

Pediatric Airway

BC Children's Hospital PICU
Physicians & Respiratory Therapists

September 11, 2023

PREPARING FOR INTUBATION IN CHILDREN

PHYSICIAN TO PHYSICIAN

CRITICAL CARE SUPPORT FROM BCCH PEDIATRIC INTENSIVE CARE UNIT (PICU)



Most Responsible Physician (MRP)
identifies the need for pediatric consult
for transport or advice
from the BCCH Pediatric ICU (PICU)



MRP/delegate phones
Patient Transfer Network (PTN):

1-866-233-2337

Requests a call with BCCH Pediatric Transport
Advisor



PTN connects with
PICU Pediatric Transport Advisor & MRP
to collaborate on an **ADVICE CALL**

New option available:

PTN can facilitate a secure [GoodSAM video conference](#) for MRP + PICU Transport Advisor +
additional specialists as needed

What is a Difficult Airway?

- **ALL** pediatric airways in an emergency setting are potentially difficult airways!
- Call the most experienced laryngoscopist for intubation of any child

- Anticipate – situational awareness
- Things to avoid during intubation
 - hypotension
 - hypoxemia
 - OXYGENATION is life saving - not INTUBATION...so if there's a problem....bag valve mask....
- Risks of medication during intubation
 - hypotension and hypoxemia – be prepared/anticipate
- Use pre-intubation checklist
- Debrief post procedure

- A child with a normal airway should always be able to be ventilated
- Classic rapid sequence induction is NOT routine in pediatric airway management
- Hypoxia during “classic” RSI is common in children, more common infants and neonates, and can be prevented by gentle facemask ventilation
- Cuffed ETT's are preferred for most children and neonates

BCCH PRE-INTUBATION TIMEOUT CHECKLIST

Is a difficult airway anticipated? If YES, CALL ANESTHESIA.

PATIENT PREPARED?

- Nasal cannulae applied
 - < 1 year 5LPM
 - 1-7 years 10LPM
 - >7 years 15LPM
- Functioning IV/IO?
- Patient exposed?
- Patient position optimized?
- Patient pre-oxygenated?
- Patient hemodynamics optimized?
- Does patient airway assessment identify any concerns?
- Failed intubation backup plan?

EQUIPMENT READY?

- Suction
 - rigid suction catheter turned onto max
- Oxygen
 - Mask
 - self inflating bag-valve
 - JR flow inflating system
- Airway equipment
 - working laryngoscope /blade
 - ETT plus 0.5 smaller size
 - lubricated stylet
 - oral airways/NPA
 - LMA
 - V-L available?
- Pharmacologic agents
 - induction/paralytic drugs
 - fluids / vasopressor?
- Monitoring Equipment
 - SaO₂
 - ECG
 - BP
 - waveform ETCO₂

TEAM READY?

- Gown, glove and eye protection
- Team members introduced
- Team leader identified
- RT/intubator checked equipment
- Nurse to administer medications
- Anticipated problems identified – anyone have questions or concerns?
- Identify recorder/capture “event start” on bedside Philips monitor

PLAN FOR CONSEQUENCES

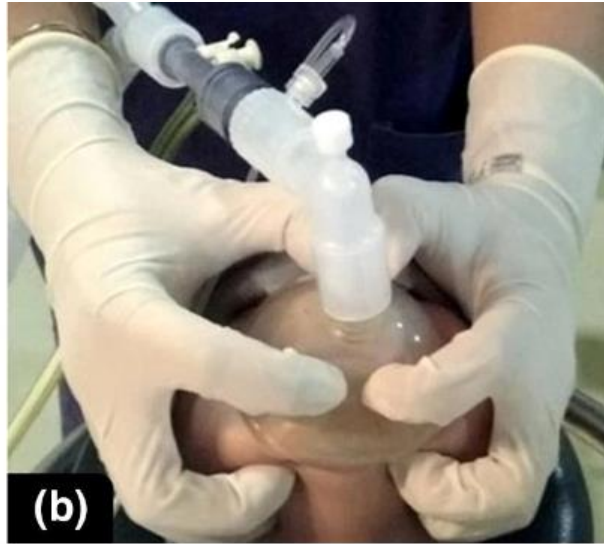
- Successful intubation?
 - secure ETT
 - CXR
 - ongoing sedation / paralysis
 - ventilation parameters set
- Document procedure in chart
- Complete NEAR4KIDS audit record
- RT to Complete NEAR4KIDS blue sheet

- **Suction** – age appropriate Yankauer
- **Oxygen and delivery devices** – nasal cannula
- **Airway**
 - age appropriate oral airways/face masks/LMAs
 - bag-valve or J-R circuit manual circuit for bag/mask ventilation
 - cuffed ETTs and stylet
 - appropriate laryngoscope blade - preferably videolaryngoscopy
- **Pharmacy**
 - anesthetic agent/muscle relaxant (ketamine/fentanyl/rocuronium)
 - resuscitation drug (adrenaline 1:100,000)
- **Monitors**
 - oximeter
 - ECG
 - BP
 - ETCO₂ for confirmation of successful intubation
- **Equipment** – adjuncts for special situations

Airway Strategies: Basic Management

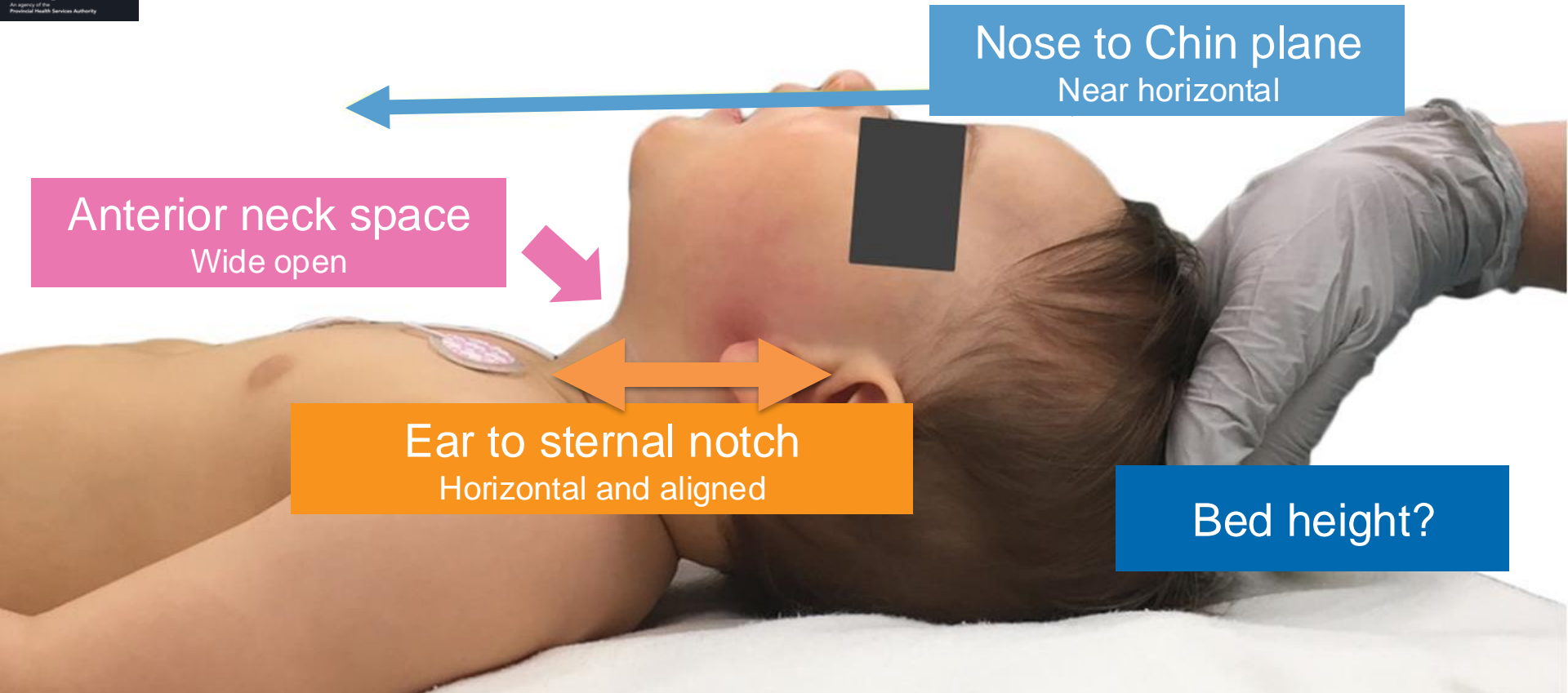
- Opening the airway
 - maneuvers
 - chin lift/jaw thrust
 - adjuncts
 - suction
 - oropharyngeal airway
 - nasopharyngeal airway
- Positioning the patient – age and clinical situation
- Assisting oxygenation
 - high flow mask/high flow nasal prongs/bag-mask
- Assisting ventilation
 - one person bag/mask
 - 2 person bag/mask

[Click here for a PALS Airway Management YouTube Video](#)



Jain, D., Goel, N., Mehta, S. *et al.* Comparison of three techniques of face mask ventilation in children less than two years of age—a randomized crossover study. *Can J Anesth/J Can Anesth* **66**, 999–1000 (2019). <https://doi.org/10.1007/s12630-019-01394-9>

Two hands are better than one



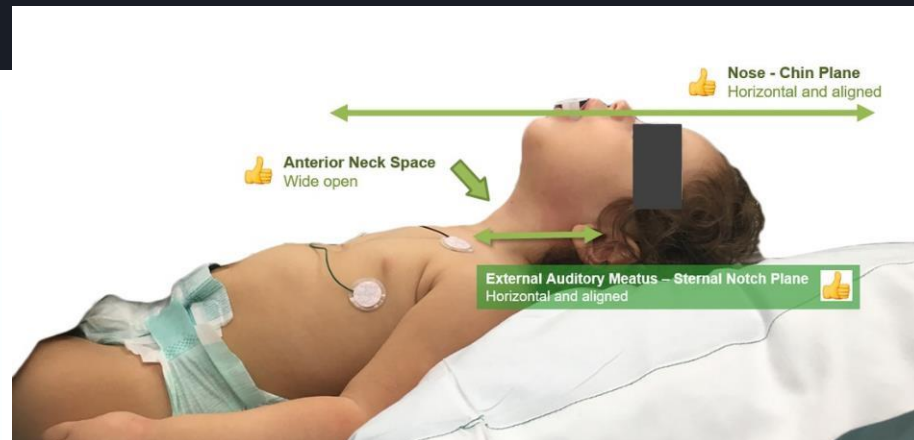
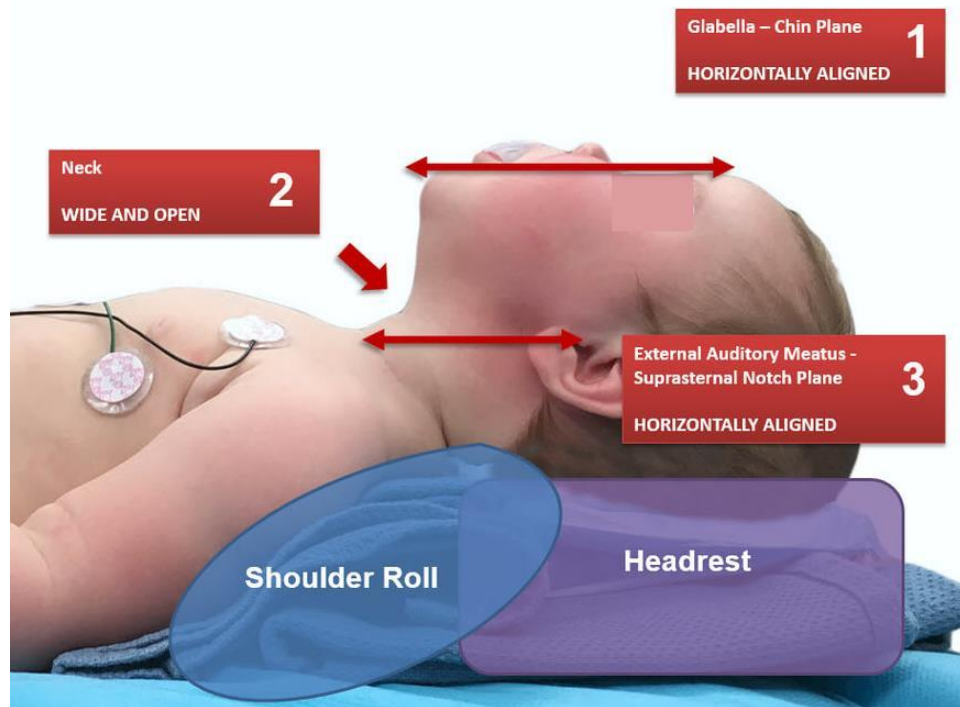
Nose to Chin plane
Near horizontal

Anterior neck space
Wide open

Ear to sternal notch
Horizontal and aligned

Bed height?

Positioning Matters



- Induction medications prepared – ketamine/rocuronium
 - fentanyl post-intubation if hypertensive
- Suction upper airway before procedure
 - consider nasal cannula oxygen before/during oral intubation to decrease desaturation
- Fluid resuscitation prior to/during procedure if hypovolemia a possibility
- Rescue medication
 - adrenaline
 - 0.1ml/kg 1:10,000 diluted to 10mls – 1ml = 1mcg/kg

- Team ready / checklist reviewed
 - anticipate/pre-treat hypotension-hypovolemia
- Pre-oxygenation during preparation
- Give induction medications
 - gentle bag mask ventilation often required prior to laryngoscopy
 - modified rapid sequence approach
- Laryngoscopy/intubation
 - may require assistant to apply BURP (back up rightward pressure)
 - attach inline ETCO₂ monitor once ETT inserted
 - connect to bagger/ventilate/observe exhaled carbon dioxide
 - observe depth mark at teeth
- Secure ETT

- Ketamine 0.5-1mg/kg IV
 - can repeat after airway secured
- Fentanyl 1mcg/kg IV
 - can repeat after airway secured
- Rocuronium 1mg/kg IV

ETT Size and Depth

ETT Size:

- 3.0-3.5 ETT for < 1 year old
- 3.5-4.0 ETT for < 2 years old
- For ≥ 2 years old:
 - Cuffed = $\text{age}/4 + 3.5$
 - Uncuffed = $\text{age}/4 + 4$

uncuffed ETT is preferred for suspected croup

ETT Depth:

- PALS estimation for > 1 year: $[\text{age (in years)}/2] + 12$
- ID estimation (for ETT ≥ 3.0): ID of ETT x 3
- Add 2-3 cm for nasal intubations



"Hockey Stick" method

Securement devices:

- For ETTs < 5.0, it is recommended to use a Neobar®
 - Sizing: ear to ear without pulling/bending the Neobar® to fit
- For ETTs \geq 5.0, it is recommended to use an AnchorFast®



Neobar®

Twill Ties:

- For facial trauma, burns, etc.
- Please watch the below video on how to secure an ETT with twill ties:
- https://www.youtube.com/watch?v=kqAooVu_a4



AnchorFast®

Tape:

- Multipore Dry Tape by 3M™
- Latex free
- When using a Neobar®, we tape using the “candy cane” method for optimal security – once around the Neobar®, then around the Neobar® and ETT in an upward swirl away from the patient



3M™ Multipore Dry Tape



“candy cane” method



- Secure the ETT/pass NG-OG
- Continuously monitor ETCO_2 / SaO_2 /BP
- Check CXR – NG and ETT position
- Ongoing sedation/analgesia/+-muscle relaxation
- Lung protective ventilation if acute lung injury
- Neuroprotection if acute neurologic problem
- Avoid gas trapping with obstructive lung disease

- Morphine 10-40 mcg/kg/hr
 - Lower dose for tube comfort
 - Higher dose if trauma and pain
- Midazolam 50-150 mcg/kg/hr
- Dexmedetomidine 0.1-0.7 mcg/kg/hr
 - To reduce midazolam dose requirements
- Rocuronium 0.5-1mg/kg prn
 - for tube safety or clinical situation



Difficult mask ventilation (MV) – during routine induction of anaesthesia in a child aged 1 to 8 years



Difficult MV



Give 100% oxygen



Call for help

Step A Optimise head position

Consider:

- Adjusting chin lift/jaw thrust
- Inserting shoulder roll if <2 years
- Neutral head position if >2 years
- Adjusting cricoid pressure if used
- Ventilating using two person bag mask technique

Check equipment

Consider changing:

- Circuit
- Mask
- Connectors

If equipment failure is suspected, change to self-inflating bag and isolate from anaesthetic machine promptly

Depth of anaesthesia

Consider deepening anaesthesia
Use CPAP

Step B Insert oropharyngeal airway

Call for help again if not arrived

Assess for cause of difficult mask ventilation

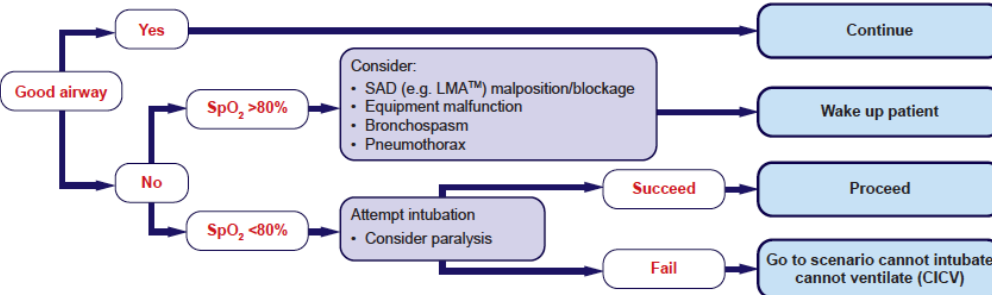
- Light anaesthesia
- Laryngospasm
- Gastric distension – pass OG/NG tube

Maintain anaesthesia/CPAP
Deepen anaesthesia (Propofol first line)

- If relaxant given – intubate
- If intubation not successful, go to unanticipated difficult tracheal intubation algorithm

Step C Second-line: Insert SAD (e.g. LMA™)

Insert SAD (e.g. LMA™) – not > 3 attempts
Consider nasopharyngeal airway
Release cricoid pressure



Difficult direct laryngoscopy



Give 100% oxygen and maintain anaesthesia



Call for help

Step A Initial tracheal intubation plan when mask ventilation is satisfactory

Ensure: Oxygenation, anaesthesia, CPAP, management of gastric distension with OG/NG tube

Direct laryngoscopy – not > 4 attempts

Check:

- Neck flexion and head extension
- Laryngoscopy technique
- External laryngeal manipulation – remove or adjust
- Vocal cords open and immobile (adequate paralysis)

If poor view – consider bougie, straight blade laryngoscope* and/or smaller ETT

Succeed

Tracheal intubation

Verify ETT position

- Capnography
- Visual if possible
- Auscultation

If ETT too small consider using throat pack and tie to ETT

If in doubt, take ETT out

Failed intubation with good oxygenation

Step B Secondary tracheal intubation plan

Call for help again if not arrived

- Insert SAD (e.g. LMA™) – not > 3 attempts
- Oxygenate and ventilate
- Consider increasing size of SAD (e.g. LMA™) once if ventilation inadequate

Succeed

- Consider modifying anaesthesia and surgery plan
- Assess safety of proceeding with surgery using a SAD (e.g. LMA™)

Unsafe

Safe

Postpone surgery
Wake up patient

Proceed with surgery

Safe

- Consider 1 attempt at FOI via SAD (e.g. LMA™)

Succeed

- Verify intubation, leave SAD (e.g. LMA™) in place and proceed with surgery

Failed intubation via SAD (e.g. LMA™)

Postpone surgery
Wake up patient

Failed oxygenation e.g. SpO₂ <90% with FIO₂ 1.0

- Convert to face mask
- Optimise head position
- Oxygenate and ventilate
- Ventilate using two person bag mask technique, CPAP and oro/nasopharyngeal airway
- Manage gastric distension with OG/NG tube
- Reverse non-depolarising relaxant

Succeed

Failed ventilation and oxygenation

Go to scenario cannot intubate cannot ventilate (CICV)

Following intubation attempts, consider • Trauma to the airway • Extubation in a controlled setting

*Consider using indirect laryngoscope if experienced in their use

SAD = supraglottic airway device