**COPD and myocardial infarction: effects on presentation, management and outcomes**

**Authors** Kieran J Rothnie1,2 & Jennifer K Quint1,2

**Author affiliations**

1. Respiratory Epidemiology, Occupational Medicine and Public Health, National Heart and Lung Institute, Imperial College London, London

2. Faculty of Epidemiology and Population Health, London School of Hygiene & Tropical Medicine

**Corresponding author**

Kieran J Rothnie

Respiratory Epidemiology, Occupational Medicine and Public Health

National Heart and Lung Institute

Emmanuel Kaye Building

Imperial College London

London

SW3 6LR

Email: [k.rothnie@imperial.ac.uk](mailto:k.rothnie@imperial.ac.uk)

Tel: +44 20 7594 8824

**Abstract**

People with chronic obstructive pulmonary disease (COPD) have a higher incidence of and mortality from cardiovascular disease, and reducing cardiovascular mortality is an important target area for reducing overall mortality in those with COPD. Huge strides have been made in recent decades in reducing mortality after myocardial infarction (MI) in the general population, however, these improvements may not have been mirrored in all patient groups, such as those with COPD. Recently, much attention has been paid to investigating how COPD patients present with acute MI and how their management and outcomes compare to non-COPD patients. The evidence seems to point to an increased risk of death after MI in people with COPD, however it is unclear if this difference is due to COPD itself or if it is due to potentially modifiable factors, such as less aggressive treatment after MI. We review the evidence for differences between COPD and non-COPD patients after MI in terms of presentation, recognition of MI, in-hospital care, secondary prevention and outcomes both in-hospital and in the longer term.

**Background**

Myocardial infarction (MI) is a very common reason for admission to hospital and is associated with substantial morbidity and mortality. Recent decades have seen a large decrease in the incidence of and mortality from acute MI[1](#_ENREF_1). Much of the decrease in the incidence of MI has been attributable to a decrease in ST-elevation MI (STEMI). Rates of non-ST-elevation MI (non-STEMI) may not have decreased and may well be increasing[2](#_ENREF_2). People who have a non-STEMI rather than STEMI tend to be older and are more likely to have co-morbidities. The reasons for the increasing prevalence of non-STEMI may include increased prevalence of risk factors, or better clinical awareness. It has been recognised that comorbidity is a major risk factor for death following an MI, and that multimorbidity due to population ageing has created a more complex population of those with acute MI[3](#_ENREF_3). As well as prevention of MI, much of the decrease in MI mortality has been attributed to improved care after MI[4](#_ENREF_4). Although drives to improve acute care and secondary prevention of MI have drastically decreased mortality after MI, it is not clear if this has been optimised for all patient groups. Some groups have received a lot of attention, for example, in people with diabetes, thresholds are lower for treating risk factors for MI (for example, blood pressure) and it is recognised that presentation may be different, for example, without chest pain. One common co-morbid condition which has previously been understudied, but is now coming under increasing attention is chronic obstructive pulmonary disease (COPD).

Chronic obstructive pulmonary disease (COPD) is a common and progressive lung disease characterised by airflow limitation which is not fully reversible. The prevalence of diagnosed COPD varies between countries. In Europe the average prevalence of diagnosed COPD is around 1.5% of the adult population, however the true prevalence may be as high as 10% as many remain undiagnosed[5](#_ENREF_5). In the developed world, the biggest risk factor for COPD is tobacco smoking [6](#_ENREF_6). COPD is also associated with increasing age, indoor and outdoor pollution, poor nutrition and low socioeconomic status[6](#_ENREF_6).

COPD is associated with an increased risk of many other diseases, which are thought to be due, in part, to “spill over” of inflammation in the lung to the systemic circulation[7](#_ENREF_7) (Figure 1). Cardiovascular disease is perhaps the most common and important co-morbidity in those with COPD. People with COPD are at higher risk of MI than those who do not have COPD, independent of smoking status[8](#_ENREF_8), [9](#_ENREF_9). As well as increased inflammation, it is thought that this increased risk may be due to increased endothelial dysfunction and increased arterial stiffness in those with COPD[10](#_ENREF_10). This increased burden of MI attributable to COPD seems to be borne by younger COPD patients[9](#_ENREF_9). Most people with COPD do not die from respiratory diseases[11](#_ENREF_11), and one of the most common reasons for death in those with COPD is cardiovascular disease, with up to 30% of people with COPD dying from cardiovascular disease[12](#_ENREF_12). Due to both shared risk factors and the increased risk of MI for those with COPD, COPD is very common in those with acute MI. The prevalence of COPD in those with acute MI varies between countries, and has been estimated to be 10-17%[13-16](#_ENREF_13).

This article aims to review the literature on the effect of COPD on presentation, management and outcomes after acute MI and how these may be interrelated.

**Presentation**

Several studies have investigated differences in presentation between those with COPD and those without COPD. The prevalence of previously diagnosed COPD among all people presenting to hospital with an MI has been estimated to be between 10-17%[13-16](#_ENREF_13). Particularly, as COPD is a risk factor for MI, however, the true prevalence including those with undiagnosed COPD may be significantly higher. In terms of presenting symptoms, several studies have reported that COPD patients with MI are less likely to present with typical chest pain, and are more likely than non-COPD patients to present with breathlessness[13-15](#_ENREF_13), atypical chest pain[13](#_ENREF_13), and palpitations[13](#_ENREF_13). In terms of type of MI, two studies have found that COPD patients are more likely to present with a non-STEMI than a STEMI compared to non-COPD patients[16](#_ENREF_16), [17](#_ENREF_17). Intriguingly, several studies have found that COPD patients had lower levels of peak cardiac enzymes after an MI and this was true for both troponin[18](#_ENREF_18) and creatine kinase[19](#_ENREF_19). In addition, Bursi et al[19](#_ENREF_19) found that COPD patients had a higher average heart rate than non-COPD patients and were more likely to have a delay (>12 hours) in presentation to hospital after MI.

**Differences in recognition and management of MI between COPD and non-COPD patients**

One possible consequence of differences in presentation after an MI between COPD and non-COPD patients is delay in recognition of MI. For people with COPD, even with presentation of typical MI symptoms, these symptoms may be erroneously attributed to their COPD. This is of particular importance for those with STEMI, as early identification of MI should reduce time to reperfusion and therefore would be expected to improve outcomes. In an analysis of over 300,000 first MIs in the UK Rothnie et al.[16](#_ENREF_16) found that after a STEMI, COPD patients were more likely to have an initial incorrect diagnosis (i.e. not MI) and had a longer median time to reperfusion. This was 153 min (IQR, 74-706 min) for those with COPD and 109 min (IQR, 50-260 min) for those without COPD, and was only apparent in COPD patients with a delay in diagnosis of MI compared to non-COPD patients with a delay in diagnosis of MI. This difference also remained on analysis adjusted for age, sex and comorbidities.

Recent studies conducted in Sweden and the UK have shown that COPD patients are less likely to receive primary percutaneous intervention or other reperfusion strategies after a STEMI[14](#_ENREF_14), [16](#_ENREF_16). Older studies in the USA also showed that those with COPD were less likely to receive primary percutaneous coronary intervention (pPCI) after a STEMI [15](#_ENREF_15), [19](#_ENREF_19), however a more recent study has found no difference in the proportion of COPD and non-COPD patients receiving pPCI after STEMI in the USA, suggesting they have started to recognise previous discrepancies in recognition and management and are changing clinical practice[18](#_ENREF_18).

After a non-STEMI, current guidelines[20](#_ENREF_20), [21](#_ENREF_21) suggest that patients who are at moderate (3%) or higher predicted risk of death within 6 months receive angiography in-hospital within 72 hours of the event. Angiography, and then subsequent PCI if indicated improves outcomes after non-STEMI and it is known that those who are at higher risk have more to gain from this intervention[22](#_ENREF_22), [23](#_ENREF_23). Several studies[14-16](#_ENREF_14), [18](#_ENREF_18), [19](#_ENREF_19) have shown that those with COPD are less likely to receive angiography in hospital after a non-STEMI compared to non-COPD patients, despite being at higher risk of death. One explanation for this difference could be that COPD patients are older and more likely to be deemed sicker or frailer than non-COPD patients, and as a result are not thought to be appropriate for more aggressive intervention. However, one study[16](#_ENREF_16) conducted a sensitivity analysis excluding those who were deemed inappropriate for angiography for example, due to advanced cancer or dementia, and this did not change the findings that those with COPD appear to be under treated compared to non-COPD patients with similar patient characteristics.

After a MI, current guidelines[20](#_ENREF_20), [21](#_ENREF_21) suggest that unless these are contraindicated, patients should be prescribed a β-blocker, an ACE inhibitor or angiotensin receptor blocker, a statin, and dual antiplatelet therapy (aspirin indefinitely and P2Y12 receptor antagonist for one year following the event). For some time it was thought that β-blockers were contraindicated in those with COPD as it was thought that they might cause bronchospasm. However, many studies have since demonstrated that cardioselective β-blockers are not associated with either change in FEV1 or an increase in exacerbations of COPD [24](#_ENREF_24). Despite this, β-blockers continue to be underused in those with COPD with several studies demonstrating they are much less likely to be prescribed following MI than in non-COPD patients[14-16](#_ENREF_14), [19](#_ENREF_19). Smaller differences are apparent for other secondary prevention medicines although discrepancies do exist. Some studies have reported that COPD patients are slightly less likely to receive aspirin, statins and ACE inhibitors/angiotensin receptor blockers[14-19](#_ENREF_14), however no studies reported significant differences in the prescription of P2Y12 receptor antagonist. Findings from studies which have investigated differences in treatment between COPD and non-COPD patients after an MI are summarised in Table 1. An interesting observation is that differences in management between COPD and non-COPD patients are not apparent in all settings and appear to have changed over time. As previously mentioned, differences between rates of pPCI after a STEMI between COPD and non-COPD patients appears to have narrowed over time in the USA[18](#_ENREF_18). There is also evidence that prescription of β-blockers to those with COPD after MI by physicians in the USA has also improved markedly over time[15](#_ENREF_15), however it is not apparent that this increase has also occurred in European countries [14](#_ENREF_14), [16](#_ENREF_16). These differences between countries suggest two things: that differences in treatment between COPD and non-COPD patients do represent undertreatment, and that change is possible.

**Outcomes after MI in people with COPD**

***All-cause mortality***

Several studies in different settings have demonstrated an increased risk of death after MI for those with COPD compared to non-COPD patients. However, there have been mixed findings concerning an increased risk of in-hospital death for those with COPD, with some finding an increased risk[14](#_ENREF_14), [15](#_ENREF_15), [18](#_ENREF_18), [19](#_ENREF_19), [25-28](#_ENREF_25), and others finding no difference[13](#_ENREF_13), [29](#_ENREF_29). A recently conducted systematic review and meta-analysis[8](#_ENREF_8) which appraised this evidence concluded that after pooling maximally adjusted estimates from several studies, there is weak evidence for a difference in in-hospital mortality for those with COPD (OR 1.13, 95% CI 0.97-1.31) and strong evidence for an increased risk of death during follow-up (HR 1.26, 1.13-1.40, Figure 2). However, heterogeneity of effects for these meta-analyses was moderately high. It is known that differences in treatment for MI between COPD and non-COPD patients varies between countries. If some of the increased risk of death associated with COPD is due to this difference in treatment, this may explain some of the heterogeneity in findings.

Interestingly, the effect of COPD on risk of death following MI is modified by some patient characteristics. A recent study in the UK demonstrated that after adjusting for potential confounders the effect of COPD on the risk of death after MI was higher after a non-STEMI than a STEMI for both in-hospital (OR 1.40 (95% CI, 1.30-1.52) compared to OR 1.27 (95% CI, 1.16-1.39)) and 6-month mortality (OR 1.63 (95% CI, 1.56-1.70) compared to OR 1.43 (95% CI, 1.29-1.58)). A study in the USA also demonstrated an increased effect of COPD on risk of death after a non-STEMI (OR 1.21, 95% CI 1.11-1.33) compared to that for STEMIs (OR 1.05, 95% CI 0.95-1.17)[18](#_ENREF_18). In addition, it appears that the effect of COPD on risk of MI is greater for younger compared to older patients (Figure 3). This suggests that the “excess” risk of death, and therefore potentially avoidable deaths, for COPD patients attributable to COPD are clustered in younger patients. This effect was also demonstrated in a study by Dziewierz et al[27](#_ENREF_27) who only found an increase in the risk of death in those under the age of 75 after MI for those with COPD compared to non-COPD patients.

As previous studies have demonstrated that there may be a significant degree of delay in diagnosis of MI for those with COPD. It would seem likely that there are a proportion of COPD patients who have an MI and this is missed entirely. The prevalence and impact of this potential problem is currently unclear. In addition, all of the studies which have investigated the risk of death for COPD patients compared to non-COPD patients after MI have done so in patients admitted to hospital. As many of those who have an MI do not survive until admission to hospital, the impact of COPD on risk of death after MI may be underestimated.

***Other outcomes***

As well as death following MI, other outcomes are important and have been investigated in those with COPD.

In terms of in hospital adverse events, Stefan et al[15](#_ENREF_15) found that after adjusting for possible confounders, people with COPD were more likely to experience acute heart failure (OR 1.59, 95% CI 1.37-1.83), but not atrial fibrillation, cardiogenic shock or stroke. In unadjusted analysis, Hadi et al[13](#_ENREF_13) also found an increased risk of acute heart failure in people with COPD, but not cardiogenic shock, re-infarction or stroke in hospital. In another unadjusted analysis, Enriquez et al[18](#_ENREF_18) found an increased risk of acute heart failure, cardiogenic shock, re-infarction, stroke and major bleeding for in hospital COPD patients following an MI.

In terms of adverse events following discharge from hospital, two studies have investigated the risk of heart failure for COPD patients after MI. Andell 2014 et al[14](#_ENREF_14) found that COPD patients were at higher risk of new-onset heart failure during the year following MI (HR 1.35, 95% CI 1.24-1.47). In a study including those with both MI and heart failure or left ventricular systolic dysfunction, COPD patients were more likely to have a hospitalisation for heart failure in the three years following MI (HR 1.19, 95% CI 1.05-1.34)[30](#_ENREF_30). Hawkins 2009 also found that COPD patients had a higher risk of sudden death compared to non-COPD patients (HR 1.26, 95% CI 1.03-1.53). However, this study was conducted in a population who all had heart failure or left ventricular systolic dysfunction and had been selected for a randomised controlled trial of treatment for heart failure and therefore may not be representative of the general population.

After a MI, COPD patients do not appear to be at higher risk of re-current MI[14](#_ENREF_14), [30](#_ENREF_30), stroke[30](#_ENREF_30), angina[17](#_ENREF_17), or major bleeds[14](#_ENREF_14) compared to non-COPD patients.

**Are differences in recognition and management related to differences in outcomes?**

As it is known that people with COPD have poorer outcomes compared to people without COPD, that they are less likely to have their MI recognised, and that they are less likely to receive guideline recommended treatment and investigation, one important question is whether these differences in management explain some of the differences in outcomes.

It is known that people with atypical presentations of MI have poorer outcomes compared to individuals with typical presentations, and that this might be related to differences in treatment[31](#_ENREF_31), [32](#_ENREF_32). People who present atypically are less likely to receive any reperfusion therapy after a STEMI, or angiography and percutaneous coronary intervention after a non-STEMI, and are less likely to receive β-blockers, statins or antiplatelet therapy on discharge from hospital[32](#_ENREF_32). It has been known for some time that older individuals, women, and people with diabetes or heart failure are more likely to have atypical presentations of MI. However, it has not been widely recognised that those with COPD may present with atypical symptoms of MI.

A recent study[16](#_ENREF_16) aimed to investigate whether differences in recognition and management of MI could explain some of the difference in mortality after MI for those with COPD. The findings showed that both recognition and management explained some of the difference in mortality after MI between COPD and non-COPD patients. Particularly, delay in diagnosis, timing and use of reperfusion after a STEMI, use of angiography after a non-STEMI and use of secondary prevention medicines were all potential explanations for the difference in mortality between COPD and non-COPD patients after an MI. Similarly, Andell et al[14](#_ENREF_14) found that adjusting for differences in in-hospital and discharge treatment reduced the HR comparing mortality in COPD patients to non-COPD patients from an HR of 1.32 (95% CI, 1.24-1.40) to an HR of 1.14 (95% CI, 1.07-1.21). However, adding treatment into the regression models in a study by Salisbury et al[17](#_ENREF_17) made no difference to the effect of COPD on mortality. These findings suggest that much of the difference in mortality between COPD and non-COPD patients after MI may be mediated by differences in recognition and treatment of MI rather than differences in treatment confounding the effect of COPD on risk of death. Differences in treatment between countries may be a possible reason for heterogeneity in effects of COPD on risk of death after MI. This is an important finding as, although some of the increased risk of death is likely to be due to COPD itself, if a proportion is due to differences in treatment, then this could potentially be modified.

One of the largest differences in management after MI between COPD and non-COPD patients in prescription of β-blockers as secondary prevention. As well as being safe for COPD patients recent work has demonstrated their effectiveness for secondary prevention after MI. Quint et al[33](#_ENREF_33) conduced a propensity score matched cohort study among those with COPD after MI comparing those prescribed β-blockers and those not prescribed β-blockers after MI. Those started on a β-blocker during hospital admission for MI had significantly better survival than those not prescribed β-blockers (HR 0.50, 95% CI 0.36-0.69). Similarly, in a population of people with heart failure, Hawkins et al 2009[30](#_ENREF_30) found that COPD patients prescribed a β-blocker following an MI had better survival than those not prescribed a β-blocker (HR 0.74, 95% CI 0.68-0.80). COPD did not appear to modify the effect of β-blockers on mortality. The reluctance to prescribe β-blockers to COPD patients may drive much of the increased risk of heart failure and death in the months and years following an MI in those with COPD.

A schematic diagram of the possible mechanisms underlying the relationship between COPD and risk of death after MI is presented in Figure 4.

**Areas for future research**

***Are MIs completely missed with those with COPD?***

Evidence has shown that there is sometimes delayed recognition of acute MI in people with COPD. One likely explanation for this is that the symptoms of their MI, such as breathlessness, may be misattributed to their COPD. In addition, atypical presentation may also contribute to the delay in diagnosis. It is therefore possible that the diagnosis of many MIs in those with COPD are not only delayed, but may also be missed completely. Indeed, it is known that around 8% of patients admitted to hospital with an acute exacerbation of COPD meet the Universal Definition for Myocardial Infarction (raised troponin with ECG changes and/or chest pain)[34](#_ENREF_34). As it is known that exacerbations of COPD are a period of higher risk of MI for COPD patients, it is unclear how many of these are MIs triggered by an exacerbation and how many are MIs initially misdiagnosed as exacerbations. In another study, among those hospitalised for an acute exacerbation of COPD, it was found that around 2/3 of all COPD patients with evidence of a previous MI as assessed by the cardiac infarction injury score had a recorded diagnosis of MI, and that this was even higher among women with COPD[35](#_ENREF_35). Missed diagnosis of MI has been a long established finding in those with diabetes, and is associated with increased mortality in this group[31](#_ENREF_31). Further research should investigate the prevalence of missed diagnosis of MI and the impact of this potential problem.

***What other aspects of COPD are related to mortality after MI?***

Although several studies have investigated mortality after MI for those with COPD, none have investigated which aspects of COPD itself may modify this relationship.

COPD severity defined by degree of airflow obstruction appears to be a risk factor for MI[36](#_ENREF_36). It is unclear however, if degree of airflow obstruction is also a risk factor for death after MI in those with COPD. Much of the research on risk of death after MI in those with COPD has been conducted using national MI registries, and as such do not have data on lung function.

After an MI, one of the most effective things a current smoker can do to reduce their risk of death and further MI is to quit smoking[37](#_ENREF_37). As many COPD patients are current smokers and can be very heavily dependent on nicotine, quit rates may be lower in those with COPD and recidivism may be higher in those COPD patients who do quit. Recent work has suggested that smokers are not frequently prescribed recommended smoking cessation pharmacotherapy[38](#_ENREF_38) and that in contrast to those with stable coronary artery disease, pharmacotherapy may not be effective for smoking cessation after acute MI[39](#_ENREF_39). However, COPD patients may well represent a group in whom this therapy could be targeted towards.

COPD exacerbations are an acute worsening of symptoms of cough, breathlessness and sputum volume and/or purulence beyond normal day-to-day variation and which may require a change in treatment. Acute exacerbations of COPD are associated with increased systematic inflammation and are important drivers of morbidity and mortality in those with COPD[40](#_ENREF_40). Some COPD patients appear to be particularly susceptible to exacerbations, and these patients have been termed frequent exacerbators. Periods of exacerbation have been found to be associated with increased risk of MI for those with COPD[8](#_ENREF_8), [41](#_ENREF_41), [42](#_ENREF_42). Further research is needed to investigate what effect, if any, the frequent exacerbator phenotype has on outcomes after MI.

***Predicting risk of death after MI in people with COPD and differences in treatment***

The risk management paradox refers to the observation that although those who are at highest predicted risk of death after MI are most likely to benefit from early aggressive intervention, especially after a non-STEMI, they are the least likely to receive it[43](#_ENREF_43). As those with COPD certainly seem to be at higher risk of death after MI, and less likely to receive early aggressive intervention, such as cardiac catheterisation within 72 hours after a non-STEMI, this may apply to those with COPD. There may be several reasons for this paradox in those with COPD. The first is that current systems which score patients based on risk of death after MI do not perform well in those with COPD compared to non-COPD patients. Early findings from a study of the performance of the GRACE score in those with COPD compared to those who do not have COPD suggests that it does not perform as well at predicting risk of death after acute coronary syndromes in COPD patients[44](#_ENREF_44). However, evidence also suggests that even when COPD patients have the same GRACE score predicted risk of death as non-COPD patients, they are less likely to receive guidelines recommended investigation and treatment, suggesting there may be other forces at play[44](#_ENREF_44). The second is perhaps therapeutic nihilism towards treating comorbidities in those with COPD. It may be that COPD patients are seen as older, frailer patients in whom secondary prevention is not worthwhile. However, as previously discussed, many COPD patients do in fact die from cardiovascular disease. In addition, much of the excess deaths after MI in those with COPD are among younger patients and even in studies which adjusted for age and comorbidities, differences in treatment did seem to be associated with poorer mortality for those with COPD. Both performance of risk scores after MI and clinical decision making around the selection of patients for invasive treatment and secondary prevention drugs is needed.

***Cardio-respiratory rehab in COPD patients after MI***

While the benefits of cardiac rehabilitation post MI are fairly well established generally, it is recognised that certain groups of people are less likely to be referred than others[45](#_ENREF_45). People with COPD are likely to be in that group and yet may actually have more to gain by rehabilitation. This is certainly an area that requires further exploration, and perhaps even development of modified or combined cardiac and pulmonary rehabilitation courses.

**Conclusions**

It is clear that COPD patients have poorer long term mortality after MI compared to non-COPD patients. The effect of COPD on risk of death after MI is higher for younger people and for those with a non-STEMI. They do not appear to be at higher risk of recurrent MI, however they do seem more likely than non-COPD patients to develop heart failure. COPD patients also seem to be at higher risk of in-hospital death after MI in some settings, however this may depend on quality of care for COPD patients after MI. Some of the difference in in-hospital and longer term mortality appears to be due to differences in recognition and management of MI in those with COPD.

Those with COPD present differently after acute MI than non-COPD patients. They are more likely to present with breathlessness and atypical chest pain. This may contribute to a delay in recognition of MI in those with COPD, and may also mean that many MIs in those with COPD are missed entirely.

In terms of in-hospital care, COPD patients are less likely to receive reperfusion after a STEMI, and prompt angiography after a non-STEMI. COPD patients are also less likely to receive secondary prevention drugs after an MI, in particular β-blockers. β-blockers are safe and effective for secondary prevention after MI in those with COPD and should not be withheld from this group.

Further research is needed to investigate the extent and impact of missed diagnosis of MI in those with COPD. In addition, identifying those with undiagnosed COPD after an MI is vital for reducing mortality in this group. Researchers should also focus on investigating how risk scores function in those with COPD and how they are used to guide treatment in this group.

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Figure 1. Diagram representing how inflammation in COPD may “spill over” into the systemic circulation and increase the risk of several diseases including cardiovascular disease. Original image from Barnes 2010[7](#_ENREF_7).



Figure 2. Long term risk of death following MI comparing COPD to non-COPD patients. Original image from Rothnie et al. 2015[8](#_ENREF_8).



Figure 3. Effect of COPD on risk of death 6 months after MI split by age group. Adapted from data presented in Rothnie et al. 2015[16](#_ENREF_16).

**Delayed reperfusion after STEMI**

**Heart failure**

**Missed MI**

**Atypical presentation & misdiagnosis**

**Misunderstanding of benefits and risks of secondary prevention for COPD patients**

**Smoking and other shared risk factors**

**Underuse of secondary prevention**

**Inflammation, thrombosis, arterial stiffening & endothelial dysfunction**

Figure 4. Schematic diagram of the possible mechanisms underlying the relationship between COPD and risk of death after MI.

Table 1. Summary of studies which investigated differences in treatment after MI between COPD and non-COPD patients

|  |  |  |  |
| --- | --- | --- | --- |
| **Study** | **Design and setting** | **Population** | **Differences in management** |
| **Andell 2014**[**14**](#_ENREF_14) | Cohort study within the Swedish SWEDEHEART registry between 2005-2010. | Consecutive patients admitted to Swedish coronary care units. COPD diagnosis ascertained through linkage to the Swedish National Patient Registry. | **In-hospital management:**  Percutaneous coronary intervention  COPD: 37.7 %  Non-COPD: 55.7%  p<0.001  Coronary angiography:  COPD: 72.5%  Non-COPD: 55.4%  P<0.001  **Discharge medicines:**  ACE inhibitors  COPD: 50.6%  Non-COPD: 55.5%  p<0.001  Angiotensin receptor blockers  COPD: 12.6%  Non-COPD: 11.1%  p=0.001  Aspirin  COPD: 85.5%  Non-COPD: 90.1%  p<0.001  β-blockers  COPD: 77.7%  Non-COPD: 86.1%  p<0.001  Statin  COPD: 68.4%  Non-COPD: 79.2%  p<0.001  P2Y12 inhibitor  COPD: 62.5%  Non-COPD: 72.2%  P<0.001 |
| **Bursi 2010** | Cohort study in Olmsted County, Minnesota from 1979-2007 | 3438 local residents in Olmsted County. ICD-10 codes used to ascertain COPD. | **In-hospital management:**  Reperfusion  COPD: 41%  Non-COPD: 52%  p<0.01  Angiography-in hospital  COPD: 51%  Non-COPD: 59%  p<0.01  **Discharge medicines:**  ACE inhibitor  COPD: 37%  Non-COPD: 29%  p<0.01  β-blocker  COPD: 47% Non-COPD: 61%  p<0.01  Diuretic  COPD: 34%  Non-COPD: 23%  p<0.01  Statin  COPD: 29%  Non-COPD: 30%  P=0.61 |
| **Enriquez 2013** | Cross sectional study of National Cardiovascular Data Registry in the USA between January 2008- December 2010 | 158,890 patients with an acute MI. COPD was ascertained from history of COPD or were using long term inhaled or oral β-agonists, inhaled anti-inflammatory agents, leukotriene receptor antagonists or inhaled steroids. | **STEMIs**  **In-hospital management**  Primary percutaneous coronary intervention  COPD: 83.1%  Non-COPD: 85.4%  p<0.001  Overall reperfusion  COPD:92.8%  Non-COPD: 94.3%  p<0.001  **Discharge medicines:**  Aspirin  COPD: 97.8%  Non-COPD: 98.7%  P<0.001  β-blocker  COPD: 89.4%  Non-COPD: 93.1%  P<0.001  ACE inhibitor or angiotensin receptor blocker  COPD: 78.0%  Non-COPD: 78.4%  p= “not statistically significant”  Statin  COPD: 92.9%  Non-COPD: 94.7%  p<0.001  P2Y12 inhibitor  COPD: 79.6%  Non-COPD: 86.6%  P<0.001  **nSTEMIs**  **In-hospital management**  Cardiac catheterisation  COPD: 69.9%  Non-COPD:81.2%  p<0.001  Percutaneous coronary intervention within 48 hours  COPD: 37.2%  Non-COPD 48.9%  p<0.001  **Discharge medicines:**  Aspirin  COPD: 95.9%  Non-COPD: 97.3  p<0.001  β-blocker  COPD: 85.5%  Non-COPD: 90.5%  p<0.001  ACE inhibitor or angiotensin receptor blocker  COPD: 69.6%  Non-COPD: 69.6%  p= “not statistically significant”  Statin  COPD: 85.9%  Non-COPD: 89.5%  p<0.001  P2Y12 inhibitor  COPD: 65.5%  Non-COPD: 71.6%  p<0.001 |
| **Rothnie 2015** | All UK patients admitted to hospital in the MINAP registry between 2003-2013 | 300161 patients with a first MI | **STEMI**  **In-hospital management**  Primary PCI  OR 0.87 (95% CI, 0.83-0.92)\*  **Discharge medicines**  Aspirin  OR 0.90 (95% CI, 0.85-0.94)\*  β-blocker  OR 0.26 (95% CI, 0.25-0.27)\*  ACE inhibitor or angiotensin receptor blocker  OR 0.89 (95% CI, 0.85-0.93)\*  Statin  OR 0.91 (95% CI, 0.86-0.95)\*  P2Y12 inhibitor  OR 0.98 (95% CI, 0.94-1.03)\*  **Non-STEMI**  **In-hospital management**  Angiography in-hospital  OR 0.69 (95% CI,0.66-0.71)\*  **Discharge medicines**  Aspirin  OR 0.91 (95% CI, 0.88-0.94)\*  β-blocker  OR 0.25 (95% CI, 0.24-0.25)\*  ACE inhibitor or angiotensin receptor blocker  OR 0.94 (95% CI, 0.91-0.97)\*  Statin  OR 0.93 (95% CI, 0.90-0.96)\*  P2Y12 inhibitor  OR 0.97 (95% CI, 0.94-1.01)\*  \* All ORs compared COPD to non-COPD patients and are adjusted for age, sex, smoking status and co-morbidities |
| **Salisbury 2007** | Cohort study in 19 centres in the USA between 2003-2004 | 2481 MI patients in PREMIER study restricted to patients discharged alive after MI | **In-hospital management**  Cardiac catheterisation  COPD: 45.7%  Non-COPD: 41.2%  p=0.094  Percutaneous coronary intervention  COPD: 50.9%  Non-COPD: 62.9%  p<0.001  **Discharge medicines**  Aspirin  COPD: 87.8%  Non-COPD: 94.5%  p<0.001  β-blocker  COPD: 86.2%  Non-COPD: 92.6%  p<0.001 |
| **Stefan 2012** | Cohort study up of patients hospitalised with acute MI at greater Worcester, Massachusetts between 1997-2007 | 6,290 Patients hospitalised with acute MI in greater Worcester, Massachusetts medical centres | **In-hospital management**  Cardiac catheterisation  OR 0.56 (95% CI, 0.48-0.65)\*\*  Percutaneous coronary intervention  OR 0.64 (95% CI, 0.54-0.77)\*\*  **Discharge medicines**  β-blocker  OR 0.44 (95% CI, 0.35-0.50)\*\*  Anticoagulant  OR 0.81 (95% CI, 0.69-0.95)\*\*  Statin  OR 0.70 (95% CI,0.60-0.82)\*\*  Calcium channel blocker  OR 1.31 (95% CI, 1.13-1.52)\*\*  \*\* ORs compare COPD to non-COPD patients and are adjusted for age, sex, year, cardiovascular disease history, renal failure, length of stay and type of MI (STEMI or non-STEMI) |