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### ► To cite this version:

Corinne Schmitt, Romain Torrents, Mathieu Glaizal, Bastien Domangé, Luc de Haro, et al.. Ammonia poisoning in drug users, is there an emerging problem?. *Toxicologie Analytique et Clinique*, 2021, 33 (3), pp.211-215. 10.1016/j.toxac.2021.05.004 . inserm-03651002

**HAL Id: inserm-03651002**

**<https://inserm.hal.science/inserm-03651002>**

Submitted on 16 Oct 2023

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## **Ammonia poisoning in drug users, is there an emerging problem?**

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## **Abstract**

Concentrated ammonia solutions are strong mineral bases that can induce severe lesions of the upper gastrointestinal tract when ingested. Little is known about the circumstances of poisoning with these solutions. The aim of this study was to compare ammonia exposure between patients who were drug users or abusers with non-user patients. A retrospective study was conducted on the Poison Control Center in Marseille (PCCM) data over a period of 11 years (2009-2019). A total of 614 patients were registered with 564 non-user drugs (NUD) and 50 patients with drug use or addiction (UD). Results founds that UD patients contacted the PCCM mostly for oral exposure (86%), whereas NUD patients were exposed to inhaled ammonia (64%). Repackaging accidents were the major circumstance of poisoning in UD patients (68%) with predominant digestive symptoms (86%). Severity scores evaluated according to the PSS were higher in UD patients even if only the oral route is considered (72% PSS  $\geq$  2,  $p < 0.001$ ). Only one death was recorded, in a 65-year-old patient with a history of alcoholism. The annual number of poisoning cases in UD patients was increasing with 56% patients reported during the last two years. Medical teams in contact with patients at risk need to be made aware of this type of accident, which may be rare but can have potentially catastrophic consequences for the user and their close family and friends.

**Keywords** : caustic ingestion, ammonia, repackaging, drug user, cocaine, crack

## **Introduction**

Caustic exposures to household products such as cleaners and detergents are regularly encountered by Poison Control Centers (PCC). Ammonia solution is a strong mineral base with multiple uses whether for household (cleaning products) or industrial use (cooling industry, manufacture of electronic components...). Cases of accidental poisoning with

ammonia are regularly reported too, most often with dilute cleaning solutions during household activity, usually benign.

However, as with all alkali caustic solutions, ingestion can induce severe poisoning, especially related to a suicidal attempt. In those circumstances, severe delayed lesions of the upper gastrointestinal tract can occur, leading sometimes to necrosis and perforation [1]. Serious cases of ingestion may also occur during less classic circumstances such as accidental setting in patients who use drugs. The aim of this study was to compare ammonia exposure regarding the patient's relationship with drug use. We wanted to compare patient with a present or past history of drug use or drug abuse to non-users patients in order to study, among other things, the circumstances and severity of ammonia intoxications.

## **Methods**

### **Call management**

The Poison Control Center in Marseille (PCCM) teams give medical advice regarding exposure to toxic agents 24/7 and each call is coded in the national common base, the SI-CAP program. The PCCM is responsible for the geographic area including the south-east of France and the overseas French territories in the Indian Ocean (Mayotte, Reunion Island), i.e. a population of 6.5 million inhabitants with around 25000 calls per year.

### **Data source**

Data were extracted from the Local Database of Poisoning Cases (BLCI) which collects all exposure reported to the PCCM. BLCI is authorized by the French data protection authority (Commission Nationale Informatique et Liberté, CNIL). The personal data of patients were anonymized before studying their medical records.

## **File selection**

All files reporting ammonia exposure between 01/01/2009 and 31/12/2019 among one or more humans were extracted from the BNCI. Files with no actual ammonia exposure were excluded (information or prevention queries). Patients suspected of drug use (party context, in the evening or in the night, unlabelled product in a bottle of beer or cola, patient refusing to give their contact details, their medical history, refusing healthcare...) but who did not admit to it were also excluded from the study.

## **Data collected**

For each file, the following parameters were collected: demographic characteristics of the patients (age and gender), poisoning context (route and circumstance of exposure) and relationship with drugs or addiction. In the drug user group (UD group), we also collected clinical data regarding the intoxication (symptoms, length of hospital stay).

Severity was estimated using the poisoning severity score (PSS) [2]. Digestive burns were defined using Zargar classification [3].

## **Statistics**

Data were analysed using IBM SPSS v20 software. Descriptive statistic analysis was performed for all variables: frequency, average and standard deviation. Association between categorical variables was studied using the Chi2 test, and Fischer's exact test for small numbers. Quantitative variables were studied using Student's t-test. All of the percentages were calculated and shown in columns. All percentages shown are valid, i.e. do not account for missing data. Statistical significance was set at 0.05.

## **Results:**

Over the study period, 636 patients had ammonia poisoning, all routes and circumstances combined. Among these patients, 564 were not drug users (NUD patients) and 50 patients acknowledged that they were drug users or abusers or dependant on substances (UD patients). The 22 patients who were suspected of drug use were excluded from the study.

### **UD Patients**

Average age was  $34 \pm 9$  years old with extremes ranging between 17 and 65 years old, mainly men (34 M/16 F). Among the 50 UD patients, 23 (46%) acknowledged using cocaine. In the majority of cases, poisoning was by oral or buccal route (n=43 i.e. 86 %) (table 1). The main reason for poisoning was due to a repackaging (34/50) in various containers; bottle of methadone, bottle of beer, fruit juice or water. There were 7 cases of suicide (6 oral and 1 IV administration).

The quantity of ammonia ingested was not precise in the files but it varied between one mouthful and 500mL. Exposure mostly took place in the evening (n=23) or in the early morning (n=12). The lapse of time between ingestion and obtaining medical advice, whether directly (emergency department) or by phone (call to the poison centre) was known for 45 cases, with an average delay of 4h22 [5 min-3 days].

Symptoms were essentially digestive, with pain in the mouth and throat (14/50), dysphagia (10/37), hypersalivation (13/50), vomiting more or less blood (13/50), corrosive oropharyngeal burns (32/50), corrosive oesophageal (16/50) and gastric burns (14/50) (Zargar grade I to IIIb) (figure 3).

Twenty-three patients (46%) had upper gastrointestinal endoscopy. Twenty-four patients (48%) were admitted to Resuscitation or Digestive departments. One patient died in hospital after 3 weeks of monitoring in a specialised ward.

Length of hospital stay was known for 35 cases with an average of 6.5 days (between 1 and 24 days). One patient was still fed via a jejunostomy tube at M2. In 5 cases the patients left emergency against medical advice. Severity scores were high ( $PSS \geq 3$ ) or medium ( $PSS=2$ ) in the majority of cases (74%) (table 1).

There was a rise in the number of UD patients with ammonia poisoning contacting the CAPM, with a significant difference between the first half and the second half of the study period ( $p < 0.001$ ). It should be noted that 56% of these patients ( $n = 28$ ) were reported within the last 2 years (figure 2). Of these 28 patients, 19 (67%) admitted to being cocaine users.

### **NUD Patients**

Age was given for 497/564 of the NUD patients, with an average age of  $38 \pm 17$  years old with extremes ranging between 18 month and 91 years old. There were 24 cases of children under 6 years old. From the 534 patients whose gender was known, there were more women than men (56% F and 44% M). The main route of poisoning was by inhalation (364/564 i.e. 65 %) primarily at home, as the result of a domestic accident or while cleaning or doing DIY (table 1).

There were 27% of poisonings by oral route with more than half due to repackaging (61%). There were 15 cases of suicide (14 oral and 1 IV administration). The majority of cases had low or null severity scores (94%) (table 1). Among the 6% of cases with medium or high scores,  $\frac{1}{4}$  were in a suicidal context, 2 patients were children under 2 years of age ( $PSS \geq 3$ ).

Ammonia poisoning, all circumstances combined, were significantly more severe in UD patients ( $p < 0.001$ ) which may be explained by the fact that the vast majority of NUD patients were exposed by inhalation and not ingestion.

However this difference remains significant when the cases of ingestion are compared between the groups (total=195) ( $p<0.001$ ) as is shown in the table 2. Likewise for unlabelled products, (N=142) a history of drug abuse is still a factor for worse prognosis with 68% of UD cases with medium or high severity versus 8% in NUD patients ( $p<0.001$ ).

## **Discussion**

Ammonia solutions are colourless liquids with a characteristic pungent smell that is due to ammonia gas fumes. They are strong mineral bases available on sale at concentrations ranging from less than 1% to 13%. As with all alkali caustic solutions, the ingestion of ammonia can cause severe and delayed burns to the upper digestive tract leading to necrosis and perforation. As with any ingestion of caustic substances, oesophageal injuries may rapidly lead to stricture development or subsequently maybe even to cancer [4,5].

Generally the poison centres are called for cases of ammonia poisoning by accidental inhalation of the product (58% in our study) mainly during a cleaning or DIY accident and they are benign.

Why be interested in drug users? We know that in France, and even in Europe, cocaine has become more popular in the past few years [6-8]. Data from the OFDT (French observatory for drugs and drug addiction) also show that the crack abuse is increasing [8]. Crack cocaine is either sold ready-made as rocks, or it is made extemporaneously by the user, by diluting cocaine hydrochloride in water, mixing it with a base (ammonia or sodium bicarbonate), heating it to remove hydrochloride, and then it is smoked [9]. While the direct or indirect consequences of using these drugs have been studied [6, 10-12], we did not find any data on collateral damage resulting from the manufacture of crack or freebase cocaine.

Whatever the source of poisoning, drug users are difficult patients to assess, because they are reluctant to answer health questionnaires and are sometimes in an altered state of



consciousness, refusing to give the circumstances of poisoning or their medical history. In some cases they refuse the healthcare offered (in our study there was 1 refusal of healthcare and 5 cases of leaving against medical advice) and/or do not answer follow-up calls from the poison centre. For these reasons, the number of UD patients is probably under-represented in our study.

Despite this, our small series enables us to confirm that the number of these cases is rising, with more calls from this particular profile of patients in recent years. This data is coherent with the reported increase of cocaine and crack abuse in France.

The toxicity profile of the 50 UD patients was entirely different from that of the NUD patients, with a majority of accidental ingestion, resulting from unlabelled ammonia solution (68%) in a bottle of beer, fruit juice, cola, water or even methadone. These accidents happened late at night or when the patients woke up the next morning.

Unsurprisingly, these patients developed primarily ENT and digestive symptoms with corrosive digestive burns that were often moderately to highly severe. Whether one considers cases of ingestion or of unlabelled product, UD patients who ingested ammonia developed a significantly more severe clinical picture than did NUD patients ( $p < 0.001$ ). This severity may be linked to the state of consciousness of the patient: an altered state resulting from taking drugs may have led to a greater quantity being ingested than by a non-drug user. It is also possible that the concentration of the ammonia solution had an influence on severity, however this data was not provided and we do not know whether the unlabelled products were diluted or not. The lapse of time between the accident and seeking medical advice was between 4 to 5 hours, which probably had no influence on severity as caustic burns progress rapidly following ingestion and there is no specific emergency antidote for them.

While ammonia is known to be caustic, there have only been a few papers describing detailed cases of poisoning which can be severe, mainly in adult suicide cases [1,5,13-15].

We only found one case of accidental ammonia poisoning linked to freebase cocaine abuse in scientific literature. This was a 2 year-old child whose parents admitted to being freebase cocaine users. The little girl had drunk from an unmarked plastic container the morning after a party, while her parents were still asleep. She suffered from severe oropharyngeal and oesophageal corrosive burns which fortunately progressed favourably within a few weeks [13]. In our study there were 2 children with severe poisoning; in both of these cases it was a boy aged under 2 years old, but we have no data concerning their parents' profile.

As a whole, these first results, which are admittedly partial, show that the number of cases of ammonia poisoning reported to the CAPM are rising in patients with present or past history of drug use/abuse ; most are cases of accidental ingestion of unlabelled products, in the evening or early morning with severe digestive symptoms. A study on a national level would be necessary to confirm this tendency. In the meantime, medical teams in contact with patients at risk need to be made aware of this type of accident, which may be rare but can have potentially catastrophic consequences for the user and their close family and friends.

### **Declarations of interest**

Authors have no conflict of interest to declare

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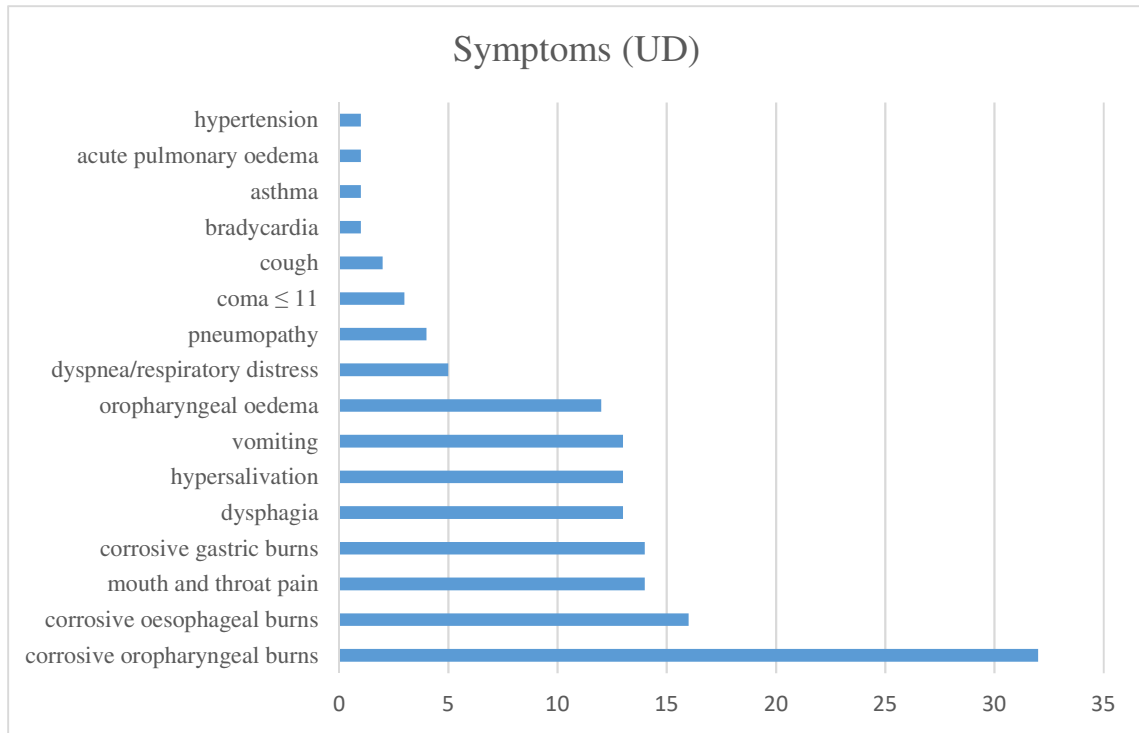


Figure 1: Symptoms observed in UD patients

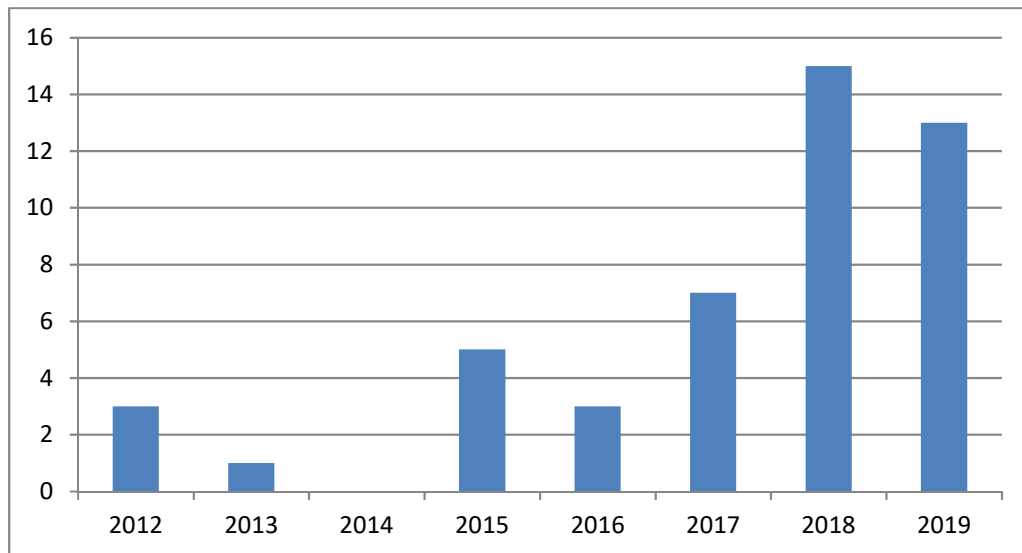


Figure 2 : Evolution of the annual number of UD patients

	<b>UD (n=50)</b>	<b>NUD (n=564)</b>	<b>Total (n=614)</b>	<b>p</b>
<b>Gender (%)</b>				
Female	16 (32)	299 (56)	315	<0,001
Male	34 (68)	235 (44)	269	
unknown	0	30	30	
<b>Mean Age ± SD (YO)</b>	34±9	38±17	547	<0.01
<b>Route (%)</b>				<0,001
inhaled	5 (10)	364 (64,5)	369	
oral	43 (86)	152 (27)	195	
ocular	1 (2)	24 (4)	25	
cutaneous	0 (0)	23 (4)	23	
intravascular	1 (2)	1 (0,5)	2	
<b>circumstances (%)</b>				<0,001
repackaging	34 (68)	108 (19)	142	
occupational	0 (0)	111 (20)	111	
suicide	7 (14)	15 (3)	22	
criminal	1 (2)	6 (1)	7	
addiction	5 (10)	0 (0)	5	
cleaning/DIY	0 (0)	149 (26)	149	
accidental (other)	3 (6)	175 (31)	178	
<b>PSS Score (%)</b>				<0,001
0	1 (2)	79 (14)	80	
1	12 (24)	451 (80)	463	
2	20 (40)	23 (4)	43	
≥3	17 (34)	11 (2)	28	

Table 1 : Comparison of different factors between UD and NUD patients

<b>Severity (oral route) (%)</b>	<b>UD</b>	<b>NUD</b>	<b><i>p</i></b>
PSS 0	0 (0)	22 (14)	<0,001
PSS 1	12 (28)	109 (72)	
PSS 2	16 (37)	14 (9)	
PSS ≥ 3	15 (35)	7 (5)	

Table 2: Comparison of severity focused on oral route