Original Article

Localization of Tracheal Space: Innovation of an Available Technique

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Abstract

Background: Percutaneous dilatational tracheotomy (PDT) procedure is becoming popular for its safety, cost effectiveness, better stoma, and less dissection and occurrence of damage to tissue; but it is known a relatively expensive procedure, that is why we conducted this study. Research Question: Our question was whether this technique is feasible and what possible side effect is expected. Study Design and Method: Eighty six patients, aged more than 18 years, without coagulation disorder, unstable spine or normal airway anatomy were sedated and a new technique was done to insert tracheostomy tube. Then operation time, side effects and success of the method was recorded. Results: The mean procedure time was 10±2 min. The majority of the percutaneous tracheotomies were performed without any adverse effects except in 3 cases and the procedure was successful in all but 2 patients. The most frequent acute complication was bleeding and pneumomediastinoma and pneumothorax. Interpretation: PDT via this technique is a safe bedside procedure that can be performed with very low morbidity by skilled practitioners.

Keywords: PDT, Medical equipment reuse, loss of resistance technique

Introduction

PDT has become gradually popular with an extensive acceptance worldwide [1, 2]. The modern PDT procedure has also evolved to whereby it can be safely performed bedside in the ICU. Moreover, bedside PDT has proven clinical outcomes and can save hospital resources, take less time, small PDT incision, the tightly fitted tracheostomy tube against the stoma, and less dissection and occurrence of damage to tissue [3, 4]. These advantages are probably responsible for the encouraging outcomes described in short-term and long-term follow-up studies of patients undergoing PDT [3, 5, 6], including fewer wound complications like bleeding, infection and scar [7]. Today, the technique has become the tracheostomy procedure of choice; so that many surgeons perform this procedure and it may expanding, especially among pulmonologists and intensivists.

Several tracheostomy techniques have been described as percutaneous [8]. All employ a modified Seldinger technique [9] with Concomitant bronchoscopy that enable tracheal view which helps repositioning the endotracheal tube (ETT) above the incision and helps to visualize needle placement and subsequent stomal dilatation. Although bronchoscopy can decrease posterior tracheal wall injury, confirm tube placement and help airway toilet and is strongly recommended [10, 11] but also it is a rather expensive method. Moreover, the Fantoni translaryngeal technique requires retrograde passage of a wire parallel to the ETT [12].

Moreover, other way of creating a stoma exsist. The Ciaglia technique uses sequential tracheal dilators over the guidewire [13]. Variations of this create percutaneous tracheostomy introducer sets. Otherwise, the Blue Rhino technique employs a single large tapered dilator and uses dilating forceps over the guidewire [14]. In Iran, as a result of sanction and economic, medication and medical devices import restriction through the country in the last decade, specialists searched novel techniques to compensate shortage of equipment as well as PDT sets which are either unavailable or very expensive. In our hospital, we decided to reprocess, reuse and disinfect some crucial apparatuses. Reprocessing medical devices intended for single use, has always been a part of the

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medical-device life cycle, in both the developed and the developing economies of the world [15]. While it has now transformed into an important, cost-saving, refined process and is expected to change the medical device industry over the next years. We had some part of central line catheter (introducer and guidewire) and PDT kit (dilators) sterilized about 86 times before and after each procedures and used loss of resistance technique for localization of tracheal space in a new technique.

The loss of resistance technique (LORT) for identifying the epidural space was originally described by Dogliotti in 1933 [16], and was based on the different densities of tissues bumped into as the needle tip passed through the ligamentum flavum into the epidural space and is now by far one of the most commonly used technique. In our PDT procedure, the intratracheal lumen space is identified by using the LORT. This technique is based on the perception of loss of resistance as the advancing needle passes through the ligament and muscles into the tracheal space during compression of the plunger of the syringe and just after endotracheal tube is gradually removing; As the technigue done in searching epidural space.

Study Design and Method

Eighty six patients, aged more than 18 years, without coagulation disorder, unstable spine or normal airway anatomy underwent sedation with 5 mg diazepam and 5 mg Morphine Sulfate and local anesthesia and the proposed innovation was incorporated. For sedation maintenance, a total dose of 10 ^{cc} propofol 10% were used if needed. Mandatory ventilator modes was set for all patients went through bedside percutaneous dilation tracheostomy and patients delivered oral care before procedure with 0.12% chlorhexidin mouthwash. First of all, the patient was positioned supine with a bolster placed transversely behind the shoulders to extend the neck and provide optimal exposure (unless the patient requires cervical spine precautions). Then the head of the bed was typically elevated 15°–20° to decrease venous engorgement. After achieving proper positioning and prep and drape of the surgery site and once intravenously injecting epinephrine plus 2% Lidocaine, the cricoid was palpated and a 2-cm transverse skin incision was made at the level of the second tracheal ring and strap muscles were departed by means of a Kelly clamp till reaching the tracheal ring. Then the endotracheal tube was withdrawn after cuff deflation (until the tube depth was about 17 cm for males and 15 cm for females) gradually by an assistant resident and at a same time proper needle position and tracheal localization was confirmed by air regurgitation with a syringe containing normal saline (22 needle gauge) after feel of loss of resistance by the intensivist when the ETT had just passed 1-2 or 2-3 tracheal cartilage. After localization of the tracheal lumen, it was punctured at the middle of the incision using a 16 gauge IV cannula by slightly tilting the syringe needle as a guide and a guide wire driven from a CVL set, was inserted after removing the cannula needle.

Then we used mosquito pence to dilate intra cartilages space and Rhino dilator was introduced to the tracheal space through the guidewire. For convenience tracheostomy tube entrance, we also used a17 gauge PDT dilator. The left over PDT procedure was performed using the previous standard method and a 7 to 8 tracheostomy tube was inserted.

Medical equipment reuse

After sanction and initiation of drug and medical devices shortage crisis in the country; we decided to make a bank of reused devices. The process executed include a detergent washing cycle, followed by a rinsing cycle, followed by a sterilization or disinfection cycle, followed by a rinsing cycle, followed by air flush for drying and storage.

Detergents use for sterilization of heat sensitive devices which are exposed to the critical and semi critical surfaces like tissue and mucus include high level disinfectant agents. In this case, we stink equipment in *Steranios*® 2% solution for 60 minutes after each surgery and once cleaning the devices with 10 min rest in *aniosayme* DD1 solution. Then we stored them in a sterile z pack for later use.

Result

The mean procedure time was 10±2 min. The majority of the percutaneous tracheotomies were performed without any adverse effects except in 3 cases and the procedure was successful in all but 2 patients.

The most frequent acute complication was bleeding, which was observed in one patients and bleeding site was sutured after that. Two patients experienced pneumomediastinoma and pneumothorax. Bleeding in all patients was well controlled in the ICU and chest tube was inserted for those patients with pneumothorax. Long-term (> 7 days) follow-up showed no late complications and no deaths related to PDT.

Conclusion

Since tracheostomy is among the most frequently performed procedures in critically ill patients and PDT is a safe bedside procedure that can be performed with very low morbidity by skilled practitioners; we hope that technical adjuncts will improve patient safety while diminishing costs. As our experience and knowledge with PDT technique and equipment grows, current procedure evolve in the hope of covering more patient's need, especially in low income country.

Conflict of interest

No conflict.

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