

ORIGINAL ARTICLE

Reconstruction of benign tracheal stenosis: Experience of a high-level complexity hospital in Colombia

Reconstrucción de estenosis traqueal benigna: experiencia de un hospital de alta complejidad en Colombia

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Abstract

Introduction. The most common cause of benign laryngotracheal stenosis is iatrogenic, secondary to orotracheal intubation. Surgical management continues to be the alternative that has shown better long-term results. The objective of this study was to analyze the experience in the surgical management of laryngotracheal stenosis for 15 years in a high-level complexity hospital in Colombia.

Methods. Medical records of patients treated with reconstruction of benign tracheal stenosis between 2005 and 2020 were reviewed. Descriptive statistical methods were used, with frequency analysis and measures of central tendency or dispersion.

Results. Thirty-eight patients with laryngotracheal stenosis were identified, with a variable degree of stenosis. Nasofibrolaryngoscopy was well tolerated and safe to determine the degree and length of the stenosis. The use of tomography served to determine the extension and anatomical characteristics. The results of the present study are similar to those of the literature in terms of complications, mortality and failure of the anastomosis. The most frequently reported complications are restenosis, surgical site infection, nerve injury, and fistula, which generally occur in one third of patients.

Conclusions. The experience of surgical management of laryngotracheal stenosis in our hospital allows us to conclude that tracheal reconstruction is a safe option in our environment. Treatment success and failure rates are comparable to those reported in the literature.

Keywords: trachea; tracheal stenosis; tracheal intubation; reconstruction; thoracic surgery.

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Resumen

Introducción. La causa más común de estenosis laringotraqueal benigna es iatrogénica, secundaria a intubación orotraqueal. El manejo quirúrgico sigue siendo la alternativa que ha mostrado mejores resultados a largo plazo. El objetivo de este estudio fue analizar la experiencia en el manejo quirúrgico de la estenosis laringotraqueal durante 15 años en un hospital de alta complejidad en Colombia.

Métodos. En este estudio se revisaron las historias clínicas de todos los pacientes tratados con reconstrucción de estenosis traqueal benigna, entre los años 2005 y 2020. Para el análisis estadístico se usaron métodos de estadística descriptiva, con análisis de frecuencias y medidas de tendencia central o de dispersión.

Resultados. Se identificaron 38 pacientes con estenosis laringotraqueal, con un grado variable de estenosis. La nasofibrolaringoscopia fue bien tolerada y segura para determinar el grado y la longitud de la estenosis. El uso de tomografía sirvió para determinar la extensión y las características anatómicas. Los resultados del presente estudio son similares a los de la literatura mundial en cuanto a complicaciones, mortalidad y falla de la anastomosis. Las complicaciones más frecuentemente reportadas son reestenosis, infección del sitio operatorio, lesión nerviosa y fistula, que en general se presentan en un tercio de los pacientes.

Conclusiones. La experiencia de manejo quirúrgico de estenosis laringotraqueal en este hospital permite concluir que la reconstrucción traqueal es una opción segura en nuestro medio. Las tasas de éxito y de falla del tratamiento son equiparables a las reportadas en la literatura.

Palabras clave: tráquea; estenosis traqueal; intubación intratraqueal; reconstrucción; cirugía torácica.

Introduction

The most common cause of benign laryngotracheal stenosis (tracheal or subglottic) is iatrogenic, due to orotracheal intubation¹⁻². In these cases, secondary formation of granulomas may occur at the site of injury and the fibrous tissue leads to stenosis and compromise of the airway lumen. The incidence of post-intubation stenosis varies between 0.6 and 20%, depending on the study²⁻³. The increase in the number of patients with prolonged intubation and advances in critical care have increased laryngotracheal injuries associated with intubation. Keane et al⁴ reviewed the complications associated with orotracheal intubation and found that the factors that are related to tracheal and laryngeal complications are the size of the tube, duration of intubation, presence of trauma during intubation, movement of the tube within the trachea, chemical composition of the tube and the pneumoplug, as well as the pressure of the pneumoplug.

The treatment for laryngotracheal stenosis is based on an accurate assessment of the length and degree of stenosis, and of the peritracheal

anatomy. Flexible bronchoscopy remains the gold standard for this evaluation. Similarly, computed tomography (CT) with volumetric techniques has proven to be a reliable diagnostic tool^{1,5-7}.

The management of tracheal stenosis requires an adequate surgical plan. There are multiple strategies, among which are the use of dilators, balloon expansion, endoscopic laser, and stent placement⁸. Additionally, the stenosis site can be resected, performing a tracheo-tracheal anastomosis with laryngotracheal reconstruction, in cases of subglottic stenosis. Patients in whom the stenosis cannot be resolved using these techniques require permanent tracheostomies. It should be noted that surgical management continues to be the alternative that has shown the best long-term results, despite the fact that there are minimally invasive techniques with promising results^{7,9}.

The use of dilators and minimally invasive techniques is usually sufficient for the management of non-complex benign stenosis, where this treatment is usually curative^{10,11}. In cases where tracheoplasty is necessary, good results have been shown when performed by a multidisciplinary

team with experience in advanced airway management¹²⁻¹⁹.

The literature that exposes the experience in our country is scarce. When carrying out the review of the literature, only one publication was found that addresses the subject²⁰. The objective of this study was to analyze the experience in the surgical management of benign laryngotracheal stenosis over 15 years in a high complexity university hospital in Bogotá, Colombia.

Methods

For this descriptive observational study, the medical records of all patients treated by the Thoracic Surgery Service in conjunction with the Department of Surgery at Hospital Universitario San Ignacio, a tertiary university hospital in the city of Bogotá, Colombia, were reviewed between September 2005 and December 2020, who had undergone nasofibrolaryngoscopy, and if was possible, spirometry or neck CT.

In addition to sociodemographic data, information on the site and degree of stenosis, etiology, forced expiratory volume in 1 second (FEV1), presence or absence of tracheostomy, main symptoms, and treatment were collected in a predesigned format. The evolution of the patients and adverse events or management failure were also reviewed.

For the statistical analysis, descriptive statistical methods were used, with frequency analysis and, when the variables allowed it, measures of central tendency or dispersion.

Results

De los 30 pacientes en los que se menciona el número de anillos traqueales resecaados, en 2 se resecó un solo anillo, en 8 dos anillos, en 7 tres anillos, en 6 cuatro anillos, en 4 cinco anillos, en 2 seis anillos y en 1 diez anillos. A todos se les practicó estudio de anatomía patológica, que descartó malignidad; en general se describe fibrosis, inflamación aguda y crónica, y metaplasia escamosa.

During the study period, 38 patients with laryngotracheal stenosis secondary to orotracheal intubation were treated at our institution (Table 1),

of whom 31 (81.5%) had been in the intensive care unit between 1 and 45 days (mean 6, standard deviation 15; median 6 days). Follow-up time was highly variable, ranging from 1 day to 90 months. CT was necessary in 34 patients (89.5%).

Regarding the surgical technique, the most used approach was cervicotomy (31 patients, 81.6%), the procedure was an emergency in half of the patients and elective in the rest, and 3 patients required transfusion of blood products in the intraoperative. The type of anastomosis was tracheo-tracheal in 32 patients (84.2%), tracheo-cricoid in 5 (13.1%), and tracheo-thyroid in 1 (2.6%). The length of the tracheal resection varied between 1 and 5 cm, with an average of 2.9 cm; in 12 patients (31.6%) the resected length was greater than or equal to 4 cm. Regarding release maneuvers, suprahyoid release was performed in nine (23.7%) patients, carina dissection in five (13.1%), infrahyoid release in four (10.5%), hyoid fracture in three (7.9%), and dissection of the pulmonary hilum in two patients (5.3%).

Of the 30 patients in which the number of resected tracheal rings is mentioned, in two patients only one ring was resected; in eight, two rings, in seven, three rings; in six, four rings, in four, five rings; in two, six rings; and in one, ten rings. A pathological anatomy was performed on all of them, which ruled out malignancy; Fibrosis, acute and

Table 1. General characteristics of the patients (n=38)

Variable	Frecuency (%)
Male	22 (57%)
Age (years)	
Average (SD)*	30 (19)
Median	31
Range	1 - 85
Hospitalization (days)	
Average (SD)	7 (14)
Median	6
Range	3 - 61
Surgical approach	
Cervicotomy	31 (81.6%)
Cervicoesternotomy	6 (15.8%)
Esternotomy	1 (2.6%)

* SD: standard deviation

chronic inflammation, and squamous metaplasia are generally described.

Discussion

Esta serie de casos incluye pacientes con un grado variable de estenosis laringotraqueal. Además de las diferencias en edad, la estenosis varió en severidad, en algunos pacientes afectaba un solo anillo mientras en otro de nuestros pacientes comprometió diez anillos.

Tracheal stenosis is a condition that affects any stage of life, as evidenced by the sample of this study, which included subjects from an infant to an older adult. The common history that all subjects had was orotracheal intubation, a procedure that may be required at any time in life. The performance of tracheostomies, a measure that saves lives, can be temporary or permanent.

This case series includes patients with a variable degree of laryngotracheal stenosis. In addition to differences in age, the stenosis varied in severity, in some patients it affected only one ring while in another of our patients it involved ten rings.

In general, nasofibrolaryngoscopy was well tolerated and safe to determine the degree and length of the stenosis. The use of CT was useful to determine the extent of the stenosis and to specify the anatomical characteristics of each case; this diagnostic method was used when it was not possible to determine the length of the stenosis by nasofibrolaryngoscopy. In the four patients in whom treatment failure occurred, at least one of

the risk factors described by Wright²¹ was identified: resection greater than or equal to 4 cm, laryngotracheal resection, postoperative intubation or extensive maneuvers of tracheal release resection.

The results in this series of patients with laryngotracheal stenosis are similar to those in the literature in terms of complications, mortality, and anastomosis failure (Table 2). This study has, like other series listed in Table 2, the limitations of any retrospective design. Compared with large series, such as that by Grillo at Massachusetts General Hospital, which collected 589 patients between 1965 and 1992, the limited number of subjects reflects the relatively low frequency of the procedure.

The most reported complications in the different studies are restenosis, surgical site infection, nerve injury, and anastomosis fistula, which generally occur in about one third of patients. In our series, the frequency of stenosis (6%) is similar to several of the publications.

In the largest series, a mortality of around 2% is reported, probably attributable to the comorbidities of the operated patients, but in our patients there were no mortality events.

Conclusions

Our experience in the surgical management of laryngotracheal stenosis allows us to conclude that tracheal reconstruction is a safe therapeutic option in our setting, despite the technical com-

Tabla 2. Comparison between similar studies in the literature.

	Our study	Grillo ⁷	Rea ¹³	Laccourreya ¹⁴	Rubikas ¹⁵	Almudhafer ¹⁶	Paris ¹⁷	Couraud ¹⁸	Wynn ¹⁹
Number of patients	38	589	65	32	75	16	81	120	28
Excellent or good	88%	94%	85%	87%	97%	87%	92%	97%	89%
Failure	12%	4%	15%	13%	3%	12%		2%	11%
Mortality	0.0%	2.4%	1.5%	-	2.6%	0.0%	2.9%	2.5%	0.0%
General complication	36%	32%	36%	43%	46%	25%	-	-	-
Anastomotic complication	5%	6%	11%	6%	-	6%	-	-	-

plexity, and with good results in most patients. Treatment success and failure rates are comparable to those reported in the literature¹²⁻²⁰.

Compliance with ethical standards

Informed consent: According to Colombian regulations (Resolution 8430), descriptive studies are of less than minimum risk. Informed consent will not be requested, only the respective permission of the ethics committee for the review of clinical records and database. It is guaranteed that the due confidentiality and privacy of the patients will be kept. The institutional ethics committee approved the study design and methodology.

Conflicts of interest: The authors declare that they have no conflicts of interest.

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Author's contributions:

Conception and design of the study: FAS, MP, HR, JGB, AC.
Data acquisition: JGB.

Data analysis and interpretation: DR.

Drafting the manuscript: DR.

Critical review: FAS, MP, HR, JGB, AC, DR.

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