Newborn Critical Care Center (NCCC) Clinical Guidelines

Tracheostomy Guidelines in Patients with Severe Established BPD (sBPD)

DETERMINATION AND DECISION MAKING

There is little data to guide exact timing for placement of tracheostomy. Concepts to consider are changing developmental needs and restrictions inherent to the presence of an endotracheal tube (ETT), degree of respiratory support presently and in the future weeks/months, and factors such as co-morbidities affecting growth and improvement. In addition, children with significant airway concerns may follow a differing decision-making pathway with recommendations from the ENT service.

FAMILY DISCUSSIONS

A family meeting should be scheduled once it is possible that their infant may need a tracheostomy. Generally, these discussions and possibilities are best held several weeks before the decision is clear and may require more than one family meeting. This will allow the family to understand the goals of care and progress considered in the decision for or against tracheostomy (weaning on ventilator, making progress towards or achieving extubation goals, goals of growth, etc), as well as the implications for care at home.

Stakeholders that may be present at the family discussion include ENT, Pulmonary, and Supportive Care. The patient should be included in the NC Children's Airway Center for weekly discussion during this active decision-making. The decision for tracheostomy is significant and should be made together by the medical team and family, ensuring that long term tracheostomy and home care needs can be supported.

PRE-OPERATIVE CONSIDERATIONS

Gastrostomy Tube Placement

Virtually all infants that receive a tracheostomy will need a gastrostomy tube placed before discharge home. If a patient is deemed stable for tracheostomy placement by the primary team and the ENT surgeon agrees the patient is a good candidate for placement, it should be discussed if a gastrostomy tube can be placed during the same surgery. If able to have both procedures at the same time, Pediatric Surgery should be consulted with adequate time for dual scheduling.

Gestational age

In publications from the BPD collaborative, an international group of ID neonatal and pediatric pulmonary teams, the range of timing of tracheostomy placement in this population was 48-52 weeks post-menstrual age (PMA). At UNC NCCC, over the last 2 years, the average timing for BPD related tracheostomy was 49 weeks PMA. Although there may be exceptions, in general, tracheostomy placement should occur at >/= **44 weeks PMA.**

GOALS

The primary goal in caring for patients prior to tracheostomy placement is to achieve a ***stable and consistent state with evidence of respiratory reserve*** in the weeks up to their surgery. These concepts will be described in more detail below.

A. Ventilation

The patient's baseline ventilatory status should be optimized prior to surgery. In established severe BPD, the most common physiology is obstructive lung disease. Therefore, maintenance of adequate recruitment, adequate chest rise and consistent airflow and good breath sounds, as well as adequate time for emptying of the lungs are key concepts.

Ventilation goals:

- Normal ventilation as indicated by a CO_2 of < 50 consistently on blood gases. The goal is to consistently achieve values within the normal range over time. This contrasts with preterm infants, and permissive hypercarbia as an effort in the **prevention** of BPD.
- Good chest rise awake and asleep. Visible chest rise is the goal, not bounding. Tidal volume range is often 12-15ml/kg/day, however due to high airway resistance it is important to consider good air exchange in all states.
- Absence of cyanotic spells or abrupt loss of airflow
- The post-term patient with severe BPD (sBPD) should be able to maintain airflow in differing positions, such as tolerance of holding, cares, and therapies.
- Chest Xray should show "well recruited" lungs without significant areas of atelectasis and good expansion.
- Ventilator strategies should avoid significant over-inflation. These include adjustment of the rate, and inspiratory time to allow for adequate emptying.
- Albuterol should be considered for maintaining consistent airflow in infants still displaying variable work of breathing and/or diminished breath sounds or infants with high volume of secretions and/or ongoing areas of atelectasis. Frequency of treatments q4-6 hours can be considered.

B. Oxygenation

Oxygenation should be consistent prior to surgery with the absence of wide variability. The infant should not be having frequent desaturations and predictable oxygen needs, not requiring significant changes in oxygen needs. Saturation goals should be at > 92% during all states.

- Consistent oxygen needs of 40% or less likely reflects a more stable state. Achieving this oxygen requirement prior to surgery is an appropriate goal.
- FiO2 < 0.40 is ideal for tracheotomy to minimize risk of airway fire. If unable to achieve, ENT surgeon will determine comfort in only using Bipolar or other non-monopolar techniques for hemostasis and appropriate timing of surgery.

C. Signs of Inflammation

Consideration of signs of pre-operative inflammation may be helpful in the timing of tracheostomy placement and avoidance of extreme post- operative inflammatory response.

- The patient should have normal electrolytes, including chloride, and the absence of rapid weight gain.
- Excessive weight gain in the setting of normal caloric intake and appropriate fluid (120-150 ml/kg/day) may be reflective of an inflammatory state.
- Secretions should be at baseline. A significant increase in secretions may indicate a change in inflammatory status or potentially an infection.

D. Linear Growth

Consistently achieving linear growth reflects a balanced or “pro-growth” state in sBPD and has been associated with respiratory stability.

E. Adrenal Health

- Prior steroid exposure should be reviewed with pharmacy, in conjunction with measures of adrenal health.
- A plan for mineralocorticoid coverage need should be determined.
- At times, there may be a need for glucocorticoid coverage, especially if post-operatively the patient displays signs of significant changes in support and stability. (see below).

Additional pre-operative logistical considerations:

- Central access will be necessary in patients with sBPD in the postoperative period (10-14 days duration typical) for adequate pain control and sedation. Consideration of central line access should be discussed and implemented in advance of procedure.
- Pain and sedation medication drips should be ordered, and ideally pharmacy alerted with adequate time for medications to be at the bedside when the patient returns from the OR.
    - Pain and sedation plan should be made with pharmacy, giving consideration to goals of pain and sedation (listed below) and also previous exposure history.
- Discussion should occur prior to OR with Anesthesia team not to reverse medications prior to NCCC return. Consistent sedation is the goal.
- Prior to surgery, there should be discussions with nursing regarding who will cover the patient in the first few days post-operatively with priority to primary nurses.

For the most at-risk patients with high PEEP and/or high FiO2 still determined to be at most optimized condition for tracheotomy, may consider:

- Transport ventilator from NICU to OR to minimize transition time with Ambu bag and circuit disconnections.
- OR start time if possible, to allow for full team care coordination

- Preoperative evaluation with Anesthesia including participation in Family Meeting and consent.
- Discussion with family and Pediatric Surgery prior to tracheotomy if patient is ECMO candidate should escalation of respiratory support to ECMO occur postoperatively.

POST-OPERATIVE CONSIDERATIONS

In the post-operative period, the goal is both sedation and pain control. There should be no gross arm and leg movements, and infrequent head and neck movement. Head thrashing may be painful for the patient with a fresh tracheostomy and increase overall agitation. The tracheostomy tube placed in surgery must remain in place and not be dislodged until the tracheostomy site is evaluated by ENT and stoma matured. This is usually evaluated with a tracheostomy tube change around 7 days post-operatively. This is to allow maturity of the artificial airway tract.

Until the first airway change, the infant is considered to have a critical airway. Loss of placement of the tracheotomy tube before maturation of the tract can lead to a false tract on reinsertion, and the risk of inability to replace the tracheostomy tube. If the airway is without stenosis, in an emergency, the trach site may be covered, and emergency intubation from above attempted.

A. Pain Management

- It is extremely important to adequately address post-surgical pain. Inadequate pain control may lead to risk of agitation and alter respiratory stability.
- Important considerations including previous exposure, and length of exposure, to specific drug classes, which may have resulted in high tolerance levels and need for increased dosing postoperatively.
- Pain may be exacerbated by head turning and movement. The inter-relatedness of pain and sedation in this scenario, as well as potential effect on respiratory stability, should be considered. Adequate pain management and sedation should permit tolerance of cares and position changes without significant physiological changes.

B. Sedation

- In the immediate postoperative period, prior to the first trach change, it is important to ensure that the safety of the operative site and new tracheostomy is maintained. The goal is to prevent large muscle movements and any grabbing or pulling on the new tracheostomy by the patient.
- The patient should be sedated enough to be sleepy and comfortable with cares and positioning changes. This is important for appropriate pulmonary toilet and avoidance of atelectasis.
- The use of gabapentin is common in these babies and should be resumed by feeding tube as soon as possible due to chronic exposure and risk of side effects with abrupt stoppage.
- Effects of sedation and/or paralysis on infants with severe BPD can be significant. This should be carefully considered as these medications are weaned, there may be

a need to increase PC to maintain tidal volumes needed for good chest rise, and adequate airflow and ultimately adequate ongoing recruitment.

- Pharmacy is working toward more specific pain and sedation guidelines for patients with severe BPD. In the meantime, the most common medications utilized post-tracheostomy placement are Lorazepam (Ativan- intermittent iv dosing), Midazolam (Versed ,as continuous hourly infusion) Fentanyl (as continuous hourly infusion) and dexmedetomidine (Precedex , as continuous hourly infusion) to achieve adequate pain management and sedation goals listed above. Review past medication exposures with pharmacy, as well as preparation and timing of medication with procedure. Nursing should also be included in discussions
- In addition, a conversation should take place with anesthesia at hand-off to surgery, that the patient should return sedated (the patient goal should not to be to achieve awakening before returning to the NCCC).

C. Ventilation and Recruitment

- If the infant is well sedated, they may ventilate sufficiently on preoperative ventilator settings. Alternatively, inflammation and stress, may result in a change in airway resistance and/or lung compliance. ***In this case, the following should be considered:***
    1. SIMV mode should be utilized.
    2. Increased PIP may be necessary.
    3. Chest X-rays should show good recruitment and expansion with the goal of avoiding atelectasis and consideration of hyperinflation.
    4. Physiological based settings should continue to be used to address lung recruitment and emptying. This involves adequate peak inspiratory pressure to achieve good air entry on exam, and adequate but not bounding chest rise. Peak inspiratory pressure usually needed is 25 to 45, occasionally higher. The rate generally will be 15-25 breaths per minute. Due to lower rates, inspiratory time (I-time) must be adjusted in the range of 0.5-0.6 sec at a rate of 25, to an I-time of 0.8 sec at a rate of 15.The physical exam should confirm adequate breath sounds on inspiration and adequate time for emptying. The most common physiology in this group of patients with established severe BPD is obstructive in nature, hence the need for high peak inspiratory pressures to overcome airway resistance and lower rates to allow adequate emptying.
    5. Baseline bronchodilator use should continue, and it may be necessary to temporarily increase dosing to promote airflow. Xopenex is an option if tachycardia is a concern. In assessing infant comfort versus post bronchodilator tachycardia, the tachycardia after bronchodilator treatment should improve 30-60 minutes after dosing.
    6. If an infant requires paralysis for stability post-operatively, the pressure control/PIP/PEEP may be weaned based upon blood gases, and as importantly, the adequacy of breath sounds and chest excursion. However, it

is important to realize once paralysis is lifted, that the pressure control/PIP and/or PEEP will need to be adjusted for adequate support in the more awake state. This is also true for infants with sedation in the post-operative course, sedation often leads to less need for respiratory support transiently **BUT** must be adjusted back as sedation is weaned.

7. Airway clearance, pulmonary toilet and positioning are important for maintaining adequate recruitment. Specifically, if the infant is having variable oxygen needs, inadequate airflow and/or atelectasis should be evaluated. Chest PT and albuterol may be indicated. Careful evaluation of need for suctioning should be prioritized.
8. With sedation and/or paralysis, careful evaluation of positioning and skin changes should be a priority.

D. Oxygenation

- Infants with sBPD undergoing surgery may have changes in lung function and pulmonary vascular resistance. For these reasons, oxygen should be **slowly** weaned postoperatively especially in the first 7 days until tracheostomy change, and oxygen saturations should be maintained at >92% at all times.

E. Steroids for Anti-inflammatory Effects

- If glucocorticoid coverage is needed for stability post-operatively, consider methylprednisolone (IV) or prednisolone (PO) for 3-7 days at a dose of 1-2 mg/kg/day.
- **Note:** IV methylprednisolone has no mineralocorticoid activity. You may need to consider hydrocortisone in this clinical situation. The oral equivalent of IV methylprednisolone, prednisolone, does contain mineralocorticoid activity. If there is concern for adrenal insufficiency, consult pharmacy with changes/additions of steroids in the postoperative period.
- Glucocorticoid steroids should be used judiciously, and the shortest course and lowest doses used to effect. Also, neuromuscular blockade, although effective in extreme obstructive lung disease, should be used judiciously also and only when unable to oxygenate and ventilate with all other supportive measures.

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