

PRACTICE



CLINICAL UPDATES

Management of patients after primary percutaneous coronary intervention for myocardial infarction

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For those who present with an acute ST elevation myocardial infarction (STEMI) in the UK, nearly 90% are treated with a primary angioplasty within 90 minutes of arrival at hospital.¹ One out of every seven deaths is due to coronary heart disease, with one person having a “heart attack” every 40 seconds, based on US data.² In the UK, 288 per 100 000 people visit hospital with a suspected heart attack each year.³

Patients are usually discharged three days after treatment for a STEMI with an uncomplicated primary percutaneous coronary intervention (PCI).¹⁻⁴ They may present in the community for further advice shortly after discharge, so close collaboration between the cardiologist and the wider healthcare team is essential.⁵ This article provides an update on the immediate and longer term management of such patients (see fig 1⇓).

The first consultation after myocardial infarction

The diagnosis

Check the hospital discharge notification to confirm if the final diagnosis was a STEMI, which artery was treated, and the type and number of stents implanted. Explain that PCI involved reopening a blocked or narrowed artery (fig 2⇓).

What to watch out for after PCI

Patients are not routinely advised to see their GP at a specific interval after PCI, but a follow-up consultation within four weeks of discharge can be helpful to detect uncommon but important complications.

Complications related to access site—These are rare but can include infection or swelling. Examine the access site area, usually over the right radial artery, but sometimes the right femoral or left radial artery.

Cardiovascular complications—Always perform a cardiovascular examination to detect signs of atrial fibrillation, a pericardial rub, or a cardiac murmur. Signs of heart failure should prompt a review of titrating the dose of the angiotensin converting enzyme (ACE) inhibitor to the maximum tolerated, with a view to specialist referral to consider further drug or device therapy. Table 1⇓ highlights red flag symptoms that need urgent attention.

Which drugs are used for secondary prevention?

Five classes of drug are recommended when patients are discharged after successful revascularisation for uncomplicated STEMI: dual antiplatelet therapy, a β blocker, an ACE inhibitor, and a statin. Each is independently associated with improved survival, based on large randomised trials and meta-analyses summarised in national and international guidelines.⁸⁻⁹ Table 2⇓ summarises the recommendations from international guidelines on the use of secondary prevention drugs.

Dual antiplatelet therapy—Aspirin is given together with one of the P2Y₁₂ inhibitors (clopidogrel, prasugrel, or ticagrelor) as dual antiplatelet therapy to prevent stent thrombosis and reduce the risk of future cardiovascular death, myocardial infarction, and further revascularisation.¹⁴ The duration of dual antiplatelet therapy is usually 12 months, with aspirin continued indefinitely thereafter.¹⁴

Adapting prescribing patterns of antithrombotic therapy

Patients who require anticoagulation—The optimal combination and duration of antithrombotic therapy remain under investigation.¹⁵⁻¹⁶ Emerging evidence has led to variations in the duration of dual antiplatelet therapy prescribed following a

What you need to know

- Hospital discharge within three days after uncomplicated primary percutaneous coronary intervention (PCI) for ST elevation myocardial infarction is considered safe
- Advise patients to report any persistent discolouration, pain, or swelling over the arterial access site, and any new or recurrent chest pain, shortness of breath, palpitation, or ankle swelling
- Dual antiplatelet therapy is essential after primary PCI to prevent recurrent ischaemia and stent thrombosis, but can be associated with an increased bleeding risk
- After myocardial infarction, international guidelines recommend cardioprotective drugs and referral to a cardiac rehabilitation programme that promotes smoking cessation, physical activity, a healthy Mediterranean-style diet, and psychological support
- Annual review of symptoms, adherence to secondary prevention therapy, lifestyle change, and cardiovascular risk factors reduce recurrent cardiovascular events and improve survival

Sources and selection criteria

We searched PubMed, Cochrane Library, Medline, and Google using the terms “secondary prevention after a myocardial infarction,” “secondary prevention after a heart attack,” “ST elevation myocardial infarction,” and “management after percutaneous coronary intervention.” Specific searches were used to highlight certain aspects of management after primary percutaneous coronary intervention such as dual antiplatelet therapy.

Other major sources of information were guidelines published by the European Society of Cardiology, American Heart Association, and National Institute for Health and Care Excellence; randomised trials, meta-analyses, and observational studies reported in major peer reviewed medical and clinical cardiovascular journals; and personal and patient experiences.

PCI,¹⁴ and scoring tools are being developed to aid decision making.¹⁶

In a patient with atrial fibrillation or a mechanical valve prosthesis after STEMI, “triple therapy” is sometimes required, and is usually initiated by the cardiologist before discharge. This involves dual antiplatelet therapy plus (a) anticoagulation with warfarin for mechanical valve prosthesis or (b) warfarin or a direct oral anticoagulant (such as apixaban, rivaroxaban, or dabigatran) for preventing stroke in patients with atrial fibrillation.^{14 17} When these two antithrombotic indications coexist—that is, PCI and stroke prophylaxis—dual or triple therapy is prescribed for three, six, or 12 months depending on the individual patient profile and type of stent used.^{14 17} One year after PCI, this is usually replaced by monotherapy with anticoagulation alone.¹⁴ A reduction in the risk of recurrent coronary events is balanced against an increase in the risk of bleeding. It is important not to discontinue antithrombotic therapy, so check with the hospital cardiologist if the patient’s treatment plan is not clear.

Prescribing in elderly patients—About 40% of patients who have had a myocardial infarction are older than 75 years.¹⁸ Multiple comorbidity and polypharmacy are common in elderly patients,¹⁹ with higher risks of adverse events such as bleeding.¹² Careful monitoring and using lower doses of hypotensive medication may help avoid further morbidity. Global and national registry data suggest that aspirin and β blockers are prescribed less in the elderly, and there is a call for trials targeted to this population to establish the effectiveness of intensive secondary prevention.^{18 20}

What questions and concerns might patients have?

Patients may ask about aspects of their recovery and ongoing management. The following might help patients to make informed choices.

Driving

Variations in rules on driving exist. In the UK, patients can resume driving a car a week after a successful PCI, as long as no further revascularisation is planned within four weeks of the acute event and the left ventricular ejection fraction is $>40\%$. Bus, coach, and lorry drivers are required to notify the Driver

Vehicle Licensing Agency and are usually permitted to drive if left ventricular ejection fraction is $>40\%$ and they have a successful exercise function test at six weeks.²¹ In the US, there is interstate variation in driving regulations, so patients should check with their state’s motor vehicle department.

Flying

Low risk patients who are asymptomatic can fly within a week after an uncomplicated primary PCI.²² Patients at high risk (with left ventricular ejection fraction $<40\%$ or awaiting further investigations, revascularisation, or device therapy) should seek specialist advice before flying.^{22 23} Advise all patients to inform their travel insurance company.

Sexual activity

A prospective observational study reported that counselling for resumption of sexual activity after a myocardial infarction has not been provided adequately by physicians and is often unnecessarily restrictive.^{24 25} Most patients who are asymptomatic with mild to moderate physical activity—walking two flights of stairs or walking briskly for a few minutes—should be able to resume sexual activity around a week after an uncomplicated myocardial infarction.⁸⁻²⁷ Information about sexual activity is usually included in cardiac rehabilitation programmes.

Erectile dysfunction affects around 62% of men after myocardial infarction.²⁸ A recent longitudinal study found no association between the use of β blockers and erectile dysfunction.²⁸ It is safe to prescribe phosphodiesterase type 5 inhibitors (such as sildenafil, vardenafil, and tadalafil) in patients with erectile dysfunction who have stable disease after myocardial infarction.²⁷ A US guideline recommends that nitrate medications should be avoided within 24 hours of taking sildenafil or vardenafil and within 48 hours of taking tadalafil based on a small randomised trial.^{27 29}

In women topical oestrogens for vaginal dryness and dyspareunia are unlikely to increase cardiac risk.²⁷

Lifestyle advice

After discharge from hospital, most patients do not achieve guideline standards for secondary prevention, with unhealthy diets, physical inactivity, and poor control of cardiovascular

risk factors.³⁰ Encouraging an informed choice for changing to a healthier lifestyle can be crucial (table 3⇓).

Smoking

Smoking cessation after myocardial infarction is associated with a 36% reduction in all-cause mortality,³² and the risk of recurrent coronary events decreases to that of a non-smoker three years after smoking cessation.³⁹

Cardioprotective diet and weight management

A meta-analysis of 18 prospective studies assessing the association between adherence to a Mediterranean diet and outcomes reported an 8% reduction in overall mortality and 10% decrease in cardiovascular events or death.⁴⁰ A Mediterranean diet is now recommended by international guidelines (box 1).⁵ The aim is to achieve a body mass index of 20–25 kg/m² in those <60 years old and a higher target of <30 kg/m² in elderly patients.⁵

Physical activity and cardiac rehabilitation

A Cochrane review of 63 randomised trials of exercise based cardiac rehabilitation, which included 31 trials in patients after myocardial infarction, reported an absolute reduction in the risk of cardiovascular mortality from 10.4% to 7.6%. Most studies also showed improvements in quality of life and a reduction in acute hospital admissions.⁴⁹

The current UK uptake of cardiac rehabilitation after myocardial infarction and PCI is 58% with an overall dropout rate of 23%.⁴ Those unable to attend a centre based rehabilitation programme should be encouraged to follow a home based programme, which has a similar efficacy.^{10–52} Cardiac rehabilitation programmes include education on levels of physical activity and dietary modification.^{8 53} Many conduct a symptom-limited exercise test before participation to develop an individual exercise prescription for aerobic training. International guidelines recommend a minimum of 2.5 hours a week of moderate aerobic activity such as walking, treadmill, cycling, rowing, and stair climbing in multiple bouts each lasting ≥10 minutes (with an aim of 30 minutes a day on 5–7 days of each week) and resistance training two days a week for patients with stable coronary artery disease.^{5–58}

Psychological impact

Assess patients' psychological wellbeing, as depression and anxiety (recorded with the Hospital Anxiety Depression Scale⁵⁹) can affect 20% and 28% of patients, respectively, at the point they enter a cardiac rehabilitation programme.⁴ An observational multicentre study reported higher mortality at one year in patients with untreated depression after myocardial infarction than in those without depression.⁶⁰ Psychological interventions alleviate symptoms,⁶¹ and studies are under way to assess the role of enhanced psychological therapy within rehabilitation.⁶² Therapeutic options include stress management, management of depression, and referral to a clinical psychologist.^{8 63}

Managing residual disease identified at angiography

During primary PCI of the occluded artery, incidental disease may be identified in other “non-culprit” vessels; no clear consensus exists regarding the optimal timing of further PCI.^{64 65} A “50% stenosis” reported on a discharge summary, indicating moderate disease, may cause the patient considerable anxiety.

Take the opportunity to have a general discussion with the patient about possible future treatment.

Mild to moderate coronary disease is usually treated with antianginal drugs and secondary prevention therapy. Significant coronary stenosis ≥70% in one of the major epicardial coronary arteries may be treated after recovery from the acute event. In some patients with severe multivessel coronary disease, particularly that involves the left main stem or is associated with diabetes, it may be appropriate to consider revascularisation with coronary artery bypass surgery. When the optimal treatment is uncertain, reassure the patient that the angiographic findings are discussed in hospital at a regular multidisciplinary “heart team” meeting by cardiologists and cardiac surgeons, with a consensus opinion communicated to the patient.⁶⁶

Long term follow-up

Most patients do not require follow-up with a specialist after an uncomplicated STEMI. Ensure enrolment for cardiac rehabilitation⁶⁷ and review adequate up-titration of drug doses, assess for dyspeptic symptoms resulting from dual antiplatelet therapy, and check renal function. Cardiology follow-up is arranged when, for example, a STEMI may not be associated with an occluded artery and may be mimicked by a takotsubo (stress) cardiomyopathy, spontaneous coronary artery dissection, recanalised occlusion, or myocarditis.

In the community, annual review allows the primary care physician or nurse to assess cardiovascular symptoms and psychological wellbeing and to discuss maintaining lifestyle change, smoking cessation,³³ blood pressure control, and adherence with statins⁶⁸ to reduce cardiovascular risk. Provide patients with sources of information about heart attacks (box 2 and see table 1⇓)

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Contributors: HMD conceived the article based on an editorial in the *BMJ* in 1996.⁶⁹ FD contributed to the literature review on lifestyle measures, drafting and revising the article, and approving the final version. CV contributed to the literature review on cardioprotective medication, and approving the final version. MMG and HMD contributed to the literature review, drafting, design, and revision of the article. All authors approved the final manuscript.

Competing interests: We have read and understood the BMJ Group's policy on declaration of interests and declare the following interests. HMD has co-authored Cochrane reviews on cardiac rehabilitation, is co-chief investigator on a National Institute for Health Research (NIHR) and NHS-funded programme grant for applied research (NIHR PGfAR RP-PG-0611-12004), and is an ordinary member of the council of the British Association of Cardiovascular Prevention and Rehabilitation (BACPR). MMG is a co-investigator on the NIHR funded CADENCE study of enhanced psychological interventions in cardiac rehabilitation.

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Box 1: Advice about cardioprotective Mediterranean-style diet

- Recommend total fat intake <30% of total energy intake, intake of saturated fat <7% of total energy intake, and increased intake of polyunsaturated fatty acids⁵⁻⁴²
- Use olive oil or rapeseed oil instead of animal based fats such as butter^{13,42}
- Take 4-5 portions (120-150 g) of unsalted nuts and seeds a week^{13,43}
- Oily fish (such as mackerel and salmon) can be incorporated into the diet, but deliberate increase of intake, although not harmful, has no good evidence base. For this reason, dietary supplements including omega-3 capsules or vitamin supplements are not recommended^{13,44}
- Advise >5 portions (400-500 g total) of fruit and vegetables a day^{13,45}
- Encourage fibre intake with wholegrain cereals^{13,46}
- Limit salt intake to <6 g/day⁴⁷
- Minimise intake of foods containing refined sugars, including fructose, as part of weight management^{6,46}
- Maintain recommended alcohol limits (1 drink* a day for women and ≤2 a day for men^{9,13}) and advise against binge drinking (>3 alcoholic drinks in 1-2 hours)⁴⁸

*1 drink=2 units of alcohol

Box 2: Additional educational resources*For healthcare professionals*

- National Institute for Health and Care Excellence. Myocardial infarction: cardiac rehabilitation and prevention of further cardiovascular disease (clinical guideline 172). 2013. www.nice.org.uk/guidance/cg172
- Steg PG, James SK, Atar D, et al. ESC guidelines for the management of acute myocardial infarction in patients presenting with ST-segment elevation. *Eur Heart J* 2012;33:2569-619
Updated ESC guidelines will be published in August 2017
- O'Gara PT, Kushner FG, Ascheim DD, et al. 2013 ACCF/AHA guideline for the management of ST-elevation myocardial infarction: a report of the American College of Cardiology Foundation/American Heart Association Task Force on Practice Guidelines. *Circulation* 2013;127:e362-425
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- British Association for Cardiac Prevention and Rehabilitation (BACPR). Standards and core components for cardiovascular disease prevention and rehabilitation 2017. (3rd ed). www.bacpr.com/resources/6A7_BACR_Standards_and_Core_Components_2017.pdf

For patients and carers

- British Heart Foundation. *Primary angioplasty for a heart attack*. www.bhf.org.uk/publications/heart-conditions/primary-angioplasty-for-a-heart-attack
- American Heart Association. Ways to lower your risk of another heart attack. www.heart.org/HEARTORG/Conditions/HeartAttack/LifeAfteraHeartAttack/Life-After-a-Heart-Attack_UCM_487069_Article.jsp#.WQ1wHjE2zyQ
- National Heart, Lung, and Blood Institute. www.nhlbi.nih.gov/health/health-topics/topics/heartattack/lifeafter. Webpage with easy-to-follow advice on what to do after a heart attack, including a video link that features a 36-year-old television reporter who had a heart attack
- NICE. *Information for the public: helping you recover from a heart attack*. www.nice.org.uk/guidance/cg172/ifp/chapter/Helping-you-recover-from-a-heart-attack#/your-cardiac-rehabilitation-programme (open access, no registration)

Going home after a heart attack—a personal view from Philip Boorman, retired air traffic controller

"Heart attacks are for other people!"

Once that misconception is put to bed and you are discharged from hospital, it is time for reflection and the realisation that your life may have changed forever.

Even the journey home was a mixture of relief, fear, and a definite feeling that things had changed. I had been fortunate in requiring only one stent, while others in the ward were waiting for bypass surgery. However, I was carrying what seemed like a stash of drugs, which drove home the seriousness of the situation.

There was a slight mismatch between the "Go and get on with it" approach of the consultant and the cautious approach of the cardiac nurse who visited me afterwards. She answered most of the questions I had, and there was little else to ask the GP on my first visit after the heart attack. Reassessment in 12 months was almost certainly mentioned, but I missed it and wondered if it was a case of "Fix and forget."

I was invited back for a comprehensive review by one of the nursing team. The review procedure seems to vary from practice to practice, but in mine the system works well, and for that I am very grateful.

Disease Prevention in Clinical Practice (constituted by representatives of 10 societies and by invited experts). Developed with the special contribution of the European Association for Cardiovascular Prevention & Rehabilitation (EACPR). *Eur Heart J* 2016;37:2315-81. doi:10.1093/eurheartj/ehw106 pmid:27222591.

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Education into practice

- This article covers several issues including medication, PCI, rehabilitation, and lifestyle advice. Could you improve how you offer or share this information with patients?
- What support or follow up, if any, do you offer after primary PCI in your setting? Could you consider any aspects of this in a different way?
- Patients after myocardial infarction generally take at least five different drugs. Consider ways you could work with patients and pharmacy teams to ensure they are fully informed about their medication after myocardial infarction. Consider using Patient Decision Aids as per NICE guideline on medicines optimisation⁷⁰
- Audit project: How could you streamline your local cardiology pathway to ensure earlier referral for patients to cardiac rehabilitation after myocardial infarction and PCI (such as direct referral from PCI unit)? Aim for >70% participation in cardiac rehabilitation over the next 12 months as per Ades et al⁷¹

How patients were involved in the creation of this article

Philipp Boorman, a retired air traffic controller who was admitted with a heart attack in January 2015 and had a percutaneous coronary intervention (PCI), was a patient of one of the coauthors and has shared his experience of being admitted to hospital and the aftercare he has received in the community. He has read various drafts of this clinical review and said that "despite the upbeat nature of article one, I have never had any form of review and it's now over two years since my MI." After contacting the practice, he was followed up, and this is reflected in his personal view, where he comments that not all post-myocardial infarction patients are fortunate to get a review in their own practice.

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Tables

Table 1 | Red flag symptoms after primary percutaneous coronary intervention for myocardial infarction

Symptom	Possible causes	Comment
Chest discomfort:		
Exertional	Post-infarct angina	Due to residual coronary disease, or in-stent restenosis (<5%) typically 3-6 months after PCI
Non-exertional	Pericarditis	Pain on inspiration or lying supine. Can be difficult to distinguish from musculoskeletal pain or dyspepsia associated with DAPT; elevated CRP level and low grade pyrexia may be additional pointers
	Recurrent infarction	Rare; immediate admission if suspected clinically
Dyspnoea	Persistent left ventricular systolic dysfunction	Symptoms or signs of heart failure warrant specialist referral for consideration of additional drugs or device therapy ⁶
	Mitral regurgitation	
Presyncope or palpitation	Atrial fibrillation ⁷	Resting and ambulatory ECG to exclude non-sustained ventricular tachycardia or bradycardia with AV block
	Postural hypotension	Review blood pressure and drug dose

PCI=percutaneous coronary intervention; DAPT=dual antiplatelet therapy; CRP=C reactive protein; ECG=electrocardiography; AV=atrioventricular.

Table 2 | Drugs with a class 1* recommendation for use after ST elevation myocardial infarction⁹¹⁰

Drug	Dose	Caution	Comment	Level of evidence†
Aspirin	75-100 mg	Review bleeding risk	Haemoglobin monitoring in high risk patients ¹¹	A
P2Y ₁₂ inhibitor:				
Clopidogrel	Loading 600 mg, maintenance 75 mg once daily		12 months' duration (6 months is reasonable if high bleeding risk) ^{11 12}	B
Prasugrel	Loading 60 mg, maintenance 10 mg once daily	Not if prior TIA or stroke	Avoid or reduce dose if <60 kg weight or older than 75 years	B
Ticagrelor	Loading 180 mg, maintenance 90 mg twice daily	Dyspnoea is a side effect		B
β blocker	Bisoprolol, metoprolol, or carvedilol to maximum tolerated dose	Prolonged first degree or high grade AV block	Usually tolerated in patients with stable COPD	B
ACE inhibitor	Ramipril, lisinopril, captopril, ortrandolapril titrated to maximum tolerated dose	Hypotension, renal failure, hyperkalaemia	Use ARB for patients intolerant of ACE inhibitors	A
Statin	High dose statins ¹³ (such as once daily atorvastatin 20-80 mg, rosuvastatin 10-40 mg, simvastatin 80 mg)	Monitor for myopathy. Hepatic toxicity	Dose may require reduction to promote long term compliance	B
Aldosterone antagonist	Eplerenone 25 mg/day, increased to 50 mg/day	Hyperkalaemia, renal failure	Only in patients taking β blocker and ACE inhibitor if EF <40% and symptomatic heart failure or diabetes	B

*Class 1: evidence or general agreement that a given treatment is beneficial, useful, and effective.

†Level of evidence: A= multiple populations evaluated, data derived from multiple randomised controlled trials or meta-analysis; B= limited populations evaluated, data derived from a single randomised control trial or non-randomised studies.

TIA=transient ischaemic attack; AV=atrioventricular; COPD=chronic obstructive pulmonary disease; ACE=angiotensin converting enzyme; ARB=angiotensin receptor blocker; EF=ejection fraction.

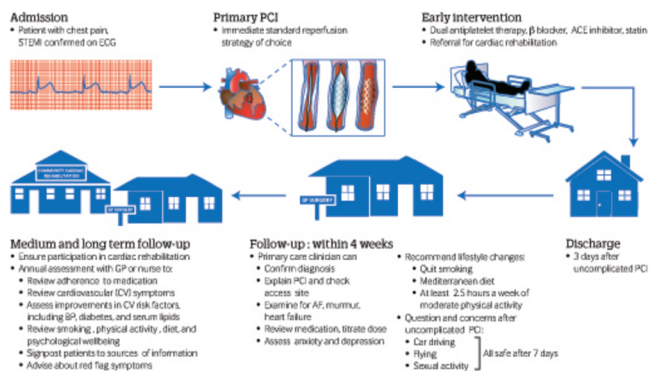
Table 3| Key risk factors for secondary prevention after ST elevation myocardial infarction (STEMI)*

Risk factor	Advice	Comment
Poor adherence to dual antiplatelet treatment (DAPT)	Reinforce importance of aspirin (lifelong) and a P2Y ₁₂ receptor antagonist (clopidogrel, prasugrel, or ticagrelor) for one year to reduce risk of stent thrombosis and subsequent ischaemic events	Stent thrombosis is a potentially fatal complication prevented by DAPT ³¹ There is a trade-off between reducing ischaemic risk and increasing bleeding risk with longer duration of DAPT ¹⁶ 12 months of DAPT is recommended for most patients after STEMI ¹⁴
Resumption of cigarette smoking	Smoking cessation	Smoking cessation after myocardial infarction reduces subsequent mortality by 36% ³² Counseling and cardiac rehabilitation may be complemented by nicotine replacement therapy ^{8,34}
Blood pressure control	Review after discharge	In haemodynamically stable patients, aim for <140/90 mm Hg ³⁵
Diabetes	Target HbA _{1c} <7%	Uncertainty around precise target for glycaemic control ³⁵
Blood cholesterol level	Encourage statin therapy for all patients	High intensity statins are recommended, ¹³ but adherence is suboptimal ³⁷ attributed to muscle side effects ³⁸

*Diet (see box 1) and physical activity are discussed in the text.

HbA_{1c}=glycated haemoglobin.

Figures



STMI=ST elevation myocardial infarction, ECG=electrocardiography, PCI=percutaneous coronary intervention, AF=atrial fibrillation, BP=blood pressure

Fig 1 Management of patients after an acute ST elevation myocardial infarction

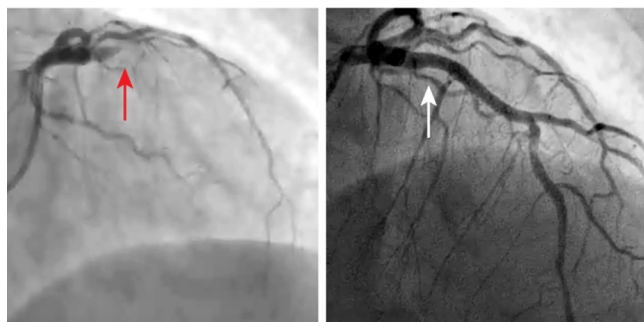


Fig 2 Angiograms before (left) and after (right) primary percutaneous coronary intervention in a blocked left anterior descending artery (arrows)