ANESTHETIC EMERGENCIES USING MANIKIN BASED SIMULATIONS WITH SIM-MAN

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HISTORY

- “Above all, do no harm”
- Medicine has traditionally relied on the “see one, do one” approach
  - This creates an inherit risk to patients
- Hence, developments have been made in healthcare training to avoid these risks – simulation training
- Simulation training can be found in other facets of industry – airline industry
Simulation is defined as a situation in which a particular set of conditions are created artificially to experience something.

Simulation training comes in various forms and levels of function:
- Low fidelity to high fidelity models
- Multiple life-like functions
Figure 1: Intravenous insertion arm

Figure 2: Resusci-Anne

Figure 3: "Harvey" cardiology simulator

Figure 4: METI Human patient simulator (HPS)
SIMMAN FEATURES

- **Multiple Airway skills/features**
  - Controllable open/closed airway
  - Head tilt/chin lift
  - Jaw thrust w/ articulated jaw
  - Suctioning (oral and nasopharyngeal)
  - Bag-mask ventilation
  - Intubation
  - Cricothyrotomy
  - Airway resistance
  - Right main stem intubation
  - Stomach distention

- **Airway complications**
  - Tongue fallback
  - Tongue edema

- **Breathing**
  - Simulated spontaneous breathing
  - Bilateral or unilateral chest rise and fall
  - Normal and abnormal breath sounds
  - Lung auscultation
  - Oxygen saturation and waveform
FEATURES

• Breathing Complications:
  • Cyanosis
  • Needle thoracentesis – bi-lateral
  • Unilateral & Bilateral chest movement
  • Chest tube insertion – bilateral

• Cardiac Features:
  • Extensive ECG library
  • Heart sounds
  • ECG rhythm monitoring (4 wire)
  • 12 lead ECG display
  • Defibrillation and cardioversion using training pads – ShockLink™ (SimMan ALS w/ ShockLink)
  • Defibrillation and cardioversion using live defibrillation pads or paddles (SimMan ALS LiveShock)
  • Pacing

• Circulation Features:
  • BP measured manually by auscultation of Korotkoff sounds
  • Carotid, femoral, radial pulses synchronized with ECG
  • Pulse strength variable with BP
  • Pulse Palpation is detected & logged

• Vascular Access:
  • IV access (right arm)
  • Intraosseous access (tibia)
PRINCIPLES OF SIMULATION TRAINING

• Simulation is a tool for training
• Opportunity for deliberate practice
• Recreate scenarios that are rarely encountered
• Team training/debriefing with the staff to explore communication, decision making, judgement, and leadership
• Adjunct to medical training and not replacement for real life
GOALS OF SIMULATION

• Higher level of competence
• Patient safety
• Improves performance and knowledge of the individual, team, and system
• Resident training and experience
• Teach clinical skills
• Learn from mistakes and achieve proficiency
AAOMS NATIONAL SIMULATION PROGRAM

The American Association of Oral and Maxillofacial Surgeons (AAOMS) has employed this technology to develop the National Simulation Program, a three-part program that addresses the needs of the oral and maxillofacial surgery office-based anesthesia team. The program is comprised of:

- The Office-Based Emergency Airway Management (OBEAM) module
- Office-Based Crisis Management (OBCM) module
- Sedation online module (in development)

Course description:

- Hands-on emergency airway simulation that allows participant to practice and master critical techniques for administering and monitoring office-based anesthesia. Program is standardized so that each participant receives the same experience. Provides an effective method of assessing their readiness to meet an office anesthesia emergency situations

- Currently offered at this CalAOMS meeting and will be offered at the AAOMS meeting in San Diego

- As of 2026, AAOMS members will need to complete simulation training to maintain their membership in the organization
ALAMEDA HEALTH SYSTEM – HIGHLAND HOSPITAL

- The OMFS simulation program began in 2022
- Goal: To build on the residents’ didactic lecture-based learnings through practical scenario
- Resident will typically be paired with dental assistants
- Overall atmosphere is created as close to real life as possible
- Debriefing of each case
- Dropbox - AHS SimLab - Simplify your life
SIMULATION TOPICS

- Throughout the year, the scenarios will cover all topics that are tested on the general anesthesia permit evaluation
  - Airway Obstruction – Foreign Body
  - Airway Obstruction – Laryngospasm
  - Allergic Reaction
  - Angina – Myocardial Infarction
  - Bronchospasm
  - Cardiac Arrest
  - Convulsions
  - Emesis – Aspiration
  - Hypertension
  - Hypoglycemia
  - Hypotension
  - Respiratory Depression
  - Syncope

- AHS OMFS Simulation outline and curriculum
  - Case Summary
    - Scenario
  - Curriculum Plan
    - Learning goals and objectives
  - Scenario Set-up
    - Room set-up
  - Patient profile
    - HPI
  - Patient case
    - Patient’s response to the described scenario and physiologic changes that reflects that
    - Participants response accordingly
  - Debriefing plan (quizzes)
SIMULATION ROOM
EXAMPLE OF SCENARIO - LARYNGOSPASM

- 16M referred by general dentist for extractions of #1,16,17,32. No significant pmh. NKDA. 60 kg. MP 2. Negative ROS.
In the middle of the uneventful procedure, the patient begins to develop respiratory effort with stridor, cough, followed by complete cessation of air movement.
### Section 6: Debriefing Plan

#### General Debriefing Plan

<table>
<thead>
<tr>
<th>Individual</th>
<th>Group</th>
<th>With Video</th>
<th>Without Video</th>
</tr>
</thead>
</table>

#### Learning Goals & Objectives

**Education Goal:**

- Verbalize the recognition of a laryngospasm based on clinical signs.
- Administer positive pressure ventilation with 100% oxygen to break a laryngospasm.
- Know the correct dosages for propofol, succinylcholine, and mormonium to break a laryngospasm.

**Clinical Objectives:**

- Appropriate delegation of tasks (ventilation, acquisition of medications, etc.)

**Teamwork/Communication Objectives:**

- Appropriate delegation of tasks (ventilation, acquisition of medications, etc.)

#### Sample Questions

- Let us quickly review the objective of this scenario.
- Let’s go around the group and in one word describe how that went for you.
- Can someone give a two-sentence summary of the case?
- I notice that ___ and I thought that was ___ Tell us more about what was happening?

#### Key Moments

**Identify the endotracheal tube (ETT) from the photos below**

- What is the best way to administer positive pressure ventilation?
  - Using an oropharyngeal airway alone
  - Using a nasopharyngeal airway alone
  - Using an AmbuBag with a well-fitting mask
  - By performing a chin-lift

**Identify the endotracheal tube (ETT) from the photos below**
pressure.

What is the recommended adult dosing for Naloxone for opioid reversal?

- 0.01mg IV/IM at 2-3 minute intervals to the desired degree of reversal
- 0.1mg IV/IM at 2-3 minute intervals to the desired degree of reversal
- 0.4mg IV/IM at 2-3 minute intervals to the desired degree of reversal
- 4mg IV/IM at 2-3 minute intervals to the desired degree of reversal

The figure below shows a normal end-tidal capnography waveform.

Which letter represents the expiratory phase?

- A
- B

In a 2006 study by Passik et al, what percentage of persons presenting for treatment of oxycodone addiction were first exposed to opioids through a prescription for pain?

Passik SD, Hays L, Elsen N, et al. Psychiatric and pain characteristics of prescription drug abusers entering...
CLINICAL PEARLS AND PITFALLS

• “It’s the little details that are vital. Little things make big things happen” – John Wooden

• Some examples that seems obvious at first but is where the team may fumble on during the simulation
  - How to use the BVM and remembering to connect it to the supplemental oxygen
  - How to administer albuterol on a sedated patient
  - Knowing what medications are in the medications box
  - Knowing what form and concentration the epinephrine comes in and administering it appropriately
  - Patient positioning
WHAT DOES THE LITERATURE SAY?

Republished: Simulation training improves ability to manage medical emergencies

Miriam Ruesseler,¹ Michael Weinlich,² Michael P Müller,³ Christian Byhahn,⁴ Ingo Marzi,¹ Felix Walcher¹

Simulation-based medical teaching and learning

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Simulation and anaesthesia

Milind Bhagwat
Department of Anaesthetics, East Surrey Hospital, Canada Avenue, Redhill, Surrey, RH1 5RH, United Kingdom
Aim: Controlled, blinded trial study evaluates the effect of simulation training on undergraduate medical students managing medical emergencies

Study design: 44 students total, intervention group compared to control group
  • Intervention group participate in 3 standardized simulation-based training

Measurement: OSCE (Objective structure clinical examination) used consisting with six complete emergency scenarios, three with standardized patients and three with Manikins
  • Students were score via checklist, out of 25 points calibrated by emergency physicians and OCSE experts
  • The examiners were blinded
RESULTS
LIMITATIONS

• The development of a simulation center can be costly
  • A high-fidelity simulator and associated equipment can cost up to $200,000
  • Low fidelity simulation can be cost effective, but its capabilities are limited

• Training through simulation should be viewed as adjunctive and not a replacement for learning with real patients such as in residency
FUTURE OF SIMULATION TRAINING

- Simulation training is playing an increasing role in medical training
- It is integral in building a safer healthcare for our patients
- Virtual Reality
- Advancement in technology
- Reduced work hours in medical education
- Increasing intolerance of medical errors and the high cost of such
THE END
REFERENCES

- Simulation-based medical teaching and learning Abdulmohsen H. Al-Elq Department of Internal Medicine, College of Medicine, University of Dammam, Kingdom of Saudi Arabia

- Simulation and anaesthesia Milind Bhagwat Department of Anaesthetics, East Surrey Hospital, Canada Avenue, Redhill, Surrey, RH1 5RH, United Kingdom

- Republished: Simulation training improves ability to manage medical emergencies Miriam Ruesseler,1 Michael Weinlich,2 Michael P Mu¨ller,3 Christian Byhahn,4 Ingo Marzi,1 Felix Walcher1

- Training and simulation for patient safety Rajesh Aggarwal,1 Oliver T Mytton,2 Milliard Derbrew,3 David Hananel,4 Mark Heydenburg,5 Barry Issenberg,6 Catherine MacAulay,7 Mary Elizabeth Mancini,8 Takeshi Morimoto,9 Nathaniel Soper,10 Amitai Ziv,11 Richard Reznick12
FEATURES

• CPR:
  • QCPR feedback and scoring compliant with 2010-2015 Guidelines
  • CPR compressions generate palpable pulses, blood pressure waveform and ECG artifacts
  • Realistic compression depth and resistance
  • Automatic detection of depth, release and frequency of compressions as well as hand placement

• Eyes:
  • Manually set to: Open, closed and partially open
  • Set of interchangeable pupils

• Other Features:
  • Fully articulating pelvis
  • Leg rotation in all natural directions
  • Foley catheterization without urine output
  • Pre-prepared for use of the SonoSim Ultrasound solution
  • Patient Voice
    • Pre-recorded sounds
    • Custom sounds
    • Instructor can simulate patient’s voice wirelessly
  • Adjustable patient monitoring: HR, BP, Sat, EtCO2, EKG, RR
ADVANTAGES

• Enhance clinical competence at the undergraduate and graduate level
• Improve patient safety
• Debriefing after the simulation

Table 3: Advantages of simulation in healthcare training

<table>
<thead>
<tr>
<th>Advantage</th>
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</thead>
<tbody>
<tr>
<td>Reduces the risk to patients and inconvenience to participants</td>
</tr>
<tr>
<td>Optimal manipulation of environment allows realistic replication</td>
</tr>
<tr>
<td>Allows standardised, repeated training</td>
</tr>
<tr>
<td>Controlled pace of training can be achieved</td>
</tr>
<tr>
<td>Recorded events make individual performance assessment and feedback possible</td>
</tr>
</tbody>
</table>
# General Anesthesia Permit Evaluation

## Airway Obstruction—Laryngospasm Algorithm

<table>
<thead>
<tr>
<th>Scenario requirements</th>
<th>Interventions</th>
<th>Examine responses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient unresponsive to verbal command</td>
<td>1. Recognition of emergency</td>
<td>□ Satisfactory</td>
</tr>
<tr>
<td>2. Sudden cessation of respiratory sounds</td>
<td>2. Place patient in the supine position</td>
<td>□ Unsatisfactory</td>
</tr>
<tr>
<td>a. may have breath-holding</td>
<td>a. may include attempts to improve airway by head tilt-chin lift, jaw thrust,</td>
<td></td>
</tr>
<tr>
<td>b. may have paradoxical breathing</td>
<td>or tongue protrusion and may include ventilation attempts with 100% oxygen</td>
<td></td>
</tr>
<tr>
<td>efforts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Initial response fails to resolve problem</td>
<td>3. Remove materials from mouth</td>
<td>□ Satisfactory</td>
</tr>
<tr>
<td>a. may include deepening of anesthetia</td>
<td>4. Suction hypopharynx</td>
<td>□ Unsatisfactory</td>
</tr>
<tr>
<td>Response fails to resolve problem</td>
<td>5. Positive pressure ventilation with 100% oxygen</td>
<td>□ Satisfactory</td>
</tr>
<tr>
<td>a. may include airway adjuncts</td>
<td>a. may include airway adjuncts</td>
<td>□ Unsatisfactory</td>
</tr>
<tr>
<td>b. may include intubation attempt or</td>
<td>b. may include intubation attempt or laryngeal mask airway placement if</td>
<td></td>
</tr>
<tr>
<td>laryngeal mask airway placement if</td>
<td>laryngospasm not suspected</td>
<td></td>
</tr>
<tr>
<td>laryngospasm not suspected</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Response fails to resolve problem</td>
<td>6. Administer muscle relaxant</td>
<td>□ Satisfactory</td>
</tr>
<tr>
<td>a. may use succinylcholine in a dose of</td>
<td>a. may use succinylcholine in a dose of 0.3 to 1.5 mg/kg IV or 4 mg/kg IM if</td>
<td>□ Unsatisfactory</td>
</tr>
<tr>
<td>0.3 to 1.5 mg/kg IV or 4 mg/kg IM if no</td>
<td>no IV access</td>
<td></td>
</tr>
<tr>
<td>IV access</td>
<td>b. may use competitive blocker in an intubating dose if succinylcholine</td>
<td></td>
</tr>
<tr>
<td>c. may use competitive blocker in an</td>
<td>contraindicated</td>
<td></td>
</tr>
<tr>
<td>intubating dose if succinylcholine</td>
<td>7. Positive pressure ventilation with 100% oxygen</td>
<td></td>
</tr>
<tr>
<td>contraindicated</td>
<td>a. assess vital signs when possible</td>
<td></td>
</tr>
<tr>
<td>Response fails to resolve problem</td>
<td>8. Consider laryngoscopy and intubation</td>
<td>□ Satisfactory</td>
</tr>
<tr>
<td>11. Consider EMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overall response to emergency scenario</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Comments:
**SCENARIO 2 - ANAPHYLAXIS**

- HPI: 18M referred from general dentist for extractions of tooth #1,16,17,32
- No significant pmh
- Meds: Zoloft
- Allergy: NKDA
- 70kg and MP 2
- NPO > 8 hours
• 2g of ampicillin given pre-op
• Sedation with 3mg versed, 50 fent, 20 Ketamine
• After several minutes, patient started develop swelling of cheeks, eyes, lips