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Percutaneous dilatational cricothyroidotomy: outcome with 44 consecutive patients

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Abstract Objective: To assess the value of the percutaneous dilatational technique in elective cricothyroidotomy.

Design: Forty-four consecutive patients requiring prolonged mechanical ventilation.

Setting: The general 14-bed intensive care unit of a university hospital.

Interventions: Forty-four percutaneous dilatational cricothyroidotomies using a multiple-dilator wire-guided procedure.

Measurements and results: The average duration for the procedure was 11 min in 37 patients. No significant complications occurred intraoperatively except for one para-tracheal cannula insertion. Postoperative complications were one case

of stoma infection, three cases of transient phonatory changes, two cases of a small peristomal granuloma, and one case of persistent stoma. Of 21 decannulated patients, 16 survived to discharge. Long-term follow-up was possible in 14 surviving patients. All were asymptomatic several months after decannulation.

Conclusions: Percutaneous dilatational cricothyroidotomy can be a quick, safe technique, as good as the percutaneous subcricoid approach in ventilated, critically ill patients.

Key words Cricothyroidotomy · Critically ill patients · Mechanical ventilation · Percutaneous · Tracheotomy

Introduction

Since 1976, when Brantigan and Grow [1] presented encouraging results with elective surgical cricothyroidotomy, this procedure has been frequently used in intensive care units. The main advantages of the cricothyroidal approach are its simplicity, speed, and low rate of complications. Other published series [2–5] supported the first results. However, some authors [6, 7], mostly otolaryngologists, disagreed questioning the elective use of cricothyroidotomy and recommending it only as an emergency procedure because of the risk of subglottic stenosis and vocal cord paralysis.

The polemic about cricothyroidotomy seems to have been put to one side after the diffusion of the percutane-

ous tracheotomy technique as an alternative to surgical tracheotomy in patients requiring prolonged mechanical ventilation. Percutaneous tracheotomy is carried out in the subcricoid space, between the first and second rings or between the second and third rings. However, to our knowledge, no study has been published using the percutaneous dilatational technique at a cricothyroidal level. In this paper, we present the results obtained with this procedure in 44 consecutive patients.

Subjects and methods

From February 1993 to February 1995, 44 percutaneous elective cricothyroidotomies were performed in our general intensive care

unit in 44 patients requiring mechanical ventilation for respiratory failure. Initially, all patients were intubated orotracheally and were given intravenous analgesia (fentanyl), sedation (midazolam or propofol), and a neuromuscular blocker (pancuronium) during the procedure. The inspired oxygen fraction was then increased to 100%. Blood pressure, ECG, and oximetry were continuously monitored. Patients were positioned with the neck hyperextended. The cricothyroid space was identified by touch. A horizontal 1-cm skin incision was performed. A guide wire was introduced through the incision into the laryngotracheal lumen. We used a commercially available kit (Ciaglia percutaneous tracheotomy introducer set, Cook Critical Care, Bloomington) and Seldinger's technique. Successively wider dilators were introduced around the guide wire until an adequate diameter was obtained for inserting the cannula through the cricothyroid space. A standard tracheotomy double cannula (Shiley tracheostomy tube, Mallinckrodt Medical, Irvine, Calif.) with an internal diameter of 7 mm was used. A chest X-ray was taken after each cricothyroidotomy to detect possible abnormalities resulting from the operation. Procedure-related complications were recorded at the time of the cricothyroidotomy. Hospital follow-up was carried out by daily observation until discharge. Long-term follow-up was made by clinical examination or telephone interview from 2 months to 2 years after decannulation.

Results

Percutaneous cricothyroidotomy was performed in 33 men and 11 women. The mean age of the patients was 56 years (range 17–82). The patients' underlying disorders are given in Table 1. All patients present respiratory failure and needed prolonged mechanical ventilation.

The mean duration of the orotracheal intubation was 15 days (range 2–44) before cricothyroidotomy. The mean procedural time was 11 min (range 5–25), excluding the first six procedures and one that was unfinished. During all the procedures, hemodynamic and respiratory tolerance were good, and no significant hypotension was observed. Oxygen saturation was always higher than

Table 1 Underlying disorders

Disorder	Patients (<i>n</i>)
Pneumonia	23
Chronic obstructive pulmonary disease	9
Status after cardiopulmonary resuscitation	8
Acute renal failure	7
Adult respiratory distress syndrome	6
Septic syndrome	6
Chest trauma	5
Spinal cord trauma	3
Pancreatitis	3
Head injury	3
Acquired immunodeficiency syndrome	3
Heart failure	2
Coagulation disorder	1
Chronic renal failure	1
Brain hemorrhage	1

Table 2 Complications of the procedure

	Patients (<i>n</i>)
Intraoperative	
Misplacement	3
Paratracheal cannula insertion	1
Premature extubation	1
Loss of guide wire during dilation	2
Transient lung atelectasis	1
Postoperative	
Stomal infection	1
Transient vocal changes	3
Peristomal granuloma	2
Persistent stoma	1

90%. Intraoperative and postoperative complications are summarized in Table 2.

Intraoperative complications

A misplacement occurred in three patients. In two cases, this was noticed when the first dilation was attempted and was easily solved by restarting the procedure. In the third case, the incident went unnoticed and the cannula was inserted paratracheally. The patient was orotracheally reintubated. She remained in this condition and no further percutaneous cricothyroidotomy was attempted. She died 10 days later from the progression of her disease. Loss of the guide wire during dilation (in two cases) did not cause clinical complications since the wire was easily reintroduced. A single case of premature extubation was quickly resolved by reintubating the patient.

Hospital follow-up

Of the 43 patients cannulated correctly, 18 died with the cannula in place due to progression of their underlying disease. The average duration of cannulation was 26 days (range 3–132) in these patients. Twenty-one patients were decannulated (average cannulation time 16 days, range 6–63). Of the 21 decannulated patients, five died several days after discharged from the intensive care unit, and 16 were discharge from the hospital. Three other patients were transferred to other hospitals without decannulating, although two required no further ventilatory support. The remaining patient was still cannulated at the time of writing.

The most important postoperative complication was stoma infection in one case. The peristomal cellulitis required removal of the tracheal cannula and orotracheal intubation. Postoperatively, this patient also had minor, self-limited bleeding related to the cellulitis. He died 5 days later because of the evolution of his disease.

In 20/21 decannulated patients, the stoma closed quickly after decannulation in a mean of 4 days (range 1–9). No cosmetic deformity was observed. The remaining patient was cannulated for 63 days and had a small persistent stoma which needed surgical closure.

Three cases of transient phonatory changes were noted. An endoscopic examination was performed after cricothyroidotomy close in 13 patient and there were no pathologic findings, apart from a small peristomal granuloma in two cases.

Long-term follow-up

Long-term follow-up was possible in 14 surviving patients. All were asymptomatic several months after decannulation. No endoscopic examinations were carried out after the patients had been discharged from hospital.

Discussion

Studies comparing percutaneous and surgical tracheotomy favor the former because of its lower rate of complications and the speed of the procedure [8, 9] and many reports corroborate its suitability [10–15]. Several kits for the percutaneous introduction of the tracheal cannula have been developed [16–19]. Ciaglia's (Seldinger's method with progressively wider dilators) seems quite safe [11, 12, 16]. The kits from Toye and Schachner's allow a quicker procedure but complications seem to be more frequent [17, 20]. We decided to perform the technique at a cricothyroidal level, bearing in mind the well-established superiority of the percutaneous procedure and the safety of the easy-handling (Ciaglia) kit.

Some published series on percutaneous tracheotomy have reported cases of bleeding which required transfusions and which even caused the death of one patient [10, 12, 13]. In our series, there were no cases of significant bleeding. Pneumothorax and subcutaneous emphysema appear as complications in most series [10, 13, 17]. No cases of pneumothorax were observed in a long series of surgical elective cricothyroidotomies [1, 3], and we also had no cases. The paratracheal insertion of the cannula is a complication sometimes reported [12, 17]. The use of a percutaneous technique with endoscopic guidance could reduce the risk of this complication [21–23], although the procedure is more complex.

During the percutaneous cricothyroidal procedure, the endotracheal tube is placed in a very proximal position, to prevent it from being impaled by the needle during the percutaneous insertion, and this can increase the risk of accidental extubation during the procedure. Although we had only one case of this complication, it is advisable for a member of the team other than the principal operator

to constantly check the endotracheal tube in case a reintubation should be necessary.

One incident that does tend to occur quite often and which is also related to the proximal position of the endotracheal tube is that the cuff of the tube is perforated by the needle. In our experience, there have been no cases where this has had any clinical repercussions, because the procedure is of short duration and the air leak can be compensated by the ventilator. Nevertheless, it could be useful to purposefully deflate the endotracheal tube cuff before initiating the technique so that the airway can be sealed during the procedure should it be necessary to do so. The incidence of other complications was similar in our series to those reported by other authors using percutaneous techniques [9–13].

In six cases using the percutaneous cricothyroidal technique, Toye and Weinstein [17] found that the only difference between this technique and the tracheal approach was the greater strength needed in the former to insert the cannula. This is not applicable to our series because we used the Ciaglia technique of progressive dilation with easier cannula insertion. Of course, definitive conclusions should not be drawn from comparisons of noncontrolled series of percutaneous techniques, in which the different complications are not uniformly defined. Even so, we can suggest that the cricothyroidal approach has the following advantages over the tracheal approach: there is no bleeding (there are practically no vessels in that space), no risk of pneumothorax due to the higher access to the airway, and no difficulty in finding the cricothyroidal space in comparison to the tracheal rings, particularly in short, fat necks.

The other advantages of percutaneous tracheotomy over the surgical approach such as speed, a low rate of infections, no cosmetic deformities and low cost are also shared by percutaneous cricothyroidotomy according to our results. The greatest disadvantage of the cricothyroidal approach would be the risk of stenosis in the subglottic region. The stenosis and granulomas in this area are technically more difficult to treat than those located lower down in the trachea. No symptomatic subglottic stenosis was detected in our study, although we endoscopically controlled only 13 patients after cricothyroidotomy closure. It should be pointed out that classical reports on surgical cricothyroidotomy have shown a low rate of subglottic stenosis [1–5]. However, laryngeal pathology and airway obstruction after a previous intubation should be considered as absolute contraindications for cricothyroidotomy.

In conclusion, percutaneous cricothyroidotomy using progressive dilators can be a quick, safe technique and seems to be a valid alternative to the percutaneous subcricoid approach in patients on prolonged mechanical ventilation.

Addendum

While this manuscript was being revised, we carried out a further 26 procedures with no serious problems and over progressively shorter periods: the procedure now takes about 5 min.

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