

Plastic tracheostomal-widening procedure: the "petal" technique

Plastica di allargamento del tracheostoma: tecnica "a petali"

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Key words

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Parole chiave

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Summary

Severe tracheostomal stenosis after total laryngectomy may require the permanent use of a tracheostomy tube which undoubtedly represents a personal and social handicap (cosmetic impairment, accumulation of sputum, noisy breathing, cough stimulation, tube management). In patients with voice prostheses, this is a major obstacle to phonation and device maintenance. Stenosis is so pronounced, in some cases, as to cause dyspnoea. The main causes of stenosis are perichondritis of the upper tracheal rings or, more frequently, a defect in the tracheostoma preparation. All such cases require surgical revision of the tracheostomal diameter, for which numerous procedures have been described in the literature. The "petal" technique, adopted by the Otorhinolaryngology O.U. in Vittorio Veneto, for four years, has been used in 59 patients. The technique is described and results of retrospective study, to assess outcome, are outlined. In 40 cases, outcome was immediately satisfactory, while recurrence of stenosis was observed in 19 patients, 9 of whom preferred to accept tube dependence while 10 were reoperated, with permanent successful results in 6 cases. In our opinion, since this is an easy surgical procedure to perform and, in the majority of cases, is carried out under local anaesthesia with good patient compliance, absence of complications and good long-term results, this should be considered the method of choice for surgical widening of permanent tracheostomas.

Riassunto

Una stenosi significativa del tracheostoma nel paziente sottoposto a laringectomia totale può obbligare all'utilizzo permanente della cannula. Ciò rappresenta indubbiamente un handicap personale e relazionale (danno estetico, ristagno di secrezioni, respiro rumoroso, stimolo alla tosse, gestione della cannula). Nel paziente portatore di protesi fonatoria ciò rappresenta un ostacolo importante alla fonazione ed alla manutenzione dell'impianto. A volte la stenosi è tanto pronunciata da causare dispnea. Le cause principali della stenosi sono una perichondrite dei primi anelli tracheali o, più frequentemente, un difettoso confezionamento del tracheostoma. In tutti questi casi si rende necessaria una revisione chirurgica del calibro del tracheostoma e numerose sono le procedure suggerite nella letteratura. La tecnica "a petali" è in uso nell'U.O. di Otorinolaringoiatria di "Vittorio Veneto" da quattro anni ed è stata utilizzata in 59 pazienti. Presentiamo uno studio retrospettivo che descrive la metodica e ne valuta i risultati. In 40 casi il risultato è stato subito soddisfacente mentre in 19 pazienti si è verificata una recidiva della stenosi; di questi, 9 hanno preferito accettare la dipendenza dalla cannula mentre 10 sono stati sottoposti a reintervento che ha avuto successo permanente in 6 casi. La semplicità di esecuzione chirurgica, attuata nella maggior parte dei casi in anestesia locale con buona compliance da parte del paziente, l'assenza di complicanze e la bontà dei risultati a distanza ne fanno, a giudizio degli Autori, la tecnica di scelta per l'allargamento chirurgico del tracheostoma definitivo.

Introduction

Stenosis of permanent tracheostomas is a relatively common complication in laryngectomy and is reported, in the literature, to occur in 15-20% of these patients. It is, however, not easy to define: morphometric criteria, i.e., tracheostomal diameter, only apply when considered as a function of body mass of the patient, since patients of small build are known to support small tracheostomas without any problem. Functional criteria are, instead, more reliable and are

based on dyspnoea under stress (or at rest). Furthermore, stenosis results in a laminar flow becoming turbulent, with an increase in speed and resistance of air transit, leading to dehydration of the mucosa and the accumulation of crustiform tracheostomal secretions. In some cases, this gives rise to severe superinfection-related tracheal inflammation, known as crust-like tracheitis, causing haemoptysis and (occasionally very severe) dyspnoea. An ample tracheostoma is, on the other hand, an essential condition in the application, functionality and

maintenance of voice prostheses, which must be easily accessible for cleaning and replacement purposes. The cause of tracheostomal stenosis has been linked to various factors: among the most widely quoted in the literature^{3 4} are chondro-perichondritis of the uppermost tracheal rings (as a result of bacterial inflammation, pressure necrosis or preoperative radiation treatment), followed by cicatricial constriction.

However, the most common cause appears to be inadequate tracheostomal preparation at the time of total laryngectomy. Special care must be taken to ensure that: 1) there is not an excess of peristomal skin, 2) the most lateral stitches are applied so that skin traction lateralises the posterior side of the cartilaginous ring, 3) in suturing, the skin is well in excess of the tracheal section margin, 4) the suture thread has a sufficiently wide diameter to avoid cutting the tracheal ring under traction, 5) early removal of the tracheostomy tube is effected in order to avoid micro-trauma and local inflammation⁴⁻⁶. There is still controversy as to whether it is preferable to incise the trachea transversally or with a flute-lip conformation: some Authors report a lower incidence of stenosis with this latter option while others consider incision of the tracheal rings to be the cause of post-operative chondritis and potentially, therefore, of tracheostomal stenosis⁸.

From a morphological point of view, tracheostomal stenoses are described as prevalently concentric or inferior diaphragm-like⁵. The so-called "vertical-fisure" type often give rise to more complex problems, since they are often accompanied by tracheomalacia with a sabre sheath conformation.

At the Otorhinolaryngology Division of Vittorio Veneto, a surgical technique has been developed to widen simple tracheostomas that can be performed rapidly and which we have called the "petal" technique.

Patients and methods

A retrospective study is presented on 59 patients (48 male, 11 female) submitted, over the last 4 years, to plastic tracheostomal-widening procedure using the "petal" technique. Of these patients, 45 had undergone mono- or bilateral laterocervical neck dissection; 10 patients had received radiotherapy prior to laryngectomy and 22 post-laryngectomy. A primary phonatory fistula had been effected in 42 patients. Indications to widen the tracheostoma by plastic surgery were made on average 5 months after the operation.

SURGICAL TECHNIQUE

The procedure is generally performed under local anaesthesia, with light sedation and with the anaes-



Fig. 1. Laryngectomised patient with concentric stenosis of permanent tracheostoma.

thesia tube inserted in the trachea and inflated to prevent blood from being inhaled (Figs. 1, 2). The skin and subcutis are incised to create two diverging, caudally oriented, "petals" (Fig. 3), which are raised upwards (Fig. 4). The triangle of skin separating them is, instead reflected downwards (Fig. 5).

The trachea is then isolated for a length of 2-3 rings and the tracheostomal scar tissue causing the stenosis is removed, together with the two upper "petals" (Fig. 6). After carefully localising the common carotid arteries laterally and the innominate artery caudally by finger pressure, dissection may be performed with an electrosurgical knife.

The residual trachea is incised vertically (Fig. 7) and the angle produced by divaricating the section



Fig. 2. Cuffed anaesthesia tube is inserted in tracheostoma and local anaesthesia is induced.



Fig. 3. Two petals with an inferior apex are cut through cutis and subcutis.

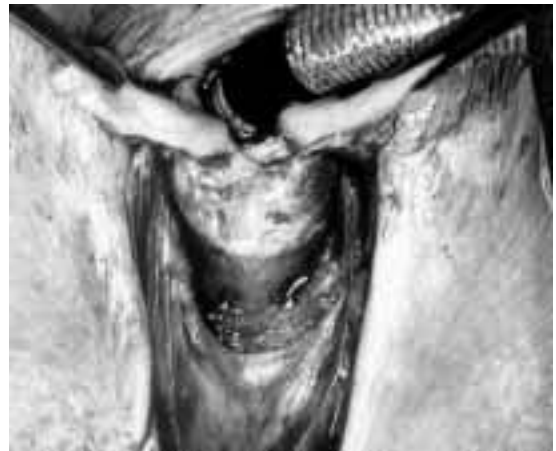


Fig. 5. The cutaneous-subcutaneous triangular flap formed between the two petals is isolated and turned downwards. Upper tracheal rings are skeletonised. Thyroid isthmus is exposed.



Fig. 4. Petals are turned upwards.



Fig. 6. Stenotic scar tissue and two petals are removed. *Pars membranacea* of trachea is left intact.

is sutured to the apex of the previously raised lower skin triangle (Figs. 8, 9). The apexes of the tracheal section are, instead, sutured to the skin at the lateral apexes of the shape (Fig. 10). A further two stitches anchor the lateral base of the petals to the cervical skin, the elasticity of which provides lateral traction (Fig. 11) proportional to the dimensions of the petals.

Strong silk is used for these five stitches, which give the tracheostoma its new conformation; other finer thread is used to complete the suture (Fig. 12). When suturing, the skin must exceed the tracheal ring cartilage.

Pre-operative antibiotic prophylaxis is sufficient for the procedure. A n. 14 plastic tracheostomy tube is introduced for about ten days and the stitches are re-

moved after ten days. The patient can usually be discharged on the 2nd or 3rd post-operative day.

Results

Of the 59 patients, 48 were operated upon under local anaesthesia applied topically and injected into the tissues (local anaesthesia with a vasoconstrictor, unless contraindicated) following sedation with an anxiolytic injected intramuscularly one hour prior to the procedure.

Outcome was immediately satisfactory in 40 cases,



Fig. 7. An anterior vertical incision is made on remaining tracheal profile, involving 1 or 2 tracheal rings.



Fig. 9. Suturing with strong silk thread. Trachea is held to avoid thread cutting tracheal tissue.



Fig. 8. Apex of inferior cutaneous triangle is sutured to apex of tracheal section.



Fig. 10. Edges of tracheal section are sutured to lateral apices of cutaneous shape remaining after removal of petals. Closure of nodes causes trachea to open like a book.

while stenosis recurred in 19 patients; of these, 9 preferred to maintain the tracheostomy tube while 10 were submitted to a repeat procedure based on the same technique, which led to a successful outcome in 6 cases.

Of the 4 remaining patients, 3 were affected by recurrence of crustiform tracheitis requiring repeated hospital admissions on account of acute dyspnoea and haemoptysis. Remission was achieved with parenteral antibiotic and cortisone therapy in addition to humidification of inhaled air with normal saline solution and bicarbonate. Albeit, one patient presented with the continuous formation of bleeding tracheostomal granulomas, requiring removal of the phonatory fistula and periodic surgical revisions.

These data refer to a mean follow-up period of 25 months (range 6 to 54 months).

Discussion

The rationale behind this plastic tracheostomal-widening procedure appears to be interruption of the concentric scar retraction lines with radial incisions and the interposition of cutaneous advancement flaps. Almost all the techniques described in the literature are based on one or both of these concepts¹⁻⁷. Even in the case of chondro-cutaneous-diaphragm-like tracheostomal stenosis of the inferior semicir-



Fig. 11. Another two stitches lateralise tracheal ring apices.



Fig. 12. On completion of procedure, tracheostoma presents an adequate diameter. It should be stressed that *pars membranacea* of trachea remains intact and that stitches are anchored so that the skin exceeds tracheal section margins.

cumference, simple correction with an electro-surgical knife exposes patients to the risk of recurrence.

So-called “star” reconstructive surgery procedures are currently those most frequently employed and are undoubtedly efficacious. Three- and four-point versions have been proposed². The “petal” technique is based on a similar concept but, in our opinion, is unmatched in terms of simplicity of execution. It acts on roughly three-quarters of the circumference, leaving the superior tracheostomal profile intact. This is because tracheostomal stenosis usually does not involve the *pars membranacea* of the trachea, which is pure epithelial-connective septation between the trachea and cervical oesophagus, where the cartilaginous ring is interrupted. Moreover, the voice prosthesis may be present, at this level and, therefore, this area should be left intact.

In the “petal” procedure, the predominant skin tension line lies laterally and can be likened to the opening of a book the pages of which are drawn laterally by the elasticity of the neck skin. The lower cutaneous sliding flap is interposed to maintain tracheal continuity and fill the defect.

No post-operative complications occurred and the only technical difficulties observed were the presence of hypertrophic thyroid glands or dangerous proximity of the innominate artery during skeletonisa-

tion of the upper tracheal rings. Overall, the procedure was successful in 46 of the 59 patients.

It should be stressed that of the 9 patients declining reoperation and of the 4 presenting a negative outcome, 10 were post-radiation patients. It is worthwhile pointing out that in 3 of the 4 patients unsuccessfully retreated, stenosis did not involve only the tracheostoma (which presented “fissure-like” constriction) but extended to the trachea in the same way, in a “sabre sheath” conformation, due to tracheomalacia.

In 2 patients affected by fissure-type tracheostomal stenosis, it was deemed necessary to section the sternal component of the sternocleidomastoid muscles.

Conclusions

In our experience, plastic widening of the tracheostoma, using this technique we refer to as the “petal” technique, preserves the principles and efficacy of conventional, so-called “star” methods. It differs, instead, in terms of simplicity and speed with which it is carried out, with positive repercussions on patient compliance to treatment.

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