10. Critical Care for Trauma

Educational materials and pathways regarding the evaluation and management of the critically ill.

- Adult ICU Electrolyte Replacement
- Evaluation and Management of Atrial Fibrillation
- Nebraska Medicine Brain Death Criteria
- Percutaneous Tracheostomy Protocol

Adult ICU Electrolyte Replacement

Purpose

To define patients eligible for the electrolyte replacement protocol; to define the process for a provider to order the electrolyte replacement protocol; for a nurse to order and administer electrolyte replacement using this protocol; for a pharmacist to ensure safe dosing of electrolyte replacement; and for when the provider should be contacted when a patient has the electrolyte replacement protocol order set placed.

Policy

Standardized electrolyte replacement will be available for eligible adult ICU patient using an interdisciplinary approach. This includes but is not limited to medication management and monitoring.

Exclusion criteria are as follows:

- Pediatric patients (less than 19 yrs of age)
- Weight < 40 kg
- Renal dysfunction (serum creatinine 1.5 mg/dL or greater **or** increase in serum creatinine by 50% **or** renal replacement therapy) within the past 3 days
- pH <7.2 or pH >7.5 within the past 24 hours
- Diabetic ketoacidosis

Procedure

1. The ICU Electrolyte Replacement Order Set will be initiated by the ordering provider. The provider will select which electrolytes (magnesium, potassium) they would like to have replaced via protocol, as well as the goal electrolyte level and preferred route of replacement.
    - **NOTE:** if exclusion criteria has been met, the provider will be unable to place the order.
2. The ICU Electrolyte Replacement Order Set will be continued perpetuity and should be evaluated daily to ensure appropriateness of continuation. If a patient develops exclusion criteria and the electrolyte protocol is still ordered, the nurse will be notified of the exclusion criteria that the patient has met and will be instructed to contact the provider regarding replacement.

3. With the provider initiating and signing the ICU Electrolyte Replacement order, this allows the nurse to enter appropriate replacement and laboratory monitoring orders.
4. When entering subsequent orders the nurse will enter those orders using the appropriate provider name and "Per protocol: cosign required".

Magnesium Replacement

- The ICU Magnesium Replacement Order Set will be initiated by the ordering provider. They will be required to select the preferred route of replacement (enteral/parenteral or IV only) as well as the magnesium goal level.
- With the provider initiating and signing the ICU Electrolyte Replacement Order Set, this allows the nurse to enter the appropriate replacement and laboratory monitoring orders per Table A or B.
- when entering subsequent orders, the nurse will enter those orders using the appropriate provider name and "Per protocol: cosign required".
- If the Magnesium Replacement Order Set is initiated and the patient has sub-therapeutic magnesium levels within the previous 3 hours, a task will be added to the nursing work list.
- To address the magnesium electrolyte replacement, the nurse will access the ICU Electrolyte Replacement Order Sets within the manage orders tab. The order set will be listed under suggestions. Upon opening the order set, appropriate replacement and lab orders will be presented to the nurse per Table A or B, to enter and sign.
- During verification, the pharmacist will confirm that the order is appropriate per Table A or B.
    - Duplicate replacement orders will flag on the verification screen.
    - "Off protocol" oral replacement will be allowed in certain instances (i.e., continuation of home scheduled magnesium regimen).
- After pharmacist verification and acknowledgement of the order, the nurse will administer the ordered dose orally or via the infusion pump.
- The following situations describe when the ordering provider or designee MUST be contracted:
    - The patient meets exclusion criteria and is ineligible to receive ongoing electrolyte replacement via this protocol.
    - The magnesium level is below threshold specified by Table A or B.

Table A: Standard Magnesium Replacement for Goal Magnesium > 1.8 mg/dL

Magnesium Level	Enteral and/or parenteral	IV only
1.0 or less	Notify Provider. Provider to order replacement and recheck labs	
1-1.3 mg/dL	Magnesium sulfate 4 gm IV over 4 hours x 1 dose Recheck magnesium in 7 hours	Magnesium sulfate 4 gm IV over 4 hours x 1 dose Recheck magnesium in 7 hours
1.4-1.5 mg/dL	Magnesium oxide 400 mg (250 mg elemental magnesium) PO every 4 hours x 4 doses Recheck magnesium with AM labs	Magnesium sulfate 3 gm IV over 3 hours x 1 dose Recheck magnesium with AM labs
1.6-1.7 mg/dL	Magnesium oxide tablet 400 mg (250 mg elemental magnesium) every 4 hours x 3 doses Recheck magnesium with AM labs	Magnesium sulfate 2 gm IV over 2 hours x 1 dose Recheck magnesium with AM labs

Table B: Standard Magnesium Replacement for Goal Magnesium > 2.0 mg/dL

Magnesium Level	Enteral and/or parenteral	IV only
1.0 or less	Notify Provider. Provider to order replacement and recheck labs	
1-1.3 mg/dL	Magnesium sulfate 4 gm IV over 4 hours Q4H x 2 doses Recheck magnesium in 10 hours	Magnesium sulfate 4 gm IV over 4 hours Q4H x 2 doses Recheck magnesium in 10 hours
1.4-1.6 mg/dL	Magnesium sulfate 4 gm IV over 4 hours **and** Magnesium oxide 400 mg Q4H x 2 doses Recheck magnesium in 10 hours	Magnesium sulfate 4 gm IV over 4 hours x 1 dose Recheck magnesium in 7 hours
1.7-1.8 mg/dL	Magnesium oxide tablet 400 mg (250 mg elemental magnesium) every 3 hours x 4 doses Recheck magnesium in 9 hours	Magnesium sulfate 3 gm IV over 3 hours x 1 dose Recheck magnesium 6 hours
1.8-1.9 mg/dL	Magnesium oxide tablet 400 mg (250 mg elemental magnesium) every 4 hours x 3 doses Recheck magnesium with AM labs	Magnesium sulfate 2 gm IV over 2 hours x 1 dose Recheck magnesium with AM labs

Potassium Replacement

- The Potassium Replacement Order Set will be initiated by the ordering provider. They will be required to select the preferred route (enteral/parenteral or IV only) as well as the potassium goal level.
- With the provider initiated and signing the ICU Electrolyte Replacement Order Set, this allows the nurse to enter appropriate replacement and laboratory monitoring orders per Table C or D.
- When entering subsequent orders, the nurse will enter those orders using the appropriate provider name and "Per protocol: cosign required".
- If the Potassium Replacement Order Set is initiated and the patient has sub-therapeutic potassium levels within the previous 3 hours, a task will be added to the nursing work list.
- To address the potassium electrolyte replacement, the nurse will access the ICU Electrolyte Replacement Order Sets within the manage orders tab. The order set will be listed under suggestions. Upon opening the order set, appropriate replacement and lab orders will be presented to the nurse per Table C or D, to enter and sign.

        - **NOTE:** if the RN has central line access, but is unable to administer using the central line due to concomitant infusions, they will contact the pharmacist to request a change in concentration.
    - During verification the pharmacist will confirm that the order is appropriate per Table C or D.
        - Duplicate replacement orders will flag on the verification screen.
        - "Off protocol" oral replacement will be allowed in certain instances (i.e., continuation of home scheduled potassium regimen or intermittent loop diuretic doses).
    - After pharmacist verification and acknowledgement of the order, the nurse will administer the ordered dose orally or via the infusion pump.
    - The following situations describe when the ordering provider or designee MUST be contacted:
        - The patient meets exclusion criteria and is ineligible to receive ongoing electrolyte replacement via this protocol.
        - The potassium level is below threshold specified by Table C or D.

Table C: Standard Potassium Replacement for Goal Potassium > 3.8 mEq/L

Potassium Level	Enteral and/or IV	IV only
2.5 or less	Notify Provider. Provider to order replacement and recheck	
2.6-2.9 mEq/L	Potassium Chloride 40 mEq PO q2h x 2 doses Recheck potassium in 4 hours	[Central Line] Potassium Chloride 80 mEq IV over 4 hours [Peripheral] Potassium chloride 80 mEq IV over 8 hours [Central Line] Recheck potassium in 6 hours [Peripheral] Recheck potassium in 10 hours
3.0-3.3 mEq/L	Potassium Chloride 30 mEq PO Q2H x 2 doses Recheck potassium with in 4 hours	[Central Line] Potassium Chloride 60 mEq IV over 3 hours [Peripheral] Potassium Chloride 60 mEq IV over 6 hours [Central Line] Recheck potassium in 5 hours [Peripheral] Recheck potassium in 8 hours
3.4-3.5 mEq/L	Potassium Chloride 40 mEq PO x 1 dose Recheck potassium with AM labs	[Central Line] Potassium Chloride 40 mEq IV over 4 hours [Peripheral] Potassium Chloride 40 mEq IV over 4 hours [Central Line] Recheck potassium with AM labs [Peripheral] Recheck potassium with AM labs
3.6-3.7 mEq/L	Potassium Chloride 20 mEq PO x 1 dose Recheck potassium with AM labs	[Central Line] Potassium Chloride 20 mEq IV over 2 hours [Peripheral] Potassium Chloride 20 mEq IV over 2 hours Recheck potassium with AM labs

Table D: Standard potassium replacement for goal potassium > 4.0 mEq/L

Potassium Level	Enteral and/or IV	IV
2.5 of less	Notify Provider. Provider to order replacement and recheck	
2.6-2.9 mEq/L	Potassium chloride 30 mEq PO Q2H x 2 doses **and** [Central Line] Potassium Chloride 40 mEq IV over 2 hours [Peripheral] Potassium chloride 40 mEq IV over 4 hours [Central Line] Recheck potassium in 5 hours [Peripheral] Recheck potassium in 6 hours	[Central Line] Potassium Chloride 60 mEq IV over 3 hours [Peripheral] Potassium chloride 60 mEq IV over 6 hours [Central Line] Recheck potassium in 5 hours [Peripheral] Recheck potassium in 8 hours
3.0-3.3 mEq/L	Potassium chloride 40 mEq PO x 1 dose **and** [Central Line] Potassium Chloride 40 mEq IV over 2 hours	[Central Line] Potassium Chloride 80 mEq IV over 4 hours [Peripheral] Potassium Chloride 80 mEq IV over 8 hours

	[Peripheral] Potassium chloride 40 mEq IV over 4 hours [Central Line] Recheck potassium in 4 hours [Peripheral] Recheck potassium in 7 hours	[Central Line] Recheck potassium in 6 hours [Peripheral] Recheck potassium in 10 hours
3.4-3.5	Potassium chloride 30 mEq PO Q2H x 2 doses Recheck potassium in 6 hours	[Central Line] Potassium Chloride 60 mEq IV over 3 hours [Peripheral] Potassium chloride 60 mEq IV over 6 hours [Central Line] Recheck potassium in 6 hours [Peripheral] Recheck potassium in 9 hours
3.6-3.7 mEq/L	Potassium Chloride 40 mEq PO x 1 dose Recheck potassium in 4 hours	[Central Line] Potassium Chloride 40 mEq IV over 2 hours [Peripheral] Potassium Chloride 40 mEq IV over 4 hours [Central Line] Recheck potassium in 4 hours [Peripheral] Recheck potassium in 7 hours
3.8-3.9 mEq/L	Potassium Chloride 20 mEq PO x 1 dose Recheck potassium with AM labs	[Central Line] Potassium Chloride 20 mEq IV over 2 hours [Peripheral] Potassium chloride 20 mEq IV over 2 hours Recheck potassium with AM labs

Authors

- Medication Management Committee (06/2022)
- P&T Formulary Committee (06/2022)
- Clinical Governance (07/2022)

Last Updated

7/2022

Evaluation and Management of Atrial Fibrillation

Purpose

- Establish a unified guideline for the diagnosis and treatment of new-onset atrial fibrillation (AF) in Acute Care Surgery patients.

Background/Definitions

- Primary AF: AF with no precipitating cause
- Secondary AF: AF precipitated by a secondary or reversible condition (e.g., surgery, sepsis, acute MI, etc. --most of our ICU patients)

Inclusion Criteria

- Patients with new onset atrial fibrillation.

Exclusion Criteria

- Patients with chronic atrial fibrillation.

Diagnostic Evaluation

- History:
  - previous history of arrhythmia?
  - currently on anticoagulation?
- Physical:
  - irregular heart rhythm
- Imaging/Labs/Tests:
  - ECG
  - BMP+Mg+Phos
  - Other labs at discretion of provider (CBC, blood cultures/infectious work-up, cardiac enzymes, etc)

Practice Recommendations for Management

- New-onset, secondary AF is an organ dysfunction that signals something is wrong--need to address *underlying cause* while seeking to control rate/rhythm.

- Helpful questions to guide initial approach of patient with AF:
  - 1) is the AF causing an immediate problem?
  - 2)why is AF happening now (is this primary or secondary AF)?
  - 3) should I worry about longer-term problems from the AF?

- Is the AF causing an immediate problem?
  - When to consider rhythm control first:
    - Emergent AF with severe decompensation:
      - hypotension (SBP<100 or <110 for patients 65 and older), acute heart failure, altered mental status, cardiac ischemia
      - if yes --> DCCV (direct current cardioversion)
      - consider pairing DCCV with anti-arrhythmic such as amiodarone to increase probability of longer-term success.
    - Non-emergent AF:
      - consider a rhythm control strategy first if you think the patient needs atrial kick (i.e. severe mitral stenosis, aortic stenosis) or cannot tolerate nodal blocker (Wolf Parkinson White Syndrome)
  - When to consider rate control first:
    - *Note: in most instances you can use rate control FIRST.*
    - Heart rate is higher than it would be with acute illness, but not immediately life threatening to require DCCV.
    - Patient has contraindications to anticoagulation.
    - Evidence to support a rate control strategy first during secondary AF: success of DCCV is low in secondary AF (as in ICU) --43% at 1 hr, 23% at 24 hrs remain in NSR.

- Why is AF happening now?
  - Fix electrolytes (magnesium is an effective rhythm control treatment).
  - Fix volume status.
  - Look for untreated infection.
  - Remove beta-agonists.

- Should I worry about long-term problems from the AF?
  - Arterial thromboembolism and AF recurrence are long-term concerns after new-onset AF in critically ill patients
  - 44% af AF recurrence in 1 year after new-onset AF in sepsis.
  - Cardiology follow-up (either inpatient or outpatient) for long-term rhythm monitoring and treatment plan should be considered.

Outcome Measures and Guideline Adherence

- AF (arrhythmia) is a PI filters for Trauma and Critical Care Surgery that is actively tracked/monitored.

Related Policies

Key Contributors

- Keely Buesing ,MD, FACS, Acute Care Surgery Division

Last Updated

February, 2023

References

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2. 2014 AHA/ACC/HRS Guideline
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4. Arrigo M et al. Disappointing success of electrical cardioversion for new-onset atrial fibrillation in cardiosurgical ICU patients. Crit Care Med. 2015;43(11):2354-2359.
5. Walkey AJ et al. Practice patterns and outcomes of treatments for atrial fibrillation during sepsis: a propensity-matched cohort study. Chest. 2016;149:74-83.
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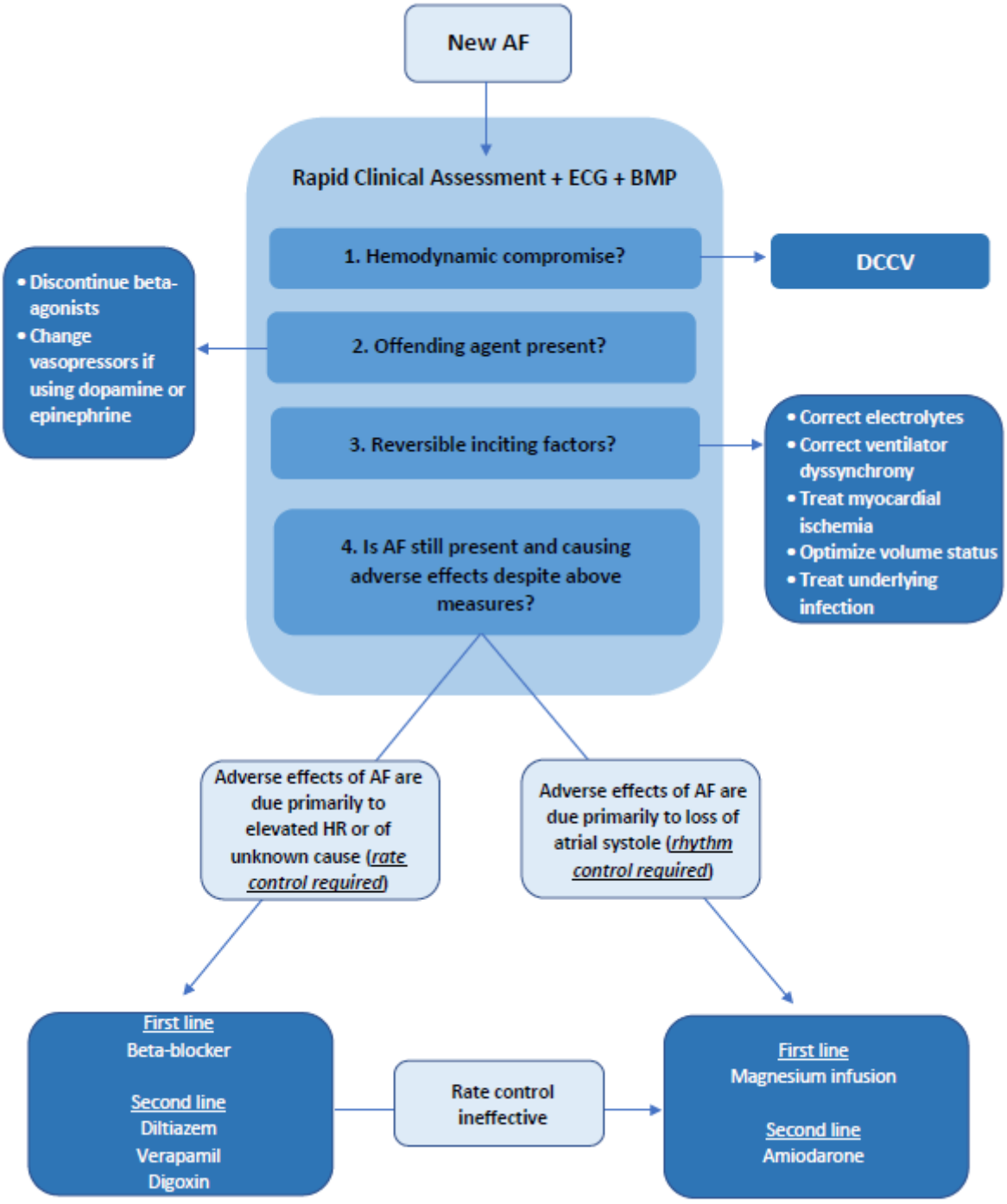
7. Davey MJ et al. A randomized controlled trial of magnesium sulfate, in addition to usual care, for rate control in atrial fibrillation. Ann Emerg Med. 2005;45(4):347-353.
8. Onalan O et al. Meta-analysis of magnesium therapy for the acute management of rapid atrial fibrillation. Am J Cardiol. 2007;99(12):1726-1732.
9. Bosch NA et al. Atrial fibrillation in the ICU. Chest. 2018;154:1424-1434.

Supplemental Materials

- “Etiology of Atrial Fibrillation” schematic.


New AF
Rapid Clinical Assessment + ECG + BMP
1. Hemodynamic compromise?
DCCV
2. Offending agent present?
• Discontinue beta-agonists
• Change vasopressors if using dopamine or epinephrine
3. Reversible inciting factors?
• Correct electrolytes
• Correct ventilator dyssynchrony
• Treat myocardial ischemia
• Optimize volume status
• Treat underlying infection
4. Is AF still present and causing adverse effects despite above measures?
Adverse effects of AF are due primarily to elevated HR or of unknown cause (rate control required)
Adverse effects of AF are due primarily to loss of atrial systole (rhythm control required)
First line
Beta-blocker
Second line
Diltiazem
Verapamil
Digoxin
Rate control ineffective
First line
Magnesium infusion
Second line
Amiodarone

Nebraska Medicine Brain Death Criteria

Nebraska Medicine Policy Number: MS 29

Purpose

To give an accurate and complete description required to establish a diagnosis of breath death/Death by Neurological Criteria (BD/DNC), and to describe the roles and responsibilities of various clinicians and staff members in the process.

Scope

This policy applies to all patients at least 37 weeks corrected gestational age or older at Nebraska Medicine for whom a diagnosis of BD/DNC is considered.

Background

Nebraska Medicine follows the definition of BD/DNC as established by the State of Nebraska in statute 71-7202 and utilizes the accepted medical standards for determining BD/DNC.

A diagnosis of breath death is a clinical diagnosis that can only be established by a staff physician with privileges in neurology or critical/intensive care medicine. The staff physician will document the results of the brain death evaluation in the medical record. The time of death is determined at the time the evaluation is complete. Physicians in training, who are at an advanced level of training and deemed appropriate by the staff physician and working under the staff physician's *direct* supervision, can perform parts of the examination. The staff physician is fully responsible for the diagnosis, declaration, and documentation of brain death.

Brain Death Evaluation

A complete brain death evaluation consists of three components. All three components must be completed to establish a diagnosis of brain death:

1. Establish permanent and proximate cause of coma
2. Establish absence of cortical function and brain stem reflexes by neurologic examination
3. Establish absence of spontaneous respirations by performing an apnea test

Completion of the three components of the brain death evaluation is sufficient to establish a diagnosis of brain death.

Ancillary Testing

Ancillary testing is not required if all three of the above components are completed. Ancillary tests may be used to support the diagnosis of brain death when uncertainty exists about the reliability of parts of the neurologic exam, when parts of the exam cannot be performed, or to shorten the interval between exams. the current acceptable ancillary tests are: Cerebral angiography, cerebral scintigraphy, and transcranial doppler (if age appropriate).

The interpretation of these tests must be interpreted by a staff physician with the required level of expertise.

Special circumstances:

1. Physicians with recognized or potential conflicts of interest in relation to the outcome of the patient's care must remove themselves from the BD/DNC evaluation. For instance, a transplant service physician whose patient expires and has the potential for organ donation should excuse himself/herself from declaring the patient brain dead.

References

1. Nebraska State Statute 71-7202. Determination of death. Source: Laws 1992, LB 906, 2.
2. Pediatric and Adult Brain Death/Death by Neurologic Criteria Consensus Guideline. Neurology. Dec 12, 2023 issue: 101(24):1112-1132. Greer DM, Kirschen MP, Lewis A, Gronseth GS, Rae-Grant A, Ashwal S, Babu MA, Bauer DF, Billinghurst L, Corey A, Partap S, Rubin MA, Shutter L, Takahashi C, Tasker RC, Varelas PN, Wijdicks E, Bennett A, Wessels SR, Halperin JJ.
3. The 2023 AAN/AAP/CNS/SCCM Pediatric and Adult Brain Death/Death by Neurologic Criteria Consensus Practice Guideline. A Comparison with the 2010 and 2011 Guidelines. Ariane Lewis, MD https://orcid.org/0000-0002-075807320, Matthew P. Kirschen MD, PhD https://orcid.org/0000-0003-358502687, and David Greer, MD https://orcid.org/0000-0002-2026-8333 AUTHORS INFO & AFFILIATIONS. December 2023 issue.

Related Policies and Procedures

Acute Bereavement Care -- TX02

Staff Accountability:

- Critical Care Medicine (09/2024)
- Medical Ethics Committee (09/2024)
- Pediatric Quality Committee (11/2024)
- Medical Staff Bylaws Committee NMC (11/2024)
- Medical Staff Medical Executive Committee NMC (11/2024)
- Board of Directors (11/2024)

Brain Death/Death by Neurologic Criteria (BD/DNC) Evaluation

Nebraska Medicine follows the definition of BD/DNC as established by the State of Nebraska in statute 71-7202 and utilizes the accepted medical standards for determining BD/DNC

Available at: nebraskalegislature.gov/laws/statutes.php?statute=71-7202&print=true

Additional metabolic derangements, drug-specific information and BD/DNC Guidelines are available as a reference however, the exact abnormal values at which could affect the clinical evaluation are uncertain and determination will be at the discretion of the provider.

Available at: https://cdn-links.lww.com/permalink/wnl/d/wnl_2023_11_20_wessels_1_sdc4.pdf

Patient last name:	Patient first name:	DOB:	MRN:

SECTION I. PREREQUISITES FOR CLINICAL EXAMINATION	
1. Ascertainment that the patient has sustained a catastrophic, permanent brain injury caused by an identified mechanism that is known to lead to BD/DNC	☐ Yes ☐ No Etiology: _____
2. Neuroimaging has been obtained it is consistent with mechanism and severity of brain injury (i.e., in patients with primary posterior fossa injury, neuroimaging should demonstrate catastrophic supratentorial injury)	☐ Yes ☐ No
3. Observation for permanency: a) ≥48 hours after acute brain injury (particularly ischemic brain injury) for patients ≤ 24 months old OR b) ≥24 hours after hypoxic ischemic brain injury for patients ≥24 months old OR c) A sufficient amount of time after brain injury to ensure there is no potential for recovery of brain function as determined by the evaluator based on the pathophysiology of the brain injury	☐ Yes ☐ No Observation period (hours): _____
4. Core temperature should be 96.8°F / 36°C or greater for 24 hours.	☐ Yes ☐ No Temperature (°C): _____
5. Recommend systolic blood pressure (SBP) ≥100 mm Hg for patients 19 years of age or older with adjustment in consideration to known underlying illness/chronic disease that varies from their age based normal OR SBP and MAP ≥5th percentile for patients 37 weeks corrected gestational age up to 19 years of age. OR Patients 19 years of age or older on ECMO: VV reach systolic MAP Pressure of ≥100 mmHg and VA target of ≥75 mm Hg mean arterial pressure only OR Patients less than 19 years of age on venoarterial extracorporeal membranous oxygenation (VA-ECMO) MAP ≥5th percentile for age-(Please reference pediatric table 1)	☐ Yes ☐ No SBP (mm Hg): _____ MAP (mm Hg): _____
6. Consider exclusion of pharmacologic paralysis (if administered or suspected) through use of train-of-four stimulator or demonstration of deep tendon reflexes	☐ Yes ☐ No ☐ Not indicated
7. Pharmacy Consultation regarding drug levels (if testing is available) for medications that may suppress central nervous system function are therapeutic/subtherapeutic • If clinically indicated, ensure blood and urine drug screen are negative • pentobarbital level is <5 mcg/mL (if the patient received phenobarbital) • and at least five half-lives for all other such drugs have passed (longer if there is renal/hepatic dysfunction or if the patient is obese or was hypothermic).	☐ Yes ☐ No
8. Alcohol blood level ≤80 mg/dL (if clinically indicated)	☐ Yes ☐ No ☐ Not indicated
10. Exclusion of severe metabolic, acid-base, and endocrine derangements	☐ Yes ☐ No
Prerequisite Summary (check one):	
☐ All prerequisites were met	
☐ Unable to adequately correct metabolic derangements, but all other prerequisites were met, so will complete the clinical exam and if they are consistent with BD/DNC, will perform ancillary testing	

SECTION II. CLINICAL EXAM (MUST be completed to fullest extent possible) *Patients less than 19 years of age require two exams at least 12 hours apart by two qualified, independent staff physicians (unless ancillary testing is performed to shorten the interval) First exam with a check box for Attending Second exam with a check box for 2nd Pediatric Attending	Yes	No	Not Tested
12. Coma-with unresponsiveness-to-visual-,-auditory-,-and-tactile-stimulation	☐☐	☐☐	
13. Absent motor responses, other than spinally mediated reflexes, of the head/face, neck, and extremities	☐☐	☐☐	
14. Absent pupillary responses to bright light bilaterally	☐☐	☐☐	☐☐
15. Absent oculocephalic reflex unless there is concern for cervical spine or skull base integrity	☐☐	☐☐	☐☐
16. Absent oculovestibular reflexes bilaterally	☐☐	☐☐	☐☐
17. Absent corneal reflexes bilaterally	☐☐	☐☐	☐☐
18. Absent gag reflex	☐☐	☐☐	☐☐
19. Absent cough reflex	☐☐	☐☐	☐☐
20. Absence of sucking and rooting reflexes (patients <6-months only)	☐☐	☐☐	☐☐

Clinical examination results (check one):

(1st Attending)

☐ All elements-of-the clinical-exam were completed, and findings consistent with BD/DNC

(*2nd Exam by Pediatric Attending)

☐ All elements of the clinical exam were completed, and findings consistent with BD/DNC

(1st Attending)

☐ A portion of the clinical exam other than the oculocephalic reflex could not be assessed safely or it was unclear whether observed limb movements were spinally mediated (note that even if a person does not have all limbs, painful stimulation can still be provided to the torso as close to the termination of the limb as possible, so this does not necessitate ancillary testing); however, the remainder of the test was performed to the fullest extent possible and responses were consistent with BD/DNC. *(Ancillary testing is required.)* Reason(s) for incomplete testing (check all that apply): ☐ Anophthalmia; ☐ Corneal trauma or transplantation; ☐ Fracture of the base of the skull or petrous temporal bone; ☐ High cervical cord injury; ☐ Ophthalmic surgery that influences pupillary reactivity; ☐ Severe facial trauma; ☐ Severe pre-existing neuromuscular disorder; ☐ Severe orbital or scleral edema or chemosis; ☐ Limb movements that may be spinally mediated; ☐ Other (specify):_____

(*2nd Exam by Pediatric Attending)

☐ A portion of the clinical exam other than the oculocephalic reflex could not be assessed safely or it was unclear whether observed limb movements were spinally mediated (note that even if a person does not have all limbs, painful stimulation can still be provided to the torso as close to the termination of the limb as possible, so this does not necessitate ancillary testing); however, the remainder of the test was performed to the fullest extent possible and responses were consistent with BD/DNC. *(Ancillary testing is required.)* Reason(s) for incomplete testing (check all that apply): ☐ Anophthalmia; ☐ Corneal trauma or transplantation; ☐ Fracture of the base of the skull or petrous temporal bone; ☐ High cervical cord injury; ☐ Ophthalmic surgery that influences pupillary reactivity; ☐ Severe facial trauma; ☐ Severe pre-existing neuromuscular disorder; ☐ Severe orbital or scleral edema or chemosis; ☐ Limb movements that may be spinally mediated; ☐ Other (specify):_____

Attending name (printed)	Signature	Date	Time
Attending #2 for Pedi only (printed)	Signature	Date	Time

SECTION III. APNEA TEST	Yes	No
APNEA TESTING PREREQUISITES – only to be performed by staff physicians with ventilator privileges		
22. pH is normal (7.35-7.45) unless patient has a known chronic baseline acidemia and $PaCO_2$ is normal (35-45 mm Hg), OR $PaCO_2$ is at baseline (if baseline is known), OR at estimated baseline if baseline is not known Note: ABGs should be taken from both the distal arterial line and the ECMO post oxygenator for patients on VA-ECMO.	☐ pH: _____ $PaCO_2$: _____	☐
23. PaO_2 is >200 mm Hg after ≥10 minutes of preoxygenation with FiO_2 1.0 (100% oxygen)	☐ PaO_2: _____	☐

APNEATESTING PERFORMED?	☐	☐
24. Apnea duration	Minutes: _____	
25. Post-apnea $PaCO_2$ value (mm Hg)	$PaCO_2$: _____	
26. Post-apnea pH value	pH: _____	

Final apnea testing results (check one):

☐ Apnea confirmed: no respirations AND targets reached (pH <7.30 AND final $PaCO_2$ ≥60 mm Hg AND final $PaCO_2$ ≥20 mm Hg above pre-apnea test baseline OR final $PaCO_2$ ≥20 mm Hg above chronic baseline for patients known to have chronic hypercarbia).

*Ancillary testing is required if patient is known/suspected to have chronic hypercarbia, without a known baseline $PaCO_2$.

☐ Apnea testing is inconclusive due to:

——☐ Hypotension despite titration of vasopressors, inotropes, and/or IV fluids

——☐ Progressive hypoxia

——☐ Cardiac arrhythmia with hemodynamic instability

☐ Apnea testing is negative – one or more spontaneous respirations were seen; findings are not consistent with BD/DNC

Attending name (printed)	Signature	Date	Time
_____	_____	_____	_____

SECTION IV. ANCILLARY TESTING

27. Reason(s) for ancillary testing	☐ Inability to correct metabolic derangements ☐ Inability to complete all clinical tests (e.g., fracture of the cervical spine, skull base, orbits, face) ☐ Inability to complete apnea test due to risk of cardiopulmonary decompensation or inability to interpret $PaCO_2$ level in a patient with chronic hypercarbia for whom chronic baseline is unknown ☐ Uncertainty regarding interpretation of spinally vs. cerebrally mediated motor responses
28. Type of ancillary testing performed (the tests listed here are the ONLY acceptable ancillary tests)	☐ Conventional 4-vessel catheter angiography (digital subtraction angiography) ☐ Cerebral scintigraphy ☐ Transcranial doppler ultrasonography (19 years of age or older only)

Final ancillary testing results (check one):

☐ Ancillary testing results are consistent with BD/DNC

☐ Ancillary testing results are not consistent with BD/DNC

SECTION V. SUMMARY OF FINDINGS

☐ BRAIN DEATH/DEATH BY NEUROLOGIC CRITERIA DETERMINED CLINICALLY

- Prerequisites for clinical testing have been fulfilled (Section I) and
- Results of clinical exams, including apnea testing, have been fully completed and are consistent with BD/DNC (Sections II and III)

Date (MM/DD/YYYY) and time (HR:MM AM/PM): _____

(Time of death is the time during the final apnea test [if more than one performed] that the ABG results are reported and demonstrate that the $PaCO_2$ and pH levels are consistent with BD/DNC criteria.)

☐ BRAIN DEATH/DEATH BY NEUROLOGIC CRITERIA DETERMINED WITH CLINICAL ASSESSMENT AND ANCILLARY TESTING

- Prerequisites for clinical testing have been fulfilled (Section I) and
- Results of clinical exams, including apnea testing, where tested are consistent with BD/DNC (Sections II and III) and
- Ancillary testing has been performed and results are consistent with BD/DNC (Section IV)

Date (MM/DD/YYYY) and time (HR:MM AM/PM): _____

(Time of death is the time an attending clinician [e.g., nuclear medicine physician or angiographer] documents in the medical record that the ancillary test results are consistent with BD/DNC criteria.)

☐ PATIENT DOES NOT MEET CRITERIA FOR BRAIN DEATH/DEATH BY NEUROLOGIC CRITERIA

Provide reasons: _____

Attending name (printed)	Signature	Date	Time
_____	_____	_____	_____

Percutaneous Tracheostomy Protocol

Purpose

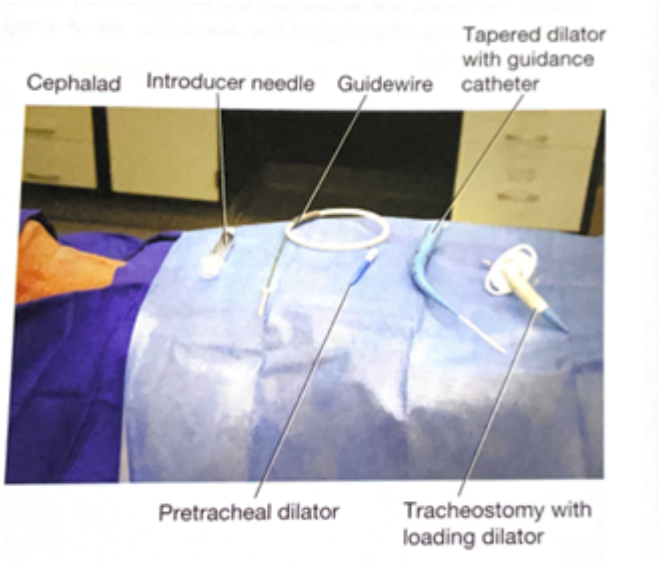
To provide guidance on safe practices to perform percutaneous tracheostomy in the operating room and ICU settings.

Preprocedural Planning

- Indications for tracheostomy at the discretion of the attending surgical intensivist.
- The procedure should be scheduled through the operating room by calling OR Charge Nurse.
- Two Attending Physicians must present at bedside to safely perform the procedure. One provider with perform the tracheostomy and one will be managing sedation. A procedure note and a sedation note need to be completed upon completion of the tracheostomy.
- Bronchoscopic guidance is required
- Medications for the procedure consist of an anxiolytic, a narcotic pain medication, and a neuromuscular paralytic. Additionally, local anesthetic may be requested.
- An intubation/airway cart with associated equipment is required at the bedside should reintubation or emergent airway be needed.

Equipment

- Blue Rhino Percutaneous Tracheostomy Kit
- Cuffed Tracheostomy (Size 6 and/or Size 8)
- Sterile Drapes and Chlorohexidine Prep
- Sterile Gowns and Gloves
- Eye protection and Head Coverings
- Bronchoscope
- Sterile water and Lubrication
- Airway cart (associated supplies needed for reintubation if needed)

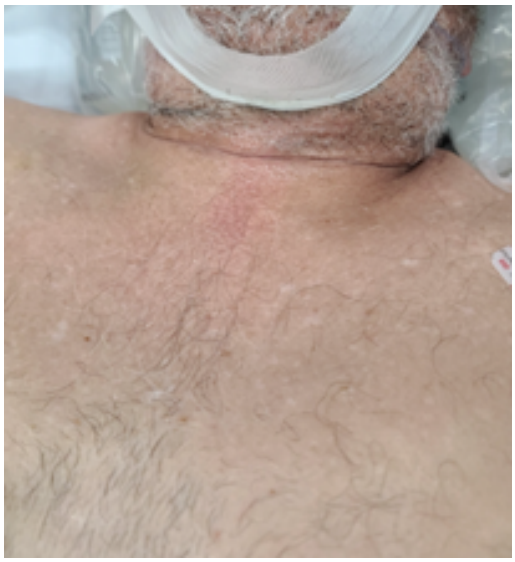


Team

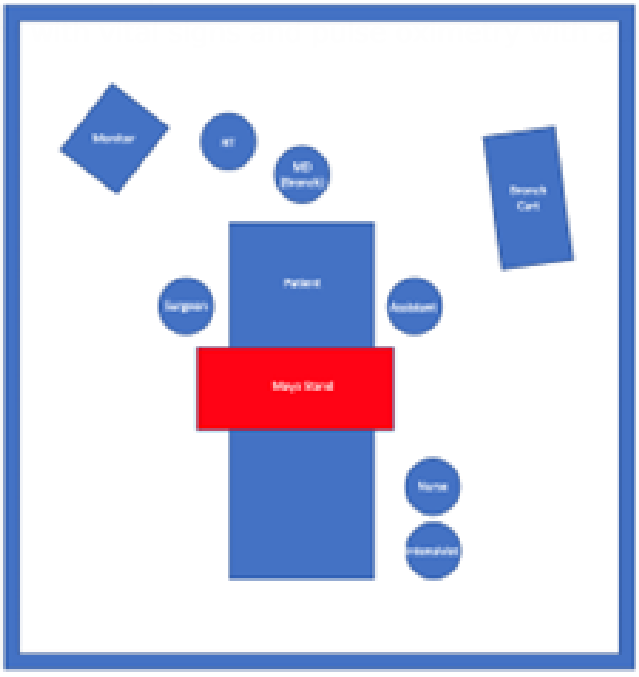
- Attending Intensivist to perform the tracheostomy
- Attending Intensivist to manage sedation
- Trainees (ICU Fellows, Surgical Residents, Medical Students)
- Critical care Nurse
- Respiratory Therapist
- OR Nursing Staff

Room Set-up and Patient Positioning

- The patient should be positioned supine with the neck slightly hyperextended with a shoulder roll if possible. If there is concern for or confirmed cervical spine injury, inline stabilization with the neck in a neutral position must be maintained with securely placed tape.



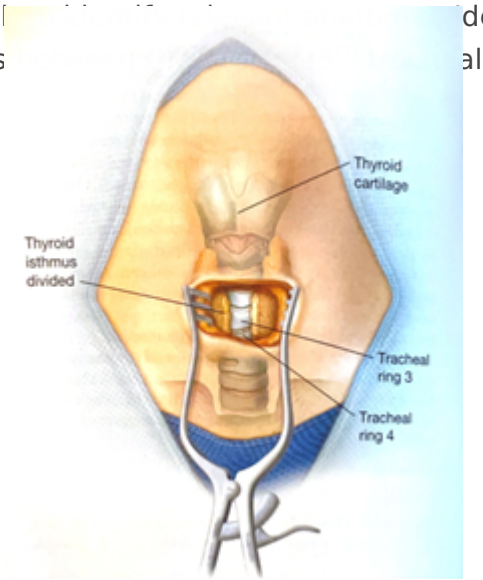
- The patient’s arms should be placed at patient’s side to ensure access to the neck bilaterally. The bed needs to be positioned to allow for access to the head of the bed so that orotracheal reintubation can be performed if needed.
- For right-handed surgeons, the bronchoscopy cart is generally placed on the patient’s left with the person performing the tracheostomy on the patient’s right. The respiratory therapist should be at the head of the bed with easy access to the patient’s airway. A second provider will be at the head of the bed performing the bronchoscopy. The patient’s nurse needs to have easy access to the patients IV in order to administer medications in a timely manner and the monit lio easily visible to all.



- Set the ventilator to deliver a set volume and rate with 100% FiO2 to preoxygenate the patient. The ICU monitor should set so the pulse oximeter is audible. Continuous hemodynamic monitoring should be achieved with ekg and arterial line or frequent BP cuff monitoring (every 3 minutes).

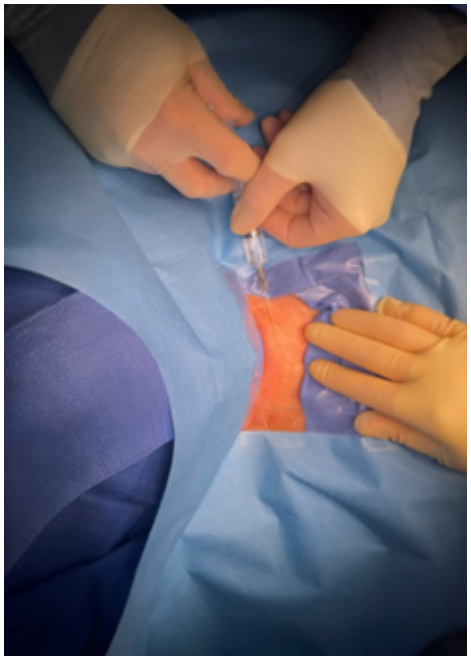
Technical Steps

1. Prior to the start of the procedure, a through “timeout” should be performed. All members of the team should be present and attentive.
2. Adequate sedation should be achieved with anxiolytic and narcotic pain medications. This is followed by paralysis.
3. Palpate the nec deal location for placement of the tracheostomy is al ring.

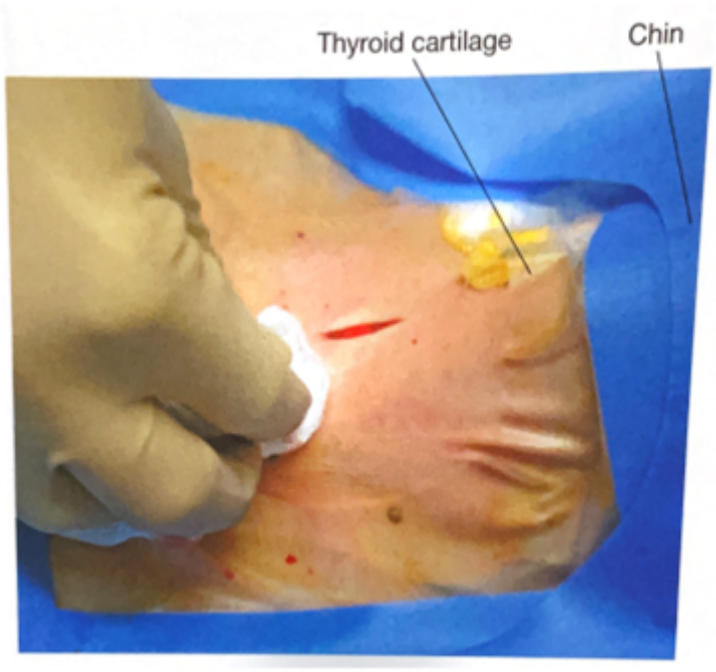


4. Don all appropriate PPE. Standard sterile surgical technique should be implemented.
5. Surgically prepare neck and upper chest with chlorohexidine skin prep. Standard sterile technique and draping should be performed. Consideration for easy access to the endotracheal tube to allow for easy airway exchange after trach is placed.

6. Anesthetize the skin and subcutaneous tissue with local anesthetic.

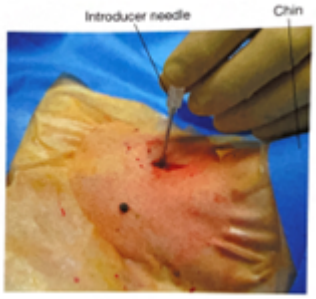


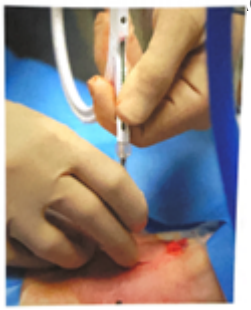
7. Using a #15 scalpel, make a 2-3 cm vertical, midline incision approximately 40 mm cephalad (1-2 finger breaths) to the sternal notch and just below the cricoid cartilage. If an anterior jugular vein is encountered in the incision (even if no injury is suspected), consider ligation proximally and distally as this is easiest to perform before the tracheostomy tube has been placed.

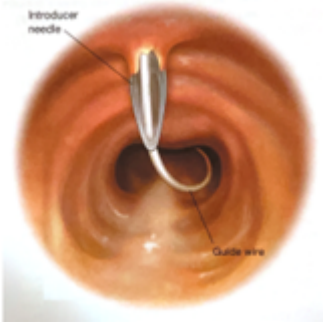


8. Using a hemostat, bluntly dissect the subcutaneous tissue and muscle in midline to the pretracheal tissue along the length of the incision to better palpate the trachea to determine the point of entry.
9. With the bronchoscope adaptor in place, advance the bronchoscope into the airway. Inspect the trachea and bronchial trees and clear any secretions.

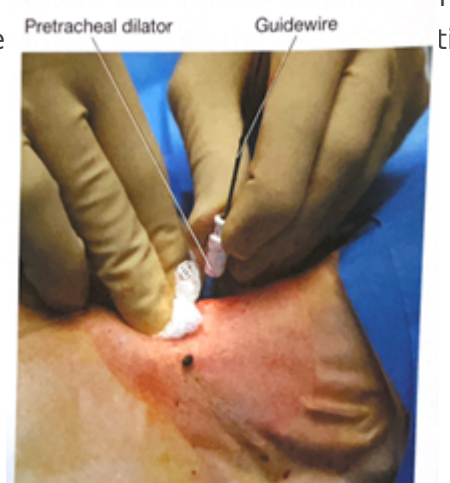
10. With the assistance of the respiratory therapist, while keeping the bronchoscope at the end of the endotracheal tube, retract both the endotracheal tube and bronchoscope simultaneously until the subglottic structures are visualized and one can see the anterior wall of trachea being palpated by the surgeon. The bronchoscope should be always kept within the endotracheal tube during this portion of the procedure in order to maintain control of the airway and ensure that the bronchoscope is not damaged.
11. ***Although usually unnecessary, cautery may be used prior to entering the trachea with the introducer needle. After entry into the trachea, cautery should not be used do to the risk of fire with open oxygen source.***
12. An introducer needle is used the enter the anterior portion of the trachea between the 2nd and 3rd tracheal ring (approximately 1 finger breadth below the cricoid cartilage). With the bevel of the needle facing downward, the guidewire is passed into the trachea. Visualization of the guide wire going in the direction of the carina is required. Advance the guidewire slightly passed the cari hair

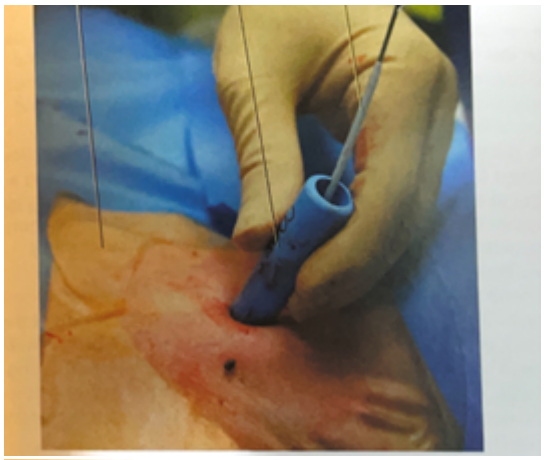


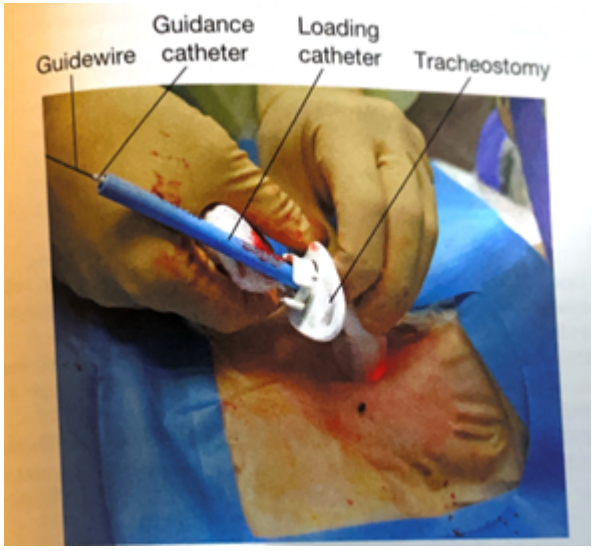


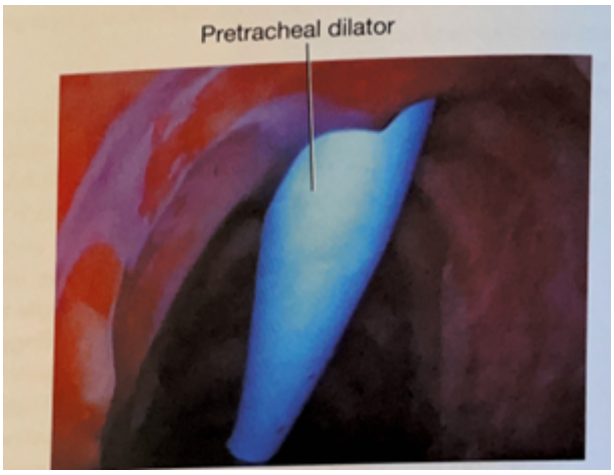


13. Using the Seldinger technique, with constant Bronchoscopic visualization and control of the wire within the trachea, the trachea is sequentially dilated. The dilator handle is hydrophobic which makes it less likely to slip in a wet environment while the actual dilating portion is hydrophilic which only requires water/liquid to be lubricated. First the small tracheal dilator is advanced over the wire to dilate the pretracheal tract. Next the single-stage tapered dilator and the guiding catheter are advanced as a unit over the wire to dilate the trachea. Markings on the side of the progressive dilators guide the depth to which they are inserted. All catheters (pretracheal dilator, tapered dilator, and guiding catheter) should enter perpendicular to the trachea as to prevent pretracheal dissection or false passage. If the patient has limited ventilatory reserve prior to the procedure, the bronchoscope can be re tion of the procedure.

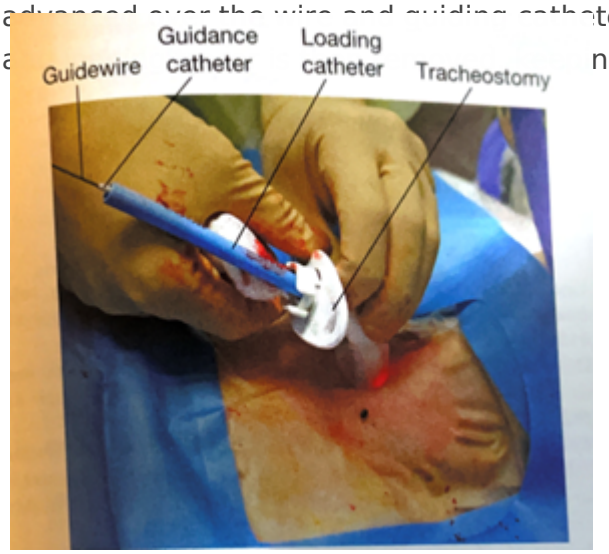


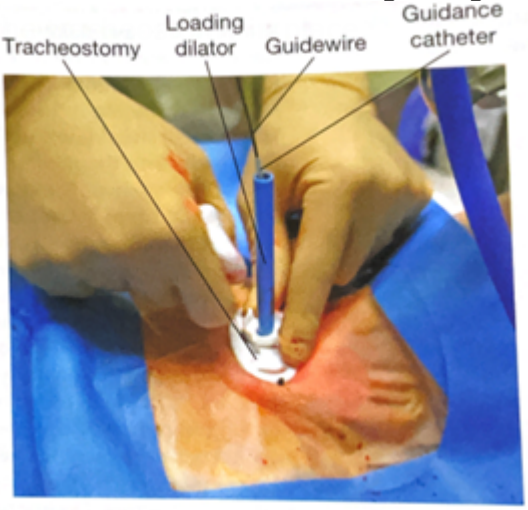






14. The tapered dilator is removed from the guiding catheter and the guidewire, leaving the guiding catheter and the guidewire in place. If there is a longer distance between the tracheal surface and the skin surface, a finger can be used to dilatate the tract to help facilitate placement of the tracheostomy during the next step.
15. Next, an appropriately sized and well lubricated tracheostomy tube with introducer is advanced over the wire and guiding catheter into the trachea. The wire, guiding catheter a n





16. Inflate the tracheostomy cuff, insert the inner canula and connect tracheostomy to ventilator circuit. The presence of end-tidal carbon dioxide after ventilation resumes confirms placement in the airway.
17. A bronchoscopy should be performed through the newly placed tracheostomy to visually confirm that it is within the trachea in proper position. Only remove ET tube after placement of tracheostomy tube within the trachea is confirmed.
18. The tracheostomy is secured with a tracheostomy collar or ties to help prevent accidental dislodgement and provide time for adequate to tract formation.
19. Obtain a chest x-ray to confirm appropriate positioning of the tracheostomy tube, rule out pneumothorax, and evaluate for bronchial obstruction.

Tracheostomy Care

- Following tracheostomy placement, standardized tracheostomy care bundles should be implemented. These protocols include steps to ensure the tracheostomy is secure, suctioning techniques, daily stoma hygiene and knowledge of emergency protocols should the newly placed airway be compromised. Special attention should be given to prevent pressure ulceration, particularly along the inferior aspect of the tracheostomy faceplate, especially if the flange is sutured to the skin.
- The tracheostomy tube should be exchanged no sooner than post-operative day 7.
- Once the patient is liberated from the ventilator and secretions are reasonably managed the process of tracheostomy tube downsizing can occur. The downsizing if the tracheostomy tube allows for improved patient comfort and the ability to participate in speech therapy.
- After the tracheostomy is no longer necessary, the patient can be decannulated. The stoma is covered with sterile occlusive dressing generally closes within two to four days.

Key Contributors

Bennett Berning, MD

Last Updated

March, 2023

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