

THE IMPORTANCE OF PERCUTANEOUS TRACHEOSTOMY IN CRITICAL CARE FOR IMPROVING PATIENT PROGNOSIS

ABSTRACT

Tracheostomy is considered to be a life-saving procedure in the field of medicine. Although its importance was vague before, new studies and research work are proving it to be indeed a life-saving, worthy procedure. Tracheostomy is a very ancient procedure that was used from around the 3500 B.C. Now, surgeons prefer it when they see that a patient is not improving their already low GCS score and is unable to maintain breathing and ventilation without any support. For such patients, usually some time is given to evaluate whether they are gradually improving under the effect of medications or not. If there is no improvement, then the patient is proceeded towards surgery for tracheostomy. For tracheostomy, there are two major techniques that are used for performing the procedure. These include the open surgical method and the percutaneous method. Both the methods are widely used in the operation theaters today, yet the indication, contraindications, and complications are different for each method.

This review reflects upon the rising trend of using percutaneous tracheostomy in critical care settings. Although there is no difference in the results and outcomes of each method, however, there are certain indications that make the percutaneous method applicable on the patients. It has helped successfully improve the GCS score of several patients and has also helped improve the prognosis of some patients who were otherwise being seen to proceed in a deteriorating manner.

This review will also reflect upon the different techniques of tracheostomy that are preferred while performing it through the percutaneous method.

Keywords: Tracheostomy, critical care, emergency department, life-saving technique, low GCS score, poor prognosis

INTRODUCTION

Critical care is one of the most important factors involved in saving the life of a patient. The prognosis of a patient, the outcomes of the treatment that was given to them and everything that revolves around it is an integral part of critical care. (1) There are different principles that revolve around the concept of critical care in medical literature, but since this field mainly revolves around the most critical and severely ill of all patients, it is best to keep the span of this review limited to those patients only.

Out of all the protocols that are followed in a critical care setting for improving the prognosis of a given patient, tracheostomy is a widely practiced one in nearly all parts of the world. (2) Tracheostomy is one of the most ancient techniques that have been known and well-recognized in medical science. They are done both surgically and percutaneously, as per the patient's condition and consciousness factors. It is known to be a life-saving procedure that has had several instances of improving the patient's Glasgow Coma Scale (GCS) or consciousness levels. Interestingly enough, the trend of opting for tracheostomy is increasing over the past years, mainly due to its promising impacts on improving the prognosis of a patient towards the favorable end. Out of the two major techniques used for tracheostomy, percutaneous tracheostomy has become the choice of intervention that many doctors prefer over the surgical one. Now, tracheostomy is recognized as a distinct procedure that has indications, contraindications, and techniques of its own. (3) It is always important to keep all these factors in mind when selecting a patient to undergo this procedure, in case it ends up doing more harm than good to the patient in the long run.

This review aims to reflect on the role of percutaneous tracheostomy in saving the life of a patient. The focus is on the need for percutaneous tracheostomy in critical care settings specifically since it is the place where many life-changing decisions have to be taken by both the doctors and the patient's families and attendants. This review will also do an overview of how the rates of tracheostomy have increased ever since it has been proven to improve the patient's prognosis.

AN OVERVIEW OF PERCUTANEOUS TRACHEOSTOMY

Tracheostomy has been present around in the field of critical or emergency medicine since the time of Alexander the Great in 1000 B.C. It was reported that it was Alexander himself who made an incision with his sword on a soldier's neck to make breathing a bit easier for him **when he got wounded in the battlefield.** (4)

Ever since then and maybe even before that, tracheostomy has been around as a life-saving procedure that has helped doctors and patients around the globe in improving the prognosis of several patients admitted to the critical care ward. (5)

Today, there are several techniques for performing tracheostomy in patients. It is commonly done through two major methods; the open surgical and the percutaneous method. Both methods have their sets of advantages, disadvantages, indications, and contraindications that are recommended for the particular patients needing them. (6) However, for the sake of convenience, this review will focus on the usage of percutaneous tracheostomy as a whole.

Percutaneous tracheostomy was introduced after the open surgical technique method in 1985. It is a method that is widely used in intensive care and critical care settings, thus proving that the implementation of percutaneous tracheostomy is usually reserved for patients **who are critically ill, intubated, or unable to maintain respiration on their own.** Percutaneous tracheostomy focuses

on using a modified Seldinger technique, which is not employed in open surgical tracheostomy. However, several techniques for inserting the tracheostomy tube have been proposed after the introduction of percutaneous tracheostomy. (7) In the modified Seldinger technique, the focus is on accessing the trachea through a needle and then inserting a guide wire through it. Once the guide wire succeeds in achieving the dilation that is needed, the tracheostomy tube is entered. (8) In the beginning when this technique was introduced, the focus was on employing the use of serial large-sized dilators to create a stoma for the tracheostomy tube. (9) However, with time, this use of serial dilators went obsolete, and a single, tapered dilator came into use. This way, only a single dilator was used and a single step was required to produce the required stoma instead of a series of steps, which were both time-consuming as well as somewhat invasive for the patient who was already in a compromised state. (10) In the United States as well as other regions of the world, Portex ULTRAPerc Single Stage Dilator Technique Kit, Bloomington, Indiana, etc. are some of the most commonly used kits for percutaneous tracheostomy. These kits have helped improve the overall technique and made the procedure feasible to be performed by the surgeons as well. (11) To this date, it is the single dilator technique that has received the most acclamations and approvals for being the least invasive method as well as the one with the least rate of complications in the patient.

Regarding the advantages that the modified Seldinger technique has for the patients who have undergone this method, there are several advantages that make it a superior choice, especially for the older and elderly ill patients. There was lesser post-operative pain and discomfort seen in the patients than in those who underwent the open technique. Moreover, the modified Seldinger technique is comparatively faster than the open technique, which makes it easier to be performed on patients who are in a much complicated state. There is also a lesser chance of developing a

scar when this method is employed. Therefore, there are several patient-centric factors that make the modified Seldinger technique an optimal method of choice. (12) Needless to say, percutaneous tracheostomy is widely performed using this method for the severely ill, intubated patients.

INDICATIONS OF PERCUTANEOUS TRACHEOSTOMY

Just like the surgical technique, there are certain indications that make the implementation of percutaneous tracheostomy in patients a necessity for improving their outcomes. It has been declared that about 5-10% of all the patients admitted to the ICU will require a percutaneous tracheostomy at some point during their stay in critical care. (13)

The first and major reason why percutaneous tracheostomy is required in these critical patients is respiratory failure. Since the patients are unable to maintain the flow of carbon dioxide and oxygen as normal patients do, it was evident that they needed continuous mechanical ventilation to help them with this.

Furthermore, percutaneous tracheostomy was also indicated in situations where the patient had some sort of upper airway obstruction. This obstruction could have arisen in a variety of different ways, such as due to angioedema, obstructive sleep apnea, malignancy, and trauma. (14)

When done in an emergency condition, it is mostly due to preserving the airway and making the suctioning of secretions easier. With a potent tracheostomy in place, it is very easy for the nursing staff to carry out the process of suctioning.

CONTRAINDICATIONS OF PERCUTANEOUS TRACHEOSTOMY

There used to be many speculations related to carrying out percutaneous tracheostomy in patients who were highly unstable or in a condition where nothing could be done to improve their prognosis. However, since a lot of research has been done on the subject, it is now easier to say

that tracheostomy could be carried out on those highly critical patients as well, only after looking at their profile and current status. (15)

Any kind of infection that involves the wall of the neck in an unstable patient is a contraindication in an unstable patient. Moreover, conditions such as obesity, limited mobility of the neck secondary to trauma, or patient's underlying disease or condition, a history of prior neck surgery or even a prior tracheostomy history, high ventilator support, and bleeding diathesis are still seen as risks before percutaneous tracheostomy.

COMPLICATIONS OF PERCUTANEOUS TRACHEOSTOMY

There have been several common instances of mild oozing of blood from the incision site. This has been effectively managed using light pressure packing or using a dressing that has been soaked in adrenaline or tranexamic acid. (16)

However, in the cases where bleeding continues or is unable to be stopped, the stoma needs to be re-explored to see where the bleeding is coming from. So far, there have only been a few deaths reported due to the incidence of bleeding after percutaneous tracheostomy.

Trachea-innominate fistula is another rare complication that might arise due to percutaneous tracheostomy. Placing the tracheostomy tube between specific tracheal rings can prevent this, while surgical re-exploration is again necessary for this treatment. (17)

Other than that, respiratory secretions, mucus plugs, and other factors can obstruct the tracheostomy tube. Subcutaneous emphysema and pneumothorax are possible post-tracheostomy complications, with higher risks in obese patients. Tube displacement, particularly in obese patients, can be life-threatening if not managed carefully. Tracheal stenosis, narrowing of the tracheal lumen, is a common issue caused by intubation or tracheostomy, but only a small

portion requires intervention. Stomal stenosis and A-form deformities can also develop due to various factors.

OUTCOMES OF PERCUTANEOUS TRACHEOSTOMY IN CRITICAL PATIENTS

Regarding the outcomes of percutaneous tracheostomy in critical patients, there have been mixed studies in this regard. Few of them have viewed this as a good sign for the patient, whereas few studies found no impact whatsoever on the health of the patient even after percutaneous tracheostomy was done.

However, an interesting trend that was found in relation to tracheostomy and its outcomes on the patient was related to the timing of the tracheostomy procedure.

A study was carried out on 412 patients in medical-surgical ICUs. In these patients, the percutaneous tracheostomy was generally performed around 11 days after intubation. The decision was heavily influenced by the patient's overall health status, prognosis, and ability to be weaned. (18)

Research has shown that patients with SARS-CoV-2 who underwent tracheostomy experienced reasonably favorable survival outcomes, with mortality rates spanning from 7% to 23%. The variation in mortality rates across studies can be attributed to factors like follow-up duration and available outcome information. Notably, a significant study conducted in Spain reported a relatively high mortality rate of 23%, which is another exception. (19)

However, the majority of the studies have shown beneficial impacts on the patient's health, when viewed irrespective of the timing of the tracheostomy. (20) In **the short term lasting for about a month following the tracheostomy**, the mortality rate following percutaneous tracheostomy appears to be relatively low. This procedure is often performed in critically ill patients who are already at high risk due to their underlying conditions. However, advancements in patient

selection, technique, and perioperative care have contributed to improved survival rates. Improved patient comfort, reduced sedation requirements, and enhanced communication are reported benefits in patients with prolonged ventilation requirements. Furthermore, tracheostomy may contribute to a smoother transition to non-invasive ventilation or eventual decannulation. While both **open surgical and percutaneous** approaches have their advantages and limitations, percutaneous tracheostomy is generally associated with shorter procedure times, reduced bleeding, and decreased hospital stays. Surgical tracheostomy might be preferred in certain cases where anatomical considerations or patient factors warrant it.

CONCLUSION

Percutaneous tracheostomy is becoming a popular interventional treatment of choice for patients with respiratory failure or those needing mechanical ventilation. It is the least invasive procedure that has especially been seen to be helpful in patients admitted to critical care departments in hospitals. **Several recent** studies suggest that percutaneous tracheostomy is associated with relatively low complication rates. These complications may include bleeding, infection, accidental decannulation (tube removal), tracheal stenosis, and pneumothorax. Advances in technique and equipment have contributed to improved safety outcomes.

So far, there have been no serious adverse events associated with the application of percutaneous tracheostomy and therefore, it is said that it is a safe means of intervention that could be used on the patients. Some studies are **also** exploring the impact of percutaneous tracheostomy on patients' quality of life beyond the acute phase. This includes factors such as speech rehabilitation, psychological well-being, and overall functional recovery.

REFERENCES

1. Kayambankadzanja, RK, Schell CO, Gerdin Wörnberg M, Tamras T, Mollazadegan H, Holmberg M, et al. Towards definitions of critical illness and critical care using concept analysis. *BMJ Open*. 2022 Sep 5;12(9):e060972.
2. Mehta C, Mehta Y. Percutaneous Tracheostomy. *Ann Card Anaesth*. 2017 Jan;20(Suppl 1):S19–25.
3. Raimonde AJ, Westhoven N, Winters R. Tracheostomy. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Aug 14]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK559124/>
4. Engels PT, Bagshaw SM, Meier M, Brindley PG. Tracheostomy: from insertion to decannulation. *Can J Surg*. 2009 Oct;52(5):427–33.
5. Frost EA. Tracing the tracheostomy. *Ann Otol Rhinol Laryngol*. 1976;85(5 Pt.1):618–24.
6. Raimonde AJ, Westhoven N, Winters R. Tracheostomy. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2023 [cited 2023 Aug 25]. Available from: <http://www.ncbi.nlm.nih.gov/books/NBK559124/>
7. Rashid AO, Islam S. Percutaneous tracheostomy: a comprehensive review. *J Thorac Dis*. 2017 Sep;9(Suppl 10):S1128.
8. Pelausa EO. Percutaneous tracheostomy: ready or not? *J Otolaryngol*. 1991 Apr;20(2):88–92.
9. Li Z, Chen L. Comparison of ultrasound-guided modified Seldinger technique versus blind puncture for peripherally inserted central catheter: a meta-analysis of randomized controlled trials. *Crit Care*. 2015;19(1):64.
10. Seldinger SI. Catheter replacement of the needle in percutaneous arteriography; a new technique. *Acta Radiol*. 1953 May;39(5):368–76.
11. Sanuki T, Son H, Kishimoto N, Kotani J. Utility of the Portex introducer, ivory type, as a tube exchanger. *J Oral Maxillofac Surg Off J Am Assoc Oral Maxillofac Surg*. 2009 Aug;67(8):1615–8.
12. Altman E, Ben-Nun A, Curtis W, Best LA. Modified Seldinger technique for the insertion of standard chest tubes. *Am J Surg*. 2001 Apr;181(4):354–5.
13. Cohen IL, Booth FV. Cost containment and mechanical ventilation in the United States. *New Horiz Baltim Md*. 1994 Aug;2(3):283–90.
14. Esteban A, Anzueto A, Alía I, Gordo F, Apezteguía C, Pálizas F, et al. How is mechanical ventilation employed in the intensive care unit? An international utilization review. *Am J Respir Crit Care Med*. 2000 May;161(5):1450–8.

15. Lewith H, Athanassoglou V. Update on management of tracheostomy. *BJA Educ.* 2019 Nov;19(11):370.
16. Simon M, Metschke M, Braune SA, Püschel K, Kluge S. Death after percutaneous dilatational tracheostomy: a systematic review and analysis of risk factors. *Crit Care Lond Engl.* 2013 Oct 29;17(5):R258.
17. Pilarczyk A, Dusse N, Marggraf A, Schönfelder M, Jakob B. Repeat bedside percutaneous tracheostomy: still a contraindication? *Crit Care.* 2014;18(Suppl 1):P327.
18. Rumbak MJ, Newton M, Truncale T, Schwartz SW, Adams JW, Hazard PB. A prospective, randomized, study comparing early percutaneous dilatational tracheotomy to prolonged translaryngeal intubation (delayed tracheotomy) in critically ill medical patients. *Crit Care Med.* 2004 Aug;32(8):1689–94.
19. Arnold J, Gao CA, Malsin E, Todd K, Argento AC, Cuttica M, et al. Outcomes of Percutaneous Tracheostomy for Patients With SARS-CoV-2 Respiratory Failure. *J Bronchol Interv Pulmonol.* 2022 Apr 5;30(1):60–5.
20. Paul G, Gautam PL, Sharma S, Sravani MV, Krishna MR. Percutaneous Tracheostomy in COVID Era: Time to Adapt and Improvise. *Indian J Crit Care Med Peer-Rev Off Publ Indian Soc Crit Care Med.* 2021 Jun;25(6):642–7.