Long-term results of laryngotracheal resection for benign stenosis

Antonio D’Andrilli a,*, Anna Maria Ciccone a, Federico Venuta b, Mohsen Ibrahim a, Claudio Andreetti b, Domenico Massullo c, Rita Formisano d, Erino A. Rendina a

a Department of Thoracic Surgery, University of Rome ‘La Sapienza’, Sant’Andrea Hospital, Rome, Italy
b Department of Thoracic Surgery, University of Rome ‘La Sapienza’, Policlinico Umberto I, Rome, Italy
c Department of Anesthesiology, University of Rome ‘La Sapienza’, Sant’Andrea Hospital, Rome, Italy
d Post-coma Division, St. Lucia Foundation, IRCSS, Rome, Italy

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Abstract

Objective: We report the long-term results of our 16-year experience with laryngotracheal resection for benign stenosis. Methods: Between 1991 and 2006, 35 consecutive patients (19 males, 16 females) underwent laryngotracheal resection for subglottic postintubation (32) or idiopathic (3) stenosis. Mean age was 43 years (range 14—71). At the time of surgery 13 patients presented with tracheostomy and 7 with a Dumon stent. The upper limit of the stenosis was from 0.6 to 1.5 cm below the vocal cords. The length of airway resection ranged between 1.5 and 6 cm. Suprahypoid release was performed in two patients and pericardial release in one. Nine patients had psychiatric and/or neurological post-coma disorders. Mean follow-up is over 5 years (61 months; range 3—194). Results: There was no perioperative mortality. Thirty patients (85.7%) had excellent or good anatomic and functional results. Four patients (11.4%) presented restenosis at a distance of 25—110 days from the operation. Restenosis was successfully treated by endoscopic procedures in all four patients. One patient (2.9%) presented anastomotic dehiscence that required temporary tracheostomy closed after 1 year with no sequelae. Three patients (8.4%) had wound infection. Long-term follow-up was uneventful also in patients who had early complications. Conclusions: Long-term follow-up confirms that laryngotracheal resection is the definitive curative treatment for benign subglottic stenosis. Surgical complications can be successfully managed by non-operative procedures. Despite the occurrence of early complications, excellent and stable results can still be obtained at long term.

Keywords: Laryngotracheal resection; Subglottic stenosis

1. Introduction

Benign stenosis, most commonly caused by postintubation injury, represents the main indication for surgical treatment of the upper airway. Involvement of the subglottic region presents increased technical problems, principally due to the need for extending the resection to the cricoid cartilage without damaging the recurrent laryngeal nerves.

Since the technical principles for a safe laryngotracheal resection and reconstruction were described [1,2], a number of studies [3—11] have reported high success rates in this setting, with low morbidity and mortality, thus affirming the role of surgery as the treatment of choice.

Endoscopic treatment modalities, including laser and stenting, whose application in tracheal surgery has greatly increased in the last years, have a limited role in subglottic stenosis due to anatomic and technical reasons [8]. The latter techniques are therefore mainly employed to stabilize the stenosis before surgical resection or to achieve an acceptable palliation in patients not suitable for surgery; the benefit is however temporary and endoscopic controls and repeated procedures are often necessary [12,13]. Long-term results in laryngotracheal surgery have rarely been reported, especially in those patients in whom early complications occur.

We hereby report our experience with laryngotracheal resections in patients with a mean follow-up of over 5 years.

2. Materials and methods

Between 1991 and 2006, 35 consecutive patients underwent laryngotracheal resection and reconstruction for benign stenosis. Nineteen were males and 16 females with an age ranging between 14 and 71 years (mean 43 years). The cause of airway stenosis was postintubation in 32 patients and idiopathic in 3 patients. The causes of intubation are reported in Table 1. A peculiar and unique subgroup of patients in this series consists of nine patients suffering from...
post-coma disorders. Five had post-coma psychiatric syndrome, one was tetraplegic, two had severe neurological deficit and one was autistic. These patients showed severely limited or no cooperation in the postoperative period.

Preoperative assessment included a laryngotracheal endoscopic examination to evaluate the extent of the airway involvement, the grade of inflammation and edema, and the mobility and trophy of the vocal cords. In the last years neck and chest CT scan was also performed with a spiral technique to obtain more information on the state of the tracheal wall and on the extraluminal region (Figs. 1 and 2a and b). At the time of surgery 13 patients presented with tracheostomy, 11 of which were done elsewhere. Patients with evidence of infection at the level of the tracheostomy were treated with systemic and local antibiotics until sterilization proved by microbiology was achieved. The upper limit of the stenosis was from 0.6 to 1.5 cm below the vocal cords. Tracheomalacia was associated in seven patients. Five patients underwent surgery after laser treatment. In seven other patients laser and endoluminal silastic stenting preceded surgery. In all these seven cases the endotracheal prosthesis was removed at operation. This strategy was employed to allow stabilization of the stenosis without tracheostomy or to improve compromised general conditions. Laryngotracheal resection was performed after 1—8 months, once the complete stabilization of the stenosis had been verified endoscopically. Technically, the operation was performed based on the principles described by Pearson in 1975 [1]: a small caliber (4—5.5) endotracheal tube was usually passed through the stenosis; this was usually sufficient for appropriate ventilation until the trachea was exposed. Occasionally the tube was placed above the stenosis. In patients with pre-existing tracheostomy this was intubated directly, and later resected together with the stenotic segment. The surgical approach is through a collar incision including the tracheostomy stoma when present, with the neck hyperextended. The trachea is exposed and mobilized circumferentially from the level of the inferior border of the cricoid cartilage above, to the lower limit of the stenosis below. Special care is taken to keep the dissection close to the tracheal surface in order to avoid injury to the recurrent laryngeal nerves. The distal trachea is transected, mobilized anteriorly and posteriorly to the carina and intubated through the operative field. The upper line of resection lies at the inferior border of the thyroid cartilage anteriorly, and continues obliquely below the crico-thyroid joint on both sides. The anterior and lateral portions of the cricoid arch are thus removed leaving intact the posterior cricoid plate. The anastomosis is performed with interrupted sutures of 3-0 absorbable monofilament material (Polydioxanone) tied outside. The sutures are placed starting from the back and are all left untied. At this point, the neck is flexed, a nasotracheal ventilation tube is introduced and advanced distal to the anastomosis and the two ends of the airway are approached applying gentle traction simultaneously on all sutures. Sutures are then tied starting from the front. The nasotracheal tube is left in place uncuffed in the awakened patient for 24 h and then removed after bronchoscopic check of the anastomosis and vocal cords. The tip of the tube is kept distal to the anastomosis to protect it and to allow safe tracheobronchial toilette.

After surgery all patients were observed until death or last date of follow-up (31 March 2007) for a mean of over 5 years. Anatomic and functional control was performed by fiberoptic laryngotracheoscopy 1 and 3 months after surgery and then

| Table 1 Causes of intubation for cardiorespiratory resuscitation |
|-----------------|-----------------|
| Cause           | No. of patients |
| Polytrauma      | 19              |
| Respiratory failure following surgery | 5              |
| Acute cardiac failure | 4              |
| Acute respiratory failure in COPD    | 4              |
| Neurological problems          | 3              |

Fig. 1. CT image of a long (6 cm) stenotic segment with an indwelling stent. Associated ossification and malacia of the tracheal wall is visible.

Fig. 2. CT image (a: sagittal reconstruction; b: volume rendering) of a long stenotic tracheal segment with strictures at multiple levels.
every 3 months for the first year, every 6 months in the second year and once a year for the following time.

The results were classified as excellent if respiration and voice appeared completely normal and bronchoscopy showed a normal diameter of the airway. Outcome was considered satisfactory when abnormal voice, narrowed anastomosis and shortness of breath on exercise were found, but not affecting normal activities. In case of major complications results were judged not satisfactory.

3. Results

There was no intraoperative or postoperative mortality. Postoperative hospitalization ranged between 5 and 19 days (median 9.8 days). Three patients (8.4%) had wound infection treated by drainage and antibiotic therapy and followed by complete healing. The length of the airway resection ranged between 1.5 and 6 cm (mean 3.8 cm). Resection of a tracheal segment longer than 4.5 cm was performed in eight patients. Suprahypoid release was performed in two patients and pericardial release (through a right lateral minithoracotomy (6 cm)) in one. In all other patients, standard mobilization of the trachea was sufficient for a tension-free anastomosis.

Extubation was done successfully in the first postoperative day in 33 patients. Two patients had to be reintubated within a few hours because of giottic edema. Definitive re-extubation was possible, after steroid therapy, 1 day later in one patient and 3 days later in the other patient.

Short-term results were excellent in 19 patients (54.3%) and good in 11 (31.4%). Four patients (11.4%) presented restenosis. In three of them restenosis occurred within 1 month after the operation (25, 28 and 31 days post-operatively) and in one patient it was diagnosed after 110 days. Successful treatment of the restenosis was achieved by laser ablation of granuloma in three patients and by mechanical dilatation for circumferential scar stenosis in one. In one patient who underwent laser therapy, we also positioned a stent that was removed after 1 year. The caliber of the anastomosis was slightly inferior to normal, but yet above 90% and without functional impairment. There was no other recurrence of stenosis during the subsequent follow-up period. One patient (2.9%) presented anastomotic dehiscence on postoperative day 4 which required a temporary tracheostomy closed after 1 year with no sequelae. One patient showing good results at 1 month presented 2 months later with shortness of breath and reduced mobility of the vocal cords limiting respiratory space, but anatomic and functional conditions returned good after 3 months of steroid and aerosol therapy. Definitive results appeared excellent in 19 patients (54.3%), good in 14 (40%) and satisfactory in 2 (5.7%).

Follow-up time ranged between 3 and 194 months (median 61 months). Two patients died of other causes. All the other living patients present normal voice and respiration except for the two patients in whom definitive results were considered satisfactory (narrowed anastomosis in one and hoarse voice in the other, not affecting normal activities). All patients with postoperative complications show stable results at long term. All nine patients suffering from post-coma disorders had excellent or good results although they presented psychiatric and/or neurological difficulties in the postoperative period.

4. Discussion

Major series of laryngotracheal resections published in literature [3–11] report good results rates ranging between 87% and 100%, and almost no mortality (generally under 1%), thus affirming the role of surgery as the treatment of choice.

Endoscopic management, principally based on laser ablation and stenting, has been proposed in the last years as a possible alternative to surgical resection. However, results in this setting show that only thin webline stenosis can be removed definitively by laser treatment, but the benefit in more extended lesions is generally temporary [12,13]. It is therefore important to demonstrate, as our series does, that the results of surgery are not only good, but also stable after long-term follow-up. Moreover, permanently good results can also be obtained in patients experiencing early postoperative problems such as granulation, scar stenosis and dehiscence.

Unfortunately, primary surgical resection is not always feasible. General contraindications to surgery are known and include the impossibility of the patient to have full control over his/her body (tetraplegia) or intolerance of neck flexion (psychiatric and post-coma mental disorders). Because upper airway stenosis generally occurs after prolonged intubation, post-coma patients can present with this problem. Adequate collaboration could not be obtained in our nine patients with neurological impairment; however intensive nursing and accelerated postoperative course fruited excellent or good results in all of them. A similar group of patients had never been reported in details before, but we think surgery should no longer be denied in this setting. Patients with neurological disorders were prepared for the operation by a long discussion with the surgical team. The patients and their families received detailed information especially regarding aspects of the postoperative course which are harder to tolerate, such as the persistence of the nasotracheal tube after awakening and the compelled cervical flexion. In the postoperative period, intense cooperation between highly qualified nurses and the patients’ relatives has proved fundamental for the final success of surgery in these cases.

Temporary Montgomery T-tube and tracheostomy have been considered the only possible alternatives to surgery in subglottic stenosis. However, tracheostomy has the disadvantages of potentially increasing the extent of the tracheal stricture and of favoring bacterial colonization. These two problems may be particularly detrimental for patients who are likely to be reconsidered for surgery thanks to improved general and/or local (laryngotracheal) conditions.

Therefore, in our experience [8], we have preferred to treat patients with high surgical risk or non-stabilized stenosis using laser resection and/or endoluminal stenting, in order to avoid tracheostomy.

The anastomotic technique we employed favors the use of interrupted sutures (3-0 absorbable monofilament material)
that are placed starting from the back and left untied while the neck is hyperextended. Stitches are then tied, together with cervical flexion, after all sutures have been placed. This technique allows avoiding tension on the anastomosis when the suture is still not complete, so that the neck can be kept hyperextended providing a perfect exposure of the airway until all sutures are placed.

Despite the relatively high number of patients undergoing resection of long segments of trachea (4.5—6 cm in eight patients), release techniques were performed in only a few cases (three patients). The standard technique of manual mobilization of the distal trachea was sufficient to obtain a tension-free anastomosis in all the other cases. This was partially due to the young mean age of the patients that is related to a superior elasticity of the tracheal wall.

All five major complications were successfully treated with non-surgical procedures (laser or dilatation for the four restenosis and temporary tracheostomy for the case of dehiscence) achieving good or satisfactory definitive results in all the patients. This shows that also in case of major morbidity successful management can be performed without reoperation.

In conclusion, laryngotracheal resection can be performed with low operative risk as the standard curative treatment for benign subglottic stenosis and leads to a high rate of successes with no mortality. These results are stable and permanently good after long follow-up even if early complications occurred and in complicated cases of post-coma patients.

References