

ORIGINAL STUDY

Laryngotracheal stenosis: Experience of a hospital in Northwestern Mexico

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ABSTRACT

BACKGROUND. Laryngotracheal stenosis is a process of fibrosis, determined by various etiologies, congenital or acquired, such as traumatic, infectious, autoimmune diseases, that results in airway obstruction. Clinical manifestations may vary from speech alteration to severe breathing impairment, possibly leading to death.

OBJECTIVE. To describe the evolution after surgical treatment of patients diagnosed with laryngotracheal stenosis.

MATERIAL AND METHODS. We performed an observational, descriptive, retrospective cross-sectional study of a series of cases with a diagnosis of laryngotracheal stenosis surgically managed from January 2015 to January 2020. The results of the statistical analysis are represented by graphs and tables.

RESULTS. We included 33 patients with mean age 42.6 years, predominantly male gender 19 (57.58%). The patients presented one or more comorbidities, such as overweight and obesity, which occurred in 54.5% of the cases. The etiology of stenosis was secondary to orotracheal intubation in most of the patients (69.69%) and the most common site was the trachea (42.42%). According to the Cotton-Myer classification, 51.5% of the patients were classified in grade III and, according to McCaffrey classification, 60.6% were included in grade II and III. 28 patients (84.8%) received surgery for stenosis, of which in 64.2% of the cases was endo-laryngeal dilatation. Re-stenosis occurred in 67.5%, successful decannulation was performed in 17.8% and mortality accounted for 7.1%.

CONCLUSION. Although our surgical results pose multiple elements of improvement, the proportion of residual stenosis is still high and mortality is not different from that described by other authors around the world referring to airway surgery.

KEYWORDS: laryngotracheal stenosis, surgery, treatment.

INTRODUCTION

Laryngotracheal stenosis (LTS) is a process of fibrosis that results in airway obstruction, which brings a significant impact on breathing and phonation. Stenosis usually occurs in the proximal larynx or trachea, but may also occur in any region of the upper airways¹.

This pathology was first described by MacEwen in patients with a history of orotracheal intubation^{2,3}, and later, in 1886, by Colles in patients with diphtheria treated by tracheostomy⁴. LTS became increasingly common due to the start of intensive care units in 1950, being treated at that time by dilations. Later, open surgical tech-

niques, dilations topical substances (steroids, anticoagulants, mitomycin c, etc.)⁵ or Laser CO₂ application endoscopically were introduced as viable treatment options.

From the etiology point of view, LTS can be congenital (laryngeal atresia, laryngeal cleft, absence of tracheal rings) or acquired, such as iatrogenic, traumatic, and infectious or autoimmune diseases. In adults, the most frequent cause is traumatic, with tracheal intubation being the main one^{1,5}, and the subglottic region is the most frequently involved^{6,7}.

To determine the size of the stenosis, various scales can be used. The Cotton-Myer classification constitutes the gold standard to establish the

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Table 1. Comorbidities of the patients included in the study group (Source: Otorhinolaryngology Department, Specialty Hospital no 2 "Lic. Luis Donaldo Colosio Murrieta" IMSS, Cd Obregón, Sonora; 2015-2020).

Comorbidity*	Number	Percentage (%)
Overweight to obesity	18	54.55
Arterial Hypertension	14	42.25
Diabetes mellitus 1 and 2	9	27.7
Heart disease	5	15.1
Rheumatoid arthritis	1	3
Lupus erythematosus	1	3
Wegener's disease	1	3
Epilepsy	1	3
Attention deficit	1	3
Thyroid disorders	3	9

*Some patients had more than one comorbidity

Table 2. Etiology of laryngo-tracheal stenosis of the patients included in our study group (Source: Otorhinolaryngology Department, Specialty Hospital no 2 "Lic. Luis Donaldo Colosio Murrieta" IMSS, Cd Obregón, Sonora; 2015-2020).

Etiology of stenosis	Number	Percentage (%)
Prolonged orotracheal intubation*	23	69.7
Firearm	3	9.09
Suicide attempt chemistry	2	6.06
Postoperative/iatrogenic	2	6.06
Autoimmune	1	3.03
Congenital	1	3.03
Idiopathic	1	3.03
Total	33	100

*pOTI \geq 21 days

Table 3. Location of the laryngo-tracheal stenosis in the patients from the study group (Source: Otorhinolaryngology Department, Specialty Hospital no 2 "Lic. Luis Donaldo Colosio Murrieta" IMSS, Cd Obregón, Sonora; 2015-2020).

Location of laryngotracheal stenosis	Number of patients	Percentage (%)
Supraglottic alone	0	0
Glottis	3	9.09
Subglottis	6	18.18
Tracheal	14	42.42
Mixed (supraglottis- subglottis and trachea)	10	30.30

grade of obstruction⁸. It is obtained by endoscopic direct visualization of the larynx and trachea and consists of four grades: Grade I - obstruction of 0-50%; Grade II - obstruction of 51-70%; Grade III - obstruction of 71-99%; Grade IV - no light/ obstruction of 100%⁸⁻¹⁰. McCaffrey's classification is used to determine the length of stenosis, using tomography visualization: Grade 1 - subglottic or tracheal stenosis less than 1 cm; Grade 2 - subglottic stenosis greater than 1 cm; Grade III - the subglottic stenosis wraps the cricoid ring and extends to the upper trachea; Grade IV - glottal injury¹¹⁻¹³. These scales can also be used to select the proper surgical approach.

The treatment for laryngotracheal stenosis is not standardized and continues to be a challenge for the otolaryngologist¹⁴.

No study has yet been conducted in the population of the northwest part of Mexico on the etiology of this pathology, the type of surgical intervention, associated comorbidities and percentage of success or failure in this therapy in our population.

MATERIAL AND METHODS

A review of records was carried out from January 2015 to January 2020 with non-probabilistic sampling of consecutive cases of patients that attended the Otolaryngology service with the diagnosis of laryngo-tracheal stenosis. Variables such as age, gender, comorbidities, stenosis etiology, stenosis subsites, Cotton-Myer and McCaffrey stenosis classification, type of surgical approach,

Table 4. Degree of laryngo-tracheal stenosis, according to the Cotton-Meyer Classification (Source: Otorhinolaryngology Department, Specialty Hospital no 2 "Lic. Luis Donaldo Colosio Murrieta" IMSS, Cd Obregón, Sonora; 2015-2020).

Degree of stenosis, according to Cotton-Myer classification	Number	Percentage (%)
I	9	27.27
II	6	18.18
III	17	51.52
IV	1	3.03
Total	33	100

Table 5. Degree of laryngo-tracheal stenosis, according to McCaffrey Classification (Source: Otorhinolaryngology Department, Specialty Hospital no 2 "Lic. Luis Donaldo Colosio Murrieta" IMSS, Cd Obregón, Sonora; 2015-2020).

Degree stenosis according to McCaffrey	Number	Percentage (%)
I	8	24.25
II	10	30.30
III	10	30.30
IV	5	15.15
Total	33	100

evolution and complications were included.

Statistical analysis used measures of dispersion and central tendency and were represented in graphs and tables.

RESULTS

We identified 37 files, 4 were eliminated for not having the selection criteria, resulting in 33 files. The average age of the patients was 42.6 years (range 11 to 72), 19 males (57.58%) and 14 women (42.42%). The state of origin was: Sonora 18 patients (54.55%), Sinaloa 6 patients (18.18%), Baja California North and South 9 patients (27.27%).

In 21 cases (63.64%), the patients had one or more comorbidities and 12 patients had (36.36%) none. Overweight and obesity occurred in 18 patients (54.55%), followed by systemic arterial hypertension in 14 cases (42.25%) (Table 1).

The main etiology was secondary orotracheal intubation (pOTI) in 23 cases (69.7%) (Table 2). These cases had a pOTI greater than 21 days. When separating the group of patients who developed stenosis by pOTI, we found that 18 (78.26%) had an intubation of ≥7 days, 3 (13.04%) a time ≤ 7 days and 2 (8.69%) 7 precise days. The most frequent site of stenosis was the trachea, in 14 patients (42.42%), followed by the mixed supraglottis-glottis-subglottis and trachea in 10 cases (30.30%) (Table 3). In the Cotton-Myer grade I classification we included 9 patients (27.27%), in grade II 6 patients (18.18%), in grade III classification 17 (51.52%), and one pa-

tient in grade IV (3.03%) (Table 4). Related to the subsites of the laryngotracheal region involved, it was found that, according to McCaffrey's classification, 20 cases (60.60%) were found in grades II and III (Table 5).

Among the 33 procedures, we found that tracheotomy was performed in 5 cases. 28 received some procedure to correct stenosis, among which 9 mixed procedures - open-dilation endo-laryngeal, 1 open-only surgery and 18 endo-laryngeal surgeries (Table 6). Re-stenosis was the most common complication in 19 of 28 patients (67.85%), tracheo-cutaneous fistula in 4 cases and 1 tracheo-esophageal fistula, subcutaneous emphysema in 3 cases, cannula migration, anastomosis dehiscence, and total occlusion with patient death, foreign body reaction in one case. In total, we have a percentage of successful decannulation of 5/28 (17.85%), a mortality of 2/28 (7.14%).

DISCUSSIONS

The average age in our study group was 42.6 years, higher than the data reported by Samaniego et al.¹⁵ of 36.22 years and by Valadez-Caballero et al.¹⁶ of 35.6 years. The distribution of male (57.5%) and women (42.2%) was found to be similar to that referred to by Valadez-Caballero et al.¹⁶, 52% and 48%, respectively. Berrios-Mejia et al.¹⁷ reported that 66.5% of the patients included in their study were male patients.

Considering the associated comorbidities, in 21 patients (64%) one or more comorbidities were present, a higher percentage than that

Table 6. Types of surgical approach and complications performed in the patients with laryngo-tracheal stenosis (Source: Otorhinolaryngology Department, Specialty Hospital no 2 "Lic. Luis Donaldo Colosio Murrieta" IMSS, Cd Obregón, Sonora; 2015-2020)

Procedure performed	Nr.	Cotton-Myer classification	McCaffrey classification	Restenosis	Fistula	Another complication	Presence of tracheotomy	Montgomery's presence	Decannulation	Death	Discharge for improvement	
≠Mixed track	n=9	I. 2	I - 0	-	-	-	-	-	-	-	-	
			II - 2	2	-	-	2	-	-	-	-	
			III - 0	-	-	-	-	-	-	-	-	
			IV - 0	-	-	-	-	-	-	-	-	
		II. 0	I - 0	-	-	-	-	-	-	-	-	-
			II - 0	-	-	-	-	-	-	-	-	-
			III - 0	-	-	-	-	-	-	-	-	-
			IV - 0	-	-	-	-	-	-	-	-	-
		III. 7	I - 1	1	-	-	-	-	1	-	-	-
	II - 3		1	-	-	dehiscence of anastomosis, mobilization of canula	1	2	-	-	-	
	III - 2		2	fistula tc	-	-	1	1	-	-	-	
	IV - 1		1	-	-	reaction to foreign body	1	-	-	-	-	
	IV. 0	I - 0	-	-	-	-	-	-	-	-	-	
		II - 0	-	-	-	-	-	-	-	-	-	
		III - 0	-	-	-	-	-	-	-	-	-	
		IV - 0	-	-	-	-	-	-	-	-	-	
										≠Subtotal	0 (0%)	
	≠√Open surgery	n=1	III. 1	I - 1	-	-	subcutaneous emphysema	-	-	1	-	1
												√Subtotal
	€VIA Endolarynx	n=18	I. 5	I - 2	1	-	M§igration from trachea to bronchus	1	1	-	1	-
II - 1				1	-	-	-	-	1	-	-	
III - 2				2	-	-	-	1	1	-	-	
IV - 0				-	-	-	-	-	-	-	-	
II. 6			I - 0	-	-	-	-	-	-	-	-	-
			II - 1	-	fistula tc	-	-	1	-	-	-	-
			III - 2	2	-	-	-	1	1	-	-	-
			IV - 3	2	esophageal fistula	subcutaneous emphysema	2	-	1	-	1	
III. 6			I - 3	2	fistula tc	subcutaneous emphysema	1	1	1	-	1	
			II - 1	1	fistula tc	-	-	-	1	-	-	
			III - 2	-	-	obstruction of cannula, mobilization with death	2	-	-	-	1	-
			IV - 0	-	-	-	-	-	-	-	-	-
IV. 1			I - 0	-	-	-	-	-	-	-	-	-
			II - 1	1	-	-	-	-	1	-	-	-
			III - 0	-	-	-	-	-	-	-	-	-
			IV - 0	-	-	-	-	-	-	-	-	-
I. 1			I - 0	-	-	-	-	-	-	-	-	-
											€Subtotal	2 (11%)
Total	n=28	28	28	19 (67.5%)			14	9	5 (17.8%)	2 (7.1%)	3 (10.7%)	

Abbreviation: tc - tracheocutaneous

found by Reyes Solarte AJ. in Colombia¹⁸ (25%) and Samaniego et al. in a Military hospital in Mexico¹⁵ (29.7%). Kim et al.¹⁹ describes that a body mass index above 35 was associated with an increase in perioperative complications.

Among the causes of laryngotracheal stenosis, secondary pOTI was found in 23 cases (69.69%), lower to those reported by Valadez-Caballero et al.¹⁶ with 84% and by Berrios-Mejia et al.¹⁷ with 96.8%. Analysing the group of patients who developed stenosis as a result of pOTI, we observed that 18 cases (78.26%) had an intubation of ≥ 7 days, 3 patients (13.04%) intubation of ≤ 7 days and 2 patients (8.6%) 7 precise days. Samaniego et al.¹⁵ reports that laryngotracheal stenosis varies to develop from 20 days to 180 days, with an average of 80.5 days. Some authors mention that the main etiology of laryngotracheal stenosis is the iatrogenic lesions associated mainly with subglottic stenosis. In a cohort study performed by Carpenter et al.²⁰ it was showed that Cotton-Myer grades I and II predominate (76.6%), as well as the female gender (98.7%), Caucasian ethnicity (94.6%), and 4.1% of the cases are tracheostomy-related. In the pediatric population, laryngotracheal stenosis of iatrogenic etiology with subglottic localization is 84.6%; 38.4% had a severe subglottic stenosis, Cotton-Myer grade III and IV. In 48.7% of the children, the initial management was tracheostomy. Of this population, 91% presented good evolution after surgical intervention (endoscopic or open surgery) with a percentage of decannulation of 79.4%, with an average follow-up of 29 months²⁰.

In our study, the most frequent site of stenosis was the trachea, in 14 cases (42.42%), followed by the mixed supraglottis-glottis-subglottis and trachea in 10 cases (30.30%). Our findings were similar to those described by Samaniego et al.¹⁵: subglottic 9 cases (33.4%), tracheal 8 cases (29.6%), glottal 6 cases (22.2%) and combined 4 cases (14.8%). On the other hand, George et al.²¹, in a series of 26 adults, reported a higher frequency of tracheal involvement than us, 76.9% compared to 42.42%, subglottis (3.8%) and mixed (19.2%). Valadez-Caballero et al. stated a 100% tracheal site of laryngotracheal stenosis in a series of 50 patients in the General Hospital of Mexico¹⁶.

According to Cotton-Myer's classification, the LTS stenosis in our study group was of grade I in 27.2% cases, grade II in 18.1% of cases, grade III 51.5% and grade IV 3%. These results were similar to those reported by Samaniego et al.¹⁵ (grade I - 7 cases (25.9%), grade II - 8 cases (29.6%), grade III - 10 cases (37.03%), grade IV - 2 cases (7.4%)) and by Berrios-Mejia et al.¹⁷ and George et al.²¹ in a series of 155 cases (14.2% grade I, 20.6% grade II, 5.8% grade III, 9% grade IV). According to the

subsites of the laryngotracheal skeleton involved, 20 cases (60.6%) were classified as II and III, according to McCaffrey classification. The results were different from what was reported by Bitar et al.²² in a series of 24 patients in Brazil, who identified 4 /25 with classification McCaffrey III and one patient in grade IV.

Some studies show that endoscopic dilations of mild (grade I and II) and short stenosis (<1cm long) have a 40.7% cure rate, 46.3% presented an improvement in relation to symptoms (improvement in a total of 72.2%) and failure of treatment in 13% of the cases, with a follow-up of 12 months^{20,23}. In a cohort study which assessed the efficacy of intralésional mitomycin-C endoscopically in patients with obstruction of 40-100% and a length between 0.5 - 2.5 cm, 63.63% presented a successful treatment free of symptoms for at least 12 months²³. Positive results were reported also by Szabo et al.²⁴. The same observation was made by Feinstein et al.¹⁴ who stated that the application of mitomycin-C in case of subglottic stenosis improved the time interval between procedures from 317 to 474 days.

Different studies mention that, in case of laryngotracheal stenosis of high degree and traumatic origin (Cotton-Myer grade III), the lack of intralésional steroid use is associated with the reduction in time between surgical interventions. The prevalence of comorbidities is also higher, including gastroesophageal reflux disease, type II diabetes mellitus, chronic smoking²⁵.

Of the 28 patients who received some procedure to correct the stenosis, 9 patients underwent mixed procedures - open-endo-laryngeal dilation, 1 open surgery and 18 patients (64.2%) pneumatic dilations by endo-laryngeal route, different from that described by Valadez-Caballero et al.¹⁶ that used open surgery in 50% in a series of 50 patients, but similar to what was reported by Samaniego et al.¹⁵ who performed the endo-laryngeal surgery in 77.8% of the 27 patients included in their study.

Re-stenosis was the most common complication in our series. It was reported in 19 from 28 patients (67.5%), much higher than the data found in the literature (5 to 22%) (18,23,24). Valadez-Caballero et al.¹⁶ described the re-stenosis in 4 out of 50 patients (8%), while Samaniego et al.¹⁵ in 25.9% of the cases in a group of 27 patients. In total, we have a percentage of successful decannulation of 5/28 patients (17.8%), extremely lower than that reported by Berrios-Mejia et al.¹⁷ with 95%. In the literature, the success reports vary from 86% to 100%. We had a mortality of 2/28 (7.1%), similar to that reported by Berrios-Mejia et al.¹⁷ (7.4%) and Carpenter et al.²⁰.

CONCLUSIONS

Our series of cases has demographic characteristics very similar to those described by different national and international authors. However, the results in therapeutic procedures present multiple areas of improvement. The proportion of residual stenosis is still high with the procedure with pneumatic endolaryngeal dilation and mortality is not different from that described by different authors referring to airway surgery. These results give us an opportunity to reflect and redirect the therapeutic measures, the establishment of a multidisciplinary group where the different specialties involved participate, such as pulmonology, chest surgery and otolaryngology, assimilating that the complexity of this pathology is not exclusive to a specialty.

Limitations of the study: This is a retrospective study with a small population, which generates limitations in strongly generalizing our results.

Conflict of interest: All authors declare that there are no conflicts of interest in this work.

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