PROSPECTIVE EVALUATION OF THE RETROGRADE PERCUTANEOUS TRANSLARYNGEAL TRACHEOSTOMY (FANTONI PROCEDURE) IN A SURGICAL INTENSIVE CARE UNIT: TECHNIQUE AND RESULTS OF THE FANTONI TRACHEOSTOMY

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Abstract: Background. Controversy surrounds the safety and practicality of the retrograde percutaneous translaryngeal tracheostomy (Fantoni procedure) compared with other percutaneous methods.

Methods. We used the Fantoni tracheostomy for 245 patients in our intensive care unit (ICU) over a period of 3 years and 6 months and conducted a prospective analysis.

Results. We are able to report a low incidence of complications (1.2%) with the Fantoni procedure. Advantages of the method are reduced tissue trauma and optimal adaptation of the stoma to the cannula, leading to less stomal bleeding and fewer infectious complications. We observed no procedure-related mortality. Under mandatory bronchoscopic control, proper puncture location and cannula placement are ensured, which prevents tracheal wall injury and paratracheal placement of the cannula.

Conclusions. Our experience shows that the major advantage of the Fantoni tracheostomy is the retrograde dilatation of the stoma, which prevents serious complications compared with other techniques. © 2005 Wiley Periodicals, Inc.

Keywords: translaryngeal tracheostomy; Fantoni; complications; ICU care; percutaneous tracheostomy

Elective tracheostomy for long-term ventilator-dependent patients is a routine procedure in the intensive care unit (ICU). In the early 1990s, a translaryngeal percutaneous tracheostomy was developed in Italy by A. Fantoni. The indications for this procedure do not differ from conventional surgical tracheostomy or from those for other percutaneous techniques described by Ciaglia and Griggs.

We present here our own experience with the Fantoni tracheostomy in surgical ICU patients.

MATERIALS AND METHODS

Since the introduction of the retrograde percutaneous translaryngeal tracheostomy (Fantoni procedure) to our ICU, this method has been exclusively used in 245 patients, with a median age of
61 years (range, 18–82 years) over a period of 3 years 6 months (Table 1).

Tracheostomies were most commonly performed on patients requiring long-term ventilation as a result of pulmonary failure in cases of pneumonia or acute respiratory distress syndrome (ARDS) at a mean of 10 days (range, 3–16 days) after endotracheal intubation.

The Mallinckrodt Translaryngeal Tracheostomy Kit (Mallinckrodt Medical GmbH, Hennef, Germany) was used for all Fantoni tracheostomies, as follows.

Before the procedure, patients were ventilated with an FiO2 of 1.0 for 5 minutes, which was then continued throughout the intervention along with constant cardiovascular and oxygen saturation monitoring. After intravenous induction of analgesia, sedation, and paralysis, patients were placed in a supine position with the head slightly hyperextended.

The endotracheal tube was retracted and positioned directly below the larynx under bronchoscopic control to gain access to the trachea. A needle was inserted between the second and third tracheal rings, and a metallic guidewire was advanced into the tracheal lumen.

Bronchoscopy ensured that the trachea was punctured at the correct midline position. The wire was then directed toward the head and led out past the temporarily deflated endotracheal tube cuff through the patient’s mouth. It was then grasped with a Magill forceps and attached to a special flexible tracheostomy tube, which has a cone-shaped, dilating endpiece with a pointed metal tip. A small skin incision was made at the puncture site to facilitate penetration of the cannula (Figure 1).

At this time, the patient’s endotracheal tube was replaced by a narrower tube enclosed in the set, as depicted in the figures. In our opinion, this was not necessary, because the time needed for the following steps was less than a minute. The bronchoscope was then removed together with the patient’s endotracheal tube. We kept the bronchoscope ready with the endotracheal tube on it in preparation for a rapid reintubation if complications were to arise.

The endotracheal tube was removed, and the cannula was inserted through the mouth. It was guided with gentle traction on the guidewire into the trachea, where it was pulled out through the stoma with moderate force under constant manual counter-pressure. Once the cannula had passed through the stoma up to the cuff, the endpiece with the wire was cut off. To properly position, an obturator was inserted and then rotated 180° such that the cuff then faced the carina (Figure 2). Finally, completion bronchoscopy was carried out to establish that the position of the cannula was correct. Postoperative lung auscultation and a chest x-ray indicating the correct positioning of the tracheal cannula were performed.

One surgeon, one bronchoscopist, and one assisting nurse were required to perform the intervention.

A team of five surgeons in our ICU (two consultants, three residents) performed all 245 procedures.

After they were decannulated, all patients were examined for dysphagia, stridor, hoarseness, and cosmetic result. Fiberoptic endoscopy of the trachea was performed with the patient under local anesthesia in some cases to assess the stability of the anterior tracheal wall.

Ten patients were excluded from the study because of a preoperative FiO2 requirement of greater than 0.8, because this was defined as a contraindication for the technique. These patients underwent the classical surgical tracheostomy. Other contraindications for the procedure, which did not apply to our patients, include infections at the puncture site, severe coagulopathy, tracheal injuries, and inability to puncture the trachea distal to the second tracheal ring.

RESULTS

After a preparation time of 15 to 20 minutes, the mean duration of the procedure from tracheal puncture to ventilation by the cannula was 7 minutes (range, 5–12 minutes). Despite a mean apnea time of 40 seconds (range, 15–91 seconds), no significant hypoxia occurred. Periprocedural oxygen saturation levels remained above 92% in all patients. No significant CO2 retention (pCO2 > 7 kPa) occurred in any patient.

The translaryngeal tracheostomy was performed without any complications in 243 of 245 consecutive cases (99.2%). In one patient (0.4%),
an endoluminal hemorrhage of a few milliliters of blood with aspiration occurred, requiring bronchoscopic lavage during the intervention. The bleeding stopped spontaneously. In another case (0.4%), an enlarging hematoma was noticed immediately after the procedure and was followed sonographically at first. However, it became necessary for the patient to undergo operative revision, and an injury of the brachiocephalic trunk was found, partly tamponaded by the tracheal cannula. This injury was repaired primarily, and the cannula was simply repositioned.

Subcutaneous emphysema, mediastinal emphysema, or pneumothoraces were not observed by x-ray examination.

During 3317 days of cannula care, postinterventional wound infection occurred in only one patient (0.4%). With local therapy, the infection resolved completely. Notably, the patient in this case was extremely obese.

Thus, the peri-interventional and postinterventional complication rate was only 1.2% (Table 2).

Two patients required a cranial MRI between the second and fourth postinterventional days.
Because of the cannula containing a metallic spinal, decannulation was necessary during imaging, and the tracheostomy was redone at a later time using the same procedure.

In 205 patients, regular decannulation was possible after 8 to 60 days (median, 12 days). After decannulation, all stomata healed within 3 to 5 days without complications. This was also true for the one patient who had the locally treated infection reported previously.

The median time from regular decannulation until discharge from the hospital was 17 days, during which no signs of tracheal stenosis occurred. All of the patients were able to speak after decannulation and had no symptoms of hoarseness or dysphagia.

For reasons unrelated to tracheostomy, 63 patients required bronchoscopy after decannulation, none of whom revealed any tracheal alteration or functional instability.

Forty patients died from their primary disease after a mean period of 29 days (range, 5–53 days) after the tracheostomy. In 31 of those patients, autopsies were performed, none of which revealed any tracheal stenosis or lesions of the tracheal wall.

**DISCUSSION**

For more than a decade, the standard percutaneous tracheostomy procedure has been the dilatation technique of Ciaglia in which the trachea is widened by an expanding catheter. Then, guided by a wire, the cannula is positioned. However, considerable problems have been reported frequently, including injury of the posterior tracheal wall (0% to 4%) and paratracheal cannulation (1% to 3%), leading to high morbidity and mortality in these patients.1–4 Similar complications were observed with the percutaneous method of Griggs, in which the tracheostomy is accomplished by widening the gap between the cartilaginous rings using a forceps.5–7 In these cases, injury of the posterior tracheal wall is reported even more frequently (2% to 5%). Griggs’ procedure does have the advantage, however, of infrequent cannula malposition (0% to 2%) and a shorter intervention time compared with the standard method. However, adjustment of the tracheostomy to the cannula size is much more difficult and carries the danger of persistent bleeding in cases in which the stoma is too wide.4,5–10

The retrograde percutaneous translaryngeal tracheostomy (Fantoni procedure) is performed without prior manual dilatation of the trachea (with its resultant tissue damage). Optimal adjustment of the tracheal cannula to the stoma11–13 protects against subcutaneous emphysema. Accordingly, this was not detected in any of our patients. The soft dilatation of the tissue by the cone-shaped tip of the flexible tube and pressure of the tissue on the tube leads to fewer bleeding and infection complications.14 This makes the procedure particularly suitable for patients carrying a higher risk of hemorrhage, because no vessels are severed but are pushed aside, and the surrounding tissue is compressed by the elasticity of the cannula.

Bronchoscopic guidance ensures complete control over the puncture and cannula placement, thereby minimizing the risk of pneumothorax or injury of the tracheal wall, which never occurred in our 245 cases. The bronchoscope should be kept ready throughout the entire procedure to allow for rapid reintubation in cases in which problems arise. We do not consider inability to hyperextend the neck a contraindication, because fiberoptic reintubation is always an option. Therefore, direct laryngoscopy is not mandatory. However, it is true that without hyperextension of the neck, difficulty may arise in accessing an adequately distal puncture site.

Little evidence of stomal infections or bleeding complications occurring as a direct result of using the Fantoni method exists, when the cannula’s route is translaryngeal.15 In our series, we observed only one stomal infection (0.4%) and one limited endoluminal hemorrhage during the intervention (0.4%).

Injury to the brachiocephalic trunk has not been reported to date in connection with a Fantoni tracheostomy. In retrospect, the reason for our observed injury should be attributed to punctur-
ing the trachea too caudally, because no anatomic abnormalities were found on exploration. Thus, our experience should serve as a reminder of the importance of an experienced bronchoscopist ensuring the proper puncture site. Even though the only infectious complication we observed was in a morbidly obese patient, we consider the Fantoni procedure most advantageous in such patients, as long as the trachea can be palpated through the overlying tissue. There are tracheostomy tubes available with diameters of 5.5 mm, 6.5 mm, 7.5 mm, 8.5 mm, and 9.5 mm, of which we almost exclusively used the 7.5 mm and 8.5 mm models.

It is considered to be disadvantageous that the presence of the bronchoscope reduces the internal diameter of the endotracheal tube. Imami et al\(^\text{16}\) reported a decrease of the SaO\(_2\) to less than 90% in 15% of patients undergoing a bronchoscopically controlled tracheostomy of Ciaglia despite peri-interventional ventilation with an FiO\(_2\) of 1.0. With the Fantoni method, hypoxia is described in up to 6% of the cases\(^\text{6}\) because of the need for removal of the ventilation tube. For this reason, the Fantoni tracheostomy was only performed if the pre-interventional FiO\(_2\) was less than 0.8. In patients requiring a high positive end-expiratory pressure (PEEP) or high inspiratory pressures, the short duration of the Fantoni procedure is a considerable advantage.

Because of the danger of displacement of the tissue layers against each other early in the wound-healing process, the tracheal cannula should not be changed for the first time before the fifth postoperative day. Otherwise, the tract into the tracheal lumen might be difficult to reaccess. This can lead to the delay of diagnostic investigations such as MRI, because the tube contains a metallic spiral. In such cases, it is possible to temporarily ventilate the patient with an orotracheal intubation. Later, a re-tracheostomy using the same method can be performed at any time. Other previous surgery of the neck should not be considered an absolute contraindication, because the constant manual counterpressure when pulling the cannula through the stoma reduces shear forces, and injury to other anatomic structures is rather unlikely using the proper technique.

CONCLUSIONS

The translaryngeal retrograde percutaneous tracheostomy is a straightforward method that is easily taught and performed in an ICU setting.

The retrograde dilatation of the trachea prevents lesions of the tracheal wall. Tissue trauma, bleeding, and wound infection are minimized. Because bronchoscopy confirms the correct placement of the guidewire, paratracheal misplacement of the tracheostomy tube is almost impossible.

In our experience, Fantoni’s tracheostomy is a very safe technique with few complications and can be recommended as a reliable method for elective tracheostomy in patients in the ICU.

REFERENCES