



## Pathology/Biology Section - 2016

---

### H87 Deaths Due to Carbon Monoxide Intoxication Involving Burning Charcoal Briquettes in Enclosed Spaces

*Patricia Aronica, MD\*, OCME, 900 W Baltimore Street, Baltimore, MD 21223; Jack M. Titus, MD, OCME, 900 W Baltimore Street, Baltimore, MD 21223; and David R. Fowler, MD, OCME, 900 W Baltimore Street, Baltimore, MD 21223*

---

After attending this presentation, attendees will have a complete understanding of carbon monoxide-involved deaths due to the burning of charcoal grills in enclosed spaces.

This presentation will impact the forensic science community by serving as a review of the demographics, toxicology findings, and manner classification of charcoal-related carbon monoxide deaths for comparison to other similar future cases.

Carbon monoxide is an odorless, colorless, and tasteless gas produced from the partial oxidation of carbon-containing compounds when oxygen is insufficient in supply to complete oxidation to carbon dioxide. Sources include cigarette smoke, house fires, and the burning of fuels in cars or trucks, small engines, boats, stoves, lanterns, fireplaces, gas ranges, furnaces, or grills. Charcoal grills use either charcoal briquettes or all-natural lump charcoal as the fuel source. Human exposure to carbon monoxide generally occurs indoors or in semi-enclosed spaces where the oxygen supply may be limited.

A ten-year retrospective search of the electronic database of the Office of the Chief Medical Examiner for the State of Maryland from 2005 to July of 2015 was performed searching for carbon monoxide in the cause-of-death line. Fire-related deaths were excluded. This list was further narrowed to those with grill and/or charcoal listed in the body of the report.

The search revealed 204 cases in which carbon monoxide intoxication or toxicity was listed as the primary cause of death and in which fire-related deaths were excluded. Of these cases, 85 involved vehicle exhaust, 40 involved generators, 17 involved furnaces/hot water heaters, 13 involved lawn mowers, 7 involved space heaters, 5 involved boats, 3 involved gas stoves, 3 involved power tools, 2 involved snow blowers, 4 involved miscellaneous, and 20 involved the burning of a charcoal grill in an enclosed space. In 5 cases, the cause of death was unknown. Of the 20 cases involving charcoal grills, 14 were male and ranged in age from 19 years to 52 years of age with an average age of 39 years. The grills were located in a motor vehicle in 13 cases (65%), in a bathroom in five cases (25%), and 1 case each in a bedroom and an office. Carbon monoxide saturation levels in the cases involving grills ranged from 46% to 81%, overall. Ethanol was positive in 60% of the cases and other drugs were positive in 45% of the cases. Drugs identified were diphenhydramine (three cases), citalopram (three cases), and one case each of venlafaxine, doxylamine, tramadol, and amphetamine. In one case, multiple other drugs were detected. Of the cases in which drugs and/or ethanol were detected, the levels could be considered potentially lethal in three cases. Manner of death was classified as suicide (19) and undetermined (1). Suicide notes and/or e-mails were present in 70% of the cases. No cases of homicide or accident were noted in the grill cases. Body position of the decedent, location in the vehicle/home, charcoal grill type, and position of the charcoal grill varied; however, the most common decedent location was reclined slightly in the driver's seat (7). None of the vehicles or home areas showed extensive internal fire damage. Most of the damage was heat-related and occurred at a point beneath the placement of the grills in the vehicles. Two individuals were found on top of or very close to the grills and showed postmortem thermal injuries on the areas of the body closest to the grills.

In conclusion, carbon monoxide-related deaths involving charcoal grills were not uncommon, representing approximately 10% of non-fire-related deaths in the past ten years in Maryland. The most common enclosed space that the grills were placed was within a motor vehicle. Because enclosed spaces have a limited oxygen supply, this allows for easier production of carbon monoxide by incomplete oxidation of the charcoal to carbon monoxide. In addition, the low and restricted oxygen levels would be associated with little flame damage and a smoldering of the briquettes with very little soot production as the limited oxygen supply would be quickly depleted.

---

#### Carbon Monoxide, Charcoal, Grills