CORRESPONDENCE

Anesthesiology
80:1404, 1994

Costs of Inhaled Anesthetics: I

To the Editor:—The last sentence in Weiskopf and Eger's[1] article reveals all: "This, of course, assumes that the relative costs of isoflurane and desflurane remain unchanged."

Was it an oversight that the authors failed to mention a 31% increase in the price of isoflurane during the 25-month period between December 3, 1989 and January 1, 1992? Does it not seem strange that the price then held steady until the release of desflurane 12 months later? How did the authors arrive at a price of $71.00 for a 100-ml bottle of isoflurane? In an article entitled "Comparing the Costs of Inhaled Anesthetics," why have the authors failed to compare the costs of other agents, such as enflurane or halothane? This article might just as easily been written by marketing consultants for desflurane, and to be sure, at our next Anaquest® drug luncheon we will likely see dozens of glossy reprints!

Has either of the authors received personal or institutional financial benefit from Anaquest®, and if so, should this conflict of interest have prefaced their report? The authors could have easily written this report using hypothetical agents and costs, thus avoiding the suggestion of personal bias, and still have presented us with an excellent example of how to calculate the costs of inhaled agents.

Until we stop ourselves from being manipulated and misinformed by pharmaceutical companies and their paid representatives, we deserve whatever blame is heaped upon us for contributing to the rapidly escalating costs of health care. We concur wholeheartedly with the authors when they state, "Not only must a new drug confer a greater therapeutic benefit, but that benefit must not be bought at too high a price."[1]

Tincture of time will tell all for desflurane.

J. Christian Abajian, M.D.
Clinical Associate Professor

Christopher M. Viscomi, M.D.
Clinical Associate Professor

Department of Anesthesiology
The University of Vermont College of Medicine
Medical Center Hospital of Vermont
Burlington, Vermont 05401

Reference

1. Weiskopf RB, Eger EI II: Comparing the costs of inhaled anesthetics. ANESTHESIOLOGY 79:1413–1418, 1993

(Accepted for publication March 9, 1994.)

Anesthesiology
80:1404–1405, 1994

Costs of Inhaled Anesthetics: II

To the Editor:—The recent report by Weiskopf and Eger[1] comparing the costs of desflurane and isoflurane is misleading. Their conclusion that the cost of desflurane can decrease to less than the cost of isoflurane during an anesthetic is unlikely.

In common clinical practice most inhalational anesthetics are delivered with fixed background flow rates of 3–6 l/min, *e.g.*, 2 l/min N_2O plus 1 l/min O_2. Few anesthesiologists use gas inductions with isoflurane or desflurane; usually, thiopental or propofol is given intravenously and a fixed flow of N_2O and O_2 administered. Desflurane, isoflurane, and anesthetic adjuvant drugs are then administered primarily according to surgical stimulation and the hemodynamic response of the patient. Unless either no induction drugs are given or substantial adjuvants are used, the vaporizer setting usually approximates 1 MAC throughout the anesthetic. Basing cost comparisons uptake characteristics during the first 30 min of a low-flow inhalational anesthetic is unrealistic. Comparing the costs of proportionally equal vaporizer settings (1 MAC) for equal times (1 h) at equal flows (3–6 l/min) is more realistic and sensible.

One can always make calculations more scientific by considering additional correcting factors, but useful cost information is often simple. Volatile anesthetic agents, once vaporized, must be paid for. Calculating uptake by various body tissues is generally irrelevant in cost considerations. Few anesthesiologists will use gas flows of 0.2 l/min, correct their settings for the 7% additional vapor that 1 ml desflurane produces, and continuously sum the uptake of desflurane by individual tissues to determine the inspired concentration required to sustain an alveolar concentration. As a simple comparison at a vaporizer setting of 1 MAC with a background flow rate of 5 l/min, the current cost per hour at my institution would be: halothane $0.78, isoflurane $13.52, and desflurane $30.67. As explained by Weiskopf and Eger,[1] comparing these figures is less accurate the shorter the anesthetic, but the cost differences are so great that they will be difficult to overcome.

Because cost containment is so important today and because the costs of anesthetic drugs are both large and discretionary, realistic cost information is necessary. By focusing on the reduced need for

overpressurization at the onset of inhalational anesthesia with a less soluble agent, Weiskopf and Eger present the most favorable cost comparison possible for desflurane. Eger has stated that he is a paid consultant to Anaquest and is potentially biased in his observations, and Weiskopf and Eger formerly have disclosed that their anesthetic drug research is supported in part by Anaquest[2]; the Journal should have included this information with this article, which is likely to be reprinted and distributed by Anaquest.

Anesthesiology departments introducing desflurane into their operating rooms will perform the ultimate cost test. If reduced payments for isoflurane and other replaced agents more than offset the extra payments for desflurane, then the introduction will be economically wise. However, I think this possibility is unlikely. Under United States law, Anaquest is the sole determiner of desflurane costs until their patent expires. The price of isoflurane is under greater market pressure because the isoflurane patent expired in January 1993. The cost of isoflurane at my institution has decreased 20% during the year since patent expiration, and competitive pressures may lead to further decreases. The patent for halothane expired many years ago, and halothane now costs only 3% of what desflurane costs. When deciding whether and to what extent to use desflurane, anesthesiologists should consider their own clinical practices and current anesthetic prices, as well as the possibilities presented by Weiskopf and Eger.[1]

Robert E. Johnstone, M.D.
Department of Anesthesiology
West Virginia University
Morgantown, West Virginia 26506

References

1. Weiskopf RB, Eger EI II: Comparing the costs of inhaled anesthetics. ANESTHESIOLOGY 79:1413–1418, 1993
2. Moore MA, Weiskopf RB, Eger EI, Wilson C, Lu G: Arrhythmogenic doses of epinephrine are similar during desflurane or isoflurane anesthesia in humans. ANESTHESIOLOGY 79:943–947, 1993

(Accepted for publication March 9, 1994.)

Anesthesiology
80:1405, 1994

Costs of Inhaled Anesthetics: III

To the Editor:—The recent article by Weiskopf and Eger[1] is an example of the kind of cost analysis in anesthesia that provides important information in this era of cost containment and health reform. In general, cost analysis can evaluate cost minimization, cost–benefit, or cost efficiency. Their article is a cost minimization study because it compares resource costs (volume of inhaled anesthetic) required for a given medical end point (1 MAC anesthesia) with the assumption that potential outcomes (*e.g.,* postoperative nausea) are equal regardless of how they are achieved. The authors efficiently outline the relations between agent solubility and MAC, uptake, background gas flows, necessary volume of liquid anesthetic, and cost in delivering 1 MAC of desflurane or isoflurane for 30- and 60-min procedures.

I would like to identify some points not addressed by the authors. The data presented in figure 1 suggest that isoflurane becomes the better cost-minimizing selection as the length of the case increases or as higher background flows of gases are used. In fact, at the flows most often used clinically (2–6 l/min), isoflurane has the cost advantage. Furthermore, it is uncertain how the slopes relating the ratio of volume of liquid anesthetic used, time, and background flow rates (fig. 2) will change as the length of the procedure increases beyond 1 h. The authors need to expand this part of their analysis to document that in fact the slopes do not change (as I think is implied) and to quantify the magnitude of this effect. This information is clinically relevant because an important fraction of surgical procedures last more than 60 min.

From a marketing and pricing perspective, a "sensitivity" analysis on the cost of desflurane *versus* that of isoflurane reveals how much the cost of desflurane needs to change until it is less costly than isoflurane. By increasing the ratio of the cost of isoflurane to desflurane per milliliter (which is stated by Weiskopf and Eger[1] to be 2.43, based on current costs of $70 per 240 ml for desflurane and $71 per 100 ml for isoflurane), desflurane becomes increasingly cost-attractive. For example, increasing this ratio to 4.86 by decreasing the cost of desflurane to $35 per 240 ml makes desflurane cost less per anesthetic than isoflurane for at least 60 min, with flows of up to 6 l/min. For each background flow rate we could determine a price for either agent to make either agent more or less cost-attractive. This "elasticity" is important because manufacturers of volatile agents may respond to the demand for the various inhaled anesthetics.

Thus, I would add to the authors' results by stating that the relative cost of administering the newer and less soluble anesthetic, desflurane, can be less than, greater than, or the same as the cost of administering isoflurane, depending on the background gas inflow rate[1] and the ratio of the agents' cost per milliliter.

Alex Macario, M.D., M.B.A.
Chief Resident
Department of Anesthesia
Stanford University Medical Center
Stanford, California 94305-5115

Reference

1. Weiskopf RB, Eger EI II: Comparing the costs of inhaled anesthetics. ANESTHESIOLOGY 79:1413–1418, 1993

(Accepted for publication March 9, 1994.)