

# Postmortem cases involving amphetamine-based drugs in the Netherlands

MIRANDA VERSCHRAAGEN, ANN MAES, BART RUITER, INGRID J. BOSMAN,  
BEITSKE E. SMINK and KLAAS J. LUSTHOF

Netherlands Forensic Institute, Department of Pathology and Toxicology, The Hague, The Netherlands

**INTRODUCTION:** Amphetamine, metamphetamine, MDMA, MDA and MDEA are widely abused recreational drugs. To obtain more insight in the number of fatal amphetamine-based drugs cases and their blood concentrations this study was performed.

**METHODS:** In this study we reviewed the postmortem cases in the years 1999 through 2004 that were presented at the Netherlands Forensic Institute. The selected postmortem cases contained amphetamine-based drugs in femoral blood in a concentration of 0.01 mg/l or higher. These cases were divided into *drug caused* and *drug related cases* using the autopsy and toxicology results and the circumstances of death; in the *drug caused* cases the amphetamine-based drug directly caused or contributed to the death, in the *drug related* cases the death was not directly caused by the amphetamine-based drug. The concentrations of amphetamine-based drugs in the postmortem cases were compared with the recreational concentrations obtained from non-fatal drivers (n=467).

**RESULTS:** Amphetamine-based drugs were present in a total of 70 postmortem cases. The mean age of the victims was 27 years and the majority of the victims were men (51 out of 70 cases). The mostly used amphetamine-based drug in the postmortem cases was MDMA (51 cases), followed by amphetamine (23 cases). MDA was detected in 46 cases (blood concentration range: 0.01 to 3.8 mg/l); in 3 of these 46 deaths MDA was likely to be taken; in the other 43 cases, the presence of MDA could be explained by metabolism of MDMA. Metamphetamine was detected in 6 cases (blood concentration range: 0.01 to 0.39 mg/l) and MDEA only in one death (blood concentration 4.6 mg/l). There were no striking differences in the yearly incidence of deaths involving amphetamine-based drugs.

The 70 postmortem cases were divided into 38 amphetamine-based *drug caused* and 32 amphetamine-based *drug related* deaths.

In 30 cases, MDMA caused death directly. The range in blood concentrations of MDMA in these cases was substantial, i.e. 0.41 to 84 mg/l with a median concentration of 3.7 mg/l. Of these *drug caused* deaths, 90% had a MDMA concentration higher than 1.5 mg/l compared to 10.7% of *drug related cases* (n=20) and 2.9% of the driving cases (n=360). MDMA blood concentrations in the *drug related* deaths and in the drivers varied up to 3.7 and 4.0 mg/l, respectively.

Seven victims died from the direct effects of amphetamine; the blood concentration of amphetamine ranged from 0.24 to 11.3 mg/l, with a median concentration of 1.7 mg/l. The median concentrations of amphetamine in the *drug related* deaths (n=13) and the drivers (n=208) were much lower, i.e. 0.28 and 0.22 mg/l, respectively. Ninety percent of the amphetamine blood concentrations in the *drug caused* cases were higher than 0.80 mg/l versus 15.9% in the *drug related* deaths and 7.2% in the driving cases. Amphetamine blood concentrations up to 6.0 and 2.3 mg/l were seen in the *drug related* deaths and drivers, respectively. One victim died most likely from the direct effects of MDA with a femoral blood concentration of 3.8 mg/l.

**CONCLUSIONS:** The most abundantly used amphetamine-based drugs in the investigated deaths were MDMA and amphetamine. The majority of MDMA- and amphetamine-caused deaths occurred with blood concentrations above 1.5 or 0.80 mg/l, respectively. MDMA and amphetamine blood concentrations in *drug related* deaths and non-fatal drivers, however, overlap the range of fatal concentrations. Therefore, MDMA or amphetamine concentrations should never be used alone to establish the cause of death.

**KEYWORDS:** *Amphetamines, Postmortem, Driving under the influence, Blood concentrations, Interpretation*

**Corresponding author:** [m.verschraagen@nfi.minjus.nl](mailto:m.verschraagen@nfi.minjus.nl)