ORIGINAL ARTICLE

Is cocaine use recognised as a risk factor for acute coronary syndrome by doctors in the UK?

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Background: Cocaine is a sympathomimetic agent that can cause coronary artery vasospasm leading to myocardial ischaemia, acute coronary syndrome and acute myocardial infarction (ACS/AMI). The management of cocaine-induced ACS/AMI is different to classical atheromatous ACS/MI, because the mechanisms are different.

Methods: Knowledge study—Junior medical staff were given a scenario of a patient with ACS and asked to identify potential risk factors for ACS and which ones they routinely asked about in clinical practice. Retrospective study—Retrospective notes reviews of patients with suspected and proven (elevated troponin T concentration) ACS were undertaken to determine the recording of cocaine use/non-use in clinical notes.

Results: Knowledge study—There was no significant difference in the knowledge that cocaine was a risk factor compared to other "classical" cardiovascular risk factors, but juniors doctors were less likely to ask routinely about cocaine use compared to other "classical" risk factors (52.9% vs >90%, respectively). Retrospective study—Cocaine use or non-use was documented in 3.7% (4/109) and 4% (2/50) of clinical notes of patients with suspected and proven ACS, respectively.

Discussion: Although junior medical staff are aware that cocaine is a risk factor for ACS/AMI, they are less likely to ask about it in routine clinical practice or record its use/non-use in clinical notes. It is essential that patients presenting with suspected ACS are asked about cocaine use, since the management of these patients is different to those with ACS secondary to "classical" cardiovascular risk factors.

Cocaine is a sympathomimetic agent, causing inhibition of pre-synaptic re-uptake of norepinephrine and dopamine as well as stimulation of the release of catecholamines.^{1,2} The increased concentration of catecholamines peripherally causes stimulation of both α and β adrenergic receptors.² This stimulation can cause coronary artery vasospasm and associated decreased oxygenated blood supply to the cardiac muscle, leading to myocardial ischaemia and acute coronary syndrome (ACS). Increased concentration of catecholamines also causes an increased heart rate and therefore increased myocardial oxygen demand, which can further worsen the myocardial ischaemia. In severe cases this can lead to acute myocardial infarction (AMI), although the pathophysiology is more one of vasospasm rather than secondary to atherosclerotic disease, so the treatment options are therefore different. This risk of ACS and AMI is greatest in the first hour following cocaine use.³

Knowledge that cocaine is a risk factor for ACS and AMI is therefore essential in ensuring correct treatment of these patients. In a study in the USA of 129 patients presenting to an emergency department with "chest pain syndromes", cocaine use or non-use was only recorded in 18 (13%) of notes.⁴ Of these episodes where cocaine use/non-use was recorded, only 9 (50%) were recorded by members of the emergency department team who are the people most likely to review patients in the first hour following cocaine use, when the risk of ACS and/or AMI is greatest. There was no comparison of those with proven ACS/AMI and other diagnoses and recording of cocaine pattern of use or non-use.

The prevalence of cocaine use is increasing in the UK and in a recent population study its point prevalence of use was 2.4%.⁵ However, a study of the recording of any cocaine use in patients with suspected and proven ACS, as well as doctors' knowledge of cocaine as a risk factor for ACS, has not previously been reported in the UK. We therefore designed a study to determine

whether junior medical staff are aware of cocaine as a risk factor for ACS and/or AMI, and whether this risk factor is being recorded in patients presenting with suspected or proven ACS and/or AMI in clinical practice.

METHODS

Knowledge of cocaine use as a risk factor for ACS

Junior medical staff, both resident and fellows, in emergency medicine and/or general internal medicine, were presented with a case scenario of a patient with ACS. They then anonymously completed a questionnaire identifying potential risk factors for ACS and their own recording of these risk factors in routine clinical practice. Additionally they were asked to identify any risk factors, with reasons if possible, that they felt would alter the immediate management of patients with suspected ACS.

Recording of cocaine use in patients with suspected ACS

A retrospective notes review of all patients presenting with chest pain attending a large inner-city teaching hospital emergency department in London, UK over a 1-month period was undertaken. The inclusion criteria were patients where the initial working diagnosis was that of ACS. Emergency department notes were then reviewed to determine whether cocaine use or non-use had been recorded.

Recording of cocaine use in patients with proven ACS

A retrospective notes review of all patients with elevated troponin T concentrations of >0.8 ng/ml (normal range <0.03 ng/ml) admitted to hospital over a 2-month period was undertaken. Patients were included if their presentation

Abbreviations: ACS, acute coronary syndrome; AMI, acute myocardial infarction; ECG, electrocardiogram; STEMI, ST elevation myocardial infarction

diagnosis was ACS, AMI or out-of-hospital cardiac arrest. Hospital notes were reviewed and the recording of classical cardiovascular risk factors (smoking history, previous ischaemic heart disease, diabetes mellitus, hypertension, hypercholesterolaemia and family history of ischaemic heart disease) and cocaine use was documented.

Statistical analysis

Data are presented as mean (SD). Statistical analysis was performed using SPSS version 10, 1999. Paired *t* tests were used to compare differences in the recording of cardiovascular risk factors, and a value of $p < 0.05$ was considered significant. χ^2 analysis was used to compare whether pre-cognition of cocaine as a risk factor for ACS would alter management.

RESULTS

Knowledge of cocaine use as a risk factor for ACS

Thirty-four residents/fellows in emergency medicine and general internal medicine completed the questionnaire survey. Table 1 shows that there was no significant difference in the knowledge that cocaine was a risk factor for ACS compared to other more classical cardiovascular risk factors. Residents and fellows were, however, significantly more likely to ask about all classical risk factors in a case scenario of ACS (table 1). Of the 16 people who did not routinely ask about cocaine use in patients with ACS, 12 (75%) stated that knowing about cocaine use would acutely alter their management of a patient with ACS. A similar proportion of those who routinely asked about cocaine use (15/18, 83.3%, $\chi^2 = 0.36$ with 1 degrees of freedom) stated that knowing about cocaine use would alter their initial management of these patients. Only 5 (18.5%) doctors who stated that knowing about cocaine use would alter their initial management of ACS gave reasons for this; all stated that thrombolysis would not be indicated or would be contra-indicated.

Recording of cocaine use in patients with suspected ACS

One hundred and nine patients attending the emergency department met the inclusion criteria of suspected ACS and notes were available for review in all cases. There were 71 (65.1%) males and the mean (SD) age was 55.7 (17.0) years (range 18–89 years). Cocaine use or non-use was only recorded in 4 (3.7%) of these patients. All 4 patients were recorded as cocaine users, although there was no recording of the last ingested cocaine.

Recording of cocaine use in patients with proven ACS

Fifty patients meeting the inclusion criteria were identified and notes were available for review for 47 (94%). There were 36

(76.6%) males and the mean age was 65.2 (15.3) years (range 21.5–90.3 years). Cocaine use or non-use was only recorded in 2 (4%) of these patients, and both were recorded as cocaine “non-use”. Admitting doctors were significantly more likely to record classical cardiovascular risk factors for ACS than cocaine (fig 1).

DISCUSSION

Cocaine use is known to be associated with ACS and/or AMI. Previous studies have demonstrated a poor recording of cocaine use as a risk factor in patients presenting to hospitals in the USA with chest pain. In this study we have shown that although junior doctors are aware that cocaine is a risk factor for ACS/AMI and that knowledge of its recent use would alter management of a patient with cocaine-induced ACS, they are significantly less likely to ask about it in routine clinical practice compared to other classical cardiovascular risk factors. This lack of enquiry about cocaine use/non-use is confirmed by the lack of recording in clinical notes of whether cocaine use or non-use has been asked about in patients with suspected or troponin confirmed ACS/AMI. However, it is possible that junior doctors may ask about cocaine use/non-use, but do not record this information in the clinical notes.

Cocaine is a potent sympathomimetic agent that not only prevents pre-synaptic re-uptake of norepinephrine and dopamine, but also stimulates secretion of catecholamines. This increase in catecholamine concentrations leads to an excessive stimulation of both α and β adrenergic receptors, which in part explains the increased risk of ACS and AMI following cocaine use. There is an increase in the heart rate leading to an increased myocardial oxygen demand, as well as coronary artery vasospasm which leads to a reduction in blood flow to the myocardium.⁶ In addition to this, cocaine has been shown to cause platelet activation and platelet aggregation,⁷ increase endothelin concentrations⁸ and reduce nitric oxide production,^{9, 10} all of which are additive to the cocaine-induced coronary vasoconstriction and can worsen myocardial ischaemia.

Classical management of AMI in patients with atheromatous coronary artery disease, in whom the mechanism of coronary occlusion is thrombus formation, is to administer aspirin, clopidogrel, and thrombolysis to reduce platelet aggregation

Figure 1 Cocaine is significantly less likely to be recorded in patients with proven acute coronary syndrome than other classical cardiovascular risk factors ($p < 0.001$ for all comparisons with recording of cocaine). IHD, ischaemic heart disease.

Table 1 Resident and fellows' knowledge of risk factors for acute coronary syndrome (ACS) and myocardial ischaemia and the rate of usual recording of these risk factors in a simulated case scenario of ACS

Risk factor	Number (%) aware	p Value	Number (%) routinely asking about	p Value
Cocaine	31 (91.1)	NA	18 (52.9)	NA
Smoking history	34 (100)	0.08	34 (100)	<0.001
Previous IHD	33 (97.1)	0.324	34 (100)	<0.001
Diabetes mellitus	34 (100)	0.08	34 (100)	<0.001
Hypertension	34 (100)	0.08	34 (100)	<0.001
Hypercholesterolaemia	33 (97.1)	0.324	31 (91.1)	<0.001
Positive family history of IHD	34 (100)	0.08	34 (100)	<0.001

IHD, ischaemic heart disease; NA, not applicable.

and treat any underlying coronary artery thrombosis. β -blockers are also used to reduce myocardial oxygen demand in the presence of reduced oxygen delivery and reduce the risk of arrhythmias. In cocaine-induced AMI/ACS, the pathophysiology is different—the decrease in coronary artery blood flow is secondary to coronary artery vasospasm rather than plaque rupture and formation of coronary artery thrombus, and therefore the management required is different. High-dose benzodiazepines and vasodilators, such as intravenous nitrates and calcium channel blockers, are the first line management in those patients with cocaine induced AMI and ACS.^{6, 11, 12} These help to reverse the cocaine-induced coronary artery vasospasm and reduce the cocaine-induced sympathetic nervous system stimulation which leads to a reduction in heart rate and therefore myocardial oxygen demand. β -blockers have no role since they can lead to unopposed α -stimulation and therefore worsen cocaine-induced hypertension.¹³ Cocaine is a relative contraindication to the use of thrombolysis, due to cocaine-induced hypertension and therefore an increased risk of intracranial haemorrhage.¹¹ Patients with cocaine-induced AMI, who are not responding to benzodiazepines and vasodilator drugs, should have coronary angiography and either angioplasty and stenting or intracoronary artery drug treatment to reverse vasoconstriction.¹¹

Following cocaine use, the risk for the development of ACS and/or AMI is greatest during the following 60 min.³ In the Determinants of Myocardial Infarction Onset Study, all patients (3946) were asked about cocaine use. Only 1% (38) had used cocaine in the year before myocardial infarction and of these 47% were using cocaine at least once per week. The risk of developing an AMI within 1 h of cocaine use was increased to 23.7 times the risk at baseline (ie, when no cocaine had been used). There were insufficient patients using cocaine 1–2 h and 2–3 h before their AMI to be powered to demonstrate a significantly increased risk at these times over baseline risk.

Diagnosis of cocaine-induced ACS/AMI is based on a positive history of cocaine use in the context of chest pain, changes in 12 lead electrocardiogram (ECG) and elevations in specific cardiac enzymes. Often rises in cardiac enzymes occur after a number of hours and therefore cardiac enzymes may not be useful in the early acute management of patients with ACS/AMI. Additionally, the ECG has been shown to be abnormal in up to 85% of patients presenting with chest pain following cocaine use, even without subsequent biochemical evidence of AMI.^{14, 15} Therefore obtaining an accurate history on presentation, which includes a history of recent cocaine use or non-use, is essential in the diagnosis of ACS/AMI since usual routine investigations may not provide timely conclusive evidence.

Recreational cocaine use in the UK is common.^{5, 16–18} In a recent survey of ~1200 people around the UK, 16% had

previously used recreational drugs and of these 34% had previously used cocaine, equating to 5.5% of the survey population having previously used cocaine.¹⁸ The prevalence of cocaine use in people aged between 16 and 59 is shown in fig 2, and demonstrates that the highest prevalence group is those aged 20–24 years.⁵ Cocaine is the second most commonly used drug after cannabis, and used recreationally in all age groups.⁵ The prevalence of recreational cocaine use in the UK is currently increasing with an overall reported use of 2.0% in 2001/2002, rising to 2.4% in 2003/2004.^{5, 15, 17}

There have been no previous studies reporting the prevalence of cocaine use in patients with suspected or proven ACS and/or AMI in the UK. Testing of urine samples from 359 patients with chest pain presenting to the emergency department in a large US city showed that samples were positive in 60 (17%) of patients.¹⁹ As samples were collected and then analysed anonymously, it was not possible to determine if those patients with urine samples positive for cocaine or its metabolites had definite ACS and/or AMI. Additionally the diagnostic tests used would detect the presence of cocaine metabolites, which can indicate use of cocaine up to 5–9 days previously. Therefore there is the potential that the chest pain may be unrelated to acute cocaine use. In a further study of self-reported cocaine use in patients aged 18–45 years enrolled in the Third National Health and Nutritional Examination survey, frequent cocaine use (≥ 10 times) was associated with an age-adjusted odds ratio for non-fatal MI of 6.4 (95% confidence interval (CI) 1.25 to 53).²⁰ Lifetime use of cocaine is not useful in demonstrating an increased risk of acute coronary artery vasospasm, since the risk is greatest within the first hour following ingestion.³

Although acute cocaine use has been clearly shown to increase the risk of AMI, the evidence that chronic cocaine use is an independent risk factor for coronary artery disease is controversial. In a retrospective study of angiograms in 33 people (mean age 37 years) with a history of known cocaine use and a history of “cardiac symptoms”, there was evidence of significant coronary artery stenosis ($\geq 70\%$ of at least one vessel) in 40%.²¹ In a post-mortem study comparing coronary artery disease in people with death secondary to either trauma or cocaine use, there was no significant difference in the incidence of atherosclerotic changes; however, those people who had died secondary to cocaine use had an increased frequency of multiple coronary artery disease.²² Mechanistic studies in pigs have further substantiated this increased risk of myocardial infarction secondary to chronic cocaine exposure.²³ There was an additive effect in those animals fed a high cholesterol diet in addition to chronic cocaine use. A more recent prospective study in patients with ST elevation myocardial infarction (STEMI) demonstrated no difference in the incidence of atherosclerosis or critical coronary artery stenosis in patients with and without a history of cocaine use, but there was an increased risk of multivessel disease in those with cocaine use.²⁴ A further larger retrospective analysis of over 500 patients undergoing coronary angiography in one centre showed no difference in the incidence of significant coronary artery stenosis, but the authors did not report whether there was any difference in frequency of multivessel disease.²⁵ Therefore chronic cocaine use may be associated with an increased risk of multivessel coronary artery disease, although there is no current evidence to suggest an overall difference in the incidence of significant or non-significant coronary artery disease.

Only one survey in the USA has reported the recording of cocaine use or non-use in patients presenting with a diagnosis of “chest pain syndrome”.⁴ Admission records from 129 patients presenting with chest pain were reviewed retrospectively to determine whether cocaine use or non-use had been

Figure 2 Prevalence of recreational cocaine use in the previous year in people aged 16–59 years in 2003/2004 (data from British Crime Survey 2003/2004).

What is already known on the subject

- Cocaine can be a sympathomimetic agent that can cause coronary artery vasospasm and therefore cause acute coronary syndrome and/or acute myocardial infarction (ACS/AMI)
- Cocaine use is common in the UK
- Previous studies in the USA have demonstrated cocaine use or non-use was only recorded in 13% of admission notes

What this study adds

- Junior doctors (residents and fellows) are aware that cocaine is a risk factor for ACS and/or AMI
- Knowledge about cocaine use would alter junior doctors' management of people with cocaine-induced ACS/AMI
- Cocaine use is not routinely asked about by junior doctors in clinical practice in patients with suspected ACS/AMI
- Cocaine use or non-use is not clearly documented in patients with suspected or proven ACS/AMI

documented. In this study, cocaine use or non-use was recorded in 13% of admission notes, compared to 3.7% with suspected and 4.3% of proven ACS and/or AMI of clinical notes in our study. The recording of other classical cardiovascular risk factors was similar in this study (58–90%) to that seen in our study (63–87%). The documented cocaine use or non-use may reflect poor documentation of information collected by doctors. Of the 27 patients in the Hollander study who remember being asked about cocaine use or non-use, review of the clinical notes revealed that this information was only documented in 44% of cases. In our survey we showed that 53% of doctors say that they routinely ask about cocaine use, but it is only documented in ~4% of clinical notes. Poor recording of information in written clinical notes may have underestimated the number of patients who are actually questioned about cocaine use in both studies. There have been no previous studies examining doctors' knowledge of cocaine as a risk factor for ACS and/or AMI, and whether it is routinely asked about in clinical practice.

We have shown that although junior doctors are aware cocaine is a risk factor for ACS and/or AMI, and that knowledge of its use would alter their clinical management of patients with cocaine-induced myocardial ischaemia, it is not routinely asked about in clinical practice or documented in clinical notes. It is important that doctors incorporate questions concerning cocaine use or non-use into routine clinical practice, since the pathophysiology and therefore management of these patients differs from classical risk factor induced ACS and/or AMI.

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