunsi et al. found that pre-TAVR PCI was associated with an increased risk of PPI (odds ratio: 1.5) [14].

**Several studies and meta-analyses have evaluated the role of prophylactic pacing in PCI:**

1. **PROTECT-PCI Study (2020)**
   - Evaluated high-risk conduction abnormalities in PCI and found that prophylactic pacing prevented hemodynamic collapse in 8% of cases where CHB developed post-PCI [15].
   - The study recommended prophylactic pacing in patients with trifascicular block or prior transient AV block.
2. **Hirsch et al. (2019)**
   - Assessed patients undergoing RCA PCI with baseline conduction defects.
   - Found that patients with bifascicular block had a 12% risk of CHB requiring temporary pacing versus 3% in those without baseline conduction issues [16].
3. **CTO-PCI Registry (2022)**
   - Examined patients undergoing complex PCI with high calcium burden.
   - Identified that LBBB developed in 6% of cases, and 3.5% required temporary pacing, supporting the use of prophylactic pacing in select cases [17].

4. **Meta-analysis of Temporary Pacing in PCI (2023)**

- Analyzed 12 studies with over 6,000 patients undergoing PCI with high conduction risk.
- Concluded that prophylactic pacing reduced emergency pacing requirements from 8.4% to 3.2% and improved procedural safety without significantly increasing complications [18].

5. **No-Reflow and Bradyarrhythmias (2023)**

- A systematic review on no-reflow in PCI found that patients experiencing prolonged no-reflow had a 6–10% incidence of transient AV block requiring pacing.
- The study recommended that temporary pacing should be available for PCI cases involving high thrombus burden, RA, or left main interventions [19].

## Practical Considerations and Recommendations

- **Use of Temporary Transvenous Pacing (TTP)**
  - Indicated for patients with high-degree AV block or significant conduction delay undergoing RCA PCI.
  - Preferred approach: Femoral vein access (allows easy removal post-PCI).
- **Prophylactic Pacing with External Pacing Pads**
  - May be sufficient in low-risk cases, such as transient bradycardia during inferior STEMI PCI.

| Clinical Scenario | Recommendations |
|---|---|
| Baseline bifascicular block + RCA PCI | Strongly consider Temporary Transvenous Pacing (TTP). |
| Inferior STEMI with transient AV block | External pacing pads may suffice. |
| Anterior STEMI with new LBBB | TTP recommended if prolonged ischemia is anticipated. |
| CTO PCI with pre-existing conduction disease | TTP in select high-risk patients. |
| Left main PCI with critical stenosis | Consider TTP to prevent hemodynamic instability. |
| PCI with slow flow/no-reflow and high thrombotic burden | Have pacing readily available. |

**Table 1:** Decision Algorithm for Prophylactic Pacing in PCI

In a case of acute inferior wall myocardial infarction, the patient required urgent primary PCI, necessitating prophylactic temporary pacing. The temporary pacing lead was intentionally positioned in the IVC to minimize complications while ensuring immediate readiness for emergency intervention, as shown in **Figure 1.**

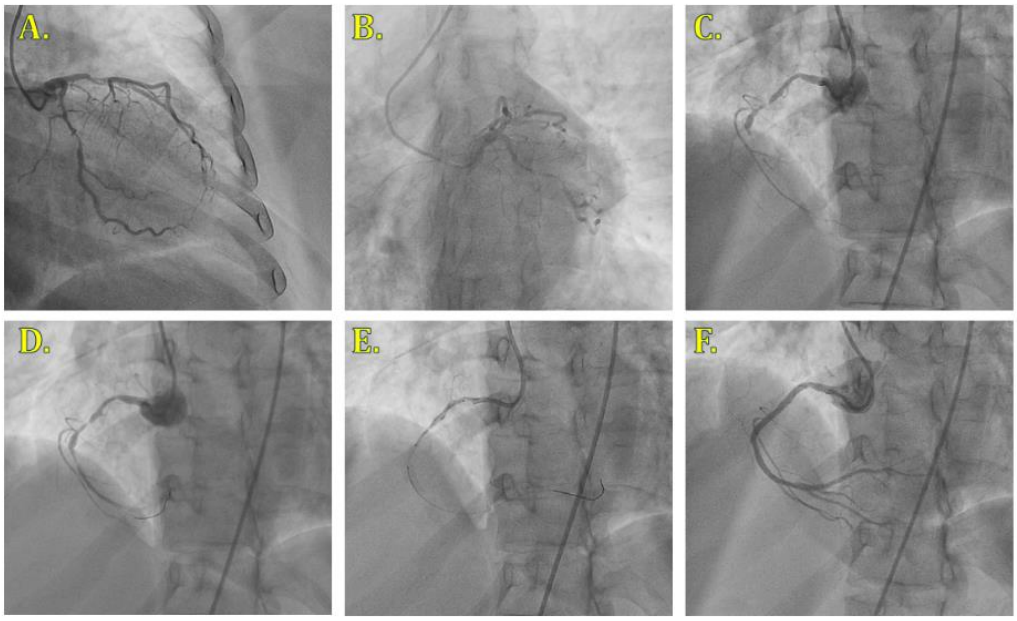


**Figure 1:** A case of acute inferior wall MI.

A. CAG shows an 85% lesion in the proximal LAD.
B. CAG shows a 95% lesion in the proximal LCx.
C. CAG shows that the RCA was completely occluded (100%).
D. In the distal RCA, a 23 x 2.5 mm drug-eluting stent (Xience Prime) positioned at 18 atm.
E. In the proximal RCA, a 23 x 3.5 mm drug-eluting stent (Xience Prime) positioned at 18 atm.
F. The final result showed good TIMI 3 flow.

**Note:** The patient presented with an acute inferior wall myocardial infarction and required urgent primary PCI, which necessitated prophylactic temporary pacing.

## Conclusion

Prophylactic temporary pacing during PCI represents a vital component of modern interventional cardiology, addressing the potential for significant cardiac rhythm disturbances. Decision-making regarding pacing should be nuanced, considering procedural complexities and patient-specific risk factors. The expansion of pacing methodologies, including transcoronary and guidewire-assisted techniques, provides interventionalists with robust tools to enhance the safety and efficacy of PCI. As research continues to evolve, a tailored approach to temporary pacing will be instrumental in optimizing clinical outcomes and supporting the advancement of PCI techniques.

## Author Contributions

The lead author of the review is Dr Rohit Mody. Dr Debabrata Dash, Dr Bhavya Mody, Dr Rahul Singla and Dr Inderjeet Singh Monga had equal and substantial contributions in the formation of this review article. They were involved in conceptualization, data curation, formal analysis, resources, software, validation, visualization, writing - original draft, Writing, review & editing.

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I thank Mr. Rohit for assisting me to finalize the review. Figures are edited by Mr. Jiwan Singh.

## Availability of Data and Materials

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

## Ethics Approval and Consent to Participate

Ethical approval was not required since it is an accepted procedure

## Consent for Publication

Written consent has been obtained to publish the review article from the guardian. The consent copy is available with the authors and ready to be submitted if required.

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