



Tracheal resection and anastomosis, continuous versus separated stitches: an experience of 15 years

Resección traqueal y anastomosis, puntos continuos versus separados: una experiencia de 15 años

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ABSTRACT. Introduction: prolonged ventilation and advances in medical care have resulted in an increase in the number of laryngotracheal injuries related to orotracheal intubation. Other etiologies such as tumors, blunt trauma and the performance of tracheostomies generate obstructive airway problems. **Material and methods:** a series of cases was carried out on all patients in whom tracheal resection and anastomosis were performed at the Bajío High Specialty Regional Hospital during the years 2007 to 2022. The data were analyzed with the Statistical Package for the Social Sciences (SPSS) version 25 program. **Results:** a total of 37 patients were collected. The main surgical indication was post-intubation stenosis, of which grade III was the most frequent. Only one patient presented re-stenosis requiring a T-cannula. No recurrent paralysis was detected. **Discussion:** the distribution by sex and average age is similar to other studies already published. No patient had a history of chronic obstructive pulmonary disease. In the patients evaluated, it was not necessary to perform supralaryngeal tracheal release maneuvers. **Conclusions:** tracheoplasty is a procedure with a low number of complications and is effective.

Keywords: tracheal resection, tracheal anastomosis, tracheal stenosis, tracheoplasty, tracheal tumor.

RESUMEN. Introducción: la ventilación prolongada y los avances en el cuidado médico ha resultado en un incremento en el número de lesiones laringotraqueales relacionadas a la intubación orotraqueal. Otras etiologías como tumores, trauma contuso y la realización de traqueotomías generan problemas obstructivos de la vía aérea. **Material y métodos:** se realizó una serie de casos de todos los pacientes en los que se efectuó resección traqueal y anastomosis en el Hospital Regional de Alta Especialidad del Bajío durante los años 2007 a 2022. Los datos se analizaron con el programa *Statistical Package for the Social Sciences* (SPSS) versión 25. **Resultados:** se recopilaron un total de 37 pacientes. La principal indicación quirúrgica fue estenosis posintubación de entre las cuales el grado III fue la más frecuente. Sólo un paciente presentó reestenosis con necesidad de cánula en T. No se detectó ninguna parálisis recurrente. **Discusión:** la distribución por sexo y la edad promedio es similar a otros estudios ya publicados. Ningún paciente tuvo antecedente de enfermedad pulmonar obstructiva crónica. En los pacientes evaluados no fue necesaria la realización de maniobras de liberación traqueal supralaríngeas. **Conclusiones:** la traqueoplastia es un procedimiento con bajo número de complicaciones y efectivo.

Palabras clave: resección traqueal, anastomosis traqueal, estenosis traqueal, traqueoplastia, tumor traqueal.

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INTRODUCTION

Tracheal resection and anastomosis is a surgical procedure, in which part of the trachea is removed to subsequently restore its continuity by using a tension-free anastomosis between the residual rings, mostly in order to resolve the tracheal obstruction that in many cases is due to stenosis.¹ Prolonged ventilation and advances in critical care, cardiopulmonary surgery and neurosurgery have resulted in an increase in the number of laryngotracheal injuries related to tracheal intubation. The COVID-19 pandemic has resulted in an increased number of mechanically ventilated patients which, associated with tracheal mucosal changes

secondary to the viral infection, increases the incidence of post-intubation stenosis.² Blunt tracheal trauma and placement of a tracheostomy tube can lead to granulation tissue and subsequent airway obstruction.³

MATERIAL AND METHODS

Patients. Data were obtained for patients who underwent tracheal resection with tracheoplasty at the Hospital Regional de Alta Especialidad del Bajío during the period from 2007 to 2022. All patients presented an obstructive pattern of respiratory function and none reported alterations in swallowing. In regard to the surgical technique, the one described by Grillo and collaborators⁴ was used, with some modifications according to the consideration of the treating surgeon. The obtained surgical pieces were analyzed in order to classify the stenosis grade by using the Myer-Cotton classification.

Variables. General information regarding sex, age, cause of stenosis, degree of stenosis (Myer-Cotton classification in surgical pieces), number of resected rings and concomitant diseases was included.

Statistics. The obtained data were compiled in an Excel spreadsheet table (Microsoft) and then analyzed statistically with the SPSS version 25 program. Quantitative variables were described by central tendency measures. The χ^2 test was used to describe associations between qualitative variables and Student's t-test between quantitative variables. A p value < 0.05 was considered significant in all tests.

RESULTS

A total of 37 patients was compiled, of whom 24.3% were female and 75.7% were male. The mean age was 32.27 years. The cause of tracheal stenosis was prolonged intubation in 91.9% of cases, tracheal trauma in 5.4% and tracheal tumor in 2.7%. In regard to concomitant diseases, 8.1% of the patients had diabetes and 2.7% had arterial hypertension.

Myer-Cotton classification divides our patients in 35.1% grade I, 5.4% grade II, 40.5% grade III and 16.2% grade IV.

As part of the initial management, 37.8% of the patients were tracheostomized and 16.2% underwent dilatation. All patients underwent resection with end-to-end anastomosis by the Thoracic Surgery Service of the Hospital Regional de Alta Especialidad del Bajío. Cricotracheal anastomosis was performed in 8.1% and tracheotracheal anastomosis in 91.9%. The anastomosis was performed with synthetic, absorbable, multifilament suture (polyglactin 910) in all cases, using continuous suture in 40.5% of patients and separate stitches in 59.5%. Regarding the number of resected rings, the mean was 3.6 rings. The average surgical bleeding was 115 mL. No drainage was left in any of the cases.

Table 1: Demographic and surgical data of the patients studied.

Variable	n (%)
Age (years)*	32.27 ± 14.47
Gender	
Female	9 (24.3)
Male	28 (75.7)
Comorbidity	
Systemic arterial hypertension	3 (8.1)
Diabetes mellitus	1 (2.7)
Cause of stenosis	
Prolonged intubation	34 (91.9)
Trauma	2 (5.4)
Tracheal tumor	1 (2.7)
Initial management	
Tracheostomy	14 (37.8)
Dilatations	6 (16.2)
Tracheoplasty	17 (45.9)
Stenosis grade (Myer-Cotton)	
I	13 (35.1)
II	2 (5.4)
III	15 (40.5)
IV	6 (16.2)
Resected rings	
2	3 (8.1)
3	13 (35.1)
4	14 (37.8)
5	7 (18.9)
Type of anastomosis	
End-to-end	34 (91.9)
Cricotracheal	3 (8.1)
Type of stitches	
Continuous	15 (40.5)
Detached	22 (59.5)
Bleeding (mL)*	115.4 ± 108.28
Complications	1 (2.7)

* Value expressed in mean ± standard deviation.

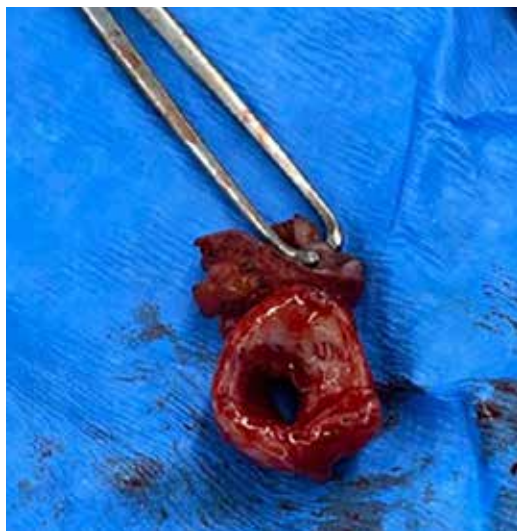


Figure 1: Surgical piece of tracheal resection. The clear decrease in the tracheal lumen can be seen.

Regarding the final results, the problem that indicated surgery was resolved in 97.2% of the patients. Only one subject presented restenosis and required management with a continuous T-cannula due to the patient's rejection of other treatment methods. No recurrent paralysis or complications related to the surgical wound (seromas, hematomas, infections) were detected. There was no relationship between suture type and restenosis ($p = 0.403$). Patient demographic and surgical data are summarized in [Table 1](#).

DISCUSSION

Tracheal resection was reported in adults for the first time by Conley in 1953 and subsequently by Gerwat and Bryce in 1974 in children.⁵

The male preponderance in this type of procedure has been previously reported in studies of patients with post-intubation tracheal stenosis;^{3,6-11} However, in studies in which patients with tracheal tumors are included, the distribution by sex is similar¹² or even inverted^{13,14} due to the higher female prevalence in thyroid tumors.^{12,14}

The mean age of the patients was similar to that published in other studies;^{3,6,8} although the type of patient analyzed in these studies must be taken into consideration. Post-intubation tracheal stenosis was the main indication in our hospital. One patient underwent tracheal resection due to tracheal tumor with histopathologic report of a 1.5×1 cm well-differentiated neuroendocrine neoplasm with tumor-free proximal and distal borders. Patients with resections secondary to neoplasms on average are older.¹²

Despite the scarce presence of comorbidities in patients treated at our institution, the absence of chronic obstructive

pulmonary disease, which is the most frequent respiratory disease in most studies, is notable.^{7,15}

The technical difficulty varies depending on the site and severity of the stenosis. Grades III and IV according to the Myer-Cotton classification were the most frequent in the literature.^{6-8,15,16} In our study, most of the patients had grade III stenosis. It is notable that the second group in terms of frequency is grade I cases. On reviewing the clinical records of these patients, we found multiple endoscopic dilatations and/or use of tracheostomy with failure of decannulation. These variations with the literature may be due to the fact that for this study the patients were classified considering the surgical piece obtained ([Figure 1](#)) and not the pre-surgical bronchoscopic/tomographic findings ([Figure 2](#)).

The surgical approach in all patients was the transcervical incision as it allows resection of lesions as low as the T1 level. No patient presented lesions below this level or close to the carina, therefore other approaches such as sternotomy or thoracotomy were not necessary.

The performance of suprahyoid tracheal release maneuvers¹⁷ has been described and their performance carries a risk of post-surgical dysphagia.⁸ In our series, these mobilization maneuvers were not necessary and tension-free anastomosis was achieved in all cases.

The number of resected rings is in agreement with some of the studies consulted.^{2,6,11,18} Regarding the suture technique, there are only two studies that explored this question. The observational study and review by Ziaian B and associates¹⁹ concluded that patients treated with continuous suturing had a shorter operative time, but no change in the final outcome beyond a small reduction in the percentage of restenosis. The study developed by Kutlu²⁰



Figure 2: Three-dimensional reconstruction of computed axial tomography. It shows concentric tracheal stenosis.

evaluated patients who underwent sleeve bronchoplasty using continuous stitches, concluding that there is no difference in outcomes compared to other similar studies using interrupted sutures. In our study there were no statistically significant differences in the final outcome (complications), so we consider that this is a topic that requires much more study and it is surprising how limited the scientific evidence on the effectiveness and safety of the different suturing techniques is, considering the wide acceptance of separate stitches.

No patient had postsurgical tracheostomy. The «guardian» suture from the chin to the sternum was used in only 15 cases without finding tracheal dehiscence or increased postoperative complications in patients in whom it was not used.

Our series had a cut-off point in 2022, at which time there was no evidence of an increase in the number of patients with tracheal stenosis undergoing tracheoplasty. Although a history of COVID-19 infection has been described as a risk factor for restenosis,² the only patient who presented this complication in our series underwent surgery in 2014.

Among patients with tracheal stenosis, there were no major complications, which is consistent with the literature consulted and confirms that tracheoplasty is a safe and effective procedure for the treatment of this pathology.²¹⁻²³

CONCLUSIONS

Despite the technical complexity of the procedure, tracheoplasty continues to be a procedure with a low number of complications and effective in clinical practice for the treatment of patients with benign or malignant tracheal stenosis. The present study does not demonstrate a benefit in the placement of the «guardian» suture or in the technique used to perform the anastomosis (continuous versus interrupted).

Conflict of interests: the authors declare that they have no conflict of interests.

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