DOI: 10.4149/BLL_2012_092

Bratisl Lek Listy 2012; 113 (7)
409 – 411

CLINICAL STUDY

Percutaneous dilation tracheostomy versus surgical tracheostomy in critically ill patients

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Abstract: *Objectives:* This study was done to compare surgical tracheostomy and percutaneous dilation tracheostomy in respect to their early postoperative complications in critically ill patients.
Methods: At a university hospital general intensive care unit, we studied 109 critically ill patients who underwent either elective surgical tracheostomy (n=63) or percutaneous dilation tracheostomy (n=46). The number and type of complications during operation and early postoperative period were recorded and compared.
Results: When comparing the perioperative period of surgical versus percutaneous dilation tracheostomy, we recorded 2 vs 0 complications (NS difference).
Average durations of postoperative observation (time until decannulation, release or death) were 16.04 and 16.09 days in group 1 and group 2, respectively; the difference in time was insignificant. When comparing the surgical versus percutanous groups we have found no significant difference in postoperative complications in respect of bleeding and leakage through the space between the cannula and the stoma (bleeding 2 (3.2 %) vs 3 (6.5 %), NS; leakage 6 (9.5 %) vs 4 (8.7 %), NS). A significant difference was found in infectious complications and disintegration of tracheostomy (inflammation 17 (27 %) vs 0 (0 %), p<0.001, disintegration 14 (22.2 %) vs 0 (0), p<0.001, total number of complications 39 (61.9 %) vs 7 (15.2 %), p<0.001). No other complications were recorded.
Conclusion: Percutaneous dilation tracheostomy is an equally safe method compared with surgical tracheostomy. While posing the same perioperative risk, it requires neither the transport to the operating theater, nor the presence of the whole surgical team. In the early postoperative period, it significantly reduces the complications, mainly infections in a critically ill patient. The latter benefits make it a method of choice in elective tracheostomies at ICU *(Tab. 2, Ref. 11)*. Full Text in PDF www.elis.sk.
Key words: percutaneous dilation tracheostomy, complications, infection.

Tracheostomy, a surgical procedure described over two thousand years ago, is one of the most commonly performed interventions in intensive care services (1). Typical indications for tracheostomy in intensive care settings include the need for prolonged mechanical ventilation, and loss of consciousness.

The traditional surgical method of performing tracheostomy in critically ill patients often requires operating room schedule, complicated transport to the operating theatre, and the whole surgical team. Percutaneous dilation tracheostomy (PDT) is an attractive alternative to surgical tracheostomy. The main advantage of PDT lies in the possibility of performing it at the patient's bedside in an intensive care unit (ICU), thereby saving the operating and personnel costs, and avoiding the transport risk factors.

With the same perioperative risks, PDT offers lower rates of early postoperative complications related to less dissection and damage to the tissue, better tightness between the cannulla and stoma, as well as less bleeding and wound infection complications. For PDT techniques, we today have the opportunity to choose from commercial sets such as Ciaglia, Griggs and Fantoni (2, 3).

The aim of this observation study was to determine the difference between surgical and percutaneous dilation techniques of tracheostomy in respect of perioperative and early postoperative complications.

Methods

One hundred and nine critically ill patients hospitalized at a general intensive care unit of a university hospital between the years 2007–2009 have been enrolled in this observational study. The tracheostomy was indicated either because of expected long-term mechanical ventilation or prolonged loss of consciousness. Patients with coagulopathy (defined as International Normalized Ratio >1.4, activated thromboplastin time >45 s, platelet count < 5000/ml) and history of previous tracheostomy were excluded from the study. The decision to perform percutaneous or surgical tracheostomy was made solely on the basis of instant availability of a physician skilled in performing PDT (1), instant availability of a commercial set for PDT (2), and possibility of an early operating schedule (3).

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The surgical tracheostomy was performed with a standard surgical technique in the operating theater. Percutaneous dilation tracheostomy was performed at the bedside, by one of the two intesivists skilled in PDT (more than 10 PDTs), using the Griggs technique, a commercial set for PDT, and assistance of another anesthesiology intensivist.

All patients were under general anesthesia (combination of Propofol and Sufentanyl), relaxed (Rokuroniumbromid), mechanically ventilated with FiO_2 1.0 with the use of standard monitoring (ECG, pulse oximetry, invasive pressure monitoring, and temperature). All procedures were performed without the use of bronchoscope.

Perioperative complications were noted in the description of procedure or in the operation protocol. Postoperative complications were evaluated according to the daily doctor's and nurse's records from the first postoperative day. Local treatment of tracheostomy was identical for both techniques according to our facility standards. Complications were divided in four categories: (1) leakage through the space between the cannula and stoma (secretion of sputum), (2) inflammation (redness, purulent secretion), (3) disintegration (purulent inflammation with the destruction of the stoma), (4) bleeding from the site of the stoma, and (5) blockage (wrong position). Other complications (pneumothorax, subcutaneous emphysema, tracheoesophageal fistula, tracheomalation) and the need for surgical revision were recorded separately.

The complications were evaluated from the first postoperative day to decannulation, death of the patient or his transfer to another clinic or facility. The time of observation (days) was also recorded.

The Chi-square, Fisher-exact test and the Mann-Whitney test were used for the comparison of indications, complications, and time factors in both groups. For comparing the dependence of complications in respect of age, gender, indication, method of tracheostomy, and time of observation, we used the test of logical regression.

Results

Together we have performed 109 tracheostomies, of which 63 were surgical (Group 1) and 46 percutaneous (Group 2). Based on the characteristics of the two groups there was no difference in indication, number of days of orotracheal intubation prior to the procedure, and time of observation of patients. The age of patients in the surgical group was significantly higher (Tab. 1).

Two perioperative complications were recorded, both of them in the surgical group. In the first case, the draping of the operation field combusted from electrocauterization and resulted in a first-degree burn on the submandibular region of the patient's face. The burn was conservatively managed and healed *ad integrum*. In the second case, there was a brief episode of hypoxia resulting in a short and successful cardiopulmonary resuscitation during the insertion of the cannula. No perioperative complication was recorded in the percutaneous group. There is no significant difference in complications between the two groups.

When comparing group 1 versus group 2, the duration of postoperative observation (time until decannulation, release or death) was 16.04 vs 16.09 days in average, thus the time difference was insignificant. We have found no significant difference in postoperative complications in bleeding and leakage through the space between the cannula and the stoma (bleeding 2 (3.2 %) vs 3 (6.5 %), NS; leakage 6 (9.5 %) vs 4 (8.7 %), NS.). A significant difference was found in infectious complications and disintegration of tracheostomy (inflammation 17 (27%) vs 0 (0%), $p<0.001$; disintegration 14 (22.2 %) vs 0 (0), $p<0.001$; total number of complications 39 (61.9 %) vs 7 (15.2 %), $p<0.001$). No other complications were recorded (Tab. 2).

Tab. 1. Characteristics of Group1 and Group 2.

	Group 1 (n=63)	Group 2 (n=46)	significance
Indication (PMV/LoC)	37/26 (58.7%/41.3%)	30/16 (65.2%/34.8%)	NS
Age (years)	54.6±19.1 SD (median 57.0)	43.89±18.4 SD (median 43.0)	p=0.004
OTI (days)	8.79±18.4 SD (median 8.0)	8.48±3.1 SD (median 8.0)	NS
Duration of observation (days)	16.4±14.7 SD (median 12.0)	16.09±15.0 SD (median 11.0)	NS

Group 1 – surgical tracheostomy, Group 2 – percutaneous dilation tracheostomy PMV – prolonged mechanical ventilation, LoC – loss of consciousness, OTI – orotracheal intubation, Significance – difference in groups – indication: Chi-square test, age, OTI, time of observation: Mann-Whitney U test, Wilcox W test

Tab. 2. Postoperative complications.

Type of Complication	Group 1		Group 2		Significance
1. Leakage between cannula and the stoma	6	9.5%	4	8.7%	NS
2. Inflammation	17	27.0%	0	.0%	p<0.001
3. Disintegration	14	22.2%	0	.0%	p<0.001
4. Bleeding	2	3.2%	3	6.5%	NS
5. Other complications	0	0%	0	0%	NS
Total	39	61.9%	7	15.2%	p<0.001

Group 1 – surgical tracheostomy, Group 2 – percutaneous dilation tracheostomy complications: 1 –leakage between the cannula and the stoma (secretion of sputum), 2 – inflammation (redness, purulent secretion), 3 – disintegration (purulent inflammation with destruction of stoma), 4 – bleeding (from the site of stoma), 5 – other complications

We have compared the dependence of complications in respect of age, gender, indication, method of tracheostomy and duration of prior intubation using the test of logical regression. A significant dependence between the method of tracheostomy and number of complications was recorded ($p<0.001$). Other parameters had no impact on the number of complications.

Surgical revisions were indicated four times in the surgical group because of tracheostomy disintegration. There was no surgical revision in the percutaneous group. The difference between the two groups was not significant.

Discussion

Percutaneous dilation tracheostomy is nowadays a standard and widely accepted method in intensive care, which, considering the perioperative complications, offers the same safety with significantly fewer postoperative complications.

Our observation was focused on comparing percutaneous and dilation tracheostomy complications in the perioperative and early postoperative period i.e. when any additional insult in a critically ill

patient can be potentially fatal. Our study group included patients with tracheostomies performed during a three-year span in a general intensive care unit at the university hospital. The indications for tracheostomies were divided in two groups based namely on prolonged loss of consciousness or anticipation of mechanical ventilation to be lasting longer than ten days. The decision about the method of tracheostomy was based on faster availability at that time and not on the health status or prognosis of the patient. We excluded patients with a history of previous tracheostomy or coagulation disorder.

According to the current state of knowledge, the timing of tracheostomy is of critical importance to the clinical course and outcome of the critically ill patient. Former recommendations to postpone tracheostomy to the 14th–21st day are now obsolete (4). It appears that early tracheostomy reduces the incidence of ventilator pneumonia and ventilator dependency as well as shortens the ICU stay (5, 6). Taking into account the heterogeneity of ICU patients, it is hard to decide on the exact time and criteria for tracheostomy. It seems beneficial to perform the tracheostomy between the 2nd and 7th days or when we are able to anticipate intubation to last longer than 14 days (7–9). The duration of intubation in our patients was 8 days in average which is closer to the upper limit, and suggests a more conservative approach. Both groups did not differ significantly.

The follow up in both groups was 16 days in average and it ended with decanullation, exitus or transfer to another clinic. The recorded complications represent perioperative and early postoperative complications in a critically ill patient with tracheostomy.

We recorded a significantly higher age in the surgical group, which according to the test of logical regression did not influence the incidence of complications.

We recorded two perioperative complications, both of them in the surgical group, which is not a significant difference when compared to the percutaneous group. Of these complications, one was minor but the second was potentially lethal, when a wrongly placed tracheostomy tube led to a hypoxic episode and eventually successful cardiopulmonary resuscitation.

We have found a significant difference in postoperative complications that was to the disadvantage of surgical tracheostomies. By using the test of logical regression we have proved that the complications rate was independent of age, duration of orotracheal intubation or that of follow up. The incidence was only significantly dependent of the method used to perform the tracheostomy. Table 2 suggests that the basic problem of surgical tracheostomies is their leakage. The loss of tightness is a natural consequence of the surgical technique since the surgeon needs enough space to insert the cannula into the trachea under visual control. Colonized mucus from the hypopharynx can then pass freely along the loose cannula. In most cases, inflammation of the stoma occurs with the disintegration of the whole orifice. Using the percutaneous method, the cannula stays tight in the bluntly dilated orifice, which results in a zero incidence of inflammation and disintegration. The severity of this problem is manifested in four cases of surgical revision indicated after surgical tracheostomy.

The incidence of bleeding is similar and rare in both techniques.

We have not observed other known complications as pneumothorax, subcutaneous emphysema, and laceration of the posterior wall of the trachea or tracheoesophageal fistula.

Similar results were published in metaanalyses comparing surgical and percutaneous tracheostomies. No relationship was observed between perioperative complications and mortality (10). Age, gender and duration of intubation had no influence on the incidence of complications (41). PDT is described as a faster and easier technique with fewer postoperative complications. According to Delaney et al. (metaanalysis PDT vs. surgical, 1,212 patients), PDT reduces the incidence of wound infection and can reduce the risk of relevant postoperative bleeding. It is therefore necessary to consider this method as that of choice in a critically ill patient (11).

Percutaneous dilation tracheostomy is an equally safe method compared with surgical tracheostomy. With the same perioperative risk, it does not require transport to the operating theater and the presence of the whole surgical team. In the early postoperative period it significantly reduces the complications, mainly infections in a critically ill patient. The latter benefits make it the method of choice in elective tracheostomies at ICU.

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Received May 5, 2010.
Accepted April 15, 2012.