Clinical Reports

Intraoperative pulmonary oedema in a young cocaine smoker

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This is a case of a 28-yr-old man who underwent general anaesthesia for emergency repair of a right lid laceration and lacrimal apparatus. Following induction of anaesthesia and local nasal application of phenylephrine (0.25%) he developed transient elevation of blood pressure, which was treated immediately with labetalol. Subsequently the patient developed acute pulmonary oedema which responded to treatment with morphine and furosemide. The diagnosis of pulmonary oedema was confirmed by blood gas studies, chest x-ray and serial echocardiograms. Subsequent investigation revealed that he was a cocaine user, as the urine tested positive for cocaine. Considering that the patient was young and otherwise healthy and that the hypertension was transient, it is unlikely that phenylephrine was the main cause of pulmonary oedema. Cardiac morbidity was most likely precipitated by the interaction of phenylephrine-induced hypertension with a cocaine-depressed myocardium.

Il s'agit d'un homme de 28 ans soumis à une anesthésie générale pour la réparation d'une laceration de la paupière et des voies lacrymales du côté droit. Après l'induction de l'anesthésie et l'application locale de phényléphrine (0,25%), il présente une élévation transitoire de la pression artérielle traitée immédiatement avec du labétalol. Par la suite, il développe un oedème pulmonaire aigu qui répond au traitement à la morphine et au furosémide. Les diagnostic d'oedème pulmonaire est confirmé par l'analyse de gaz artériels, la radiographie pulmonaire et des échocardiographies séquentielles. L'investigation

subséquente révèle qu'il est un habitué de la cocaïne laquelle est détectée dans son urine. Comme le patient est jeune et que son état de santé est bon, il est peu plausible que la phényléphrine ait été la principale cause de l'oedème pulmonaire. L'incident cardiaque a plutôt été précipité par l'action de l'hypertension induite par la phényléphrine sur un myocarde déjà déprimé par la cocaïne.

Although a single case report of pulmonary oedema caused by cocaine abuse has been published in the medical literature,^{1,2} in our experience this feature of substance abuse is not well known among anaesthetists. Unless the possibility of cocaine addiction is raised, the clinical findings of sudden onset of pulmonary oedema intraoperatively may be falsely attributed to other more common causes. This is especially true because patients are reluctant to reveal a history of drug use voluntarily.

We report a case of sudden onset of pulmonary oedema in a young patient undergoing emergency eye surgery under general anaesthesia.

Case report

A 28-yr-old black man was scheduled for an emergency repair of a right lid laceration and lacrimal apparatus with general anaesthesia. He denied any previous medical problems including heart or lung disease. There was no history of any allergies or bronchial asthma. He was a smoker (1 p.p.d. for seven years) but denied any history of drug use. He had no family history of cardiovascular disease. The rest of the history was non-contributory.

On physical examination, he appeared to be in excellent general health. He was 170 cm tall, weighed 75 kg, had BP of 137/70 mmHg and regular heart rate of 72 bpm. The lung fields were clear to auscultation. Examination of the heart revealed heart sounds, with no significant heart murmurs or gallops. The remainder of the physical and laboratory examinations were un-

Key words

COMPLICATIONS: pulmonary oedema;
DRUG ABUSE: cocaine.

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remarkable. Prior to induction of anaesthesia, he was monitored with automatic BP recording, ECG Lead II, and a pulse oximeter (SpO_2 was 100%).

Rapid sequence induction of anaesthesia was performed with thiopentone 300 mg and tracheal intubation was facilitated with succinylcholine 100 mg *iv* which proceeded uneventfully. Negative intrathoracic pressure did not occur during induction and there was no retarded inspiration. Anaesthesia was maintained with nitrous oxide 65%, oxygen 35% and 1–1.2% isoflurane. Following application of 0.25% (0.5 ml) phenylephrine nasal packing by the surgeon, its blood pressure suddenly increased to 190/100 mmHg and the heart rate to 88 bpm. Immediately, the patient was treated with labetalol 5 mg *iv* and the concentration of isoflurane was increased. In five minutes, the blood pressure decreased to 160/80 mmHg. However, after ten minutes, the blood pressure continued to decrease to 60/40 mmHg despite the discontinuation of isoflurane. Hypotension was accompanied by a decrease in SpO_2 to 80% and an increase in heart rate to 110 bpm. Coarse rales were heard in both lungs. Positive end expiratory pressure (PEEP) of 10 cm H_2O was added. Anaesthesia was maintained with incremental administration of fentanyl and 100% oxygen. Arterial blood gas analysis revealed pH 7.39, PCO_2 45 mmHg, PO_2 55 mmHg, bicarbonate 25 and O_2 saturation 84.4%. Although aspiration of gastric contents could not be ruled out, the patient was treated for pulmonary oedema with furosemide 40 mg *iv* and morphine sulphate 7.5 mg *iv*. The patient improved after 20 min. The SpO_2 increased to 92% and BP to 120/60 mmHg. After completion of surgery, the trachea remained intubated and the patient was transferred to the PACU.

An immediate postoperative chest radiograph showed widespread bilateral interstitial infiltrates and a moderately enlarged heart, considered to be diagnostic of acute pulmonary oedema. An ECG revealed sinus tachycardia HR 105 bpm and non-specific T wave changes. An echocardiogram performed in the PACU demonstrated left and right ventricular hypokinesis, ventricular dilatation and normal valvular function. Ejection fraction was estimated at 30%.

Six hours later, the patient was transferred to the Cardiac Intensive Care Unit in stable condition. On admission, a pulmonary artery catheter was inserted via the right internal jugular vein. The following data were obtained: CVP 4 mmHg, mean pulmonary artery pressure 10 mmHg, pulmonary artery wedge pressure 10 mmHg, cardiac index $2.4 \text{ L} \cdot \text{min}^{-1} \cdot \text{m}^{-2}$, stroke volume index $35 \text{ ml} \cdot \text{beat}^{-1} \cdot \text{m}^{-2}$ and systemic vascular resistance index $2571 \text{ dyne} \cdot \text{sec} \cdot \text{cm}^{-5} \cdot \text{m}^{-2}$. Repeat arterial blood gas revealed pH 7.44, PO_2 164 mmHg, PCO_2 41 mmHg, bicarbonate $28 \text{ meq} \cdot \text{L}^{-1}$ and O_2 saturation was 99.5%.

The trachea was extubated on the first postoperative day. Arterial blood gas analysis remained within the normal range. Thereafter, serial ECGs as well as CPKs showed no evidence of myocardial infarction. Clinical signs of cardiac failure disappeared over the next 24 hours. Repeated chest radiographs revealed clear lung fields. Two days after surgery, an echocardiogram revealed normal ventricular function. Before discharge, the patient underwent a stress test which was within normal limits.

During the postoperative period, the patient admitted that he was a chronic cocaine user and that he had used cocaine immediately before surgery. Subsequent urine toxicology was positive for cocaine.

Discussion

Recreational abuse of cocaine has reached epidemic proportions in the USA. The most popular method of ingestion is via "free basing" which rapidly produces high plasma concentrations of cocaine. The precipitous systemic toxicity evoked by a cocaine overdose is due to overwhelming sympathetic stimulation, with predictable sequelae in the central venous, cardiovascular and respiratory systems. Cocaine produces central and peripheral adrenergic stimulation by blocking presynaptic reuptake of norepinephrine and dopamine, thus increasing their postsynaptic concentration.³ It may induce acute tachycardia and hypertension,⁴ and its abuse has been associated with several cardiovascular complications including ventricular tachyarrhythmias,^{5,6} angina pectoris, myocardial infarction^{5–7} and sudden death.⁸

Experimentally, cocaine administration has been shown to cause constriction of the coronary arteries, both *in vitro* and *in vivo*, reduced myocardial blood flow and to cause severe depression of left ventricular function.⁹ Whether the myocardial depression is a consequence of the decrease in blood flow due to constriction of coronary arteries or a negative inotropic effect of cocaine is unknown. Several recent experimental studies have demonstrated that cocaine has a direct negative inotropic effect which may lead to acute left ventricular dysfunction and pulmonary oedema.^{10,11}

Cocaine inhalation may also result in direct alveolar damage which may lead to pulmonary oedema. Vasoconstriction of the pulmonary vascular bed following cocaine inhalation may result in "epithelial or endothelial cell damage" and precipitate alveolar haemorrhage or oedema.^{12,13} Alternatively, the alveolar epithelium may be directly injured by the inhalation of a toxic substance with subsequent involvement of the alveolar basement membrane.¹³

There is no single therapy that is universally agreed upon for the treatment of cocaine-induced cardiovascular toxicity. Robin *et al.*¹⁴ showed that propranolol blunts

the pulmonary oedema and ascites in mice given massive doses of cocaine. Although beta blockers had initially been recommended, a recent study by Lange *et al.*¹⁵ showed that propranolol further increases coronary vasoconstriction in patients receiving 2 mg · kg⁻¹ intranasal cocaine. This effect is presumably caused by blocking beta receptors in the coronary vasculature leading to unopposed alpha receptor stimulation. An agent, such as labetalol, that has both alpha and beta blocking properties might be a better choice.¹⁶

Several experimental trials have suggested that calcium channel blockers might be useful for cocaine cardiotoxicity. Rongione *et al.*¹⁷ have shown that cocaine-induced vasoconstriction is calcium-dependent. Trouve and Nahas *et al.*¹⁸ observed that the calcium channel blocker nifedipine suppressed cocaine induced ventricular arrhythmias in rats. Hale *et al.*¹⁰ showed that pretreatment of dogs with nifedipine prevented cocaine-induced coronary vasoconstriction and deterioration of left ventricular function. Although calcium blockers show some promise, additional information is needed before they can be prescribed routinely for cocaine cardiotoxicity.

Our case is unique, both for the timing of the pulmonary oedema as well as for the rapid recovery. The diagnosis of cocaine-induced left ventricular dysfunction and pulmonary oedema was based on the temporal relationship between cocaine use and the onset of symptoms. Furthermore, left ventricular dysfunction was documented by serial echocardiographic studies. The absence of pulmonary hypertension at the time of the insertion of the pulmonary catheter may not have reflected the haemodynamic change as it occurred at the time the patient was in pulmonary oedema. The absence of pulmonary hypertension also indicated that there was not a diffuse and severe pulmonary vascular injury, as has been described in chronic cocaine users.

The use of phenylephrine, in our case could be implicated as a contributing factor. Although the dose we used was small, considerable absorption may have taken place. An interaction of phenylephrine and cocaine has been reported in the literature.^{19,20} El-Din *et al.*²⁰ reported severe hypertension and myocardial ischaemia following application of intranasal cocaine and subcutaneous injection of felypressin during general anaesthesia. Phenylephrine is a vasoconstrictor which acts directly on the vascular smooth muscle. It increases both systemic and pulmonary artery pressures as well as peripheral vascular resistance. It may reduce coronary blood flow and cardiac output. If there is a preexisting cocaine-induced myocardial depression, phenylephrine may increase afterload, and precipitate acute left ventricular failure and pulmonary oedema. General anaesthesia could also be a contributing factor, by diminishing sympathetic stimulation of a

cocaine-depressed heart. In our case, all of these factors may have contributed.

In conclusion, the differential diagnosis of sudden onset pulmonary oedema in the perioperative period in an otherwise healthy, young patient should include cocaine toxicity in addition to the other more frequent causes. The use of phenylephrine or other vasopressors should be undertaken with extreme caution when topical cocaine is administered or in cocaine abusers.

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