DOI: 10.1111/pan.13453

EDITORIAL

WILEY Pediatric Anesthesia

MacGyver or Machiavellian approaches to delivery of sevoflurane in neonates

Optimal ventilation of the sick neonate is one of the most challenging practices for anesthetists. The whole infrastructure including the ventilator and connecting tubing in the operating room are often suboptimal for this specific population. In addition, comprehension of anesthesia requirements and ventilation strategies differ substantially between neonatologists and anesthetists. For example, neonatologists are more likely to use pressure-regulated volume control modes and other protective ventilation modalities than anesthesiologists who prefer pressure- or volume-controlled modes.[1] Therefore, maintaining a neonate on the same ventilation regimen to and from the neonatal intensive care unit for surgery in operating room is contended. In this issue of the journal, Brustal and Threlfo have attempted a solution by offering anesthetists a possibility to administer inhalation volatile agents within a built-on system mounted on a neonatal ventilator that can be used as an alternative to anesthesia ventilators in the operating room.[2] In this remarkable laboratory bench test, they addressed in a well-structured manner all the technical and personal challenges that arise from mounting a vaporizer into a circuit that was not initially designed for. This systematic approach has the merit to remind the anesthetists of all the potential pitfalls that evolve from redesigning a ventilator circuit. Moreover, the attention put forward to develop standard operation procedures and training schedule for health care providers is worth commending.

Anesthetists are well known to collect bits and pieces of equipment in order to adapt to weird situations where anesthesia must be delivered. No doubt the television series, MacGyver (1985-1992), was popular within the anesthesia community where problem-solving is part of daily routine. In this regard, we can appreciate efforts for overcoming technical issues due to the opposing requirements for optimal neonatal ventilation and precise delivery of volatile agents. However, established equipment used routinely in anesthesia practice are already a major source of near-misses reported to morbidity and mortality reviews.[3] Thus, applying various sundry items, even if they comply with standards, run the risk of causing difficulties such as disconnection, obstruction, or misuse. In doing so, one may unintentionally end up in a Machiavellian situation where patient safety may be threatened. In addition, using the low-pressure input as the driving gas flow for a vaporizer may introduce uncertainties in the real concentration delivered, since the inspiratory gas flow profile (constant flow or decelerating flow) may exert a biasing effect. It is not surprising that the authors found a complete discordance with high-frequency oscillation ventilation where inspiratory airflow was variable.

Promoting a system based exclusively on bench testing can cause overconfidence about the usefulness and the safety of the system developed. Translating bench findings to clinical practice in neonates requires more thorough clinical investigations by reporting the physiological outcomes, such as respiratory mechanics, proof for optimal gas exchange, and accuracy and stability of sevoflurane delivery over a prolonged time. Furthermore, while the authors have paid attention to scavenging, the issue of waste gas is not yet addressed in a satisfactory way. First, there is a lack of proper quantification of the sevoflurane concentration in the environment despite stating lack of detectability "close and within the exhalation valve cowl." Moreover, the scavenging issue has not been clarified during transportation of the patient where no suction may be available for waste gas removal. Accordingly, there is a remaining concern about the environmental concentration of exhaled sevoflurane, which may cause harm for health care providers.[4,5] Provision of sevoflurane in an open-circuit with high gas flow is not without an additional challenge. The targeted alveolar gas concentration can be readily achieved by such a system but at the expense of high consumption and waste of sevoflurane. This feature explains the lack of implementation of vaporizers on ventilators used in pediatric intensive care units and the search for alternative techniques to provide these volatile agents.[6]

A major question for pediatric anesthesiologists is about the use of sevoflurane-based anesthesia in neonates. During the last decade a real concern has arisen about the potential neurotoxicity of anesthetic agents.[7,8] While no evidence for an effect on neurodevelopment could be demonstrated following short duration surgical procedures with sevoflurane,[9] the use of this volatile agent was associated with lower blood pressures that could potentially jeopardize cerebral blood flow.[10] Moreover, neonates show limited changes in the electroencephalogram pattern with variations in sevoflurane concentrations used in clinical practice, which may lead to its overdosing with subsequent potential for burst suppression and inability to assess cerebral activity.[11] Therefore, delivering sevoflurane in neonates without the application of cerebral monitoring (eg, near intra-red spectroscopy) is like being in the eye of a storm where you have no idea about the subsequent hemodynamic consequences. Consequently, sevoflurane delivery during transportation, a well-established phase of potential instability, exposes the neonate to a greater risk of hypotension and alterations in the microcirculation. Opioid-based anesthesia in critically ill premature babies and neonates, a technique that allows better hemodynamic stability and

enables anesthesia management without the need for volatile agents, is promoted above inhalational agents.

Applying new techniques and ventilation strategies in neonates requires strong evidence of both their harmlessness and usefulness. While the highly interesting and well-designed bench test presented in this issue may be a first step in the intellectual process for improving patient management, there is a need for further measures in laboratory investigations and clinical settings before promoting their values. While anesthesiologists are famous for applying MacGyver "do-it-yourself" approaches, involvement of professional developers from ventilator industry would avoid to slide toward a near-misses situation.

CONFLICT OF INTEREST

The authors report no conflict of interest. Walid Habre is deputy editor of the European Journal of Anaesthesiology.

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