

TITLE: INTRAOPERATIVE CARBON MONOXIDE TOXICITY

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For over a decade at this institution, all blood gas analyses have included measurement of carboxyhemoglobin (COHb). Over a twelve week period in 1990, three cases of unexplained elevation of COHb have been observed during general anesthesia. Case No. 1 was a 76-year-old female non-smoker who underwent thoracotomy for resection of substernal goiter. Anesthetic agents were midazolam, thiopental, fentanyl, enflurane and nitrous oxide. Vecuronium was used for neuromuscular blockade. Initial COHb determination 25 minutes after induction of anesthesia was 9.1%. One hour later the COHb level had risen to 28%. Another blood sample obtained revealed a measurement of 29%. These readings were confirmed on two different Instrumentation Laboratories Model 482 Co-oximeters. Following the third reading, nitrous oxide was discontinued, the O₂ supply was switched to the accessory tank and the COHb level decreased. Postoperatively, the patient complained of a headache and she was treated with hyperbaric oxygen at 2.4 ATA for 90 minutes, resulting in resolution of her headache. Analysis of wall gas supplies, using a Beckman Model 220 CO Monitor revealed 0 - 1 ppm CO. A gas sample obtained from the anesthesia circuit revealed 3 - 4 ppm CO. Case No. 2 was a 60-year-old woman smoker undergoing a total hip replacement. Anesthetic agents were midazolam, morphine, thiopental, nitrous oxide and enflurane. Vecuronium was used for neuromuscular blockade. Initial arterial COHb determination was 21.2%, 2 hours and 25 minutes after induction of anesthesia. A total of

3 blood samples revealed elevated COHb level, which peaked at 24.3%. Discontinuation of wall gas supply and nitrous oxide resulted in a decrease in COHb level. There were no adverse hemodynamic consequences and the patient was asymptomatic after awakening from anesthesia. Analysis of the wall gas supply (O₂ and N₂O) and the common gas outlet of the anesthesia machine revealed < 4 ppm CO. However, analysis of gas downstream from the CO₂ absorber revealed 409 ppm CO (Biosystems Toxic Gas Monitor, Rockfall, CT, Model 3300). The enflurane used for this anesthetic was analyzed using capillary column gas chromatography/mass spectrometry with electron impact ionization. There was no evidence of contamination. Case No. 3 was a 62-year-old non-smoking male who underwent wide excision of a left flank sarcoma under general anesthesia with thiopental, fentanyl, enflurane and nitrous oxide. Muscle relaxation was accomplished with vecuronium. The first arterial blood gas determination revealed COHb concentration of 8.7%, 20 minutes after induction of anesthesia. Peak level measured shortly afterward was 11.9%. Nitrous oxide was discontinued, new CO₂ absorbent canisters were inserted and subsequent COHb levels declined to normal. One of the CO₂ absorbent canisters from each of Cases 2 and 3, when challenged with CO₂ and O₂, would elute CO up to 240 ppm. There were no intraoperative clinical clues suggesting CO poisoning in any of these patients.

The cause of these elevations in COHb remain unexplained. None of the three patients had evidence of hemolysis. Endogenous production of CO from Hb breakdown is therefore unlikely. CO accumulation within the circuit has been reported in closed circle anesthesia (Middleton, V., et al. *Anesthesiology* 26: 715-719, 1963). However, in the cases reported here, fresh gas flow was 2L/min or greater. The COHb values are also too high to be attributed to smoking. Repeatable COHb determinations and evidence of gas phase CO mitigate against laboratory error. All three individuals were the first cases anesthetized on Monday mornings, suggestive of a slow chemical reaction within the anesthesia machine. Circumstantial evidence points to the anesthesia circuit or CO₂ absorbent.

A1050**TITLE: PERSONAL ATTRIBUTES RELATED TO SUPERIOR PERFORMANCE IN ANESTHESIOLOGY**

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Superior performance in anesthesiology requires vigilance, self-discipline and the ability to work well with others,^{1,2} as well as mastery of essential medical and pharmacological skills. Analyses of mishaps in anesthesiology also stress the significance of the personality factor.^{3,4}

We present a prospective study of performance in anesthesiology based on 79 male and 16 female residents from 6 medical schools. The California Psychological Inventory (CPI)⁵ was used to assess 20 positive, ego-enhancing facets of personality (e.g., empathy and self-control).

The CPI was given early in the first year of actual anesthesiology residency. At the end of that year, residents were rated on a 7-step scale (Fig 1) by 3 or more faculty members, on 10 components of practice. Factor analysis of the 10x10 matrix revealed only one dimension that correlated .95 with a rating of overall performance in Year 1.

Accordingly, only an overall rating was asked for in Year 2 with 4 or more faculty members at each school asked to submit evaluations. The median inter-rater reliability for these was .90. A performance criterion was derived from standardization of ratings by school.

Five CPI scales correlated significantly (p<.05) with the criteria: Independence, Empathy, Socialization, Well-being, and Achievement via Conformance. It was found that a psychological portrait of the superior resident could be drawn from them incorporating these attributes:

- 1) ability to stand apart from a social consensus when necessary;
- 2) insight into how others feel and think;

- 3) deep stabilization of ethical values;
- 4) a good sense of physical and psychological well-being; and,
- 5) a drive to do well in highly structured and in open situations.

A predictive cluster of CPI scales eventually evolved. These clusters were successfully cross-validated in a separate sample of 20 residents, and further in samples of 329 male and 60 female medical school students. It is possible that an image of basic desired anesthesiology personality criteria has emerged which will be of prospective value in the arduous selection process of residents.

Figure 1. Confidential Research Rating Form

Resident's code: _____	Rater's code: _____	Date of rating: _____
Rating Scale	Factor	Rating
7 = truly exemplary	Knowledge	_____
6 = superior	Pre-operative evaluations	_____
5 = clearly above average	Intra-operative management	_____
4 = somewhat above average	IV line	_____
3 = average	A-line and CVP	_____
2 = somewhat below average	Regional techniques	_____
1 = poor or unsatisfactory	Management of critical situations	_____
	Maintenance of anesthetic records	_____
	Reliability and punctuality	_____
	Interpersonal relationships	_____

Comments _____

Overall evaluation: Your best judgement concerning the resident's current performance, and potential as an anesthesiologist _____

1. Anaesthesia and Intensive Care 9:359-365, 1981
2. Anaesthesia 35:559-568, 1980
3. Anesthesiology 6:670-676, 1987
4. American Society of Anesthesiologists Annual Meeting, 1985, pp A497
5. Gough, H.G: California Psychological Inventory administrator's guide. Palo Alto, Ca: Consulting Psychologists Press, 1987.