



Lifelong lessons I learned from my resident research project

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To the Editor,

I thank Dr. Froese for her insightful and complimentary commentary on our 1978 publication in the *Journal*.^{1,2} The visionary nature of the late Dr. Knill's contributions are appropriately described. As the junior member of the research team at the time, I learned important lessons from that research experience. I would like to add them to those noted by Dr. Froese.

I had the privilege of being one of Dr. Knill's first research residents. His grant-funded research at that time focused on elucidating the effects of anesthetics, initially halothane, on ventilatory responses to hypoxia and hypercapnia during anesthesia and the associated changes in respiratory mechanics. Our studies took place in the operating room (Figure). After the initial few studies, I commented to Dr. Knill that the intraoperative use of supplementary oxygen (i.e., $F_{i}O_2 \geq 0.3$) and mechanical ventilation were becoming increasingly common. "Wouldn't the suppressive effects on ventilation be more important in the postanesthesia care unit (PACU)", I asked naively. He explained to me that the prevailing belief was that the physiological effects of modern inhaled anesthetics were largely gone by the time the patient awoke. This prompted me to review the literature on halothane washout, especially the publications by Eger *et al.*³ Armed with calculations based on the modelling studies by Stoelting and Eger³ and my own redrawing of their figures where I extrapolated their washout lines beyond 120 min, I estimated that patients in the PACU could be at 0.1 MAC (or greater) for up to an hour, depending on the

duration of the anesthetic and the minute ventilation. I then presented them to Dr. Knill; a good discussion followed in which he pointed out that the modelling was based on an electrical analogue and my redrawing simply magnified inaccuracies in their data. He also acknowledged, however, that a study demonstrating no residual effects would be reassuring. Dr. Knill listened carefully and was not dismissive or demeaning. At the end, he smiled and said, "Well, Adrian, if you feel strongly about it and can design an experiment to demonstrate it, Jane [Jane Clement, his research assistant] can help you". Jane and I built an apparatus that could deliver very low concentrations of vapor (0.1 MAC) by diluting what came out of the vaporizer with air, carbon dioxide, and/or nitrogen. Dr. Knill and I were the initial volunteers. He suggested the re-equilibration approach we ultimately used to determine if patients still had clinically relevant concentrations of halothane in their vessel-rich tissues. We called it "PAT 0.1" (postanesthetic time at 0.1 MAC).

I learned the following lifelong lessons from this experience with Dr. Knill. (1) Our studies involved hypoxia and thus generated substantial debate about the ethics, including at the time of my presentation as part of the resident's competition at the Canadian Anesthesiologists' Society annual meeting. Our approach was "Don't ask anyone to volunteer for a study in which you or your loved ones wouldn't participate". We were always among the first volunteers. (2) Take naive questions seriously as they often challenge the currently accepted dogma and force one to see a problem from a different perspective. (3) Give students, residents, and other mentees the opportunity to investigate, within the bounds of patient safety, what they feel strongly about if they can present cogent arguments supporting their view, even if you think they have it wrong.

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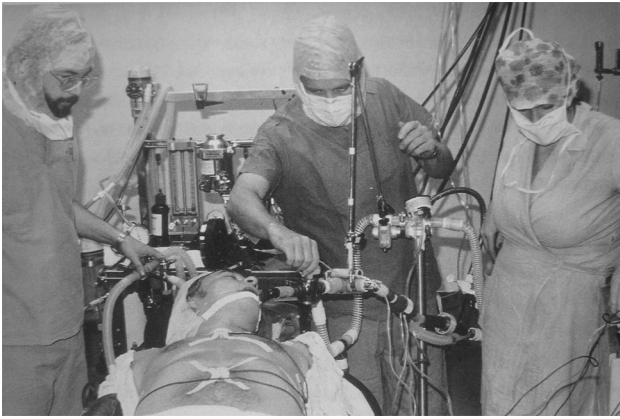


Figure Photograph obtained during the conduct of a study examining the effects of halothane on hypoxic and hypercapnic ventilatory responses performed in the operating room at University Hospital London Ontario in 1977. Left to right: Adrian W. Gelb; Charles Bryan, volunteer; Richard L. Knill; Jane Clement, research assistant

Conflicts of interest None declared.

References

1. *Froese AB*. From the Journal archives: Be alert to the risk of unexpected prolonged postoperative hypoxemia! *Can J Anesth* 2014; 61: 379-82.
2. *Gelb AW, Knill RL*. Subanaesthetic halothane: its effect on regulation of ventilation and relevance to the recovery room. *Can Anaesth Soc J* 1978; 25: 488-94.
3. *Stoelting RK, Eger EI 2nd*. The effects of ventilation and anesthetic solubility on recovery from anesthesia: an in vivo and analog analysis before and after equilibrium. *Anesthesiology* 1969; 30: 290-6.