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A Case Series of Bleeding Complication Post Percutaneous Dilatational Tracheostomy and Management

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ABSTRACT

Introduction: Percutaneous Dilatational Tracheotomy (PDT) is a procedure established for the management of airway and ventilation in the medium to long term for critically ill patients in the ICU. Bleeding is one of the most frequent early complications of tracheostomy. The comorbid conditions of critically ill patients increase the risk of bleeding complications. The aim of this case was to identify factors that increase the risk of bleeding complications in critically ill patients undergoing Percutaneous Dilatational Tracheostomy (PDT) and its management

Case: Two cases of patients experiencing bleeding complications after PDT were reported. The bleeding in these patients were suspected to be caused by coagulation disorders due to sepsis and chronic kidney disease. The bleeding occurred on day-1 and 2 post-PDT procedure. Bleeding complications that were not resolved with general management were managed by subcutaneous suturing in the anatomical region of branching arteries and veins that supply the trachea.

Conclusion: Bleeding after PDT are a part of early complications of tracheostomy procedures. This complication is more often found in critically ill patients. Management can be carried out by suturing the anatomical region of branching arteries and veins supplying the trachea.

Keywords

Percutaneous Dilatational Tracheotomy (PDT), Bleeding, Critically ill patients

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INTRODUCTION

Percutaneous Dilatational Tracheotomy (PDT) is a procedure performed to facilitate the management of the airway and medium to long-term mechanical ventilation in ICU patients.[1,2] PDT is indicated for patients with partial or total obstruction of the upper airway, failure of mechanical ventilation weaning, and the facilitation of long-term mechanical ventilation due to neurological disorders while ensuring airway patency.[3-5] As a standard care approach to prevent long-term complications of translaryngeal intubation, PDT has demonstrated benefits in preventing laryngeal complications such as mucosal erosion, scar tissue formation, stenosis, recurrent laryngeal nerve damage, permanent vocal cord damage, and upper airway damage.[6,7]

Percutaneous dilation technique is a commonly applied tracheostomy method as a procedural intervention for critically ill patients beside the bedside.[8] Research has shown a lower incidence of bleeding and infections associated with PDT compared to open surgical tracheostomy. Due to its favorable safety profile, PDT is widely accepted as a low-complication procedure to ensure safe patient care. This is particularly

crucial in the intensive care unit (ICU), where critically ill cardiovascular patients receiving anticoagulation, dual antiplatelet therapy (DAPT), or even a combination of both are treated. Additionally, critically ill patients often suffer from thrombocytopenia and/or coagulation disorders due to sepsis, organ dysfunction, and the severity of the disease, making them at risk for bleeding during percutaneous dilatational tracheotomy.[7,9] PDT is considered a safe tracheostomy procedure for critically ill patients in the ICU, even in high-risk groups for bleeding with independent risk factors for bleeding during and after PDT.[7]

CASE 1

A 64-year-old woman presented with respiratory failure requiring mechanical ventilation, undergoing thrombocyte concentrate (TC) transfusion on the first day. Coexisting complications included Chronic Kidney Disease (CKD) with routine hemodialysis, pleural effusion, pneumonia, sepsis, congestive heart failure, coronary artery disease, hypertensive heart disease, anemia, hepatic insufficiency, disseminated intravascular coagulation (DIC), and prolonged activated partial thromboplastin time (aPTT). Physical examination revealed the patient's consciousness as E3M5Vtc, blood pressure 100/60 mmHg with Norepinephrine support at 0.05 mcg/kgBW/minute, heart rate 108 beats per minute, respiratory rate 17 breaths per minute, afebrile body temperature, and 100% oxygen saturation with 60% oxygen fraction. The patient received a 500 ml fresh frozen plasma (FFP) transfusion on the second day, with plans for continuation for three days. Additionally, the patient received tranexamic acid injections of 250 mg every 8 hours. Bleeding occurred on the first day post-PDT (no bleeding during and immediately after the procedure), suspected to be related to the prolonged aPTT due to sepsis and metabolic acidosis from CKD. The management of bleeding in this case involved suturing the arterial and venous branches responsible for the front part of the trachea.

Figure 1. Bleeding on the first day post-PDT and post-suturing (lower image) of the first patient.

CASE 2

A 61-year-old female patient underwent PDT due to difficulty weaning from the ventilator. Bleeding occurred on the second day (several hours post-PDT, with no bleeding during and immediately after the procedure). The patient had a history of thyroidectomy in January 2022, presenting with severe illness, GCS E3M5Vett, equal and reactive pupils, blood pressure 116/78 mmHg, heart rate 75 beats per minute, oxygen saturation 98%

on ventilation with VCSIMV mode, VT 300, Peep 5, PS 10, FiO2 90%. The cause of bleeding in this patient was suspected to be related to her critical condition, with complicating factors such as septic shock, pneumonia, acute pulmonary edema, hypertensive heart disease, non-sustained ventricular tachycardia, cardiac arrest survivor, history of right pneumothorax, pericardial effusion without tamponade signs, hypercoagulation, hypoalbuminemia, acute-on-chronic kidney disease, and electrolyte imbalance. The management of bleeding in this case also involved suturing the arterial and venous branches responsible for the front part of the trachea.

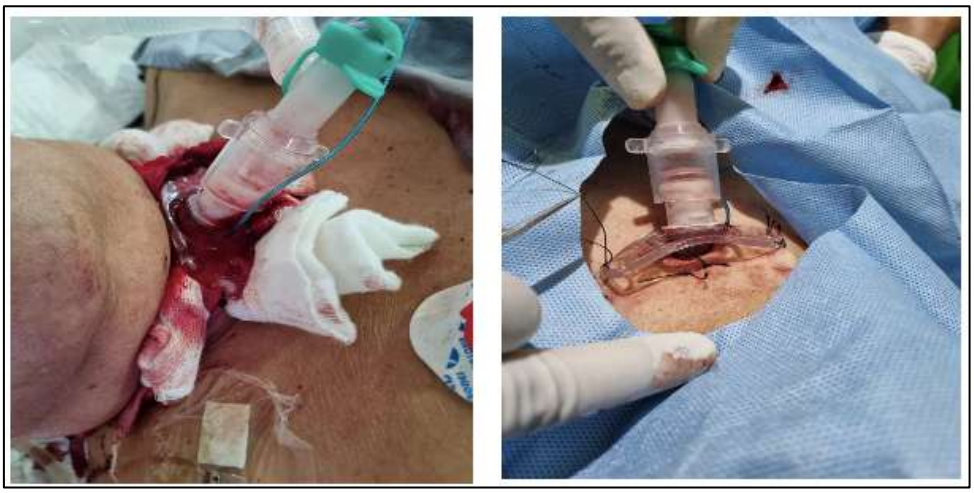

Figure 2. Bleeding post-PDT in the second patient, before suturing (left), after suturing (right).

Before suturing around the tracheostomy stoma in both patients, efforts were made to stop the bleeding according to the underlying pathology. Initial measures included:

1. Temporarily discontinuing medications that interfere with coagulation (around 24 hours post-PDT).
2. Controlling blood pressure with a mean arterial pressure (MAP) between 65-90 mmHg (according to the agreed MAP by the patient management team for the critical disease characteristics).
3. Administering procoagulant drugs (tranexamic acid, vitamin K, Adona).
4. Providing factors that aid in coagulation (FFP, TC).
5. If several measures fail to stop bleeding, suturing around the stoma is performed, with a distance of 0.5-1 cm from the edge of the stoma wound, deep into the subcutaneous tissue, at the anatomical region of the arteries and veins that manage the front part of the trachea, at the 12, 3, 6, and 9 o'clock positions. Suturing is done with 1.0 or 2.0 silk thread, following sterile principles, and then evaluating the bleeding. Despite the bleeding source being medical, this suturing technique can help stop post-PDT bleeding around the tracheal stoma.

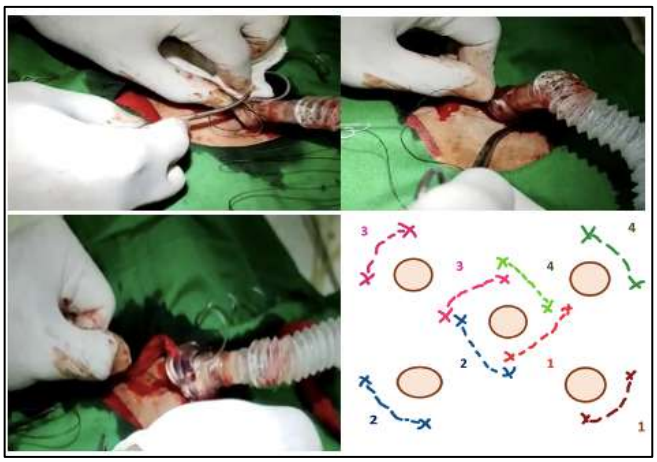

Figure 3. Stitching technique around the stoma

DISCUSSION

PDT (Percutaneous Dilatational Tracheotomy) can be performed efficiently, and the complication rate associated with the procedure is very low. Overall, there have been no cases of death directly attributed to PDT. There is only a 0.7% procedure-related resuscitation rate, all of which resulted in a return of spontaneous circulation (ROSC) without permanent damage to the patients. Clinical practice indicates that mild bleeding at the tracheostomy cannula site can be easily controlled or prevented with minimal invasive stitching techniques, consisting of two single-headed stitches at the incision points on the edge of the tracheostomy cannula stoma.[10] This technique may be considered for routine use to address bleeding after PDT, following general management efforts based on the patient's underlying condition.

The decision to perform tracheostomy is made by the executive consultant or department head. Indications for tracheostomy include respiratory failure associated with various underlying medical conditions, in this case, exacerbation of chronic pulmonary disease, muscle weakness, neurological damage, lung infection, or acute lung injury. PDT techniques are performed according to standard PDT module installation used for all patients. All procedures are carried out beside the ICU bed by an anesthesiology consultant specializing in critical care (trained in PDT according to COBATRICE guidelines, and has independently performed PDT at least 5 times) or a senior ICU training participant under the supervision of a consultant. One operating doctor and three nurse assistants or those functioning as assistants work as a team. One assistant is responsible for managing and monitoring the airway, one assists the operating doctor in performing tracheostomy and managing and monitoring bleeding, and one assistant acts as an equipment circulation, monitors overall activities, administers medication, and coordinates with other teams if needed. Informed consent and education are conducted and obtained before the procedure from the patient's closest family.

Patients are given sedation, analgesia, and relaxation as needed. Commonly used drugs include midazolam and fentanyl, with muscle relaxants chosen between rocuronium or atracurium, adjusted to the patient's condition. Inspiratory oxygen fraction is increased to 1.0 (100%), and the ventilator setting is given in synchronous control mode according to the patient's needs, or controlled ventilation mode is started during the intervention period and maintained until paralysis disappears. Continuous monitoring of heart rate, blood pressure, respiratory rate, and peripheral oxygen saturation is performed on all patients. Standard resuscitation equipment and airway equipment are prepared beside the bed. The patient is placed in a supine position with the neck straightened and supported at the shoulder. Examination using ultrasound or bronchoscopy before PDT is not routinely performed, if deemed necessary, it is prepared as needed. The oral cavity is cleaned as thoroughly as possible, then the patient is prepared for aseptic action in the area identified as the stoma incision site (approximately at the level between rings 2-3 or 3-4). Draping and preparation of PDT tracheostomy set tools are carried out according to the sequence to facilitate the procedure. Initial identification is carried out at the level between rings 2-3 or 3-4, in the middle of the trachea as the stoma incision site and trachea depth. An incision of 1-1.5 cm is made in the middle of the trachea, until a small amount of subcutaneous tissue is visible. Dull dilatation is performed around the front trachea area with a blunt curved clamp, until the trachea and ETT tube inside it can be identified. The ETT balloon is deflated, and the ETT is slowly withdrawn until the planned tracheostomy tube size or the ETT tip is felt above the stoma area but still inside the trachea (ETT withdrawal can also be guided using ultrasound or bronchoscopy in specific situations). Abbocath 14 with a guide sheath and connected to a 5 ml syringe containing fluid/lidocaine is inserted perpendicular to the tracheal lumen, while being suctioned, in the midline space between tracheal cartilage rings 2-3 or 3-4. During insertion, attention is paid, and the depth is estimated in the tracheal lumen (marked by air bubbles being suctioned from the tracheal lumen). Abbocath 14 needle is released, and its plastic channel is left in the tracheal lumen pointing caudally. The guide wire is inserted up to the recommended limit of the PDT set through the Abbocath 14 plastic channel. After the guide wire is in place, the Abbocath 14 plastic channel is released. Initial dilation is performed with the initial dilator, followed by attaching the guide wire reinforcement to perform further dilation using the advanced dilator according to the recommended limit of the PDT set. After the advanced dilation is performed according to the planned tracheostomy tube size, the tracheostomy tube is inserted into

the stoma using the guide wire. The guide wire is released, leaving the tracheostomy tube in place, the tracheostomy tube balloon is inflated, the mechanical ventilation tube is moved from the ETT to the tracheostomy tube, then ventilation graphs are observed on mechanical ventilation. If the mechanical ventilation graph is good and the chest rises, the ETT is released from the patient's mouth. The tracheostomy tube is secured with stitches on all four sides of the tracheostomy tube, and neck ties (not too tight or loose, sticking to the skin but 1-2 fingers can enter between the skin and the tracheostomy tube fixation tie). The oral cavity is cleaned as thoroughly as possible, followed by cleaning the tracheostomy tube route to the bronchi to avoid airway obstruction due to blood or debris from the PDT procedure. Chest X-rays are not routinely performed unless there is a possibility of pneumothorax after PDT. Coagulopathy, if present before PDT, is not routinely corrected.[11]

Based on current examinations, if PDT is indicated and performed correctly, it can be recommended as a safe method to secure the airway, even in cohort studies of patients at high risk of bleeding due to anticoagulation, DAPT, or a combination of both. Several advantages of tracheostomy in general, including well-documented PDT techniques, are improved patient comfort, ease of maintaining oral hygiene, reduced need for sedation and analgesia, spontaneous closure of the wound after decannulation, nearly invisible scar, reduced respiratory effort, shorter weaning periods from the ventilator, and overall shorter ICU stays. Some notes, PDT is performed 7 to 10 days after the primary intubation. Some studies comparing early tracheostomy (between two to 10 days post-intubation) with the standard (after day 14 or 21) mention no significant differences in hospital stay duration, ICU stay duration, and overall mortality, and meta-analyses indicate no association with ICU mortality or one-year mortality. The question of the optimal time for tracheostomy is still unanswered and requires further prospective randomized controlled trials to address this question.[1,7]

PDT (Percutaneous Dilatational Tracheotomy) is considered a minimally invasive procedure that can be performed in the ICU beside the patient's bed. The time required for bedside PDT is much shorter than open tracheostomy, even if performed by medical intensivists or under intensive training. Another advantage of PDT is minimizing scheduling difficulties associated with operating rooms and anesthesia staff, as it does not require transporting critically ill patients to the operating room, ultimately reducing the overall cost of tracheostomy.[12] For these reasons, PDT has become the standard technique for tracheostomy in the management of critically ill patients who are indicated for the procedure, and it is considered to have a lower risk of complications.[12]

Complications associated with PDT, such as bleeding, subcutaneous emphysema, hypoxemia, pneumothorax, tracheal injury (posterior tracheal wall perforation, tracheal ring fracture), cannula dislocation, premature decannulation, and stoma infection, and even death, have been documented. Acute bleeding is defined as endo or extrabronchial bleeding that occurs during tracheostomy (between the skin incision and insertion of the tracheostomy tube). Acute bleeding is classified as mild (extrabronchial: one to 5 ml, endobronchial: one to two tracheal rings covered in blood or some blood on the posterior tracheal wall and does not require intratracheal suctioning), moderate bleeding (extrabronchial: 5 to 20 ml, endobronchial: at the PDT stoma site, a bronchus segment is covered or blocked by blood), severe bleeding (extrabronchial: 20 to 50 ml, endobronchial: the main bronchus is blocked by blood), and major bleeding (bleeding over 50 ml and/or requires surgical intervention/blood transfusion). The volume of extrabronchial periprocedural blood loss is calculated by measuring the weight difference of the gauze before and after the procedure. The ease of tracheostomy tube placement is assessed as easy, moderately difficult, very difficult, or impossible based on the subjective assessment by the doctor performing the PDT procedure.[11]

In a study, 87 patients (54.71%) had risk factors for bleeding complications. The most common hematologic risk factors were thrombocytopenia (platelet count of 100,000/mm3 to 50,000/mm3) and treatment with antiplatelet drugs. The most common anatomical risk factors were a short neck, and ultrasound examination of the neck showed abnormalities in blood vessels near the PDT site. Dempsey et al. reported that out of 576 PDT procedures, immediate and late complications occurred in 26%, but most of the reported complications were actually technical difficulties. The actual incidence of complications was 3% immediate

complications and 0.7% late complications (4.3% experienced mild bleeding, only 1.04% experienced significant bleeding, 0.52% experienced subcutaneous emphysema, and 0.17% experienced pneumothorax).[13]

CONCLUSION

This case report indicates that PDT is a safe procedure but still requires caution for airway management in ICU patients, even in subpopulations treated with dual antiplatelet therapy and therapeutic anticoagulation. PDT is generally performed and widely accepted in critically ill patients with a risk of bleeding. Bleeding due to PDT can occur immediately or gradually. The management of bleeding due to PDT can be handled with medical and surgical interventions.

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None

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The Authors agree to publication in Journal of Society Medicine.

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The authors declare that there is no conflict of interest.

AUTHORS' CONTRIBUTIONS

All authors significantly contribute to the work reported, whether in acquisition of data, analysis, and interpretation, or in all these areas. Contribute to drafting and revising. Approved the final version to be published, agreed on the journal to be submitted, and agreed to be accountable for all aspects of the work.

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