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Is percutaneous tracheotomy safe in the context of anticoagulant therapy?

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Abstract. *Objectives:* Tracheotomy is one of the most frequent procedures performed in intensive care unit patients. The percutaneous procedure presents many advantages, such as cost-effectiveness and feasibility as a bedside technique which is time-saving in skilled hands.
Material and methods: All tracheotomies that were accomplished between January 2008 and December 2015 at Jessa Hospital, Hasselt, Belgium, were retrospectively reviewed. In our department, this percutaneous technique is always executed by two otolaryngologists using bronchoscopic guidance.
Results: We identified 231 patients who underwent tracheotomy in our hospital between January 2008 and December 2015. Sixty-five percent were male patients, the mean age at time of tracheotomy was 66 ±14 years, and the percutaneous technique was used in 87% of these cases. Tracheotomy was required at a mean endotracheal intubation period of 15 ±9 days. Results show that 80% of patients were already under anticoagulant therapy at the time of intervention, making them high-risk patients. Minor complications were observed in 7.5% of patients: minor bleeding during tracheotomy (1%), minor postoperative bleeding (4.5%), creation of false passage (1%), and tracheocutaneous fistula (1%). No major complications were noted.
Conclusions: Percutaneous tracheotomy is a safe technique in skilled hands and when performed on well-selected patients. The result shows that this technique is feasible and safe in patients with moderate to severe coagulation problems. The main contraindications in our center are obesity and difficult neck/chest anatomy.

Introduction

Tracheotomy is a common surgical procedure performed by otolaryngologists. The traditional method involves an open surgical technique, which is usually executed in the operating room or at bedside in the intensive care unit. The percutaneous tracheotomy was first introduced by Pasquale Ciaglia[1] in 1985. This technique improved with the guidewire dilating forceps method, introduced by Griggs in 1990[2], which led to a new era in airway maintenance in intensive care medicine.[3] Percutaneous tracheotomy is an established procedure for airway management in critically ill patients who require long-term respiratory support. This technique enables shorter duration of procedure, is safe if conducted under endoscopic surveillance, and can be performed in safe conditions at the patient's bedside.[4] Therefore, in the last few years, the number of percutaneous tracheotomies and the use of this technique by otolaryngologists and others have steadily increased.[5] However, the need for anticoagulant therapy in these patients is high. The aim of this study was to investigate the risks and complications of bedside percutaneous tracheotomy in patients who received anticoagulant therapy.

Methods

Design and setting

A retrospective study was conducted on all patients who underwent a tracheotomy at the Jessa Hospital. In total, 231 patients were included between January 2008 and December 2015.

A database (Microsoft Excel) was maintained on all patients. The database included demographic

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Table 1

Different combinations of anticoagulant therapy in patients treated with percutaneous technique. LMWH = low molecular weight heparins

Different combinations of anticoagulant therapy in percutaneous tracheotomy patients (n=200)		
Anticoagulant therapy	**Patients (no.)**	**Percentage**
Acetylsalicylic acid	6	3%
Acetylsalicylic acid + LMWH Acetylsalicylic acid + Vitamin K antagonist Ticagrelor + LMWH LMWH	31 1 2 109	16% 0.5% 1% 55%
Thienopyridine + LMWH Vitamin K antagonists + LMWH	8 1	4% 0.5%
Factor Xa inhibitor	1	0.5%

information, surgical technique, time of tracheotomy performance, anticoagulant therapy, complications, and treatment of the complications.

Statistical analysis

Descriptive statistics were used for all above-mentioned parameters. Correlations of anti-coagulant medication and adverse events were calculated.

Surgical technique

At our center both surgical and percutaneous tracheotomies are performed. In case of a percutaneous tracheotomy, the PercuTwist system (Rüsch/Teleflex, Atholone, Ireland) is used. This percutaneous bedside technique is executed by two otolaryngologists, one using endotracheal bronchoscopic guidance through every step of the procedure.

It is performed bedside at the intensive care unit under general anesthesia, with the patient's head in hyperextension. The skin is subcutaneously infiltrated with a local vasoconstrictive agent, caudal to the cricoid cartilage. The puncture needle with plastic cannula (17G × 70mm / 14G × 52mm) is placed generally between the second and third tracheal ring. The endotracheal tube is usually retracted under bronchoscopic control, until the puncture needle is freely visible. Once the intratracheal position of the plastic cannula has been secured, the needle can be removed and a guide wire can now be advanced caudally into the trachea. The plastic cannula can be removed at that stage, while the guidewire stays firmly in position. Next, a skin incision of approximately 6-8mm is made on each side of the guidewire. Through this incision, the self-tapping percutwist dilator can be rotated clockwise over the guidewire into the soft tissues of the neck, and eventually into the tracheal wall. When the greatest possible degree of dilation has been achieved, the self-tapping screw dilator can be removed and the cannula can be placed over the guidewire into the trachea. Finally, the correct position of the cannula in the trachea is checked endoscopically.

Results

Between January 2008 and December 2015, 231 patients underwent a tracheotomy at Jessa Hospital. The mean age of the patients at the time of intervention was 66 (±14) years and 64% of the patients were male.

The mean time between intubation and tracheotomy was 15 (±9) days.

Two hundred of 231 patients (87%) received a percutaneous tracheotomy. Within this group, 160 patients (80%) received anticoagulant therapy at the time of intervention. Forty-three patients were on more than one anticoagulant at the time of intervention. Table 1 explores in more detail the different combinations of anticoagulant therapies that were used in each of these patients.

The majority of patients received low molecular weight heparins.

Thirty-one of 231 patients (13%) received a surgical tracheotomy. The indication for performing a surgical technique was an acute setting in five cases. In 21 cases it was needed as a protective setting, in which the patient had laryngeal pathology

Table 2

Different combinations of anticoagulant therapy in patients treated with the surgical technique. LMWH = low molecular weight heparins

Different combinations of anticoagulant therapy in surgical tracheotomy patients (n=31)		
Anticoagulant therapy	**Patients (no.)**	**Percentage**
Acetylsalicylic acid + LMWH LMWH	2 11	6.5% 35%
Thienopyridine + LMWH	1	3%

and stridor and required a direct laryngoscopy, and a compromised postoperative airway was to be expected. In five cases, a surgical tracheotomy was performed due to difficult neck/chest anatomy such as a goiter, extended kyphosis with retrosternal position of the cricoid cartilage, infectious edema of the neck, or obesity.

Within this group of 31 patients, 45% received anticoagulant therapy at the time of intervention. Three patients were on more than one anticoagulant at the time of intervention. Table 2 explores in more detail the different combinations of anticoagulant therapies that were used in each of these patients. Comparable with the group of percutaneous tracheotomy patients, the majority of surgical tracheotomy patients received low molecular weight heparins.

Table 3 summarizes the complications of all the patients in both the percutaneous and surgical groups. Fifteen of the 200 patients who received a percutaneous tracheotomy had a complication (7.5%). Two patients had a prolonged tracheocutaneous fistula after cannula removal, lasting for 15 days in one patient, and for 8 weeks in the other patient. Both fistulas healed after revitalization of the subcutaneous tissue with chemocauterization using silver nitrate, without the need of surgical intervention. A false placement of the cannula occurred in two patients; immediate reposition was performed, which prolonged the procedure, but did not result in further complications for the patients, such as bleeding or injury to the surrounding tissues.

Cases of minor perioperative (n=2) and postoperative (n=9) bleeding were treated by placing an absorbable hemostatic agent between the cannula and the subcutaneous tissue (adjusting the bandage) or performing a purse string suture with Ethicon® Mersilk suture (Johnson & Johnson, Cincinnati, Ohio, USA). No major surgical re-intervention was necessary.

In the group of patients who received a surgical tracheotomy, three of 31 had a complication (9.7%) (Table 3). The single prolonged tracheocutaneous fistula after cannula removal was treated similarly to the cases occurring in percutaneous tracheotomy patients, with revitalization of the subcutaneous tissue using silver nitrate. One case of minor postoperative bleeding occurred, which was treated by a purse string suture. One patient, who received low molecular weight heparins at the time of intervention, experienced major postoperative bleeding, which required surgical revision with bipolar coagulation of a small arterial bleed in the soft tissue of the neck.

No major complications (such as pneumothorax, subcutaneous emphysema, tracheal stenosis, or tracheoesophageal fistula) occurred in either patient group.

Table 3

Complications of all the tracheotomy patients

Complications in all tracheotomy patients (n=231)				
	Percutaneous technique n=200		**Surgical technique n=31**	
Complication	**Patients (no.)**	**Percentage**	**Patients (no.)**	**Percentage**
Prolonged tracheocutaneous fistula	2	1%	1	3.2%
False passage with immediate reposition	2	1%	0	0%
Minor perioperative bleeding	2	1%	0	0%
Minor postoperative bleeding	9	4,5%	1	3.2%
Major postoperative bleeding	0	0%	1	3.2%
Total	15	7.5%	3	9.7%

Table 4

Complications in patients who received a percutaneous technique. A total of 15 patients. F = female; M = male; LMWH = low molecular weight heparins; DNR = Do Not Resuscitate. PT = percutaneous tracheotomy

Complications in patients with percutaneous tracheotomy (n=15)						
Patient	**Age, years**	**Sex**	**Anticoagulant therapy**	**Non-bleeding complications**	**Minor perioperative bleeding: treatment**	**Minor postoperative bleeding: time postoperative - treatment**
1	77	F	none		Passage through thyroid isthmus: compression by cannula	
2	44	M	none			4 days – purse string suture
3	62	M	Acetylsalicylic acid	Prolonged tracheocutaneous fistula		
4	60	M	none	Prolonged tracheocutaneous fistula		
5	69	M	LMWH			2 days – purse string suture
6	78	M	LMWH			4 days – purse string suture
7	46	F	LMWH			2 days – purse string suture
8	79	F	none		Purse string suture	
9	77	M	Acetylsalicylic acid, LMWH			2 days – adjusting bandage
10	69	M	LMWH	False passage (immediate reposition)		
11	66	M	Ticagrelor, LMWH			6 days – no treatment due to DNR code not related to PT
12	72	M	none			2 days – purse string suture
13	72	M	Acetylsalicylic acid, LMWH			7 days – purse string suture
14	84	F	LMWH	False passage (immediate reposition)		
15	47	M	Thienopyridines, LMWH			1 day – purse string suture

Table 4 shows in detail the percutaneous tracheotomy patients who had a complication. In total, 15 of 200 patients had a complication, of which five patients did not receive any anticoagulant therapy at the time of intervention. The absence of anticoagulant therapy did not prevent perioperative or postoperative bleeding in four patients. Although two patients had minor perioperative bleeding and two had minor postoperative bleeding, the total hemorrhage rate in the percutaneous tracheotomy group under anticoagulant therapy was 3.5%.

Discussion

At our center, even though both surgical and percutaneous tracheotomies can be performed, the percutaneous tracheotomy technique is by far the preferred technique due to the advantages discussed. Of the different percutaneous techniques available, the PercuTwist system (Rüsch®/ Teleflex, Athlone, Ireland)[3] is the technique of choice in Jessa hospital, because the conical dilator catches a grip between two tracheal rings, which combines the antegrade screwing of the dilator with a simultaneous elevation of the anterior tracheal wall.[3,6] Moreover, the design of the dilator is that of a self-tapping screw dilator, this results in fewer dilating maneuvers and the force is a momentum, rather than a force directed perpendicularly into the patients. In our opinion, this reduces the risk of incorrect positioning of the cannula or posterior wall damage. The percutaneous tracheotomy is always executed by two otolaryngologists, using endotracheal bronchoscopic guidance.[4] One otolaryngologist performs the surgery, while the other guides the surgeon with the help of the endoscope. At the end of the procedure, the position of the cannula is twice checked fiberendoscopically, thus avoiding malposition of the cannula.

In our series, not a single incident of posterior tracheal wall damage was recorded using the PercuTwist system. Remacle et al.[7] compared the

Ciaglia technique with the PercuTwist technique, under endoscopic control, in a total group of 190 patients; no major complications occurred in either group. One patient treated with the Ciaglia technique experienced damage to the posterior wall of the trachea, compared with four patients treated with the PercuTwist technique.[7]

As described before, a false placement of the cannula occurred in two cases from our group of patients. This was immediately detected due to the endoscopic control and treated with immediate reposition. No bleeding or damage to the surrounding tissues occurred. There were no further complications for these patients. In our opinion these events were due to the inexperience of the otolaryngologist-in-training, who placed the cannula during this percutaneous tracheotomy with endoscopic control performed by a senior otolaryngologist.

In literature, the bronchoscopic part of the percutaneous tracheotomy is performed by pneumologists, intensivists, and otolaryngologists.[8,9] In our opinion, having two otolaryngologists perform the procedure has benefits because of their anatomical and surgical knowledge of the head and neck, in case a conversion to an open surgical technique is required[9]; in addition, otolaryngologists have extensive experience performing fiberendoscopy.

Percutaneous tracheotomy has many advantages and is an established procedure for airway management in critically ill patients who require long-term respiratory support.[4]

First of all, the time required for performing bedside percutaneous tracheotomy is considerably shorter than that for an open tracheotomy. In experienced hands, the mean time of the procedure, from placement of the needle in the trachea until placement of the cannula is about 2 minutes. The procedure is performed at the patient's bedside, so there is none of the scheduling difficulty associated with the operating room and the anesthesiology team.

Furthermore, risky transportation of critical ill patients back and forth from the operating room can be prevented. Multiple caregivers are already familiar with the patient and can monitor and continue their care for the patient if the procedure is performed in the unit.[8,10]

Multiple studies have already demonstrated the significant cost savings of performing tracheotomies at the bedside rather than the operating room. Transportation of the patient to the operating room is not only risky, but also increases the cost. Multiple persons are necessary for simple transport of the patient. The operating room itself is commonly prepared for the case and on hold well before the patient arrives, and experiences a significant amount of down time when it is not being used. This is perhaps the greatest cost burden for the hospital.[8,10-12]

Percutaneous tracheotomy is a safe technique,[13] even when performed under anticoagulant therapy, as illustrated in this large group of 200 patients. This adds to all previous known advantages of the technique. In this study, 80% of the patients who received a percutaneous tracheotomy were under anticoagulant therapy (Table 1). In 7.5% of these patients only minor complications occurred, and 3.5% had a minor bleed. There were no major bleeding complications. In addition, no major complications such as pneumothorax, tracheal laceration, or subcutaneous emphysema occurred in either the percutaneous group (200 patients) or the surgical group (31 patients). In our series, the only major bleeding complication occurred in a patient who was treated with the surgical technique.

Our study therefore emphasizes that it is a safe treatment in high-risk patients under different anticoagulant protocols. These results are supported by the findings of Deppe et al.[14] This study concerned a group of 213 patients undergoing a percutaneous tracheotomy, who had impaired hemostasis. Patients were stratified into high-risk and low-risk groups in regard to bleeding complications. The study showed that both groups of patients had mild bleeding complications without the need for surgical intervention or transfusion. There were no cases of severe bleeding or other procedure-related complications. Pandian et al. performed a retrospective analysis of 483 patients who had undergone a percutaneous tracheotomy. No statistically significant difference was seen in complication rates between coagulopathic patients and control patients.[15]

Due to the advantages and the safety of the procedure, the percutaneous technique is preferred over the surgical technique at our hospital. The only indications to perform a surgical tracheotomy are an acute airway distress in a non-intubated patient, a protective setting in case of laryngeal pathology, or anatomic limitations (such as patients with obesity of the neck or a difficult neck/chest anatomy).

The limitation of our study is that the follow-up of the patients was limited to the time they stayed at the hospital and our rehabilitation center. After the patients were discharged from the hospital, no standardized follow-up was foreseen, and was only needed case of medical problems (such as a prolonged fistula).

Conclusion

This study highlights that percutaneous tracheotomy is a safe technique in skilled hands, when performed by two otolaryngologists in the intensive care unit at the patient's bedside, using bronchoscopic guidance, in patients under anticoagulant therapy. Cases of mild bleeding occurred, without the need for surgical intervention or transfusion. No severe bleeding or other procedure-related complications occurred. Therefore, anticoagulant therapy is no contraindication in our department and discontinuation of anticoagulation treatment or normalization of hemostasis prior to the procedure is not necessary. The only indications to perform a surgical tracheotomy are obesity, an acute airway setting, and a difficult laryngeal/neck/chest anatomy.

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