



ANZICS

Percutaneous Dilatational Tracheostomy

Consensus Statement

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Foreward

There is a lack of evidence to guide practice in this area. This statement was drafted by a group of experts and then scrutinised by members of ANZICS using an online survey – the results of which are available on the ANZICS website.

As a result we believe that this statement represents best current practice in Australia and New Zealand.

The contents will be updated at regular intervals.

Signed,



Clinical Associate Professor Michael O'Leary
President, ANZICS



Dr Anthony Burrell
Chair, ANZICS Safety & Quality Committee

Introduction

Tracheostomy is frequently performed in Australian and New Zealand Intensive Care Units (ICUs) to facilitate weaning from mechanical ventilation, reduce anatomical dead space, avoid laryngeal injury and aid in management of tracheobronchial and pulmonary secretions.

While the history of surgical tracheostomy dates back many centuries, the development of percutaneous dilatational tracheostomy (PDT) is more recent. In 1985 Ciaglia described a procedure that was based on a Seldinger technique, with multiple dilators¹. Subsequently the dilators were modified to a single graded tracheal dilator^{2,3}. In 1990 Griggs et al described a similar guide wire single dilatation technique using modified Howard-Kelly forceps⁴⁻⁶. In selected ICU patients both PDT techniques have been shown to be safe⁷⁻⁹ and have fewer complications than surgical tracheostomy¹⁰⁻¹⁵. Other PDT techniques exist but are not in common practice in Australasia. Surgical tracheostomy is usually reserved for patients with contraindications to PDT.

The most common risks associated with PDT are haemorrhage, hypoxaemia, loss of airway, cannula misplacement, airway injury, pneumothorax, surgical emphysema, damage to posterior tracheal wall and accidental decannulation in the immediate peri-operative period¹⁶. Locally developed guidelines may reduce PDT related complications¹⁷.

This consensus statement is intended as a guide for the safe performance of PDT in the ICU. It concentrates on the immediate risks: bleeding, airway damage and decannulation. It is anticipated that all PDTs will be authorised by a specialist intensivist or senior intensive care clinician. It is emphasized that PDT must be performed only on a stable patient by appropriately skilled staff in a controlled environment. PDT is contra- indicated for emergency airway access.

Background

Purpose and Expected outcome

The main purpose of this statement is:

- To minimise variation in technique;
- To serve as a guide for those ICUs adopting the technique ;
- To identify and minimize risks associated with PDT ; and
- To decrease or eliminate procedure related complications of PDT.

The expected outcome is:

- The consensus statement serve as a reference point for establishing local PDT protocols;
- Australasian intensivists will critically review the consensus statement, and in so doing, critically review and modify their own practice accordingly; and
- Procedure-related complications of PDT will decrease.

Definitions

- **Tracheostomy** -A tracheostomy is an artificial opening into the trachea through the neck.
- **Surgical Tracheostomy** -Involves placement of a tracheostomy tube into the trachea by dissection and incision of the trachea under direct vision. This may be performed in the Operating Room (OR) or in the ICU.
- **Percutaneous Dilatational Tracheostomy (PDT)** -This is almost always a bedside procedure performed using a Seldinger technique and dilatation of trachea between the tracheal rings to facilitate placement of a tracheostomy tube.

PDT Techniques

Three common techniques for PDT are described:

- **Ciaglia's multiple dilators.** This Seldinger-based technique involves cannulation of trachea between 1st & 2nd or 2nd & 3rd tracheal ring with a guide wire. This is followed by graded dilatation of the trachea using multiple dilators to facilitate tracheostomy tube placement
- **Griggs Technique.** This is a Seldinger-based technique similar to Ciaglia but involves a single step dilatation of trachea using modified Howard-Kelly forceps.
- **Single graduated dilator technique.** This is a modification of the Ciaglia technique in which a single graded dilator replaced the multiple dilators.

Recent technical advances in PDT include balloon dilatation techniques¹⁸ and the use of ultrasound guidance.

Indications for PDT

Airway maintenance

- Upper airway obstruction.
- Inability to protect the airway.

Prolonged Ventilation

- Prolonged dependence on mechanical ventilation (actual or anticipated).
- Secretion management.
- Permanent or long term airway access in traumatic or neurological diseases.

Contraindications for PDT

Absolute

- Informed consent not obtained (see below).
- Children <16 years of age (small, mobile and compressible airway).
- Anatomical anomalies; e.g. anterior neck mass, large goitre.
- Bleeding disorder / coagulopathy with high risk of active bleeding.
- Infection at site.

Relative

- Known or suspected difficult intubation i.e. possible difficulty in managing the airway during the procedure.
- Difficult landmarks/anatomy; e.g. obesity, short neck (cricoid <3 cm above sternal notch), high or aberrant (cervical) innominate artery, previous neck surgery distorting relevant anatomy.
- Unstable cervical spine injury.
- Platelet count < 50 x 10⁹ per litre (or severe platelet dysfunction).
- INR > 1.5, activated partial thromboplastin time (APTT) >50 or prolonged prothrombin time.
- Therapeutic unfractionated heparin infusion, especially when also on anti-platelet drugs.
- Compromised respiratory function :
 - Need for FiO₂ > 0.6;

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- PEEP dependence >10cm H₂O.

Specific Risks/Complications

Overall peri-procedural complication rates for PDT vary from 4-9%, with minor bleeding and desaturation being the most common^{8, 16, 19}. Obesity may be an independent risk factor for peri-operative complications, in an observational study a BMI ≥ 27.5 increased complications 2.7 fold²⁰.

Bleeding

Bleeding is the most common complication reported in all studies with up to 8% of patients bleeding from insertion site^{21,22}. Most bleeding is low volume and usually seen in patients with a bleeding diathesis. Life threatening and fatal bleeding from aberrant vascular anatomy is very rare. Risk factors for bleeding are platelet count $< 50 \times 10^9$, aPTT > 50 and the presence of 2 or more abnormal coagulation variables²².

Recommendations

- Consider platelet transfusion prior to PDT when platelet count is $< 50 \times 10^9$.
- Consider postponing PDT for a minimum of 8hrs following therapeutic Low Molecular Weight Heparin (LMWH) administration.
- Cease intravenous therapeutic heparin infusion for a minimum of 4 hours and check aPTT is < 50 seconds prior to PDT.
- Consider reversal of anticoagulation /correction of coagulopathy if international normalized ratio (INR) > 1.5 , activated partial thromboplastin time (aPTT) > 50 seconds or prolonged prothrombin time.
- Consider clotting factor replacement for specific deficiencies, e.g. Haemophilia.

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Airway injury

The most serious, albeit rare, injury is splitting of the posterior tracheal wall. The most likely cause is that the locating needle (and hence guide wire) transfixes the trachea causing the dilator to pass through and tear the posterior wall. The use of a bronchoscope may potentially prevent this injury by confirming that the guide wire is correctly placed within the trachea prior to dilatation (see below).

Recommendations

- Extreme care should be taken to ensure the needle/cannula is in the lumen of the trachea prior to guide-wire placement and subsequent dilatation.
- Bronchoscopic guidance of needle insertion and guide-wire placement into the trachea should be considered for every procedure following a risk/benefit assessment for each patient (see below).

Pneumothorax /pneumomediastinum /subcutaneous emphysema

May be caused by:

- Perforation of the posterior tracheal wall;
- Tangential needle passage through the trachea;
- Volutrauma caused by air-trapping during ventilation with bronchoscope in situ;
- Inappropriate placement of the tracheostomy tube anterior to the trachea; and
- Air leak from the tracheal incision trapped by a tight skin wound causing subcutaneous emphysema of the neck.

Other early complications

- Airway obstruction by clots, sputum plug or herniated tracheostomy cuff.
- Accidental decannulation with loss of airway (see below).

PDT technique

Semi-elective procedure

PDT is a semi-elective procedure, therefore all appropriate staff and equipment should be available with the potential for other distractions minimised. Similarly the procedure should be performed during normal working hours when support staff is most readily available.

Preparation of Patient

Risk assessment

An intensivist or senior trainee performs a risk/benefit assessment of the procedure for an individual patient including a review of absolute and relative contraindications. A thorough clinical examination of the anterior neck anatomy must be performed with additional imaging as indicated (e.g. ultrasound or radiological)²³. An assessment of the airway, to identify potential difficulty, must also be performed.

Consent

Informed consent must be obtained and documented in the patient's notes according to jurisdictional requirements.

Fasting

It may be sufficient to stop naso-gastric feeds and aspirate through a wide bore naso-gastric tube prior to the procedure. Alternatively, or if a fine bore tube is used, a minimum of 4 hours of fasting

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is recommended.

Ventilator settings

Pre-oxygenation and maintenance of a FiO₂ of 1.0 throughout the procedure is recommended.

Ventilator settings should be appropriate for the anaesthesia given and the ventilation requirements of the patient.

Equipment

All appropriate equipment should be readily available. This must include equipment for emergency management of the airway. A fibre optic bronchoscope must be readily available. The equipment must be checked for completeness and functionality.

Monitoring

Monitoring must include the following:

- Pulse rate;
- Blood pressure;
- Pulse oximetry (SpO₂) ;
- ECG; and
- Capnography -for confirming ventilation during PDT and correct placement of tracheostomy tube.

Procedure

The procedure should be performed in an appropriate area with adequate lighting and sufficient space for satisfactory infection control. All equipment required for the procedure must be available

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at the bedside.

PDT is usually performed under combined general and local (with vasoconstrictor) anaesthesia. The use of bronchoscopic guidance is controversial and is discussed below.

The patient is placed in a supine position (or slight head up) with the neck extended. A rolled up towel or pillow placed between the scapulae may improve access to the trachea. The endotracheal tube (ETT) is withdrawn carefully. The cuff should remain at or just below the vocal cords. If too low the endotracheal tube may be damaged in the course of the tracheostomy. Rarely the wire may be passed through the Murphy's eye of the ETT. The use of a laryngeal mask airway (LMA) for airway management during PDT has also been described.

Strict sterile precautions are mandatory. The patient must be fully draped with sterile sheets and the operator must don cap, mask, gloves, sterile gown and protective shield for eyes. All staff in close proximity should wear personal protective equipment (PPE).

Techniques for tracheal cannulation vary from skin incision, blind dilation and tracheal palpation followed by tracheal puncture to percutaneous tracheal puncture followed by skin incision. The choice is best left with local and personal expertise as there is no data supporting one or the other approach. The tube should be placed preferentially between the 2nd and 3rd rings, or failing this the 1st and 2nd rings. A tracheostomy performed between the cricoid cartilage and the first tracheal ring may fracture the cricoid and may be associated with long term sequelae.

Successful placement in the trachea must be confirmed by capnography and the tracheostomy tube

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secured. It is the responsibility of the doctor performing, or supervising the procedure, to ensure the tracheostomy tube is secured meticulously with tapes, surgical stitches or in line with local policies. The ETT should not be removed until the tracheostomy tube has been secured.

Personnel

All PDTs should be authorised by the intensivist or responsible senior clinician. The operator should be a fully trained intensivist, experienced senior practitioner or an ICU advanced trainee who has performed independent procedures in the past and has been assessed to be competent in PDT. If the trainee operator has not been assessed to be competent, she/he should be closely supervised by an intensivist or senior medical practitioner experienced in PDT. The supervising doctor must be able to immediately render assistance to the trainee during all stages of the procedure.

The doctor responsible for the anaesthetic will be responsible for the airway, monitoring and sedation as needed. Hypoxia and loss of patent airway leading to potentially life threatening complications have been reported. A skilled airway doctor to exclusively manage the airway is therefore mandatory in the peri-procedural period. If the airway doctor is also performing a bronchoscopy they must be able to immediately respond to an airway emergency.

At all times a senior doctor, competent in PDT, should be available for consultation and assistance during the procedure. Surgical skills should be available if significant bleeding or other complication occurs. There must be adequate nursing assistance.

Bronchoscopic Guidance

Fibre optic bronchoscopy can be used to identify the point of needle insertion into the trachea and confirm correct guide-wire placement²⁴. The use of a bronchoscope may also facilitate teaching and supervision of inexperienced operators. Bronchoscopic guidance may potentially minimize the risk of complication(s), especially posterior tracheal wall injury^{10,24-27}. However, bronchoscopy can increase procedural time, costs and complexity of PDT. To minimize the risk of volutrauma, the bronchoscope should be removed once the guide-wire placement is confirmed. Alternatively a thin intubating bronchoscope can be used. A post procedural bronchoscopy can also be performed to check tracheostomy position and for clot occlusion or cuff herniation.

The routine use of bronchoscopic guidance for PDT is controversial. High level evidence from well designed studies is lacking. The ANZICS Safety & Quality survey on PDT practices showed that there is not a consensus of opinion amongst Australasian intensivists²⁸. While 92% of respondents agreed that a bronchoscope should be immediately available only 57% agreed that it should always be used.

Whether or not a third person, a dedicated bronchoscopist, should perform the bronchoscopy is also controversial. Only 36% percent of survey respondents support the use of a dedicated bronchoscopist²⁸. If the bronchoscopist is also responsible for the airway they must be able to immediately respond to an airway emergency.

Risk/Benefit assessment of bronchoscopic guidance

Potential benefits

- Reduced risk of:
 - Accidental loss of airway;

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- Posterior tracheal wall injury;
 - False passage of wire, dilator and tracheostomy;
 - Pneumothorax and pneumomediastinum; and
 - Bleeding.
- Facilitate teaching and supervision.

Potential risks

- Partial occlusion of endotracheal tube and airway leading to:
 - Pneumothorax, secondary to air trapping;
 - Carbon dioxide retention; and
 - Hypoxia.
- Increased complexity of procedure.
- Distraction from airway management (when there is not a dedicated bronchoscopist).
- Damage to the bronchoscope by needle puncture.

Recommendations

- A fibre optic bronchoscope should be readily available for every PDT procedure.
- Bronchoscopic guidance of needle insertion and guide-wire placement into the trachea should be considered for every procedure following a risk/benefit assessment for each patient.
- If the bronchoscopist is also responsible for the airway they must be able to immediately respond to an airway emergency.

Ultrasound guidance

Ultrasound guided PDT techniques have been described²⁹⁻³².

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Ultrasound may potentially assist by:

- Defining the relevant anatomy;
- Identifying tracheal midline;
- Identifying blood vessels adjacent to the PDT insertion site reducing risk of bleeding;
- Estimating trachea depth from the skin surface and tracheal diameter thus assisting tracheostomy tube size selection;
- Ensuring accurate placement of needle into the trachea; and
- Identifying patients unsuitable for PDT.

Post Procedure Care

A chest X-ray should be taken following the procedure to confirm tracheostomy tube position and rule out complications, e.g. intrapulmonary aspiration, pneumothorax, pneumomediastinum and lung collapse.

The patient may be sat up in bed but should be repositioned with care in order to avoid tracheostomy tube dislodgement. Whenever the patient is repositioned a dedicated nurse or doctor must be responsible for holding the tracheostomy tube to prevent dislodgement.

If a newly inserted (< 72 hours) tracheostomy tube dislodges, orotracheal intubation is the safest method to re-establish a patent airway. If orotracheal intubation attempts fail a LMA is recommended to secure the airway. No attempts should be made to re-advance the dislodged tracheostomy tube through the newly formed PDT tract.

Competency (based on CoBaTRICE³³ competency)

Knowledge requirement

- Indications and contraindications for percutaneous tracheostomy as outlined in this Consensus Statement.
- Demonstration of adequate knowledge of the relevant landmarks and anatomy.
- Techniques of PDT and selection of appropriate tracheostomy tube.
- Complications and management of complications of PDT.
- Principles of (and experience in) anaesthesia for PDT including principles of emergency airway management.
- Principles of (and experience in) bronchoscopy.

Practical Requirement

- Prepare equipment, patient and staff prior to procedure.
- Demonstrate working knowledge of PDT kit and Seldinger technique.
- Correctly identify anatomical landmarks.
- Perform a sufficient number of PDTs under close supervision until competence is demonstrated.
- Demonstrate adequate aseptic technique.
- Recognise and manage emergencies.
- Manage anaesthesia and control of airway.

Summary

PDT is safe when performed on appropriately selected ICU patients, by competent intensive care doctors, in an ICU setting equipped to respond immediately to airway and surgical emergencies. The routine use of bronchoscopic guidance is controversial. Surgical tracheostomy is usually reserved for patients with contraindications to PDT.

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