

How to Do It

A Novel Technique for Closing a Tracheocutaneous Fistula Using a Hinged Skin Flap

MITSUHIRO KAMIYOSHIHARA, TOSHITERU NAGASHIMA, and IZUMI TAKEYOSHI

Department of General Thoracic Surgery, Maebashi Red Cross Hospital, 3-21-36 Asahi-cho, Maebashi, Gunma 371-0014, Japan

Abstract

We present the case of a 73-year-old man with successful closure of a persistent tracheocutaneous tissue defect that resulted from poor wound healing after a temporary tracheostomy was performed during treatment for drug-induced anaphylactic shock. We repaired the tracheal defect using a cutaneous flap with its cutaneous surface positioned to cover the tracheal lumen. The advantage of our method is that it minimizes the suturing required and results in fewer problems with anastomotic insufficiency. This is a simple, rapid method for treating tracheocutaneous fistulas.

Key words Tracheocutaneous fistula · Tracheotomy · Surgery · Hinged skin flap

Introduction

A frequently performed procedure,¹ a tracheotomy can usually be closed when the postoperative swelling decreases and the ability to swallow recovers. Prolonged cannulation, however, can significantly increase the risk of developing a persistent fistula. Kulber et al.² reported that 70% of tracheostomies present for more than 16 weeks resulted in tracheocutaneous fistulas. In general, the reported occurrence rate of such fistulas ranges from 3.3% to 29%,³ and local wound care and plastic reconstruction strategies are required in such cases.^{4,5} A tracheocutaneous fistula is a frequent sequela of a long-term tracheostomy or tracheal fenestration, and closure of the fistula is mandatory to prevent irritation of the surrounding skin, mucopurulent secretions, difficulty swimming and bathing due to the risk of aspiration, and tension from insufficient advancement of the adjacent soft tissues.

We present a case of successful closure of a persistent tracheocutaneous tissue defect that resulted from poor wound healing after a temporary tracheostomy was performed during the treatment of drug-induced anaphylactic shock. We describe a simple, rapid method for treating tracheocutaneous fistulas. Our method creates a pedicled flap and positions it over the tracheostomy site following a primary inversion of the edges of the tracheocutaneous fistula to minimize suturing.

Case Report

The patient underwent surgery to treat bile duct cancer and primary sclerosing cholangitis. During the postoperative course, just after the patient was given intravenous sulbactam sodium to treat suspected bacteremia, he developed anaphylactic shock. Emergency cardiopulmonary resuscitation was performed and he was intubated and placed on a mechanical ventilator. The patient developed multiple organ failure and required hemodialysis to treat renal failure, bilirubin adsorption for hepatic failure, arterial embolization for intraperitoneal hemorrhage, and mechanical ventilation with a tracheotomy through a transverse skin incision for respiratory failure. After about 3 months of intensive care, he successfully recovered and was discharged.

Decannulation was performed by removing the tracheotomy tube and spontaneous closure of the site was expected. However, the cutaneous opening into the trachea persisted for 18 months due to overgrowth of the epithelial layer onto the tracheal mucosa along the tracheotomy tract. The patient developed local skin irritation from the tracheal secretions and voice problems, and was referred to our department. We planned to close the tracheocutaneous tissue defect using a hinged skin flap.

The patient was placed in the supine position and general anesthesia was induced. A 5.5-cm longitudinal spindle-shaped skin incision was made around the

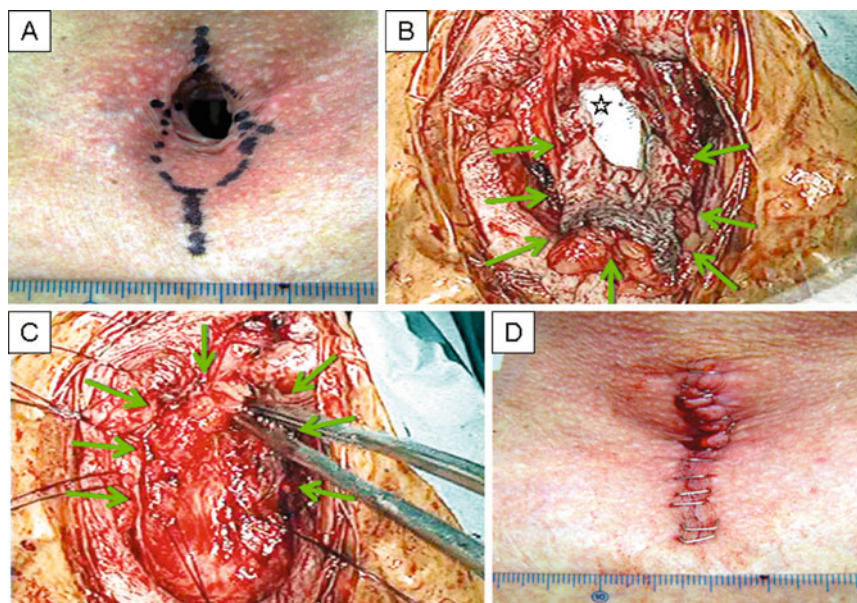


Fig. 1. **A** The spindle-shaped skin incision around the tracheocutaneous fistula. **B** A hinged skin flap is made using the skin of the lower half of the periostomal tissue (arrows); the tracheocutaneous fistula is seen (star). **C** The fistula is closed with an autogenous hinged skin flap, which is sutured to the tracheal defect with 3-0 absorbable monofilament and interrupted sutures. **D** The soft tissue defect is covered by the anterior cervical muscles, and no drain is placed.

periostomal tissues above the suprasternal notch with an oval skin pedicle from the lower half of the tracheotomy site (Fig. 1A). The lower half of the skin around the periostomal tissue was separated from the underlying subcutaneous tissues (Fig. 2A) and a hinged skin flap was made (Figs. 1B and 2B). The remaining pretracheal tissues, platysma, and sternohyoid and sternothyroid muscles were retracted bilaterally. The thyroid isthmus had already been cut when the tracheotomy was made. After local debridement and wound care, the defect in the anterior tracheal wall was closed with an autogenous hinged skin flap. The flap was sutured to the tracheal defect with 3-0 absorbable monofilament and interrupted sutures (Figs. 1C and 2C). The soft tissue defect was covered by the anterior cervical muscles. The operation took 90 min, with little blood loss. No drain was necessary (Fig. 1D).

The patient was extubated immediately after surgery. Prophylactic antibiotics were administered for 2 days postoperatively, and the patient was discharged on the fifth postoperative day. The wound was closed successfully, and no complications associated with tracheal air leakage or subcutaneous emphysema occurred. Sagittal computed tomography (CT) images on postoperative day 5 showed no stenosis of the trachea (Fig. 2D). The patient has presently no respiratory symptoms for 22 months after surgery.

Discussion

Various methods for closing tracheocutaneous fistulas have been reported, including: primary closure;⁶ biped-

icle delayed flap closure;⁷ fistulectomy with primary closure in layers, with excision of the fistula tract down to the level of the trachea and subsequent multilayer closure;^{8,9} multilayer closure of the local de-epithelialized tissue with surgical closure of the persistent tracheocutaneous fistula;¹⁰ Z-plasty with rotation of two of four triangular skin flaps that are sutured to give a Z-shaped suture line;¹¹ elevation and rotation of the epithelial lining of the tracheocutaneous fistula inward as a marginally based flap;¹² using a turnover hinge flap^{13,14} and an additional V-Y advancement flap;¹⁵ and harvesting auricular cartilage that is transplanted to the tracheal defect with transposition of a fasciocutaneous deltopectoral flap.⁴ The techniques described are a variation of others that have been previously described in two studies.^{13,14} The difference between our method and theirs is the direction of the turnover flap. The previous studies used a turnover flap of skin¹³ or fibroadipose tissue¹⁴ transversely. However, their method has some disadvantages. For example, there is a larger suturing site for closure; transverse suturing tension makes the trachea stenotic; the anterior cervical muscles are under tension transversely; and the cosmetic results of the skin incision are not optimal. Our innovation is that we repair the tracheal defect using a cutaneous flap with its cutaneous surface positioned to cover the tracheal lumen; the advantage of our method is that it minimizes the suturing required and results in fewer problems with anastomotic insufficiency.

In our patient, a transverse skin incision was performed in the initial tracheostomy. Therefore, we used a vertical skin incision and flap. If a transverse skin incision flap had been used, the scar tissue would have

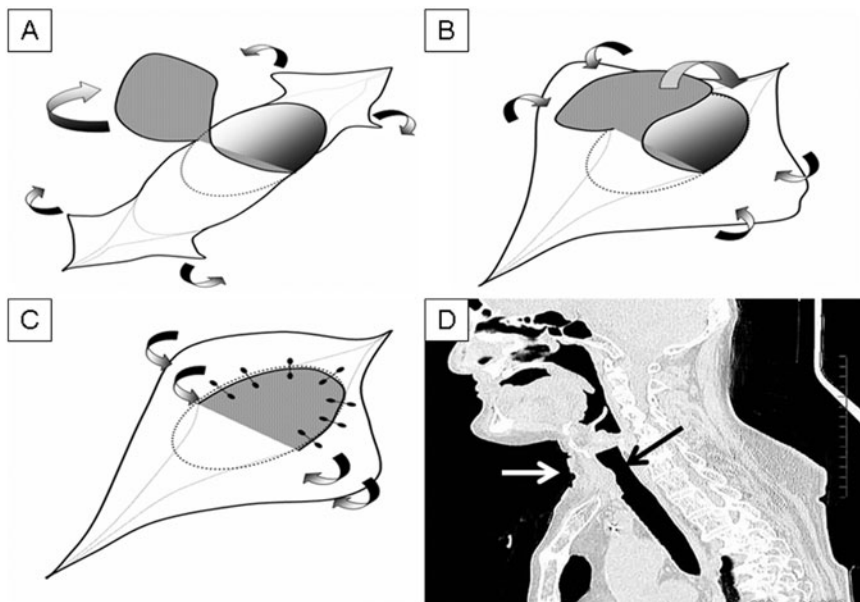


Fig. 2. A schematic depiction of our surgical technique. **A** The skin around the peristomal tissues is incised and an oval skin pedicle made from the lower half of the tracheostomy site. **B, C** These diagrams correspond to Fig. 1B and C, respectively. The *arrows* indicate the tissue movement during closure. **D** Postoperative sagittal computed tomography image shows no stenosis of the trachea (*arrows*)

hindered skin flap engraftment, as the skin incision would have coincided with the initial tracheostomy incision.

The epithelial layer can overgrow the tracheal mucosa, although whether or not the opposite can occur still remains clear; i.e., whether the mucosal layer can grow over the epithelial surface of the hinged flap. Applying flexible bronchoscopy, He et al.¹⁶ observed a healthy flap with normal-appearing granulation tissue along the boundaries of the anastomosis 2 months after repairing a tracheal defect using a pectoralis major myocutaneous flap with its cutaneous surface positioned to cover the tracheal lumen. Therefore, we believe that the epithelial layer of the hinged flap will be replaced with a mucosal layer. Although we wanted to check for this using bronchofiberscopy, we could not do so because the patient refused to undergo this procedure.

In summary, we consider the treatment of persistent tracheocutaneous defects using a hinged skin flap to be a simple, reliable procedure that can be performed in one step with low donor-site morbidity. We think that a longer follow-up for the wound is therefore needed. Reports on the use of this technique in additional cases are needed.

References

- De Leyn P, Bedert L, Delcroix M, Depuydt P, Lauwers G, Sokolov Y, et al. Tracheotomy: clinical review and guidelines. *Eur J Cardiothorac Surg* 2007;32:412–21.
- Kulber H, Passy B. Tracheostomy closure and scar revisions. *Arch Otolaryngol* 1972;96:22–6.
- White KA, Smitheringale AJ. Treatment of tracheocutaneous fistula in children. *J Otolaryngol* 1989;18:49–52.
- Riedel F, Reinhart Goessler U, Grupp S, Bran G, Hörmann K, Verse T. Management of radiation-induced tracheocutaneous tissue defects by transplantation of an ear cartilage graft and deltopectoral flap. *Auris Nasus Larynx* 2006;33:79–84.
- Ikeguchi M, Miyake T, Matsunaga T, Yamamoto M, Fukumoto Y, Yamada Y, et al. Free jejunal graft reconstruction after resection of neck cancers: our surgical technique. *Surg Today* 2009;39:925–8.
- Bishop JB, Bostwick J, Nekoi F. Persistent tracheal stoma. *Am J Surg* 1980;149:709–10.
- Jacobs JR. Bipedicle delayed flap closure of persistent radiated tracheocutaneous fistulas. *J Surg Oncol* 1995;59:196–8.
- Montgomery W. *Surgery of the upper respiratory system*. Vol. 2. Philadelphia, PA: Lea & Febiger; 1973. p. 347.
- Bressler KL, Kaiser PC, Dunham ME, Holinger LD. Primary closure of persistent tracheocutaneous fistula in children. *Ann Otol Rhinol Laryngol* 1994;103:835–7.
- Licameli GR, Marsh BR, Tunkel DE. A simple method for closure of tracheocutaneous fistula in children. *Arch Otolaryngol Head Neck Surg* 1997;123:1066–8.
- Schroeder JW Jr, Greene RM, Holinger LD. Primary closure of persistent tracheocutaneous fistula in pediatric patients. *J Pediatr Surg* 2008;43:1786–90.
- Lewis V, Manson P, Stalneck M. Some ancillary procedures for correction of depressed adherent tracheostomy scars in association with tracheocutaneous fistulas. *Gen Trauma* 1987;27:651–5.
- Rennekampff HO, Tenenhaus M. Turnover flap closure of recalcitrant tracheostomy fistula: a simplified approach. *Plast Reconstr Surg* 2007;119:551–5.
- Eliashar R, Sichel JY, Eliachar I. A new surgical technique for primary closure of long-term tracheostomy. *Otolaryngol Head Neck Surg* 2005;132:115–8.
- Lee UJ, Goh EK, Wang SG, Hwang SM. Closure of large tracheocutaneous fistula using turn-over hinge flap and V-Y advancement flap. *J Laryngol Otol* 2002;116:627–9.
- He J, Xu X, Chen M, Li S, Yin W, Wang S, Gu Y. Novel method to repair tracheal defect by pectoralis major myocutaneous flap. *Ann Thorac Surg* 2009;88:288–91.