



Ecstasy-associated pneumomediastinum

SILVANA F MARASCO¹, H KIAT LIM²

¹Department of Cardiothoracic Surgery, The Alfred and Royal Melbourne Hospitals, Australia

²Department of Surgery, Monash University, Melbourne, Australia

ABSTRACT

INTRODUCTION Ecstasy, also known as MDMA (3,4, methylenedioxymethamphetamine), is a popular illicit party drug amongst young adults. The drug induces a state of euphoria secondary to its stimulant activity in the central nervous system.

PATIENTS AND METHODS A database review at two major inner city hospitals was undertaken to identify patients presenting with pneumomediastinum and their charts reviewed. A Medline review of all reported cases of pneumomediastinum associated with ecstasy abuse was undertaken.

RESULTS A total of 56 patients presenting with pneumomediastinum were identified over a 5-year period. Review of the charts revealed a history of ecstasy use in the hours prior to presentation in six of these patients, representing the largest series reported to date.

CONCLUSIONS Review of previously reported cases reveals the likely mechanism is due to Valsalva manoeuvre during periods of extreme physical exertion, and not a direct pharmacological effect of the drug.

KEYWORDS

Mediastinal emphysema – N-Methyl-3,4-methylenedioxyamphetamine – Ecstasy

CORRESPONDENCE TO

Silvana F Marasco, Cardiothoracic Surgeon, The Alfred Hospital, Commercial Road, Prahran 3181, Victoria, Australia
T: +61 (0)3 9276 2000; F: +61 (0)3 9276 2317; E: s.marasco@alfred.org.au

Ecstasy, also known as MDMA (N-methyl-3,4-methylenedioxyamphetamine), is a popular illicit party drug amongst young adults. Chemically related to the psychostimulant metamfetamine and the hallucinogen mescaline, the drug induces a state of euphoria secondary to its stimulant activity in the central nervous system. This report outlines a series of six patients who presented to two major inner city hospitals with pneumomediastinum after taking ecstasy. A review of the cases reported in the literature is undertaken.

Patients and Methods

We conducted a retrospective review of all cases of pneumomediastinum presenting to two inner city hospitals over 5 years from January 1999 to December 2004. Inclusion criteria were radiological diagnosis of pneumomediastinum with or without pneumothorax, and a documented history of use of ecstasy in the 24 h prior to presentation. Patient charts were reviewed and information collected on the presenting complaint, pre-existing lung disease, drug use, investigations, treatment and outcome.

A review of the literature was undertaken to identify all previously reported cases of ecstasy associated pneumomediastinum.

Results

Fifty-six patients were identified who had presented to the accident and emergency department with symptoms due to spontaneous pneumomediastinum. Of these patients, six



Figure 1 Pneumomediastinum on computed tomography scan.

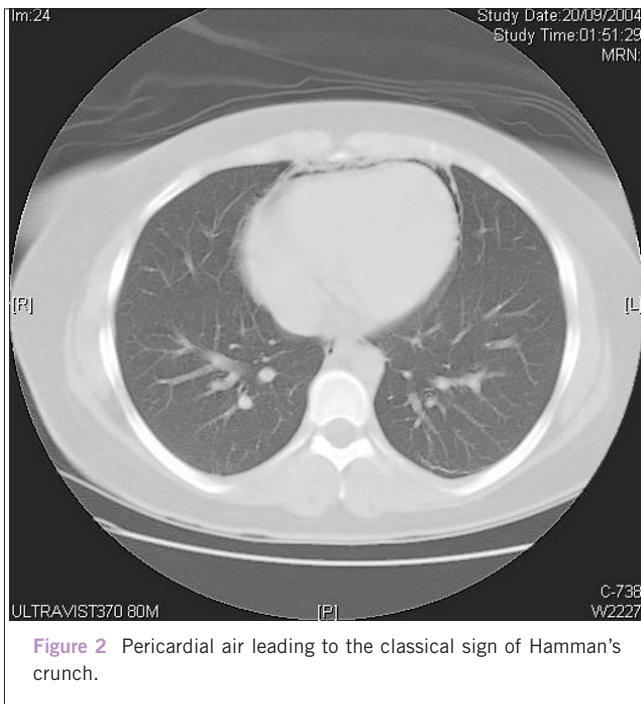


Figure 2 Pericardial air leading to the classical sign of Hamman's crunch.

had admitted to ecstasy use in the 24 h prior to presentation. All patients reported taking ecstasy orally. Details of these six patients are outlined in Table 1. Two patients were investigated further with gastrograffin swallow to exclude oesophageal dysfunction. In both cases, there was no evidence of oesophageal leak. All patients were treated conservatively initially with nil orally and intravenous fluids. One patient had a concurrent pneumothorax which was treated with an intercostal catheter. Most patients remained in hospital for only 48–72 h with the patient treated with the intercostal catheter remaining in hospital for 4 days. Images from one patient demonstrating the mediastinal emphysema are shown in Figures 1 and 2.

A literature review for ecstasy-associated pneumomediastinum was performed. Thirteen previous reports outlining case histories of 15 patients were identified in the world literature dating from 1995 (Table 2).^{1–15} Eight of the 15 patients underwent gastrograffin swallow to exclude oesophageal dysfunction. One patient had a small tear demonstrated and was treated conservatively.¹⁰ All remaining patients were also treated conservatively without any reported sequelae.

Table 1 Details of patients presenting with spontaneous pneumomediastinum and history of ecstasy use

Patient age (yr)	Gender	Activity	Underlying lung disease	Symptoms	Examination findings	Additional investigations/results
19	F	Dancing	Asthma	Shortness of breath	Tachycardia	
21	F	24 h at rave	Smoker	Chest pain	Hamman crunch	Normal gastrograffin swallow
21	F	Rave	Nil	Anxiety; shortness of breath; sore throat; swollen tongue	Tachycardia; subcutaneous emphysema; pericardial rub	Significant pneumothorax on chest X-ray and computed tomography scan
22	M	Dancing	Nil	Difficulty breathing; chest pain	Subcutaneous emphysema; Hamman crunch	
24	M	Presented 12 h after dancing	Smoker	Chest pain; swollen neck	Tachycardia; Hamman crunch	Normal gastrograffin swallow
27	M	Night-club but no vigorous activity reported	Smoker	Chest pain; difficulty breathing; swollen neck	Subcutaneous emphysema	

Table 2 Reported cases of ecstasy-associated pneumomediastinum

Author	Year of report	Patients (n)	Age (years)	History	Symptoms	Examination	Underlying lung disease	Investigations other than chest X-ray
Levine <i>et al.</i> ¹	1993	1	17	Party, vomiting	Chest pain	Tachycardia, subcutaneous emphysema, Hamman's sign	Not reported	Gastrografin swallow –ve
Onwudike ²	1996	1	22		Chest and neck pain	Subcutaneous emphysema	Not reported	Gastrografin swallow –ve
Rezvani <i>et al.</i> ³	1996	2	20 18	Retch once	Pleuritic chest pain Shortness of breath, change in voice	Tachycardia, Hamman's sign Tachycardia, subcutaneous emphysema	Not reported	Echocardiography Gastrografin swallow –ve
Pittman & Pounsford ⁴	1997	1	17	Dancing and blowing whistle for 8 h	Chest pain and neck swelling	Surgical emphysema, Hamman's sign	Non smoker	
Quin <i>et al.</i> ⁵	1999	1	25	Dancing	Chest pain		Not reported	Gastrografin swallow –ve
Harris & Joseph ⁶	2000	1	20	Dancing	Dyspnoea and sore throat	Surgical emphysema, Hamman's sign	Asthma	Gastrografin swallow –ve
Ryan <i>et al.</i> ⁷	2001	1	16	Vomiting	Chest pain and neck swelling	Surgical emphysema	Not reported	
Mazur & Hitchcock ⁸	2001	1	18	36-h dance party	Chest pain and neck swelling	Surgical emphysema	Not reported	
Le Floch <i>et al.</i> ⁹	2002	1	19		Chest pain, cough	Tachycardia, surgical emphysema	Asthma, smoker	
Rejali <i>et al.</i> ¹⁰	2002	2	23 22	Dancing/vomit once Dancing	Neck swelling Chest pain	Surgical emphysema seen in both patients	Not reported	Gastrografin swallow –ve
Badaoui <i>et al.</i> ¹¹	2002	1	27		Chest pain and shortness of breath		Not reported	Gastrografin swallow +ve (treated conservatively) Gastrografin swallow –ve, Bronchoscopy –ve
Bernaerts <i>et al.</i> ¹²	2003	1	17	Snorting ecstasy	Chest pain and shortness of breath	Surgical emphysema	Not reported	Computed tomography scan showed epidural pneumatoxis
Mortelmans <i>et al.</i> ¹³	2005	1	16	48-h party		Tachycardia, pyrexia, subcutaneous emphysema		Computed tomography scan, elevated troponin I and creatine kinase, echocardiography, cardiac magnetic resonance imaging

Discussion

Ecstasy is a popular illicit party drug which is usually taken orally. Chemically related to the psychostimulant metamfetamine and the hallucinogen mescaline, the drug produces stimulant and mild hallucinogenic effects.¹⁴ The drug is extremely popular, particularly amongst college-aged students as it is readily accessible and chronic use is not known to be associated with physical dependence. In the US, it has been estimated that more than 10 million people over the age of 12 years have used ecstasy at some time in their lives.¹⁵ In the UK, 5% of 16–24-year-olds were reported to have used ecstasy in 2002/2003.¹⁶ In comparison, the use of ecstasy is somewhat higher in Australia with a recent poll reporting that 19.7% of 20–29-year-olds have used ecstasy at some time in their lives.¹⁷

MDMA is usually taken orally although it can also be crushed and snorted, taken rectally, or injected. It readily crosses the blood–brain barrier and stimulates the central nervous system by releasing serotonin, dopamine and norepinephrine and blocking their re-uptake inactivation.¹⁴

The adverse effects of MDMA are mostly due to over-activation of the central and sympathetic nervous systems. These include anxiety, agitation, confusion, psychosis as well as cardiac arrhythmias, seizures, stroke, and sudden death. Hyperthermia is a well-reported, adverse reaction and can lead to disseminated intravascular coagulation, rhabdomyolysis, hepatic and renal failure and death.¹⁴ Severe hyponatraemia has also been reported and is thought to be due to either excessive water intake or MDMA-induced secretion of anti-diuretic hormone. The initial symptoms are nausea, vomiting, headache and muscle cramps; in severe cases can lead to seizures and coma. Longer term neuropsychiatric complications include psychosis, depression, anxiety and cognitive impairments particularly in short-term and working verbal memory.¹⁴

However, none of these effects explain the propensity to spontaneous pneumomediastinum in young adults who have ingested this drug. It is unlikely that this particular complication is a direct drug effect, and it cannot be explained based on the known pharmacological effects of the drug. Another possibility is a toxic effect of the ‘carrier’ with which the drug is mixed. Given the illicit nature of this drug, the purity of the drug is known to differ widely. In the case report by Rejali *et al.*,¹⁰ where two patients from the same rave party both presented with spontaneous pneumomediastinum, it is conceivable that the MDMA came from the same source and, therefore, contained the same contaminants. However, this hypothesis does not explain the numerous other case reports in the literature.

The most likely cause of spontaneous pneumomediastinum in patients who take MDMA is overexertion and extreme physical activity over prolonged periods. The duration of action

of MDMA is 4–6 h and party-goers typically ‘re-dose’ after several hours in order to maintain peak plasma concentrations. Ecstasy use is particularly prevalent during ‘rave’ parties which are organised to continue for 24–48 h. Thus, the drug is used in a party culture where prolonged physical exertion and drug taking defines the social experience.

The mechanism of spontaneous pneumomediastinum is due to a raised intrabronchial and intra-alveolar pressure which occurs due to forced expiration against a closed glottis (Valsalva manoeuvre). When the pressure is raised excessively, alveoli burst and air tracks along bronchovascular fascial planes to reach the mediastinum.¹⁸ From there, air will track along the path of least resistance entering the superficial fascial layers of the neck and chest wall causing surgical emphysema. Air may also enter the pericardium (pneumopericardium), pleura (pneumothorax) or the spinal canal causing epidural pneumatosis.¹² It is well-known that ecstasy can be crushed and snorted, and presumably this type of administration would increase the risk of pneumomediastinum because of the Valsalva manoeuvre involved. Certainly, pneumomediastinum has been reported as an acute complication of other inhaled illicit drug use.¹⁹

Spontaneous pneumomediastinum is an unusual presentation to hospital estimated to occur in 1 in 3400 emergency department admissions.²⁰ It can occur as the result of any activity involving the Valsalva manoeuvre such as coughing, sneezing, vomiting, exercise, childbirth, pulmonary function testing, and has also been reported as a complication of asthma, diabetic ketoacidosis, mechanical ventilation, endotracheal intubation and endoscopy.^{6,20–25}

Although many of the adverse effects of ecstasy use are life-threatening, our series suggests that ecstasy-associated pneumomediastinum is largely benign and resolves spontaneously. All patients in our series were conservatively managed without any adverse outcomes. Our review of all reported cases of ecstasy-associated mediastinum confirms this with all of the reported cases resolving with conservative management. In the patients reviewed, gastrograffin swallow had a poor yield and all patients were managed conservatively regardless of the results.

Conclusions

Ecstasy-associated pneumomediastinum is an emergency room presentation being increasingly reported over the last decade. Observation and conservative management is usually sufficient as all reported cases have resolved without further intervention or sequelae.

References

1. Levine AJ, Drew S, Rees GM. ‘Ecstasy’ induced pneumomediastinum. *J R Soc Med* 1993; **86**: 232.

2. Onwudike M. Ecstasy induced retropharyngeal emphysema. *J Accid Emerg Med* 1996; **13**: 359–61.
3. Rezvani K, Kurbaan A, Brenton D. Ecstasy induced pneumomediastinum. *Thorax* 1996; **51**: 960–1.
4. Pittman JA, Pounsford JC. Spontaneous pneumomediastinum and ecstasy abuse. *J Accid Emerg Med* 1997; **14**: 335–6.
5. Quin GI, McCarthy GM, Harries DK. Spontaneous pneumomediastinum and ecstasy abuse. *J Accid Emerg Med* 1999; **16**: 382.
6. Harris R, Joseph A. Spontaneous pneumomediastinum – 'ecstasy': a hard pill to swallow. *Aust NZ J Med* 2000; **30**: 401–3.
7. Ryan J, Banerjee A, Bong A. Pneumomediastinum in association with MDMA ingestion. *J Emerg Med* 2001; **20**: 305–6.
8. Mazur S, Hitchcock T. Spontaneous pneumomediastinum, pneumothorax and ecstasy abuse. *Emerg Med* 2001; **13**: 121–3.
9. Le Floch AS, Lapostolle F, Danhiez F, Adnet F. Pneumomediastinum as a complication of recreational ecstasy use. *Ann Fr Anesth Reanim* 2002; **21**: 35–7.
10. Rejali D, Glen P, Odom N. Pneumomediastinum following ecstasy (methylenedioxymetamphetamine, MDMA) ingestion in two people at the same 'rave'. *J Laryngol Otol* 2002; **116**: 75–6.
11. Badaoui R, Kettani CE, Fikri M, Oeundo M, Canova-Bartoli P, Ossart M. Spontaneous cervical and mediastinal air emphysema after ecstasy abuse. *Anesth Analg* 2002; **95**: 1123.
12. Bernaerts A, Verniest T, Vanhoenacker F, Brande PVD, Petre C, Schepper AMD. Pneumomediastinum and epidural pneumatosis after inhalation of 'ecstasy'. *Eur Radiol* 2003; **13**: 642–3.
13. Mortelmans L, Bogaerts P, Hellemans S, Volders W, Rossom PV. Spontaneous pneumomediastinum and myocarditis following Ecstasy use: a case report. *Eur J Emerg Med* 2005; **12**: 36–8.
14. Ricaurte GA, McCann UD. Recognition and management of complications of new recreational drug use. *Lancet* 2005; **365**: 2137–45.
15. <<http://oas.samhsa.gov>>.
16. <www.dh.gov.uk>.
17. <www.adf.org.au>.
18. Macklin MT, Macklin CC. Malignant interstitial emphysema of the lungs and mediastinum as an important occult complication in many respiratory diseases and other conditions. *Medicine* 1944; **23**: 281–352.
19. Seaman ME. Barotrauma related to inhalational drug abuse. *J Emerg Med* 1990; **8**: 141–9.
20. Mihos P, Potaris K, Gakidis I, Mazaris E, Sarras E, Kontos Z. Sports-related spontaneous pneumomediastinum. *Ann Thorac Surg* 2004; **78**: 983–6.
21. Manco JC, Terra-Filho J, Silva GA. Pneumomediastinum, pneumothorax and subcutaneous emphysema following the measurement of maximal expiratory pressure in a normal subject. *Chest* 1990; **98**: 1530–2.
22. Maunder RJ, Pierson DJ, Hudson LD. Subcutaneous and mediastinal emphysema: pathophysiology, diagnosis and management. *Arch Intern Med* 1984; **144**: 1447–53.
23. Weissberg D, Weissberg D. Spontaneous mediastinal emphysema. *Eur J Cardiothorac Surg* 2004; **26**: 885–8.

e-Letters – new additions

doi 10.1308/003588407X187649

Since the last issue of the Annals, the following letters have been published on our website
<<http://www.rcseng.ac.uk/publications/eletters/>>:

Incarcerating incarceration – clarifying hernia description

Day-care surgery for pilonidal sinus – 2 responses

Use of cortical screw to aid single piece excision of the trapezium: a simple technique – 2 responses

The future of surgical training – 1 response