

Non-Intentional Motor Vehicle-Related Carbon Monoxide Deaths-Revisited

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Summary. A study of non-intentional, motor vehicle-related, carbon monoxide-related deaths was performed on the case files of the Office of the Medical Examiner of Metropolitan Dade County in Miami, FL (USA) during the years 1980–1984. A total of 15 cases were collected during that time period. These are presented in some detail. A discussion ensues that compares the similar circumstances of these cases, notably running the engine of an automobile in an enclosed space, with older reports in the literature which emphasized defective vehicle exhaust systems as the leading etiology for these deaths.

Key words: Carbon monoxide poisoning, accidents – Traffic, carbon monoxide poisoning – Environmental health, automobile exhaust

Zusammenfassung. Eine Studie über unbeabsichtigte, kraftfahrzeugbedingte Kohlenmonoxid-Todesfälle wurde am Fallmaterial des „Office of the Medical Examiner of Metropolitan Dade County in Miami, FL (USA)“ durchgeführt, welche sich auf die Jahre 1980–1984 erstreckte. Insgesamt wurden 15 Fälle während dieser Zeitperiode zusammengetragen, die im einzelnen dargestellt werden. In der Diskussion werden die ähnlichen Umstände dieser Fälle, speziell der laufende Motor eines Automobils in einem geschlossenen Raum, mit älteren Berichten in der Literatur verglichen, die ein defektes Auspuffsystem als leitenden ätiologischen Faktor dieser Todesfälle betonen.

Schlüsselwörter: Kohlenmonoxidvergiftung, Verkehrsunfall – Umwelteinflüsse, Kraftfahrzeugabgase

Introduction

One of the more preventable, insidious environmental health hazards is carbon monoxide poisoning [1]. Several thousands of individuals in the United States

die or are injured by this gas annually [1]. One of the more common ways that carbon monoxide poisoning occurs is the non-intentional scenario involving motor vehicle exhausts [2, 3]. However, despite the magnitude of this hazard, very few reports on the subject exist in the forensic literature. Those which deal with the subject [3–8] are either purely technical or anecdotal. Accordingly, this report was designed to study these deaths over a sufficiently long period to analyze whether or not there was a common pattern to the deaths. Furthermore, a comparison of these deaths in more recent times to older literature [3] on the subject is also appropriate. Truly, a new study on this subject is needed.

Material and methods

Metropolitan Dade County in Miami, FL (USA) is a community of 2,000 square miles (5,128 km²), and a 1984 estimated population of 1,734,000 inhabitants. It is a traditional resort and retirement area. The Office of the Medical Examiner is empowered by statutory law to investigate all deaths which occur within the county of a violent, unnatural, or unexpected means. Approximately 3,500 cases are investigated annually, and of these an estimated 2,800 cases are autopsied. For this report, all cases of non-intentional carbon monoxide poisoning which were related to motor vehicles were collected during the years 1980–1984. These cases are presented in some detail. Of additional relevance is that the carboxyhemoglobin values reported in the case studies are determined using a visible light-spectrophotometric method [9] with an IL282 CO-Oximeter (Instrumentation Laboratory, Lexington, MA 02173, USA).

Case Reports

Case 1 (ME 84-3037)

Mr. C., a 20-year-old white man, was last seen alive on November 10, 1984. He was a carnival worker with a stable residence. After several days of not being heard from, the victim's brother-in-law became concerned. The brother-in-law then searched for him and proceeded to a warehouse where the family kept a motor home.

Upon entering the warehouse, the victim was found inside the locked motor home. The ignition was "ON," the air-conditioner was "ON" and the gas gauge was empty. Evidently the decedent was "living" in the motor home and "ran" the engine for the air-conditioning. At autopsy, the victim was decomposed and exhibited a cherry red lividity. Toxicologically, the heart blood carboxyhemoglobin was 64%, the heart blood ethanol was 0.01%, and the Urine EMIT drug screen was negative.

Cases 2 and 3 (ME 84-1988 and 84-1989)

Mr. J., a 34-year-old black man, and Miss C., a 25-year-old black woman, were found lying across the front seat of a 1978 Chevrolet Blazer jeep type vehicle which was parked inside the garage of a "paint and body" motor vehicle repair shop. The "roll down" door of the garage was locked, and the engine of the vehicle was "running."

Mr. J., who was partially nude, was resting on the driver's seat with his legs across the lap of Miss C., who was fully clothed. Both were decomposed. Subsequent investigation of the scene and the motor vehicle revealed that a new engine had been installed 1 month ago. The owner had complained of "dense" exhaust fumes, and the vehicle was to be repaired. Furthermore, at a position 4 in. (10 cm) from the end of the tail pipe, the exhaust pipe was "rusted" through.

At autopsy, both Mr. J. and Miss C. were in an advanced stage of decomposition and without signs of trauma. Their decomposed brain ethanol levels were 0.29% and 0.25%, re-

spectively. Both did not exhibit carbon monoxide upon analysis of decomposed muscle. However, since carbon monoxide determination on decomposed tissue can be problematic [10], in the absence of trauma or natural disease and on the basis of the scene circumstances, the cause of the deaths was certified as carbon monoxide intoxication.

Cases 4 and 5 (ME 84-1864 and 84-1865)

Mr. A., a 55-year-old white man, went to visit his former wife, Mrs. Y. A., a 54-year-old white woman, at her home at approximately 12:30 a.m. The couple went to his automobile, a 1965 Ford Fairlane two-door sedan, parked in the driveway. Later in the morning, both victims were found dead in the front seat of the vehicle. Mr. A. had his genitals exposed and Mrs. Y. A. was leaning on him. The air-conditioner was "ON," and the engine was "running" with blue exhaust type smoke observed *inside the vehicle*.

At autopsy, Mr. A. was a well-developed obese male with a pinkish discoloration. Toxicologically, the heart blood ethanol was 0.12%, the carboxyhemoglobin was 74.3%, and the Urine EMIT drug screen was negative. Mrs. Y. A. was a well-developed, well-nourished female likewise with a pinkish discoloration. Toxicologically, the heart blood ethanol was negative, the carboxyhemoglobin was 71.9%, and the Urine EMIT drug screen was negative.

Case 6 (ME 84-86)

Mr. D., a 40-year-old black man, reportedly "lived" inside his vehicle, a 1972 Buick Skylark sedan. He was last seen alive on January 8, 1984, at 1:00 a.m. He was found by friends at 4:15 p.m. inside his automobile which was parked in the parking lot of a Chevron gasoline station. The victim was lying in the rear seat fully clothed. There were no signs of trauma. However, police observed a barrel container of charcoal, still warm, on the front seat of the car. Evidently the victim, while inebriated, placed the charcoal containing drum inside the car with the coals still burning for warmth and the windows closed as he slept. Numerous beer containers were found in the vicinity of the vehicle.

At autopsy, this black man was without trauma. However, all internal organs assumed a pinkish discoloration with passive congestion of the viscera. Toxicologically the blood ethanol was 0.1%, the carboxyhemoglobin was 73.5%, and the Urine EMIT drug screen was negative.

Cases 7 and 8 (ME 83-2738 and 83-2739)

Mr. R., a 28-year-old white man, and Miss V., a 22-year-old white woman, were parked on the street in a 1975 Ford two-door sedan. Both victims were undressed from the waist down lying on the front seat. Miss V.'s head was in Mr. R.'s lap. It was additionally observed that the windows were in the "up" position, the ignition key was in the "ON" position, the air-conditioner was "ON," and the fuel gauge was empty. Additional examination of the car revealed that the tail pipe had been shortened. This shortening resulted in the exposure of the passenger compartment to exhaust fumes.

At autopsy, Miss V. exhibited a cherry red discoloration and pulmonary edema. The blood ethanol was negative, the carboxyhemoglobin was 73%, and the Urine EMIT drug screen was negative. Mr. R. likewise exhibited a cherry red discoloration and pulmonary congestion. The blood ethanol was 0.01%, the carboxyhemoglobin 73%, and the Urine EMIT drug screen was negative.

Case 9 (ME 82-2664)

Mr. V., a 30-year-old white man, was involved in a violent domestic argument with his girl friend on September 19, 1982, at approximately 10:00 p.m. Subsequently, he drove away in his 1974 Ford two-door motor car. Upon returning home he drove to his parking space but did not enter his apartment. At 7:00 a.m. they awoke and observed his vehicle in the parking space but did not examine it further until 1:30 p.m. At that time, the victim was observed in the driver's seat "slumped over" with a cherry red discoloration. The ignition switch was

"ON," the air-conditioner was "ON," the windows were closed and both doors were locked. Subsequent examination revealed that the tail pipe was "broken off" by the left rear wheel well and attached to the vehicle by a wire clothes hanger. Inside the vehicle two empty beer bottles were on the floor and a half empty beer bottle was found next to the decedent.

At autopsy, the victim was slightly decomposed with a cherry red lividity. Severe pulmonary edema was observed. Toxicologically, the heart blood ethanol was 0.11%, the heart blood carboxyhemoglobin was 97%, and the Urine EMIT drug screen was negative.

Case 10 (ME 82-1645)

Mr. O., a 41-year-old white man, was last seen alive on June 9, 1982, when he returned his girl friend to her home after a date. He had been drinking moderately. He was not heard from at work over the next 2 days. Accordingly, police were summoned to his residence. Upon their arrival, the victim was discovered in the driver's seat of his car inside his garage which has an automatic door opener. The ignition was "ON," the battery was "dead," and the transmission was in "neutral." It appeared as though he had entered the garage, closed the garage door with the remote control device, "passed out" due to drinking alcohol, and left the motor "running." He was overcome by exhaust fumes even though his car's exhaust system was without defect.

At autopsy the decedent was decomposed and exhibited a "cherry red" discoloration. Toxicologically, the heart blood ethanol was 0.15%, the carboxyhemoglobin was 72.5%, and the Urine EMIT drug screen was negative.

Case 11 (ME 82-273)

Ms. P., a 47-year-old white woman, was last seen alive on January 22, 1982, at which time she was drinking alcohol-containing beverages. She had had a recent marital separation and was living in a rented warehouse. On January 26, 1982, at approximately 12:45 p.m., the decedent's husband, with the aid of a locksmith, entered the warehouse and found the decedent dead. She was fully clothed lying supine on the floor adjacent to the right rear side of a truck parked inside the warehouse. The truck's ignition was "ON," the doors were locked, and the vehicle was out of gasoline. The exhaust system was not defective and extended out from the left rear side.

It was hypothesized that the victim was originally inside the vehicle with the air-conditioner "running." Evidently, she exited the vehicle and locked herself out with the keys inside the vehicle. The engine was still running. She left to go to call for help but was overcome by the exhaust fumes.

At autopsy the victim was an emaciated female who was decomposing slightly and who exhibited a "cherry red" lividity. Toxicologically, the blood ethanol was 0.25%, carboxyhemoglobin was 76.2%, and the Urine EMIT drug screen was negative.

Case 12 (ME 81-1957)

Mr. L., a 19-year-old black man, was a derelict who slept anywhere he could find a vacancy. On July 6, 1981, at approximately 1:00 a.m., he went to a local Chevron gasoline station and asked the owner for a place to stay. The owner turned him away. At 7:00 a.m. the owner returned only to find the victim dead in a truck parked inside the garage. Further examination revealed that the victim was lying in the front seat of the passenger compartment of a 1978 "pickup" truck with the ignition "ON," the air-conditioner "ON," and the vehicle out of gasoline. The windows of the vehicle were closed. The police hypothesized that the victim broke through a "boarded" area in a window of the garage and sought shelter in the truck. He turned the ignition "ON" for the air-conditioner and was overcome by the truck's exhaust fumes in the closed environment.

At autopsy the victim exhibited a pinkish discoloration to the internal viscera. Toxicologically, the blood ethanol was negative, the carboxyhemoglobin was 71.6%, and the Urine EMIT drug screen was negative.

Case 13 and 14 (ME 81-1620 and 81-1621)

At 2:45 p.m. on May 31, 1981, Mr. D., a 25-year-old white man, and Miss S., a 35-year-old white woman, were both found nude inside a 1979 Dodge van. This van was parked inside the garage of a service station at which Mr. D. worked. The ignition was "ON," the air-conditioner was "ON," and the battery was dead. The bay windows of the garage were closed. On the day the victims were found, the boss called at 11:30 a.m. but received no answer. Accordingly, police were summoned. It is hypothesized that Mr. D. and Miss S. met for a lover's trust. After operating the van for the air-conditioning, they were overcome by the exhaust fumes in the closed environment.

At autopsy, Mr. D. was decomposed and exhibited a pink coloration to all internal viscera. Toxicologically, the blood ethanol was 0.07% and the carboxyhemoglobin was 82.6%. Miss S. was decomposed and exhibited a bright red discoloration to her internal organs. Her blood ethanol was 0.05% and carboxyhemoglobin was 82.1%.

Case 15 (ME 80-1972)

Mr. B., a 20-year-old black man, entered his 1968 Chevrolet Impala sedan at approximately 1:30 a.m. on July 10, 1980, to sleep in the vehicle with the air-conditioner "ON." At approximately 6:00 a.m. the victim's mother came outside the house to awaken the victim. However, despite shutting off the engine at 2:00 a.m., she found him dead in the back seat of the vehicle with the engine "running" and the air-conditioner "ON." The doors of the vehicle were unlocked. Accordingly, the police were summoned. Subsequent examination of the vehicle revealed that the exhaust pipe of the vehicle was bent in such a way as to force fumes into the vehicle's trunk.

At autopsy there was generalized visceral congestion with scleral capillaries exhibiting a pink discoloration. Toxicologically, the blood ethanol was 0.02% and the carboxyhemoglobin was 71.7%.

Discussion

Non-intentional carbon monoxide fatalities, which are related to motor vehicles, are rare. During the 5-year period of this study these 15 cases accounted for 0.87% of the 1,734 non-vehicular accidental or 0.78% of the 1,934 vehicle accidental fatalities which occurred in Dade County, FL (USA) (N.B. Both categories are given depending upon which classification the reader places these types of death.) Given this rarity, the reader is cautioned in forming any conclusion or generalized implication from this study. However, even if this type of death is rare, it is still worthwhile to study since reports on this subject are few and somewhat "dated." Accordingly, although it is now a rare type of death in Dade County, is it useful to study for whatever implications it may have.

The implications of this study are both theoretical and practical. Theoretically, these cases may be compared to other studies on this subject [3]. It appears that this type of death is occurring with less frequency than in previous years [3]. However, since the other study [3] did not give what percentage of accidents their cases comprised, and further comparison of frequency is unwarranted, evidently other differences also exist. Defective exhaust systems currently are *not* common as an etiologic agent; using an engine in an enclosed space is. Furthermore, in Dade County, being semi-tropical, motor vehicle air-conditioning appears to be the motivating factor for these deaths. Alcohol acts as a catalyst (cf. Cases 6, 9, 10, and 11) with a lover's trust being a common scenario (cf.

Cases 2–5, 7, 8, 14, and 15). Other researchers [3] report similar reasons for the victim to use the motor vehicle; albeit, in a colder climate for warmth. Practically, this study and others [3] point out the need for careful scene investigation and correlation with autopsy findings. Thus, an “autopsy” of the environment may be as important as the autopsy of the victim.

A role for future work in this type of case exists. First, this writer encourages forensic scientists in all countries to write on this subject using modern case material, if possible. Secondly, public education as to the hazard of using a motor vehicle in enclosed spaces (e.g., garages with automatic doors) should be given by the forensic scientist in an effort to eliminate this type of death. Thirdly, periodic examination of the exhaust system of motor vehicles should be mandatory. It is hoped that such future work by the forensic scientist can have a favorable impact on the environment.

In summary, motor vehicle, non-intentional carbon monoxide deaths, as they occur in Dady County, FL (USA) were presented. Predominantly, human ignorance along with alcohol are the fundamental reasons for this type of death. Essentially, people use vehicles in enclosed spaces (e.g., garages, warehouses) which allow a “build up” of exhaust fumes. Defective exhaust systems are not that common in modern times. A discussion ensues as to the theoretical and practical implications of these cases along with the role for future work in this field.

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