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Multidisciplinary Treatment of Benign Central Airway Stenoses Post Intubation

Tratamiento multidisciplinario de las estenosis benignas de la vía aérea central post intubación

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ABSTRACT

Background: Postintubation laryngotracheal stenoses are lesions of a benign and progressive nature that pose a challenge to the treatment team. The narrowing of the airway lumen is responsible for increasing dyspnea, which requires rapid and effective diagnosis and treatment methods. This is why it is essential to approach this condition by a multidisciplinary team including thoracic surgeons, bronchoscopists and intensivists.
Objective: To evaluate the results obtained with the surgical treatment of patients with laryngotracheal stenosis previously selected according to the algorithm in a specific period and their complications.
Materials and Methods: The medical records of 57 patients with laryngotracheal stenosis were studied observationally and retrospectively between the years 1996 and 2023, and they were included for surgical treatment: 5 were laryngotracheal and 52 were tracheal. Resection and reconstruction were performed according to the Pearson technique in the first group, and resection with tracheotracheal anastomosis was used in the second group.
Results: Of the total 57 operated patients, 48 had a good postoperative evolution and 9 showed complications, which corresponds to 15.7% of the total. 4 air fistulas and 5 restenosis of the anastomosis were observed. There was no mortality in our series of patients.
Conclusions: Surgery is the best therapeutic option in strictly selected patients with laryngotracheal lesion, a fact corroborated by our experience and the literature. The multidisciplinary approach allows for better diagnostic and therapeutic evaluation, since interventional bronchoscopy allows us to dilate and take patients to surgery in better clinical conditions.

Key words: Laryngotracheal stenosis; Benign; Resection; Anastomosis

RESUMEN

Introducción: Las estenosis laringotraqueales postintubación son lesiones de naturaleza benigna y progresiva que plantean un desafío para el equipo tratante. El estrechamiento de la luz de la vía aérea es responsable de la disnea creciente que obliga a utilizar métodos de diagnóstico y tratamiento de manera rápida y efectiva. Es por ello que resulta indispensable el abordaje de esta patología por un equipo multidisciplinario que incluya cirujanos torácicos, broncoscopistas e intensivistas.

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Objetivo: Evaluar los resultados obtenidos con el tratamiento quirúrgico de pacientes con estenosis laringotraqueales previamente seleccionados según algoritmo en un periodo determinado y sus complicaciones.
Materiales y métodos: Se estudiaron las historias clínicas de 57 pacientes con estenosis laringotraqueal en forma, observacional y retrospectiva entre los años 1996 y 2023 a quienes se incluyó para su tratamiento quirúrgico: 5 fueron laringotraqueal y 52 traqueales. Se realizó resección y reconstrucción según técnica de Pearson en el primer grupo y resección con anastomosis traqueotraqueal en el segundo grupo.
Resultados: del total de n=57 pacientes operados, n=48 tuvieron buena evolución postoperatoria y n=9 presentaron complicaciones que corresponde al 15,7% del total. Se reconocieron n=4 fístulas aéreas y n=5 reestenosis de la anastomosis. No hubo mortalidad en nuestra serie de enfermos.
Conclusiones: La cirugía es la mejor opción terapéutica en aquellos pacientes con lesión laringotraqueal estrictamente seleccionados, hecho corroborado con nuestra experiencia y con la literatura. El abordaje multidisciplinario permite una mejor evaluación diagnóstica y terapéutica, ya que la broncoscopía intervencionista nos permite dilatar y llevar a cirugía a pacientes en mejores condiciones clínicas.

Palabras claves: Estenosis laringotraqueal, Benigna; Resección; Anastomosis

INTRODUCTION

Postintubation laryngotracheal stenosis is defined as scar lesions of benign nature, secondary to orotracheal or tracheostomy intubation, with a progressive and irreversible course.[1-3]

The subglottic stenosis refers to the narrowing of the airway between the glottis (e.g., vocal cords) and the cricoid cartilage. Tracheal stenosis refers to the narrowing of the airway lumen from the cricoid cartilage to the main carina. Laryngotracheal stenosis involves any obstruction that affects the larynx and/or trachea.[1,4,5]

From a physiopathological standpoint, prolonged or traumatic orotracheal or tracheostomy intubation compromises the laryngotracheal blood supply, causing ischemia and parietal necrosis, followed by a progressive scarring and stenotic process.[6-8]

The most common lesions are caused by hyperinflation of the endotracheal tube cuff during prolonged mechanical ventilatory assistance (MVA), or by trauma produced during the performance of a tracheostomy, either from the cuff's traumatic effect or from the tip of the cannula.[1-3,5,9]

The increasingly frequent occurrence of severe trauma in young patients requiring mechanical ventilatory assistance in the Intensive Care Unit is a major factor in the development of these lesions, since traumatic orotracheal intubation without proper attention to technique or without the use of low-pressure cuffs can injure the tracheal wall. Similarly, lesions occur as a consequence of the improper placement of the tracheostomy or if it is performed by untrained personnel.[1-10,11]

The management of this condition represents a challenge for the medical team due to its complexity, the lack of specialized equipment, and the fact that patients often have high demands, as they present with severe functional limitations. For this reason, a multidisciplinary approach to these patients is essential, requiring trained surgeons in surgical treatment, endoscopists experienced in interventional bronchoscopy, anesthesiologists accustomed to advanced management of difficult airways, radiologists, and trained physical therapists.[6,10-12]

The objective of this presentation is to share our experience in the surgical management of this complex and challenging condition, emphasizing the need for multidisciplinary collaboration in treatment.

MATERIAL AND METHODS

Between 1996 and 2023, a total of 18,815 fiberoptic bronchoscopies were performed by the Fiberoptic Bronchoscopy Service of our institution, detecting 657 patients with central airway stenosis (CAS). 57 of them were referred to the thoracic surgery service for surgical resolution, and they are the focus of our presentation. Their medical records were reviewed in an observational and retrospective manner. Figure No. 1 shows the diagnostic and therapeutic algorithm used in our population.

The patients selected for surgery met the following preoperative conditions: absence of MVA, good performance status (grade 0, 1, or 2 according to the ECOG [Eastern Cooperative Oncology Group] scale of performance status), and stenosis length less than 6 cm.

Of the 57 surgically treated patients, 31 were men and 26 were women, with a mean age of 25 years (range: 21–30). The main symptom was dyspnea, followed by stridor in 31 patients. The average duration of MVA was 16 days; and 18 patients had a tracheostomy at the time of admission to our service.

The initial diagnosis was made with fiberoptic bronchoscopy in all patients, revealing laryngotracheal lesions in 5 patients and tracheal lesions in 52. 47 of those 52 were cervical, 4 cervicothoracic, and 1 thoracic. Therapeutic bronchoscopies showed grade 4 or 5 stenosis according to the Freitag classification in 90.3% of cases. All patients underwent cervical and thoracic computed tomography. A flow-volume curve was performed in 50 patients, and helical CT of the trachea with 3D reconstruction and virtual bronchoscopy was performed in 42 individuals. This latter imaging study was essential for determining the location of the stenosis, as well as its length and distance from the cricoid cartilage above and the carina below. Due to progressive dyspnea resulting from the stenotic evolution of these lesions, 28 patients underwent dilation prior to surgery, and in 8 of them, a temporary preoperative stent was placed.

The cause of laryngotracheal stenosis in the 5 patients in our series was incorrect tracheostomy placement, which resulted in a lesion to the cricoid cartilage and the first tracheal rings. This led to fibrosis in three patients, while in the other two, the stenosis was caused by prolonged intubation. In two patients, surgery was performed with a stoma located distal to the lesion. The surgery was performed on an outpatient basis.

The Anesthesiology and Fiberoptic Bronchoscopy Service performed intraoperative orotracheal intubation below the lesion and above the carina under fiberoptic bronchoscope guidance. After the surgical incision was made in the trachea, a spiral tube was inserted into the distal end of the trachea, and the previous tube was withdrawn up to the glottis. After resection of the stenotic area and subsequent anastomosis of the posterior tracheal wall, the spiral tube was removed, and the orotracheal tube was advanced distal to the suture line and above the carina, again under fiberoptic bronchoscope guidance.

Laryngotracheal resection was performed in 4 patients using the Pearson technique, with laryngotracheal anastomosis, while tracheal resection with tracheotracheal anastomosis was performed in 52 patients. 47 of them were approached through transverse cervicotomy, 4 through cervicomanubriotomy, and 1 through posterolateral thoracotomy. In one patient with laryngotracheal lesion, resection was not feasible because the lesion extended beyond 6 cm, resulting in the patient requiring a tracheostomy (figure 2). The critical moment of the surgical procedure is determining the length to be resected, as it must be sufficient to prevent restenosis if too short, yet not so long as to risk an airway fistula. The average length of stenotic trachea resected was 3 cm. Laryngeal release maneuvers were necessary in only two patients to avoid excessive tension on the suture line. The suture was performed in a single layer with interrupted stitches using either non-absorbable or PDS-type material, whether for laryngotracheal or tracheotracheal anastomosis. There was no need to place a Montgomery T-tube across the anastomosis, nor to create a distal stoma beyond the suture.

The physiotherapy service provided postoperative care to all patients, including breathing exercises, secretion management, and especially monitoring for postoperative complications such as recurrent laryngeal nerve paralysis or swallowing dysfunction. None of these complications occurred in our series.

RESULTS

Of the 57 operated patients, 48 had a good postoperative course, while 9 (15.7%) experienced complications. The highest rate of complications

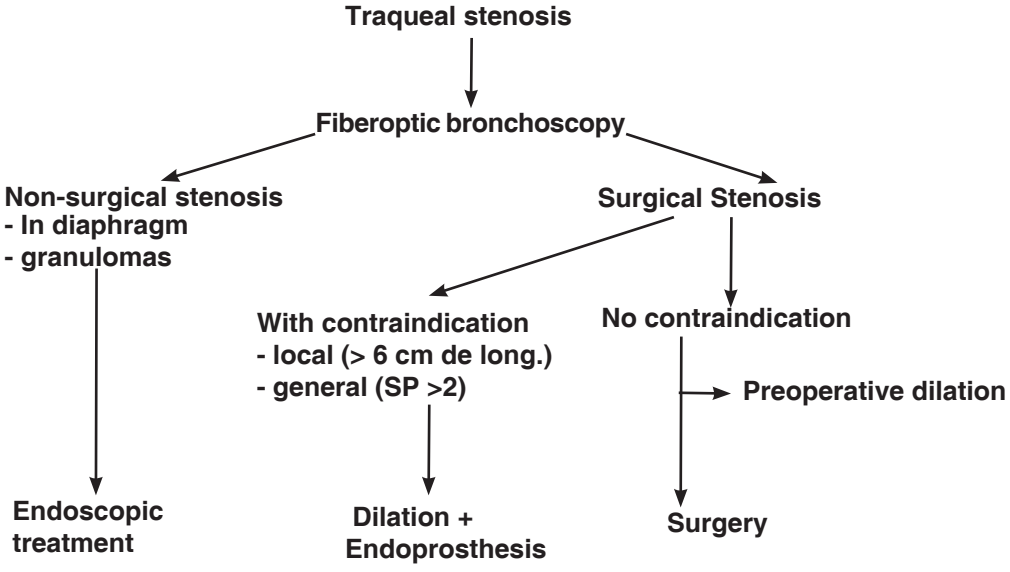
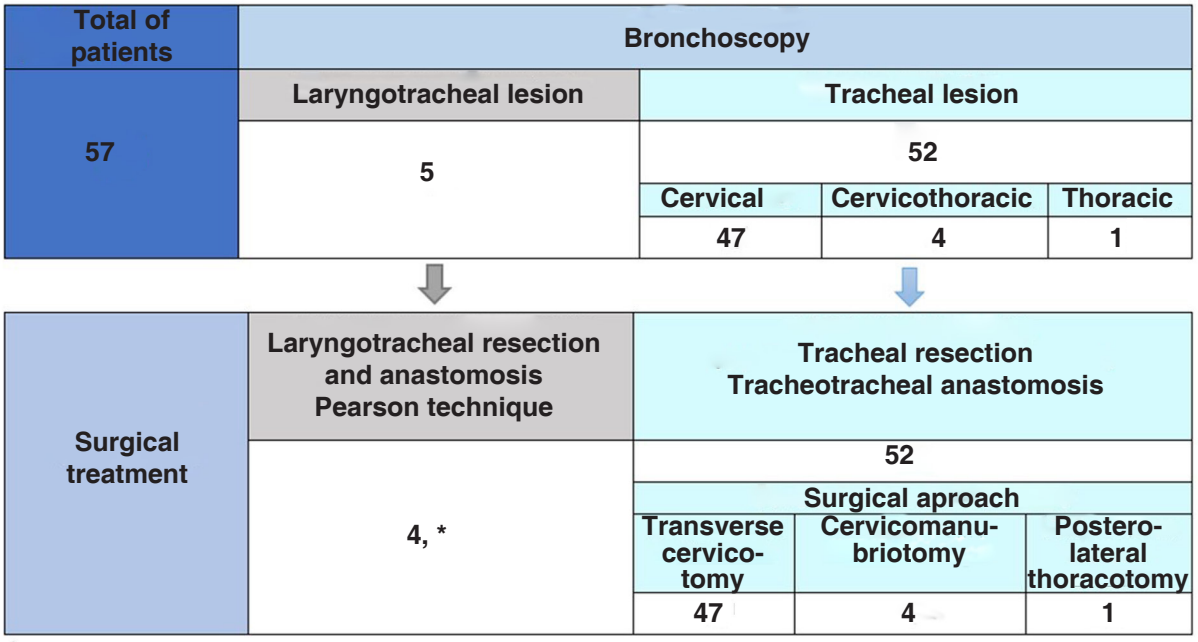


Figure 1. Therapeutic algorithm



* In one patient with laryngotracheal lesion, resection was not feasible because the lesion extended beyond 6 cm, resulting in the patient requiring a tracheostomy.

Figure 2. Localization and surgical approach

was observed in the group of patients with laryngotracheal lesions (2 out of 5). Both patients developed an airway fistula; one required a tracheostomy, and the other underwent stent placement. In the group of patients who underwent tracheal resection, 7 patients out of 52 developed complications. Two of these patients developed an airway fistula: in one case, the fistula closed spontaneously, whereas the other required stent placement. The suture re-stenosed in 5 patients, and was resolved with dilation and stent in 4 subjects, and with distal tracheostomy below the restenosis in 1. Of the total number of patients with tracheal injury complications (7), 6 had undergone preoperative dilation. The unresected patient who underwent tracheostomy had a favorable outcome. There was no mortality in our series of patients.

DISCUSSION

Adequate management of this challenging condition is achievable through strict patient selection criteria and the expertise of a multidisciplinary team. In patients with central airway stenosis who meet the aforementioned selection criteria, surgery is the best therapeutic option –a concept supported by most of the literature and also by our own experience.[3,6,10,11]

The optimal timing for performing resective surgery is after the third month, because by this point the lesion progresses to a stage of chronic fibrosis without acute inflammation, which allows for clear delineation of the length of the parietal lesion.[1,2,8,9,11]

In our series, 84.3% of the operated patients had favorable outcomes (48 out of 57), mostly from the group with tracheal lesions, as patients with laryngotracheal lesions had a higher percentage of postoperative complications (2 out of 5). Interventional bronchoscopy plays a crucial role by enabling treatment of airway stenosis in patients who are not candidates for surgery, as well as managing surgical complications. These complications are typically resolved with stent placement in cases of airway fistula, or with dilation (with or without stent placement) in cases of restenosis.[6,12]

Due to their stenotic and progressive nature, these lesions may also undergo preoperative dilation while awaiting surgery, a procedure performed

in 28 of the 57 patients in our series. However, this preoperative interventional approach carries a higher risk of postoperative complications, as dilation maneuvers are traumatic and cause lesions, parietal hemorrhage, and inflammation. This factor was crucial in the occurrence of complications in our case report, since the 7 patients who developed complications following tracheal resection had all undergone prior dilation while awaiting surgery. Another determining factor in the occurrence of complications was airway infection, as stenosis prevents proper drainage of secretions, which are frequently infected, thereby exerting a deleterious effect on the suture line.[2,8,9]

Laryngotracheal stenoses are complex lesions, difficult to resolve. They usually involve the cricoid cartilage either partially or totally, as well as the first tracheal rings. The technique proposed by Pearson –which includes anterior resection of the cricoid and the affected trachea segment followed by thyrotracheal suture– was the one used in our patients.[3,9, 11] Inclusion of the tracheostoma increased the resection length in 2 patients, resulting in postoperative fistula in both.

CONCLUSION

We consider it important to highlight some diagnostic and therapeutic strategies for proper management of this complex condition:

- In any patient with a history of prolonged orotracheal or tracheostomy intubation presenting with dyspnea and/or stridor, central airway stenosis (CAS) should be suspected.

- Fiberoptic bronchoscopy and helical CT scan of the trachea with reconstruction are two indispensable diagnostic tools. The latter provides information on the length of the stenosis and its relationship to the carina and cricoid. [1,2,4]

- Once the diagnosis of stenosis is confirmed, distal tracheostomy should be avoided whenever possible, as it contaminates the airway and increases the length of the trachea requiring resection.[3,9,11]

Surgical treatment is the best therapeutic option in patients who meet the previously described criteria. The psychological state of the patient and their environment must be considered, as performing surgery on an unstable patient can subject the tracheal anastomosis to sudden stress, increasing the risk of early dehiscence, which is the main cause of early mortality.[1,2,3,11]

Preoperative dilation with rigid bronchoscopy provides temporary relief of symptoms and allows surgery to be scheduled. However, repeated dilations cause additional parietal lesion, increasing the rate of complications.

Management of postoperative complications is usually endoscopic, either with dilation or stenting. This aspect, together with its preoperative diagnostic role, makes it indispensable to have access to an interventional bronchoscopy team.

Conflict of interest
The authors have no conflict of interest to declare.

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