Airway Management

Rapid Sequence Intubation

Prepare equipment (IV, ECG, oximeter, BVM, suction, ET tube); **CO_2 detector**; **backup airway**.

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Spinal motion restriction, as needed.

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Preoxygenate with 100% O_2.

↓

Give sedative:

- Midazolam, 0.1–0.3 mg/kg IV/IO (max single dose 10 mg). ***OR:***
- Propofol 1–2 mg/kg IV/IO, ***OR:***
- Ketamine, 1–2 mg/kg IV/IO, followed by one dose of midazolam, ***OR:***
- Etomidate, 0.2–0.4 mg/kg IV/IO, single dose only, ***OR:***
- Fentanyl 2–5 mcg/kg IV/IO

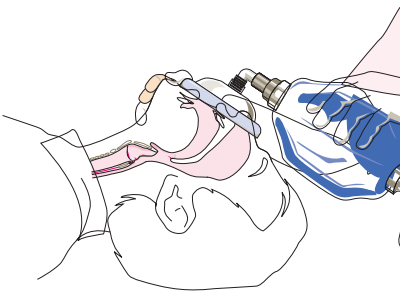
↓

If patient <2 yo., **consider atropine, 0.02 mg/kg IV/IO** (may block reflex bradycardia).

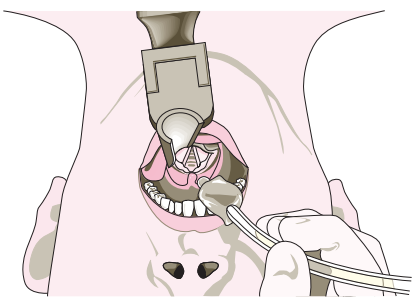
↓

Give neuromuscular blocker:

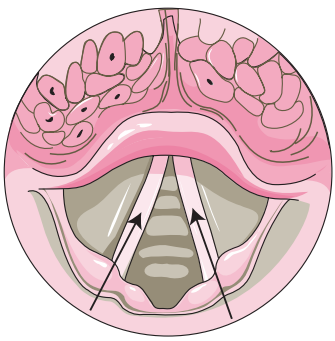
- Succinylcholine, 1–1.5 mg/kg IV/IO, ***OR:***
- Rocuronium, 0.6–1.2 mg/kg, IV/IO, ***OR:***



Place patient in sniffing position; hyperventilate with O_2



Lift tongue leftward and visualize vocal cords



Vocal cords

Go to next page

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- Vecuronium, 0.1–0.2 mg/kg IV/IO, ***OR:***
- Cisatracurium, 0.4 mg/kg IV/IO

↓

Intubate (apply cricoid pressure, as needed). Directly visualize ET tube passing through vocal cords

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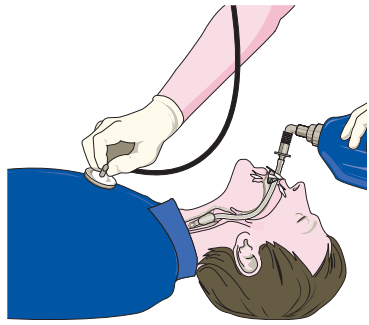

Insert ET tube; inflate cuff; check breath sounds

Inflate cuff; verify tube placement:

- **Check chest expansion**
- **Check lung sounds**
- **Check for fogging of tube**
- **Apply CO_2 detector and monitor O_2 saturation**
- **Secure with ET tube holder**
- **Continue sedation, paralytics if needed**
- **Check cuff inflation pressure**

i-gel Supraglottic Airway

Contraindications—Intact gag reflex, upper airway obstruction, trismus, caustic ingestions.

1. **Preoxygenate with 100% O_2.**
2. **Choose proper size (see chart).**

i-gel Sizing Chart

Package Color	Patient Size	Size	Weight
Orange	Large adult	5	90+ kg
Green	Medium adult	4	50–90 kg
Yellow	Small adult	3	30–60 kg
White	Large pediatric	2.5	25–35 kg
Grey	Small pediatric	2	10–25 kg
Blue	Infant	1.5	5–12 kg
Pink	Neonate	1	2–5 kg

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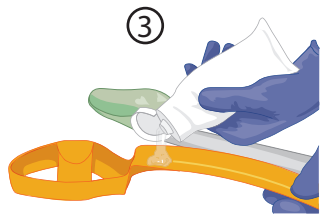
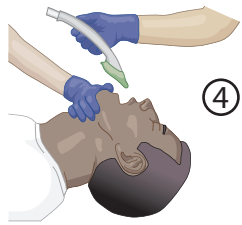
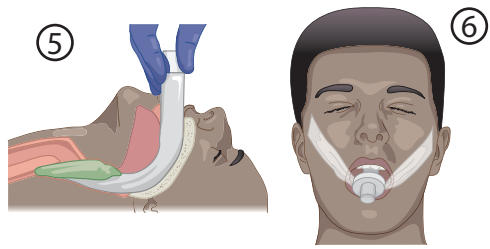
3. **Place lubricant into middle of smooth surface of cradle, and lubricate back, sides, and front of cuff with a thin layer.**
4. **Place patient in sniffing position.**
5. **Grasp i-gel by bite block, insert until definitive resistance is felt.**
6. **Secure in place, ventilate with BVM.**
7. **Verify proper placement:**
   - Check chest expansion and lung sounds
   - Apply waveform capnography, oximetry
   - Reassess periodically



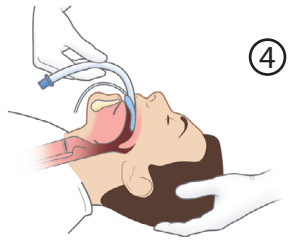


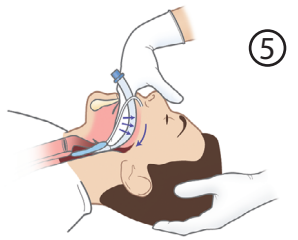


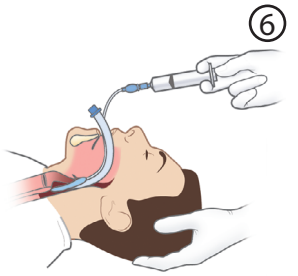
Laryngeal Mask Airway

Contraindications—Severe oropharyngeal trauma; **poorly tolerated in conscious patients**.

1. **C-spine immobilization** prn.
2. **Deflate cuff. Lubricate both sides** of the device.
3. **Preoxygenate with 100% O_2.**
4. **Sniffing position or jaw thrust**; place LMA against hard palate.
5. **Follow natural curve** of patient's airway, insert LMA until it is seated snugly.
6. **Inflate cuff** with just enough air (see chart); do not hold tube down during inflation; allow LMA to "seat itself."
7. **Verify proper placement:**
   - Check chest expansion and lung sounds
   - Secure with tape or tube holder
   - Apply CO_2 detector; oximeter
   - Reassess airway periodically







Go to next page

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Patient Size	LMA Size	Maximum Cuff Volume
Neonate/infant: up to 5 kg	1	Up to 4 mL
Infant: 5–10 kg	1½	Up to 7 mL
Infant/child: 10–20 kg	2	Up to 10 mL
Child: 20–30 kg	2½	Up to 14 mL
Child: 30–50 kg	3	Up to 20 mL
Normal adult: 50–70 kg	4	Up to 30 mL
Large adult: 70–100 kg	5	Up to 40 mL
Large adult: >100 kg	6	Up to 50 mL

King LTS-D Airway

Contraindications—Does not protect against aspiration.

1. **C-spine immobilization**, as needed. **Preoxygenate with 100% O_2.** Apply water-based lubricant to distal tip and posterior aspect of tube.
2. **Deflate cuff. Open mouth, apply chin lift, insert tip** into side of mouth.
3. **Advance tip** behind tongue while rotating tube to midline.
4. **Advance tube** until base of connector is aligned with teeth or gums.
5. **Inflate cuff** with air (see chart; use minimum volume necessary).

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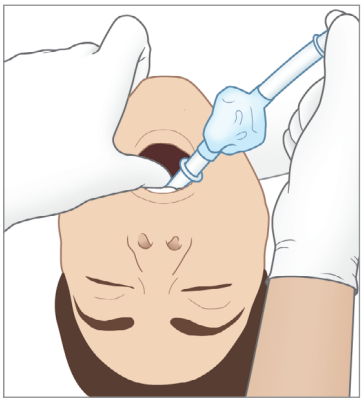

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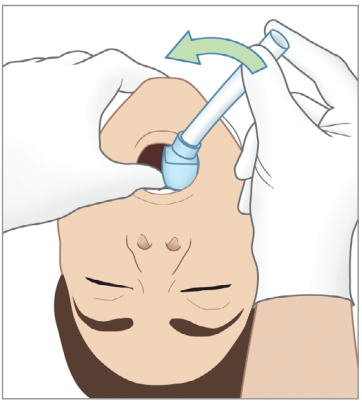

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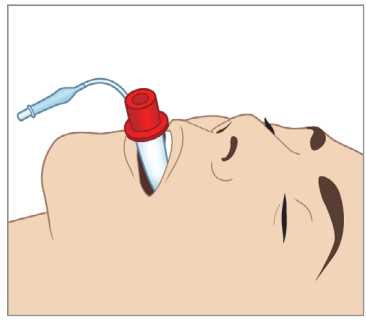
Patient Size	LTS-D Size	Cuff Volume (mL)
NB < 5 kg	0	10
Infant 5 – 12 kg	1	20
12–25 kg	2	35
25–35 kg	2.5	40–45
4–5 ft	3	50–60
5–6 ft	4	70–80
>6 ft	5	80–90

6. **Attach BVM.** While ventilating, gently adjust tube until ventilation becomes easy (i.e., good chest rise and fall).
7. **Adjust cuff inflation**, if necessary, to obtain a good seal (max 60 cm H_20).
8. **Verify proper placement:**
   - Check chest expansion and lung sounds.
   - Apply CO_2 detector; oximeter.
   - Secure with tape or tube holder.
   - Reassess airway periodically.

④



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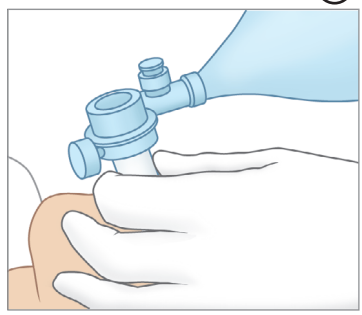

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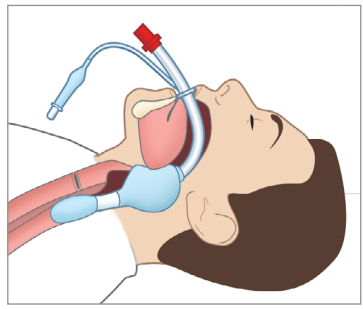

Ventilator Guidelines

Transporting a Patient Receiving Mechanical Ventilation

- Ensure adequate power and oxygen supplies during transport
- Determine current ventilator settings
- Assess most recent blood gas

Go to next page

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- Assure artificial airway is secure (taped, tied, device in place)
- Begin monitoring pulse oximetry and waveform capnography
- Power on transport ventilator
- Attach new transport ventilator circuit
- Adjust continuous flow
- Select ventilator rate, inspiratory rate, flow rate, and FiO_2
- Make mode selection (CPAP and PEEP, IMV/SIMV, AC, etc.)
- Attach patient to ventilator
- Reassess patient, pulse oximetry, and waveform capnography
- Adjust settings to maintain oxygenation (pulse oximetry, 92–94%) and adequate minute ventilation
- Maintain stable and patent airway (suction as needed)
- Verify and document ventilator settings before, during, and at end of transport
- Assess and document breath sounds
- Manually ventilate (with a BVM) if any doubt about functioning of ventilator

Troubleshooting a Ventilator Low-Pressure Alarm

- Quickly inspect the ventilator–patient connection for disconnect. Tighten all connections
- If alarm continues to sound, disconnect the ventilator and manually ventilate with a BVM
- Occlude the patient ventilator circuit with a gloved finger and observe the next ventilator-delivered breath
- If ventilator pressure manometer attempts to rise and high-pressure alarm sounds, vent circuit is intact and leak is with patient or artificial airway device

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Ventilator Settings Checklist

Noninvasive Ventilation Support

CPAP (continuous positive airway pressure)	Improves oxygenation in spontaneously breathing patients. Usual setting 5–13 cm H_2O.
BiPAP (bilevel positive airway pressure)	Improves oxygenation and ventilation in spontaneously breathing patients. Usual settings: inspiratory pressure 6–14 cm H_2O, expiratory 3–5 cm H_2O. Adjust by tidal volumes, respiratory rates, and O_2 saturations.

Consider CPAP/BiPAP for patients c/o respiratory distress. Must be awake, oriented, able to maintain open airway.

Use pulse oximetry and $ETCO_2$ monitor.

CPAP/BiPAP may be better tolerated if patient initially holds mask themselves.

Secure mask, check for air leaks. Support the patient and adjust mask as indicated. If unable to maintain O_2 sat >90%, remove device and consider BVM ventilation with PEEP and/or advanced airway. Monitor for gastric distention and/or nausea.

Contraindications: Vomiting, non-cooperative patient, respiratory arrest, shock, pneumothorax, tracheostomy, inability to maintain mask seal.

Invasive Ventilation Modes

Mode	Definition	Indication
CMV (continuous manual ventilation)	Vent delivers a preset rate and volume. Patient cannot breathe over set rate.	When a specific minute volume is required and patient apneic or chemically sedated

(*Continues*)

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Invasive Ventilation Modes (Cont'd)

Mode	Definition	Indication
AC (assist/control)	Vent guarantees minimum rate. Patient can breathe over set minimum rate, but each breath will be delivered at the preset tidal volume.	Controls work of breathing, allows patient to set own rate
SIMV (synchronized intermittent mandatory ventilation)	Vent delivers set rate and tidal volume synchronized with patient-initiated breaths. Spontaneous breaths above set rate are at the patient's own rate and depth (tidal volume).	Allows patient to assume some or most of work of breathing, depending on set rate. May be used as a weaning mode
PCV (pressure control ventilation)	Vent delivers preset pressure instead of volume. Tidal volumes may vary considerably, depending on lung compliance.	Used to avoid excessive pressures, often in conjunction with other lung protective strategies in patients for whom providing ventilation is difficult
PRVC (pressure-regulated volume control)	Vent delivers set tidal volume at least amount of pressure possible.	Used when both pressure and volume regulation are needed
IRV (inverse ratio ventilation)	Inspiratory phase is set longer than expiratory phase.	Used to increase oxygenation. Caution needed to avoid hyperinflation and breath stacking
PSV (pressure support ventilation)	A clinician-selected level of positive pressure delivered to augment each spontaneous breath.	Often used as a weaning or comfort mode. Overcomes the resistance of airway and vent circuit

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Guidelines for Initiating Mechanical Ventilation in Adults

Parameter	Definition	Setting Range
V_T (tidal volume)	Amount of air delivered with each ventilator breath	5–7 mL/kg initially, adjusted by ABG, $ETCO_2$, or PIPs
RR (respiratory rate)	Number of ventilator breaths delivered per minute	10–14 initially, adjusted by ABG, $ETCO_2$, or patient demand
Fio_2 (fraction of inspired oxygen)	Percentage of inspired oxygen expressed as a decimal	0.2–1.0, initially 1.0 (100%) titrated downward to maintain oxygen saturations of 92–94%, use lowest Fio_2 possible (<0.5) to avoid oxygen toxicity
Peak flow	Speed at which tidal volume is delivered	Varies greatly (35–100 L/minute)
I time (inspiratory time)	Time set to deliver set tidal volume or flow	Varies between 0.5 and 1.5 seconds
PIP (peak inspiratory pressure)	The peak pressure generated during ventilation	Should be maintained at lowest level possible to avoid barotrauma (20–30 cm H_2O)—should not exceed 50
I:E ratio (inspiratory to expiratory ratio)	Ratio of inspiratory time to expiratory time	1:2

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SVo_2 Values	
Normal values range from 60–80%. Does not correlate directly with Do_2 or Vo_2.	Values <60% or >80% indicate an imbalance between oxygen delivery and consumption.
↓ SVo_2	↑ SVo_2
↓ Oxygen delivery ↓ Arterial O_2 saturation ↓ Hemoglobin ↓ CO ↓ Arterial partial pressure of oxygen	↑ Oxygen delivery ↑ Arterial O_2 saturation ↑ Hemoglobin ↑ CO ↑ Arterial partial pressure oxygen
↑ O_2 Consumption	↓ O_2 Consumption
Shivering Fever ↑ Work to breathe ↑ Musculoskeletal activities Seizures Pain Patient care interventions—turning, suctioning, dressing changes, bathing	Anesthesia Hypothermia ↓ Work to breathe ↓ Musculoskeletal activities Drug sedation and paralysis Hypothyroidism Cellular dysfunction

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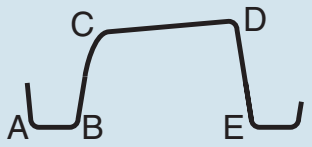
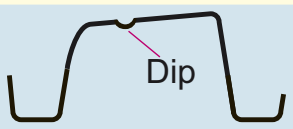
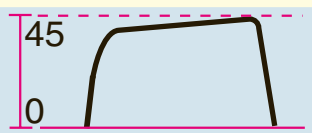
End-Tidal CO_2 Monitoring (Capnography)

Applications	Description	Waveform
Normal capnographic waveform	Four phases, plots CO_2 concentration over time AB = respiratory baseline BC = expiratory upstroke CD = expiratory plateau DE = inhalation of CO_2-free gas	
WARNING: Detect esophageal placement of ET tube during intubation!	A flat line occurs; no CO_2 is detected. Remove tube and ventilate with BVM or other advanced airway.	
Corresponds with ET tube placement in trachea	When tracheal placement occurs, exhaled CO_2 is shown on capnogram (35–45 mm Hg)	
Identify patient's attempt to breathe while paralyzed	Movement of patient's diaphragm results in a dip in the capnogram waveform	
WARNING: Indicates patient's disconnection from mechanical ventilator!	Waveform immediately disappears and goes flat	
Predictor of patient outcome	The higher the CO_2, the higher the cardiac output, and the more effective the resuscitation efforts	

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