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Acute Left Ventricular Failure in Cocaine Abused Young Patient: Case Report

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Abstract

Background: *Cocaine is responsible for LV systolic dysfunction in patients (long-term users or with acute intoxication). The mechanism leading to develop cocaine-induced cardiomyopathy is not completely understood, however development of a coronary thrombus, increased oxidative stress, calcium flux sympathomimetic effects are contributing factors in its pathophysiologic formation.*

Case Report: *A 23 year old B.Tech third year student from top of north India was admitted in cardiac emergency department with complaint of severe breathlessness and pink frothy sputum. ECG showed sinus tachycardia, hyperacute T waves without any ST elevation and depression or T wave inversion. He denied previous history of hypertension, diabetes, thyroid, asthma or tuberculosis and trauma or surgery. He stated us his personal history about cocaine abuser almost 7 years 6 to 8 times per month. On examination he was hypertensive and tachycardic with low Oxygen saturation (70%). Lab data showed an elevated Brain natriuretic peptide; urine toxicology was positive for cocaine. 2D-echocardiography showed dilated left ventricle with poor LV systolic function LVEF-30%. Coronary angiography revealed LAD spasm without any obstructive lesions, subsequently NTG infusion was given and final result was TIMI 3 flow in coronaries. He was managed medically and subsequently discharged with drug rehabilitation. On follow-up diagnostic evaluation after 6 months of cocaine cessation, his ejection function improved significantly.*

Conclusion: *Cocaine is a potent sympathomimetic agent associated with the development of possible fatal cardiovascular complications. Hypertension, Dilated cardiomyopathy, Dysrhythmias and Acute myocardial infarction are just some of many cardiovascular effects related to the abuse of cocaine. The management is like other forms of cardiomyopathy; however β-blockers should be avoided. Non-invasive testing should be performed after several months to re-evaluate the treatment response.*

Keywords: *Cocaine, Left Ventricle Systolic dysfunction, Heart Failure*

1. Introduction

More than 14 million people worldwide, mostly within the age range of 15 to 64 years, consume cocaine. Men of 15–35 years represent the majority. Dose-dependent tachycardia, hypertension along with increased arousal is the first physiological response to cocaine use. Performance improvement, attentiveness, sense of positive self-image and euphoria often accompany the cumulative use of cocaine. End-organ-damage associated with cocaine can affect almost every organ system. Cocaine results in a gradual addiction due to its vigorous sympathomimetic features with possible destructive cardiovascular effects. Dysrhythmias, acute myocardial infarction, myocarditis, hypertension, endocarditis, hypotensive shock, cerebral vascular accidents and dilated cardiomyopathy are several cardiovascular complications due to cocaine abuse **[1].** Cocaine blocks the presynaptic dopamine and catecholamine uptake, resulting in post-synaptic sympathetic stimulation and dopaminergic receptor activation **[2].** Peripheral vasoconstriction results in hypertension, tachycardia and an increase in afterload. Arrhythmias are likely to occur due to the altered autonomic action and

cardiovascular resistance results in a decreased myocardial blood supply **[3].** Negative inotropic events can also occur from cocaine abuse. Hypertrophy of the left ventricle and cardiomyopathy with significant reduction of the ejection fraction has been described in the setting of chronic cocaine consumption. Myocardial hypertrophy is likely to occur secondary to the temporary blood pressure elevation after cocaine use **[4].** Smoking and alcohol use exacerbate the cardiotoxic impact of cocaine **[5].**

2. Case report

A 23 year old B.Tech third year student from top of north India was admitted in cardiac emergency department with complaint of severe breathlessness and pink frothy sputum last 6 hrs. ECG showed normal sinus rhythm, hyperacute T waves without any ST elevation and depression or T wave inversion. He denied previous history of hypertension, diabetes, thyroid, asthma or tuberculosis, trauma or surgery. He stated us about his personal history, about cocaine abuser almost 7 years 6 to 8 times per month. He denied for alcohol taking and any iv drugs or smoking.

On examination, Initial vital signs revealed a tachycardia (heart rate: 123 beats per minute) and hypertension (blood pressure: 180/110 mmHg) patient, with peripheral oxygen saturation of 70%, Respiratory rate was 33 /min and body temperature was 98.2 degree F. On General physical examination, no pallor, no icterus, no cyanosis, no clubbing, no lymphadenopathy but jugular venous pressure was raised. Cardiovascular system revealed S1 slightly loud due to tachycardia and S2 was normal and LV S3 sound was there due to LV dysfunction with 2/6 systolic murmur at mitral valve area with radiation to the left axilla and on lung examination there were significant bilateral diffuse crepts found. Electrocardiogram on admission showed sinus tachycardia, left ventricular hypertrophy and hyperacute T wave in V1, V2 with nonspecific ST abnormalities over the anterior wall leads. Chest X-ray (Figure 1A) showed bilateral patchy opacities representing pulmonary edema. 2D Echocardiography (Figure 1B) revealed moderate left ventricle dilation (left ventricular end diastolic dimension LVEDD of 5.9 cm and LVESD of 4.8 cm, Figure 3A) without signs of apical ballooning; moderate global hypokinesis of the left ventricle with an ejection fraction of 30% (Figure 3A), Grade III diastolic dysfunction and mild to moderate mitral regurgitation **[1-6].**

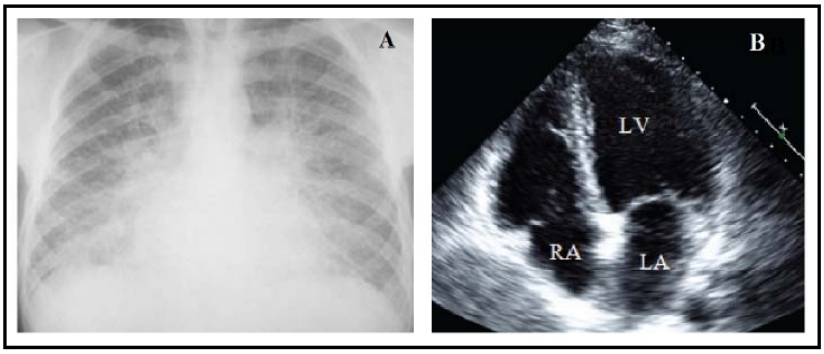

Figure-1 A. Chest X-Ray showed Cardiomegaly with Acute Pulmonary Edema, B. 2D Echo revealed dilated Left Ventricle with systolic dysfunction

Immediately he was treated aggressively for acute pulmonary edema, he was kept on high O2 and BiPap (non invasive ventilator). Initially we started iv diuretic and iv NTG infusion with small dose of morphine for high blood pressure and pulmonary edema. Initial laboratory workup at admission was insignificant except for elevated brain nautriuretic peptide of 894 ng/L and positive urine toxicology screen for cocaine. Due to his recent use of cocaine β-blockers were not used to control the hypertension however we opted to use amlodipine 10 mg daily instead. Pulmonary team was consulted; the impression was consistent with pulmonary edema from questionable congestive heart failure (CHF), which could have been from the history of cocaine use rather than a primary pulmonary cause. The recommendations

included initiating a treatment with a diuretic agent, vasodilators and obtaining 2D Echocardiography. The cardiology team has decided for further recommendations, cardiac catheterization and the possibility of implantable cardioverter defibrillator (ICD) placement. The patient was taken for cardiac catheterization on hospital day 2 to rule out ischemic cardiomyopathy which revealed LAD(left anterior descending coronary spasm without any obstructive lesions(Figure 4A). Subsequently NTG infusion was given and final result was normal TIMI 3 flow was there in LAD. (Figure 4B)

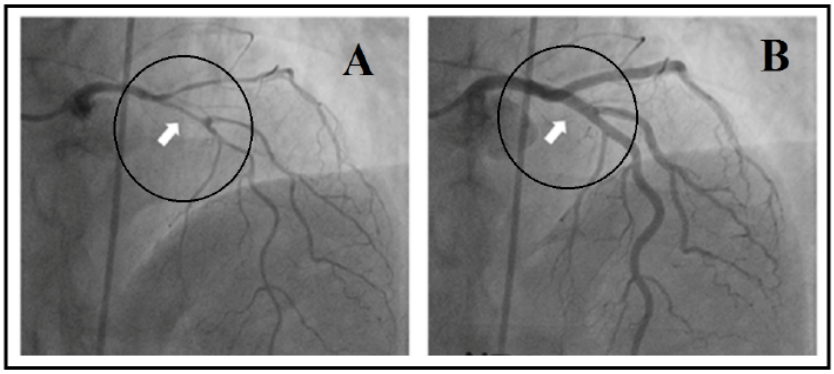

Figure-2 A. Coronary Angiography revealed Left Anterior Descending Coronary Spasm. B. Coronary Angiography revealed became normal TIMI flow after NTG IV infusion.

Management consisted of Amlodipine 10 mg daily, Furosemide 40 mg twice daily, Spironlectone 50 mg once daily, Hydralazine 10 mg daily and Ramipril 10 mg daily. By the 4th day he was clinically asymptomatic and the pulmonary examination was unremarkable. Repeat chest x-ray showed almost complete resolution of bilateral patchy airspace consolidation phenomena however with some bibasilar persistence. An association between his symptoms and the binge consuming of cocaine was established. Cardiac biopsy was not recommended at this time. Re-evaluation of all the above findings including reconsidering a cardiac biopsy 6 months after the discharge was arranged. On the 5th day, the psychiatry service counseled the patient; he agreed to undergo a rehabilitation course in an inpatient institution. On the following day he was transferred to the rehabilitation center on his CHF medications.

Six months later and after successful completing of the treatment course at the rehabilitation center the patient was re-evaluated. Chest Xray showed no cardiomegaly and clear lungs(Figure 2A). Repeat 2D echocardiography was performed and showed normal LV size(Figure 2B), an improved ejection fraction from 30% to 59%, improvement of the previously dilated size of the left ventricle (LVEDD from 6.3 cm to 5.3 cm and LVESD from 4.8 cm to 3.7 cm) Figure 3A, 3B. The clinical condition was remarkably better, echocardiographic geometric changes partially resolved. Beta-blocker was added; cardiac biopsy was not done. Evidences for the strong association between previous cocaine abuse and newly diagnosed CHF were clinically confirmed.

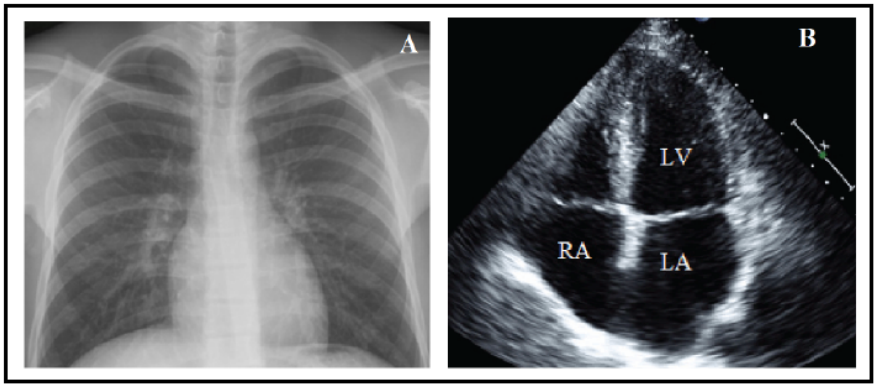

Figure-3 A. Chest X-Ray showed No Cardiomegaly with clear lungs B. 2D Echo revealed Normal Left Ventricle with good systolic function

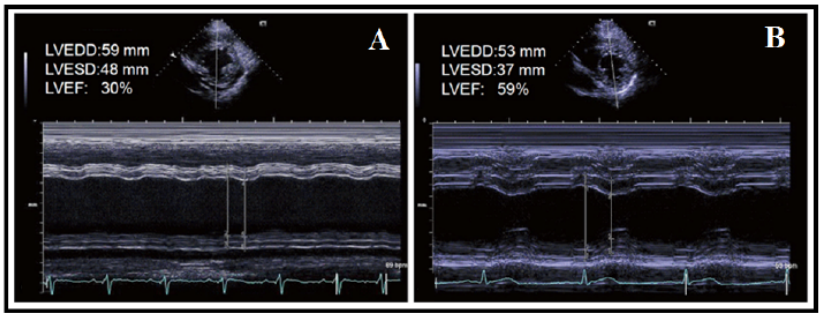

Figure-4 A. 2D Echo M Mode revealed Dilated Left Ventricle with systolic dysfunction(LVEF-30%) B. 2D Echo M Mode revealed Normal Left Ventricle with systolic function(LVEF-59%)

3. Discussion

Cocaine stimulates the sympathetic nervous system by inhibiting catecholamine reuptake at sympathetic nerve terminals, stimulating central sympathetic outflow, and increasing the sensitivity of adrenergic nerve endings to norepinephrine [7-8]. Cocaine also acts like a class I antiarrhythmic agent (local anesthetic) by blocking sodium and potassium channels, which depresses cardiovascular parameters. [9] Of these 2 primary, opposing actions, enhanced sympathetic activity predominates at low cocaine doses, whereas the local anesthetic actions are more prominent at higher doses. [8] In addition, cocaine stimulates the release of endothelin-1, a potent vasoconstrictor, from endothelial cells[10] and inhibits nitric oxide production, the principal vasodilator produced by endothelial cells. [11] Cocaine promotes thrombosis by activating platelets, [12-13] increasing platelet aggregation, [12, 14] increasing platelet α-granule release, [12, 15] increasing plasminogen activator inhibitor activity. [16]

Cocaine increases myocardial oxygen demand by increasing both heart rate and blood pressure. [17, 18] The influence of cocaine on heart rate and blood pressure is dose dependent and is mediated through α-adrenergic stimulation. [17, 18] At the same time, cocaine decreases oxygen supply via coronary vasoconstriction. Cocaine-induced coronary vasoconstriction occurs in normal (nondiseased) coronary artery segments but is more pronounced in atherosclerotic segments. [19] Combining cocaine use with cigarette smoking has additive effects on coronary vasoconstriction while markedly increasing the rate-pressure product. Long-term cocaine users demonstrate coronary endothelial dysfunction. [20, 21]. Because endothelial dysfunction increases the sensitivity of a vessel to the constrictor effects of catecholamines, [22] it may be particularly detrimental for cocaine users. Even in the absence of epicardial coronary disease, cocaine causes microvascular disease[23, 24] and is associated with thrombosis. [25, 26]

Cocaine causes systolic and diastolic dysfunction, arrhythmias, and atherosclerosis. Cocaine decreases myocardial contractility and ejection fraction by blocking sodium and

potassium channels within the myocardium. [27] Intracoronary infusion of cocaine decreases left ventricular ejection fraction and increases left ventricular end-diastolic pressure and end-systolic volume.[28] Long-term cocaine use is associated with left ventricular hypertrophy and prolonged deceleration time. [29, 30] Cocaine prolongs the PR, QRS, and QT intervals. [31, 32] Cocaine is associated with coronary atherosclerosis even in young users with relatively few cardiac risk factors. [33, 34] Cocaine causes systolic dysfunction in long-term users and with acute intoxication. In a dog model, acute cocaine intoxication caused left ventricular dilation, decreased contractility, and increased end-diastolic pressure. [35] Rabbits demonstrated regional wall motion abnormalities (mostly anteroseptal) associated with decreased left ventricular fractional shortening and increased systolic dimension in response to acute cocaine intoxication. [36] After 2 weeks of abstinence from cocaine, 6 of 84 (7%) asymptomatic cocaine users (mean age, 36 years) had an ejection fraction <55%.[37] In 33 cocaine-using patients undergoing coronary angiography (indication: chest pain, 28; congestive heart failure, 4), ejection fraction was abnormal in 18 patients (55%) and ≤30% in 6 patients (18%).[33] Moreover, 4 patients had an ejection fraction <30% with global hypokinesis. Dilated cardiomyopathy is more common among cocaine users, [34] but a case of left ventricular apical ballooning (Takotsubo cardiomyopathy) has also been described. [38] In a registry including 83 hospitals nationally, stimulant drug use (96% cocaine, 5% methamphetamine) was self-reported in 594 of 11 258 patients (5.3%) who presented to the emergency department with acute decompensated heart failure. [39] Patients with stimulant drug use were more likely to have ≥3 hospitalizations within 6 months (28% versus 11%) and had lower ejection fractions (median, 23% versus 40%).

Acute cocaine intoxication decreases myocardial contractility and ejection fraction[27, 28] and increases left ventricular end-diastolic pressure and end-systolic volume. [28] Long-term cocaine use is associated with left ventricular hypertrophy and prolonged deceleration time. [30] The pathophysiology of cocaine-associated cardiomyopathy, however, remains unclear. Of 18 cocaine users undergoing coronary angiography with an ejection fraction <55%, 12 had coronary artery disease and regional wall motion abnormalities suggesting recent or remote MI; however, 6 did not have coronary artery disease and demonstrated global hypokinesis (4 of 6 with an ejection fraction <30%).[33] Thus, a manifestation of coronary artery disease can explain cocaine-induced ventricular dysfunction in some patients, but cocaine also has a direct toxic effect on cardiac myocytes. Factors contributing to cocaine-induced cardiomyopathy may include the blocking of sodium and potassium channels within the myocardium, alterations in calcium ion handling, [28] myocardial inflammation with necrosis and fibrosis, left ventricular hypertrophy, [29, 30] alterations in gene expression, [39] and concomitant alcohol consumption. [33]

Cessation of cocaine is the primary therapeutic goal in cocaine-induced cardiomyopathy. Cocaine-induced heart failure improved dramatically with cessation of cocaine and recurred with resumption of cocaine. [34] As with CACP, medical therapy for cocaine-induced heart failure and cardiomyopathy should follow published guidelines, except all β-blockers should be avoided in the acute setting. Thereafter, β-blockers should be considered for each patient individually, after careful risk-benefit assessment, and maybe after cocaine cessation has been documented. Continued cocaine use precludes eligibility for cardiac transplantation.

4. Learning path

Cocaine use should be considered if young patients presented with heart failure, mainly without other underlying risk factors. It is important to counsel these patients regarding the deleterious effects of cocaine abuse and the potential reversal of cardiac dysfunction with abstaining from the cocaine use. The unfavorable economic impact and awareness of the possible cardiovascular effects should be considered during the initial evaluation when young adults with heart failure for medical assessment.

5. Conclusion

Cocaine is a potent sympathomimetic agent associated with the development of possible fatal cardiovascular complications. Hypertension, Dilated cardiomyopathy, Dysrhythmias and Acute myocardial infarction are just some of many cardiovascular effects related to the abuse of cocaine. The therapy of cocaine-induced cardiomyopathy is similar to the way that other types of cardiomyopathy are managed. Beta-blockers should not be considered initially; benzodiazepine is preferred to counteract the adrenergic effect. In the acute setting the addition of beta-blockers will adversely result in the alpha-adrenergic receptors being unopposed, therefore leading to coronary vasoconstriction, left ventricle wall stress and a hypertensive crisis. As recommended in other types of cardiomyopathy, pharmacological agents such as, diuretics, Angiotensin-Converting-Enzyme Inhibitors, Angiotensin-Receptor Blocker, vasodilators, or digoxin should be initially included. Cessation of cocaine is the primary goal of postdischarge therapy. The use of cocaine should be investigated in patients with cardiovascular disease, especially young patients, because its presence may influence disease diagnosis, management, and therapy. Non-invasive testing should be performed after several months to re-evaluate the treatment response.

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