**ROBOTICS IN ANESTHESIA & AIRWAY MANAGEMENT: WHAT DOES THE FUTURE HOLD?**

Patrick Tighe M.D.
Assistant Professor
Dept. of Anesthesiology
University of Florida
ptighe@anest.ufl.edu

---

**Objectives**

- The History of Robotics in Anesthesia: An Elemental Approach
- The UF Simulation Experience
  - Fiberoptic Tracheal Intubation
  - Peripheral Nerve Catheter
  - Subclavian CVL Insertion
- Future Directions

---

**An Elemental Approach**

**Pre-Op Evaluation**
- Induction
- Venous Blood
- Intubation
- Case Review

**Maintenance Phase**
- Emergencies
- Post-Op Care

**Anesthesiology and Perioperative Medicine**

---

**Preoperative Evaluation**

- Northern Ontario Telecommunication Health Network (1998)
  - 2 cameras
  - Digital stethoscope
  - Multi-position exam of airway

---

**Maintenance of Anesthesia**

- Target-Controlled Infusion (Schwilden, 1999)
  - Prevalence of 25% of TIVA in Europe
  - Automatically computes effect-site target concentration
  - 3-compartment model

---

**Maintenance of Anesthesia**

- Closed-Loop Anesthesia
  - Hamerling et al from McGill University
  - Automated titration of propofol infusion using EEG-based Bispectral Index (BIS) monitor
- McSleepy
Robots and Nerve Blocks

Robot-Assisted Regional Anesthesia: A Simulated Demonstration

Patrick J. Tighe, MD,* S. J. Badlian, MD,* I. Luna, MS,* Andre P. Bozzaart, MD, PhD,** and S. Panskat†, MD

Accepted for publication March 26, 2010.

Robotic arms. One arm was used for needle manipulation, and the needle was advanced at a 45-degree angle to the phantom under real-time US guidance. Visualization was with its video system. Aside from the stereoscopic high-definition, 60-cm, 19-gauge stimulating catheter was placed adjacent to the phantom, within reach of the DVS.

After entry into the phantom, the Tuohy needle was opened via the DVS because of concern for opening of medication ampoules, required too much force into a single viewport. The needle tip (T) can be visualized in close proximity. The US video output directly to the workstation viewport.

Before simulated nerve block placement, we first manually opened a 60-cm, 19-gauge stimulating catheter. We verified the ability of the DVS to grasp, manipulate, and remove the Tuohy needle over the catheter, and successfully stabilized the US probe over the catheter.

Having simulated placement of a single-injection nerve block, we attempted placement of a perineural catheter. We again assisted by the TilePro video system as described in Video 1.

Photographs depicting the external positioning of the robotic arms. Such stabilization was also quite helpful during simultaneous video input from third-party sources. At our hospital, the DVS is portable to add additional robotic arms. Although the DVS completed the majority of tasks without manual intervention, several steps were not robotic. Instead of a procedure-specific device, this simulation used a multiple-input video system.

The simulated robotically assisted nerve block required 2 robotic arms. One arm was used for needle manipulation, and the needle was advanced at a 45-degree angle to the phantom. The simulated peripheral nerve block was not addressed during this demonstration. Clearly, the development of task-specific robots, and methods for use with multiple robotic arms, may be warranted in view of the advantages, such as dexterity, efficiency, and feasibility abound. Indeed, the multimillion dollar investment in robots and equipment for surgical care for the geographically remote patient. Current anesthesia and analgesia is feasible using existing clinical equipment. The DVS was not designed for use with clinical equipment.

• Robots and Nerve Blocks

Simulated Peripheral Nerve Block

Sonosite S-Nerve + C50x linear transducer

Blue Phantom Simulator

Arrow StimQuick
21Ga. x 90mm

Dual-Video Input Via TilePro Video System

T = Needle Tip
Robots and Nerve Blocks: Single-Shot

Robots and Nerve Blocks: Catheter

Robots and Nerve Blocks: Conclusion

Robotic-Assisted Fiberoptic Intubation

Robot-Assisted Airway Support: A Simulated Case

Patrici J. Tighe, MD, S. J. Bediyan, MD, L. Luria, BS, MS, S. Lempotang, PhD, and S. Parekattil, MD
Robotic-Assisted Fiberoptic Intubation

- DaVinci Camera
- DaVinci Graspers
- Fiberoptic Bronchoscope With Camera

Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Ideally, this exercise would have required zero nonrobotic interventions. However, because of the cost of the DVS and the associated robotic telesurgery with acceptable latencies.

Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Traditionally, such distances have been limited by latencies between user input, robot action, and robot-user feedback. Minimizing such limitations, allowing long-distance robotic interventions.

Progress in adapting data packet transmission along existing telecommunication systems has allowed long-distance robotic interventions. Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Traditionally, such distances have been limited by latencies between user input, robot action, and robot-user feedback. Minimizing such limitations, allowing long-distance robotic interventions.

Progress in adapting data packet transmission along existing telecommunication systems has allowed long-distance robotic interventions. Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.

Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.  

Further work will be necessary to explore how well robotic intubation can be performed using the DVS, including the potential for improved image transmission along existing telecommunication systems. Our initial attempts at robotic-assisted intubation focused on direct laryngoscopy. However, we had considerable difficulty using the DVS robotic graspers to lift and manipulate both Macintosh and Miller laryngoscope light cones. The DVS was quite challenging. On the other hand, the focus of our experience indicates that because of the support and potential to capitalize on the capabilities of the DVS.
In Progress: Central Venous Line Insertion

Pre-Op Evaluation
Induction
Nerve Block
Intubation
Line Placement

Maintenance Phase
Emergence
Post-Op Care

Where to Next?

Summary of Objectives

- The History of Robotics in Anesthesia: An Elemental Approach
- The UF Simulation Experience
  - Fiberoptic Tracheal Intubation
  - Peripheral Nerve Catheter
  - Subclavian CVL Insertion
- Future Directions
Perioperative Robotics!