

SURGICAL APPROACHES TO RETROSTERNAL TUMOURS OF THE THYROID**Dr. Jaspreet Singh Badwal***

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ABSTRACT

Though surgery is the undisputed choice of treatment for large substernal masses of the thyroid gland, the debate focuses on the ideal choice between a transcervical approach and a sternotomy approach. The cervical route is appropriate for most of the substernal thyroid masses. The present manuscript will discuss both the surgical approaches in detail.

KEYWORDS: Thyroid cancer, tumours of thyroid, substernal extension, retrosternal goiter.**INTRODUCTION**

Although surgery is the undisputed choice of treatment for large substernal masses of the thyroid gland, the debate focuses on the ideal choice between a transcervical approach and a sternotomy approach. Substernal or mediastinal extension of a cervical tumour warrants an approach different from that used for routine thyroidectomies.

The Transcervical Approach

The rationale for approaching substernal thyroid masses from a cervical incision stems from the fact that the principle vascular supply to the mass is the inferior thyroid artery. Infrequently, a complete intrathoracic blood supply has been documented. Recognition of the fact that the primary feeders come from the neck gives the surgeon confidence to approach these lesions from the cervical route. Early control of the pedicle should facilitate bloodless surgery. In routine thyroid surgery, easy access to the viscerovertebral angle is possible, with separation of the strap muscles in the midline and lateral retraction. However, this is not possible in the presence of large thyroid masses.

The highlights of the cervical approach to large substernal thyroid masses are: 1) complete mobilization of the sternocleidomastoid muscle (SCM); 2) early identification of the carotid artery and internal jugular vein; 3) transection of the sternothyroid muscle and its resection in selected tumours that are malignant, invasive, or extremely large; 4) lateral access to the neurovascular pedicle and mediastinum; and 5) finger dissection to deliver the substernal component of the mass. Other aspects of the technique represent standard thyroidectomy procedure, namely use of Gelfoam for homeostasis around nerves, identification of parathyroid

glands, and tracheoesophageal and mediastinal node exploration in all cases of malignancy.

Preoperative anaesthetic evaluation is routine. In the past, undue emphasis has been placed on tracheal deviation. In the vast majority of cases, the larynx is relatively undisplaced; therefore, intubation is usually uneventful. On the other hand, preoperative identification of tracheal compression from a large thyroid mass is critical. This finding calls for a small endotracheal tube. However, when severe compression necessitates preoperative intubation for airway control, successful postoperative extubation is almost always possible. In cases of severe tracheomalacia, intubation for 24 to 48 hours is warranted. It is important to note that large bilateral substernal masses with tracheal deviation and compression should be resected bilaterally, even if the pathology is unilateral. This is because if the uninvolved side is not resected, it will cause postoperative deviation and compression.

Surgical Technique**Incision**

A curvilinear incision is planned in a natural skin crease, about two finger breadths above the sternal notch. This is done with the patient awake and sitting. The patient's neck is flexed to identify the crease. At this stage, two creases can be marked; the final decision is made with the patient in the operative position. This is particularly relevant in patients with mobile neck skin and/or large breasts, where low incisions create a scar overlying the clavicular heads when the patient sits.^[1] The incision should be as low as possible in the flexed position, but high enough in the extended position to minimize the length of the upper flap. In general, the incision should be made at about the level of the cricoid. After the

patient is asleep, a 27-gauge needle dipped in methylene blue is used to outline the planned incision with puncture or ink marks at intervals (Fig. 1). The incision is somewhat longer than the standard thyroidectomy incision, extending from the mid-SCM on the involved side to a similar point on the contralateral side. If necessary, it can be extended to the lateral border of the SCM. The incision is carried through the skin with a cold knife. A Shaw hemostatic scalpel or surgical cautery tip is used to extend the incision through the platysma. Hemostasis is achieved with bipolar cautery. Flaps are raised in a subplatysmal plane with the Shaw scalpel or surgical cautery tip. The inferior flap is raised to the clavicle (Fig. 2) and the superior flap is elevated to the level of the hyoid (Fig. 3).

Exposure

It has been found that moving the cutaneous window with retraction in one direction at a time allows superior exposure. Simultaneous retraction both superiorly and inferiorly will create a narrow window that actually handicaps the procedure. However, if required, the incision should be extended laterally on both sides. The medial border of the SCM is defined by sharp dissection all the way from the level of the hyoid down to the sternal notch (Fig. 4). The key to gaining access to the superior mediastinum is complete mobilization of the SCM, particularly its sternal attachment. Superiorly, the exposure may be enhanced by laterally retracting or transecting the omohyoid muscle. This allows early identification of the carotid artery and the internal jugular vein and access to the mediastinum. Using Green or Cushing retractors, the SCM is retracted laterally and the omohyoid muscle and vagus nerve are identified (Fig. 5). The middle thyroid vein is carefully dissected and ligated. Note that the thyroid gland is still covered by the strap muscles at this stage. Attention is now turned to the midline. The sternohyoid muscles are separated by sharp dissection (Fig. 3). In cases of bilateral disease, both SCMs and carotid can be dissected and the midline need not be separated. The muscle is then completely mobilized and freed from the deeper sternothyroid. It is also dissected away from the SCM, which lies lateral to it. Sometimes the exposure is inadequate, requiring transection of the sternohyoid muscle. When transection is required to enhance exposure, it is performed high in the neck, because the sternohyoid muscle is innervated by the ansa hypoglossi, lower down.

The sternothyroid muscles meet each other in their inferior portion and diverge superiorly to gain attachment to the oblique line of the thyroid cartilage. Immediately deep to this muscle is the thyroid gland. Therefore, based on oncologic principles, it may be necessary to resect this muscle in continuity with the mass if it is invaded by tumour. Most substernal tumours can be removed with preservation of both sternohyoid and sternothyroid muscles. Some very large masses require transection or excision of both muscles.

Thyroid Dissection

The inferior thyroid vein forms a venous plexus anterior to the trachea. Most authors recommend bipolar cautery to coagulate smaller vessels; larger tributaries should be ligated. The thyroidea ima artery, if present, is also ligated. The field is kept perfectly dry at all times. Saline irrigation with a 10 mL syringe improves visibility in the field and removes any blood staining of tissues. The inferior thyroid artery is traced medially, behind the gland. This vessel is not ligated until the recurrent laryngeal nerve and parathyroids have been definitively identified.

The recurrent laryngeal nerve is next sought in the vicinity of the inferior thyroid artery. After the nerve is identified, it is followed cranially until it reaches the inferior border of the cricoid cartilage. The nerve is found deep to the posterior suspensory ligament of Berry, which is divided carefully. There is an inconsistent relationship between the nerve and the inferior thyroid artery. Steinberg *et al.*^[2] reported that the RLN ascends in the neck between the branches of the inferior thyroid artery in about 6.5%, posterior to the inferior thyroid artery in 61.5%, and anterior to the inferior thyroid artery in 32.5%. Interesting is, also, the relationship of the RLN to the tracheoesophageal groove. It has been reported by Hunt *et al.*^[3] that on the right side the RLN ascending in the neck is located in the tracheoesophageal groove 65% of the time, whereas on the left it is there 77% of the time. It was found that the nerve is located lateral to trachea 33% of the time on the right and 22% on the left. Rarely it ascends anterolateral to the trachea and, consequently is widely exposed to surgical injury. Difficulty in finding the recurrent laryngeal nerve warrants searching for a nonrecurrent nerve in a more lateral direction.

The presence of a large thyroid mass with possible substernal extension does not affect the position of the parathyroids significantly. In most cases, the inferior parathyroid gland is located near the terminal branch of the inferior thyroid artery, along the posterior aspect of the gland. The superior parathyroid gland also maintains a constant relationship with the upper terminal branch of the inferior thyroid artery. It is not unusual to find the superior parathyroid in an intracapsular location. The importance of this finding lies in the fact that the gland can be devascularized during the dissection. Intracapsular parathyroid glands should be removed and reimplanted as thin slices into the SCM after their identity is confirmed by frozen section analysis. The implantation site should be tagged with nonabsorbable suture.^[4] Depending on the preoperative indication for the procedure and the intraoperative findings, a decision is then made regarding the extent of surgery. In cases of unilateral disease, thyroid tissue is transected at the junction between the isthmus and the contralateral lobe. Usually, the medial margin of the contralateral lobe is included in the specimen. Horizontal running mattress

sutures are placed over the cut edge of the gland, followed by a return over-and-over locked stitch.

Gentle downward traction on the gland will improve exposure of the superior pole. The external laryngeal nerve is identified in the space between the thyroid sheath and inferior constrictor muscle. The identity of the nerve can be confirmed by using a nerve stimulator set at 0.5 mA; this stimulation should produce a contraction of the ipsilateral cricothyroid muscle.^[5] In about 20% of cases the nerve courses within the inferior constrictor in its terminal portion.

Once the external laryngeal nerve is identified (Fig. 5), the superior thyroid vessels may safely be ligated. Any remaining attachments between the gland and the trachea may be sharply dissected provided there is no tracheal invasion. Substernal extension of the thyroid mass can almost always be removed through the cervical incision. As emphasized earlier, complete mobilization of the SCM is crucial. The sheer size of the mass and its location can displace and jeopardize the recurrent laryngeal nerve. On occasion, it may be essential to identify the nerve in a more superior location and follow it in a retrograde direction towards the mediastinum. Extreme care must be taken to protect the great vessels. The substernal component can usually be delivered into the neck with careful finger dissection (Fig. 6). Fragmentation or morcellation of the mass has been recommended by some authors to aid removal without sternotomy.^[6,7] However, Lawson *et al.*^[8] advise against this procedure because it incurs the risk of haemorrhage and potential spillage of malignant cells. In some cases, even with lateral dissection, the recurrent laryngeal nerve cannot be identified before delivery of the mediastinal mass. In these cases, finger dissection and delivery of the mass is performed before nerve identification.

Closure

After ensuring satisfactory hemostasis, a Penrose drain is placed and the wound closed in layers. Large tumours that leave behind a significant cavity warrant a 10 mm Davol or Jackson Pratt drain connected to a suction device. Running subcuticular or interrupted sutures are used for the skin.

The Sternotomy Approach

The tumour occasionally descends very low into the mediastinum and adequate resection is possible only with a transsternal approach. Unlike resections for squamous cell carcinomas of the upper aerodigestive tract, the transsternal approach for thyroid cancer does not require removal of bone. Although mediastinotomy might appear to be a radical treatment for a disease with an often somewhat benign course, it must be remembered that thyroid cancer kills.^[9] Moreover, those who die often do so as a direct result of extensive local disease.^[10]

The skin incision is in the midline, bisecting the collar incision and descending over the upper third of the

sternum. Soft tissue is incised down to the sternal periosteum. The tough fibrous tissue band that stretches over the rostral surface of the manubrium and extends onto its deep surface forms a protective sheet for the underlying structures during the sternal osteotomy. Careful finger dissection between the manubrium and this fascia will permit insertion of a ribbon retractor to protect the underlying soft tissue. A periosteal elevator is used to clear a track for the sternal split as outlined in Figure 7. A single angled cut with a power saw into the second intercostal space may be sufficient; however, a second relaxation osteotomy into the first intercostal space facilitates retraction and enhances the exposure. The heavy protective retromanubrial fascia can now be cut and the sternotomy propped open with a self-retaining retractor such as a paediatric Finochietto.

The contents of the upper anterior mediastinum are now well visualized (Fig. 8). Care must be exercised to avoid the pleural reflections that form the lateral boundaries of the space. The principal features obvious at this juncture are direct extension of tumour, the thymus and lymphatic and loose connective tissue. The somewhat amorphous thymus gland is dissected free of the vascular twigs that supply and drain it, with care taken to ensure hemostasis. As recommended by Lore,^[11] dissections should proceed from right to left over the superior vena cava and the left innominate vein (Fig. 9). The left innominate vein crosses the mediastinal space and if tumour extensions or involved lymphatics course deep to the innominate vein, it may be ligated (Fig. 10). This also facilitates dissection around the aorta. Care must be taken to avoid damaging the recurrent laryngeal nerve at this level as it courses around the ligamentum arteriosum. Tumour may invade the trachea, the larynx or the cervical esophagus. This is more commonly seen in the older patients. These structures must be removed and appropriate reconstruction done. The entire dissection can be done in continuity with the cervical block and the tissue is now all removed.

After implantation of the parathyroid tissue, the sternum is closed with braided non-absorbable suture or wire and threaded through drill holes (Fig. 11). A soft drain is placed in the mediastinum and the wound is closed.

Legends for figures



Fig. 1: The incision is marked in a natural skin crease with a 27-gauge needle dipped in methylene blue.

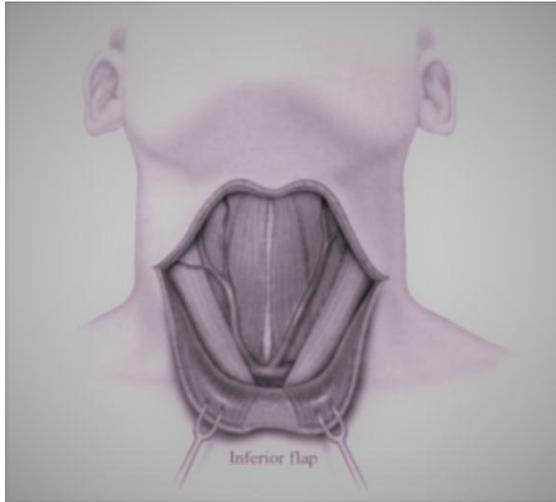


Fig. 2: The inferior skin flap is elevated to the sternal notch.

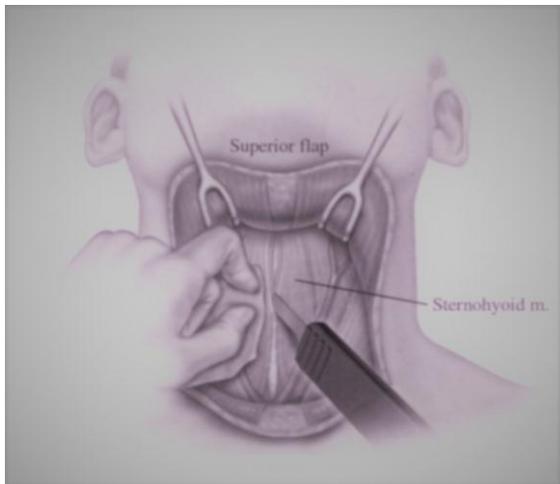


Fig. 3: Sharp dissection is used to separate the sternohyoid muscles in the midline.

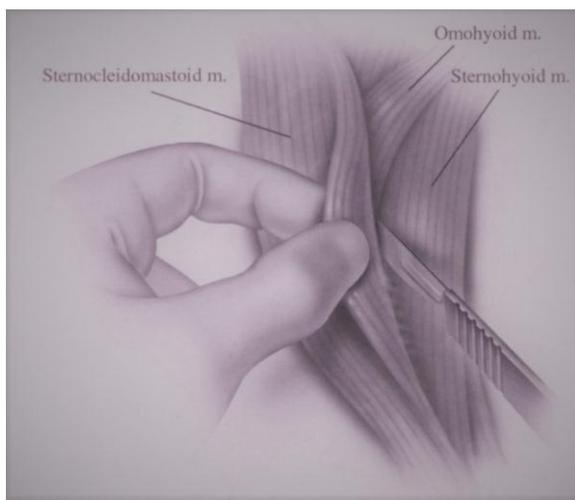


Fig. 4: Sharp dissection defines the medial border of the sternocleidomastoid muscle.

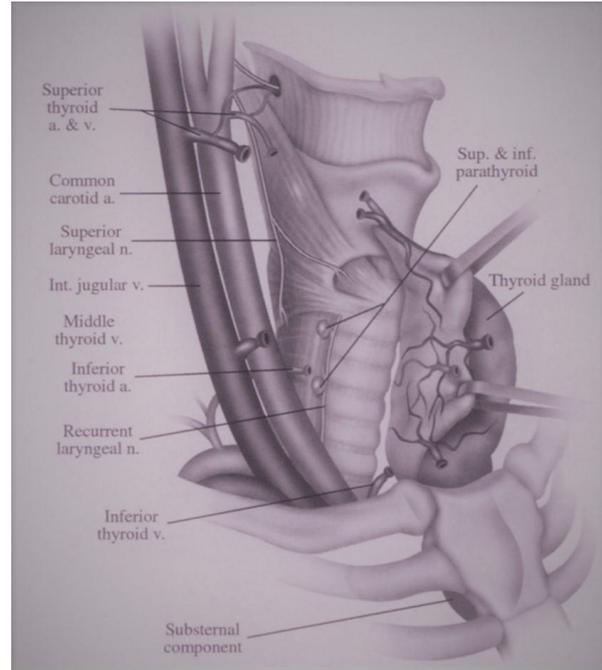


Fig. 5: Superior and inferior pedicles are ligated after identification of the recurrent laryngeal and external laryngeal nerves.

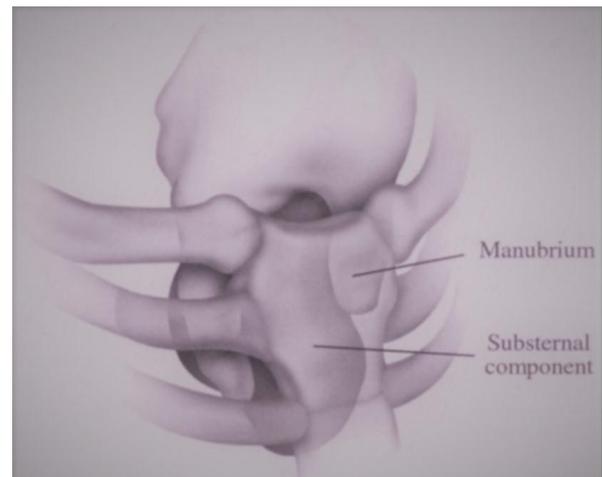


Fig. 6: A demonstration of finger dissection to deliver the substernal component into the neck.

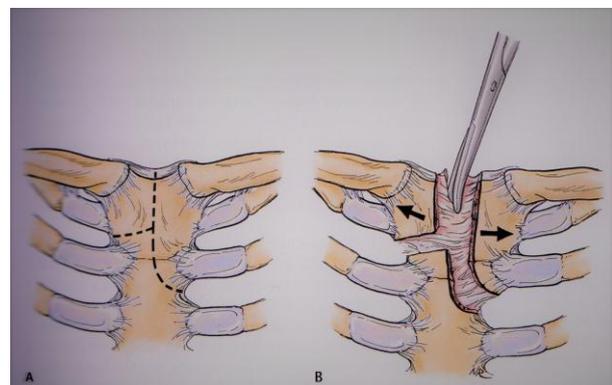


Fig. 7: (A) Sternal split outlined (B) Thick protective periosteum on the deep surface of the manubrium being incised.

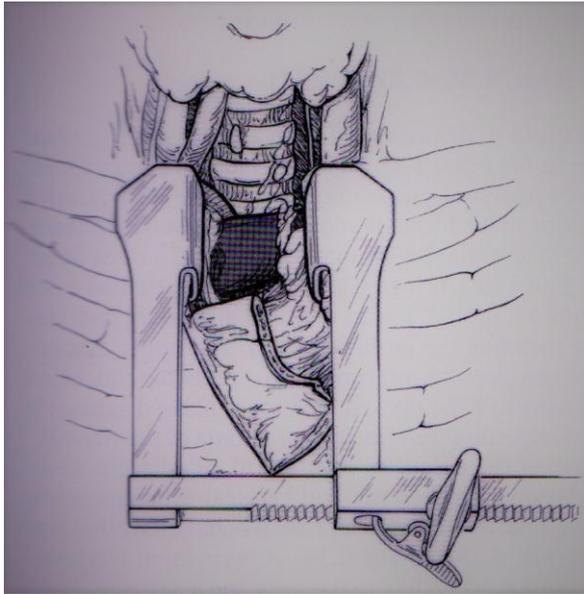


Fig. 8: Pediatric sternal retractor is inserted and the mediastinal contents are exposed. The innominate vein obscures a complete view of the mediastinal structures.

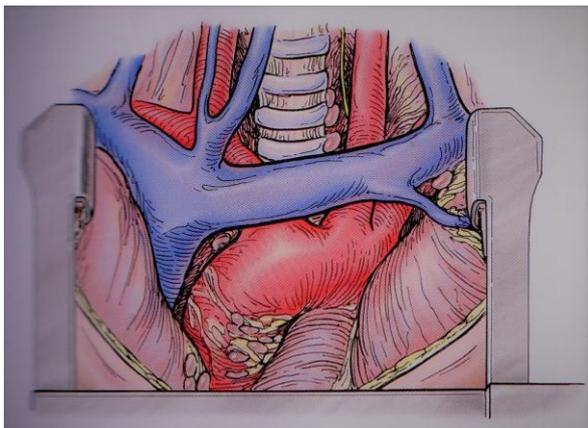


Fig. 9: Mediastinal exposure to the level of aorta. The left innominate vein is exposed from the superior vena cava to the takeoff of the left jugular vein. Illustration reveals more exposure than is usually apparent.

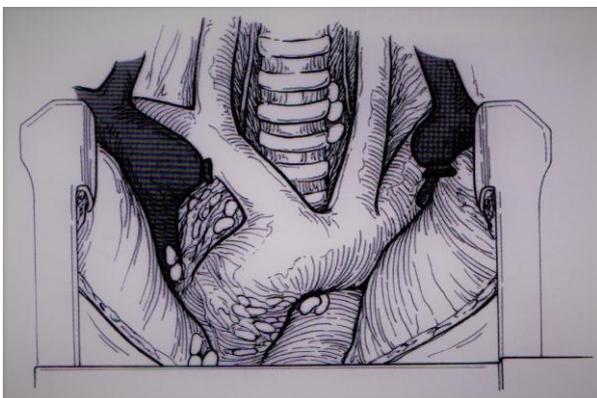


Fig. 10: The left innominate vein is carefully ligated with silk-ties and incised; the rest of the anterior mediastinum is exposed.

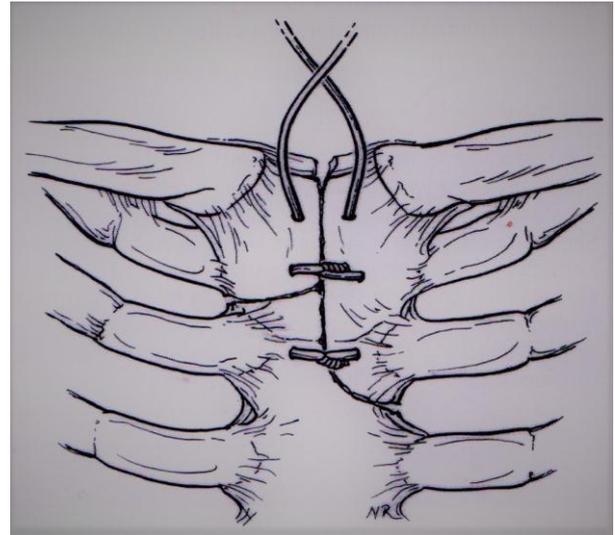


Fig. 11: Sternotomy closed with braided wire.

CONCLUSION

The cervical route is appropriate for almost all substernal thyroid masses. Although the vast majority of substernal extensions can be resected via the neck incision, it is occasionally prudent to resort to sternotomy. This decision usually can be made before surgery with the help of radiographic studies.

AUTHOR CONTRIBUTIONS

Author No. 1: Participated in the conception and design of the manuscript, drafting of manuscript and literature search.

CONFLICT OF INTERESTS

The author declares that there is no conflict of interests that could influence this work.

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