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HOW I DO IT

Surgical technique—unwrapping the neck node levels around a sternocleidomastoid muscle bar: A systematic way of performing (modified) radical neck dissection

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Abstract *Aim*: Description of a systematic approach to the neck for removal of lymph node bearing tissues in levels I-V.
Method: A (modified) radical neck dissection is divided in three steps: (1) Dissection of levels I-IV, (2) dissection of level V and (3) transection of SCM bar and finalisation of the dissection. The sternocleidomastoid muscle (SCM) is used as a 'bar', around which the different neck levels can be systematically unwrapped, warranting permanent cranio-caudal tension of the neck specimen, while anatomical relations remain intact.
Results: In a group of 115 (modified) radical en bloc neck dissections with or without post-operative radiotherapy 10% regional recurrences, 2% post-operative chylous fistulas and <5% post-operative wound infections occurred. The overall 5 years survival was 45% (95% confidence interval: 36-54%).
Conclusion: A systematic unwrapping of lymph node levels around the sternocleidomastoid bar provides a reliable systematic method for performing (modified) radical neck dissections without a negative influence on clinical outcome.

Introduction

The surgical treatment of neck node metastases is by far the most frequent procedure in daily head and neck surgical practice. The development of a classification of neck dissections based on the level system for describing location of lymph nodes in the neck, has been of tremendous help in systematizing this type of surgery.[1,2] The classical radical neck dissection entails a comprehensive removal of the lymph node-bearing tissues of the neck (lymph node levels I-V) for

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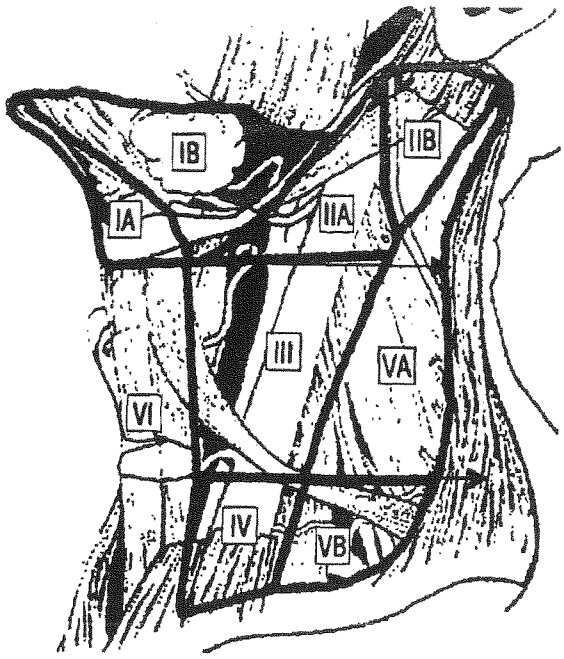

Figure 1 Localisation of (sub)levels I-VI in the neck. The schematic drawing copied with permission of the publisher from the article by K.T. Robbins et al. Neck dissection classification update: Revisions proposed by the American Head and Neck Society and the American Academy of Otolaryngology-Head and Neck Surgery. Arch Otolaryngol Head Neck Surg 2002;128:751-8. Copyright© 2002, American Medical Association. All rights reserved.

regionally metastasised carcinomas of the upper aero-digestive tract and skin (Fig. 1). When preservation of one or more non-lymphatic structures (internal jugular vein (IJV), spinal accessory nerve (SAN) and sternocleidomastoid muscle (SCM) is involved, the procedure is named (modified) radical neck dissection.[1,2] A thorough knowledge of the neck anatomy and understanding of the extent of the neck disease in relation to the primary tumour, in case the latter should be removed in an en bloc procedure, are the basis for a smooth course of the neck dissection procedure. The understanding of a basic systematic surgical approach may add in optimal exposure of the neck node levels and decreases the risk of complications. Although surgeons will always develop adaptations depending on their personal skills to recommended surgical schemes, the basic knowledge on a schematic approach should always prevail. We describe a schematic technique for performing a (modified) radical neck dissection using the sternocleidomastoid muscle (SCM) as a bar, around which the different neck levels can be systematically unwrapped. The advantages of this technique are discussed.

Technique

The way we approach the (modified) radical neck dissection with or without preservation of SAN and/or IJV can be divided into three major steps. The sequence of these steps may vary, depending on the site of the primary tumour.

Skin flaps and setting the borders

In case of removal of levels I-V the Schobinger incision is the preferred incision; a 'Y' shaped incision combining a bow shaped suprahyoid incision—running from the midline of the mandible to the mastoid tip—and a vertically placed 'lazy S' incision perpendicular to it.[3] This incision creates excellent exposure and can be extended to a midline incision of the chin in case of a commando procedure. After the incisions are made, skin flaps are raised in a subplatysmal plane. Cranially this is performed until the level of the lower border of the mandible, distally until the clavicle, and posteriorly until the anterior border of the trapezius muscle, hereby setting the dissection borders. The anterior border runs from the mandibular midline to the attachment of the sternal head of the SCM muscle at the clavicle. Cranioposteriorly, the platysma is absent and both great auricular nerve and external jugular vein then serve as indicators for the posterosuperior dissection plane reaching over the parotid gland up to an imaginary line drawn from the lower rim of the mandible in a posterior direction. Absence of the subplatysmal plane is also cumbersome in raising the posterior skin flap. While the assistant is retracting the posterior skin flap using two large six-prong rakes, the anterior inferior border of the trapezius muscle is first identified near the attachment of the muscle to the clavicle, from where the anterior border is followed cranially. From the level where the trapezius muscle bends off posteriorly, the posterolateral dissection plane in the aplatysmal zone is indicated by the anterior rim of the lower part of trapezius muscle until the posterior attachment of the SCM to the mastoid tip. By dissecting in a proper plane over the superficial cervical fascia there is no risk for SAN injury.

Step I—dissection of levels I-IV (Fig. 2)

Step I encompasses the dissection of levels I-IV and starts with the identification of the marginal branch of the facial nerve, which runs over the facial artery and vein near the lower rim of the mandible. This nerve branch should be dissected posteriorly into the tail of the parotid and determines the cleavage

Figure 2 After a 'Y' shaped Schobinger skin incision, step I comprises removal of neck node levels I-IV. Surgical exposure of the carotid sheath is significantly increased by transection of the medial part of the omohyoid muscle, followed by cutting the sternal head of the sternocleidomastoid muscle (SCM) from the sternum.

plane through the parotid gland of which the tail is included in the neck dissection specimen. The branch is then mobilized cranially, beyond the lower border of the mandible, allowing for ligation and transection of the facial artery and vein. With the use of a folded gauze, the superficial neck fascia is stretched in a caudal direction, followed by incision of the fascia along the border of the mandible, under visualization of the underlying mylohyoid muscle. The submental dissection starts with the identification of the contralateral anterior belly of the digastric muscle removing all lymph node bearing tissue in the submental triangle by dissecting from the contralateral anterior digastric belly to the homolateral digastric muscle, under continuous stretching of the submental tissue by clamps. After complete dissection of the homolateral anterior belly of the digastric muscle, the tendon of the posterior belly is identified at the hyoid level. The submandibular tissue is then stretched in a posterior direction with the use of a folded gauze facilitating easier dissection of the underlying mylohyoid muscle. An incision of the superficial layer of the deep cervical fascia along the posterior border of the mylohyoid muscle combined with careful anterior retraction of this muscle by a Langenbeck hook opens the way to the sublingual space, including the medial part of the submandibular gland, lingual nerve, submandibular ganglion, hypoglossal nerve and submandibular duct, in this manner creating a greater mobility in the submandibular tissue specimen. A Duval clamp is applied to the submandibular gland to stretch it into caudal direction enabling identification of the lingual nerve and the submandibular ganglion. The ganglion and its accompanying artery are ligated and transected, the hypoglossal nerve is identified over a greater length running over the surface of the hyoglossal muscle and the submandibular duct is transected after ligation. This manoeuvre creates more space in the submandibular region and by continued retraction of the submandibular gland and its surrounding tissue, easy identification and transection of the facial artery is enabled, which crosses over the posterior belly of the digastric muscle. At this stage the anterior border of the SCM is released by cleavage of the superficial cervical fascia from mastoid towards the sternoclavicular joint. The medial part of the omohyoid muscle is transected, followed by cutting the sternal head of the SCM from the sternum to increase exposure of level IV. The clavicular head of the SCM is preserved in order to keep a cranio-caudal tension on the tissue, and forms the basis of the systematic stepwise surgical unwrapping of the neck. The carotid sheath is opened by blunt dissection in cranial direction with preservation of the hypoglossal ansa, followed by identification of the retromandibular veins, which are subsequently ligated and divided. Thereafter, the hypoglossal nerve is freed from its surroundings towards where it crosses the external carotid artery and lies in the groove between the internal and external carotid artery. Keeping the SCM muscle intact at this stage of the operation to maintain cranio-caudal tension does imply continuous posterior retraction of the SCM by a surgery assistant with two Langenbeck retractors, to enhance surgical exposure.

Step II—dissection of level V (Fig. 3)

Next, the posterior triangle (level V) is dissected. The SAN surgically and anatomically divides this area into an upper and a lower posterior neck triangle. This nerve has a relatively predictable course, running 1 cm cranially from the place where the greater auricular nerve wraps around the posterior border of the SCM towards its entrance in the trapezius muscle approximately 4 cm from the clavicular attachment of the muscle. Nevertheless, identification of the accessory nerve in the posterior triangle is less easy than one may expect at first glance, particularly in adipose patients. The first step in searching for the SAN is inspection, while

Figure 3 Step II comprises removal of neck node level V starting with the lower posterior neck triangle after identification of the spinal accessory nerve (SAN) followed by the upper posterior triangle. The dorsal part of the SCM is transected cranially to create more exposure at this site, with maintenance of a muscular bar, constituted by the remaining SCM, warranting a preserved cranio-caudal tension in the neck dissection specimen.

looking for a glimpse of the nerve under a translucent superficial neck fascia. If the nerve cannot readily be localized in this manner, identification starts by incision of the fascia along the medial lower part of the trapezius muscle in the neck with anterior retraction of the posterior neck fascia. From there the nerve can be dissected cranially towards its entrance in the SCM, while stripping it from the tissues around it under exposure of the deep muscles of the neck. The procedure then proceeds with dissection of the lower posterior neck triangle. After division of the external jugular vein, the superficial neck fascia is incised under tension along the cranial border of the clavicle. The underlying omohyoid muscle is cut as far lateral as is easily reached. After all cutaneous nerves are transected, the remaining median part of the omohyoid muscle is grasped and pulled superiorly using a Duval clamp, with inclusion of the supraclavicular fat pad and its contained lymph nodes. The remaining deep supraclavicular tissues are swept cranially by pushing it upwards with a gauze wrapped around the thumb leaving the deep cervical fascia intact and—if appropriate—the transverse cervical artery and vein as well. Both brachial plexus and phrenic nerve are identified, by lifting up the clavicular head of the SCM. Attention is then focused on the superior posterior triangle, where the lymph node bearing tissue is dissected from laterally to medially over the deep neck muscles. To create more exposure at this site, the dorsal part of the SCM is transected cranially with maintenance of a muscular bar, constituted by the remaining SCM, warranting a preserved cranio-caudal tension in the neck dissection specimen.

Step III—transection of SCM bar and finalisation of the dissection (Fig. 4)

Finally, the SCM is transected superiorly off the mastoid tip and the SAN is identified in level II. The surgeon then changes temporarily position to the head of the patient for visualization of the SAN when dissecting it in cranio-caudal direction through the SCM. While the assistant keeps the rostral end of the SCM under tension with two Allis clamps, the SCM is divided along the accessory nerve. By cutting the nerve branches for innervation of the SCM, the SAN is further dissected with special attention for a sharp curvature of the nerve near the posterior border of the SCM. After division of the second connecting cervical plexus branch, the SCM can be pulled through medially under the preserved nerve. The IJV is exposed cranially and, if oncologically indicated, ligated and transected. Next, transection of the SCM is completed at the clavicle. Under the SCM, a thick layer of adipose tissue is encountered, which can contain the tranverse cervical artery and vein, and major or minor lymphatic duct(s) with variable connections to

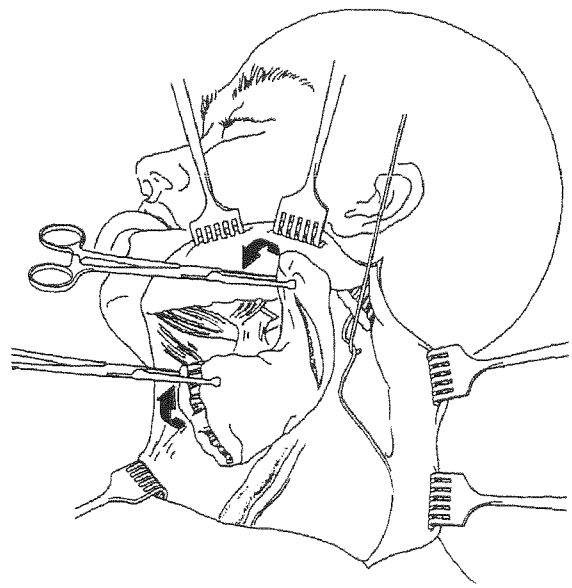

Figure 4 Step III represents distal and cranial transection of the SCM and transection of the sensory branches of the cervical plexus.

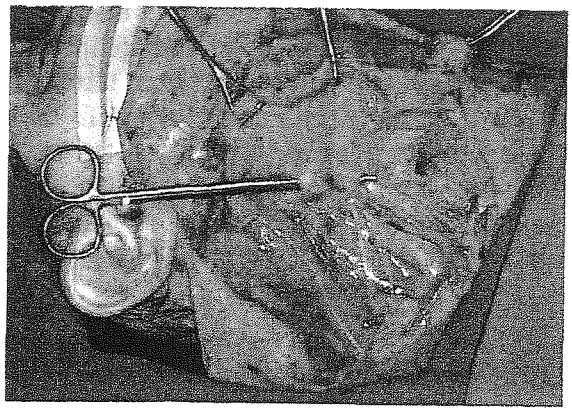

Figure 5 Sensory branches of the cervical plexus are transected at a one centimeter distance lateral from their origin between the anterior and middle scalenus muscles to prevent possible damage to the root of the phrenic nerve.

the internal jugular vein. Dissection should, therefore, be performed with great care to ensure timely recognition of all vascular structures in this region.

The last part of the neck dissection consists of cutting the sensory branches of the cervical plexus in such a manner that these nerves are transected at a one centimeter distance lateral from their origin between the anterior and middle scalenus muscles to prevent possible damage to the root of the phrenic nerve, which runs sometimes high up into the neck. Since, the cervical branches are overlapping like roof tiles, transection can best start at the lowest level. Pulling the specimen into a medial/anterior direction over the carotid artery warrants an optimal exposure (Fig. 5).

Results

From 1995 to 2000 en bloc (modified) radical neck dissections for primary disease (stage III and IV) with or without preservation of SAN and/or IJV were performed in 128 head and neck cancer patients. Thirteen patients were lost to follow-up. The following head and neck sites were included: Oral cavity ($n=37$), oropharynx ($n=37$), larynx ($n=27$), and hypopharynx ($n=27$). As quality control parameters we analysed regional recurrence, surgical complications (chyle leakage, wound infections). Leaving out patients with a simultaneous local recurrence, the regional failure percentage was 10%. Post-operative chylous fistulas occurred in 2% of patients and perioperative wound infection in less than 5%, under perioperative antibiotic prophylaxis of 24 h for contaminated neck dissections. Overall 5 years survival was 45% (95% confidence interval: 36-54%).

Discussion

The described technique for unwrapping of the neck specimen in three separate stages forms a valuable tool in improving a surgeon's skills for systematic surgery. Preservation of the sternocleidomastoid muscle as a 'bar' until the very end of the operation, provides a continuous tension in the neck specimen and facilitates detection of the vital structures in the neck more than dissecting from below upward,[4] as these structures keep running in their original anatomic position. The bar also prevents undesirable traction of the dissected tissue to vital nerves and vessels or lymph-node metastases. The oncological rationale of this surgical approach is found in the stepwise dissection neck node levels. Even in case of en bloc procedures for oral and oropharyngeal cancers, this approach can be applied by starting at step I with identification of the posterior belly of the digastric muscle and hypoglossal nerve, while leaving the cranial part of level I connected to the primary tumour. Moreover, this technique creates optimal conditions for sharp dissection using a 10 knife blade, while working from landmark to landmark. For experienced surgeons this may safe operation time. Finally, also from an educational point of view we think this technique is of great value in teaching the neck dissection to residents and head and neck oncology fellows, since, the structured procedure per neck level creates an easy tool for improvement of soft tissue skills.

Our data on regional recurrence (10%), overall 5 years overall survival (45%) and post-operative complications (<5%) give a global impression of the outcome after en bloc neck surgery with or without adjuvant post-operative radiotherapy. In a group of 402 (modified) radical neck dissections performed in a large tertiary referral center[5] a regional recurrence figure of 7.5% was described. However, this last study group was limited to oral cancer only, whereas in our study all head and neck sites were included with different prognostic impact. In a series of 352 comprehensive neck dissections for tumour positive necks (N+) 9.7% recurred regionally.[6] Comparisons between overall survival rates are often difficult to establish, for the reason of varied composition of patients series. Our 5 years overall survival rate is in the same range as published by Shah for surgically treated oral cancer patients. His group found a survival of 49% for stage III and IV[7] in patients treated by surgery with or without post-operative radiotherapy. The post-operative risk for chyle leakage (2%) improved over the years[8] and compares with other series.[9,10] Also the low incidence of perioperative wound

infections (<5%) is in agreement with reporting by others.[11] These results reflect no negative influence of the described technique on outcome.

Key points

1.1 Preservation of the main part of the SCM during neck dissection—after transection of the sternal head caudally and posterior muscle fibers cranially—warrants a permanent cranio-caudal tension of the neck specimen, while anatomical relations remain intact.

1.2 Dissection of the inferior posterior triangle is significantly facilitated in sweeping the deep supraclavicular tissue cranially by pushing it upwards with a gauze wrapped around the thumb, leaving the deep cervical fascia intact.

1.3 Transection of the sensory branches of the cervical plexus should be performed in such a manner that these nerves are transected at a one centimeter distance lateral from their origin between the anterior and middle scalenus muscles, to prevent possible damage to the root of the phrenic nerve.

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