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Elevated Acetone Concentrations in Hypothermia Deaths

by
M.J. Ward and J.G. Wigmore

ELEVATED ACETONE CONCENTRATIONS IN HYPOTHERMIA DEATHS

Blood and urine samples submitted to the Toxicology Section of the Centre of Forensic Sciences are routinely analyzed for volatiles by headspace gas chromatography. Elevated acetone concentrations have been detected in victims of physical trauma (1,2,3). Elevated acetone concentrations have also been detected in victims of hypothermia as illustrated by the following case reports.

The analysis for acetone, in each case, was performed on a Perkin-Elmer Multifract F-45 gas chromatograph under conditions reported previously (3).

CASE REPORTS

Case 1

A 42 year old man was reported missing when he failed to return from snowmobiling in Northern Ontario during March. A search party located his frozen body, just off the usual trail near his snowmobile.

The blood of the victim contained 26 mg/dL ethanol and 6 mg/dL acetone.

Case 2

An 80 year old man, described as an "eccentric", was found dead in his unheated house in February. The pathologist listed cause of death as probably due to "exposure to cold" or "hypothermia".

The blood contained 2 mg/dL acetone; no ethanol or common drugs could be detected. The urine contained 7 mg/dL acetone.

Case 3

A 33 year old man who did not return from vacation in Northern Ontario was found dead in the bush. The cause of death was recorded as due to "exposure".

The blood was found to contain 18 mg/dL acetone and no ethanol.

Case 4

The body of a 20 year old man was found two days after he was reported missing while snowmobiling. The deceased was found approximately 400 metres from the snowmobile, which was on its side.

The blood of the deceased contained 21 mg/dL ethanol, 1 mg/dL acetone and traces of tetrahydrocannabinol. The urine contained 120 mg/dL ethanol, 12 mg/dL acetone and cannabinoids.

Case 5

A 69 year old woman who had a history of confusion and a tendency to wander was found dead on a snow bank. Abrasions and lacerations were found to her face, knuckles and knees. The cause of death was listed as "consistent with death from exposure".

The blood of the deceased contained 2 mg/dL acetone and therapeutic concentrations of salicylate and diazepam. The urine contained 2 mg/dL acetone.

Case 6

A man in his twenties, who went duck hunting in November, had a boating accident while trying to cross a large lake. The body was found one day later. The cause of death was reported as "aspiration and hypothermia".

The blood contained no alcohol or acetone. The urine contained 1 mg/dL acetone.

DISCUSSION

Exposure to cold represents a strong metabolic stress in man (4). One of the responses to cold exposure is an increase in the release of the catecholamines, epinephrine and norepinephrine(5). The release of catecholamines results in an increase of free fatty acids (FFA) and ketone bodies (7,8,9). Increased concentrations of catecholamines have been reported in hypothermia deaths (6,7).

The mechanism for the elevated acetone concentrations in hypothermia victims is similar to that proposed in our earlier report (1) and is outlined in Figure 1. Cold stress results in the release of catecholamines, with subsequent fatty acid mobilization. The consequences of increased FFA in the blood include an increase in the ketone body concentrations in the blood and urine, with peak values usually reached in the blood 40 to 90 minutes after the initial appearance of the catecholamines (10,11). A recent study of hypothermia deaths indicates that, in the majority of cases, the duration of cold exposure was 3-6 hours at -10°C (6), thereby allowing adequate time for the development of the stress response and the resultant ketone body production.

Hypothermia as a cause of death is difficult to determine during autopsy (7,12). Elevated acetone concentrations in absence of physical trauma or other causes (eg. diabetes, starvation) may provide another indication of hypothermia.

CONCLUSION

Elevated acetone concentrations have been detected in the blood and urine of, hypothermia victims and may be an indication of prolonged exposure to cold.

M.J. Ward
J.B. Wigmore
Centre of Forensic Sciences

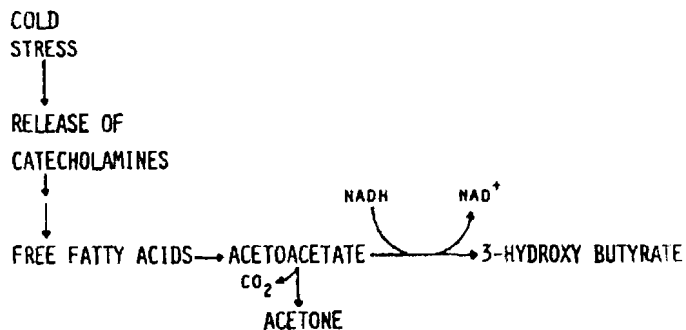


FIGURE 1: COLD INDUCED KETOGENESIS

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