Oxygen Failure in the OR

Etiology

Loss of Pipeline Oxygen
- Exhaustion of central O₂ supply.
- Obstruction of central O₂ supply line to OR.
- O₂ shutoff valve in OR is off.
- Obstruction or disconnection of O₂ hose in the OR.
- Failure of O₂ regulator in the anesthesia machine.

Faulty Oxygen Supply
- Crossing of pipelines during construction/repairs.
- Incorrect connection of gas hoses.
- Non-O₂ cylinder at the O₂ yoke.
- Wrong gas in the O₂ cylinder.
- Broken flowmeter.

Prevention

Preanesthesia Machine Check
- Check pipeline pressure ~50 psi.
- Check O₂ tanks >50% full.
- Calibrate O₂ analyzer.

Supply-Side Safety Features
- Color-coded gas tanks
- DISS, PISS, and Quick Connects

Anesthesia Machine Safety Features
- Flowmeter arrangement
- O₂:N₂O ratio controller
- Oxygen supply failure protection device (“fail-safe valve”)

Gas Cylinders

<table>
<thead>
<tr>
<th>Gas</th>
<th>E-Cylinder Capacity (L)</th>
<th>Pressure (psi)</th>
<th>Color (USA)</th>
<th>Color (Int’l)</th>
<th>Form</th>
</tr>
</thead>
<tbody>
<tr>
<td>O₂</td>
<td>660</td>
<td>1900</td>
<td>Green</td>
<td>White</td>
<td>Gas</td>
</tr>
<tr>
<td>Air</td>
<td>625</td>
<td>1900</td>
<td>Yellow</td>
<td>White &amp; Black</td>
<td>Gas</td>
</tr>
<tr>
<td>N₂O</td>
<td>1590</td>
<td>745</td>
<td>Blue</td>
<td>Blue</td>
<td>Liquid</td>
</tr>
<tr>
<td>N₂</td>
<td>650</td>
<td>1900</td>
<td>Black</td>
<td>Black</td>
<td>Gas</td>
</tr>
</tbody>
</table>

How long can you use an O₂ tank starting at 430 psi running at 5 L/min?
A leak in the upstream $\text{O}_2$ flowmeter ("Incorrect sequence") results in a hypoxic gas mixture.

A leak in the Datex-Ohmeda or Draeger flowmeter arrangements may deliver less Air or $\text{N}_2\text{O}$ than expected, but the mixture will NOT be hypoxic because $\text{O}_2$ is closest to the FGF outlet.

Linkage mechanisms between flow valves can be either mechanical (above), pneumatic, or electronic.
Oxygen Failure Protection Device

Detection

- Pressure gauges fall (pipeline, tanks)
- Low O₂ alarms (O₂ supply failure, FIO₂ analyzer)
- Flowmeters fall (O₂ and other gases)
- O₂ flush inoperative
- Bellows inoperative
- Apnea alarms (spirometer, capnograph)
- Increasing O₂ flow makes the problem worse
- Hypoxemia, hypercarbia
- Arrhythmias, bradycardia, cardiac arrest

Management

- Notify surgeon, call for help.
- Verify problem (pressure gauges, flowmeters, O₂ flush, O₂ analyzer, capnograph).
- Switch to O₂ cylinder (calculate remaining time).
- Use manual ventilation to conserve O₂.
- Check valves, hoses, couplers.
- D/C supply lines if crossed pipelines suspected.
- Call for backup O₂ tanks.
- Close breathing circuit, manually ventilate.
- Switch to self-inflating bag (Ambu-Bag), Jackson-Reese with external tank, or mouth-to-ETT if necessary.
- Consider switch to TIVA until cause of failure is known.

References