

HEAD AND NECK

Tracheocutaneous fistula in patients undergoing supracricoid partial laryngectomy: the role of chronic aspiration

Fistola tracheocutanea in pazienti sottoposti a laringectomia sovracricoidea: il ruolo dell'aspirazione cronica

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SUMMARY

The aim of the present retrospective controlled study was to analyse and compare risk factors for tracheocutaneous fistula in patients who received tracheostomy after supracricoid partial laryngectomy with those who received tracheostomy for other causes. We enrolled 39 patients with tracheocutaneous fistulas who were divided into two groups. The first received temporary tracheostomy for supracricoid partial laryngectomies (n = 21), while the control group consisted of patients who received temporary tracheostomy for other causes (n = 18). Risk factors believed to play a role in the pathogenesis of tracheocutaneous fistula were examined including advanced age, cardiopathy, local infections, radiotherapy, elevated body mass index, malnutrition, decannulation time and aspiration grade. The Leipzig and Pearson scale score was significantly higher in the supracricoid partial laryngectomy group (p = 0.006 and 0.031 for univariate and multivariate analyses, respectively). The penetration/aspiration score was significantly higher in the supracricoid partial laryngectomy group as determined by univariate analysis (p = 0.014). The decannulation time was significantly lower in the supracricoid partial laryngectomy group (p = 0.004 and 0.0004 for univariate and multivariate analyses, respectively). The number of surgical closures for tracheocutaneous fistula was significantly higher in the supracricoid partial laryngectomy group by univariate analysis (p = 0.027). These results suggest that chronic aspiration and related cough may be important pathogenic factors for tracheocutaneous fistula and could be responsible for the significantly higher rates of closure failure in patients after supracricoid partial laryngectomy.

KEY WORDS: Aspiration • Risk factors • Supracricoid partial laryngectomy • Tracheocutaneous fistula • Tracheostomy

RIASSUNTO

Lo scopo del presente studio retrospettivo controllato è quello di analizzare e confrontare i potenziali fattori di rischio per fistola tracheocutanea tra i pazienti sottoposti a tracheostomia dopo laringectomia sovracricoidea e pazienti che hanno ricevuto tracheostomia per altre cause. Abbiamo arruolato 39 pazienti con fistola tracheocutanea e li abbiamo suddivisi in due gruppi. Il primo gruppo era costituito da pazienti che hanno ricevuto tracheostomia temporanea dopo laringectomia sovracricoidea (21 pazienti) mentre il gruppo di controllo era costituito da pazienti che hanno ricevuto tracheostomia temporanea per altre cause (18 pazienti). I seguenti fattori di rischio ritenuti svolgere un ruolo nella patogenesi della fistola tracheocutanea sono stati esaminati: età avanzata, cardiopatie, infezioni locali, radioterapia adiuvante, elevato indice di massa corporea, malnutrizione, tempo di decannulazione e grado di aspirazione. Il punteggio della scala di Leipzig e Pearson era significativamente più alto nel gruppo sottoposto a laringectomia sovracricoidea (p = 0,006 e 0,031 rispettivamente all'analisi univariata e multivariata). Il punteggio della scala penetrazione/aspirazione era significativamente più alto nel gruppo sottoposto a laringectomia sovracricoidea, come determinato dall'analisi univariata (p = 0.014). Il tempo di decannulazione era significativamente più basso nel gruppo sottoposto a laringectomia sovracricoidea (p = 0,004 e 0,0004 rispettivamente all'analisi univariata e multivariata). Il numero di procedure chirurgiche richieste per la chiusura della fistola tracheocutanea era significativamente più alto nel gruppo sottoposto a laringectomia sovracricoidea, come determinato dall'analisi univariata (p = 0,027). Questi risultati suggeriscono che l'aspirazione cronica e la tosse correlata potrebbero essere importanti fattori di rischio per fistola tracheocutanea e potrebbero essere responsabili del significativamente più alto tasso di fallimento di chiusura della fistola in pazienti sottoposti a laringectomia sovracricoidea.

PAROLE CHIAVE: Aspirazione • Penetrazione • Laringectomia sovracricoidea • Deglutizione • Fistola tracheocutanea

Introduction

Tracheocutaneous fistula (TCF) is commonly regarded as a pathological complication of temporary tracheostomy that results from the failure of spontaneous tracheostomy closure after decannulation. Chronic TCF can significantly impair quality of life, vocalisation and local hygiene¹. Although many of these fistulas close spontaneously after decannulation or after local debridement, a significant percentage do not and require surgical closure². The incidence of fistula formation is known to be related to cannulation time. Kulber et al. reported that fistulas do not develop if the cannulation time is less than 16 weeks, but that the incidence increases to 70% when the cannulation period is greater than 16 weeks³. Furthermore, other factors such as previous irradiation of the neck, previous tracheostomy and obesity have been suggested to be risk factors for TCF⁴.

Despite the fact that TCF is a common complication of supracricoid partial laryngectomy (SPL) and that SPL has been used for a number of decades⁵⁻⁷, there is a paucity of studies in the English language literature on its incidence, risk factors and pathogenesis in patients undergoing SPL. In our experience with SPL, tracheostomy closure after decannulation occurs spontaneously or after local debridement in about 70% of cases, while in about 30% of cases surgery is required. After SPL, TCF surgical closure is challenging since the laryngeal airway can be suboptimal and abnormal increases in subglottic pressure during the expiration phase can be present⁵⁻⁷. Nonetheless, patients who have undergone SPL are often chronic inhalers with different degrees of cough⁸, which could represent a further obstacle characterised by a sudden and strong increase in subglottic pressure.

The aim of the present retrospective controlled study was to analyse and compare the incidence of potential risk factors for TCF between patients who underwent SPL and those who received tracheostomy for other causes.

Materials and methods

This study was designed as a retrospective controlled evaluation of patients who underwent surgical TCF closure at the Sensory Organs Department of Policlinico "Umberto I", Sapienza Università di Roma between September 2007 and May 2013. Approval for this study was obtained from the local Institutional Review Board.

Patients

Inclusion criteria were as follows: 1) adequate clinical documentation; 2) adequate respiratory space before decannulation (i.e. the ability to maintain a closed tracheal cannula for at least 7 days before decannulation); 3) absence of steroid therapy for at least 1 month before decannulation; 4) adequate swallowing and/or adequate swallowing rehabilitation therapy; 5) adequate follow-up (at

least 6 months after surgical TCF closure); and 6) TCF persistence for at least 2 weeks post-decannulation. Tracheostomies were performed by the same surgical team using the Bjork flap technique⁹. Patients with previous histories of decannulation were excluded from the study. A total of 39 patients were enrolled.

Risk factors and comorbidities

The medical records of identified patients were examined for the following risk factors that are believed to play roles in the wound healing process: advanced age, cardiopathy, local infections, neck radiotherapy, body mass index (BMI) and malnutrition. Advanced age was defined as greater than 65 years. Cardiopathies were considered in cases of diagnosed diseases that had been treated with medications or lifestyle changes. Local infections were defined as tracheostomal infections with or without fistulae that required systemic antibiotic treatment and/or advanced local dressings. Neck radiotherapy included primary and adjuvant treatments. Overweight patients were defined as those with a BMI > 25. Malnutrition was defined as > 10% weight loss in the 20 days before surgery due to reduction in oral food intake.

Furthermore, we evaluated other clinical factors that are possibly implicated in the pathogenesis of TCF such as delayed decannulation (> 16 weeks), chronic inhalation and related cough. Assessments of inhalation were obtained for each patient using the Leipzig and Pearson scale^{10 11} (LPS) and the Penetration Aspiration Scale¹² (PAS); these scales evaluate the degree of penetration/aspiration. The LPS is scored as follows: 0, no problems; 1, occasional cough but no clinical problems; 2, constant cough worsening with meals or swallowing; and 3, pulmonary complications. The PAS is scored as follows: a, contrast does not enter the airway; b, contrast enters the airway and remains above the vocal folds with no residue; c, contrast remains above the vocal folds, and visible residue remains; d, contrast contacts the vocal folds, and no residue is present; e, contrast contacts the vocal folds, and visible residue remains; f, contrast passes the glottis, and no subglottic residue is visible; g, contrast passes the glottis, and visible subglottic residue is present despite the patient's response; and 8, contrast passes the glottis, and visible subglottic residue is present in the absence of a patient response.

Patients were divided into 2 groups. The first consisted of patients with TCF after SPL (SPL group), while the control group included patients with TCF after bilateral vocal cord palsy, transoral laser surgery for malignancy, open oral/oropharyngeal carcinoma surgery, or prolonged intubation (OC group). Even if the control group was composed of patients who had undergone tracheostomy for different causes, in all cases main laryngeal architecture was preserved and no upper airway strictures responsible for increased upper airway resistance were present.

TCF surgical closure

TCF closure was performed for all patients using the same surgical technique under local anaesthesia. A horizontal skin incision passing through the lower border of the TCF was made followed by a second incision circling the TCF border. When possible we repositioned the cartilage flap obtained after Bjork flap technique tracheostomy. The tracheocutaneous fistula was isolated and vertically closed using 3/0 vicryl suture. Skin flap was reapproximated using 3/0 subcutaneous vicryl suture. The redundant skin was trimmed to obtain a horizontal cosmetic suture, and closure of the skin was completed using 4/0 silk suture. Oral antibiotic therapy was administered for 9 days.

Statistical analyses

Statistical analyses were performed using SPSS 15.0 for Windows. Comparisons of qualitative variables were performed with the chi-square test. Multivariate analysis was performed with multiple logistic regression. P values < 0.05 were considered statistically significant.

Results

Within the study period, 83 patients underwent SPL in our department. Twenty-seven (32%) developed TCF, and 6 (7%) patients were excluded because they did not meet inclusion criteria. In the same period, 127 tracheostomies were performed for other reasons. Twenty (16%) developed TCF, and 2 (1.5%) cases were excluded because they did not meet inclusion criteria. The incidence of TCF between SPL patients and those who received tracheostomy for other reasons was statistically significant ($p = 0.007$). All TCF derived from the failure of conservative TCF closure strategies after decannulation such as fistula debridement with compressive dressings. Relevant demographics and patient characteristics, including primary pathologies for the OC group, are reported in Table I. Given our inclusion and exclusion criteria, we enrolled a total of 39 patients with TCF, and of these 21 (54%) patients were

enrolled after SPL (SPL group), while 18 (46%) received tracheostomy for other reasons (OC group).

TCF closure was accomplished successfully in all cases. All patients experienced regular postoperative courses during the first week without complications in terms of bleeding and airway compromise. Four patients (10%) experienced foreign body reactions to the absorbable sutures that required small incisions for their removal. Among the SPL group, 9 patients (43%) required more than 1 surgical treatment: 7 (33%) required 2 treatments, and 2 (10%) required 3 treatments. In the OC group, only 1 patient (6%) required more than 1 surgical treatment (2 treatments). When the residual fistula was less than 2 mm in diameter, the surgical technique consisted of debriding of margins and closure with simple suture; otherwise, the technique described above was utilised.

The risk factor data are summarised in Table II. When comparing the two groups, the overall multivariate model revealed a statistically significant difference ($p = 0.003$). However, there were no significant differences between the SPL and OC groups in terms of advanced age, cardiopathies, local infection, neck radiotherapy, BMI, or malnutrition ($p > 0.05$). LPS scores were significantly higher in the SPL group according to univariate and multivariate analyses ($p = 0.006$ and 0.031 , respectively), with $t = 2.25$ and standard error = 0.11. The PAS scores revealed penetration/aspiration in 39% of cases in the SPL group and in 17% in the OC group. This difference was statistically significant in univariate analysis ($p = 0.014$), but not in multivariate analysis ($p = 0.561$, $t = 0.58$, standard error = 0.08). Decannulation times were significantly lower in the SPL group according to univariate and multivariate analyses ($p = 0.004$ and 0.0004 , respectively), with $t = -3.99$ and standard error = 0.15. The numbers of surgical procedures were significantly higher in the SPL group according to univariate analysis ($p = 0.027$, Table III).

Discussion

TCF is a complication of temporary tracheostomy that results from the failure of spontaneous tracheostomy closure after decannulation that can significantly impair quality of life, vocalisation and local hygiene^{12 13 14}. Despite its clinical impact, there are few studies in the English literature on its risk factors and pathogenesis. Although decannulation time seems to be the only universally accepted risk factor for TCF, previous irradiation of the neck, previous tracheostomy and obesity have been suggested to be risk factors for TCF. Incidences of TCF up to 70% have been reported when tracheostomies are maintained for more than 16 weeks³. However, further investigations are needed to confirm the roles of the currently suspected risk factors and to identify new ones. Agents affecting wound healing could potentially represent risk factors for TCF, and for this reason we included data on age, cardiopa-

Table I. Demographics and comorbidities.

Characteristics	
Mean age (years)	59.3
Age range (years)	32-80
Gender, N (%)	
Male	27 (69)
Female	12 (31)
Tracheostomy for (N, %):	
Supracricoid laryngectomy	21 (53)
Bilateral vocal cord palsy	7 (18)
Transoral laser surgery for malignancy	5 (13)
Open oral/oropharyngeal carcinoma surgery	3 (8)
Prolonged intubation	3 (8)

Table II. Univariate and multivariate analysis of risk factors.

Characteristic	SPL (21)	OC (18)	p univariate	p multivariate
Age, N (%)				
≥ 65 years	8 (38)	5 (28)		
< 65 years	13 (62)	13 (72)	0.733	0.153
Cardiopathy, N (%)				
present	5 (24)	3 (17)		
absent	16 (76)	15 (83)	0.878	0.168
Local infection, N (%)				
present	2 (10)	2 (11)		
absent	19 (90)	16 (89)	0.714	0.788
Radiotherapy, N (%)				
yes	6 (29)	3 (17)		
no	15 (71)	15 (83)	0.618	0.666
BMI				
≥ 25	3 (14)	5 (28)		
< 25	18 (86)	13 (72)	0.520	0.192
Malnutrition, N (%)				
present	3 (14)	1 (6)		
absent	18 (86)	17 (94)	0.714	0.711
Leipzig and Pearson Scale, N (%)				
0	5 (24)	13 (72)		
1	8 (38)	4 (22)		
2	8 (38)	1 (6)	0.006	0.031
Penetration-Aspiration Scale, N (%)				
1	13 (62)	17 (94)		
2	3 (14)	1 (6)		
3	3 (14)	-		
4	2 (10)	-	0.014	0.561
Decannulation time, N (%)				
≤ 16 weeks	14 (67)	3 (17)		
> 16 weeks	7 (33)	15 (83)	0.004	0.0004

BMI: body mass index; Bolded values: statistically significant.

thies, local infections, neck radiotherapy, BMI and malnutrition¹⁵⁻¹⁸.

In the light of our long-term experience with SPL, we were interested in investigating the role of chronic cough and aspiration in the pathogenesis of TCF. SPL causes important alterations to the normal anatomy of the upper digestive tract, particularly in its intersection with the airways⁵⁻⁷. Postoperative sequelae affecting swallowing and phonation are always present, and postoperative rehabilitation is required. Although functional deglutition is usually recovered and allows the patient to be decannulated, sporadic episodes of aspiration can occasionally occur. In a previously published series of 116 patients, our group reported that chronic aspiration was suspected in 68% of patients, based on fibre optic endoscopic evaluation of swallowing and radiologically documented with videofluoroscopy in 39% of cases. On these bases, at least three mechanisms that could delay the tracheos-

tomy closure in SPL patients can be hypothesised: 1) aspiration with chronic coughing that is related to sudden and important increases in subglottic pressure; 2) inhaled saliva that, due to proteolytic activity, may be responsible for fibrin digestion and delays in wound healing; and 3) stenotic neoglottal space with abnormal increases in subglottic pressure during the expiration phase. In the current study, we quantified chronic cough and inhalation using the LPS^{10,11} (cough grade) and the PAS¹² (inhalation grade). We also collected data on the surgical success of TCF, quantifying and comparing the number of surgical procedures between the SPL and OC groups.

Our results showed that advanced age, cardiopathies, local infections, neck radiotherapy, BMI and malnutrition were not significantly different between the SPL and OC groups (Table II). Thus, these variables had the same potential impact in the SPL group as in the OC group. Interestingly, decannulation times were significantly low-

Table III. Surgical procedures.

Surgical Procedures, N (%)	SPL (21)	OC (18)	p
1	12 (57)	17 (94)	
2	7 (33)	1 (6)	
3	2 (10)	-	0.027

er in the SPL group by both univariate and multivariate analyses ($p = 0.004$ and 0.0004 , respectively). TCF occurred after 16 weeks in 33% of cases in the SPL group compared with 83% in the OC group. While the data on the OC group conform with the previous literature, the results in the SPL group show that the incidence of TCF was not influenced by delayed decannulation^{19,20}. The prevalence of penetration/aspiration was higher in the SPL group (38% SPL group, 6% of OC group), with a difference that was statistically significant in univariate analysis ($p = 0.014$). Furthermore, LPS scores were significantly higher in the SPL group in both univariate and multivariate analyses ($p = 0.006$ and 0.031 , respectively). Finally, the numbers of surgical procedures were significantly higher in the SPL group by univariate analysis ($p = 0.027$, Table III). In cases in which the TCF failed to close, patients complained of saliva leakage through the surgical wound. These findings were consistent with our hypothesis and were strengthened by the results of PAS and LPS scores.

To our knowledge this is the first study to investigate the risk factors and pathogenesis of TCF in SPL patients. We showed that the incidence of TCF was significantly higher in SPL patients. The incidence/prevalence of commonly recognised risk factors and factors affecting wound healing were not statistically different between the SPL and OC groups, while chronic aspiration and related cough were significantly higher in the SPL group. Based on these results, we hypothesise that TCF in SPL patients has a different pathogenesis compared to that in patients who received tracheostomy for other pathologies. Chronic cough and aspiration could play an important role favouring the onset of TCF, independent of decannulation timing, and may also influence the surgical failure and relapse rate.

On this basis, as recently advocated by Schindler et al.²¹, patients should be prepared for subsequent endoscopic surgery, laser surgery, or injective laryngoplasty in order to correct the anatomic and functional results of SPL, to achieve the best laryngeal function possible and to minimise complications such as TCF.

Finally, in order to better clarify the role of chronic cough and aspiration further studies are needed. It would be particularly desirable to conduct a prospective study investigating possible correlations between the degree of chronic cough and aspiration with the incidence and relapse rate of TCF using spirometric data (in particular FEV1).

Conclusions

The results of our experience suggest that chronic aspiration and related cough with saliva leakage should be investigated as pathogenetic factors in TCF formation and closure failure in patients who have undergone SPL.

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