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Infravestibular Horizontal Partial Laryngectomy
A New Surgical Method

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Zusammenfassung. Bei den glottischen und subglottischen Karzinomen des Kehlkopfes, bei denen eine totale Exstirpation des Larynx notwendig erscheint, haben wir eine neue funktionelle Chirurgie durchgeführt. Es handelt es sich um eine partielle horizontale infravestibuläre Laryngektomie. Der Tumor wird zusammen mit den glottischen und subglottischen Räumen des Larynx entfernt. Die Wiederherstellung eines funktionsfähigen Kehlkopfes mit Hilfe der Trachea und des supraglottischen Raumes wird beschrieben. Phonation, Schlucken und Atmung auf natürlichem Wege gelang 8 von den 12 operierten Patienten.

Schlüsselwörter: Kehlkopfkarzinom – Funktionelle Larynx-Chirurgie – Partielle Laryngektomie.

Summary. We have developed a new functional surgical technique for cancers of the larynx specially those situated glottically and subglottically which are considered remedial to a total laryngectomy. Specifically an infravestibular horizontal partial laryngectomy can be performed to remove neoplasms together with the glottis and subglottis. The larynx then may be reconstructed by suturing the bands to the ascended trachea and the conserved upper half of the tyroid cartilage. The results have been encouraging. Swallowing, phonation and respiration by the natural vias has been obtained in 8 of the 12 patients so operated.

Key words: Cancer of the larynx – Functional surgery of the larynx – Partial laryngectomy.

Cancers of the glottic or subglottic region are not always amenable to a functional surgery with a guarantee of cure. These functional partial techniques and their indications are well known. However, some lesions due to their location or extension in these regions continue to be subject to a total exeresis of the larynx by a majority of laryngologists.

The works of Arslan and Serafini (1970) have indicated, once again, the need for a less mutilating and more functional surgery for the laryngeal cancers. Neverthe-

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less, Serafini's technique, simple and moderate, does not provide a complete solution to the problem. As is well known, many patients have postoperative problems swallowing and with the decannulation.

Many authors experienced with the technique of a total reconstructive laryngectomy (R. Bartual, J. Marco, T. Sacristan, J. Algaba, and J. Bartual) feel it leaves much to be desired.

Spurred by these difficulties and recognizing the brillant results achieved by Alonso and others authors with more than 20 years experience using a supraglottic horizontal partial laryngectomy, we think that if cancers are always detained in their growth towards the glottis at the ventricular level and if the surgical removal of the superior half of the larynx is feasable then it should be equally feasable to apply a technique infraglottically. Specifically, we suggest the exeresis of the inferior half of the larynx with the tumor and the ulterior reconstruction of the larynx using the trachea and the supraglottic space. Based on this hypothesis, we conceived and developed in November 1972 the technique of an infravestibular partial horizontal laryngectomy which we presented at the "Reunión Anual de la Sociedad Española de O.R.L. y Patología Cérvicofacial" in November 1973.

1. Basis of the Infravestibular Horizontal Partial Laryngectomy

The larynx first appears in the phylogenetic scale as a muscular sphincter which protects the respiratory tract from the entrance of foreign bodies. Later, the other laryngeal functions begin to appear attaining the all important phonetic function in the human species. Physiologically the vocal cords are the most important, while the other structures, principally the epiglottis and the bands only play a cooperative role. But, if the vocal cords are removed, their sphincteral function can be compensated for to a great extent by the vicarious hypertrophy of the bands and by the action of the entire intrinsic and extrinsic musculature of the larynx which intervenes in swallowing and phonation. If, in addition, part of the laryngeal skeleton is conserved to maintain the airway patent and to also serve as support for the musculature it is also then possible to conserve or reestablish the laryngeal functions when the vocal cords have been removed along with the inferior part or half of the laryngeal skeleton by rejoining the trachea to the remaining superior half of the laryngeal skeleton.

The technique described by Alonso has incontrovertibly demonstrated that the epiglottis and the bands can be prescinded without modifying or sensibly altering the laryngeal physiology. Likewise, it can also be admitted that the superior half of the larynx can succesfully compensate for the removal of the vocal cords and the entire lower half of the larynx. The physiology of the larynx undergoes, without doubt, a profound change but it becomes sufficiently reestablished to guarantee its essential functions.

2. Purpose of the Technique

We hope to achieve the following:

a) A complete exeresis of the tumor by removing the inferior half of the larynx,

including or not the first two tracheal rings according to the tumor's caudal extention.

b) The conservation of a part of the laryngeal skeleton, specifically the superior third of the thyroid cartilage in order to mantain permeable the laryngeal airway and to make it possible to decannulate the patient as well as to prevent a postoperative stenosis.

c) To restore the phonatory, deglutition and respiratory functions and also the protective function of the larynx due to conservation of the epiglottis, the bands and in some cases the arytenoids.

3. Indications

We consider this technique to be indicated in the following cases:

a) Cancers in the glottic region, especially cancer of the vocal cords with immobility even if there is invasion of the arytenoids and posterior commisure.

b) Cancers of the subglottic region whatever its location, but only when the cartilaginous frame of the larynx, i.e., the thyroid cartilage has not been infiltrated.

c) In the local recurrence of cancer of the vocal cords previously treated by thyrotomy or cobalt therapy.

d) In subglottis stenosis of the larynx including the first two tracheal rings (Fig. 1).

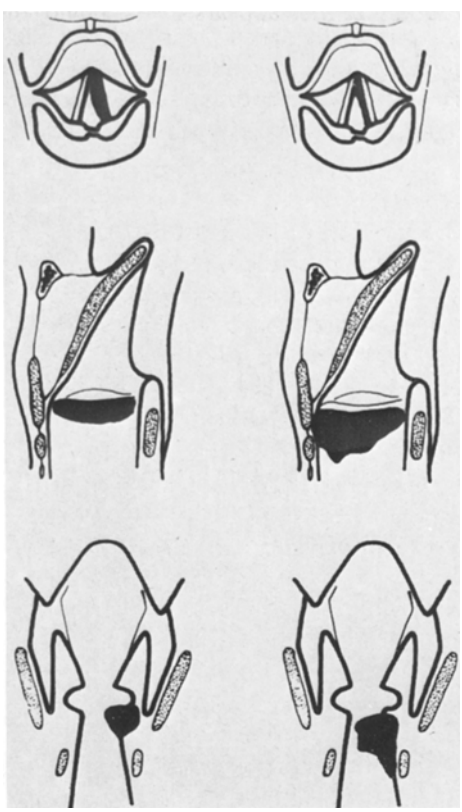

Fig. 1. Left: Neoplasm of the vocal cords with immobility. Right: A subglottic anterior lateral neoplasm. Indications of an infravestibular horizontal partial laryngectomy

4. Contraindications

We consider that this operation is formally contraindicated in the following circumstances:

a) In cancers of the vestibule of the larynx.

b) In cancers of the anterior commisure or whenever the commisure has been invaded by a cancers of the vocal cords.

c) In cancers of the laryngeal ventricle, especially when its lateral wall has been affected, or in those of the cords involving the ventricle self.

This technique can be only employed when the epiglottis, the bands the aditus laryngis are free of cancer.

5. Technique

Given the location and size of the lesion, it is almost always necessary to do a tracheotomy instead ot intubating the patient. Actually we perform a tracheotomy as the first step using a loco-regional infiltration. We make a low transversal Skolpnik-Fornatto incision at the level of the fourth tracheal ring. We then intubate the patient with air ballon tubes which isolated the lover respiratory passages. The operation is then begun using general anesthesia.

The fundamental steps are the following:

a) A Glück-Tapia incision which can be completed with a lateral discharge incision towards the supraclavicular fossa in order to remove the lymphnodes partially or completely (neck dissection) if necessary. Exposure of the prelaryngeal

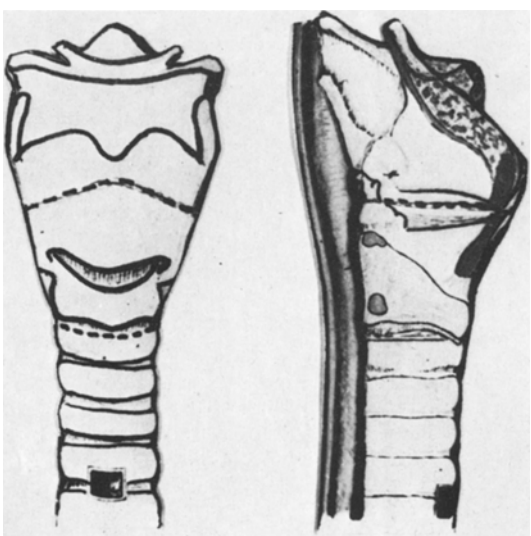

Fig. 2. Left: Anterior view of the larynx, hyoid and trachea. The dotted line indicates the section of the laryngeal skeleton. To the right a sagital view of the larynx, trachea and pharynx. The two transversal sections which are performed in the operation: one passes inferiorly between the trachea and the cricoid and the other superiorly between the cords and the ventricular bands

musculature and sectioning of the hyoid insertions of muscles retracting the sectioned muscles downwards. Originally we used a mid line approach as in a laryngofissure or as in the Serafini approach in order to incise the perichondrium of the tyroid allae in a lateral direction and lifting the musculature with the perichondrium. Now, instead, we make a transverse incission in the perichondrium at the level of the inferior border of both tyroid alae and lift it upwards to the superior border of the tyroid cartilage and also laterodorsally to the posterior border.

b) Transversal section of the thyroid cartilage 3.5—6 mm below the vertex of the thyroid incissura, i.e., depending of the development of the larynx which is variable in each patient. In this way, $\frac{1}{3}$ of the thyroid allae remain above the section together with its internal perichondrium, bands and epiglottis. The bands are inserted in the most elevated front part of the angle of the thyroid cartilage. The vocal cords and thyro-arythenoid ligaments are inserted about 3 mm below the bands. However, the individual variations are numerous and for that reason we refer to the diagram of Gurr to calculate the distance between the pomum Adami and the thyro-arytenoid ligament. This distance oscillates in the male between 3.5 and 6 mm and in the female between 3 and 5 mm. The insertion of the cords is usually indicated by a small depression or fossa in the angle formed by the confluence of both thyroid laminae which is a precious reference point for the surgeon to locate the level of the cartilaginous section (Fig. 2).

c) Transverse section of the mucosa and part of the intrinsic musculature of the larynx immediately below the ventricular bands paralleling their free border until reaching the anterior facies of the arytenoids. In some cases it is possible to conserve the arytenoids in one or both sides, but in the majority of cases, given the indications of this technique, the scalpel will have to slide along the anterior facies of the aryte-

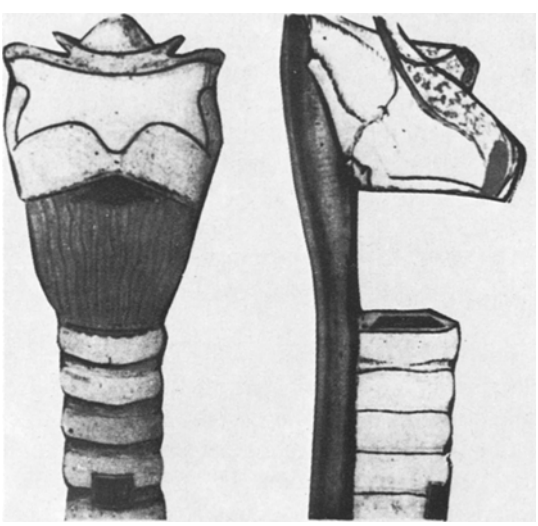

Fig. 3. In both diagrams the infravestibular portions have been eliminated showing the height of the tracheotomy and the superior pharyngostoma after separating the hypopharynx from the larynx

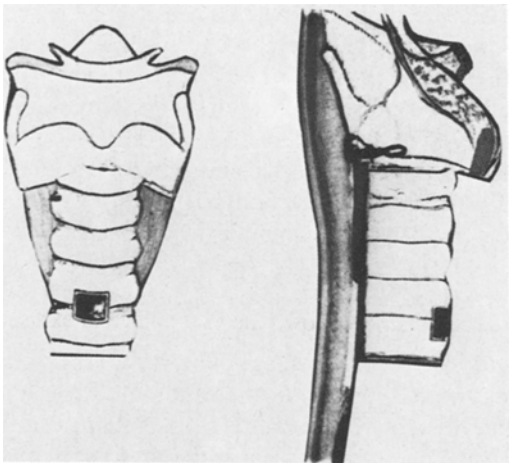

Fig. 4. The trachea has been ascended and the bands have been sutured to it. In the posterior wall of the trachea a mucous flap is formed by the suture of the mucosa of the anterior face of the hypopharynx. This flap helps to close the laryngeal lumen thereby making possible phonation and swallowing earlier than otherwise

noid until reaching the corniculate cartilage and then continue along the mucosa of the wall of the hypopharynx and sectioning parallel to the posterior border of the aditus. The exeresis is completed with the a transverse sections between the cricoid and the first tracheal ring with a lifting upwards as in the technique of Perier until reaching by way of the posterior surface of the cricoid laminae the before mentioned line of section. In those cases in which the neoplasia extends to the trachea the first three tracheal rings can be included in the exeresis (Fig. 3).

d) The reconstruction is initiated after placing a nasoesophagal tube by means of suturing both arytenoids or both corniculates to the lateral extremes of the posterior wall of the trachea. The lateral walls of the trachea are sutured to the submucous tissue of the respective bands and to the conserved portion of the thyroid cartilage. The mucosa of the anterior surface of the hypopharynx is sutured border to border to the mucosa of the posterior surface of the trachea. Then the perichondrium of the thyroid alae is replaced covering all of the new larynx and trachea. Its inferior border is sutured to the trachea as a reenforcement (Fig. 4). Finally, a thorough reconstruction of the muscular, fascial and cutaneous layers is undertaken and then a tracheal canula is placed. We recommend the application of a slightly compressive bandage.

6. Results and Postoperative Evolution

To date we have operated with this technique a reduced number of only 12 patients. The results are the following: 2 Recidivisms, 1 death, 8 decannulated, 1 not decannulated. With these first cases it has been sufficient to administer a wide spectrum antibiotic to obtain healing per primam in the first week. In one case there was an error in patient selection. The patient was 69 years old and had diabetes and a generalizated discrete vascular sclerosis and a prior history of TB. The postoperative

progress was acceptable as concerns his general health but the patient developed a dehiscent slough of the sutures between the trachea and the thyroid cartilage. The result was an initial subcutaneous emphysema followed by a pharyngostoma. Consequently we have performed a total laryngectomy, but he ded.

The decannulation has been possible except in on case. Routinely the cannula is plugged on the sixth postoperative day and has always been perfectly tolerated. Nevertheless, the decannulation is not a always performed until it is seen that swallowing is performed sufficiently well as to impede aspiration by any false vias. This has been achieved between 12 and 22 days.

Phonation is reestablished from the moment that the cannula is patched. At first it is poor because the separation between the bands allows the escape of the expired air between them. The timber is monotone but more intelligible than that of the reconstructive laryngectomy.

Swallowing is possible by the natural via in a more or less short period of time depending on the personality of the patient, his intelligence and cooperation. In general, swallowing is tried from the tenth day on. Liquids provoke a violent crisis of coughing and suffocation and come out trough the tracheostoma. But when the patients learn to chew, then inspire and not to breathe during the act of swallowing ingestion then becomes possible. The oesophagal catheter can then be removed. Normally 3 weeks have been satisfactory for oral alimentation. This coincides with the vicarious hypertrophy of the bands and a mucous mamelon which during inspiration is aspirated towards the tracheal cavity flapping as an operculum (lid) to the middle posterior of the trachea and restoring a certain mobility of the bands. If one or both arytenoids are conserved swallowing is possible a few days before, although with difficulties and the respiration ist very bed.

The laryngeal image has been followed in the postoperative by both direct and indirect laryngoscopy. At 2 weeks the epiglottis has a normal form and mobility and behind it a mucous flap can be seen which during inspirated is aspirated towards the tracheal cavity and closing the posterior half as a lid. The middle anterior of this neoglottis remains open thanks to the conserved laryngeal skeleton and the relaxation of the bands. During expiration the laryngeal cavity remains closed because of the mucous flap which is also vibrates vertically during phonation with an increased intensity. On each side of the midline the bands can be seen diverging backwards and outwards terminating in the salient formed by the corniculate cartilages or the arytenoids when they have been conserved. At first the bands are absolutely rigid and the laryngeal cavity in its middle anterior remains immobile because of the rigidity of the thyroid alae. But with time and improvement of the laryngeal function with training the elasticity and mobility of these muscultendinous structures increases being able to observe a certain amplification caused by the abduction during inspiration and the contrary during expiration, especially during forced expiration.

Phonation and above all swallowing are precosiously restored satisfactorily due to, in our opinion, the fact that both superior laryngeal nerves are respected which, also, thusly conserves the sensitivity of the remaining portion of the larynx. This sensitive afferent pathway makes it possible to restore the deglutatory deffensive reflexes which exist in the normal larynx.

References

Algaba, J., Infantes, E., Vergez, A., Castillo, F.: Nueva técnica quirúrgica de laringectomía, conservadora. Laringectomía horizontal transventricular. Acta otorrinolaring. esp. **XXV/III,** 121 (1974)

Arslan, M., Serafini, I.: La laryngectomie totale a vec rétablissement de la phonation et de la respiration naturelles. Ann. Oto-laryng. (Paris) **87/9,** 509 (1970)

Bartual, R., Bartual, J., Otero, M.: Sobre la laringectomía total reconstructiva. Técnica de Serafini. Acta otorrinolaring. esp. **XXV/II,** 1 (1973)

Bartual, J., Portela, J.: Laringectomía parcial horizontal infravestibular. Indicaciones y técnica. Acta otorrinolaring. esp. **XXV/VI,** 81 (1974)

Bartual, J., Marco, J., Sacristan, T.: Cáncer laríngeo y Faringolaríngeo. Ponencia Oficial al IX Congreso de la Sociedad Española de Otorrinolaringología y Patología Cérvico-Facial. Acta otorrinolaring. esp., Núm. Extra-ord. 473 (1975)

Serafini, I.: Laringectomia totale con mantenimento della respirazioni per via naturale. Minerva otorinolaring. **XX,** 1 (1970)

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