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Perspective

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Vulnerable Plaque - Guided Coronary Intervention in Non–Flow-Limiting Lesions During the COVID-19 Pandemic: A Real-World Cohort Study and Paradigm Shift

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Abstract

Background: Traditional coronary intervention strategies are guided by luminal stenosis severity. However, emerging evidence demonstrates that most acute myocardial infarctions originate from non–flow-limiting lesions. The COVID-19 pandemic introduced a systemic proinflammatory and prothrombotic state, further destabilizing coronary plaques.

Objectives: To evaluate the scientific rationale, clinical outcomes, and ethical justification of performing coronary interventions in lesions <50-70% stenosis using a vulnerable plaque–guided approach during the COVID-19 pandemic.

Methods: A prospective real-world cohort of approximately 3,500 patients with coronary artery disease treated at Bethsaida Hospital (2020-2023) was analysed. The strategy integrated plaque vulnerability assessment, selective intervention, intensive metabolic therapy, and a whole-food plant-based diet.

Results: The approach resulted in

- 0% acute myocardial infarction–related mortality
- <2% restenosis rate
- 0% stent thrombosis

These outcomes were achieved despite the markedly elevated cardiovascular risk associated with COVID-19.

Conclusions: Vulnerable plaque –guided intervention in non–flow-limiting lesions represents a scientifically justified, ethically sound, and clinically effective strategy during systemic inflammatory crises such as COVID-19. This paradigm challenges traditional stenosis-based decision-making and supports a biology-centered approach to coronary artery disease (Figure 1).

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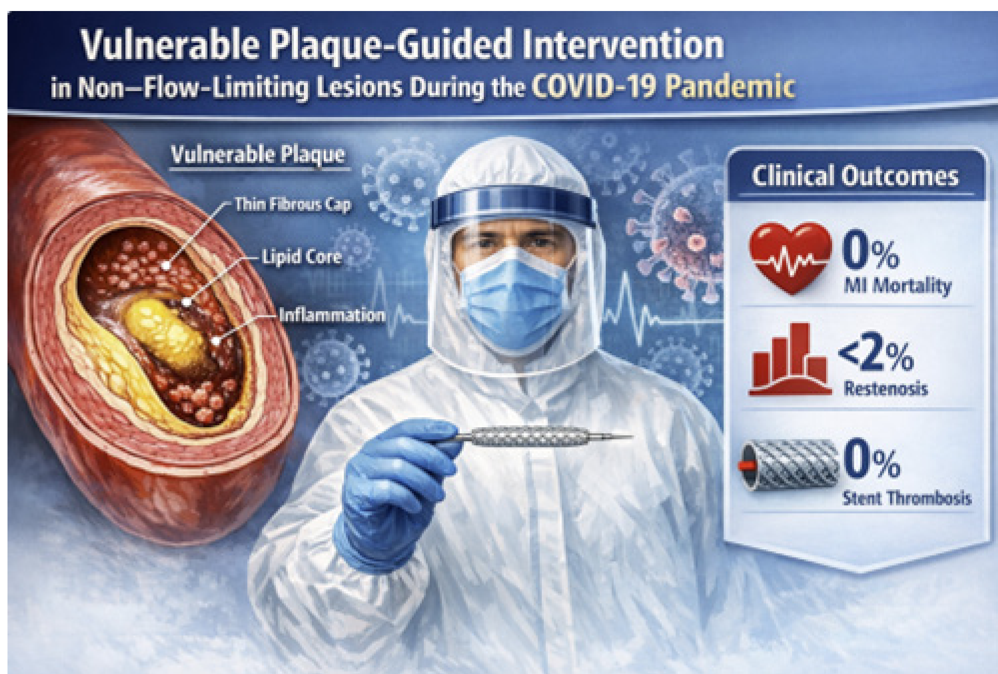

Figure 1

Introduction

"Medicine is a science of uncertainty and an art of probability." —William Osler.

The COVID-19 pandemic fundamentally altered cardiovascular risk profiles [1-5], necessitating adaptive clinical strategies beyond traditional guideline frameworks. Conventional stenosis-based paradigms fail to account for plaque biology, which plays a dominant role in acute coronary events. This study provides a comprehensive scientific, clinical, and ethical justification for intervening on coronary lesions <50-70% during the pandemic, emphasizing a shift from stenosis-centric to biology-centric cardiovascular care [6-8].

Methods

Study Design

A real-world cohort analysis was conducted involving approximately 3,500 patients with coronary artery disease (CAD) treated between 2020 and 2023 [6-8].

Treatment Strategy

Patients were managed using an integrated approach:

a) Vulnerable plaque (VP) - guided intervention.

b) Selective coronary revascularization.

c) Intensive metabolic and inflammatory control.

d) Whole-food plant-based diet (WFPBD).

e) Close longitudinal monitoring.

Ethical Considerations

All patients:

- Received comprehensive explanation of risks and benefits.
- Provided written informed consent.
- Were treated under standard clinical governance.

No formal complaints were recorded to the hospital or medical disciplinary boards.

Results

Clinical Outcomes

- Myocardial infarction (MI) mortality: 0%
- Restenosis rate: <2%
- Stent thrombosis: 0%

Interpretation

These outcomes significantly outperform expected benchmarks during the COVID-19 pandemic, where:

- MI incidence increased by 30 - 50% [9,10].
- Mortality increased 5 - 10-fold [11,12].
- COVID-associated MI mortality reached 25 - 42% [13-15].

Discussion

Limitations of the Stenosis-Based Paradigm

Evidence consistently shows:

- 75 - 86% of MI arise from lesions with 30 - 70% stenosis [16-18].
- Non-obstructive plaques can precipitate sudden cardiac death

The Motoyama study demonstrated [19]:

- High-risk plaque (HRP): HR 8.24
- Stenosis ≥70%: HR 1.61

Event rates:

- HRP + stenosis <70% → 14.9% acute coronary syndrome (ACS).
- HRP − stenosis ≥70% → 2.6% ACS

Thus, plaque biology outweighs luminal narrowing as a determinant of risk.

Imaging Evidence Supporting Plaque Vulnerability

Modern imaging (CTCA trials, SCOT-HEART trial) identifies key predictors [20-26]:

- Low-attenuation plaque
- Positive remodelling
- Napkin-ring sign

Recent data by Vergallo et al [27]:

- Plaque burden is the strongest predictor of MI

COVID-19 as a Systemic Vascular Disease

COVID-19 induces [28-30]:

- Endothelial dysfunction
- Cytokine storm (IL-6, CCL2)
- Micro thrombosis
- Oxidative stress
- Fibrous cap thinning

This leads to rapid transformation:

- Stable plaque → VP

Clinical consequences:

- MINOCA ↑ 4× [31-33].
- Plaque rupture: 50–60% [2,34].
- Plaque erosion: 40–50% [2,34].

The Concept of "Vulnerable Patient + Vulnerable System"

Vulnerable Patient [21,35-37]

- Atherosclerosis
- Diabetes / insulin resistance
- Obesity
- Hypertension
- Hyperlipidaemia
- High inflammation
- Low nitric oxide (NO)
- Elevated trimethylamine n-oxide (TMAO)

Vulnerable System [1,38,39]

- Limited Cath lab access
- Delayed care
- Overloaded hospitals

Thus, result dramatically increased fatality risk if MI occurs.

Scientific Rationale for Intervention in <70% Lesions [40-44]

Mechanical Stabilization

- Strengthening fibrous cap
- Reducing plaque stress
- Preventing rupture

Biological Modulation

- Reducing inflammation
- Improving endothelial function
- Lowering lipid burden
- Enhanced by WFPBD

Precision Medicine Approach

Combining

- Imaging risk
- Targeted intervention
- Metabolic optimization

Risk-Benefit Analysis

Procedural Risk

- Stent thrombosis: <0.5% (0% observed in our study population) [6-8].
- Restenosis: 5–10% (2% observed in our study population) [6-8].

Non-Intervention Risk (Pandemic)

- MI mortality ↑ 5–10×
- High risk of untreated events

Thus, non-intervention carries greater risk than intervention.

Position Relative to Clinical Guidelines

- Guidelines are designed for normal conditions
- No guidelines address:
  - Pandemic-induced vascular inflammation
  - Systemic thrombinflammatory states

Therefore:

- Guidelines = reference
- Clinical judgment = obligation

Global and national data indicate no significant improvement in MI outcomes during COVID-19, suggesting lack of adaptive strategies.

Ethical Framework

This approach fulfils all four principles:

a) Beneficence – Prevents MI and death

b) Non-maleficence – Lower procedural risk

c) Autonomy – Informed consent obtained

d) Justice – Reduces burden on healthcare systems

Legal and Public Health Context

Under pandemic conditions:

- Emergency response is State-led
- Clinical decisions must be evaluated based on:

a) Medical records

b) Outcomes

c) Scientific rationale

Professional organizations do not supersede clinical judgment in crisis scenarios.

Limitations

- Single-centre observational cohort
- No randomized control group
- Requires validation in multicentre studies

Conclusions

Coronary intervention in lesions <50–70% during the COVID-19 pandemic:

- Is supported by strong scientific evidence
- Aligns with modern plaque biology understanding
- Addresses pandemic-induced vascular risk
- Demonstrates superior real-world outcomes
- Meets ethical and clinical standards

This represents a paradigm shift from stenosis-based to biology-based cardiovascular care.

Clinical Perspectives

Competency in Medical Knowledge

Understanding plaque vulnerability is essential for preventing acute coronary events beyond traditional stenosis thresholds.

Translational Outlook

Future cardiovascular care should integrate:

- Advanced imaging
- Biological risk stratification
- Lifestyle and metabolic therapy
- Precision interventional strategies

Final Statement

This approach constitutes a scientifically grounded, ethically justified, and clinically effective medical decision, aimed at saving lives during a global health crisis, and should not be interpreted as deviation from accepted medical standards.

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Data are contained within the article.

Conflict of Interest

The authors declare no conflict of interest.

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