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A more conservative technique for anterior mediastinal tracheostomy after sub-total resection of the trachea

Emmanuel Martinod a,c, *, Jean-Yves Guillame b, Dana M. Radu a,c, Gilles Despreaux b

a Department of Hemato-Onco-Thorax, Unit of Thoracic and Vascular Surgery, Faculty of Medicine SMBH, Assistance Publique, Hôpitaux de Paris, CHU Paris, Seine Saint-Denis, Avicenne Hospital, Paris 13 University, Bobigny, Paris, France
b Department of Hemato-Onco-Thorax, Unit of Oto-Rhino-Laryngology, Faculty of Medicine SMBH, Assistance Publique, Hôpitaux de Paris, CHU Paris, Seine Saint-Denis, Avicenne Hospital, Paris 13 University, Bobigny, Paris, France

c EA Laboratory for Bio-Surgical Research, Paris Descartes University, Alain Carpentier Foundation, Assistance Publique, Hôpitaux de Paris, Georges Pompidou European Hospital, Paris, France

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Abstract

Anterior mediastinal tracheostomy (AMT) is a rare but challenging operation associated with a high morbidity and mortality rate mainly related to the invasiveness of the procedure. In order to provide a more conservative technique with a lower risk of major postoperative complications, we proposed: (1) to reduce the extent of chest wall resection to only a trapezoidal segment of the manubrium; (2) to use a simple pedicle pectoralis major flap instead of myocutaneous or omental flaps; and (3) to perform a simple relocation of the residual trachea (RT) below the brachiocephalic artery instead of artery ligation, percutaneous stent placement or replacement by cadaveric allograft. This technique was used in a patient with cancer recurrence at the cervical stoma after total laryngectomy. Despite a short 2.5-cm RT, it was possible to perform AMT without any tension at the mediastinal stoma. Postoperative course showed only regressive minor complications. There was no late complication related to the procedure with a one-year follow-up. This more conservative technique for AMT could be used as an alternative to previously described procedures in order to reduce postoperative complications and mortality rate after sub-total resection of the trachea.

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1. Introduction

Anterior mediastinal tracheostomy (AMT) is indicated for extensive laryngotracheal or esophageal malignancies and cancer recurrence at the cervical stoma after total laryngectomy. In these circumstances, a cervical tracheostomy is not possible after curative resection because the length of residual trachea (RT) is too short. In a detailed review, Grillo described the development of surgical techniques for this rare but challenging procedure [1]. Despite significant advances, AMT is still associated with major postoperative complications. In most important series, the mortality rates ranged from 7% to 18.8% and the morbidity rates from 25% to 70.4% [2–8] (Table 1). Facing the high risk of AMT, we proposed a more conservative technique derived from those previously reported.

1.1. Patient

A 44-year-old male patient was referred to our center with a past medical history of total laryngectomy for squamous cell carcinoma. Facing cancer recurrence at the stomal site of cervical tracheostomy, a new surgical resection associated with AMT was proposed because there was no alternative option for a curative therapy in this young patient with a good health-status. The procedure was performed after approval by the multidisciplinary staff meeting, information and consent of the patient.

1.2. Surgical exploration

Under general anesthesia and ventilation assured by using a cross-field tube (CFT), surgical exploration confirmed that cancer recurrence was limited to the cervical stoma and the underlying trachea with no involvement of great vessels or esophagus.

2. Technique

2.1. Patient

Skin incisions were completed to achieve tumor-free margins at the peristomal site, partial manubriectomy and...
adequate placement of the mediastinal stoma (MS) (Figs. 1a and 2a). Only a limited trapezoidal segment of the manubrium was resected (Figs. 2b and 3a). After entire dissection, the trachea was divided at 2.5 cm from the carina. En-bloc resection was performed after re-intubation of the RT with the CFT (Fig. 2b). Perioperative pathological examination confirmed tumor-free margins. As the tracheal stump was too short, a relocation of the RT below the brachiocephalic artery (BCA) was done (Figs. 2c and 3b).

### 2.4. Reconstruction

A pedicled pectoralis major muscle flap (PMF) was harvested through an oblique skin incision at the right site (Figs. 1a and 2a). The PMF was released by dividing its attachments inferiorly to the lower margin of the chest wall, superiorly to the humerus and the lateral segment of the clavicle (CL). After division, the inferior part of the PMF was interposed between the BCA and the RT, thereby fixed to the MS and surrounding tissues (Fig. 2d). Using interrupting absorbable 2-0 polyglactin sutures, the MS was not sutured to the skin except at the inferior part but circumferentially to the muscle flap. Using the same sutures, the muscle flap was then sutured deeply to the margins of the manubrium and superficially to the skin. The superior part of the PMF was placed in order to fully cover the defect at the peristomal site (Figs. 1a and 2d). Two suction tubes were placed to drain the neck, mediastinum and subcutaneous spaces. Only the incision performed for muscle flap harvest was closed. A tracheal cannula was placed in the MS.

### 3. Results

The postoperative course showed regressive minor complications (left pleural effusion with atelectasis of the lower lobe, left upper arm edema). The patient was discharged on postoperative day 15. The muscle flap at the peristomal site was progressively covered by regenerated skin during the first postoperative month. This allowed additional irradiation when healing at the peristomal site was accomplished. The tracheal cannula was removed at one month with no evidence of MS contraction. Distant metastases occurred at the six-month follow-up and were treated using radio-chemotherapy. There was no late complication related to the procedure at the one-year follow-up (Figs. 1b and 3c,d).

### 4. Discussion

The main problem encountered with AMT is the risk of stomal tension that could lead to major complications, such as anastomotic separation, mediastinal sepsis and erosion of great vessels [1–8]. In order to prevent these complications, efforts have been made to reduce tension at the stomal anastomosis, to fill the dead space in the upper part of the mediastinum and to separate the trachea from the BCA. This was firstly accomplished by removing the bony chest wall over the upper mediastinum including bilaterally the medial heads of the CLs, the first two costal cartilages and the part of sternum down through the second interspace [1]. As it was not sufficient, the use of pectoralis major myocutaneous or omental pedicle flaps was proposed [1–9]. This was also associated with relocation of the RT below the BCA or artery ligation and more recently with BCA stenting or replacement by cadaveric allograft [1–11]. The present technique was performed with a total respect to the major key point of the operation: to reduce the tension at the stomal anastomosis. None of the joints...
Fig. 2. Schematic view representing the different steps of the procedure. (a) Skin incisions performed to achieve (A) tumor-free margins at peristomal site, (B) partial manubriectomy and adequate placement of the mediastinal stoma, (C) harvest of the pectoralis major flap. (b) Resection of a limited trapezoidal segment of the manubrium (D). En-bloc resection of cancer recurrence after re-intubation of the 2.5-cm-long residual trachea (RT) with a cross-field tube (CFT). (c) Relocation of the residual trachea and the mediastinal stoma (MS) below the brachiocephalic artery (BCA). (d) Reconstruction using a pedicled pectoralis major flap (PMF). Interposition of the inferior part of the PMF (E) between the BCA and the residual trachea, thereby fixed to the mediastinal stoma and surrounding tissues. Placement of the superior part of the PMF (F) to fully cover the defect at peristomal site.

Fig. 3. Postoperative 3D CT-scan reconstruction. (a) Anterior view; only a limited trapezoidal segment of the manubrium (d) was resected with respect of the medial heads of the clavicles (CL), the first two costal cartilages (K1, K2) and the part of sternum down through the second interspace. (b) Posterior view; relocation of the residual trachea (RT) and the mediastinal stoma (MS) below the brachiocephalic artery (BCA). (c) Postoperative CT-scan (sagittal oblique view) at long-term follow-up showing the absence of late complications at the MS. (d) Postoperative CT-scan (frontal oblique view) at long-term follow-up showing the patency of BCA. CT, computed tomography.
between the manubrium and the CLs or the first ribs have been opened in order to avoid extensive anterior chest wall resection as recommended by other techniques or the risk of chronic infection if cartilage was exposed. In addition, the preservation of these joints allowed to maintain the structural stability of the upper anterior chest wall. To minimize the operation, a simple PMF was used instead of myocutaneous or omental flaps. In contrast to procedures using a pectoralis major myocutaneous flap, the RT at the MS was sutured not to the skin but to the muscle flap except at the inferior level. Despite previous radiation therapy, the muscle was progressively covered by regenerated skin tissue. This showed that a cutaneous flap could be not necessary to allow healing of the stomal area. The complexity of the operation depends also on the possibility of vascular erosion. As the BCA was not invaded in the present case, a simple relocation of the RT below the BCA was performed. BCA ligation, stenting or replacement using a cadaveric allograft should be recommended only in cases of major involvement. This more conservative technique for AMT could be used as an alternative to previously described procedures in order to reduce the morbidity and mortality rate after sub-total resection of the trachea.

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