RESEARCH

COMPARISON BETWEEN SURGICAL AND PERCUTANEOUS TRACHEOSTOMY EFFECTS ON GERIATRIC PATIENTS IN THE ICU

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Abstract

Introduction: Increase in life expectancy across the globe has contributed to a rise in geriatric population. This has also led to an increase in geriatric ailments, causing an increased number of geriatric patients requiring intensive care, including mechanical ventilation. Tracheostomy is commonly surgical procedures performed in geriatric patients hospitalised at intensive care unit. Studies comparing percutaneous and surgically performed tracheostomy on geriatric patients with a mechanical ventilator requirement are rare.

Materials and methods: A significant proportion of ventilator-dependent geriatric patients need a tracheostomy during an intensive care unit stay. A tracheostomy can be performed using the traditional surgical tracheostomy or percutaneous dilatory tracheostomy methods. In the current study, we retrospectively compared different tracheostomy methods in intensive care unit geriatric patients with regard to procedure duration, the safety of the procedure and complications. A total of 55 geriatric patients underwent tracheostomy and demographic characteristics and outcomes were recorded.

Results: From the 55 patients, %59.1 were women. The mean age of patient was 71±15.4 years. The mean value of procedural time was significantly lower in the percutaneous dilatory tracheostomy group compared with surgical tracheostomy group (P<0.001). Bleeding, accidental decannulation, air leak from the fistula were also significantly lower in the percutaneous dilatory tracheostomy group compared with the surgical tracheostomy group. Percutaneous dilatory tracheostomy is safer and simpler than surgical tracheostomy in intensive care unit geriatric patients.

Conclusion: Percutaneous dilatory tracheostomy via Griggs tecnique is safe, cost-effective and can be done rapidly at bedside in intensive care unit geriatric patients.

Keywords: Tracheostomy; Intensive Care Units; Geriatrics.

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INTRODUCTION

Around the world, the population of people aged 65 years and older is rising, leading to an increase in the use of health services by geriatric patients. Thus, the evaluation and maintenance of elderly patients are increasingly important. With the increased life expectancy in geriatric patients, sustainably improving their quality of life and functional independence is also of increasing importance (1). This demographic change has also brought about a rise in the number of geriatric patients requiring intensive care, including mechanical ventilation (MV). Advanced age is considered an independent risk for mortality in patients admitted to the intensive care unit (ICU) (2). A tracheostomy is a standard procedure followed in the ICU for patients who require long-term MV. There are basically two approaches for performing a tracheostomy. A bedside percutaneous dilatational tracheostomy (PDT) is frequently used in the ICU, and a surgical tracheostomy (ST) is used in the operating room. A PDT is preferred over an ST in ICU patients because of its easy applicability in the ICU, and it eliminates problems that may arise during the transfer of patients under MV to the operating room. The procedure can be performed at the bedside by ICU physicians, regardless of the presence of a surgeon or availability of an operating room. An ST procedure is the traditional method in which a tracheal fistula is secured by a tracheal tube. An ST is occasionally followed by some complications, including major bleeding, surgical site infections and tracheal stenosis (3). As an alternative method, PDT was first introduced in 1985 by Ciaglia et al. described a PDT where dilatation was performed gradually from small to large blunt-ended dilators (4). Griggs modified this technique by adding guide wire dilating forceps, which are similar to blunt-edged modified Howard–Kelly forceps. Later, the Ciaglia Blue Rhino (dilatation in a single step) and PercuTwist (controlled rotational dilatation with single-screw dilatator) methods were described. Various techniques for PDT are still used worldwide (5,6). This retrospective study aimed to evaluate the safety of PDT by comparing the rate of perioperative complications between PDT and ST procedures performed in ICU geriatric patients receiving MV and evaluate its impact on the outcomes of their clinical condition.

MATERIALS AND METHODS

Upon approval by the Ethics Committee of Elazığ Fırat University Faculty of Medicine (19-07/2019), data from 55 geriatric patients who underwent PDT or ST at the ICU of the Anaesthesiology and Reanimation Department of Elazığ Fethi Sekin City Hospital between December 2018 and December 2019 were assessed in retrospectively. All patients were over 65 years old. All tracheotomies were elective and performed by an anaesthesiologist using the PDT technique, whether at the bedside (ICU) or performed by the otolaryngologist in the operating room. In the present study, we compared ST and PDT in geriatric patients with regard to procedure duration and vital parameters. Those with unstable cervical vertebra fracture, ST, platelet count < 60 000 mm³, international normalised ratio (INR) of prothrombin time > 1.5, fraction of inspired oxygen (FiO_2) > 0.8 and positive end-expiratory pressure (PEEP) > 12 cm H_2O were excluded from the study. All the tracheostomies were performed under general anaesthesia. Emergent tracheostomy, presence of infection or mass in the site of tracheostomy, unintubated patients, difficult access to the trachea, restrictions in opening the mouth and upper airway obstruction conditions are not included in this study. Griggs method was used during PDT.

Tracheostomy Procedure

All PDTs were performed in the ICU using the technique described by Griggs et al. Bronchoscopy was not performed during the operation. However, in certain cases suspected for paratracheal insertion or tracheal injury, a confirmation

bronchoscopy was carried out immediately after the procedure. We considered absolute and relative contraindications in the geriatric patients, including uncontrolled coagulopathy (platelet count < 60 000 mm³, INR > 1.5 and/or partial thromboplastin time > 50 s), high PEEP or FiO_2 requirement, PEEP > 12 cm H_2O, difficult anatomy (morbid obesity, short and thick neck or excessive goitre) and hemodynamic instability. All STs were performed in the operating room using standard techniques described elsewhere. The surgical procedures were conducted by an otolaryngologist. The PDT procedures were conducted by an anaesthesiologist at the bedside in the ICU. All anticoagulants were discontinued at least 12 h before the procedure or after the indication of coagulopathy correction. Before starting, FiO_2 was increased to 1.0, and positive pressure ventilation was used during the procedure. An electrocardiogram, invasive or non-invasive blood pressure and pulse oximetry were monitored routinely. All tracheostomy procedures were performed under general anaesthesia with propofol 2–3 mg/kg, analgesia (fentanyl 1 µg/kg) and relaxation (rocuronium 0.8 mg/kg), and the neck was hyperextended (unless there was severe cervical spine injuries or other precautions). Skin and subcutaneous tissue were infiltrated with 2% lidocaine/epinephrine, and subcutaneous tissue was eliminated with a 1-cm horizontal incision. The trachea was perforated with a 14-gauge needle in the posterior-caudal direction, and tracheal access was confirmed upon air aspiration of the syringe that was filled with 5 cc of lidocaine. After the tracheal puncture, a J-tip guide wire was inserted according to Griggs technique. For the initiation of stoma formation, an initiating dilator was introduced over the guide wire and then removed. Afterwards, guide wire dilating forceps were placed on the guide wire, and when these were opened, soft pretracheal tissues were allowed to expand. The forceps were re-applied to the guide wire and advanced until resistance was felt and the tip of the forceps had passed into the tracheal lumen. The forceps were then opened to stomatize the trachea and then the forceps were removed in the open position. A specially designed tracheostomy tube with an obturator and cuff was advanced over the guide wire, and an adequately lubricated introducer was added into the formed tracheal stoma. The obturator and guide wire were then removed. After placement of the tracheostomy tube, the surrounding parts of the tracheal stoma were covered with a sterile povidone-iodine sponge. The time elapsed from skin incision to the placement of a tracheostomy tube was recorded. Its position was verified by chest X-ray. Demographic variables and any perioperative or late postoperative complications were recorded. The procedural time and the duration between the first skin incision and tracheostomy tube placement were also recorded. The number of minor procedural complications, including cuff leak, posterior wall injury, difficult dilatation, intraprocedural hypoxia, hypotension and bleeding, postprocedural bleeding, several attempts at insertion, paratracheal insertion and reintubation were compared. The number of major complications, pneumomediastinum, pneumothorax and subcutaneous emphysema was also compared.

Measurements and Outcomes.

As baseline charecteristics (Table 1), data were collected regarding the following variables; gender, age, height, body weight, diagnosis, acut physiology and chronic health evaluation II (APACHE II) score at ICU admission, method of tracheostomy (PDT or ST) and duration of invasive MV and blood analysis (platelet count, activated partial thromboplastin time (APTT) and international normalized ratio of prothrombin time before the tracheostomy procedure. As a baselines outcome, we compared the rates of perioperative complications occuring during the tracheostomy procedure and until 10 postoperative days in the PDT and ST groups. Complications including desaturation (SpO_2< 85) during the tracheostomy

Table 1. Characteristics of subjects in the PDT and ST.

	PDT (n=28)	ST (n=27)	p value
Age	77(65-88)	75(65-91)	0.24
Gender (male/female)	12/16	13/14	0.56
BMI	21.6±3.6	21.8±3.3	0.15
APACHE II score at ICU admission	32.9(13-45)	34.6(14-45)	0.18
Glaskow Scale	6(4-8)	7(6-9)	0.06
Laboratory data before tracheostomy			
Platelet(10^4/mm^3)	23 ± 10.2	24.5±11.8	0.14
Pt-INR	1.07(1.03-1.29)	1.05(0.99-1.22)	0.22
APTT (seconds)	33.3(28.0-40.7)	32.8(25.0-37.1)	0.05
Reason for ICU Admission			<0.001
Neurologic	15	8	
Respiratory failure	5	11	
Heart failure	8	8	
Sepsis	0	0	
Trauma	0	0	

PDT; percutaneous dilatory tracheostomy group. ST; surgical tracheostomy group. APACHE II; acut physiology and chronic health evaluation II

procedure, active bleeding that required some treatment such as ligation of blood vessels and blood transfusion, reintubation during the procedure, subcutaneous emphysema, pneumothrax, pneumomediastinum, cardiac arrest, extratracheal insertion were compared as intraoperative complications. Bleeding that needed some treatment, such as blood transfusion and suture, accidental decannulation, air leak from the fistula were evaluated as immediate postoperative complications and granulation of the surgical site, surgical site infection and pneumonia were also evaluated as a late postoperative complication (Table 2). The mean durations of operation times were recorded.

Statistical Analysis

The analysis of the data was performed using the Statistical Package for the Social Sciences (SPSS, IBM Corp., Armonk, NY, US), version 20. The data were presented as simple measures of percentage, mean, range (minimum-maximum) values, and standard deviation (SD). The level of significance for the differences in the quantitative data was tested using the Student's t-test, and the level for the differences in the qualitative data, using the Pearson's chi-squared test. Values of $p < 0.05$ were considered statistically significant.

Table 2. Primary outcomes.

	PDT (n=28)	ST (n =27)	p value
All complications N(%)	5 (13.4)	11 (25.4)	0.013
Intraoperative complications N(%)	2 (3.8)	8 (13.1)	0.026
Hypoxemia	0	0	
Active bleeding	0	2	
Extratracheal insertion	0	0	
Desaturation SpO_2<85	1 (5.1)	3 (11.2)	
Subcutaneous emphysema	0	1	
Pneumomediastinum Pneumothorax Cardiac arrest	0 0 0	0 0 0	
Postoperative Complications N(%)	3 (9.6)	7 (34.6)	0.003
Immediate postoperative complications			
Bleeding	3	7	
Accidental decannulation	0	1	
Air leak from the fistula Late postoperative complications	0	2	
Pneumonia	0	0	
Granulation of surgical site	0	0	
Surgical site infection	0	0	

PDT; percutaneous dilatory tracheostomy group. ST; surgical tracheostomy group.

RESULTS

This retrospective study was performed in a 26-bed ICU of Elazıg Fethi Sekin City Hospital. During the study period (between December 2018-December 2019), 55 geriatric patients underwent tracheostomy at the bedside in ICU or operating room. Among these, there were 28 geriatric patients in the PDT group and 27 geriatric patients in the ST group. A PDT using the Griggs' technique was performed on 28 geriatric patients hospitalised at the ICU, and a tradational ST was performed on 27 geriatric patients in the operating room. As shown in Table 1, the PDT and ST groups demonstrated no significant differences in their baseline characteristics other than APTT (PDT vs. ST: 33.3 (28.0-40.7) vs. 32.8 (25.0-37.1) seconds p=0.05). Gender distribution showed that 56.4% (n=30) were female and 43.6% (n=25) were male. Apache II score was (PDT vs. ST: 32.9 (13-45) vs 34.6 (14-45), p>0.05) and the Glasgow Scale was (PDT vs. ST: 6 (4-8) vs. 7 (6-9), p>0.05). Mean body mass index of the subjects was 24.07 kg/m2 (Table 1). Diagnosis at ICU admission was significantly different between both groups (p< 0.001). While the number of geriatric patients with neurological disorders who received PDT was higher than those receiving ST, the ST procedure

Table 3. Secondary outcomes.

	PDT (n=28)	ST (n =27)	p value
The procedural time (minute)	4,41 (4-6)	15,67 (12-19)	0.001
Length of ICU stay (days)	76.6 (10-298)	69.5 (10-275)	0.052
Duration of mechanical ventilation posttracheostomy (days)	22,78 (21-98)	17,84 (19-89)	0.171

ICU: intensive care unit

was performed more frequently in geriatric patients with respiratory failure. Some primary clinical outcomes were detected, such as 7 cases postoperative minor bleeding in the ST group and 3 cases in the PDT group (p=0.003) (Table 2). As secondary outcomes, we also assessed the lenght of ICU stay, tracheostomy procedural time, duration of mechanical ventilation after tracheostomy procedures (Table 3).

DISCUSSION

We are faced with the need for tracheostomy in both the operating room and the ICU. For this reason, our knowledge in this subject should be adequate and up to date. The PDT procedure has recently been preferred in critically ill patients when prolonged control of the airway is required. Table 4 shows the potential advantages of tracheostomy over continued translaryngeal intubation. In a follow-up study of patients who were randomised either to remain translaryngeally intubated for a prolonged period or to receive early tracheostomy, Blot et al. reported that oral comfort scores, feeling of mouth uncleanliness, perception of change in body image, feelings of safety and overall comfort were lower in the prolonged-intubation group (7). A tracheostomy provides a reduction of pulmonary dead-spaces, easy clearance of pulmonary secretion, facilitation of weaning from a mechanical ventilator and declined risk of nosocomial infections. The bedside procedure reduces the risk of transferring an unstable and critically ill patient from the ICU to the operating room and its accompanying risks (5,6).

Table 4. Potential advantages of translaryngeal intubation versus tracheostomy

In addition, several techniques have been developed to minimise complications and ensure patient safety during percutaneous tracheostomy. After the ST, first, Ciaglia's technique was described for percutaneous tracheostomy, followed by the Griggs, Ciaglia Blue Rhino, Percu-Twist and Fantoni translaryngeal methods (8). Each of these techniques was compared with others to discuss their advantages and disadvantages (9). It is desirable to have a technique that ensures reduced PDT-related morbidity and mortality and facilitates the procedure. All these techniques have been designed to simplify the procedure to offer applicability in a bedside setting and avoid transfer into the operating room at the expense of a small incision with fewer wound complications. In a meta-analysis, Cabrini et al. compared PDT techniques performed between 1998 and 2010 and reported that Griggs technique was as safe and effective as other techniques. Covering 13 studies (five of which did not use fibre-optic bronchoscopy) and 1 030 patients, this review reported that the rate of minor complications was 31% (10). We opted for Griggs technique during the percutaneous tracheostomy procedure

Table 4. Potential advantages of translaryngeal intubation versus tracheostomy.

Translaryngeal Intubation	Tracheostomy
Ease and rapidity of initial placement of device	Safety of reinsertion after stomal maturation
Avoidance of acute surgical complications	Less skilled care environment
Bleeding	Earlier mobilization
Tracheal injury	Reduced laryngeal damage
Nerve injury	Laryngeal stenosis less likely
Barotrauma	Less voice damage
Low initial cost of device placement	Better oral hygiene
Lower resource use for placement	Better pulmonary secretion removal
Avoidance of late surgical complications	Less likely tube occlusion
Stoma infection	Better ability to communicate
Vascular erosion	Lip reading
Nerve injury	Speaking valve
Stomal stenosis	Less oral-structure injury (teeth, tongue, lips)
	Better patient comfort
	Less sedation needed
	Lower incidence of sinusitis
	Preservation of glottic competence
	Lower aspiration risk
	Less risk of ventilator-associated pneumonia
	Better swallowing function
	Earlier oral feeding
	More rapid weaning from mechanical ventilation
	Lower airway resistance to breathing
	Less dead space
	Lower work of breathing

in this study based on our extensive experience using this method. Higgins et al. reviewed 15 studies in their meta-analysis and reported lower PDT-related complication rate at the expense of a higher accidental decannulation rate (11). A meta-analysis of 17 studies by Delaney et al. indicated that PDT was associated with a lower rate of wound infection but was similar in terms of bleeding or other complications compared with ST (12). The most common complication that we observed with Griggs technique during percutaneous tracheostomy was minor bleeding (41%), which could be controlled with compression and required no additional intervention. In this study, all minor bleeding complications were prevented simply by compressing a sterile gas. In fact, bleeding complications may be reduced either by performing the procedure after INR and platelet count follow-up and fresh frozen plasma replacement if appropriate or by

administering local anaesthetics with adrenaline to the subcutaneous tissue around the puncture site. Since PDT is an elective procedure, there is usually sufficient time to complete the required preparations. In 1989, the guidelines of the American College of Chest Physicians on artificial airways consensus conference recommended considering performing a tracheostomy in patients receiving MV for more than 21 days (13), but the proper timing to perform the tracheostomy has remained a matter of debate over the last two decades. Some international surveys record the preferable timing of tracheostomy as between 7 and 15 days post-intubation (14,15). In geriatric patients, PDT is rapidly becoming the preferred method of long-term airway control. The placement of a tracheostomy has gained popularity as a means of facilitating the weaning of patients from the respirator, as it reduces pulmonary dead space, provides access for clearing pulmonary secretions under various pathologic conditions and improves the patient's comfort. However, percutaneous tracheostomy techniques might also be associated with serious, even life-threatening complications, and any technique that reduces the morbidity and mortality associated with PDT is desirable. Therefore, efforts have been made to reduce the risks associated with the use of different PDT techniques. With advanced technology and increasing interest in minimally invasive procedures, variations on the standard open-ST have been developed over the recent years. Turkmen et al. stated that PDT is as safe and effective as ST, although the early and late postoperative complication rates were not significant with the ST method (16). Another study reported that PDT using the Blue Rhino technique is a safe, quick and effective method, while the overall complications were comparable in the two groups (ST and PDT) (17). The PDT procedure is safer, quicker and simpler than ST in ICU patients. Both the Ciaglia Blue Rhino and Griggs forceps methods are feasible techniques with similar complication rates (18), and PDT is as safe and as effective as ST. Therefore, it seems that PDT has gained popularity to become a common method in geriatric patients. The Griggs technique is a widely performed procedure in ICUs. It is safe, cost-effective and can be done rapidly at the bedside. The difficulties and limitations of studying long-term complications include a high mortality rate among the patients. Although the early and late postoperative complication rates were not significant in the PDT group, we believe that further investigations with larger groups are necessary to establish long-term outcomes following PDT.

CONCLUSIONS

We preferred Griggs technique during bedside PDT in the ICU because of our greater experience using this technique. Studies have not been able to prove the superiority of one technique over the others. In the present study, our aim was to share our experiences rather than to make a technical comparison. The use of technologically advanced methods (e.g. fibre-optic bronchoscopy or ultrasonography) in PDT improves the success of the procedure. As in all invasive procedures, the experience of the practitioner and a procedure of shorter duration reduce complication rates. The Griggs' technique is safe and cost-effective and can be done rapidly at the bedside in ICU. The procedures performed in critically ill patients in the ICU carry substantial risks, requiring close monitoring of vital signs and mechanical ventilator parameters. In addition, checking for bleeding, assessment of airway integrity, X-ray evaluation and follow-up of late-phase complications should be performed.

CONFLICTS OF INTEREST

The authors of this article state that they have no conflict of interest.

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