

# Carbon Monoxide Poisoning: Some Aspects of the Problem in Great Britain

A. KEITH MANT

*Department of Forensic Medicine, Guy's Hospital,  
University of London, England*

In Great Britain, until recently, domestic gas was made from coal and was always referred to as "coal gas." Today we are beginning to use natural gas, and the term coal gas is being replaced by "town gas." Most of the domestic supply, however, is still coal gas, which has a high though variable percentage of carbon monoxide (Mant, 1964). In any event it is always present in a highly lethal concentration. As coal gas is so readily available, it has been the most popular suicidal poison for many years, although the recent figures show that barbiturates are overtaking it in popularity. Nevertheless, out of the 5,000 odd suicides that occur annually in England and Wales, some two-fifths are due to coal gas poisoning. Perhaps even more alarming are the 1,000 odd persons each year who die from some form of accidental carbon monoxide poisoning, usually due to the accidental release of coal gas.

*Suicide* by coal gas rarely presents any medico-legal problem. In the majority of cases the suicide makes himself or herself comfortable for the act of self-destruction. The most popular method is to use the gas oven, and in a typical case the oven shelves are removed and a pillow or cushion, upon which the suicide puts his head, is placed inside. In some cases a blanket or coat is thrown over the oven, and some gesture may be made to seal the doors and windows. In a relatively small number

of cases a suicide note is left, although the more thoughtful may pin a warning on the kitchen door—"Danger—Gas." In other cases the suicide may make up a bed on the floor near a gas point, or go to bed and lead a flexible tube from the gas point beneath the bed-clothes. Coal gas suicides only become suspicious when relatives or friends alter the scene in an endeavour to mislead the authorities.

Cases of *accidental* carbon monoxide poisoning, however, are of great medico-legal interest. Accidental deaths from this cause have risen rapidly since World War II and now stand at over 1,000 per annum. The increase during the last 20 years is not as great as it would at first appear. Until the end of the last war the numbers of autopsies carried out on old persons who had apparently died a natural death were relatively few. Today they are frequent in all large urban areas, and, as a result, many completely unsuspected cases of carbon monoxide poisoning—up to 40% in some series—are being discovered (Mant, 1960; Simpson, 1954). A number of cases of carbon monoxide poisoning are unassociated with the simple accidental release of coal gas, but are usually due to faulty ventilation where some form of gaseous, liquid or solid fuel burner is operating. This last group provides the greater medico-legal challenge.

Where death is due to the accidental release of coal gas, the vast

majority of deaths occurs among the very old. These old people have frequently lost their sense of smell, are deaf and partially blind, and their memories for very recent events are bad. Accidents usually occur because the old person has either turned on the gas and omitted to light it or made an attempt to light it and failed, without realizing the fact. In some cases where there are a number of burners on the top of a gas stove, one will be lit and another turned on but unlit. On examining the scene of such a fatality, one usually finds a kettle or some cooking appliance on the gas ring with unignited gas escaping. Spent matches or a faulty ignitor are usually evident. The deceased may not necessarily be found in the kitchen but in some other room, perhaps even on another floor. When one questions the relatives or neighbours, one frequently finds a history of the deceased having turned the gas on and failed to light it. In order to prevent this hazard the Gas Board has developed a number of safety appliances where the gas cannot flow unless a pilot light is first lit. The pilot light heats a bimetal strip which opens the valve when it is hot, and when the gas flows, it is ignited automatically. There are other devices which will automatically shut off the supply of gas to a piece of apparatus if the gas pressure should fall in the main supply. The gas will not flow through the apparatus when the pressure returns without the valve being deliberately released.

Many of the prewar hazards have now been neutralised. These included badly designed taps that could be turned on accidentally and burners which would operate with only some of the jets ignited, thus allowing the escape of gas into the room.

A number of deaths occurred towards the end of the war, and shortly thereafter, as the result of bomb damage to mains and old, inadequately maintained installa-

tions. Again it was the aged who were the principal victims, as they could not smell the escaping gas.

Deaths from inadequate ventilation or incomplete combustion of fuel are slightly more common in the 20-50 age group. It is this group of cases which emphasizes the great toxicity of carbon monoxide (Mant, 1964).

Fatalities occur in houses, bungalows, trailers or any other establishment where some form of combustion is used to provide heat and cooking facilities. In all cases there is some error in ventilation or in the efficiency of the system in use. Weather may be a precipitating factor. With normal weather conditions three complete air changes per hour take place in an average room when the windows and doors are closed. When there is thick fog these air changes may not take place, and so a heating system which is adequately efficient under normal conditions may convert a room, or even a house, into a lethal chamber.

The dangers associated with different kinds of heating systems will now be described.

#### Solid fuel boilers

Solid fuel boilers are used for central heating and supplying domestic hot water. A certain type of oven is also heated by solid fuel. Most of the fatalities are seen with the boiler which heats the domestic water supply. The apparatus itself is comparatively small and may have hand- or automatically controlled ventilation. Fatalities occur when soot or other debris blocks some part of the chimney system, or when the chimney becomes cracked and develops a leak. Some systems have a damper in the actual flue pipe that regulates the draught, and if the damper is closed, or the flue becomes partially blocked and too much ventilation is permitted below the boiler, the products of combustion, containing a variable volume of carbon

monoxide, will escape into the room. In most fatal cases associated with solid fuel boilers, one finds that the flue pipe has been blocked by a fall of soot or the chimney itself has been obstructed by soot at one of its angles.

In a typical case one finds the deceased lying in bed or in a chair as if asleep. If there are dogs in the house, they are frequently found dead with their noses pressed to the underside of the door, having died while endeavouring to breathe uncontaminated air.

Solid fuel boilers are also used to heat trailers which are permanently sited as year-round residences. In this group of fatalities it is invariably found that all forms of ventilation have been blocked.

#### Gas appliances

Any gas appliance, whether it burns coal gas, natural gas or butane, will produce carbon monoxide if it is used in a vitiated atmosphere. Fatalities have been seen where small flueless gas fires have been used for long periods in unventilated rooms and where unorthodox apparatus, such as a bucket with a long flange, has been used for boiling clothes over a gas ring. The initial coolness of the water and the air space due to the flange prevent the complete combustion of gas and, hence, cause the production of carbon monoxide.

In one case a young man was found dead in a trailer. The trailer was heated by a single-element butane gas fire. When the caravan was opened, the fire was noticed to be burning with a smoky flame which soon became clear when fresh air was admitted. A heavy deposit of soot lay beneath the element. Every ventilator in the caravan was blocked. It was found that even under these conditions the fire burned for four hours quite safely, but after this time the atmosphere became so vitiated that carbon monoxide evolved in an increasingly lethal concentration.

## Liquid fuel burners

Kerosene is used for central heating, portable space heaters and small cooking heaters. I have never seen a fatality associated with a central heating system, but I have seen several associated with the use of kerosene space heaters in trailers and bungalows. In one case a man used the popular type of kerosene pressure cooking ring in his caravan as a space heater and died from carbon monoxide poisoning. In each case evidence of incomplete combustion was apparent from the deposit of soot in the room where the heater was in use.

It is important to remember that where there is smoke there is incomplete combustion. A few years ago I examined an elderly couple who died from carbon monoxide poisoning which evolved from charring potatoes in a saucepan that had been allowed to burn dry over a paraffin heater.

The final example I shall give you is of a type of fatality already described (Mant, 1961). It is a case which really emphasizes the danger of carbon monoxide and the small volume necessary in the atmosphere to cause death. In this case a night worker returned home one foggy morning to find his wife dead in the kitchen. On the stove was a bucket on a simmering gas, and in the bottom of the bucket were six charring handkerchieves. Under normal weather conditions there was adequate air space around the two closed doors and through the air brick to provide regular changes of air. It was found that no incomplete combustion occurred under the bucket when the gas was alight, even when full on, but when material equivalent to six handkerchieves was allowed slowly to char in the bucket, a lethal concentration of carbon monoxide was present in the atmosphere after some 20 minutes.

## References

- MANT, A. K. Accidental carbon monoxide poisoning. *Medicolegal J.* 28: 30-39, 1960.
- . Carbon monoxide poisoning —an unusual case. *J. Forensic Med.* 8:134-138, 1961.
- . Accidental carbon monoxide poisoning with special reference to incomplete combustion. *J. Indian Acad. Forensic Sci.* 3:1-10, 1964.
- . The problem of carbon monoxide poisoning in Great Britain. *Virginia Med. Monthly* 91:50-56, 1964.
- SIMPSON, K. The danger of accidental carbon monoxide poisoning. A review of 100 cases. *Brit. Med. J.* 2:774-776, 1954.