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Original Article

Percutaneous dilatation tracheostomy at liver transplantation intensive care unit by surgeons

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Abstract

Aim: Tracheostomy has evolved to be a routine procedure for prolonged mechanical ventilation patients in the intensive care unit. We aimed to analyze retrospectively our patients underwent percutaneous dilatation tracheostomy due to prolonged mechanical ventilation following liver transplantation.

Material and Methods: Data of 34 patients who underwent percutaneous dilatation tracheostomy by general surgeons due to prolonged mechanical ventilation following liver transplantation were analyzed and evaluated retrospectively.

Results: Patients did not experience any complications except minor bleeding following liver transplantation. Besides this technique facilitated patient compliance as well as comfort, which were essential during an accurate weaning process.

Conclusion: Percutaneous dilatation tracheostomy is a safe method due to its low complication rate and easy applicability in hands of surgeons who are familiar with the neck anatomy.

Keywords: Tracheostomy; intensive care unit liver transplantation

INTRODUCTION

First tracheostomy was performed in B.C. 3600'sa and was introduced into modern medical practice in the 17th century (1). Trousseau conducted prophylactic tracheostomy in the diphtheria and polio epidemic in 1833re and he reported saving 47 of 215 patients until 1869. The 25% mortality rate was regarded as quite successful at that time (2).

The tracheostomy technique was introduced as a surgical procedure by Jackson (2, 3) in 1909. In 1969, Toye and Weinstein applied the percutaneous technique for the first time which was introduced by Seldinger for percutaneous nephrostomy, regarded to be more simple and safe and subsequently, Ciaglia et al., introduced the multiple dilatation technique in 1985. During the ongoing period of over 30 years, tracheostomy was regarded as a gold standard method by several authorities due to its advantages.

Tracheostomy was suggested for patients who may require long-term mechanical ventilatory support in intensive care units to minimize the complications of prolonged endotracheal intubation. Tracheostomy shortens the length of intensive care unit stay with its protective effect against morbidity and sometimes against mortality which may occur due to enabling airway suctioning, decreasing tracheobronchial dead-space, prevent food aspiration, and the endotracheal tube nonadherence of the patient (4). Indications and contraindications of tracheostomy were given in Table 1,2.

Table 1. Indication for tracheostomy in liver transplant patients
Enabling easier extubation
Tracheobronchial lavage
Preventing aspiration
Patients under prolonged ventilator support
Minimizing sedation requirement

Unless it is performed by an experienced surgeon, percutaneous dilatation tracheostomy is not suggested in the emergency unit (4). Percutaneous dilatation tracheostomy technique which is frequently performed in the intensive care units in recent years can be performed through modified methods by adding original properties to

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Table 2. Absolute and relative contraindication for tracheostomy	
Absolute contrindications	Relative contrindications
Infant	thyroid gland hyperplasia
Infection in the potential tracheotomy site	Pulsatile vascular structures in incision region
Lack of experience	Coagulopathy
Uncontrolled coagulopathy	Burn, surgical wound
Unstable cervical vertebra trauma	Previous history of tracheostomy
	Radiotherapy in neck region (in the last 4 weeks)
	Anatomical difficulties
	• Short neck
	• Morbid obesity
	• Limited neck extension
	• Local malignity
	• Tracheal deviation
	High peep (>70%) or FiO_2 (>10 cm H_2O) requirement
	High innominate artery

the basic tracheostomy technique as well as performing it by the individual modification of these methods (Table 3). In intensive care practice, percutaneous dilatation tracheostomy technique is usually performed by intensivists, without surgical practice and patients are referred to surgical units in presence of anatomical variations in the neck, coagulopathy which requires a surgical inspection to avoid dissection of the thyroid gland, pulsatile vascular structure, previous neck surgery, short neck, or obesity (5-7). In our study, we planned to evaluate efficacy and safety of the percutaneous dilatation tracheostomy process which was performed by an experienced team on surgical tracheostomy and thyroid surgery, in patients who underwent liver transplantation.

Table 3. Percutaneous tracheotomy techniques
Percutaneous tracheotomy techniques
Ciaglia Multiple Dilatation Method
Ciaglia Single Dilatation
Griggs Method
Fantoni Translaryngeal Tracheostomy Method
Frova's Percutaneous Tracheotsomy Method
Single-Step Balloon Dilatation Method (Ciaglia BlueDolphin)
Controlled Rotation Method (Percutwist)

MATERIAL and METHODS

In our institution, liver transplantation was being performed since 2002, with a total number of patients over 28,00, which refers to 250 to 270 liver transplantations annually. An initial percutaneous tracheostomy was performed in 2014. In 2019, 50 patients were diagnosed with prolonged mechanical ventilation postoperatively in the intensive care unit. Among these 50 patients, 9 (18%) underwent a percutaneous dilatation tracheostomy.

In our study, the data of 34 patients who underwent liver transplant from January 2014 to January 2019 with percutaneous dilatation tracheostomy in intensive care unit due to prolonged mechanical ventilation were evaluated retrospectively. All of the processes were performed in intensive care and under intravenous fentanyl and midazolam anesthesia. Enteral nutrition was ceased 4-6 hours before the process and the gastric content was aspirated by controlling the gastric residue during the process. Before the process, positive pressure ventilation was applied with 100% oxygen and during the process, peripheral O_2 saturation was monitored with pulse oximetry. A blood sample was taken for peripheral blood gas analysis before and after the procedure. The process was performed by two general surgery specialists, experienced in thyroid surgery.

A standard procedure that was first performed by Griggs was performed on all of the patients. Lidocaine subcutaneous injection was performed after surgical site preparation. The cuff of the endotracheal tube was lowered and it was drawn back in a controlled manner so that it would be placed right under the vocal cords. With a 14G needle, trachea lumen was entered by palpating the second and third tracheal cartilage and performing a vertical incision. After the guidewire was placed in a tracheal lumen, the needle was pulled from the wire and it was widened by the dilator. Based on the endotracheal tube, the appropriate size of the tracheostomy tube was placed in the lumen after the skin, subcutaneous, and trachea were widened by the modified Howard-Kelly forceps. The cuff of the

tracheostomy cannula was inflated. After confirming the location of the cannula by listening to respiratory sounds, the endotracheal tube was removed. The tracheostomy cannula was placed by binding the equipment in the set to the neck posterior. Additionally, to prevent hemorrhage, subcutaneous tissues were closed with purse string 2/0 Vicryl sutures. The cannula was placed in the skin with 2/0 silk suture. After the process, required adjustments in the mechanical ventilation were reviewed.

The demographic characteristics of the patients, their indications of admission in intensive care, the duration of their intubation, and the duration until the tracheostomy and coagulation parameters were included in the evaluation.

RESULTS

Twenty-five of the patients (73.5%) in the study were male and 9 of them (26.5%) of them were female with a mean age of 51.91 ± 12.9. Before the tracheostomy, patients received mechanical ventilation with endotracheal intubation for an average of 15.7 ± 7.49 days. After the process, mechanical ventilation with tracheostomy was applied to the patients for an average of 23.7 days. There weren't any complications in any of the patients, including minor bleeding. A tracheostomy was applied to all of the patients (n=34, 100%) due to prolonged mechanical ventilation. The endotracheal intubation indications of patients were given in detail in Table 4. The patients' mean INR was 1.36 ± 0.26, mean aPTT was 52.7 ± 37.8, their mean platelet count was 78200 / mm3 ± 73000 and their mean fibrinogen level was 262 mg/dL ± 124.9 before tracheostomy.

Table 4. Endotracheal intubation indications for our liver transplant patients

Etiology	Number	Percentage (%)
Intraoperative Intubation	15	44.1
Pneumonia	10	29.4
Sepsis	4	11.8
Encephalopathy / Attack	3	8.8
Aspiration pneumonia	1	2.9
Pulmonary edema	1	2.9
Total	34	100

DISCUSSION

Tracheostomy improves the outcomes of patients who are considered to require prolonged mechanical ventilation in intensive care units. In some of the studies, a morbidity rate of 13%-33% was reported during the transportation of patients who are in critical intensive care and 25% of the patients were negatively affected by the patient management (3, 7). Being able to be applied bedside contributes to increasing the frequency of using percutaneous dilatation tracheostomy in intensive care practices. percutaneous dilatation tracheostomy substituted the surgical tracheostomy in many centers for patients without contraindication due to its adverse effect profile, lower cost, and easy application.

An extensive number of complications were reported either after percutaneous or surgical tracheostomy, from minor bleeding to pneumothorax and even innominate artery traumatization. In a study conducted by Simon et al., the mortality rate was stated at 0.17% (8). Among the major causes of death, bleeding, tracheal wall perforations, airway complications were reported (4-6). In a study conducted by Friedman et al. (8), it was reported that bronchoscopy usage would significantly decrease the rate of complication. Bronchoscopy was not used on patients who were included in our study. A chest X-ray was taken in all of the patients after the procedure to confirm the lack of any cannula malposition.

Although various opinions were given for the timing of tracheostomy, a consensus was not achieved. Randomized controlled studies demonstrated that early tracheostomy (<10 days of intubation) is not superior to late tracheostomy (>10 days of intubation) in the subjects of mortality, duration, ventilator-related pneumonia and duration of intensive care stay (9,10), although many studies contradict with these (11,12). The average duration from intubation to tracheostomy was 15.7 ± 7.49 days in our study.

Pulmonary complications following liver transplantation and especially pulmonary infections are among the leading reasons for mortality. In a study conducted by Atar et al., the most frequent reason for morbidity and mortality was determined as pneumonia (13). The most frequent etiological factors in the patients that were included in the study were pulmonary complications, notably pneumonia.

Coagulation parameters of patients who underwent liver transplant may vary significantly compared to the normal population. Due to immunosuppressive treatment, mostly steroids, the incompetency of liver functions, and bone marrow which emerge after infection, hemorrhagical complications stand out as more serious morbidity and even mortality in this patient group (14).

In a study, which bleeding complications following percutaneous dilatation tracheostomy were evaluated (15), a low level of fibrinogen (373.6 ± 159.1 mg/dl) was defined as a high risk in cardiothoracic surgery intensive care. Although this level is regarded as normal for the nontransplant patient group, it is a rare fibrinogen level to inspect in patients with sepsis following a liver transplant. Before the procedure, necessary blood product transfusion was performed to our patients to achieve fibrinogen levels over 200 mg/dl and this value was confirmed before the process.

CONCLUSION

As a result, percutaneous dilatation tracheostomy is a safe method due to its low complication rate and easy applicability by surgeons who are familiar with the anatomical structure of the surgical site.

Competing interests: The authors declare that they have no competing interest.

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