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College of Medicine
DIVISION OF CONTINUING MEDICAL EDUCATION
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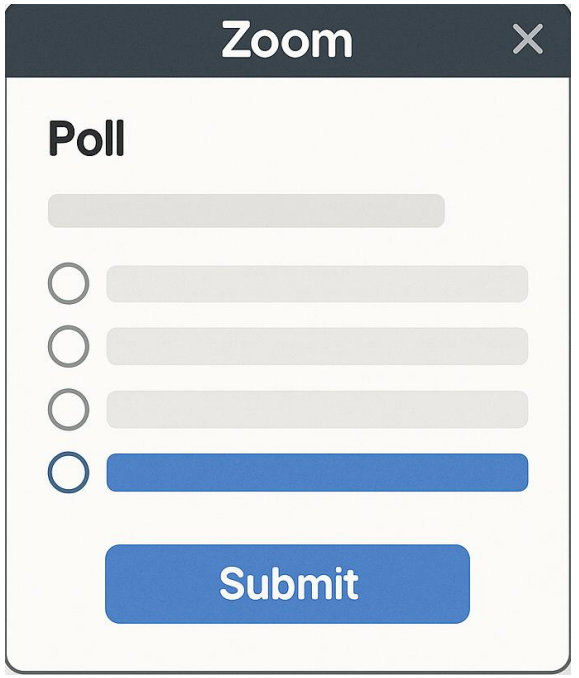
Welcome to the Division of Continuing Medical Education's Post COVID-19 Condition 2026 Webinar Series

Treaty Acknowledgment

As we gather here today, we acknowledge we are on Treaty 2, 4, 5, 6, 8 and 10 Territories and the Homeland of the Métis. We respect that Indigenous people have rich cultural and traditional practices that have been known to improve health outcomes. We pay our respect to the First Nations and Métis ancestors of this place and reaffirm our relationship with one another.

Quick Poll

- Please select your role from the list, so we can see who is in the audience.
- Please rate your **knowledge level** about the Post COVID-19 Condition (PCC) topics **before** attending the webinar.



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  This activity meets the certification criteria of the College of Family Physicians of Canada and has been certified by the Continuing Medical Education Division, University of Saskatchewan for up to 1.0 Mainpro+® Certified Activity credits.

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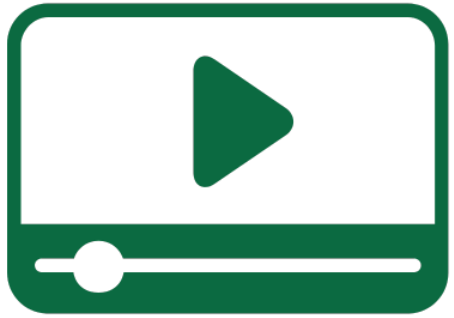

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Questions:

- Throughout the presentation and during the Q&A period, attendees can submit written questions through **Zoom's Q&A function** (anonymously, if desired) or **chat function** (addressed to "everyone")
- During the presentation, attendees will be muted.
- During the Q&A period following the presentation, attendees can use the **raise hand function** and **unmute** to ask a question.

Video:

- Video has been enabled and is optional for attendees.
- During the Q&A period, any speakers, including our main presenters, will be recorded.

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- 'Event Supporters' are not provided the opportunity to have commercial influence towards the educational content being delivered.
- Continuing Professional Development (CPD) material is peer reviewed and elevated to the Director of Accreditation, CME for further review, if required, until in compliance with the national accreditation standards.
- Brands/medical equipment/etc. are equally presented with no bias and/or with a generic brand listed.
- Survey results are documented, reviewed and addressed when bias is identified.

Dr. Andrea Lavoie, MD, FRCPC, FACC

- *Assistant Professor, Staff Cardiologist at the Mosaic Heart Centre, University of Saskatchewan, Regina.*
- *Medical lead for the Division of Cardiology in Regina.*
- *Her clinical and research activity places a primary emphasis on interventional cardiology with an interest in heart failure.*
- *She was the former president of the Canadian Association of Interventional Cardiologists.*
- *She was the former governor for the prairies chapter of the American College of Cardiology.*

The Long Shadow

Cardiac Post-COVID Condition: State of the Art 2026

May 12, 2026

Dr. Andrea Lavoie

University of Saskatchewan | College of Medicine

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PRESENTER DISCLOSURE

Presenter: Dr. Andrea J Lavoie

Relationships with financial sponsors:

- Grants/Research Support: NONE
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- Patents: NONE
- Other: NONE

LEARNING OBJECTIVES

By the end of this session, learners will be able to:

- **Identify the most common cardiac manifestations of post covid condition**
- **Identify the current understanding of the mechanisms of these problems**
- **Review an approach to diagnosis of management of these cardiac issues**

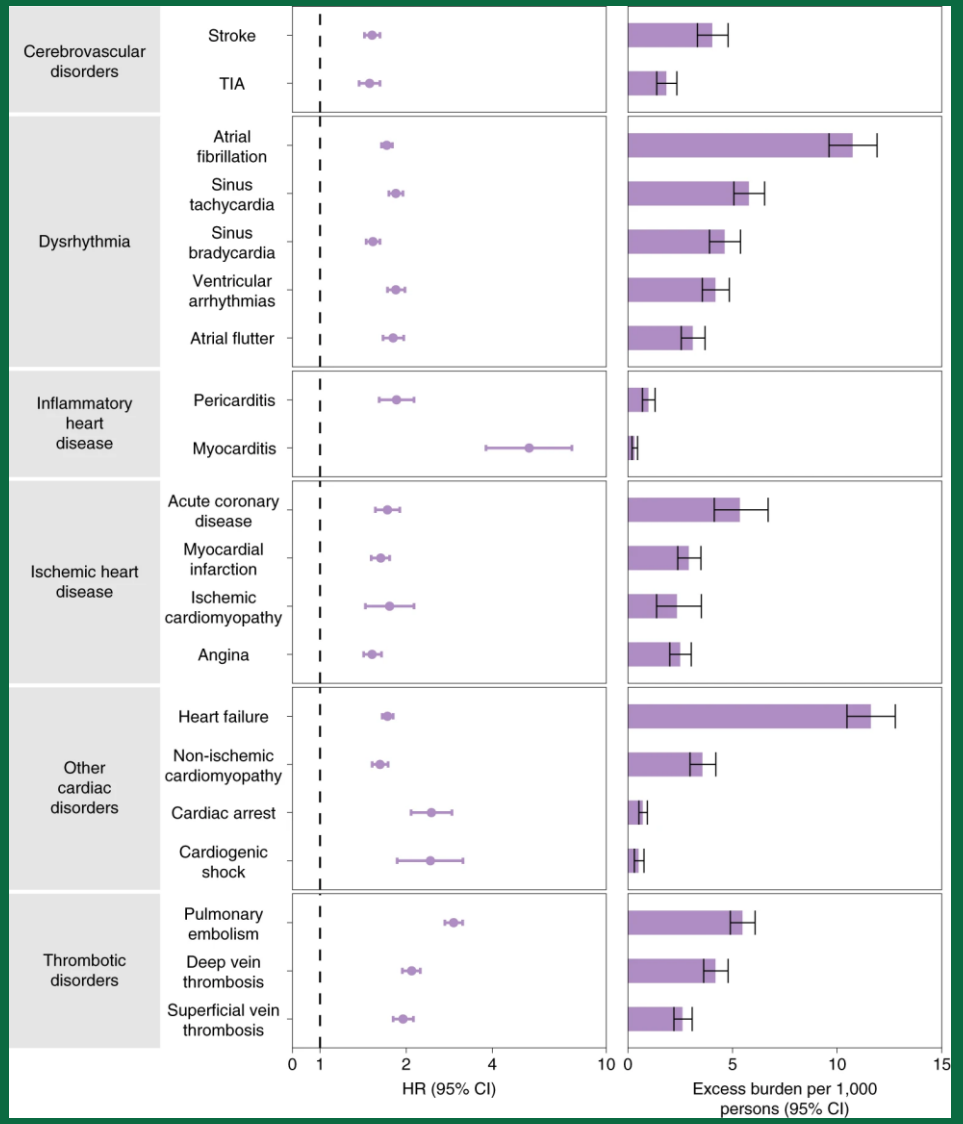
Definitions

Long-term CV Outcomes Post COVID-19

Outcomes 30 d after the COVID-19-positive test until the end of follow-up.

COVID-19 cohort ($n = 153,760$) and contemporary control cohort ($n = 5,637,647$).

Adjusted HRs and 95% CIs are presented. The length of the bar represents the excess burden per 1,000 persons at 12 months, and associated 95% CIs are also shown.



Xie et al., 2022
Nature Medicine (*Nat Med*), ISSN 1546-170X (online) ,ISSN 1078-8956 (print)

Temporal Stages of Post-COVID

Acute & Ongoing

Acute Stage: Symptoms lasting up to 4 weeks post-infection.

Ongoing Symptomatic: Persistence of cardiac symptoms between 4 to 12 weeks, marked by initial inflammatory markers.

Post-COVID Syndrome

Chronic Phase: Manifestations appearing beyond 12 weeks that are not explained by alternative diagnoses.

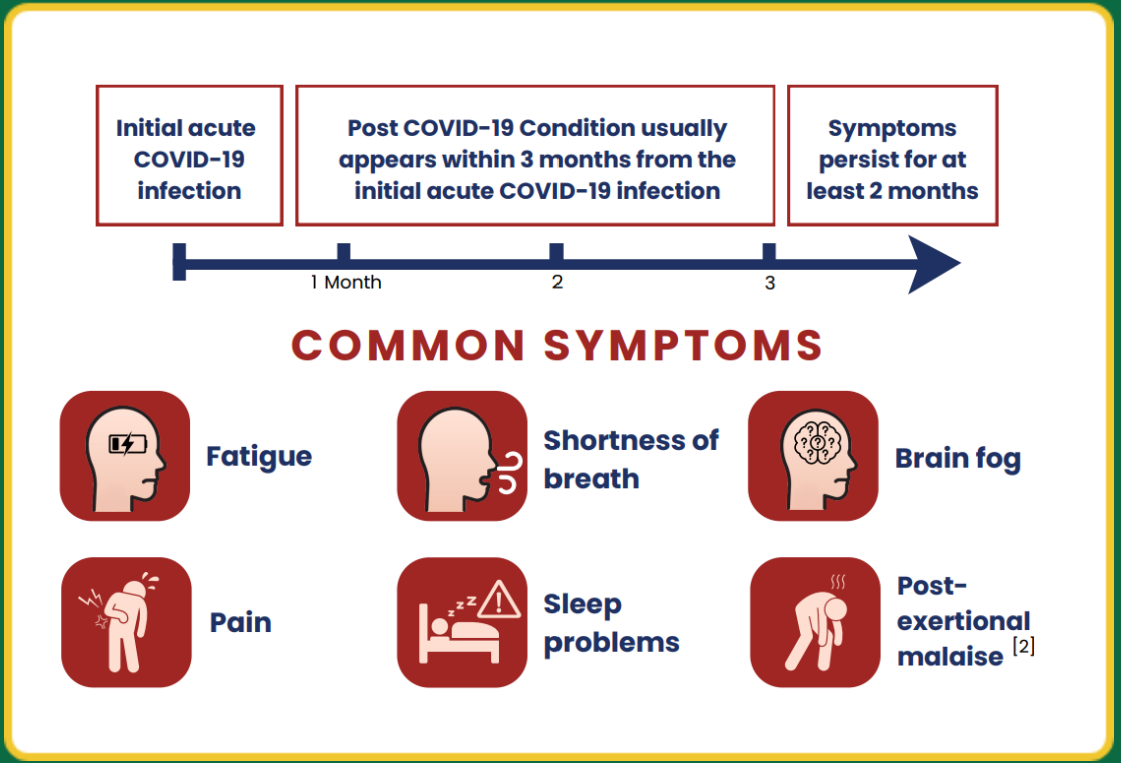
Affects even non-hospitalized individuals without prior history of cardiovascular disease.

Public Health Agency of Canada. (2024). *Post-COVID-19 condition (long COVID).* Government of Canada. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms-testing-post-covid-19-condition.html

Post-COVID-19 Condition (PCC): Government of Canada Definition

The Public Health Agency of Canada (PHAC) defines Post-COVID-19 Condition (Long COVID) as the presence of physical or psychological symptoms that:

- **Timeline:** Occur **3 months** after a confirmed or suspected SARS-CoV-2 infection.
- **Persistence:** Last for **at least 2 months.**
- **Exclusion:** Cannot be explained by an alternative diagnosis.



Public Health Agency of Canada. (2024). *Post-COVID-19 condition (long COVID)*. Government of Canada. https://www.canada.ca/en/public-health/services/diseases/2019-novel-coronavirus-infection/symptoms-testing-post-covid-19-condition.html
https://cmelearning.usask.ca/documents/post-covid-condition/what-is-pcc-infographic-patients.pdf

Bridging the Definition to Cardiovascular Practice: The Diagnostic Challenge

The broad PHAC defintion requires clinicians to distinguish between general post-viral malaise and de novo cardiovascular pathology

Xie et al., 2022
Puntmann et al., 2020

Cardiac Sequelae

Classification of Post-COVID Cardiovascular Manifestations

The Four Primary Domains

Inflammatory

Focused on myocardial and pericardial inflammation (e.g., myocarditis, pericarditis).

Vascular

Thromboembolic events and endothelial dysfunction in macro/microcirculation.

Electrical

Incident arrhythmias and autonomic nervous system dysregulation (POTS).

Structural

Subclinical remodeling leading to incident heart failure (HFpEF/HFrEF).

1. Inflammatory Disease

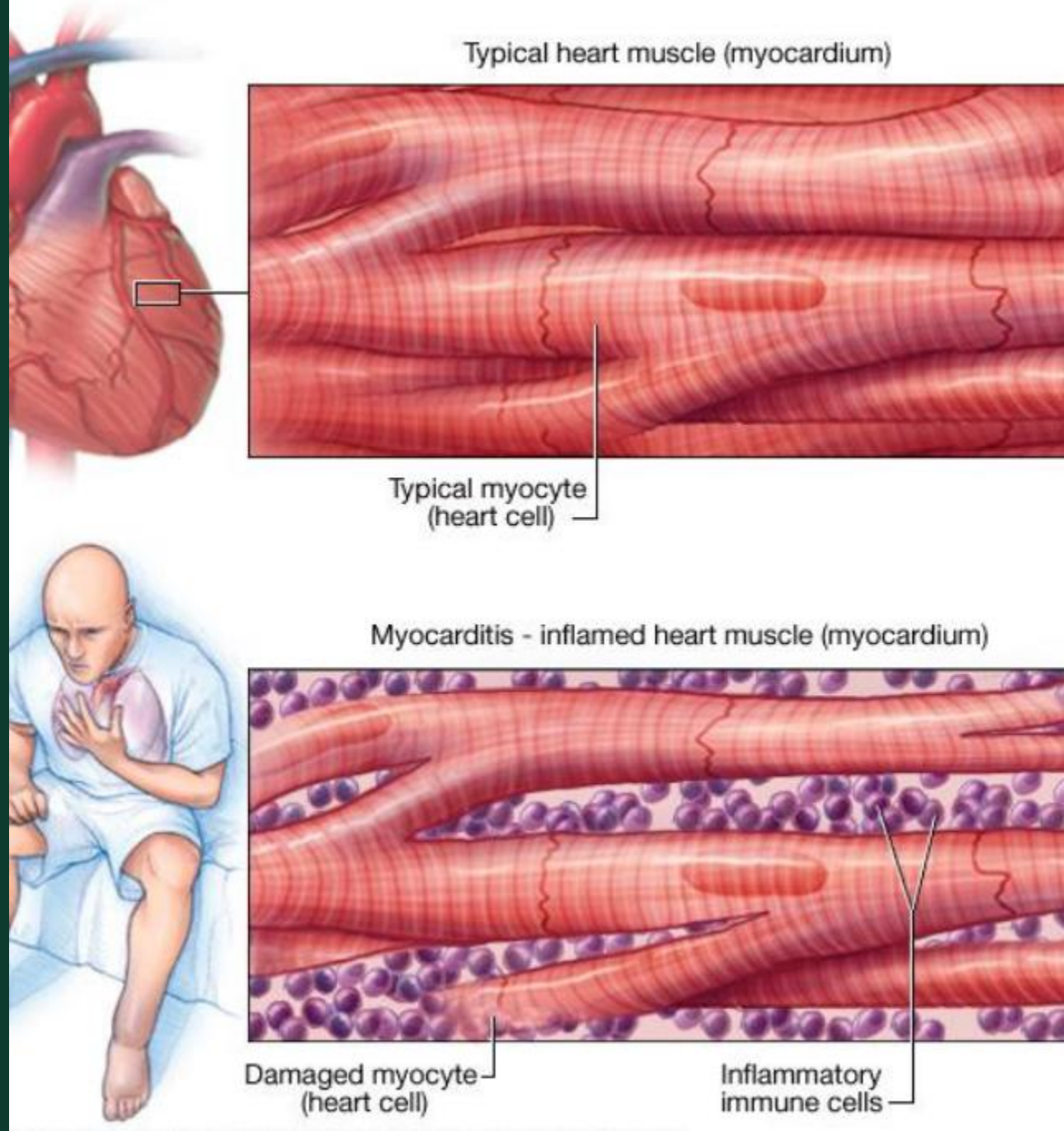
Persistent myocardial inflammation is a hallmark of PCC, even in non-hospitalized patients.

Manifestations include:

- **Acute/Chronic Myocarditis:** Focal or diffuse inflammation.
- **Pericarditis:** Inflammatory effusion or thickening.
- **Myocardial Edema:** Active T2-mapping changes on CMR.

Mechanistic link: Cytokine persistence and molecular mimicry triggering autoimmunity.

https://www.altru.org/sites/default/files/styles/original_scaled/public/health-images/Myocarditis-8col-3802786-001_0.jpg?itok=scrdqFB7

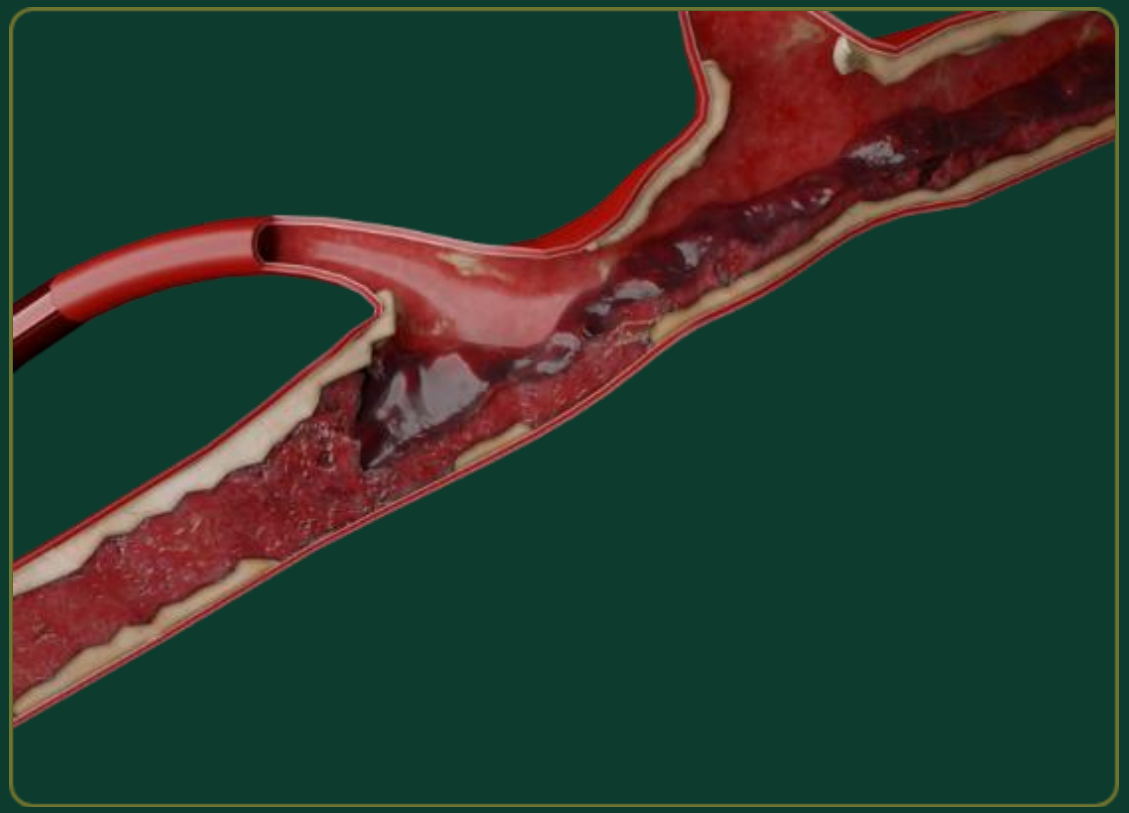


2. Thromboembolic & Vascular

Macro & Microvascular Damage

The post-acute phase is characterized by a prolonged prothrombotic state:

- **Incident Clots:** Increased risk of DVT and PE.
- **Microthrombosis:** Capillary-level occlusion hindering perfusion.
- **Endothelialitis:** Direct vessel wall inflammation.



https://storage.googleapis.com/dev_resources_voka_io_303011/3d-diseases-and-disorders/Vascular%20Diseases/3D-Model-of-Arterial-Thrombosis-of-Lower-Limbs.webp

ANOCA & Microvascular Damage

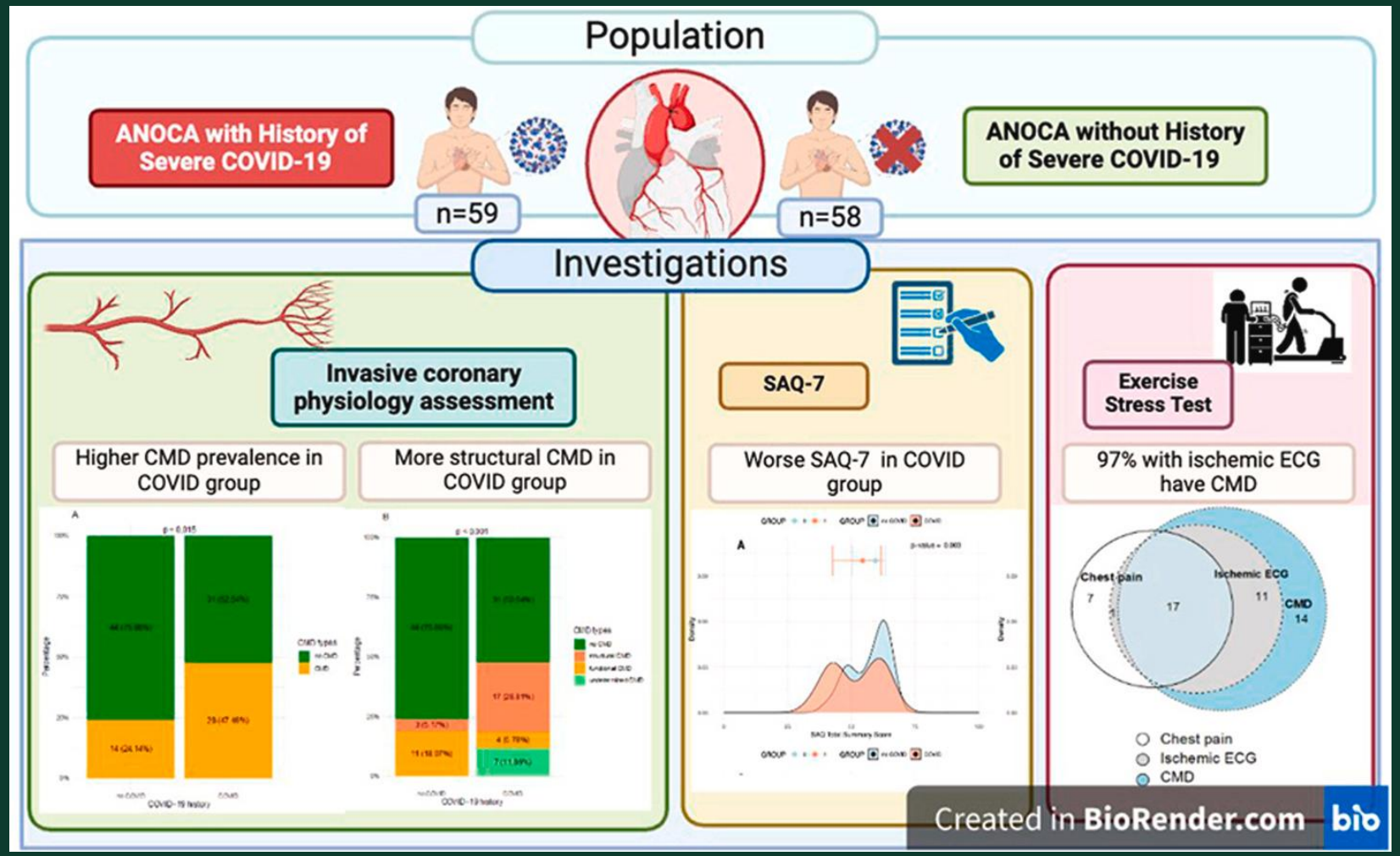
Patients with severe COVID-19 infection history have higher prevalence of CMD compared to controls.

Structural CMD (elevated IMR) predominates in post-COVID patients, while functional CMD is more common in non-COVID patients.

Post-COVID patients with angina report worse physical limitations and quality of life despite similar angina frequency.

Exercise-induced chest discomfort and ischemic ECG changes were more frequent in patients with severe COVID-19 history.

Exercise stress testing showed high specificity for identifying CMD in post-COVID patients.



Serruys, PW et al. https://doi.org/10.1016/j.atherosclerosis.2025.120389

3. Arrhythmic & Autonomic

Electrical Instability

Dysregulation of the heart's electrical and nervous control systems:

- **Dysautonomia:** Often manifesting as POTS (Postural Orthostatic Tachycardia Syndrome).
- **AFib/Flutter:** Incident atrial fibrillation even in young cohorts.
- **Inapporopriate Sinus Tachycardia:** Persistent elevated resting heart rate.

https://www.heart.org/-/media/Images/Health-Topics/Arrhythmia/ECG-tachycardia.jpg?sc_lang=en

4. Structural & Functional HF

Incident Heart Failure

SARS-CoV-2 creates a substrate for myocardial remodeling and impaired filling:

- **HFpEF:** Preserved ejection fraction with significant diastolic dysfunction.
- **Reduced GLS:** Subclinical systolic impairment (Strain reduction).

Chronic Remodeling

Transition from acute injury to diffuse fibrosis:

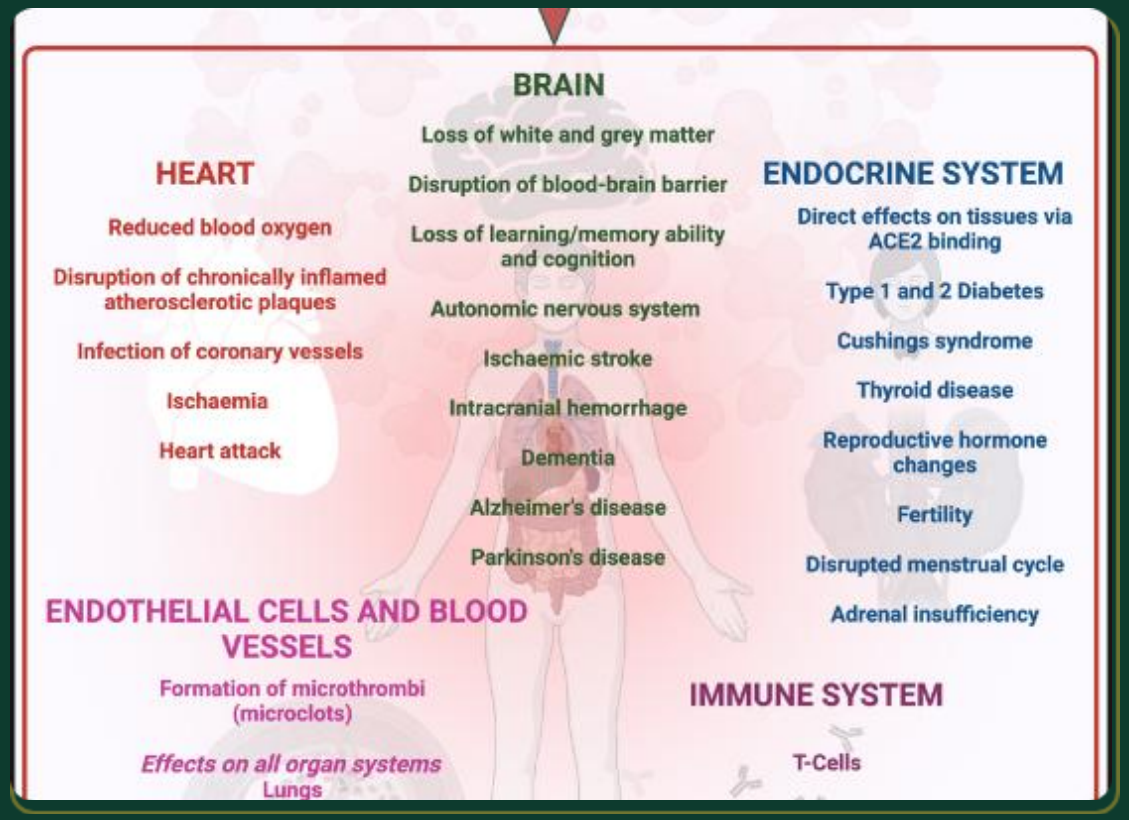
- **LGE Presence:** Late Gadolinium Enhancement as a marker of permanent scar tissue.
- **Hypertrophy:** Compensatory wall thickening due to chronic vascular resistance.

Hazard Ratios by Category

Hazard ratios compared to non-infected control groups at 12 months post-infection.

Xie, Y., Xu, E., Bowe, B., & Al-Aly, Z. (2022). Long-term cardiovascular outcomes of COVID-19. *Nature Medicine, 28*(3), 583–590. https://doi.org/10.1038/s41591-022-01689-3

Multiorgan Interdependence



The Heart-Lung-Brain Axis

Cardiac manifestations do not occur in isolation:

Pulmonary Overlap: Hypoxia and PE-induced right heart strain.

Neurological Overlap: Brain-stem autonomic center damage causing heart rate instability.

Renal Overlap: RAS system activation worsening fluid retention and cardiac load.

https://whn.global/app/uploads/2024/03/lc.png

What Drives These Sequelae?

Viral Reservoirs

Persistent SARS-CoV-2 RNA in myocardial tissues causing chronic low-grade damage.

Autoimmunity

Cross-reactive antibodies targeting myocardial and endothelial surface antigens.

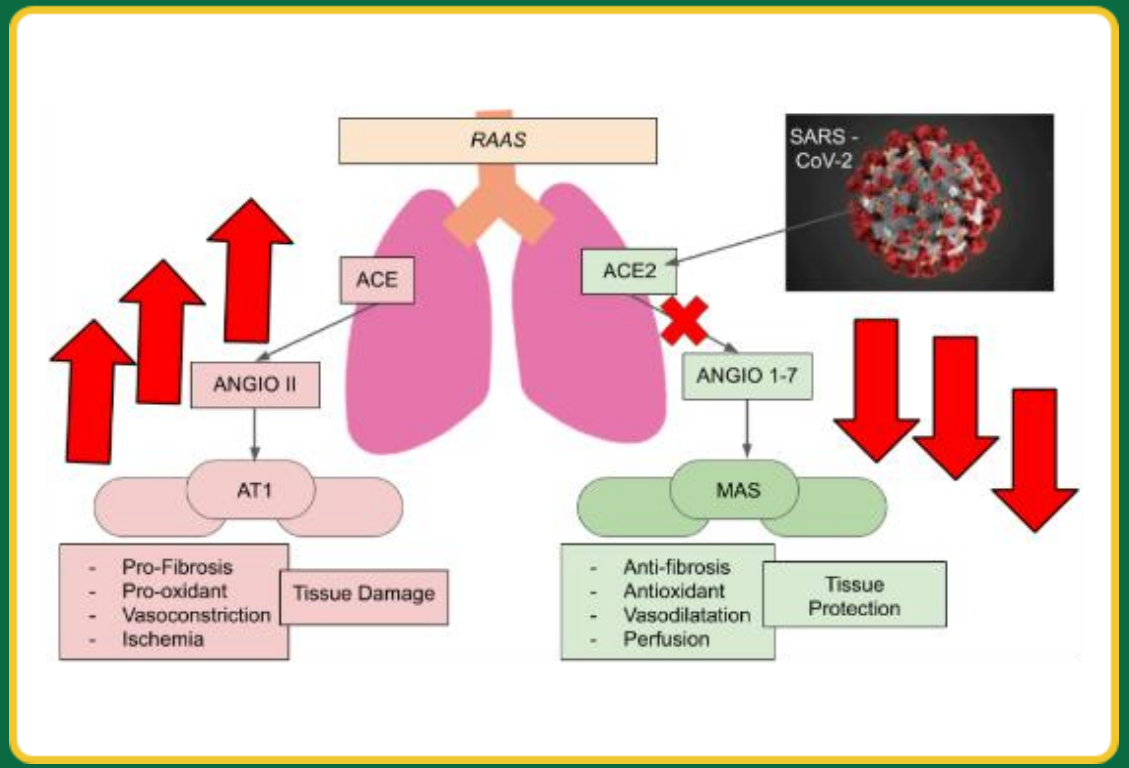
ACE2 Loss

Downregulation of protective ACE2 pathways leading to increased fibrosis and inflammation.

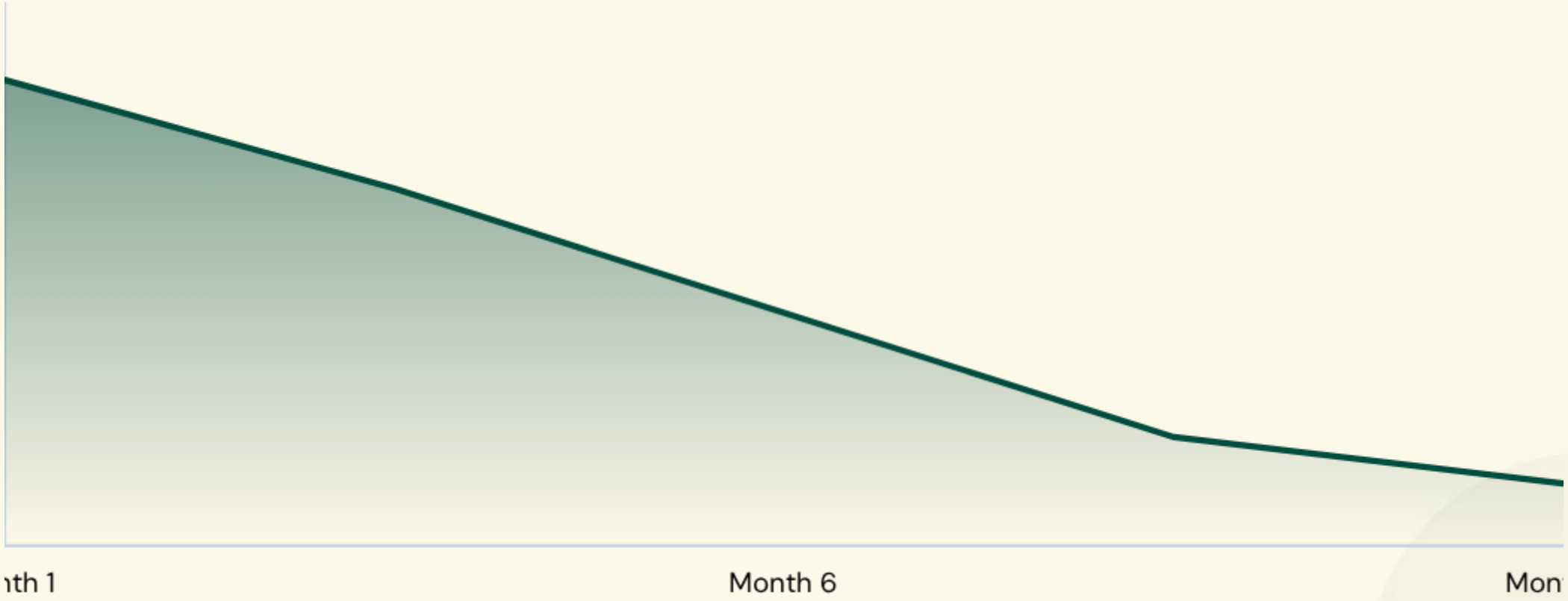
Molecular Mechanisms of Injury

Three Key Pathways

- **Viral Persistence:** Spike protein reservoirs trigger smoldering myocardial inflammation.
- **RAAS Derangement:** ACE2 downregulation leads to Angiotensin II excess and endothelial stiffness.
- **Micro-thrombosis:** Persistent microclots impair capillary perfusion.



Recovery Trends: Symptom Prevalence



Incidence of cardiac symptoms remains significant but gradually declines over a 12-month period post-acute infection.

COVID-19 longer-term symptoms among Canadian adults - Public Health Agency of Canada - Canada.ca

Diagnostic Pathway

ESC 2026 Diagnostic Pathway

Stage 1: Triad testing

Rule out organic disease with ECG, Troponin, and Transthoracic Echo.

Check NT-proBNP if dyspneic.

Can consider iron studies.

Stage 2: Functional

Active Stand Test for POTS.

Holter for IST.

Screen for PESE (Exercise Intolerance).

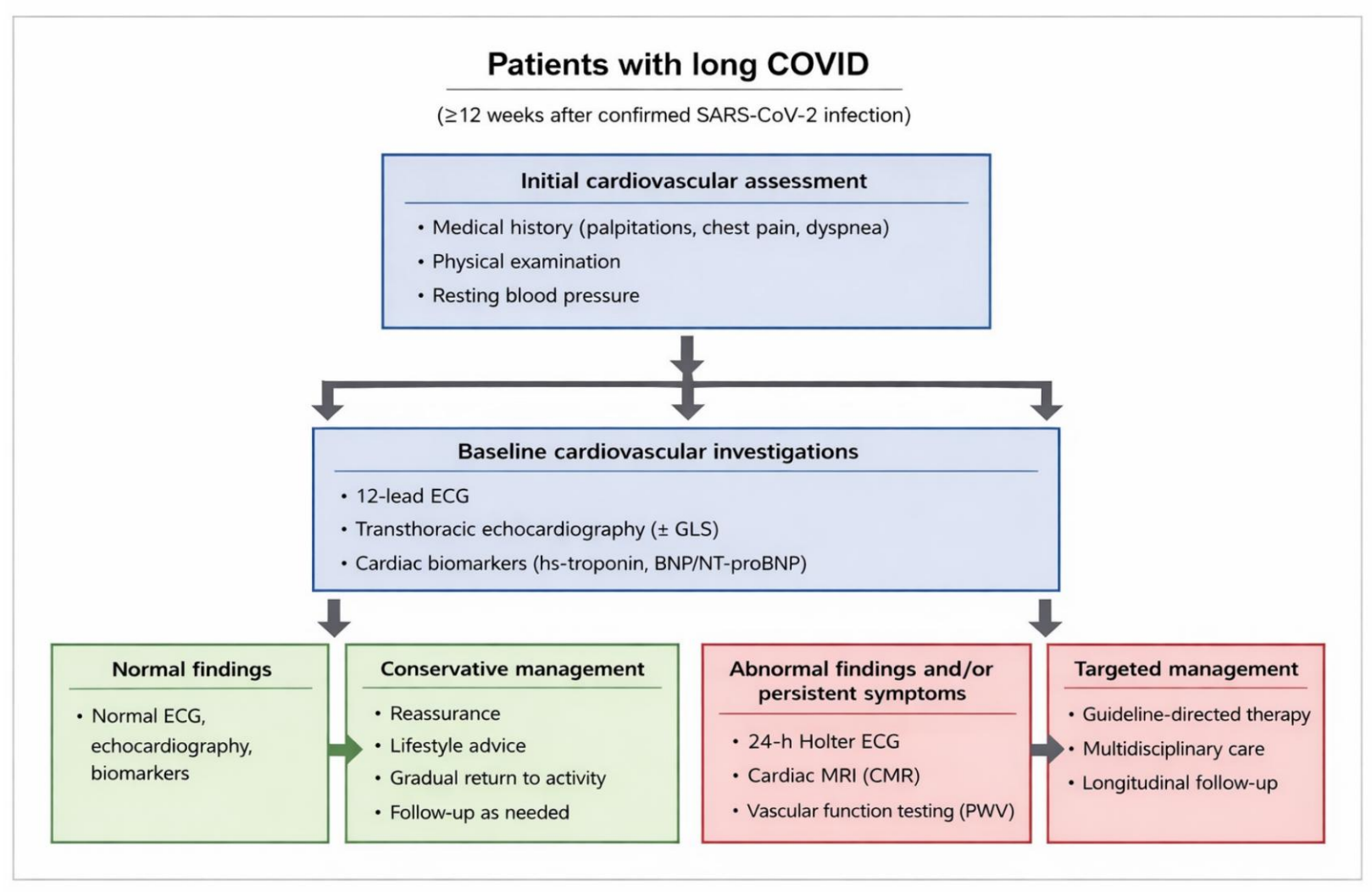
Stage 3: Tissue

Cardiac MRI (T1/T2 mapping) to detect subclinical edema or non-ischemic scar.

Note: Normal ECG does NOT exclude Cardiac Post-COVID Condition.

Vassiliou, V. S., et al. (2025). Cardiovascular disease prevention and management in COVID-19: A clinical consensus statement of the European Association of Preventive Cardiology (EAPC). *European Journal of Preventive Cardiology*, *152*(5).

Algorithm In Patients with PCC



Mihaela, A.I et al. *J. Respir.* **2026**, *6*(1), 4; https://doi.org/10.3390/jor6010004

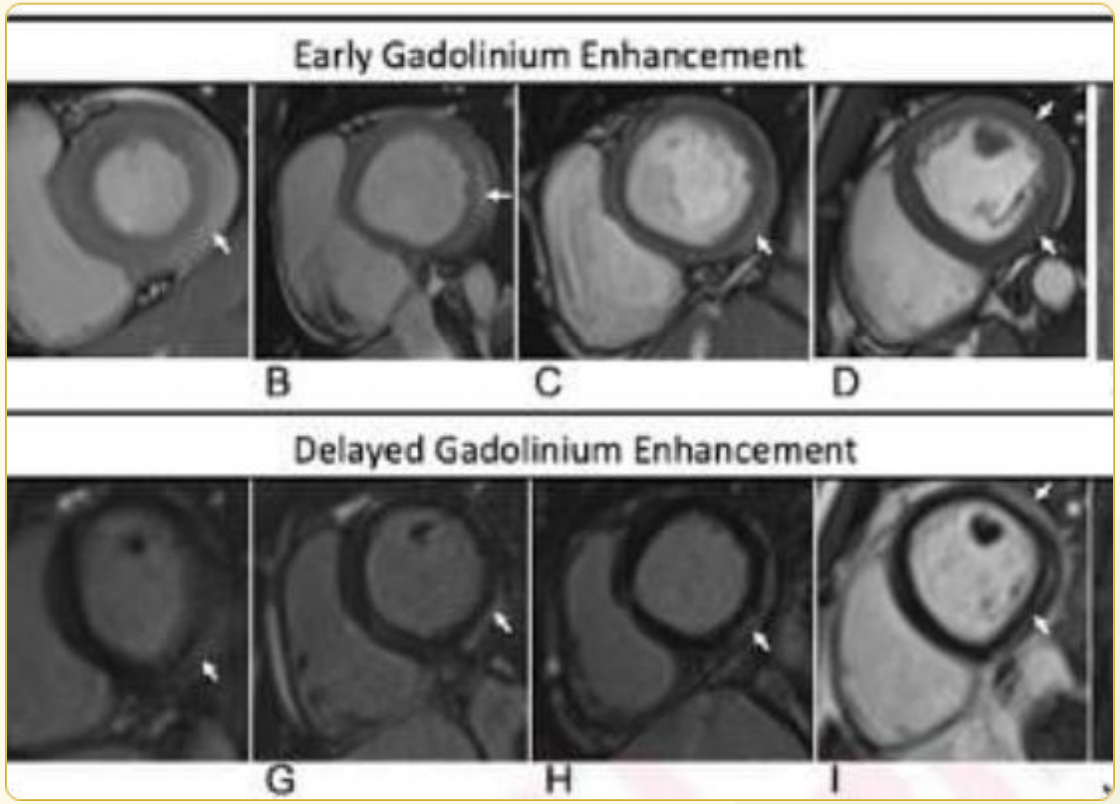
Objective Diagnostic Imaging

The Value of Cardiac MRI

The updated review highlights Cardiac MRI (CMR) as the "gold standard" for validating PASC symptoms:

- **Late Gadolinium Enhancement (LGE):** Detects permanent focal fibrosis in 25-30% of post-COVID patients.
- **T1/T2 Mapping:** Identifies diffuse interstitial edema and active inflammation.

Validates symptoms in patients with normal echocardiograms.



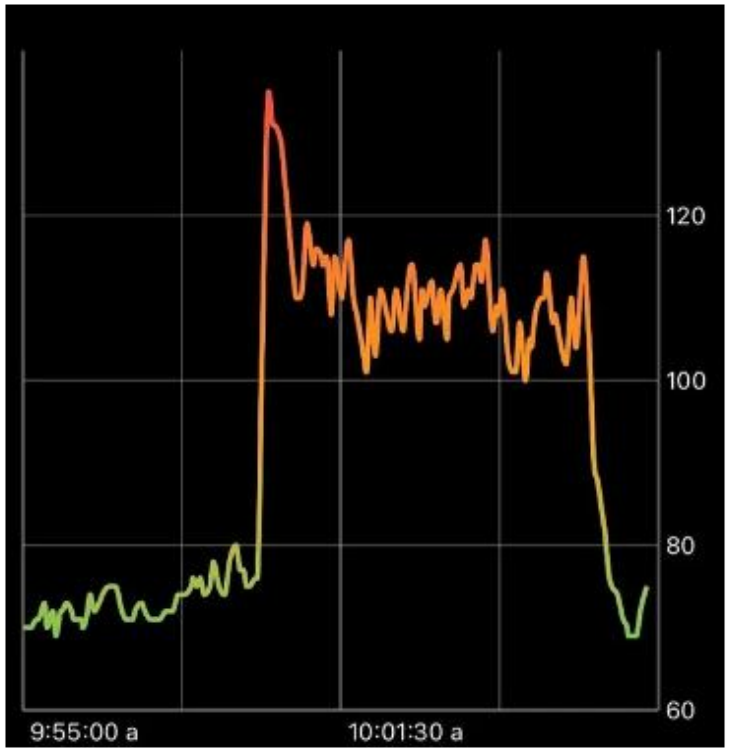
Approach to POTS /IST + Pericarditis

AUTONOMIC DYSFUNCTION: POTS & Inappropriate Sinus Tachycardia

The Neurological Component

Post-acute autonomic dysfunction is estimated to affect **15-20%** of the PCC cohort, significantly impairing quality of life.

- **Diagnostic Criteria:** Sustained HR increase ≥30 bpm within 10 mins of standing (Adults).
- **Autoimmunity:** Adrenergic autoantibodies found targeting GPCRs.
- **Ivabradine:** Gold standard therapy (Class IIa) for rate control without hypotension.



Heart Rhythm O2 (2025); AHA Scientific Statement on PASC (2026).

POTS: The Lifestyle Foundation

Non-Pharmacological Pillars

- **Hydration:** 2-3 Liters of fluid daily (titrated to volume).
- **Salt Loading:** 6-10g of salt daily (unless hypertensive).
- **Compression:** Abdominal binders and thigh-high garments (30-40 mmHg).
- **Recumbent Posture:** Mitigation of orthostatic stress during peak symptoms.

POTS: The Pharmacological Roadmap

Ivabradine

Ivabradine: Selective SA node blocker. Lowers HR without dropping BP. **Class IIa (ESC 2026).**

Beta-blockers

Propranolol is a non-selective β-blocker and is preferred over cardiac selective β-blockers to reduce pathogenic peripheral and visceral vasodilation

Fludrocortisone

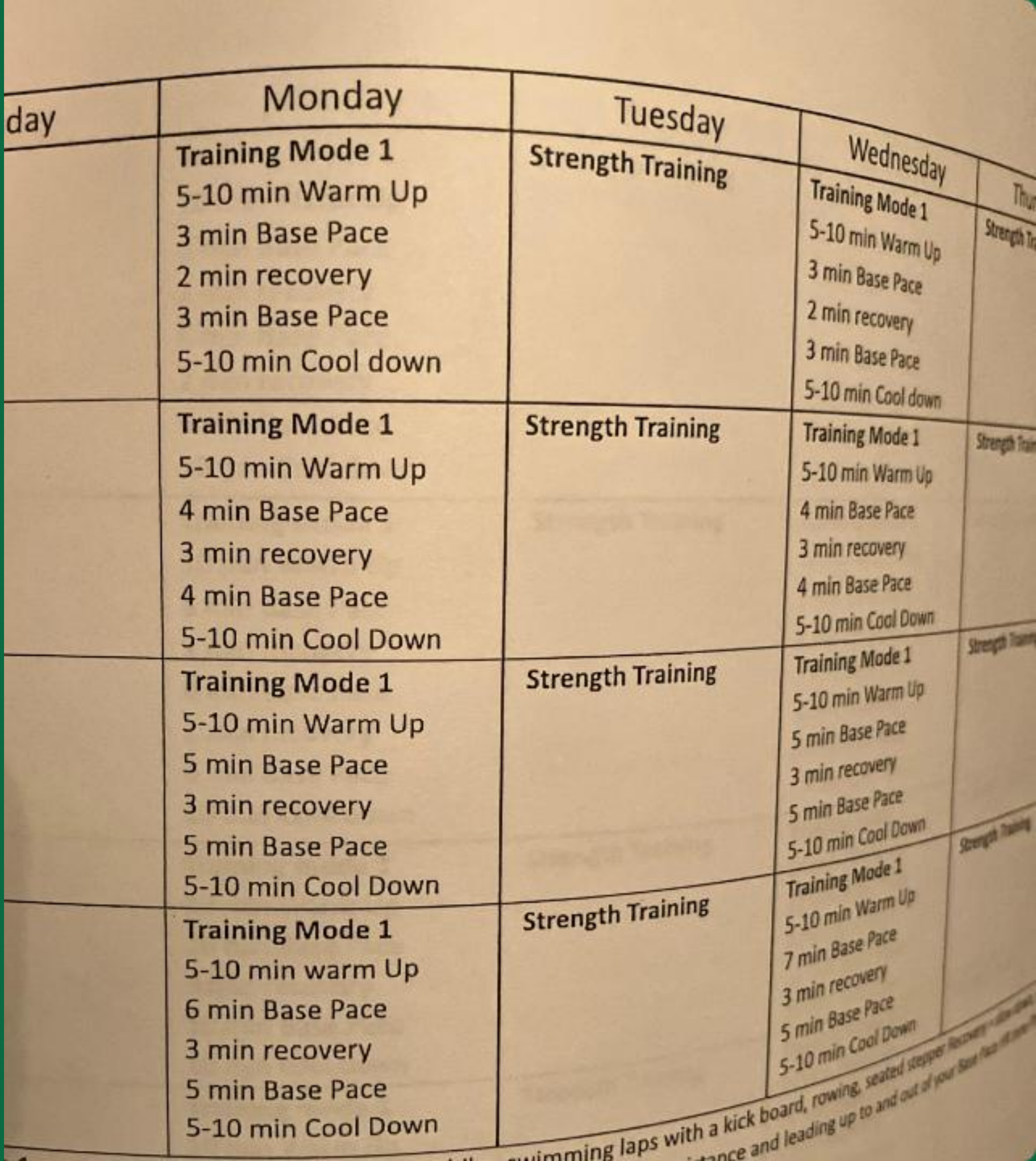
Can be considered if refractory and low blood pressure

POTS: The Levine Protocol

Safe Exercise Progression

Traditional "graded exercise" can cause a "crash" if PESE is present. Use a recumbent-first approach.

- **Horizontal First:** Rowing, swimming, or recumbent bike.
- **Energy Pacing:** Strictly avoid exertion beyond the "energy envelope."
- **Sustained Effort:** Slow, steady volume increase before intensity.



day	Monday	Tuesday	Wednesday
	Training Mode 1 5-10 min Warm Up 3 min Base Pace 2 min recovery 3 min Base Pace 5-10 min Cool down	Strength Training	Training Mode 1 5-10 min Warm Up 3 min Base Pace 2 min recovery 3 min Base Pace 5-10 min Cool down
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Contemp Clin Trials . 2022 Oct 5;122:106955

Pericarditis: The Pharmacological Roadmap

Anti-inflammatories

Temporary NSAIDS.

Inflammation

Colchicine (0.6mg): First-line for persistent chest pain from pericarditis.

Advanced Cases

Anti-IL-1 (Anakinra): Preferred over steroids for recurrent/refractory pericarditis cases.

PCC Risk Reduction

CCS 2025: Canadian Guidelines for Risk Reduction Post Covid

Targeted Risk Reduction

- **SBP < 120:** Aggressive BP targets post-COVID to protect endothelium.
- **A1c Screening:** 40% increase in incident Diabetes; check baseline and 6 months.
- **HFpEF Screen:** NT-proBNP screening for exertional dyspnea (2-4x higher risk).

The 30-Day Rule

The CCS emphasizes optimization within the first month post-acute phase to blunt the 3-year vulnerability window.

Therapeutic Management

- **Vaccination Status:** Key moderator of hazard ratios; vaccinated patients show ~40% lower MACE risk.
- **Neurohormonal Blockade:** Early use of ACEi/ARBs for patients with subclinical remodeling signals.
- **Graduated Exercise:** Managing the autonomic "mismatch" through heart-rate limited protocols.
- **Biomarker Surveillance:** Periodic testing of NT-proBNP and high-sensitivity Troponin in the 3-12 month window.

Ferrias et al. Front Immunol . 2025 Nov 19;16:1686572.

Cardiometabolic Risk Assessment

Cardiac Issue	Risk Profile	Screening Action
Conduction	AV Block / New-onset AFib	Serial ECGs; low threshold for Holter
Metabolic	New Diabetes / Metabolic Syndrome	Annual HbA1c screening
Vascular	Microvascular Angina (ANOCA)	Gated CCTA or Functional PET
Autonomic	POTS / IST (15% prevalence)	Active Stand Test (In-clinic)

Monday Morning Clinician Pearls

- **Don't Dismiss:** PCC is a molecular disease (RAAS/Spike), not a psychosomatic one.
- **Don’t Wait on Rehab:** Screen for PESE before starting any exercise program.
- **BP Matters:** Treat hypertension aggressively post-COVID (Target < 120/80).
- **Check the A1c:** Screen for Diabetes in all hospitalized COVID survivors within 12 months.

THE PRAIRIE PCC PHENOTYPE:

Long COVID and Cardiovascular Risks in the West

Molecular & Inflammatory Pillar

Spike Protein Reservoirs persisting in tissue

SARS-CoV-2 spike proteins persist

Persistent Myocardial & Pericardial Inflammation

MYOCARDITIS

T-cell infiltration

Localized edema

LGE

Persistent Microclots foe small fibrin network blocking fine capillaries

FATIGUE

BRAIN FOG

Chest Pain

Dyspnea

Thickened, inflamed and inflammatory pericardial effusion

Coronary Microvascular Dysfunction (ANOCA/INOCA)

Healthy

Dysfunvessels

Capillary Rarefaction

Impaired Endothelial-Dependent Flow

CHEST PAIN (ANOCA)

MICROVASCULAR DISEASE: >40% of PCC Angina due to dysfunction (CMD)

Autonomic & POTS Pillar

RAAS Derangement

Angiotensin II VS ACE2

Tilt-Table Test

ALERT: Elevated Arrhytimia & Conduction Risk (HFpEF common)

PALPITATIONS

ORTHOSTATIC INTOLERANCE

Prairie Environmental Context

LONG-TERM RISK EXPOSURE (3-5 Year Window)

3-YEAR VULNERABILITY WINDOW (VA data)

ANOCA (MICROVASCULAR): ~2.1x increased risk

Acute Coronary Syndrome (ACS) Risk

SECONDARY PREVENTION

SBP < 120 target

COLCHICINE 0.5-0.6mg

Recumbent bicycle

ACS RISK: Accelerated Atherosclerosis & Plaque Instability

Plaque Rupture/ Erosion Potential

ACS RISK: 1.5x - 2.5x higher MACE rate in survivors, persisting for years.

Future Perspectives

Ongoing research is focusing on anti-viral clearance strategies and anti-fibrotic agents to prevent the transition of Long COVID into chronic end-stage heart sequelae.

The global cardiac landscape will be defined by how we screen and treat this emerging cohort today.

Conclusions

PCC is a complex molecular that involves the cardiovascular system.

There are a several cardiovascular consequences of COVID- 19 that make PCC complex to diagnose.

Treat risk factors aggressively post-COVID and screen for cardiac disease in patients with persistent symptoms

Use the screening triad and refer if concerns persist

Continue to be curious about your patients persisting symptoms and work with us to monitor and study these patients.

Q&A

Discussion & Strategic Takeaways

Thank you for attending!

Please complete our survey by scanning the QR code above or by clicking on the link in the chat box.

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