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CASE REPORT

Death by 'ice': fatal methamphetamine intoxication of a body packer case detected by postmortem computed tomography (PMCT) and validated by autopsy

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Abstract Fatal acute methamphetamine (MA) poisoning in cases of internal drug trafficking is rarely described in the literature. This case study reports an MA 'body packer' who died from fatal methamphetamine intoxication due to leaking drug packages in the alimentary tract. The deceased was examined by postmortem computed tomography (PMCT), and the results were correlated to subsequent autopsy and toxicological findings. The deceased was arrested by the police when he was found disoriented in the city of Kuala Lumpur. He was transferred to the emergency department on suspicion of drug abuse. The initial drug screening was reactive for amphetamines. Shortly after admission to the hospital, he died despite rigorous resuscitation attempts. The postmortem plain chest and abdominal radiographs revealed multiple suspicious opacities in the gastrointestinal tract attributable to body packages. An unenhanced whole body PMCT revealed twenty-five drug packages, twenty-four in the stomach and one in the transverse colon. At least two were disintegrating, and therefore leaking. The autopsy findings were consistent with the PMCT results. Toxicology confirmed the diagnosis of fatal methamphetamine intoxication.

Keywords Postmortem CT · Autopsy · Methamphetamine intoxication · Drug packing

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Introduction

Smuggling packages of illegal drugs by internal concealment either by swallowing (body packer or stuffer) or insertion into the body cavities (body pusher) is a recognized method of drug trafficking. Lethal acute methamphetamine (MA) intoxication due to the leakage of ingested body packages within the alimentary tract in body packers has rarely been reported in the literature [1, 2]. Takekawa et al. [2] described three cases, one of whom died, using antemortem plain radiograph and CT scans but without a postmortem scan. The antemortem imaging showed a multitude of body packs in the stomach. However, drug container leakage was neither detected nor described on imaging prior to death in the recent literature on cases of MA body packing.

The purpose of this case report is to compare postmortem computed tomography (PMCT) findings with conventional autopsy findings in a case of fatal MA body packing.

Case report

The behavior of a 31-year-old male who was found to be delirious and disoriented attracted the attention of the local authorities. He was arrested on suspicion of drug abuse and

taken to the Emergency Department (ED) of the Kuala Lumpur Hospital for medical treatment.

At the ED, he presented with increased agitation. Because the initial urine drug screen was positive for amphetamines, his treatment was based on the diagnosis of MA intoxication, and he was admitted for observation. His vital signs were closely monitored in the ward, and he was rehydrated. Body packing was not suspected by the attending physician. Three hours after admission, he became more aggressive and was sedated with 2.5 mg of intravenous (i/v) diazepam and 2.5 mg of haloperidol. One gram of paracetamol was also given orally due to his high body temperature. Six hours after admission, he was noted to be cyanosed and unresponsive. Immediate resuscitation attempts commenced but were unsuccessful.

The forensic pathologist requested a supine plain chest and abdominal radiograph due to his suspicion of possible drug packing which was based on the unnatural death of a young man with the signs and symptoms of intoxication. There were multiple suspicious opacities projected over the gastrointestinal tract attributable to body packages. Furthermore, an unenhanced whole body PMCT was acquired prior to autopsy at the National Institute of Forensic Medicine (NIFM) in the Kuala Lumpur Hospital.

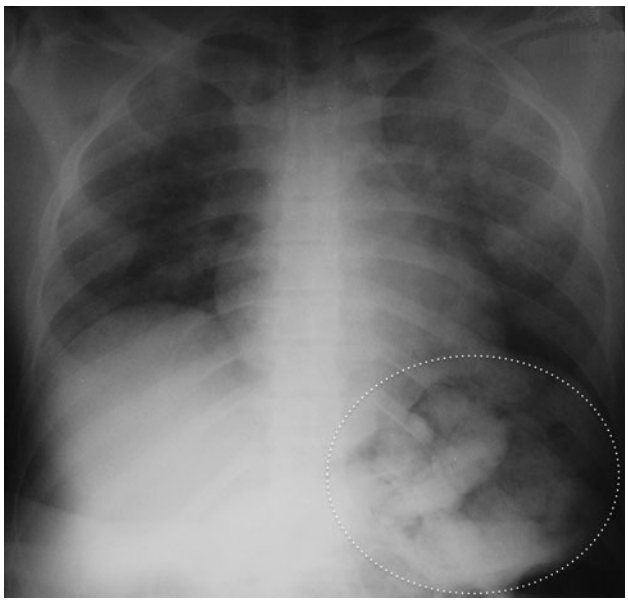

Fig. 1 Postmortem supine plain chest X-ray. No pneumothorax or pleural effusion was detectable. Note the bilateral pulmonary edema. In the projection over the stomach, there are multiple suspicious round and oval shaped radio-opacities that were diagnosed as body packs (*white dotted circle*)

Radiological findings

A supine plain X-ray of the chest and abdomen revealed bilateral pulmonary edema. No pneumothorax or rib fractures were noted. There were multiple suspicious round to oval shaped radio-opacities projected over the stomach that were identified as body packages (Fig. 1).

An unenhanced whole body PMCT was performed 2 h after death using a dedicated 64 multi-detector scanner (Toshiba, Aquilion 64 CFX Medical Systems Corporation, Tochigi, Japan). The slice thickness was 2.0 mm, and multiplanar reconstructions (MPR) in a hard kernel (pulmonary window) and a soft kernel (abdominal window) were obtained. The imaging findings were evaluated in consensus by two board-certified radiologists with additional training in forensic imaging. The images were assessed for the presence, number and characteristics of the suspected drug packages in the alimentary tract and other findings possibly related to the cause of death.

Bilateral pulmonary edema was noted in both lungs (Fig. 2a) with ascending pneumomediastinum in the anterior mediastinum and a unilateral left pneumothorax without pleural effusion (Fig. 2b). Typical position-dependent internal livores of the lungs were present [3].

On the abdominal scan, the stomach was distended with multiple drug packages. There were a total of twenty-five drug packages; twenty-four in the stomach, and one in the transverse colon (Fig. 3a). These packages were longitudinal in shape, measured approximately 2.2–2.5 cm × 4.5–5.0 cm and showed heterogeneous densities with Hounsfield Units (HU) ranging from −100 to 200. On imaging, there were two disintegrated and fluid-intruded drug packages with air-fluid levels detectable within the stomach (Fig. 3b). On the PMCT, the brain showed no abnormality, despite the typical postmortem loss of the corticomedullary differentiation. There were no other thoraco-abdominal pathologies present.

An autopsy and toxicology analysis were suggested to confirm the diagnosis and cause of death.

Autopsy findings

The body was that of an adult male with an average build, 172 cm in height and 70 kg in weight. Apart from contact areas, hypostatic lividity was present on his back. Rigor mortis was fully established. There was no external injury observed on his body, except the small medical intervention puncture sites, including the subclavian venous line used during clinical treatment and resuscitation.

The brain was congested and weighed 1,520 g. There were no other pathologic findings on the head and neck. The lungs (right 860 g, left 720 g) were congested and edematous. There was no pneumothorax detected during the autopsy.

Fig. 2 Postmortem computed tomography. **a** Axial plane in the pulmonary window with the depiction of the cervical ascending pneumomediastinum (*black dotted oval*). **b** Axial plane in the pulmonary window with the left anterior pneumothorax (*white asterisk*). Again, both lungs display diffuse ground-glass areas of increased attenuation with a gravitational anteroposterior gradient due to pulmonary edema and concomitant typical internal livores

The mediastinal and airway structures were unremarkable.

The stomach was grossly distended. Upon opening the stomach, twenty-four drug packages were found. Two packages were noted to have different configurations than the others. One had completely disintegrated, and the other was partially ruptured (Fig. 4a).

Further exploration of the gastrointestinal tract revealed another drug package within the transverse colon (Fig. 4b). The intact packages were of variable weight, each between 10 and 16 g. The total weight of all twenty-five packages was 360 g.

Toxicological findings

During the autopsy, samples of blood, urine, stomach contents, bile, and vitreous humor were taken. The specimens were sent to the Malaysian Chemistry Department for toxicological evaluation using solid phase extraction with liquid chromatography tandem mass and mass spectrometry analysis. The results revealed a toxic MA level of 52.0 μg per milliliter in the blood. MA was also detected in the urine, bile, and stomach but not the vitreous humor. The amphetamine blood level was 1.3 μg per milliliter. The diazepam, nordiazepam, and temazepam blood levels were all less than 0.05 μg per milliliter. Paracetamol was detected at 0.5 μg per milliliter in the blood. Diazepam, nordiazepam, and temazepam were detected in the urine and bile. Paracetamol, norephedrine and pseudoephedrine/ephedrine were detected in the bile sample. In the stomach content, paracetamol, norephedrine, and pseudoephedrine/ephedrine were detected.

Cause of death

A diagnosis of acute MA intoxication with pulmonary edema was established. The cause of death in this case was concluded to be unnatural death due to acute MA intoxication secondary to drug leakage in the stomach from swallowed drug packages. The cause of death was consistent with the radiology, autopsy, and toxicology findings.

Discussion

International drug trafficking is rising, and body concealment of illegal drugs is one of the trafficking methods used [4]. Body packers swallow a multitude of packages and can hide more than one hundred packages within themselves to bypass the security controls at airports [5]. The common types of drugs transported in this manner include heroin, cocaine, and methamphetamine. Cocaine has a higher level of demand in temperate countries, whereas methamphetamine (also known as ‘syabu’ or ‘ice’) is more popular in the tropics.

The majority of body packers stay asymptomatic, but the internal packages may leak or rupture and can cause substance toxicity and bowel obstruction [6] or perforation [7]. The most severe complication of body packer syndrome is acute fatal intoxication. Death due to MA leaking into the alimentary tract has been reported [1, 2].

Traditionally, in cases of MA-related death, conventional autopsy and histological and toxicological examinations are performed to investigate the cause of death.

Plain abdominal radiography is the most widely used imaging modality to detect body packers clinically and is reported to have sensitivity of up to 90 % [8, 9]. Plain radiograph examinations are easily accessible in most centers. However, radiologists need to know how to interpret the x-ray films of possible body packers, stuffers, and pushers and how the packages appear on radiographs [10, 11]. The increasing use of more precise cross-sectional imaging modalities in forensic radiological practice has

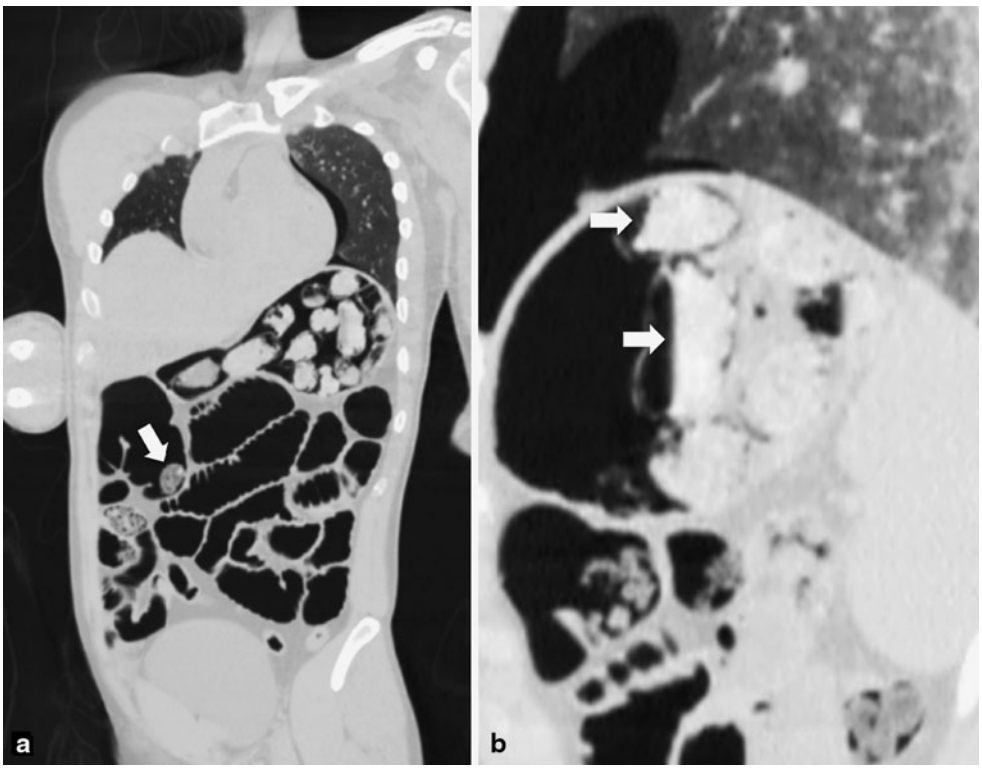

Fig. 3 Postmortem computed tomography. **a** Angulated coronal CT image in the lung window depicting the variable drug packages in the stomach and the sole one in the transverse colon (*white arrow*). **b** Sagittal magnified slice of the disintegrated and fluid-intruded packs inside the stomach with fluid-air levels indicated by the *white arrows*. Note the left-sided anterior pneumothorax above the diaphragm

Fig. 4 Autopsy specimens. **a** Note the flattened and disintegrated pack within the stomach (*white arrow*). **b** The single pack in the transverse colon (*black arrow*)

encouraged a number of forensic centers to evaluate the use of PMCT and magnetic resonance imaging (MRI) in the mortuary [12].

In this case, the PMCT findings were useful in assisting the forensic pathologist to assess the deceased and accurately determine the possible cause of death prior to autopsy. With the proper use of windowing and MPR techniques, the identification of intact and ruptured internal drug packages is possible. Isodense or hypodense drug packages are best seen in the 'lung window' rather than the 'soft tissue' window [13]. In addition, the PMCT depicted the exact locations, number, sizes and dimensions of the drug packages within the alimentary tract. The total number of drug packages reported by PMCT was equivalent to

that found by autopsy. There were two drug packages within the stomach that showed leakage and a single drug package in the colon, which were confirmed by autopsy.

In routine cases, some institutes do not open the intestines (except for the duodenum and rectum), and palpation does not always disclose the presence of packages in the intestines. In such cases, PMCT would be a valuable tool to indicate that the intestines should be opened, or at least to direct the forensic pathologist toward the location of any intestinal packs.

Drug packages can be differentiated from the normal feces in the colon based on a few radiological characteristics of drug packages on computed tomography, which include the double condom sign, halo sign, and rosette sign [4, 13]. The shape of drug packages with well-defined margins is different from that of feces. Furthermore, the measurement of the HU differentiates the drug packages from feces. In this case study, the drug package in the colon had all the typical radiological characteristics of a drug package, thereby helping with its identification.

PMCT demonstrated the presence of the bilateral pulmonary edema that was confirmed during autopsy, which is a common finding in intoxication cases [14, 15]. Ascending pneumomediastinum and a left-sided pneumothorax were also noted on the PMCT but were missed during the autopsy. These subtle findings might be missed during autopsy, particularly if no exams are performed to specifically target them. Although no rib fractures were present, those findings most likely resulted from the resuscitation attempts. Hence, PMCT provided additional information and a superior diagnosis of pathologies, such as pneumomediastinum and pneumothorax.

PMCT has proven to be a more sensitive tool in the diagnosis of body packers. However, false-negative results have been reported in the literature [16]. In this case, the PMCT findings were completely concordant with the conventional autopsy findings. However, PMCT has some limitations, as demonstrated in this case report. It was not able to provide the weights of the congested lungs and distended stomach, or the total weight of the swallowed drug packages. Also, PMCT, in contrast to autopsy, does not provide direct access to the internal organs for sampling and toxicological analysis. However, these issues could be overcome by image-guided biopsy and fluid sampling. Furthermore, in drug packing-related cases, autopsy is mandatory to remove all of the drug packages from a corpse before its release because of the medicolegal implications.

There are several criteria for the classification of the MA concentration in the blood [17–19], including Nagata's criteria [18], which is widely used in Japan, and the Winek criteria [19]. Winek suggested that the MA therapeutic level is 0.01–0.05 μg per millimeter, the toxic level is 0.6–5.0 μg per millimeter, and the lethal level is > 10 μg per millimeter. In our case, the level was 52.0 μg per millimeter, which exceeded the threshold of the lethal level.

The final cause of death was determined based on the autopsy findings and postmortem toxicology and was supported by clinical data, clinical toxicology, and postmortem radiological studies. Therefore, the cause of death was classified as unnatural death due to acute MA intoxication secondary to drug leakage in the stomach from swallowed drug packages.

Conclusion

The PMCT findings in this case provided the possible cause of death reliably and even added information that was missed during autopsy. If no additional biopsy is performed, then the drawbacks of PMCT are limited access to the ingested drug packages and the lack of toxicological analysis. Nevertheless, PMCT acts as a useful adjunct to conventional autopsy and may even guide the forensic pathologist to focal pathologies. In this case, PMCT was able to establish the diagnosis of the most likely cause of death prior to the autopsy while detecting all drug packages, including the leaking packages, which were confirmed by the autopsy.

Key points

1. Fatal acute methamphetamine (MA) poisoning in cases of internal drug trafficking is rare.
2. PMCT acts as a useful adjunct to conventional autopsy in cases of internal drug trafficking.
3. In this case, PMCT was able to establish the diagnosis of the most likely cause of death prior to autopsy.
4. The autopsy findings were consistent with PMCT.

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Conflict of interest None.

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