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Management of Tracheal Stenosis in Sub-Saharan Medicalized Context: Real Challenge about Two Clinical Cases

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Abstract

Introduction: Post-intubation tracheal stenosis (STPI) is a complication of ventilatory assistance by intubation and/or tracheotomy. Her frequency is estimated between 10% to 20%. The treatment of choice remains surgery. It is based on tracheal resection-anastomosis which guarantees satisfactory and reliable long-term results. **Objectives:** To determine the frequency of post-intubation tracheal stenosis, to specify the diagnostic and therapeutic methods, to determine the complications and the evolution. **Material and Methods:** This was a study carried out in the ENT and head and neck surgery department of the University Hospital Center Gabriel TOURE. Our study focused on two (02) cases of post-intubation tracheal stenosis (STPI) collected during a period of 1 year (January 2021 to December 2021). **Results:** They are all acquired, secondary to an intubation. The two (02) cases benefited from a tracheal anastomosis resection, the indications of which were specified and the results and complications evaluated. **Conclusion:** Our results show that resection anastomosis remains the reference treatment for STPI.

Keywords

Tracheal Stenosis, Intubation, Tracheostomy

1. Introduction

Post-intubation tracheal stenosis (STPI) is a complication of ventilatory assis-

tance by intubation and/or tracheostomy [1]. Its frequency is estimated between 10% to 20%. Only 1% to 2% of these stenoses are severe and are manifested by a picture of inspiratory dyspnea that does not yield under corticosteroid treatment, in a patient with a history of intubation and/or tracheostomy [2] [3]. Endoscopic and radiological explorations make it possible to study the characteristics of the stenoses in order to adapt an adequate therapy. The treatment includes a medical component and an endoscopic component (instrumental dilation, laser) allowing permeabilization of the tracheal canal. The treatment of choice remains surgery. It is based on tracheal resection-anastomosis which guarantees satisfactory and reliable long-term results [1] [4]. The many studies that continue to be published on this topic confirm the persistence of the problem and the need to seek rational and effective therapeutic solutions while emphasizing prevention, particularly in patients on ventilatory assistance [5]. The objective was to report our experience through 2 clinical cases in the management of post-intubation tracheal stenosis and to review the literature.

2. Means and Methods

This was a study carried out in the ENT and head and neck surgery department of the Center Hospitalier Universitaire (CHU) Gabriel TOURE. It focused on two (02) cases of STPI collected during a period of 1 year (January 2021 to December 2021).

1) Inclusion criteria: All data used in our work were collected from the records of patients in the ENT department of the CHU GABRIEL TOURE. After studying the records of patients who were admitted for treatment of a tracheal stenosis, we selected those acquired (2 cases). These STPIs occurred after a variable time interval following intubation.

2) Exclusion criteria: From our study were excluded:

- Patients lost to follow-up.
- Unusable files.
- Tracheal stenosis by extrinsic compression.
- Tracheal stenosis of tumoral origin.

3) The data recorded in the files concerns: age, sex, nature of the initial pathology, clinical signs, duration of intubation, results of endoscopic and radiological explorations, therapeutic modalities, complications observed during follow-up and treatment.

4) Ethical consideration:

The principles of good medical practice have been observed, i.e., respect for ethics.

3. Results

3.1. Observation 1

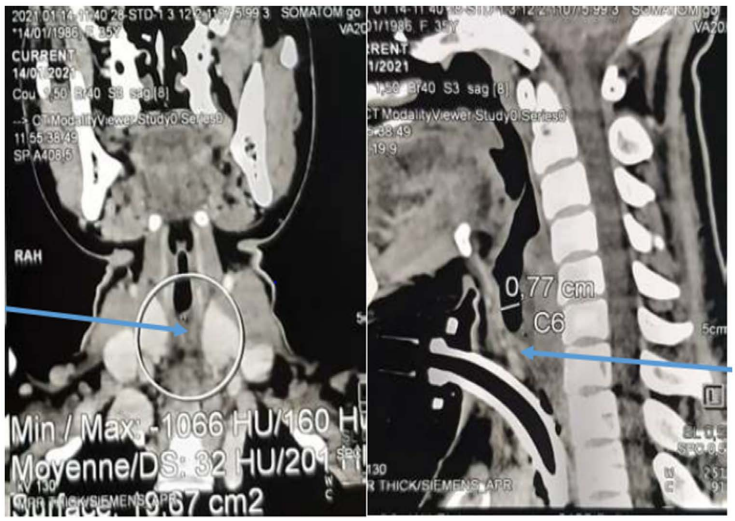
AG, aged 35, housewife, who was seen in consultation for progressive inspiratory dyspnea. One (01) month ago, she underwent a caesarean section for eclampsia.

This surgery was complicated by cardio-respiratory arrest requiring tracheal intubation for months in intensive care. Dyspnea occurring 10 days after extubation was associated with dysphonia. There was no dysphagia, fever, neck pain. She had a history of unmonitored arterial hypertension and an obstetrical history of caesarean section with eclampsia. On general examination, the conjunctivae were stained, no cyanosis, the temperature was at 36.5˚C, the heart rate was at 110 beats/min, the respiratory rate was at 27 cycles/min, the blood pressure was at 130/100 mm/hg.

The ENT physical examination revealed Chevalier Jackson and Pineau stage III dyspnea requiring an emergency tracheostomy (sternal and supraclavicular pulling strong, spinning pulse, high blood pressure, agitated patient). Corticosteroid therapy and antibiotic prophylaxis were instituted.

The cervical computed tomography performed showed a tracheal stenosis next to C6 up to T1 (**Figure 1**). A laryngotracheal endoscopy was performed to clarify the characteristics of the stenosis, it was a complex 2.5 cm stenosis with damage to 2 cartilaginous rings. The biological and radiological operability assessments performed came back normal.

We proceeded to a surgical treatment of the end-to-end tracheal anastomosis resection type under general anesthesia and intubation through the tracheotomy orifice (**Figure 2(a)**). The approach was an arciform cervical incision above the sternum of the Kocher type, the technique adopted was that of Montgomery which combines a section of the mylohyoid and geniohyoid muscles inserted on the superior face of the hyoid bone and the small horns and a section on either side of the body inside the large horns. The trachea-tracheal suture was performed without tension with Vicryl 3.0 curved needle in separate stitches. The suture begins with the posterior plane then the anterior plane by circling an upper and lower ring. A suction drain was placed for 72 hours. We put in place a naso -gastric tube for 10 days. The neck was kept in a neutral position using a



(a) (b)

Figure 1. Cervical CT Blue Arrow showing the stenosis opposite from C6 to T1 in sagittal (a) and coronal (b) sections.

suture to avoid hyper-extension for 2 weeks (Figure 3(a)). We did not encounter any difficulties during the surgery. The patient stayed in intensive care for 48 hours before being transferred to the service. The postoperative course was simple (Figure 3(b)), with clinical and endoscopic monitoring for up to 6 months without complications before being lost sight.

3.2. Observation 2

SD, 18-year-old student, male, presented with inspiratory dyspnea that gradually began and continued to evolve after a 4-day intubation for cerebral malaria.

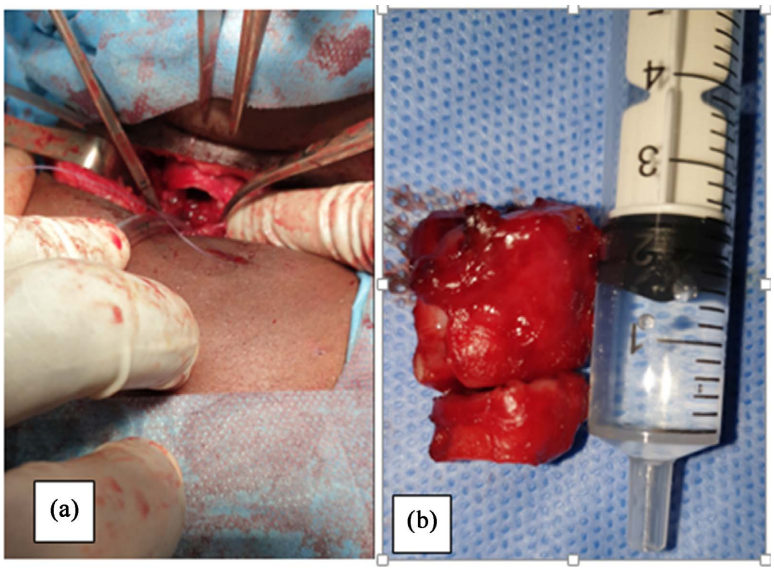


Figure 2. (a) Intraoperative patient image; (b) Image of the surgical part (resected part).

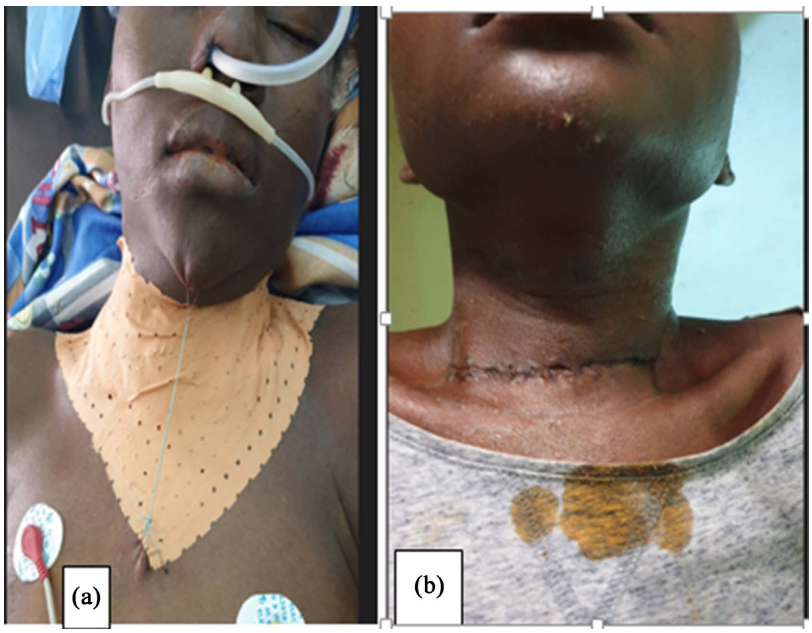


Figure 3. (a) Postoperative patient image fixation Chin to sternum; (b) patient healed on D17 postoperative.

This respiratory distress, which appeared 15 days earlier, was associated with a dry cough. He had no notion of fever, dysphonia, dysphagia, wrong food route. No specific medical and surgical history was found, he was a non-alcoholic and tobacco user.

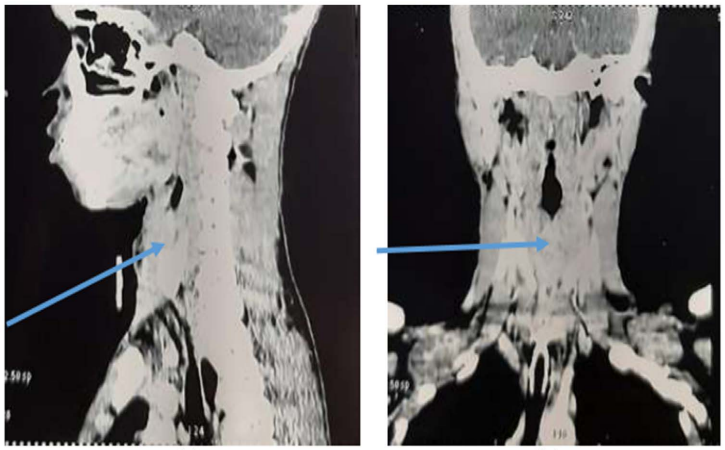
On general examination, the conjunctivae were colored, with no cyanosis, temperature 37.1˚C, heart rate 85 beats/min, respiratory rate 22 cycles/min, blood pressure 120/80 mm/hg.

The ENT physical examination revealed Chevalier Jackson and Pineau stage II dyspnea (moderate sternal indrawing, agitated patient). Nasofibroscopy revealed subglottic stenosis at the tracheal level and inflammation of the vocal cord mucosa.

Cervical computed tomography showed tight stenosis of the trachea over 31 mm from C6 to T2 associated with pseudo-nodular infiltrations of the upper lobes of the thyroid gland (**Figure 4**).

At the end of the endoscopic and radiological assessment, it was a complex stenosis characterized by a 3 cm stenosis with a fibrotic lesional process extending to the entire tracheal wall and involving 3 cartilaginous rings. A safety tracheotomy and an endoscopic assessment were performed beforehand, associated with prophylactic antibiotics and corticosteroid therapy.

After a preoperative assessment which came back without particularities, we performed a resection with trachea-tracheal anastomosis under general anesthesia using the same surgical technique and the same material as the previous case. We did not encounter any operational difficulties (**Figure 5**). A naso-gastric tube for 10 days. The neck was maintained in a neutral position using a suture in order to avoid hyper-extension for 2 weeks (**Figure 5(b)**). The patient spent 48 hours in intensive care before being transferred to the service. The evolution was marked by a re-stenosis following the reconstitution of a granuloma after 45 days leading to dyspnea and then the death of the patient.



(a) (b)

Figure 4. Cervical CT in sagittal sections (a) and coronal (b) showing tracheal stenosis from C6 to T2 associated with pseudo-nodular infiltrations of the lobes of the thyroid gland.

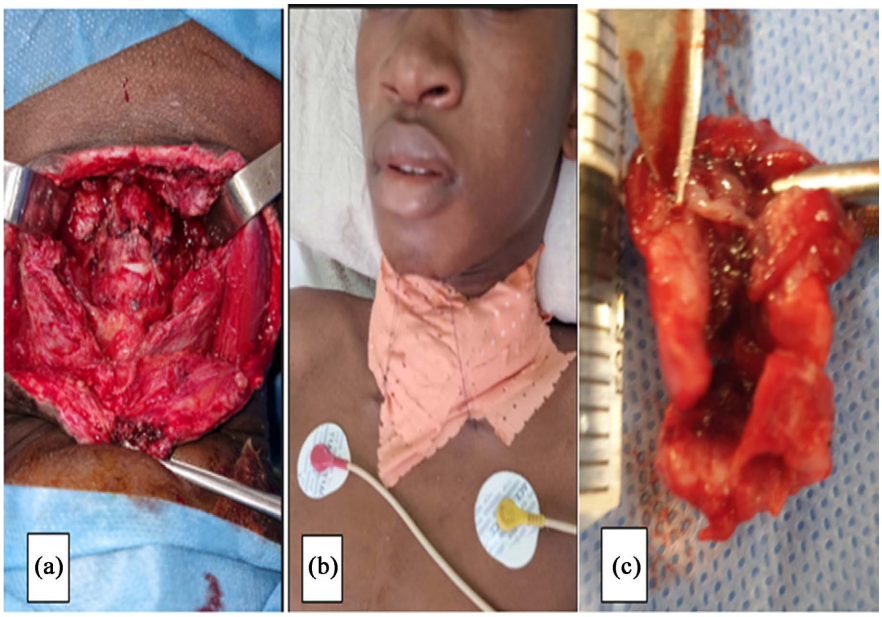


Figure 5. (a) Intraoperative image; (b) Patient image in post operation. Neck held in flexion with skin wire; (c) Tracheal resection piece.

4. Discussion

4.1. Hospital Frequency

The frequency of STPI is variably assessed by the different series. Recent prospective studies report a frequency of stenosis after intubation and/or tracheotomy of 10% to 19% [1] [4]. The stenoses responsible for a significant functional narrowing are however much rarer, their frequency is of the order of 1% [1] [4] [6] [7] [8].

STPIs represent a frequent and formidable complication of respiratory assistance. They are due to the healing process of the lesions caused by the contact of the balloon with the tracheal mucosa [9] [10] [11]. Strictures may also be due to mucosal erosions caused by the distal end of the airway tube, especially in children intubated with uncuffed tubes [12]. Gradual improvements in tubing materials and design as well as the widespread use of high-volume, low-pressure balloon tubing have reduced the incidence of STPI [9] [11]. In the literature, all age groups can be affected, the average age varies between 20 and 52 years and the male sex seems to predominate [1] [6] [13] [14]. In our series, the frequency was 1.4%, the age of our patients was respectively 18 and 35 years with an equal distribution between the two sexes.

4.2. Clinical Aspects

The clinical diagnosis of STPI is made on the association of inspiratory bradypnea with indrawing and horniness in a patient with a history of intubation and/or tracheotomy. This diagnosis is sometimes difficult but should be considered in any patient with a history of intubation and/or tracheostomy presenting with recent or unusual dyspnoea [4] [7] [15]. In our series, STPI was identified

as such on admission in both cases.

The duration of intubation is also considered as a risk factor for stenosis, it is 12% in the event of intubation for more than 10 days [1] [16] [17] [18] [19]. The time to onset of tracheal stenosis is variable in the literature. It is from a few hours after extubation or decanulation, to several months or even a few years. This period is between the 15th day and the 5th month [20] [21] [22]. In our series, the duration of intubation was 4 days and 30 days; and the time to onset of stenosis was 15 days and 10 days respectively for our patients.

4.3. Paraclinical Aspects

A rigorous para-clinical assessment must be established, not only to make the diagnosis of a tracheal stenosis, but also to determine the characteristics of this stenosis and to pose the appropriate therapeutic indication [1] [2] [15].

The laryngotracheal endoscopy is the essential stage of the exploration, it makes it possible to specify the seat, the extent, the inflammatory or organized nature of these lesions, to appreciate their complexity and to check the laryngeal mobility [1] [2] [15] [20].

The radiological assessment is also an essential step in the management of tracheal stenosis. Currently, the reference examination is computed tomography (CT).

Iodine opacification is not compulsory and is reserved only for the exploration of tumor pathologies or in the presence of a para-tracheal mass with extrinsic compression [1] [2] [23].

Multi-slice CT (MB-CT) has established itself as the reference imaging technique for exploring the trachea in adults. Axial sections have certain limitations for analyzing the trachea: difficulty in detecting moderate stenoses, underestimation of the longitudinal extension of stenoses, difficulty in analyzing anatomically complex lesions. Thanks to CT-MB, several types of reconstructions are currently possible: 2D and 3D reconstructions [1] [2].

Magnetic resonance imaging (MRI) has demonstrated its superiority for the study of tracheal lesions, thanks to its power of spatial resolution and contrast and its multiplanar T1 T2 acquisitions. Indeed, it gives a dynamic sequence, it makes it possible to identify the part of the thickening of the mucosa and the collapse of the tracheal wall in the genesis of the stenosis.

But it remains uncommonly used and very few authors have reported their experience in exploring STPI by MRI [1] [2] [23].

In our study, all our two patients benefited from endoscopy and CT to confirm the diagnosis, locate the stenosis, specify type and importance and finally guide treatment.

4.4. Therapeutic Aspects

4.4.1. Preoperative Evaluation [5] [14]

Among the absolute contraindications to resection, we will retain:

- The poor general condition of the patient, in particular neurological (coma, tetraplegia, cervical spinal arthrodesis, etc.), or major respiratory failure.

- Non-cooperating and agitated patients (post-traumatic frontal syndrome, suicidal psychiatric terrain, etc.) who will not respect the post-operative head flexion instructions.
- The extent of the stenosis to more than half of the trachea, or multiple storied stenoses. Such resections require both lowering of the larynx and raising of the trachea.

Among the contraindications relating to resection, we will retain:

- The tracheal opening: classically it represents an indication of calibration, but some authors have shown their feasibility. If the tracheotomy is recent (for acute dyspnoea), resection anastomosis according to the usual technique is possible.

The old tracheal opening contraindicates a thoracic gesture (manubriotomy) to carry out the resection because of the risk of mediastinitis. It is then necessary to prefer a calibration by Montgomery tube.

- The presence of inflammatory phenomena, at the level of the stenosis, represents a temporary contraindication in view of the increased risk of post-surgical recurrence. The medical treatment and the installation of an endoprosthesis must allow a deferred intervention, on a non-evolving fibrous stenosis.
- A history of horizontal partial laryngeal surgery should prompt discussion of an alternative to resection anastomosis. Indeed, the laryngotracheal height being already reduced, the release techniques will not be feasible, especially if the patient has already received radiotherapy.
- The age, although often quoted, does not seem essential in the decision of the choice of the treatment.

4.4.2. Therapeutic Modalities

The treatment of tracheal stenosis is based on several therapeutic components.

[1]. Medical treatment aims to reduce inflammatory lesions and fight infections. The corticosteroids administered are effective on edematous and granulomatous lesions. In the literature, treatment with inhaled beclomethasone has been described [24]. Antibiotics are used in case of bronchopulmonary infections for better preparation for surgery [1] [2]. Our two cases all received medical treatment.

Endoscopic treatment occupies an important place in the treatment of tracheal stenosis. Indeed, endoscopy allows the practice of instrumental dilatations, the performance of microsurgical gestures and the use of laser [1] [2]. The only stenoses that we can hope to stabilize thanks to dilations alone are short stenoses in the diaphragm [17] [18] [19]. For strictures longer and more complex, endoscopic treatment combined with medical treatment makes it possible to overcome acute asphyxia by restoring a satisfactory tracheal pathway with good immediate progress and disappearance of dyspnea [7]. Calibration is indicated in inflammatory strictures after dilation and in complex strictures [17] [18] [19]. For laser treatment, most authors agree that the best indications remain diaph-

ragmatic stenoses and postoperative granulomas [20].

Recourse to tracheal modeling with endoprostheses is done each time the stenosis is extended with a strong malacic component, in the event of restenosis after anastomosis resection or in the event of poor general condition, contraindicating surgery [21]. The prostheses are maintained for 6 to 12 months with regular endoscopic checks.

However, regardless of the contribution of medical or instrumental treatment, the best treatment for pure tracheal stenosis remains surgical treatment based on end-to-end resection-anastomosis [1] [2].

The approach is usually cervical via a typical suprasternal arcuate incision.

Kocher or midline vertical if the stenosis is extensive or if a possible laryngeal lowering or sternotomy is planned [1] [2] [25]. Diaphragm circumferential stenoses require short resections of 2 to 3 rings, while ferrule stenoses require more extensive resections of 6 to 7 rings [26]. The tracheal anastomosis is performed in case of resection less than 7 tracheal rings [2] [27]. All the authors emphasize the importance of a tension-free suture on healthy mucosa using vicryl 3.0.

The sutures should be made with a slow-absorbing suture starting with the posterior trachea and then the anterior trachea. When the tracheal resection is important, the anastomosis is difficult to achieve. Laryngeal lowering procedures are then used allowing better restoration of continuity without tracheal tension [1] [25] [27]. In our series, both patients received systemic and aerosol corticosteroid treatment and antibiotic treatment. We carried out a preoperative preparation for our two patients. The surgical treatment was based on an end-to-end resection anastomosis under general anesthesia with intubation through the tracheotomy orifice. Suturing was done with 3.0 vicryl in separate stitches without tension, starting from the posterior plane.

The resected fragments concerned 2 rings in both cases measuring 3cm and 2.5 cm respectively.

In the literature, other techniques have been developed by several authors based on tracheal replacement, they are of four (04) types [28] [29] [30]:

- Transplantation of the tracheal or laryngo-tracheal axis from a donor has been done successfully in a few cases. It is a complex procedure, difficult to reproduce and requires immunosuppression.
- The aortic allograft, results in a significant shortening of the length of the implanted aortic substitute, and requires the maintenance of a stent endo -aortic postoperative, source of congestion, infection and complications such as esophageal or mediational vascular erosion.
- The autograft of the trachea, this is a conduit made up of a free fascia cutaneous flap of the forearm, of the Chinese flap type, reinforced by several costal cartilages around a silicone stent. The flap is vascularized by the anastomosed radial artery and vein at the cervical level. The stent is left in place postoperatively for approximately two weeks, then removed.
- Tissue engineering and uses a decellularized tracheal matrix seeded with

stem cells. It has been performed in a few cases of bronchial or tracheal replacement, some of which were undoubtedly accessible to a conventional technique of resection anastomosis.

4.4.3. Evolution and Prognosis

The success criteria of surgical treatment are evaluated according to clinical, endoscopic and radiological data. The immediate complications can be the type of respiratory distress following an inflammatory edema of the mucosa, particularly at the level of the laryngotracheal junction, or secondary to bilateral recurrent damage. It can also be a compressive hematoma or subcutaneous emphysema indicating a leaky tracheal suture [1] [27].

Other early complications can appear such as dysphonia by unilateral recurrent impairment, swallowing disorders mainly in cases of lowering of the larynx, or rupture of the brachiocephalic arterial trunk which can be fatal [1] [7] [10].

Late, it may be a granuloma on the anastomosis thread requiring endoscopic dilatation or laser photodestruction [1] [2] [27].

The most formidable complication is restenosis (6% to 38% in the different series) [1] [4]. It requires a new resection anastomosis or a laryngotracheal calibration. A definitive tracheotomy remains a treatment indicated as a last resort. The failure rate of surgical treatment is around 15% with a mortality of between 1.8% and 5% [6] [26].

In our experience, the evolution was favorable in a patient with clinical and endoscopic monitoring up to 6 months after the patient was lost to sight. However, we found a case of restenosis after 45 days which resulted in death in a context of respiratory distress.

5. Conclusion

Post-intubation tracheal stenosis is a debilitating and life-threatening condition that is usually caused by iatrogenic events following endotracheal intubation or tracheotomy. The clinical diagnosis of STPI is most often easy. Radiological and endoscopic explorations make it possible to specify the characteristics of these stenoses. The management of tracheal stenosis is based on a precise evaluation and evolution of the stenosis, its seat, its extensions and its functional impact. The basic treatment remains resection anastomosis of the trachea. It aims to restore a satisfactory respiratory system by natural means. However, it requires a multidisciplinary approach in order to avoid the complications guaranteeing the success of the intervention in order to reduce morbidity and mortality.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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