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Myocardial Infarction in Carotid Endarterectomy Patients Anesthetized with Halothane, Enflurane, or Isoflurane

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Myocardial infarction (MI) is one of the major complications following carotid endarterectomy. In the patient population undergoing this type of surgery, cardiac symptoms are common. There is evidence that isoflurane can modify myocardial flow in compromised coronary circulation states to produce an experimentally demonstrable "steal" phenomenon. This retrospective review examines the incidence of myocardial infarction in our patients undergoing carotid endarterectomy during anesthesia with three commonly used volatile anesthetics.

MATERIALS AND METHODS

The records of patients who underwent 2,223 carotid endarterectomies between 1972 and 1987 were reviewed with approval from the Institutional Review Board. Patients who suffered a nonfatal or asymptomatic MI based on ECG evidence and enzyme changes or a fatal MI within 3 weeks of surgery were included for analysis. Data were analyzed by Chi square with $P < 0.05$ considered statistically significant.

RESULTS

Of the 2,223 procedures reviewed, the primary anesthetic agent was halothane in 493, enflurane in 919, isoflurane in 784, Innovar in 24, and other in 3. Halothane was used most commonly from 1972-1977, enflurane from 1977-1981, and isoflurane from 1982-1987. As each of these newer anesthetics became available, there was a period of overlap in use with the preceding anesthetic. At present, the most commonly used agent is isoflurane, although occasionally the other anesthetics are utilized for certain indications.

In both the halothane and enflurane groups, there were five fatal and five nonfatal myocardial infarctions. In the

isoflurane group, there were 14 nonfatal and 2 fatal myocardial infarctions. The fatal infarction rate was 1.0% for halothane, 0.5% for enflurane, and 0.25% for isoflurane (table 1). The number of fatal myocardial infarctions was significantly lower in those patients receiving isoflurane ($P < 0.05$) compared to the other anesthetic agents.

DISCUSSION

The incidence of symptomatic coronary artery disease in patients scheduled for carotid endarterectomy ranges from 17 to 55% and asymptomatic coronary artery disease occurs in even greater numbers (49-66%).¹⁻³ The most frequent cause of perioperative mortality following carotid endarterectomy is myocardial infarction.²⁻⁵

In very general terms, the most common intraoperative events that might contribute to myocardial ischemia and infarction are hypotension, hypertension, and tachycardia. Recent work has suggested that an anesthetic agent itself might contribute to intraoperative myocardial ischemia.

The studies implicating isoflurane as a causative agent in coronary "steal" lead to the inevitable consideration of the clinical applicability of those data.⁶⁻¹³ Our data presented do not indicate an increased incidence of MI with isoflurane as compared to halothane and enflurane. There are several possibilities to explain this finding. Perhaps the coronary steal effect is a subtle and infrequent occurrence which, in consort with all the other clinical problems faced in the management of these patients, becomes clinically inconsequential. There may be a subgroup of patients in whom coronary steal is a problem, and they are not identified in this study. This is a retrospective study and the various agents were introduced and used in sequence, not in parallel. If advances have been made over the years of this study in decreasing the incidence of myocardial ischemia intraoperatively, then the rate of MI for isoflurane should be least if these anesthetics are equivalent in their cardiac effects. A rate that is not different for isoflurane might be interpreted to mean that isoflurane has increased the incidence of ischemia. While the overall numbers of MI with isoflurane were not different from halothane and enflurane, the occurrence of fatal MI was statistically reduced in those patients receiving isoflurane. Whether this is due to some favorable effect of isoflurane or improved clinical care in the control of factors that lead to mortality cannot be

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TABLE 1. Carotid Endarterectomy and Perioperative Myocardial Infarction (MI) (1972-1985)

	N	MI	%	Deaths	%
Halothane	493	10	2.0	5	1.0
Enflurane	919	10	1.1	5	0.5
Isoflurane	784	16	2.0	2*	0.25

$P < 0.05$ for mortality in those patients with MI by Chi square.

* Significantly decreased.

ascertained from these data. It is of interest (but not statistically significant) that the rate of fatal MI showed a downward trend over the time period of this study.

Thus, we conclude that whatever effect the coronary steal with isoflurane might have, it was not clinically evident in this large population at risk for cardiac complications. We are aware that the use of beta-adrenergic blockers preoperatively and intraoperatively has steadily increased over the years of the study in our practice. The effect, if any, of this therapy on the incidence of myocardial infarction in this study is unknown.

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Lightwand Intubation in Children with Abnormal Upper Airways

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The first report of an "illuminated introducer" for endotracheal intubation appeared in 1957,¹ followed shortly

by a very brief description of a similar device to be used with direct laryngoscopy.² Subsequently, advantages and clinical applications of the lightwand for orotracheal intubation in normal adults were reported.^{3,4} Recently, further enthusiasm in normal adults, including those requiring "awake" intubations, has been expressed.⁵⁻⁷ This technique may be equally applicable in the pediatric population,⁸ particularly with regard to recognized high-risk conditions for routine laryngoscopy and tracheal intubation. We report our experience with 31 patients with abnormal upper airways.

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Key words: Equipment: lighted stylet. Intubation, endotracheal: technique.

MATERIALS AND METHODS

We studied 31 patients of mean age 12.5 yr (range 5-45 yr) scheduled to undergo elective surgery not neces-