

## Lethal Intoxications with Centrally Stimulating Amines in Sweden 1966—1973

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*Summary.* Fatal intoxications with centrally stimulating amines (CSA) have become increasingly common in Sweden. Toxicological data and pathological findings of 32 cases of amphetamine and phenmetrazine intoxications which occurred from 1966—1973 in Sweden are described. Furthermore, 13 cases where these drugs were not the cause of death, but found in urine and organs, are reported.

*Zusammenfassung.* Tödliche Vergiftungen mit Amphetamin und Phenmetrazin haben in den letzten Jahren in Schweden stark zugenommen. Es wird über 32 Fälle aus den Jahren 1966—1973 berichtet, bei denen diese Drogen als Todesursache festgestellt wurden. Toxikologische Daten (Konzentrationen in Körperflüssigkeiten und Organen) und pathologische Befunde werden mitgeteilt. Außerdem werden 13 Fälle beschrieben, bei denen zwar Amphetamin nachgewiesen, für den Tod jedoch andere Ursachen festgestellt wurden.

*Key words:* Amphetamine — Centrally stimulating amines — Lethal intoxications, Amphetamine, Phenmetrazine — Phenmetrazin.

### Introduction

A survey of poisoning with amphetamines was made in 1972 by Gunne *et al.*, who gave a brief report on fatal intoxications with centrally stimulating amines (CSA) occurring in Sweden between 1966 and 1971. A total of 24 cases were registered during that period. Of these, 15 were caused by phenmetrazine or amphetamine alone, and 9 by phenmetrazine or amphetamine in combination with other drugs. 3 of the lethal amphetamine intoxications had been reported previously by Orrenius and Maehly (1970). The purpose of the present paper is to describe the morbid anatomic and toxicologic findings in cases of lethal intoxications involving CSA in Sweden 1966—1973.

### Material

The material consisted of 26 men and 6 women coming to autopsy mainly at the different departments of Forensic Medicine in Sweden 1966—1973. For comparison, a further 13 autopsy cases are presented in whom CSA were detected. In those cases death was caused in connection with traffic accidents, homicide, suicide, hanging, gun shot wounds and carbon monoxide intoxication and was not due to amphetamines.

Table 1. Pathological and toxicological findings in 32 cases of lethal intoxication with CSA in Sweden 1966—1973

Year	Age/ Sex	Case history	CSA concentration	Other drugs	Autopsy findings	Route used
1966	47 ♂	Died after drinking party	5.5 mg% phenmetrazine in urine	0.16% ethanol in blood  0.26% ethanol in urine 0.17% ethanol in kidney 3.0 mg barbiturate acid derivative per 100 g liver 1.0 mg barbiturate acid derivative per 100 g kidney	Pulmonary congestion	Probably oral
28 ♂ <sup>a</sup>		Found dead in a drying room	9.0 mg% amphetamine in urine		Aspiration	Intravenous
1967	37 ♂	Found dead at home	4.4 mg% amphetamine in urine		Putrefaction	Intravenous
1968	18 ♀ <sup>b</sup>	Found dead in a hotel room	0.7 mg% amphetamine in urine 1.2 mg amphetamine per 100 g liver 0.3 mg amphetamine per 100 g muscle 0.8 mg amphetamine per 100 g kidney		Pulmonary congestion Pulmonary bleeding	Intravenous
					Gastric mucosal bleeding	
59 ♂ <sup>b</sup>		Found unconscious in a bathtub. Died after 30 hrs	<0.05 mg% amphetamine in blood 4.5 mg amphetamine per 100 g liver 0.4 mg amphetamine per 100 g kidney		Pulmonary congestion Subpleural bleeding Subendocardial bleeding Gastric mucosal bleeding Subacute focal hepatitis Fatty degeneration of the liver	Intravenous

1968	49 ♂ <sup>b</sup>	Found dead near a highway. Suicide?	0.6 mg% amphetamine in blood 70 mg% amphetamine in urine 3.5 mg amphetamine per 100 g liver 1.1 mg amphetamine per 100 g kidney			Pulmonary congestion Fatty degeneration of the liver	Not known Possibly i.v.
	28 ♂ <sup>a</sup>	Taken unconscious to hospital. Died on arrival	4.0 mg% phenmetrazine in urine	0.5 mg% pentobarbital or amobarbital in blood 1.0 mg pentobarbital or amobarbital per 100 g liver 0.2 mg% diazepam in urine		Pulmonary congestion Fatty degeneration of the liver	Intravenous
1969	47 ♂	Suicide, found dead at home	<0.2 mg% amphetamine in urine	9.5 mg vinbarbital + amobarbital per 100 g liver		Pulmonary congestion Broncho-pneumonia	Intravenous
	23 ♀	Found dead at home	0.1 mg% phenmetrazine in blood 10 mg% phenmetrazine in urine	1.9 mg% vinbarbital + amobarbital in blood 3.5 mg vinbarbital + amobarbital per 100 g liver		Pulmonary congestion	Intravenous
	50 ♂	Suicide, found dead at home Farewell letter	<0.1 mg% amphetamine in urine	2.9 mg pentobarbital per 100 g liver		Pulmonary congestion	Intravenous
1970	38 ♀	Found dead at home	<0.1 mg% amphetamine in urine	2.9 mg amobarbital per 100 g liver		Slight coronary arteriosclerosis Pulmonary congestion	Intravenous
	53 ♀	Found dead at home	0.2 mg% phenmetrazine in blood 0.4 mg% phenmetrazine in urine			Pulmonary congestion Myocarditis Liver cirrhosis	Intravenous
1970	57 ♂ <sup>a</sup>	Found dead at home	4.1 mg% phenmetrazine in urine			Fatty degeneration of the liver	Intravenous

Table 1 (continued)

Year	Age/ Sex	Case history	CSA concentration	Other drugs	Autopsy findings	Route used
	18 ♂	Found dead at home	<0.1 mg% 2.5 mg% <0.1 mg	phenmetrazine in blood phenmetrazine in urine phenmetrazine per 100 g liver	Pulmonary congestion  Slight aspiration	Intravenous
	25 ♂ <sup>a</sup>	Found dead	<0.05 mg% amphetamine in urine	4.5 mg% morphine alkaloids in urine <0.1 mg% benzodiazepine derivatives in blood 0.5 mg% benzodiazepine derivatives in urine	Pulmonary congestion Aspiration Slight hepatitis	Intravenous
1971	25 ♂	Taken to hospital with hyperthermia, tachy- cardia, hypotension and paranoid psychosis. Died after 3 hrs	0.5 mg% 8.5 mg% 1.0 mg	phenmetrazine in blood phenmetrazine in urine phenmetrazine per 100 g liver	Pulmonary congestion Slight fatty degeneration of the liver	Intravenous
	31 ♂	Taken to hospital with hypermotility, tachy- cardia and cyanosis. Died after 13 hrs of hypo- tension	0.5 mg%	phenmetrazine in urine	Pulmonary congestion Slight cholangitis	Intravenous
	29 ♀	Found dead at home	1.6 mg% 11 mg% 5.5 mg	phenmetrazine in blood phenmetrazine in urine phenmetrazine per 100 g liver	Pulmonary congestion Subpleural bleeding	Intravenous
	27 ♂	Found psychotic, taking a bath in a fountain. On arrival at a hospital unconscious with hyper- motility, hyperthermia and tachycardia. Died after 1 hr	5.0 mg% 0.5 mg	phenmetrazine in urine phenmetrazine per 100 g liver	Aspiration Ischemic myocardial changes	Intravenous

30 ♂ <sup>a</sup>	Found in a street kicking and beating a dog. Taken to hospital with tachycardia and hypotension. Died shortly after arrival	1.4 mg/% 50 mg/% 1.2 mg per 100 g liver	phenmetrazine in blood phenmetrazine in urine phenmetrazine per 100 g liver	Aspiration Ischemic myocardial changes	Intravenous
33 ♂ <sup>a</sup>	Found dead at home	0.4 mg/% 32 mg/% 0.9 mg	amphetamine in blood amphetamine in urine amphetamine per 100 g liver	Ischemic myocardial changes Coronary microthrombosis Slight fatty degeneration of the liver	Intravenous
43 ♂	Circulatory collapse 3 hrs after injection. Died at home	0.3 mg/% 2.0 mg/%	phenmetrazine in blood phenmetrazine in urine	Coronary arteriosclerosis with old myocardial infarction and enlargement of the heart Pulmonary congestion	Intravenous
44 ♂	Found dead at home after oral intake of phenmetrazine and wine	0.3 mg/% 4.0 mg/% 0.4 mg	phenmetrazine in blood phenmetrazine in urine phenmetrazine per 100 g liver	Pulmonary congestion	Oral
1971 45 ♀	Suicide, found dead at home	1.1 mg	phenmetrazine per 100 g liver	Putrefaction	Intravenous
		0.06% 12 mg 14 mg 0.7 mg 5.3 mg	ethanol in kidney amobarbital per 100 g liver amobarbital per 100 g kidney methaqualone per 100 g liver methaqualone per 100 g kidney		

Table 1 (continued)

Year	Age/ Sex	Case history	CSA concentration	Other drugs	Autopsy findings	Route used
1972	26 ♂ <sup>a</sup>	Found dead in a park	4 mg% phenmetrazine in urine	0.13% ethanol in blood 0.18% ethanol in urine	Aspiration Pulmonary bleeding	Intravenous
	30 ♂ <sup>a</sup>	Died in a police station. Drunken behaviour	3 mg% phenmetrazine in urine	0.8 mg methadone per 100 g liver	Aspiration Pulmonary and sub- pleural bleeding	Not known
	26 ♂	Found dead in a park	12.7 mg phenmetrazine in urine	0.3 mg% morphine derivative in urine	Pulmonary congestion Hepatitis	Intravenous
	23 ♂	Found naked in a street. Dead on arrival at a hospital	8.5 mg% amphetamine in urine		Pulmonary congestion	Probably i.v.
	27 ♂ <sup>a</sup>	Found dead in a hotel	0.4 mg amphetamine per 100 g liver		Aspiration	Intravenous
1973	42 ♂	Psychosis and tachy- cardia. Died before arrival at a hospital	2.3 mg% amphetamine in urine		Aspiration Pulmonary bleeding	Intravenous
	40 ♂	Brought to hospital with seizures. Died on arrival	0.8 mg% amphetamine in blood 26 mg% amphetamine in urine	0.04% ethanol in blood 0.08% ethanol in urine	Fatty degeneration of the liver	Not known Possibly i.v.
	29 ♂	Died in hospital after abdominal pain	0.6 mg% amphetamine in urine		Pulmonary congestion Myocardial fibrosis Wire-loop glomerulo- nephrosis Hepatitis	Intravenous

<sup>a</sup> Died shortly after imprisonment or a period of hospitalization.<sup>b</sup> Reported by Orrenius and Maehly (1970).

Table 2. Pathological and toxicological findings in 13 cases of sudden violent death in whom amphetamines were detected

Age/Sex	Case history	CSA concentration	Other drugs	Route used
26 ♂ <sup>a</sup>	Suicide, shot through the head	0.8 mg% phenmetrazine in blood 5.0 mg% phenmetrazine in urine	0.04% ethanol in blood	Not known
34 ♂	Suicide by hanging	2.4 mg% phenmetrazine in urine	0.06% ethanol in blood	Intravenous
47 ♂ <sup>a</sup>	Suicide by gassing with light gas	34 mg% phenmetrazine in urine	0.09% ethanol in urine 65—70% carbon monoxide Hb <0.3 mg methaqualone per 100 g liver	Intravenous
23 ♂ <sup>a</sup>	Traffic accident Driver, died of aortic laceration	0.2 mg% phenmetrazine in blood 2.0 mg% phenmetrazine in urine	0.7 mg amobarbital per 100 g liver	Intravenous
27 ♂	Suicide by hanging	0.4 mg% phenmetrazine in blood 0.1 mg% amphetamine in blood	0.05% ethanol in blood	Intravenous
29 ♂	Died by drowning	1 mg% phenmetrazine in urine		Intravenous
35 ♀	Suicide, shot through the head	0.1 mg phenmetrazine per 100 g liver	0.20% ethanol in muscle 0.27% ethanol in kidney	Intravenous
37 ♂ <sup>a</sup>	Traffic accident Driver, died of fractured skull	46 mg% phenmetrazine in urine		Intravenous
18 ♀	Traffic accident Passenger, died of multiple wounds	<0.05 mg% phenmetrazine in urine 1.7 mg% amphetamine in urine		Intravenous
47 ♂	Suicide by hanging	1.1 mg phenmetrazine per 100 g liver		Intravenous
22 ♂	Homicide, shot in the chest	6.3 mg% phenmetrazine in urine	0.4 mg% benzodiazepine derivatives in urine	Intravenous
32 ♂	Traffic accident Driver, died of chest wounds	1.5 mg% phenmetrazine in urine 5 mg% amphetamine in urine	0.5 mg barbiturate acid derivative per 100 g liver	Intravenous
28 ♂	Suicide, shot through the head	30 mg% amphetamine in urine		Intravenous

<sup>a</sup> Died shortly after imprisonment or a period of hospitalization.

## Methods

Samples of blood, liver, kidney and muscle as well as urine, when present, were collected at autopsy and analyzed for the presence of CSA by the procedures of Bonnichsen *et al.* (1969) and Petrovics (to be published). In the last year identification of these drugs was established by mass spectrometry (Bonnichsen *et al.*, 1970). In all cases the liver was routinely screened for other drugs (Bonnichsen *et al.*, 1961; Machly *et al.*, 1962).

## Results

The morbid-anatomic and toxicologic findings are presented in Table 1. From 1966 to 1973 a total of 32 lethal intoxications were registered. 28 of the subjects were criminals. In 9 cases death occurred shortly after imprisonment or a period of hospitalization. 19 intoxications were caused by phenmetrazine or amphetamine alone and 13 by phenmetrazine or amphetamine in combination with other drugs. In 3 patients there was evidence of pre-existing cardiac disease (myocarditis, coronary arterial disease, systemic lupus erythematosus with myocardial fibrosis) which might have been a contributory cause of death. Liver disease might also have contributed to the fatal outcome in some cases. Various degrees of fatty degeneration of the liver and subacute hepatitis were seen in 7 and 4 cases, respectively. In one case slight cholangitis was observed and in another case cirrhosis of the liver. Pulmonary congestion was observed in 20 cases and signs of aspiration in 9 cases. Subpleural, subpericardial and/or pulmonary bleeding was also seen in some cases. Small recent ischemic myocardial changes were noted in 3 of 10 cases investigated in this respect, even in the absence of overt coronary disease.

In Table 2, 13 cases of sudden violent death in whom CSA were detected, are presented.

## Discussion

During 1966—1973, 32 cases of lethal intoxications involving CSA were known of in Sweden. In 15 of these cases, death was caused by CSA in combination with other drugs. In 3 cases pre-existing heart disease and in some cases liver disease might have contributed towards the death. The concentrations of CSA in the liver and blood in the cases of combined intoxications were, on the average, somewhat lower than in the cases of intoxications with CSA alone. The patients dying from other causes than intoxication with CSA and in whom amphetamines were detected (Table 2) did not differ significantly in their average tissue concentration of amphetamines from those with lethal CSA intoxications. Many persons dying from intoxication might therefore have a reduced tolerance to the drug, e.g. due to long periods of imprisonment and an uneven supply of the drug on the market. 9 of the patients dying from CSA intoxication had in fact been in prison or in hospital shortly before death. However, the same was true for 4 persons in the reference group.

Another interesting finding in this study was the ischemic myocardial changes seen in 3 cases even with normal coronary arteries. In all these patients tachycardia had been noted before death. The myocardial changes observed might therefore have been caused by the tachycardia or by ventricular fibrillation pro-



voked by tachycardia. We consider, therefore, that microscopic investigation of the myocardium for ischemic changes should be performed as routine in cases with suspected CSA intoxication.

### References

- Bonnichsen, R., Maehly, A. C., Åqvist, S.: Arzneimittel und Fahrtüchtigkeit. II. Zentralstimulierende Amine und aromatische Kohlenwasserstoffe. *Blutalkohol* **6**, 245 (1969)
- Bonnichsen, R., Maehly, A. C., Frank, A.: Barbiturate analysis: Method and statistical survey. *J. forens. Sci.* **6**, 411 (1961)
- Bonnichsen, R., Maehly, A. C., Mårde, Y., Ryhage, R., Schubert, B.: Determination and identification of sympathomimetic amines in blood samples from drivers by a combination of gas chromatography and mass spectrometry. *Z. Rechtsmedizin* **67**, 19 (1970)
- Gunne, L.-M., Holmgren, P., Lindquist, O., Saldeen, T.: Amfetamin intoxicationer (amphetamine intoxications). *Läkartidningen* **69**, 4373 (1972)
- Maehly, A. C., Linturi, M. K.: Detection of drugs other than barbiturates in the routine method for barbiturate. *Acta chem. scand.* **16**, 283 (1962)
- Orrenius, S., Maehly, A. C.: Lethal amphetamine intoxication. *Z. Rechtsmedizin* **67**, 184 (1970)

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