

## H82 The Relationship Between Wischnewski Spots and Stress Hormones During Hypothermia

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**Learning Overview:** After attending this presentation, attendees will know the main risk factors of hypothermia in Japan, and the hypothermia animal model could be expected to help clarify the mechanisms underlying Wischnewski spots in hypothermia.

**Impact on the Forensic Science Community:** This presentation will impact the forensic science community by identifying additional morphological and pathological findings in regard to hypothermia.

Numerous classical morphologic findings are commonly associated with the diagnosis of hypothermia, including Wischnewski spots (gastric erosions), color differences between left and right heart blood, frost erythema, and urinary retention. In general, risk factors for hypothermia include being a child or elderly, cold environmental conditions, wet clothing, being under the influence of alcohol or drugs, head trauma, decreased production of body heat, and malnutrition. There are many methods for creating a hypothermia animal model. For example, in the water bath model, a young animal is placed in a refrigerator at -20°C until the core body temperature drops below 35°C. Then, the animal is placed in a Styrofoam™ box packed with ice. However, with such methods, morphologic features such as Wischnewski spots do not develop. The present study developed a hypothermia animal model based on risk factors and characteristic morphologic findings (including adrenal glands.)

Risk factor analysis was performed based on the records of autopsies performed between 2008 and 2018. Eighty-three deaths related to either hypothermia or secondary cold exposure were investigated. Sex, age, Body Mass Index (BMI), medical history, clothing, prescription medicine, urinary bladder and stomach contents, Wischnewski spots, blood alcohol level, detected drugs, and autopsy findings were reviewed. Out of 83 autopsies, 52 deaths were attributed to hypothermia and 31 involved secondary cold exposure. The decedents ranged in age from the high 60s to the 80s, with 26% more males than females. Regarding the BMI, 47% were underweight, and 43% were normal weight. Medical records showed that the most common condition in decedents was a history of high blood pressure ( $n=23$ ), followed by dementia ( $n=13$ ). Most cases showed evidence of paradoxical undressing ( $n=58$ ). Overall, no stomach contents were found in 76% of the cases, and Wischnewski spots were present in 92%. In addition, 45 cases in which Wischnewski spots were present showed evidence of being under the influence of alcohol. Postmortem toxicologic analysis showed evidence of opioids and barbitals ( $n=5$ ), benzodiazepines ( $n=4$ ), and tricyclic antidepressants ( $n=3$ ).

For the corresponding hypothermia animal model, Sprague Dawley rats were used and cold exposure conditions were created based on the human risk factors. Computed Tomography (CT) was used for postmortem imaging after cold exposure. The adrenal glands, stomach, and intestines were fixed in 4% paraformaldehyde embedded in paraffin. Each section was stained with the stress hormone corticosterone, hematoxylin, and eosin. With this animal model, Wischnewski spots were observed under the following conditions: an environmental temperature below 5°C, being under the influence of alcohol (2%), and if the animal model was hairless and the age group was 15~30 weeks. Fasting and water deprivation for three days resulted in the expression of Wischnewski spots involving more than 90% of the stomach; however, emphysema was not seen on Computed Tomography (CT). Regarding the immunohistologic findings, in the adrenal glands, corticosterone was mainly localized in the cytoplasm for the alcohol-induced, fasting, and dehydrated hypothermia model. Positive staining was seen in 60~80% of the zona fasciculata cells. Therefore, an animal model of hypothermia was established based on risk factors and morphological findings. Most of the classical morphological findings, including color differences between the left and right heart blood, retained urine contents, and the presence of Wischnewski spots, were visible in this animal model.

### Hypothermia, Animal Model, Risk Factors