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症 例 報 告

A case of multiple organ failure due to benzine ingestion

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——Summary——(Jpn J Clin Toxicol 2013 ; 26 : 234–239)

A 42–year–old woman was admitted to our ICU for acute respiratory failure due to benzine ingestion. On arrival at the hospital, the patient's consciousness level was GCS 3 and her SpO_2 was 89% when receiving oxygen at 10 L/min. She was immediately intubated and placed on a ventilator. Chest X–ray and CT scanning showed a wide infiltrative pulmonary shadow bilaterally, and a diagnosis of acute respiratory distress syndrome (ARDS) was made. Subsequently, she became anuric and required haemodiafiltration on the 2nd day. Complications such as prolonged circulatory failure, liver dysfunction and disseminated intravascular coagulation (DIC) were then observed, and plasma exchange therapy was initiated. The patient's condition improved and a complete recovery ensued. The patient remained suicidal and was moved to the psychiatric ward for psychiatric support. Benzine is purified oil containing aliphatic hydrocarbons and is liquid at room temperature. In this case, the patient had already ARDS that required immediate intubation on arrival at the hospital. On this basis, aspiration of benzine into the lungs was considered to have occurred concomitantly with its ingestion, which therefore led to the complication of chemical pneumonitis in addition to that of circulatory shock, acute kidney injury, liver dysfunction and DIC.

Key words：acute respiratory distress syndrome (ARDS), acute kidney injury (AKI), chemical pneumonitis, disseminated intravascular coagulation (DIC)

Introduction

Benzine is a mixture of liquid aliphatic hydrocarbons such as n–pentane and n–hexane and is obtained from petroleum[1]. It is commonly used as a fuel for platinum body warmer or as eradicators and is readily available commercially. A small number of benzine poisoning cases have been reported[2)~9)]. The usual cause of death due to petroleum ingestion is chemical haemorrhagic pneumonitis, with the risk of aspiration into the lung depending on the boiling point of the intoxicant[10]. Because benzine has a much lower boiling point than other chemicals of its class and is volatile, its ingestion can easily cause lung damage[1]. We report a critical case of benzine ingestion in which the patient was rescued despite having not only acute respiratory distress syndrome (ARDS) but multiple organ failure (MOF) as circulatory shock, acute kidney injury (AKI), liver dysfunction and disseminated intravascular coagulation (DIC).

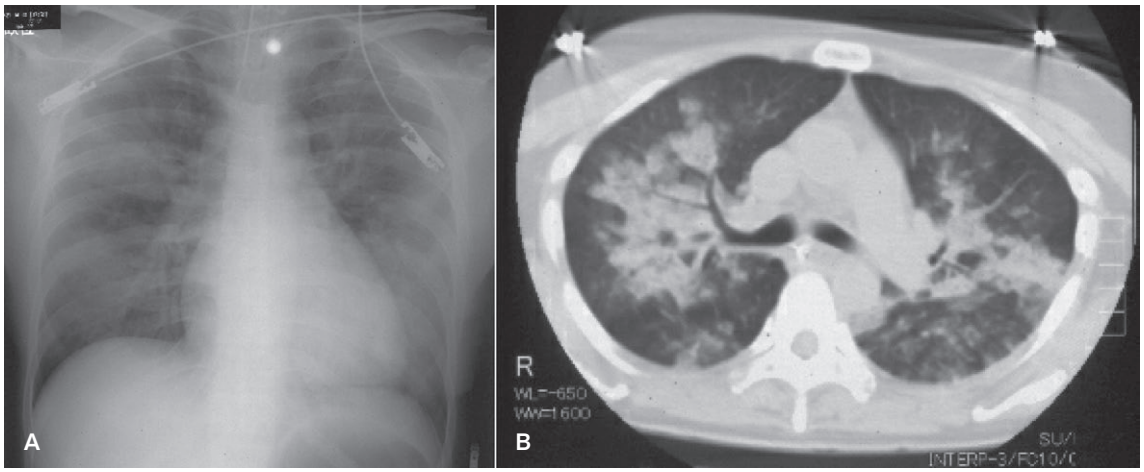

Fig. 1 Chest radiography (Panel A) and computed tomography (CT) scan (Panel B) on arrival at hospital
Chest radiograph shows an extensive infiltration and consolidations of lung fields bilaterally. Chest CT scan shows diffuse parenchymal infiltrates. No other abnormal findings were observed

Case presentation

A 42-year-old woman was discovered in a public park, having attempted to hang herself. When the emergency medical service arrived at the scene, she had already been rescued by a discoverer and had a Glasgow Coma Scale (GCS) score of 14 (E4V4M6). Containers of synthetic detergent and benzine were found beside her. Once in the ambulance, her consciousness level deteriorated to GCS 3 (E1V1M1) and was accompanied by generalized tonic–clonic seizures. On arrival at our hospital, her initial systolic blood pressure was 124 mmHg with a pulse of 79/min and the respiratory rates 36/min with oxygen-saturation 89% despite a face mask, with oxygen reservoir at 10 L/min. The seizures remitted but the GCS score remained at 3 (E1V1M1). Immediate tracheal intubation was required for mechanical ventilation and frothy blood-tinged sputum was aspirated through the tracheal tube. Arterial blood gas analysis showed PO_2 and PCO_2 of 112 mmHg and 23 mmHg, respectively, pH of 7.03 and HCO_3 levels of 7.2 mEq/L after intubation with 100% oxygen. Other laboratory examination revealed a white blood cell count of 16,660/mm^3, haematocrit of 49.1%, haemoglobin of 15.9 g/dL and platelet 225,000/μL. Biochemical analyses revealed no abnormalities. Coagulation test showed prolonged prothrombin time (PT) 13.7 sec (control, 11.3 sec), activated partial thromboplastin time (APTT) 38.1 sec (control, 32.8 sec) and elevated FDP 31.1 μg/mL and D-dimer 15.08 μg/mL. Chest radiography demonstrated an extensive infiltration and consolidations in both lung fields (Fig. 1A) and chest computed tomography (CT) scanning showed diffuse parenchymal infiltrates and little or no pleural effusion was noted (Fig. 1B). A funicular scar was recognized on her neck, but cervical radiography and CT scanning showed no significant changes. A diagnosis of acute respiratory distress syndrome (ARDS) was made probably because of inhalation of the chemical agent. Acute physiological assessment and chronic health evaluation (APACHE) II score was 36 and sequential organ failure assessment (SOFA) score was 15. On ICU admission, after 4 hours of arrival, she required catecholamines and continuous infusions of dopamine (4 μg/kg/min), dobutamine (5 μg/kg/min) and epinephrine (0.02 μg/kg/min) were started. Her P/F ratio was 80.8 mmHg. On the 2nd day, the patient developed

Table 1 Laboratory data and clinical parameters before and after plasma exchange therapy

	24 hours before PE	6 hours before PE	3 hours after PE	18 hours after PE
WBC (/μL)	279,100	32,700	32,920	26,010
RBC (10^6/μL)	4.31	5.22	4.70	4.01
Hb (g/dL)	13.2	12.6	14.2	11.9
Hct (%)	42.9	41.7	43.1	36.1
Plt ($\times 10^4$/μL)	10.4	8.6	7.7	9.8
Alb (g/dL)	2.9	2.4	3.5	2.8
T-bil (mg/dL)	0.6	0.4	0.8	0.6
AST (U/L)	85	108	59	96
ALT (U/L)	16	23	22	26
LDH (U/L)	1,093	1,205	529	605
ALP (U/L)	202	184	232	181
BUN (mg/dL)	17.5	46.0	42.9	28.0
Creatinine (mg/dL)	1.59	2.87	2.65	2.18
PT (sec)	15.4	17.7	12.4	12.9
APTT (sec)	69.1	76.9	75.6	43.2
ATⅢ (%)	68	49	80	70
FDP (μg/mL)	83.4	75.4	8.9	8.7
Hepaplastin test (%)	90.4	67	104	>150
P/F ratio (mmHg)	119	80	185	132
SOFA score*[1]	15	18	17	13
DIC score*[2]	4	5	3	2

*[1]GCS point is calculated as four points because of the patient in a sedated state
*[2]DIC score is calculated following the DIC diagnostic criteria established by the Japanese Association for Acute Medicine

acute kidney injury (AKI) with decreased urine output of 15 mL/hr. Her serum creatinine and HCO_3 levels were to 2.4 mg/dL and 7.2 mEq/L, respectively, despite fluid resuscitation therapy. Haemodiafiltration (HDF) therapy was therefore initiated. Catecholamines were still required with dopamine (15 μg/kg/min), dobutamine (5 μg/kg/min), epinephrine (0.02 μg/kg/min) and norepinephrine (0.03 μg/kg/min), and her P/F ratio was 131 mmHg. On the 3rd day, her condition became complicated with overt disseminated intravascular coagulation (DIC) and acute liver dysfunction. The platelet count was 86,000/μL, prothrombin time was 17.7 sec (control, 11.3 sec), fibrin degradation products was 75.4 μg/mL, activated partial thromboplastin time was 76.9 sec (control, 32.8 sec), fibrinogen was 293 mg/dL, antithrombin Ⅲ was 49% and hepaplastin was 67%. Decreases in antithrombin Ⅲ activity and hepaplastin values were precipitous (Table 1). Therefore acute liver dysfunction was also diagnosed with DIC status. Plasma exchange therapy was initiated for acute liver dysfunction with HDF since no remission of AKI had occurred. After 3 hours of plasma exchange, she escaped DIC status and liver function was improved (Table 1). ARDS improved and all catecholamines were withdrawn on the 4th day, and the patient was extubated on the 10th day. By the 23rd day, she could be weaned from HDF therapy. The clinical course was showed in Fig. 2. She confessed to ingest a half bottle of benzine, assumed to be 50 mL in her attempt at suicide prior to hanging herself, but not to ingestion of the synthetic detergent. The patient's definitive diagnosis was ARDS due to benzine-induced chemical pneumonitis, with complications of circulatory shock, AKI, acute liver failure and DIC. Because the patient still exhibited suicide ideation, on the 48th day, she was moved to the psychiatric ward for continuation of therapy, without any complications.

Discussion

Benzine is a fraction of the distillate from refined

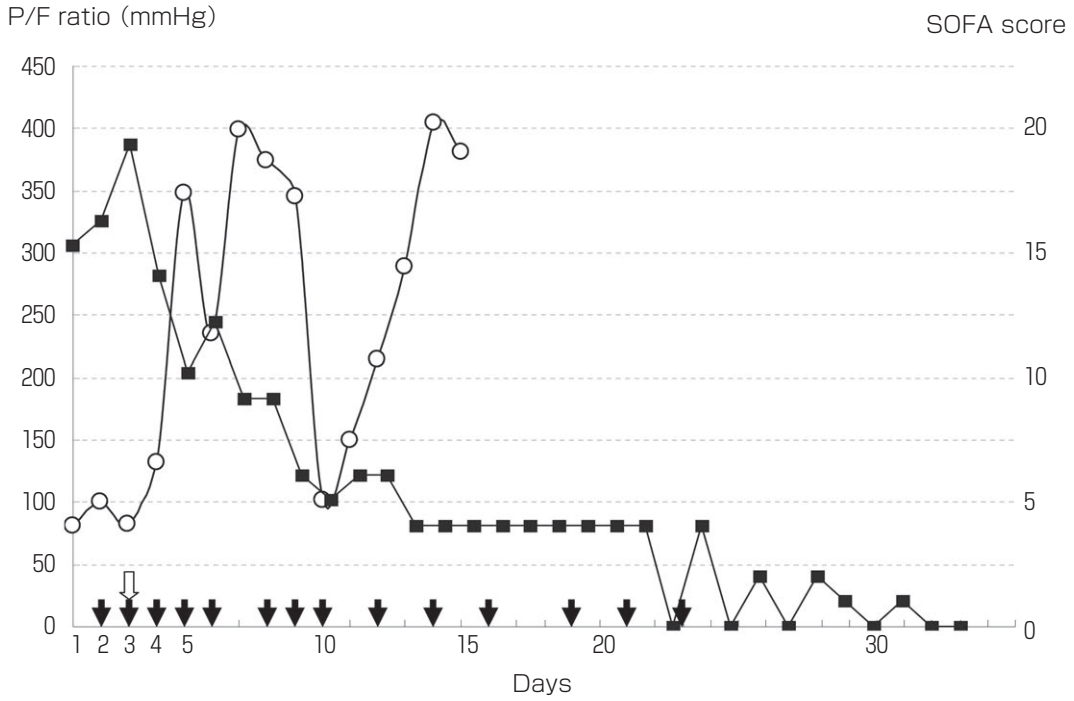

Fig. 2 Clinical course of the case

P/F ratio (open circle) and SOFA score (closed square) are shown. Black arrows indicate initiation of haemodiafiltration (HDF) or haemodialysis (HD). The white arrow indicates initiation of plasma exchange (PE)

petroleum refineries and easily evaporates at ambient temperature because of its ingredients n-pentane and n-hexane[1]. Therefore, when benzine is ingested, it is easily vaporized in the oral cavity and aspirated into the airways causing chemical pneumonitis and also damaging the central nervous system[1]. Only avoiding the aspiration of petroleum into the lungs is not definitely safe, because vapourized benzine suppresses the central nervous system and causes seizures or coma[1]. Our patient exhibited general seizures in the ambulance and became comatose, although the toxic effects of benzine might have affected her unconsciousness more profoundly as she had attempted to hang herself. When the patient arrived at the hospital, she was comatose followed by general seizures and hypoxaemia. At that point, whether she had ingested benzine and/or detergent was unknown. However, on the basis of the characteristic smell of her breath and chest CT imaging, we judged that she had ingested benzine or something similar. Moreover, the patient had ARDS despite immediate intubation on arrival at the hospital. Aspiration into the lung might have occurred concomitantly with benzine ingestion, causing chemical pneumonitis prior to arrival at the hospital. The combination of shock, acute respiratory failure, metabolic acidaemia persisting for more than 24 hours and AKI made HDF mandatory. The grade of AKI in our case was 'Failure' according to the Risk, Injury, Failure, Loss, End-stage kidney disease (RIFLE) criteria[11] and 'Stage 3' according to the AKIN critera[12]. One report described a case of acute renal insufficiency requiring hemodialysis therapy because of nephrotoxic tubular necrosis after oral ingestion of petrol[13]. Moreover, Landry et al. also described a patient who developed acute tubular necrosis following overexposure to petroleum naphtha[14]. These authors postulated that a chemical mediator or toxic compound produced by aliphatic hydrocarbons had induced vasoconstriction in renal deep cortical zone and medulla, thereby causing acute tubular necrosis. AKI might have been

attributable to direct renal tubular toxicity from benzine and/or the prolonged shock status. Furthermore, AKI along with DIC and liver dysfunction occurred in our patient. Although plasma exchange therapy might not have been specifically indicated for the present case, we chose this therapy in combination with HDF to ameliorate liver dysfunction, DIC, a prolonged state of shock, and AKI. Because benzine is liposoluble, the distribution volume is large, it has a longer elimination half-life and easily infiltrates the central nervous system, and thus we considered it might be difficult to eliminate benzine and its metabolites by only HDF. In our case, following plasma exchange therapy, prothrombin time, AT Ⅲ activity, hepaplastin test, SOFA score, DIC and circulatory shock status improved markedly and the patient subsequently recovered completely. Generally, the purposes of PE for intoxications are to eliminate causing substances and their metabolites, and to treat of organ dysfunction such as liver dysfunction following poisoning[15]. Accordingly, to eliminate benzine and its metabolites before resulting in organ failure, especially when acute liver dysfunction develops causing DIC, plasma exchange therapy might be considered at an earlier stage, such as on the admission or on day 1. Benzine intoxication is uncommon, but is more liable to cause acute respiratory failure and hypoxaemia due to haemorrhagic chemical pneuminitis and central nervous system suppression than intoxication from other refined petroleum products, because of its easy vaporization. And MOF might be developed, with subsequent nephrotoxic tubular necrosis, coagulopathy and liver dysfunction, circulatory failure in such the present case.

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要旨

症例は 42 歳，女性。ベンジン飲用による急性呼吸不全のため，ICU へ入院となった。来院時の意識レベルは GCS 合計点 3 点，酸素 10 L/min 投与下で SpO_2 は 89％であった。直ちに気管挿管を施行し，人工呼吸管理となった。胸部 X 線と CT 検査で，両肺の広範な浸潤影を認め，急性呼吸促迫症候群と診断された。第 2 病日には無尿となり，血液濾過透析治療を行った。第 3 病日には，遷延する循環不全に肝機能障害と播種性血管内凝固症候群を合併したため，血漿交換療法を施行し，その後全身状態は改善した。希死念慮が持続するため精神科病棟へ転科転棟となった。ベンジンは石油精製物で，脂肪族炭化水素から成り，常温では液体である。ベンジンを吸引すると化学性肺炎を引き起こし，さらに急性腎障害や肝機能障害，播種性血管内凝固症候群を合併することがある。本症例は，ショック状態が遷延し多臓器不全という重篤な病態に至った症例であった。