

ONCOLOGY

Linear stapler closure of the pharynx during total laryngectomy: a 15-year experience (from closed technique to semi-closed technique)

Sutura meccanica della faringe in corso di laringectomia totale: 15 anni di esperienza (da tecnica chiusa a tecnica semi-chiusa)

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SUMMARY

Personal experience in performing linear stapler closure of the pharynx during 70 total laryngectomies is reported. Laryngeal staplers (55 and 60 cm) with an angled handle were used, permitting vertical closure with 19 or 20 metal staples in a double row. A closed technique was initially used, but, over the years, this has gradually been replaced by the semi-closed technique to avoid trapping the suprahyoid part of the epiglottis between the jaws of the stapler. The stapler is inserted below the larynx after having separated it from all muscular and neurovascular connections, and after performing a mini-pharyngotomy at the vallecule epiglottica in order to extract the epiglottis, evert it ventrally and suture it to the hyothyroepiglottic space. The jaws of the stapler are closed and the staples are fired while the flaps of the mini-pharyngotomy are raised above the jaws. The scalpel is inserted above the stapler to remove the larynx. When the stapler is opened, the vertical linear suture of the pharynx is evident and can be examined. This procedure takes only a few minutes to perform. It guarantees a long-term stable watertight closure, dramatically reduces contamination of the operating field by pharyngeal secretions, and permits rapid healing time, greatly lowering patient management costs. In the cases presented here, there was a 1.8% rate of pharyngocutaneous fistulae in patients who were not radiated, whereas the rate was 13.1% in pre-radiated patients. In agreement with the international literature, this procedure does not increase the rate of fistulae and, in fact, it seems to reduce it. Moreover, it is particularly indicated for pre-radiated patients. Nevertheless, the Authors recommend reserving this type of procedure to cases in which, based on meticulous pre-operative assessment by means of endoscopy and imaging, the endolaryngeal site of the tumour has been assessed and there is no need for peri-operative exploration of the pharynx or tongue base.

KEY WORDS: Larynx • Total laryngectomy • Autosuture • Semi-closed technique

RIASSUNTO

Gli Autori riferiscono la loro esperienza nell'esecuzione di una sutura meccanica della faringe nel corso di 70 laringectomie totali. Sono state utilizzate stapler lineari con manico angolato da 55 e 60 mm che consentono una sutura meccanica verticale con 19 o 21 agrafo metalliche disposte in doppia fila. Nel corso degli anni la tecnica, inizialmente totalmente chiusa, è diventata "semi-chiusa" per evitare l'incarceramento dell'apice dell'epiglottide fra le ganasce della stapler: la suturatrice viene inserita al di sotto della laringe una volta che questa sia stata liberata da tutte le sue connessioni muscolari e vascolo-nervose e dopo che, mediante una "mini-faringotomia" a livello delle vallecule glosso-epiglottiche, l'epiglottide sia stata estratta, rovesciata ventralmente e fissata con un punto alla loggia io-tiro-epiglottica. Le ganasce della stapler vengono chiuse e i punti "sparati" mentre i bordi della mini-faringotomia vengono tenuti sollevati al di sopra delle ganasce stesse. Quindi, mediante un bisturi fatto scorrere al di sopra della stapler, la laringe viene rimossa. Aprendo la suturatrice, la sutura lineare, verticale, della faringe diviene evidente e può essere ispezionata. La metodica richiede solo pochi minuti, garantisce una tenuta ermetica e stabile nel tempo, riduce nettamente l'inquinamento del campo operatorio da parte della secrezione faringea, consente tempi di guarigione rapidi ed evidente riduzione dei costi di gestione del paziente. Nella casistica presentata l'incidenza di fistole faringo-cutanee è stata dell'1,8% nei pazienti non irradiati, del 13,1% in quelli pre-irradiati. In accordo con la letteratura internazionale, si può pertanto affermare che tale metodica non aumenta l'incidenza di fistole ma anzi verosimilmente la riduce, trovando particolare indicazione nei pazienti pre-irradiati. Gli Autori raccomandano comunque di limitare questo tipo di procedura ai casi nei quali, ad una attenta valutazione pre-operatoria endoscopica e di imaging, sia certa la sede endolaringea del tumore e non vi sia necessità di esplorare intraoperatoriamente la faringe o la base linguale.

PAROLE CHIAVE: Laringe • Laringectomia totale • Sutura meccanica • Tecnica semi-chiusa

Introduction

In a previous study conducted in 1990¹, we discussed the results of the first 13 cases of closure of the pharyngeal space during total laryngectomy using a 55 mm linear stapler. Our team subsequently applied this technique, derived from gastrointestinal surgery and now widespread in that field, improving the manageability and results of this procedure. However, since this technique has not gained the widespread application in laryngology that, in our opinion, it deserves, the present report focuses on an additional 70 cases treated using this procedure over the past 15 years.

Materials and methods

From 1990 to 2005, 154 total laryngectomies were performed at the Otolaryngology and Head and Neck Surgery Clinic of the University of Perugia. A more detailed examination of this period reveals that total laryngectomies have decreased constantly over the years, with a concomitant increase in functional laryngectomies, above all reconstructive supracricoid laryngectomies. Nevertheless, this is an operation that must still be performed today. In 70 patients (45.4%), pharyngeal linear staple closure was performed with a 55 mm or 60 mm linear stapler. In each case, the decision to perform this type of suture was made pre-operatively and was limited strictly to the cases in which, following endoscopy and imaging, no peri-operative exploration of the pharynx or tongue base was

required and cancer had not spread to the free portion of the epiglottis or the postcricoid area.

Of the 70 patients, 15 (21%) underwent radiotherapy prior to surgery.

All the staplers used were linear models with an angled handle and 55 or 60 mm jaws, depending on the size of the larynx (recently the 60 mm type has been routinely used) (Fig. 1). Some models were disposable, others were reloadable; no difference was observed between the two. The instrument holds a double row of staples. In the 55 mm stapler there are 19 staples made of malleable steel; the 60 mm model, more recently used, holds 21 titanium staples.

The instrument has a lever that closes the jaws, as well as a second lever that “fires” the sutures, which close instantly in a B shape and suture the tissue between the jaws. A double staggered row of staples forms the suture, ensuring maximum impenetrability (Fig. 2).

The stapler – with its jaws open – is inserted below the larynx after it has been separated from the trachea, detached from the oesophagus from bottom to top, and separated from all muscular and neurovascular connections. Initially, all mucosal connections were left in place and a Babcock clamp was used to retract the suprahyoid part of the epiglottis, identified via a “see-through effect” of the mucosa of the vallecula epiglottica, so that it would not be caught in the stapler jaws. This represents a completely closed technique, in which there was no overlap between the operating field

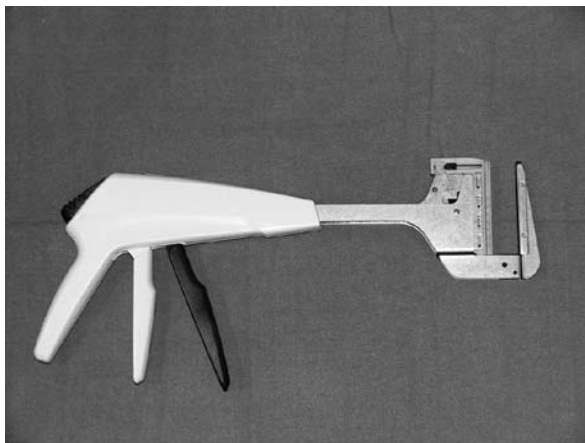


Fig. 1. Stapler used by the Authors.

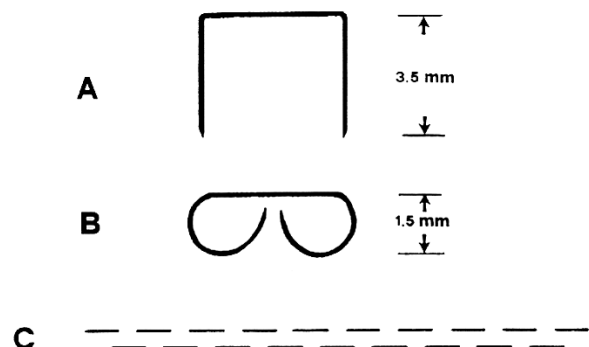


Fig. 2. Shape (A and B) and arrangement (C) of staples, open and closed.



Fig. 3. Median mini-pharyngotomy to identify and evert epiglottis.

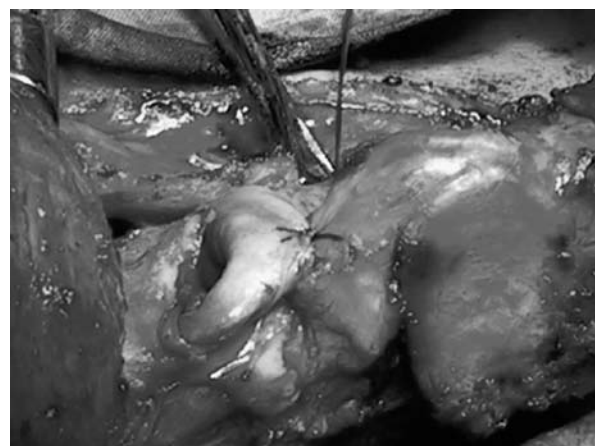


Fig. 4. Suture of epiglottis to hyothyroepiglottic space.

and the endopharyngeal area. However, in several cases involving a particularly long or stiff epiglottis, the upper portion was caught in the jaws of the instrument and thus in the pharyngeal suture. Although these cases did not have any functional or oncological problem over the long term, we recently modified the closed technique and transformed it into a “semi-closed” technique. Once the larynx has been detached from the oesophagus, a small opening is made at the vallecula epiglottica (“median mini-pharyngotomy”) through which we identify the apex of the epiglottis (Fig. 3), evert it ventrally, then suture it to the tissues of the hyothyroepiglottic space (Fig. 4). At this point, the open jaws of the stapler (Fig. 5) are inserted below the larynx and are immediately closed, without the risk of trapping the epiglottis. As the surgeon closes the jaws, an assistant using one or two forceps raises the small opening made in the vallecula in order that it remains entirely above the suture. With the other lever, the staples are fired to close the pharynx, and a scalpel is inserted above the instrument in order to remove the entire larynx. The stapler is then removed in order to inspect the suture and check that it has been placed correctly; the suture will be completely linear (Fig. 6). The pharyngeal constrictor muscles and the prelaryngeal muscles are drawn together and sutured, using the same procedure as that performed in the traditional technique.



Fig. 5. Application of stapler beneath larynx and mini-pharyngotomy.



Fig. 6. Linear stapler closure of pharynx following removal of larynx and stapler.

Results

In some of the 13 cases described in the first report on this technique (1990), the feeding tube was not inserted and the patients received a liquid diet, so they could swallow already on the third day post-operatively. Subsequently – and strictly as a precautionary measure – it was considered more ethical to use the feeding tube for all patients, removing it on approximately the tenth day postoperatively.

In this new group of 70 cases, pharyngo-cutaneous fistulae occurred in 3 patients (4% of total). Two had undergone radiotherapy prior to surgery (13.3% of the group of 15 pre-radiated patients). Of these 3 cases, one was treated conservatively with compressive medication, whereas surgical revision was successfully performed in the other two.

No significant differences in clinical course (general health, infections, fever, recovery of swallowing) were observed in these patients compared to those submitted to the traditional technique.

Specifically, we observed a 5.7% post-operative infection rate (vs. 7.7% in the group operated upon using the traditional technique), 7.1% of cases still with fever after the third post-operative day (vs. 8.4% in the other group).

On average, the feeding tube was removed on the tenth day (the same as in the other group).

Likewise, as far as concerns oesophageal speech (we routinely train all laryngectomised patients), we observed the same success rates as in the other cases (78% vs. 81%).

In 1990, we reported having performed hypopharyngoscopy, with optic fibres, on all 13 patients, one month after surgery demonstrating normal hypo-pharyngeal conditions, and manometry of the superior oesophageal sphincter which showed a mean basal tone within the normal range (25-100 mm Hg), normal release during swallowing and well-preserved pharyngo-oesophageal coordination.

In some patients, X-ray of the hypopharynx, performed one to three months after surgery, demonstrated correct positioning of the metal staples as well as their progressive elimination with time (through the oesophageal lumen), as occurs in gastrointestinal surgery.

Discussion

Until a few years ago, mechanical staplers were used only sporadically for closure of the pharyngostoma during laryngectomy, generally following excision of the larynx. The stapler was applied while the flaps of the space were raised with forceps or threads, performing a single vertical suture with one instrument or a T-suture with two staplers^{2,7}. In general, a decrease in the incidence of fistulae was observed (15-5%), the feeding tube was left in situ for less time (3-5 days) and hospitalisation time decreased. Santaolalla Montoya et al.⁸ compared 38 cases of linear stapler closure, performed with a closed technique, with 12 performed in which an open technique was employed, observing advantages from all standpoints (duration of surgery, start of oral feeding, hospitalisation, complications) in the first group. The most extensive study was recently described by Bedrin et al.⁹ with 1415 cases of pharyngeal closure using a linear stapler. These Authors reported simple and fast surgery, watertight closure of the suture, excellent haemostasis, normal swallowing and voice recovery, no increase in recurrences, and lower costs of surgery. Pharyngo-cutaneous

fistulae were observed in 12% of pre-radiated patients and in 5% of those not submitted to radiotherapy. All Authors who have performed closed techniques have found that, in some cases, it is difficult to keep the supra-hyoid part of the epiglottis outside the jaws of the stapler, as observed also by our team. Some⁹ introduce a hook into the laryngeal lumen through the trachea and, after blindly harpooning the apex of the epiglottis, retract the epiglottis towards the lumen and thus upwards. To avoid this problem, we found it simpler and safer to transform the closed technique into a "semi-closed" technique by creating a small opening in the mucosa of the vallecula epiglottica, through which we extract the epiglottis; after everting it, with one stitch we secure it to the tissues of the hyothyroepiglottic space. As the linear stapler closure is performed, the second surgeon must take care to keep the edges of this mini-pharyngotomy well above the jaws of the stapler. Given the small size of this opening and the brief operating time, the operating field is not contaminated by endopharyngeal secretion. With this modified technique, it is impossible for the epiglottis to remain trapped in the suture.

Mechanical suture requires only a few minutes, and thus the operating time is significantly reduced. This is beneficial not only for the entire surgical and anaesthesiology team, but also for patients at risk.

Based on our experience, linear stapler closure shows excellent results over time. Only 3 patients had pharyngo-cutaneous fistulae (4% of total). Of the 55 non-radiated patients, 1.8% presented fistulae, whilst of the 15 pre-radiated patients, the rate of fistulae was 13.3%. The rate of pharyngo-cutaneous fistulae following laryngectomy varies from 4-5% to 66%¹⁰⁻¹³ and depends on various factors, such as type of pharyngeal suture and material used, presence of pre-operative tracheostomy, type of antibiotic treatment, use of blood transfusions, removal of lymph nodes in the neck, gastro-oesophageal reflux, post-operative anaemia but, above all, pre-operative radiation treatment¹⁴⁻¹⁹, the latter increasing the rate of fistulae to the highest levels. Our study, like those of most other Authors, is not large enough to draw statistically significant conclusions. However, our experience confirms that stapler suture ensures watertight closure and does not increase the risk of fistulae, despite the fact that it is sutured outwards (mucosa-mucosa), as opposed to the traditional procedure in which the mucosal edges are sutured inwards (serosa-serosa). The double row of metal staples ensures duration and impenetrability, whereas the B shape of the closed staples permits good blood supply to the

facing edges, avoiding ischaemia and necrosis. There is also clinical evidence showing that a linear suture of the pharynx, such as the type created with use of the stapler, permits better closure than the traditional T-suture, in which the point of trifurcation shows inherent criticality¹². Cicatrization evidently proceeds at the connective tissue outside the mucosa: in fact, all gastrointestinal surgery using staplers has now achieved excellent and well-established results in terms of cicatrization and long-term closure with this type of suture.

Swallowing is recovered in the same timeframe as observed with the traditional technique; the feeding tube is left in situ for the same amount of time (mean 10 days). In our personal experience no late problems were observed as far as concerns swallowing. Likewise, there were no additional problems in speech rehabilitation. For those who use primary tracheo-oesophageal puncture, a few simple technical expedients are essential⁷.

Linear stapler closure does not interfere with post-operative radiotherapy and, given the small size of the staples, it does not create any artefacts in computed tomography imaging. In this regard, it is worthwhile pointing out that, within 3-4 months of surgery, most of the sutures are eliminated through the digestive tract.

Conclusions

To summarise, pharyngeal linear stapler closure during laryngectomy, performed with the "semi-closed" technique that we used on 70 patients, offers a number of positive aspects:

- significant reduction of operating time;
- minimal contamination of the operating field by endopharyngeal secretion;
- no bleeding of the edges of the pharyngostomy;
- excellent long-term watertight closure and reduced risk of pharyngo-cutaneous fistulae;
- rapid recovery of swallowing;
- overall decrease in patient management costs;
- specific indication for pre-radiated patients.

One important recommendation is that, considering the procedure is relatively easy to perform, it should not be applied indiscriminately in all cases of total laryngectomy but only in those in which meticulous pre-operative endoscopic examination and imaging have been performed, thereby avoiding the need for direct visualisation of the tumour and/or pharynx during surgery.

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