SciDoc Publishers
Infer, Interpret & Inspire Science

International Journal of Anesthesiology & Research (IJAR)
ISSN 2332-2780

Innovations in Anesthesia: Past, Present, and Future

Editorial

Jense RJ*

Assistant Professor, Department of Anesthesiology & Pain Medicine, University of Washington, USA.

Modern anesthesia has evolved markedly since William Clark et al., introduced vinyl ether in the mid nineteenth-century. That history, coupled with current clinical trends, provide context for considering future possibilities in Anesthesiology. Three dynamic components of the field: 1) pharmaceutical agents, 2) information/mechanical technologies, and 3) human systems design can further evolve to improve patient safety and care in more efficient and socially conscious ways.

Pharmaceuticals

Volatile anesthetic agents have been the backbone of clinical anesthesia for 150 years. The neurophysiologic properties produced by vinyl ether allowed for creation of an anesthetic state, and thus performance of more complex surgical procedures. This discovery provoked the development of better volatile agents: non-flammable, less toxic, and more predictable. Today, most anesthetics are conducted with one of these highly fluorinated ethers: Isoflurane, Sevoflurane, or Desflurane. While each agent has distinct clinical utility, they share the debit of being offensive greenhouse gases. Desflurane, for instance, under normal daily operating conditions produces greenhouse gases equivalent to driving fifty cars a day. Isoflurane and Sevoflurane, though roughly an order of magnitude better, are still potent offenders [1]. A potential savior for gas-delivered-anesthesia exists in the noble gas xenon. Xenon can produce anesthesia with potential to offer significant cardio and neuro-protection without greenhouse effects [2]. While expensive and lacking clinical infrastructure, the promise of xenon is inching its way into anesthesia practice.

Intravenous anesthetic agents/adjuncts have been used in various combinations since invention of the hypodermic needle in the 1850s. While morphine continues to maintain broad clinical utility since being isolated from the poppy in the early nineteenth century, opioid derivatives have entered almost every facet of modern medicine. Notably, Remifentanil, with its very short context-sensitive-half-life (~5 minutes) and relative high potency (~100-200 times greater than morphine), has become a useful pharmacologic tool for the induction and maintenance of total-intravenous-anesthesia (TIVA): allowing both rapid titration of intense analgesia and rapid "awakening". Moreover; of particular interest to Pain specialists in the setting of a national opioid epidemic, PZM21 is an experimental opioid that has the potential to offer analgesia with minimal untoward side effects. This could represent a paradigm shift in the treatment of acute and chronic pain.

Barbituric acid is a hypnotic agent synthesized in 1864 that gained relevance in the early 1900's following discovery that it could produce "sleep" in dogs. Its clinical utility as an anti-seizure medication followed, and also use in anesthesia. Sodium thiopental then came on-board. This shorter-acting agent allowed for rapid induction of a general anesthetic state, transforming the ability of the provider to secure the airway and control ventilation. However; since the late 1980s, Propofol has been the ubiquitous option as it can more rapidly induce/maintain general anesthesia and also provide for the full spectrum of sedation.

Neuromuscular blocking agents, commonly called *muscle relaxants* or paralytic agents are also important to the specialty. Curare, a plant extract, achieved currency following isolation and synthesis in the early 1940s. This new category of medications allowed for production of a reliable paralytic state, and thus the ability to perform more complex surgical procedures. While the pharmaceutical industry has created a variety of case-specific options, dynamic patient physiology or unexpected surgical timing can require that some patients be maintained under an anesthetic until they can be safely *reversed* from paralysis [3]. Sugammadex, a drug from a novel class of reversal agents is beginning to change this equation. When properly administered after Rocuronium induced paralysis, Sugammadex rapidly forms a chemical-complex rendering Rocuronium inactive, and thus the immediate *reversal* of the deep paralytic state [4]. Of note, the overall necessity for *paralytic* use is decreasing as modern anesthetic agents have ancillary capacity to produce *relaxation*.

***Corresponding Author**:
Ryan J. Jense, M.D.,
Department of Anesthesiology & Pain Medicine, University of Washington, Box 356540, 1959 NE Pacific Street, BB-1469, Seattle, WA, USA.
Tel: 206-755-9119
E-mail: rjjense@uw.edu

Received: April 18, 2017
Published: April 21, 2017

Citation: Jense RJ (2017) Innovations in Anesthesia: Past, Present, and Future. *Int J Anesth Res.* 5(1e), 1-2. **doi:** http://dx.doi.org/10.19070/2332-2780-170003e

Information/Mechanical Technologies

Data collection and record keeping can be traced back to the era of vinyl ether anesthesia. Poor outcomes, including death, were common. Clinicians quickly realized the value of biometric data, especially blood pressure and heart rate. In 1930, Elmer McKesson invented the automated intraoperative blood pressure machine called the Nargraf. This machine better allowed clinicians to respond to deviations in intraoperative patient physiology. Value was too placed on organizing such data into a standardized anesthesia account, a process that informs modern-day patient safety initiatives and other computer driven data analyses.

With these advancements however, clinicians are continuously challenged to determine data relevancy mid a deluge of information. As such, some medical centers have opted for real-time computerized clinical interactive feedback tools to help providers make better evidence based decisions. Systems can be programmed to alert providers to redose antibiotics per pharmacokinetic models, start insulin infusions when triggered by elevated glucose measurements, or issue warnings when other selected biometric boundaries are reached [5]. Modern electronic medical records integrate billing and coding for physicians and administrators: a template for efficiencies throughout healthcare.

Medical devices likewise figure into evolving anesthetic practice. For example, with the advent of volatilized ether for surgical use, initiatives followed to better administer anesthetic gases. None of the early generation blow-by-gas glass-vaporizers were able to consistently deliver variable concentrations of volatile anesthetics; that is, until Lucien Morris and Ralph Waters began work on the *copper kettle* in 1948. Within a few years, they revolutionized the delivery of volatile anesthesia. Their chamber controlled the temperature of the anesthetic while simultaneously percolating the carrier gas through the anesthetic liquid, and thus delivering known quantities of vaporized anesthetic gas. For the first time, the provider could accurately adjust the depth of anesthesia: another safety and quality milestone. The Draeger and Ohmeda Corporations now have vaporizers designed for specific anesthetic gases - products "smarter" than their predecessors–with no longer a need to perform lengthy calculations before each anesthetic.

Other advancements have improved anesthetic care. A variety of case specific endotracheal tubes, supraglottic airways (laryngeal mask airways, oral airways, and nasal airways), and devices used to place these airways (curved/straight hand-held blades, fiber-optic bronchoscopes, and video laryngoscopes) exist today. Current ventilators reflect refinements in biomechanical engineering, and improved bedside ultrasound technologies continue advancement in the cardiovascular and regional anesthetic subspecialties. Other modern biometric devices allow real-time hemodynamic monitoring, exhaled gas analysis, and even practical use of EEG profiles to determine depth of anesthesia.

In the future, much could be gained through technological advancement related to total-intravenous-anesthesia. Novel pump technology coupled with integrated novel medication storage is key; a device to deliver anesthetic medications with the touch of a button – continuous infusions and rapid boluses on-command. Properly configured, this could radically transform the field: the standard armamentarium of medications turned *on-demand*, a new gold standard for TIVA to be followed by development of pharmaceutical agents tailored to such capacity. In fact, Remimazolam (a super-short acting benzodiazepine) and ABP-700 (a super-short acting hypnotic) are currently under investigational status.

Human Systems Design/Patient Safety

Clinicians, colleagues, administrators, and educators do their best to facilitate interpersonal systems that build upon their predecessors' pursuits. Diverse practice models, society-level initiatives, national and international work force allocations, payee reimbursement models, and education initiatives exist in today's quilt of anesthetic care. Political decision-making enters, with a complexity of concerns that mandate separate discussion.

But most importantly, innovation in all realms of anesthesia continues to improve patient safety. In fact, the safety improvement profiles in anesthesia are comparable to those found in the airline industry: often considered to be an industrial gold standard. Much of this safety data can be traced to the *Closed Claims Project*, an ongoing initiative that compiles legal data as a metric for overall quality of care [6].

And, we can always do better…

Disclosure

The author selected historical and contemporary illustrations without necessarily privileging these over others that readers may propose.

Acknowledgements

The author would like to thank The Wood Library Museum for their online resources, and also thank Dr. Andrew Bowdle and Professor Richard Baldasty for their assistance with this discussion.

References

[1]. Ryan SM, Nielsen CJ (2010) Global warming potential of inhaled anesthetics: application to clinical use. Anesth Analg. 111(1): 92-98.
[2]. Maze M, Pirracchio R (2016) Will Xenon Be a Valuable Addition in Perioperative and Critical Care Settings? Anesth Analg. 122(3): 593-6.
[3]. Thilen SR, Bhananker SM (2016) Qualitative Neuromuscular Monitoring: How to Optimize the Use of a Peripheral Nerve Stimulator to Reduce the Risk of Residual Neuromuscular Blockade. Curr Anesthesiol Rep. 6: 164-169.
[4]. Keating GM (2016) Sugammadex: A Review of Neuromuscular Blockade Reversal. Drugs. 76(10): 1041-52.
[5]. Nair BG, Newman SF, Peterson GN, Wu WY, Schwid HA (2010) Feedback mechanisms including real-time electronic alerts to achieve near 100% timely prophylactic antibiotic administration in surgical cases. Anesth Analg. 111(5): 1293-300.
[6]. Cheney FW (1999) The American Society of Anesthesiologists Closed Claims Project: what have we learned, how has it affected practice, and how will it affect practice in the future? Anesthesiology. 91(2): 552-6.