

**CASE REPORT****PATHOLOGY/BIOLOGY**

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**Urinary Incontinence, Hyperthermia, and Sudden Death**

**ABSTRACT:** An 84-year-old woman is reported whose death was associated with strenuous exercise on an extremely hot day (maximum temperature = 43.1°C, 109.6°F). At autopsy there was evidence of exposure to high environmental temperatures with early putrefactive changes and mummification. There was underlying cardiomegaly with mild pulmonary emphysema. No significant injuries were detected. Toxicology revealed therapeutic levels of oxybutynin prescribed for urinary stress incontinence. Death was considered to be heat related, exacerbated by oxybutynin therapy, exercise, and cardiomegaly. Given that it has been predicted that there may be an increase in the number of heatwaves and in their intensity and duration, it is possible that such cases may be encountered more often in future. The assessment of all deaths occurring during conditions of extreme heat will require consideration of postmortem toxicology, particularly if there are underlying conditions such as stress incontinence that may be associated with anticholinergic drug therapy.

**KEYWORDS:** forensic science, hyperthermia, heat-related death, anticholinergic medication, stress incontinence

Heat related deaths are sometimes difficult to investigate as environmental and body core temperatures are often not taken during scene investigations, and high ambient temperatures accelerate putrefactive changes thus complicating diagnoses (1). Risk factors include prolonged heat exposure, old age, underlying medical conditions, and certain medications (2). A case of collapse in an elderly woman associated with medication prescribed for urinary incontinence is described to demonstrate the problem of anticholinergic drug administration during times of high temperature.

**Case Report**

An 84-year-old woman was found collapsed in the driveway of her home underneath her bicycle, surrounded by shopping items. It appeared that she had cycled to nearby shops during a heatwave when the maximum daily temperature had been 43.1°C (109.6°F). Her past history included arthritis for which she was prescribed analgesics and stress incontinence for which she was prescribed oxybutynin.

At autopsy there was evidence of exposure to high environmental temperatures with early putrefactive changes and mummification. No significant injuries were detected and there was underlying cardiomegaly (heart weight 487 g; body weight 58 kg) with mild pulmonary emphysema. There were no other significant pathological abnormalities. A previous total hip replacement for arthritis was noted. Toxicological evaluation of blood revealed therapeutic levels of oxybutynin, morphine, and codeine. No other anticholinergic drugs were identified. No body or adjacent environmental temperatures had been taken. Death was considered accidental and heat-

related, exacerbated by oxybutynin therapy, exercise, and cardiomegaly.

**Discussion**

Some communities, including South Australia, have recently been experiencing higher than normal temperatures (3). One consequence of warmer than usual ambient temperatures is the possibility of an increase in the number of heatwaves and in their intensity and duration (4). This will have the unfortunate consequence of increasing the number of heat-related deaths (5) that present for medico-legal investigation. Such deaths would be expected to be more common in individuals in high-risk groups or in those exposed to certain situations where environmental temperatures are excessive.

In a previous study from South Australia, those whose deaths were thought to be related to high environmental temperatures included tourists who were not acclimated to the harsh Australian climate, and individuals who were obese, wore excessive clothing or had underlying conditions such as dementia or alcoholic liver disease. Intoxication with alcohol and the ingestion of certain medications such as benzotropine and trifluoperazine were also significant contributory factors (2). Lethal hyperthermia may also occur in localized environments such as in saunas or sweat lodges being used for “new age” ceremonies (6). The literature identifies the elderly and urban poor as vulnerable groups, in addition to those with alcoholism or significant cardiovascular, cerebrovascular, and respiratory disease (2,4).

Prescription medications that may predispose to hyperthermia include drugs with anticholinergic effects such as tricyclic antidepressants and antihistamines, in addition to certain antiparkinsonian drugs and neuroleptic drugs such as some of the major tranquilizers (7). Hyperthermia occurs due to interference with normal thermoregulation from reduced sweating. Illicit drugs such as

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Received 23 Mar. 2010; and in revised form 11 June 2010; accepted 10 July 2010.

to cocaine, “ecstasy” (3,4-methylenedioxymethamphetamine or MDMA) and other ring-derivative amphetamines may also cause lethal hyperthermia. The mechanism of hyperthermia in these cases is believed to involve alteration of central nervous system neurotransmitter levels, such as dopamine and serotonin, in addition to noradrenergic effects (8).

Urinary stress incontinence refers to involuntary loss of urine associated with an increase in intra-abdominal pressure from coughing, laughing, or sneezing. It is a common problem affecting more than a third of women aged over 40 years (9). One of the standard treatments for stress incontinence involves the use of anticholinergic medications such as oxybutynin (10) that function by increasing bladder outlet resistance. A side effect is to reduce sweating, a major method of decreasing body temperature during hot weather.

In the reported case an elderly woman with underlying cardiomegaly had undertaken strenuous exercise in extremely hot weather. An additional contributory factor was the presence of a therapeutic level of oxybutynin in the blood. Oxybutynin has anticholinergic effects and is contraindicated in individuals exposed to high environmental temperatures, particularly if there is excessive exercise. This is clearly pointed out in the manufacturer’s literature.

The significant issues that are raised by this case include the use of an anticholinergic drug in conditions of extreme heat, exacerbated by exercise. When heatwaves occur pathologists should be cognizant of the possibility of prescribed medications initiating fatal hyperthermia, and should also be aware of the range of common conditions that may involve the use of anticholinergic medications. Thus, despite stress incontinence being an apparently innocuous and incidental condition, it most likely played a pivotal role in death. Given the incomplete nature of medical information provided at the time of autopsy, routine toxicology is advisable in all cases where there has been exposure to high temperatures so that the potential side effects of prescribed medications will not be overlooked.

#### *Acknowledgment*

We would like to thank the South Australian State Coroner, Mr. M. Johns, for permission to publish selected details of this case.

#### **References**

1. Byard RW, Farrell ER, Simpson E. Diagnostic yield and characteristic features in a series of decomposed bodies subject to coronial autopsy. *Forensic Sci Med Pathol* 2008;4:9–14.
2. Green H, Gilbert J, James R, Byard RW. An analysis of factors contributing to a series of deaths due to exposure to high environmental temperatures. *Am J Forensic Med Pathol* 2001;22:196–9.
3. Wassel JJ. Public health preparedness for the impact of global warming on human health. *Am J Disaster Med* 2009;4:217–25.
4. O’Neill MS, Carter R, Kish JK, Gronlund CJ, White-Newsome JL, Manarolla X, et al. Preventing heat-related morbidity and mortality: new approaches in a changing climate. *Maturitas* 2009;64:98–103.
5. Whitman S, Good G, Donoghue ER, Benbow N, Shou W, Mou S. Mortality in Chicago attributed to the July 1995 heat wave. *Am L Pub Health* 1997;87:1515–8.
6. Byard RW, Riches KJ. Dehydration and heat-related death. Sweat lodge syndrome. *Am J Forensic Med Pathol* 2005;26:236–9.
7. CDC. Heat-related illnesses and deaths: Missouri, 1998, and United States, 1979–1996. *MMWR* 1999;48:469–73.
8. Byard RW, Gilbert J, James R, Lokan RJ. Amphetamine derivative fatalities in South Australia—is “Ecstasy” the culprit? *Am J Forensic Med Pathol* 1998;19:261–5.
9. Caruso DJ, Gomez CS, Gousse AE. Medical management of stress urinary incontinence: is there a future? *Cur Urol Rep* 2009;10:401–7.
10. Hay-Smith J, Herbison P, Ellis G, Morris A. Which anticholinergic drug for overactive bladder symptoms in adults. *Cochrane Database Syst Rev* 2005;3:CD005429.

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