K7 Hydrogen Sulfide (H_2S) Poisoning in the Workplace: Toxicological Investigations in a Fatal and Non-Fatal Accident

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After attending this presentation, attendees will understand that in cases of occupational asphyxiation, it is important to both conduct a complete postmortem toxicological analysis and to perform accurate scene investigations supported by environmental-toxicological monitoring.

This presentation will impact the forensic science community by highlighting the usefulness of the measurement of thiosulfate that represents an important step in a toxicological investigation of H_2S poisoning because it can supply information regarding the time of death and toxicokinetics.

H_2S is a toxic gas involved in deaths in the workplace. Few cases have been reported in the literature and the accident occurs predominantly in the sour gas industry and in other industrial settings.

The reported case regards fatal and non-fatal intoxications due to H_2S asphyxiation involving six seamen who were working on a ferryboat.

Accident scene reconstruction revealed that three workers had to remove the waste fluid from a bilge of the ferryboat. The first victim unscrewed bolts of the bilge manhole and in a few minutes fell unconscious. Two other seamen who saw what happened asked for help and approached the subject, but they too fell unconscious. Three other workers arrived to move the three unconscious seamen and only one had a protective mask. The first victim died in the workplace, the second one died in the ambulance, while the third one died in the emergency room. Of the remaining three workers, one had a severe pulmonary edema that required intensive treatment, the second had pulmonary injuries also involving the heart, and the third, who wore the mask, had lung injuries.

Toxicological environmental analyses were performed two hours after the accident on air samples from the bilge, the area in front of the bilge manhole, and on the waste fluid collected from the bottom of the bilge. The analyses revealed high levels of H_2S in all specimens.

Autopsies were performed after 48 hours and the findings were the same for all the victims, showing edema of the lungs and multi-organ congestion.

Toxicological analyses were performed both on venous blood taken from the living subjects on arrival at the emergency room and on femoral blood and urine taken during autopsy to evaluate the presence of volatile hydrocarbons, carbon monoxide, hydrogen cyanide, and H_2S. Results from the surviving workers were negative and, in particular, H_2S concentrations were below the quantification limit, being already biotransformed and eliminated in the urine, either in the form of unmodified sulfide or as thiosulfate. In the deceased workers, the toxicological investigation was positive for high levels of H_2S; thus, thiosulfate research was performed to distinguish between the H_2S concentrations in blood secondary to lethal poisoning and those produced by a putrefactive phenomena. Thiosulfate evaluation revealed significant levels in femoral blood (45.7µg/ml) and even more in the urine (510.1µg/ml) belonging to the first decedent. Lower levels were observed in samples from the second decedent (blood: 35.5µg/ml; urine: 10.4µg/ml). Even lower levels were determined in the blood of the third decedent (21.5µg/ml) and no measurable concentrations were in the urine.

These findings demonstrated that the seamen died from asphyxia due to H_2S poisoning. Moreover, the toxicological results allowed for the evaluation of several different survival times. In fact, the first seamen survived for a longer time because metabolism of much of the inhaled sulfides had occurred and a high amount of metabolite (thiosulfate) had eliminated in the urine. The second worker survived briefly and was able to metabolize a smaller amount of sulfides and to eliminate a small amount of thiosulfate in the urine. Finally, the third survived for a very short time because the urine thiosulfate was negative.

This presentation also highlights the importance of safety devices used as well as compliance to the relative Italian legislation.

Hydrogen Sulfide, Toxicological Analysis, Occupational Accident