Chapter 116: Total Laryngectomy and Laryngopharyngectomy

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Total Laryngectomy

Historical development

Although Patrick Watson of Edinburgh is often credited with the first total laryngectomy in 1866, there is no recorded proof that the operation actually occurred. Research into Watson's own paper (Stell, 1981) apparently puts the matter to rest; Watson himself stated he performed only a tracheotomy during a patient's life and then postmortem laryngectomy of the syphilitic larynx. Billroth of Vienna, however, on December 31, 1873 carried out the first total laryngectomy for laryngeal cancer. One month earlier, he had performed a vertical cricothyrotomy and local intralaryngeal excision of this patient's lesion. However, gross recurrence had necessitated further radical ablation (Stell, 1973), and the operation was punctuated by considerable bleeding, coughing, and arousal from the anesthetic. A large pharyngocutaneous fistula was crated, but the patient was fed successfully by mouth and was even fitted with an artificial larynx (Gussenbauer, 1876).

Billroth and Gussenabauer's patient died 7 months postoperatively (Alberti, 1975), but Bottini of Turin performed a total laryngectomy in 1875 on a patient who then survived for 10 years. Thiersch (also of split skin graft renown) reported another long-term survivor in 1880, but Gluck in 1880 and others subsequently noted in retrospect that operative or early postoperative mortality rates were approximately 50%. This led Gluck, of Germany, to develop a two-stage procedure in which the tracheal separation was performed first, such that a well-healed tracheocutaneous stoma was present when the laryngectomy and pharyngeal closure were performed 2 weeks later. In the 1890s, with his pupil Sorenson, he then developed a successful single-stage operation, similar to contemporary techniques, in which the larynx was removed from above downward (Holinger, 1975). Solis-Cohen, advancing from partial laryngectomies in the 1860s (Alberti, 1975), reported a total laryngectomy using similar Gluck-Sorenson techniques at the 1892 Philadelphia County Medical Society Meeting. However, Frederick Lange of New York apparently reported America's first total laryngectomy in 1879 (Holinger, 1975).

Radiation therapy was very popular for laryngeal cancer during the first half of the twentieth century. However, with improvements in surgical and anesthetic technique and a recognition of radiation therapy's limitations, surgery (including total laryngectomy) continues to play a major contemporary role.

Indications

Malignant disease

With the popularization of conservation laryngectomies (hemilaryngectomy (Ogura and Thawley, 1980) and supraglottic laryngectomy (Bocca et al, 1983)), the need for total laryngectomy as the only surgical option for laryngeal cancer has diminished. Varieties of near-total laryngectomy, including those described by Pearson (1981), Laccourreye et al (1990), and Tanabe et al (1985), have been proposed to preserve voice, a normal airway, or both, yet still provide durable cancer control.

Nonsurgical treatment for laryngeal malignancy is also established as primary treatment in some centers. This includes definitive radiation alone with surgery for salvage for primary lesions up to T3 (Harwood et al, 1979; Viani et al, 1991) or neoadjuvant chemotherapy and radiation therapy, with total laryngectomy reserved for unresponsive tumors (Vikram et al, 1988; Wolf, 1988). The effectiveness of this latter approach awaits confirmation by further multi-institutional studies. The place for total laryngectomy in the 1990s, however, remains established in the following situations.

Primary surgery

1. Advanced tumors with cartilage destruction and anterior extralaryngeal spread.

2. Posterior commissure or bilateral arytenoid tumor distribution.

3. Circumferential disease with or without bilateral vocal cord paralysis.

4. Subglottic extension, either longitudinal or circumferential, sufficient to preclude near-total, tracheopharyngeal shunt formation.

5. Completion laryngectomy for failed conservation surgery.

6. Hypopharyngeal tumor arising on or spreading to the postcricoid mucosa (see discussion of total laryngopharyngectomy).

7. Massive neck metastases for thyroid tumors (usually recurrent)invading both sides of the larynx.

8. Advanced tumors of certain histologic types that are incurable by radiation therapy; for example, adenocarcinoma, spindle cell carcinoma, sarcomas, minor salivary gland tumors, large cell neuroendocrine tumors.

9. Total pharyngectomy for tumor that also necessitates either sensory or motor denervation of the larynx.

10. Patients requiring surgery, but whose pulmonary and general performance status precludes surviving the postoperative state and potential morbidity of supraglottic laryngectomy.

Radiation therapy failures

1. Recurrent cancer following both conservation surgery and radiation therapy, in whichever order.

2. Circumferential endolaryngeal malignancy, persistent or recurrent following definitive radiation therapy. (Any tumor distributions as indicated above would also necessitate a total laryngectomy after failing definitive radiation therapy.)

Although not exhaustive, the above lists include cases for which the physician has chosen surgery or radiation or planned combined therapy as primary treatment. The reader is referred elsewhere (Kaplan et al, 1984) for a discussion of the relative merits of surgery or radiation in the treatment of laryngeal carcinoma.

Benign disease

Although infrequent, the following indications may necessitate total laryngectomy.

1. Radiation necrosis of the larynx, despite tumor control, unresponsive to adequate antibiotic and hyperbaric oxygen treatment.

2. Severe irreversible aspiration, with the laryngectomy being for complete separation of the air and food passages.

Patient selection and workup

The following patient requirements should be met before a total laryngectomy is performed:

1. Candidate for general anesthesia.

2. Informed consent, including realistic understanding of total laryngectomy state and life-style after surgery.

3. Sufficient performance status, especially dexterity, to allow basic self-care of stoma.

The workup required for a total laryngectomy includes the anesthetic-related assessment of general health (not elaborated here) and specific tests relevant to the larynx. Assuming the patient has a laryngeal carcinoma, the following is required:

1. History (especially details of any prior radiation) and physical examination.

2. Focused head and neck examination, especially the neck, for detection of cervical metastasis.

3. Biopsy proof of malignancy.

4. Synchronous primary tumor screening, including bronchoscopy, esophagoscopy,

barium swallow, chest x-ray film, or chest CT film.

5. Metastatic screens, including chest imaging plus bone, brain, and liver studies for high-stage lesions.

6. Neck CT for assessment of cartilage or preepiglottic space invasion and neck metastasis.

Surgical technique

Resection

Patient positioning requires access to the anterior part of the neck for both surgeon and assistant. This is conveniently achieved by placing the patient on a table fitted with a head holder, allowing the head to be cantilevered out but well supported. In advance of the operation day, airway management is planned with the anesthesiologist such that a common agreement is reached regarding timing of tracheotomy and intubation. In the nonobstructed larynx, the anesthesiologist can pass an orotracheal tube with anesthetic induction, which can be removed at subsequent tracheotomy or left until tracheal transection is performed at the end of the laryngectomy. With an obstructed airway, or in a case where intubation might displace malignant tissue into the lower airway, a preliminary tracheotomy with the patient under local anesthesia is performed. The tracheotomy skin incision is made at the intended site of the final stoma, and every attempt should be made to enter the trachea at the ultimate level for tracheal transection with a horizontal cut. A precurved or flexible reinforced, cuffed tube is then passed into the trachea and adequate ventilation confirmed.

For access to the larynx iteself, a curved horizontal neck skin incision is preferred because of its minimal intersection with the pharyngeal closure and its potential for extension laterally into a neck dissection incision. The laryngectomy incision is made from sternomastoid to sternomastoid, at or above the level of the cricoid such that a 2 to 3 cm bridge of skin is preserved between the main incision and the upper stomal verge (Fig. 116-1). This configuration avoids the bilateral, complicated, three-point closures at the stoma necessitated by exteriorizing the lower cut tracheal end through the laryngectomy skin incision. Also, it allows diversion of pharyngeal contents away from the stoma should a pharyngocutaneous fistula complication occur.

Once the incision is deepened through, but not beyond the platysma, flaps are elevated superiorly and inferiorly in the subplatysmal plane until there is exposure above to the upper border of the hyoid bone and below to the cervical trachea. The anterior jugular veins and the prelaryngeal Delphian node are left undisturbed on the specimen, as are the strap muscles. The sternocleidomastoid muscle is then identified along its anterior border on each side. The investing layer of cervical fascia is incised longitudinally from the hyoid above to the clavicle below. The omohyoid is then divided, which allows entry to the loose areolar compartment bounded laterally by the sternomastoid muscle and carotid sheath and medially by the pharynx and larynx contained in the visceral compartment of the neck.

The strap muscles are then divided inferiorly from their sternal origins and elevated to expose the thyroid gland. The isthmus and the lobe ipsilateral to the laryngeal tumor are

left attached to the larynx and trachea for en bloc resection. Therefore the ipsilateral superior and inferior thyroid vascular pedicles are ligated and divided as is the middle thyroid vein. After dividing the thyroid isthmus, the contralateral lobe is then dissected off the laryngotracheal skeleton from medial to lateral, thereby preserving blood supply to the remaining thyroid and parathyroid parenchyma via superior or inferior thyroid vessels. Next, after dividing and ligating the upper and lower extent of the anterior jugular veins, the superior aspect of the hyoid bone is skeletonized by detaching mylohyoid geniohyoid, digastric sling, and hyoglossus in sequence from medial to lateral. "Cold" knife dissection should be used lateral to the lesser cornu, avoiding excess electrical stimulation or direct damage to the hypoglossal nerve. The sternohyoid and thyrohyoid muscle attachments on the lower border of the hyoid bone remain undisturbed. Further laryngeal cartilage skeletonization is now performed if tumor does not extend outside the piriform fossa. The posterior border of the thyroid cartilage lamina is rotated anteriorly by traction with a double hook, allowing sharp release of the constrictor muscles from inferior to superior cornu. Above the superior cornu, the laryngeal branch of the superior thyroid artery should be identified, ligated, and divided before it penetrates the thyrohyoid membrane.

The pharyngotomy incisions and definitive laryngeal removal are now performed. To avoid contact with the neoplasm or cutting through its submucosal extension, the pharynx is entered contralateral to the tumor. If superior extension to the tongue base is present, lateral pharyngotomy behind the thyroid cartilage is performed and, using a headlight, the extent of tumor is inspected. A safe 2 cm margin of normal-looking mucosa is then preserved with further cuts from below, progressing superiorly behind the thyrohyoid membrane, around the hyoid bone, and then trasnversely across the vallecula or tongue base. By contrast, if the disease is confined below the level of the hyoid, entry via the vallecula is feasible with a direct anteroposterior approach in the horizontal plane of the upper hyoid border. Strict maintenance of this plane, avoiding inferior traction of the hyoid itself, will preclude violation of the preepiglottic space. Once the mucosa is breached, the epiglottis' tip is identified, grasped with an Allis forceps if tumor free, and gently pulled anteriorly out of the pharyngotomy. A view of the endolarynx and pharynx is now possible, again to assess tumor extent and plan the appropriate mucosal cuts.

Using Mayo scissors, bilateral, inferiorly direct cuts are now made, releasing the lateral pharynx from the larynx. The inside scissors blade is on mucosa, and the outside blade is on constrictor musculature. As these vallecula to piriform sinus incisions are made, the larynx is further angled anteriorly out of the wound until it is released to the apices of the piriform sinuses. This widely exposes the postcricoid mucosa, which is incised sharply in the transverse direction connecting the inferior extent of both lateral incisions across the lower half of the cricoid lamina. A plane of blunt dissection, initially behind the posterior cricoarytenoid muscle, but from there down between trachealis and longitudinal esophageal muscle, is then opened until the desired level of tracheal transection is reached. Optimum exposure of the trachea at this stage is achieved by further lateralization of the preserved thyroid lobe and then followed by knife transection of the trachea itself (Fig. 116-2), with special care not to encroach on any subglottic tumor extension. If the latter is present, a 1.5 to 2.0 cm margin of healthy-appearing trachea should be resected in continuity with the larynx to avoid stomal recurrence (Sessions et al, 1975). If a preliminary tracheotomy had not been performed, the oral endotracheal tube is next withdrawn from the tracheal stump and a new, cuffed, flexible tube inserted for connection to new anesthesia tubing. After the specimen is

passed from the table, it is carefully inspected for adequacy of resection and a pathologist's frozen section study of all the patient's cut margins is requested. These will include trachea, tongue, and pharyngeal mucosa. The wound is thoroughly irrigated, all clots removed, and hemostasis achieved.

If a primary tracheoesophageal puncture is to be performed, the permanent tracheal stoma is created before pharyngeal repair. This enables definitive positioning of the trachea relative to the esophagus and skin before a puncture site is selected. A pair of right-angled forceps is then passed into the esophagus with the tip elevating posterior tracheal wall at the intended puncture site (Fig. 116-3). A tracheo-esophageal stab incision is made, exposing the forceps tip, and with these a No. 14Fr gauge feeding tube is grasped pulled into the pharynx, and then fed down the esophagus until its end is positioned in the stomach.

Clearly the above resection technique needs to be modified according to the extent of tumor spread. A common variation is the "wide-field" laryngectomy in which overlying neck skin is resected in continuity with the larynx and thyroid gland (Fig. 116-4). This is recommended for radiation recurrences that have invaded soft tissue outside the laryngeal skeleton.

Repair and reconstruction

Pharynx. Pharyngeal reconstruction is currently performed by direct closure or flap augmentation. A direct repair may be horizontally or longitudinally linear or T shaped in configuration (Fig. 116-5). Selection of closure is based on an assessment of the shape and size of the pharyngeal defect and simulated wound approximation before suturing. The least tensioned apposition of wound edges is the bezt and will usually be T shaped. This results in minimal or no horizontal shelf formation (Davis et al, 1982).

The pharyngeal wall is closed in two layers, the first being mucosal/submucosal and the second being muscle. A running or interrupted closure, according to the surgeon’s preference, is used with particular attention to inversion of the mucosal edges into the pharynx. This inversion is achieved with an absorbable stitch that runs horizontally through the submucosa, without penetration of the mucosal surface (Fig. 116-6). A longer retained material, such as polyglycolic acid, is necessary for radiated tissue. The muscle layer closure requires advancement of the cut constrictor margins over the mucosal closure for reinforcement. This maneuver always tightens the neopharynx to some extent and should be left undone at points where narrowing may be excessive. In fact, one study (Olson and Callaway, 1990) has shown that a mucosal closure alone is sufficient for sound healing.

If there is insufficient pharyngeal wall to close over a No. 36FR dilatator, a flap repair should be considered to augment the circumferential dimension of the neopharynx. Options currently include a myocutaneous flap, a muscle flap, or a microvascular free flap. My preference is for the jejunal “patch” graft (Figs. 116-7 and 116-8) being created by splitting a revascularized jejunal segment down its antimesenteric border for reconstruction of the anterior pharyngeal wall. Other donor tissue could include the radial forearm flap (Kato et al, 1987), which has also recently been proposed for neoglottic reconstruction (Hagen, 1990).

Whatever method of closure is used, it is sometimes prudent to fashion a control fistula for prevention of uncontrolled, complicated wound breakdown or infection. Patients with previous radiation therapy or other impediments to rapid wound healing, such as poor nutrition, diabetes, or immunosuppression, are suitable candidates for this. The “mushroom” end of a No. 16FR or 18FR Maleckot catheter is inserted into the neopharynx and secured in position with chromic catgut (Fig. 116-9, A). The pharyngeal wall closure is then approximated closely to the circumference of the catheter stem, which is led out through the wound away from the carotid arteries and stoma. If a myocutaneous flap has been used for closure, the catheter can pierce the muscle belly (Fig. 116-9, B) for additional security and may be led out through a separate stab incision in the neck skin. Low, continuous wall suction is administered through the catheter for salivary decompression of the pharyngeal repair for 7 to 10 days, after which the catheter is removed. A very small amount of discharge sometimes continues from the catheter track for several days but thereafter spontaneously heals.

Tracheal stoma. The permanent end tracheal stoma is created before or after pharyngeal repair. An appropriate shield-shaped skin button is removed from the lower neck flap in the midline, just above the sternal notch (see Fig. 116-1). Any excess adipose tissue or bulky sternomastoid muscle/tendon is excised deep to the skin flap to minimize tracheostenosis. The tracheal end is then passed through the hole and secured with several stay stitches. The circumferential suture line should provide support for the trachea and accurate skin-mucosal apposition without cartilage exposure. This is best achieved by a modified vertical mattress suture that traverses (1) skin (peripherally), (2) cartilaginous tracheal wall (extramucosally), and (3) skin (centrally) (Fig. 116-20). It is advisable to place all eight sutures in position before any are tied.

Postoperative management and complications

Apart from routine postsurgical care, the specific management of the early postlaryngectomy patients include the following monitoring:

- Systemic vital signs, fluid balance.

- Oxygenation.

- Wound drain vacuum retention and output.

- Neck flap viability.

Postoperative treatments are as follows:

- Ventilator assistance, as per respiratory status.

- Tracheostomy tube care (cleaning, cuff pressure checks).

- Airway humidification.

- Bronchodilator treatments and/or chest physical therapy.

- Suture line care tid.

- Nasogastric or tracheoesophageal fistula tube feeding once bowel sounds are present.

Drains are removed when output is below 25 mL/day for two consecutive days and oral feeding is normally begun on the seventh postoperative day in the nonirradiated patient. Laryngectomees previously radiated are fed on the twelfth to fourteenth day postoperatively to allow a longer hearing time for the pharyngeal repair.

Early complications

Early complications usually occur during the patient's postoperative hospitalization.

Drain failure. Drains unable to hold a vacuum represent a serious threat to the wound. There is usually either a leak in the pharynx or the skin/stoma closure that needs to be promptly detected and sealed.

Hematoma. Although rare, hematoma requires prompt intervention to avoid pressure separation of the pharyngeal repair and compression of the upper trachea. The patient is returned to the operating room, the clot is evacuated, and any detectable bleeding is controlled. New drains are inserted since blockage of the original ones with clot is inevitable.

Infection. A subcutaneous infection after total laryngectomy is recognized by increasing erythema and edema of the skin flaps at the third to fifth postoperative day. Associated odor, fever, and elevated white count will occur. If an infected collection is present, the wound is opened under sterile conditions and the pus evacuated and cultured. Dead space between the neopharynx and skin flap is managed with repeated antiseptic gauze packing until healed. Antibiotic coverage is modified according to culture results and a pharyngocutaneous fistula suspected if wound discharge continues or increases. A chylous fistula must be ruled out if neck dissection was performed.

Pharyngocutaneous fistula. Patients with poor preoperative nutritional status and positive surgical margins are at significant risk for fistula development (Shemen and Spiro, 1986). Contrary to the widely held notion, two studies (Shemen and Spiro, 1986; Thawley, 1981) do not show a significantly increased fistula rate in patients who have had preoperative radiation therapy. This may be attributable to contemporary awareness of the need for flap reinforcement when successful primary closure is dubious. A fistula begins as a significant, accumulating salivary leak from the pharyngeal closure into the subcutaneous space beneath the skin flaps and may be encouraged by a tight hypopharyngeal closure distally. Its existence will often be heralded by erythema and edema around part of the wound closure, which, on opening, drains purulent material and saliva. Such fistulas may occur 1 to 6 weeks postoperatively, depending on the presence or absence of prior radiation, and communication with the pharynx is confirmed by a methylene blue swallowing test. Persistent or recurrent tumor should always be ruled out.

Initial management is by regular, antiseptic gauze fistula-track packing, antibiotic therapy, and giving the patient nothing by mouth. A useful adjunct is to "sterilize" the fistula from within by administering 10 mL of 0.25% acetic acid by mouth three to four times daily. If the above measures are unsuccessful in sealing off the pharynx from the neck within 2 weeks in a nonradiated patient or 3 weeks in a radiated patient, operative close should be considered. Although spontaneous closure may occur up to 6 weeks after onset, most patients prefer a more rapid resolution so that oral feeding can begin.

An excellent option for fistula closure before complete epithelialization is a pedicled muscle flap (pectoralis, trapezius, or latissimus dorsi) slipped between the pharyngeal and skin defects. Such flaps endow excellent blood flow and antibacterial benefits to an avascular, infected bed (Gosain et al, 1990). A control pharyngostome catheter-suction system as described in the discussion of surgical technique may also be used to direct saliva away from the carotids. Further surgery at this stage should also correct any benign pharyngeal stricture distal to the fistula.

Wound dehiscence. Wound dehiscence may accompany a tensioned skin closure, the postradiation state, wound infection, fistula, or poorly designed, ischemic neck flaps. Local wound care should suffice for healing by secondary intention, but if the carotid becomes persistently exposed, vascularized muscle flap coverage is advisable.

Late complications

Stomal stenosis. Prolonged use (6 to 12 months) of a laryngectomy tube or stoma button should prevent stenosis. This is especially necessary if the patient has received or will receive radiation therapy after surgery. Tracheoesophageal fistula speech and prosthesis management, however, are inhibited by this situation; therefore a stomaplasty may be more expeditious for rehabilitation. The "fish-mouth" design of stomal revision is invariably effective (Fig. 116-10) but should be delayed until 6 months after radiation is completed to avoid wound healing problems.

Pharyngoesophageal stenosis/stricture. Tumor recurrence should be suspected, but once excluded by endoscopy and biopsy, outpatient dilation is usually very effective. An adequate lumen (No. 36FR) is necessary not only for swallowing and nutrition, but also for tracheoesophageal speech production. If dilation is unsuccessful, flap augmentation, such as a jejunal free flap, may be necessary (de Vries et al, 1990) for successful rehabilitation.

Hypothyroidism. Preoperative or postoperative radiation therapy plus hemithyroidectomy is usually sufficient to induce a low thyroid state. Thyroid function tests every 1 to 2 months after completion of all treatment will indicate when supplemental thyroid medication is required.

Rehabilitation

Swallowing

Oral intake is usually commenced on the seventh postoperative day, although waiting until 14 days is advisable if the patient has had preoperative radiation therapy. In a Brazilian study, 625 laryngectomees were fed on the third postoperative day and showed no increase in complications. They were able to avoid a nasogastric tube altogether (Aprigliano, 1990). Once a soft diet is tolerated, the patient may advance to normal intake, but edentulous patients need to be especially cautious about solids.

If dysphagia prevents adequate caloric or fluid intake, pharyngeal stricture, stenosis, or tongue weakness may be responsible. Modified barium swallows (Logemann, 1983) or manofluorography (McConnel et al, 1988) will help diagnose which component or components of the swallowing tract or mechanism are faulty. Radiation fibrosis of the neck, causing pharyngeal stensosi some months after completion of treatment, must be counteracted by regular dilation. Neuromuscular paralysis or weakness may be either preexisting or iatrogenic from surgical damage to the hypoglossal nerve. In either case, time and speech therapy exercises will assist recovery.

Voice

Mechanical devices. Mechanical devices are useful in the early, postoperative phase, before it is safe for the healing pharyngeal wall to be insufflated. Some patients also use them for permanent communication. Their major disadvantage is the monotonous, mechanical sound production, poor intelligibility, and the need for a cumbersome external device.

Esophageal speech. Although esophageal speech is mastered only by a few patients (Gates et al, 1982), a good esophageal speaker may eventually undertake public speaking engagements. Air charging is achieved by thrusting the tongue back and forcing a bolus through the cricopharyngeus. This is then regurgitated through the pharyngoesophageal segment, which vibrates to produce sound. Spasm of the pharyngoesophageal musculature or fixed stricture may preven acquisition of this technique, as may poor patient motivation.

Tracheoesophageal speech. The principle behind tracheoesophageal speech is diversion of exhaled air into the pharynx via a permanent, surgically constructed tracheoesophageal fistula. The pharyngoesophageal segment above the fistula vibrates, producing a neovoice. Singer and Blom (1980) and Panje (1981) have developed prosthetic devices that allow airflow to the pharyngoesophagus but that prevent salivary leak into the trachea. Tracheostomal occlusion is either digital or by wearing a valved stoma button that flaps shut with forceful exhalation.

The tracheoesophageal puncture can either be done primarily at the time of laryngectomy or as a secondary procedure when wound healing is complete. Most surgeons advise a waiting period of 6 months after completion of radiation therapy before secondary puncture. This allows the acute radiation reaction and thickening in the peristomal tissues and mucosa to regress sufficiently for rapid fistula epithelialization. Also, manipulation of peristomal tissue and vibratory excursion of pharyngoesophageal mucosa will ensue once

phonation training begins. Both may cause excessive edema unless thorough tissue recovery from radiation has occurred. A stoma at least 1 cm in diameter is required, so stomaplasty (see Fig. 116-11) is often done simultaneously with the puncture procedure. The reader is referred to Chapter 118 for further details of tracheoesophageal speech and prosthesis management.

Total Laryngopharyngectomy

Total laryngopharyngectomy is a total laryngectomy and associated circumferential pharyngectomy. The vertical extent of the pharyngectomy may be from the nasopharynx above to the cervical esophagus below, depending on tumor location and spread. Advanced squamous carcinoma of the hypopharynx or cervical esophagus with pharyngeal extension is the most common clinical entity requiring this operation.

Historical development

The operation of total laryngopharyngectomy was a logical extension of total laryngectomy. Thus, after Billroth's landmark total laryngectomy in 1873, von Langenbeck removed a larynx plus much of the pharynx and cervical esophagus in 1875. Czerny, who had assisted Billroth in the first total laryngectomy, performed the first total laryngopharyngectomy in 1877 (Simpson, 1966). According to Macbeth (1969), little had been done to reconstitute the pharynx until the 1920s, when Trotter pioneered the concept of skin flaps turned in from the neck to form a posterior pharyngeal wall at stage one, followed by circumferential tubing for the second stage. However, Gluck, operating in the late nineteenth century, is also credited with discovering this concept (Simpson, 1966), in which bilateral, laterally based neck skin flaps were utilized.

Once the complications of sepsis and perioperative mortality had been minimized, attention turned to better reconstruction. Wookey (1942) in Toronto published a successful series of total laryngopharyngectomies followed by a unilaterally based skin flap reconstruction. Since then, advances have centered on more sophisticated forms of single stage reconstruction, with the resectional techniques for larynx and pharynx remaining standard.

Indications

Assuming surgery is advised, advanced tumors of the hypopharynx with the following features require total laryngopharyngectomy.

Piriform sinus carcinoma

Pharyngeal spread beyond the midline posteriorly or the esophageal inlet necessitates circumferential pharyngectomy. The larynx, even if not involved, is usually sacrificed because it loses its dynamic pharyngeal support for swallowing or becomes denervated. Operations are available, however, in which the uninvolved larynx is splayed open and used for food passage lining (Simpson, 1966). Sporadic cases of total pharyngeal reconstruction with laryngeal preservation, have been described (Calteaux et al, 1986) but require superb patient performance status. This is unusual in the patient population with hypopharyngeal cancer.

Laryngeal spread, as indicated above, nearly always necessitates total laryngectomy. Again, some cases may be suitable for near-total larynectomy (Dumich et al, 1984), but these also usually require flap reconstruction of the pharynx.

Carcinoma of posterior hypopharyngeal wall

When carcinoma of the posterior hypopharyngeal wall extends anteriorly into the piriform sinuses or inferiorly below the level of the arytenoids, total laryngopharyngectomy is necessary.

Postcricoid carcinoma

Postcricoid carcinoma usually presents late, after spread downward into the esophageal inlet has occurred, and this tumor may be extensive. In this context total laryngopharyngectomy will be required, especially if there is vocal cord paralysis.

Patient selection and workup

The same general considerations apply as outlined for total laryngectomy. However, special features of the preoperative workup of hypopharyngeal cancer patients include nutritional assessment and supplementation, careful scan staging of disease extent, and endoscopy with mapping biopsies. An assessment of resectability is then made (carotid artery, vertebral column, and extensive neck metastatic involvement is common), followed by full evaluation of potential donor sites (for example, visceral) for pharyngoesophageal reconstruction. Preoperative calcium and thyroid hormone levels are assessed as a baseline for postoperative management.

Surgical technique

Resection

Patient positioning and anesthetic considerations are the same as for total laryngectomy. However, an in-continuity neck dissection is nearly always performed for hypopharyngeal tumors requiring primary surgery. Occasionally where primary site radiation failure has occurred but the neck remains clinically negative, laryngopharyngectomy alone is sufficient. The abdomen should be prepared for jejunum harvesting or gastric mobilization if visceral reconstructions are planned.

The neck dissection is performed first, the specimen being pedicled medially on the pharyngeal wall from the hyoid level down to the cricopharyngeus. Suitable arterial stumps (lingual, facial, superior thyroid, trasnverse cervical) are preserved, provided oncologic compromise will result, to allow a microvascular free tissue transfer. Similarly, the external jugular, internal jugular vein tributaries, or transverse cervical vein may be kept unless a classic radical neck dissection is necessary. If esophageal resection inferior to the thoracic inlet is required to obtain clear margins, a total esophagectomy and visceral transposition will probably be the best reconstruction, obviating the need for recipient vessel preservation.

The initial dissection steps for laryngopharyngectomy are the same as for total laryngectomy except that mobilization of the larynx, pharynx, and cervical esophagus as a unit is performed by extending the lateral dissection into the retropharyngeal and retoresophageal space. Careful observation is maintained for spread beyond the buccopharyngeal and prevertebral fasciae into the prevertebral muscles or vertebral bodies. The prevertebral fascia itself is a moderately resistant barrier to tumor spread but is resected in continuity with the specimen if necessary.

Once the pharynx, larynx, and upper cervical esophagus are circumferentially mobilized, the thyroid gland must be dissected free from its vascular pedicles to be removed with the specimen. The parathyroids contralateral to the tumor's epicenter can sometimes be preserved but are usually removed to ensure continuity with the surrounding paratracheal nodes. If there is no oncologic risk, reimplantation into a muscle bed is advised.

The pharynx is entered above the hyoid contralateral to the site with the most superior spread. Piriform sinus tumors may extend superiorly into the base of the tongue, thereby requiring a wide margin of resection under direct observation. The pharyngeal mucosa cuts are then continued horizontally around and onto the posterior pharyngeal wall at least 2 cm above the highest extent of the lesion, such that the whole upper pharynx and larynx are now free. The trachea is then transected, followed by the cervical esophagus at the level appropriate to tumor extent. If total esophagectomy is to be performed, blunt dissection of the esophagus continues from above downward until the inferior esophageal dissection is encountered (Fig. 116-12). Superior mediastinal adenopathy is dealt with using a manubrial resection approach (Fig. 116-13; Harrison, 1969).

Reconstruction

An extensive history and voluminous surgical literature deals with reconstruction of circumferential pharyngeal defects. My technique currently utilizes jejunal free transfer (Fig. 116-14), and in a personal series of 12 cases to date, 11 jejunal segments have survived and allowed resumption of swallowing. In the second case of the series, the failed flap was replaced with a tubed pectoralis major reconstruction, also enabling satisfactory swallowing rehabilitation. Alternative donor tissue is the tubed forearm flap (Kato et al, 1987), but it is only applicable to short defects. If the esophageal resection extends below the thoracic inlet, a visceral transposition is used, thus avoiding anastomoses in the mediastinum. Further details of hypopharyngeal reconstruction are given in Chapter 117.

Postoperative management and complications

Postoperative management

The same management applies as that described for total laryngectomy. However, one or more neck dissections and abdominal donor sites are frequently employed, and this greater magnitude of surgery necessitates special attention to pulmonary function, fluid/nutritional balance, and local wound conditions in the neck, thorax, and abdomen. Regular postoperative checks of calicum, magnesium, and phosphorus levels are necessary and supplementation with calcium, magnesium, and 1,25-dihydroxycholecalciferol is usually required.

Early complications

Early fistula formation is more common than in total laryngectomy alone and needs especially aggressive management because of the mediastinitis risk. When a fistula or infection in the neck is detected, the wound is opened widely and left open with the track packed and directed to pass away from the carotids. Leaking visceropharyngeal anastomoses may need to be controlled with pharyngostoma formation and, if healing is poor, should be reinforced with fresh, vascularized, nonradiated flap tissue (for example, trapezius or pectoralis muscle flaps).

Late complications

Stricture. Strictures are more common at the inferior, esophageal end of the pharyngeal reconstruction than superiorly, where the recipient lumen of the pharynx is wider. A stricture causing dysphagia may develop some weeks or months after surgery or radiation therapy is complete. Whether the reconstruction is skin or visceral, the principles of stricture management are the same as for postlaryngectomy: repeated, outpatient dilation once tumor recurrence is excluded, progressing to surgical revision if the latter is unsuccessful or poorly tolerated.

Functional swallowing problems. The jejunal free flap frequently maintains its contractility following transposition to the neck. This has been shown to cause functional dysphagia in some cases if the food bolus is delivered simultaneously with circumferential contractions (McConnel et al, 1988). Even myotomy of the bowel wall does not obliterate jejunal motility completely, according to a recently developed canine model (Haughey and Forsen, 1991). To elucidate methods of modulating contractility, research is continuing. Regurgitation of food is a recognized complication of the gastric transposition procedure. This is usually caused by narrowing at the pylorus rather than anastomotic stricture and may be variable in its severity. Frequent, mechanically blenderized meals eaten slowly are usually sufficient to maintain nutrition.

Rehabilitation

The considerations in swallowing are the same as those above in the discussion of functional swallowing problems following total laryngectomy.

Voice

Despite the interposition of circumferential visceral, skin, or myocutaneous tissue, voice can be attained using a tracheoneodigestive tract fistula technique. The stomach (Bleach et al, 1991), the jejunum (Ziesman et al, 1989), and skin or myocutaneous flaps (Medina et al, 1987) are capable of sufficient vibration to produce intelligible speech. My practice is to perform secondary versus primary punctures in total laryngopharyngectomy patients because the trachea has been completely separated posteriorly from the esophagus or the neoesophagus. A primary puncture would have to traverse this potential dead space. An unacceptably high risk of leakage and infection is thereby created.

Summary

A review of contemporary indications, techniques, and rehabilitation for patients undergoing total laryngectomy and total laryngopharyngectomy is presented. Most patients requiring these operations have head and neck cancer, and the scope of the chapter is limited to the relevant clinical details of operative and perioperative events. Readers are referred elsewhere (Foote et al, 1989; Lam et al, 1988) to consider the effectiveness of these operatins in cancer control.