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## SURGERY OF SUBSTERNAL AND INTRATHORACIC GOITERS \*

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In denoting the presence of a prolongation or of the enlargement of the entire thyroid gland behind the sternum or within the thoracic cavity, the terms "substernal" and "intrathoracic" have been used synonymously. In this article, the term intrathoracic goiter will be limited to those growths of the thyroid in which the major portion of the tumor lies within the thorax. This does not necessarily imply that the greater portion of the entire thyroid gland lies concealed, for obviously the greater portion of the goiter may be cervical and confined to one lobe, while there may be a large, but smaller, growth in the other lobe entirely within the cavity of the chest. All other tumors of the thyroid whose inferior projection, varying in depth below the sternal border from 1.25 cm. to 7.5 cm., and equivalent to less than one half of the growth, are classed as substernal goiters.

### MECHANISM OF PRODUCTION

Occasionally in emphysematous patients with short necks the diffuse hyperplastic gland may lie partially behind the sternum, yet its downward projection is usually limited to 1.25 cm. or less, and offers no additional difficulty in its removal. This type will not be considered in this discussion.

The large substernal and intrathoracic growths consist of the simple benign or malignant adenomas, either cystic or solid, and occasionally a diffuse colloid projection. Various causes for the descent of these tumors have been suggested, namely, the pressure exerted by the depressor muscles of the hyoid and the sternomastoid (Lahey), the

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1. Lahey, F. H.: Intrathoracic Goiter, Boston M. & S. J. **176**:341 (March 8) 1917; Diagnosis and Management of Intrathoracic Goiters, J. A. M. A. **75**:163-166 (July 17) 1920.

influence of swallowing, ptosis of the larynx, gravity, flexion and extension of the head, and the development of an adenoma in a normally low thyroid, which has been congenitally displaced by traction of the thymus during its embryologic development. All of these may be contributing influences. When the anatomy of the region is borne in mind, it seems natural that the extension of growths developed in the lower poles should be downward behind the sternum. The thyroid is only relatively fixed, since it follows the movements of the trachea in deglutition. It is bound firmly to the trachea by connective tissue attachments, and to the larynx and hyoid bone by median bands,

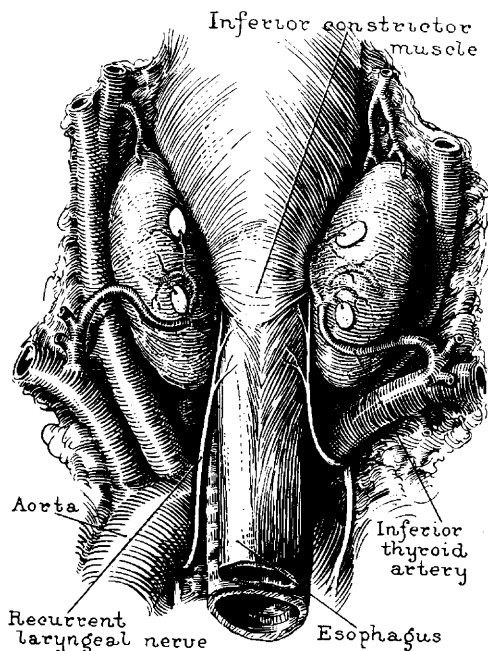


Fig. 1.—Position of recurrent laryngeal nerves and inferior thyroid arteries, viewed posteriorly.

the suspensory ligaments, and it is partly anchored at the points of entrance of the two main arteries. The superior thyroid artery joins the gland at its superior pole, but the inferior thyroid artery enters the capsule on the posterior surface near its mesial border, slightly below a point half way between the superior and inferior poles (Fig. 1). As the inferior thyroid artery ascends in the neck behind the carotid sheath, it is snugly bound behind the prevertebral layer of the deep cervical fascia, from which it emerges a short distance before joining the gland. It will readily be seen that this affords a good anchorage for this portion of the lobe. However, the part of the gland below

this level, amounting to nearly half a lobe, has no firm attachments to the neighboring structures. The inferior thyroid veins leaving the gland at its inferior pole offer only a meager support. The thyroid is loosely encased between the middle and the prevertebral layers of the deep cervical fascia, both of which extend down into the mediastinum. It can be readily appreciated that an adenoma developing in this part of the lobe below the level of the entrance of the inferior thyroid artery will extend downward between the fascial planes in the direction of least resistance. Anteriorly and laterally its extension is resisted by the overlying muscles, especially the sternohyoid, sternothyroid, omohyoid, and the sternomastoid; posteriorly, by the muscles covering the spine, and superiorly, by the firm attachment of the upper part of the lobe to the trachea and to the inferior thyroid artery. Inferiorly, it is separated from the thorax by thin areolar tissue only.

The influences of deep respiratory movements of the thorax in coughing, straining, and the like, play an equally important rôle in the mechanism of production of substernal and intrathoracic goiters. The shape of the thoracic cage is that of an irregular truncated cone. Its reniform inlet formed by an imaginary plane slanting downward and forward from the top of the first thoracic vertebra to the sternum is the narrowest part, the anteroposterior diameter measuring 5.5 cm. and the transverse diameter 10.5 cm. (Woolsey).<sup>2</sup> In forced inspiration the sternum is raised, thus increasing the anteroposterior diameter; since the ribs swing upward and outward, the transverse diameter is likewise increased (Piersol).<sup>3</sup> Also, in deep inspiration, because of the greatly increased capacity of the thorax, a negative pressure is created within the chest which tends to drag the goiter downward. The effect of this can be tested by observing a small cervical goiter entirely disappear behind the sternum when the patient takes a deep breath.

As the adenoma enlarges, the direction of its growth continues in the line of least resistance; that is, downward into the cavity of the chest, where it is obstructed only by the bony walls of the cage. When the condition develops in the young, a deformity of the chest wall may occur (Fig. 2). The shape of the larger tumors is molded by these boundaries, resulting in the characteristic flask or pear shape, the small end corresponding to the constricted inlet. As long as the size of the intrathoracic portion remains less than that of the inlet, the tumor may be forced, partially or completely, up into the neck by coughing or swallowing, which accounts for the occasional so-called

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2. Woolsey, G.: *Applied Surgical Anatomy*, Philadelphia, Lea and Febiger, 1908, p. 228.

3. Piersol, G. A.: *Human Anatomy*, Ed. 5, Philadelphia, J. B. Lippincott Company, 1916, p. 166.

diving goiter, *goître plongeant* of Fodéré.<sup>4</sup> When the intrathoracic goiter has enlarged so that it cannot be forced up through the narrow strait, one of two things may happen. As the intrathoracic portion is relatively fixed and as the cervical part of the gland continues to follow the movements of the trachea, intermittent traction is exerted at the juncture, and either this connecting portion becomes more attenuated, resulting in a partial or complete detachment of the intra-

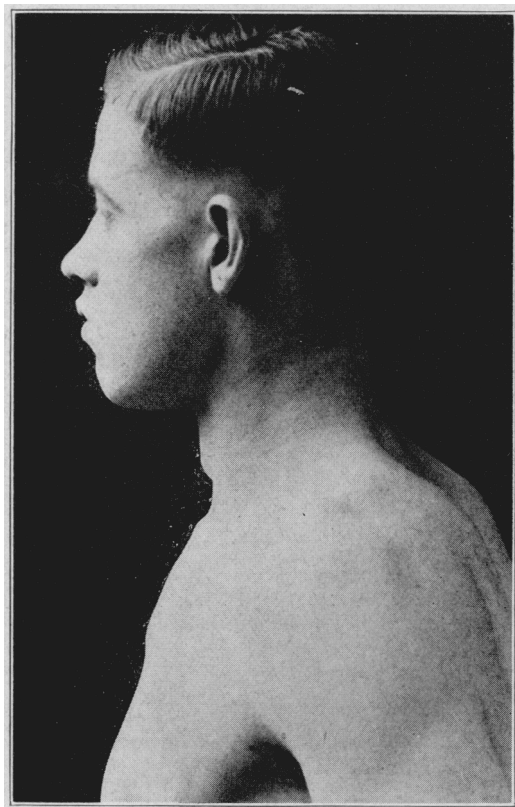


Fig. 2 (Case 297878).—Deformity of chest in case of large intrathoracic goiter.

thoracic portion, or the cervical lobe is dragged down into the chest. It appears that a great many of the accessory intrathoracic goiters are developed in this manner from the cervical thyroid rather than from the enlargement of the so-called aberrant thyroid tissue. Analogous growths are not infrequently found in the neck when adenomas lie in the posterior cervical triangle joined to the original goiter by only

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4. Fodéré, quoted by Sharpe, N. W.: Report and Analysis of a Goiter with Marked Intrathoracic Extension, *Interstate M. J.* **18**:314-325, 1911.



a small band of connective tissue, or completely detached, living a parasitic existence. In this series, the intrathoracic tumor was detached from the cervical goiter in seven patients.

## INCIDENCE

Within a period of approximately three and one-half years, from Jan. 1, 1917, to June 6, 1920, 4,006 thyroidectomies were performed in the Mayo Clinic for simple colloid and adenomatous goiters. Five hundred and forty-two (13.5 per cent.) were found at operation to be substernal, and twenty-five (0.6 per cent.) of these were classified as intrathoracic.

The duration of the goiter ranged from two months to forty-eight years, averaging eighteen and one-half years. Seven patients had no knowledge of the presence of a goiter. The oldest patient was 71 years of age, the youngest 15, and the average age was 46.11 years.

TABLE 1.—SITUATION OF SUBSTERNAL PROJECTION

| Situation        | Cases |
|------------------|-------|
| Right lobe ..... | 158   |
| Left lobe .....  | 299   |
| Both lobes ..... | 66    |
| Isthmus .....    | 8     |
| Not noted .....  | 11    |
| Total .....      | 542   |

TABLE 2.—DEPTH OF GOITER

| Depth                    | Cases |
|--------------------------|-------|
| 1.25 cm. to 2.5 cm.....  | 300   |
| 3.75 cm. to 5.0 cm.....  | 170   |
| 6.25 cm. to 7.5 cm.....  | 60    |
| 8.75 cm. to 12.5 cm..... | 12    |

The influence of sex does not apparently play an important rôle in the total incidence of substernal goiter. While in the male, heavier neck muscles develop, in the female this additional influence is offset by the fact that the upper aperture is wider, and that thoracic rather than abdominal breathing is the rule. In this series, substernal or intrathoracic goiter occurred in 82 males (13.5 per cent.) and in 460 females, or 1 male to every 5.6 females. During the same period, the ratio of incidence in males and females in all other simple goiters was 469 to 2,295, respectively, or 1 to 6.38. However, of twenty patients between the ages of 15 and 25 with substernal or intrathoracic goiter, six (30.0 per cent.) were males.

There was malignant degeneration in seven goiters.

## SYMPTOMS

Substernal and intrathoracic goiters, are, in the greater number of cases, associated with cervical enlargement, and the symptoms from which the patient seeks relief vary from deformity of the neck to a train of symptoms incident to hyperthyroidism, or to the pressure of the tumor on the neighboring structures.

In seventy-two patients of the series, there were no symptoms other than the presence of a tumor. In 128 patients (25.4 per cent.), the goiter was associated with definite hyperthyroidism, evidenced by

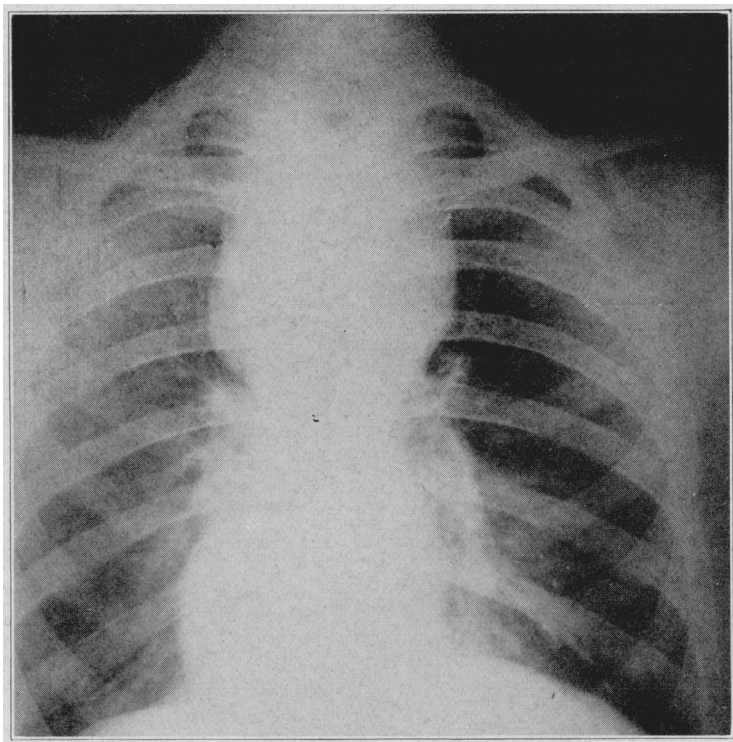


Fig. 3 (Case 297878).—Anteroposterior view of large intrathoracic goiter shown in Figure 2, before operation.

the symptoms and physical examination and corroborated by an increased basal metabolic rate.

The symptoms resulting from the pressure of the substernal tumor vary according to the structure compressed, and the symptoms and their intensity vary not in proportion to the size of the tumor, but to the degree of compression. A small adenoma lying just within the inlet, in front of or behind the trachea, may produce marked dyspnea or choking spells, while a huge, completely intrathoracic tumor

may be wholly without pressure symptoms. This is illustrated by the subjoined case history.

*History* (Case 297878).—A man, aged 21, was admitted to the Mayo Clinic, Nov. 25, 1919, having been discharged from the army a year before on account of tachycardia. The patient stated that he had always enjoyed good health and had been an active athlete. Because he did not have so much “pep” as formerly, he consulted a physician a few weeks prior to his admission to the Clinic. A diagnosis of exophthalmic goiter in a substernal thyroid was made by his family physician. There was no dyspnea, palpitation, or other complaint.

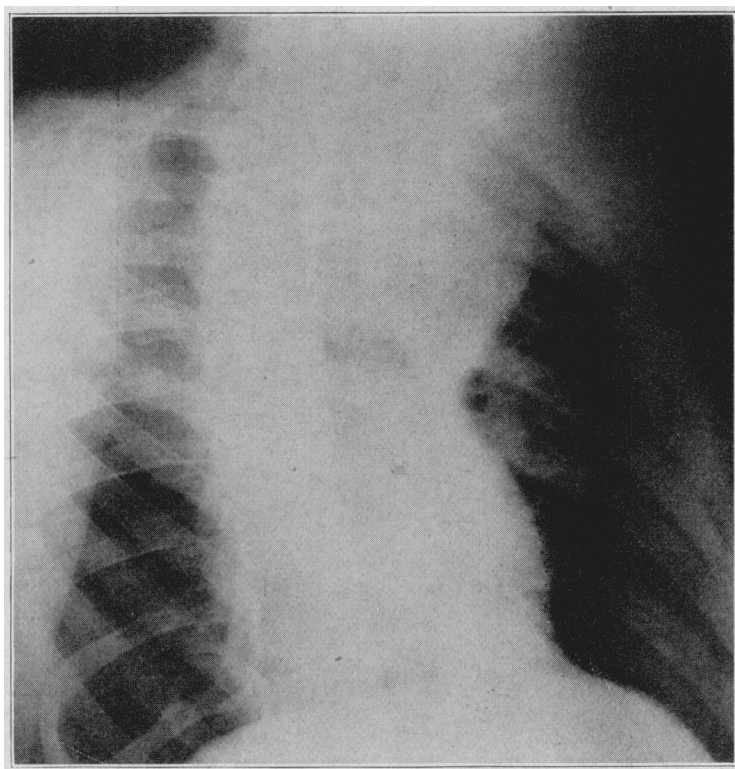


Fig. 4 (Case 297878).—Lateral view of large intrathoracic goiter shown in Figure 2, before operation.

The patient said that his chest had always been prominent, probably more than usually prominent for the last six months (Fig. 2). He had not lost weight.

*Examination.*—No enlargement in the cervical region was found; but there was an area of dullness which extended downward 5 cm. on each side of the midsternal line. The systolic blood pressure was 164, the diastolic 84, and the pulse 120. The urine was normal. The basal metabolic rate taken on three different occasions was +33, +29 and +23. A roentgenogram revealed a bilateral mediastinal tumor, and the fluoroscopic examination revealed a mediastinal mass atypical for substernal goiter (Figs. 3 and 4). There was no

exophthalmos. A diagnosis of mild hyperthyroidism in an intrathoracic goiter was made.

*Operation and Results.*—A partial thyroidectomy, resection of the left lobe and division of the isthmus, was performed, Dec. 12, 1919, for a single degenerated colloidal adenoma in a substernal goiter. A huge substernal goiter, about 12 or 15 cm. in diameter, lay in front of the trachea, resting on the base of the heart. It originated in the left lobe and probably the isthmus, drawing the isthmus and superior pole of the left lobe down to the base of the neck. The curved collar incision was prolonged downward, with the idea

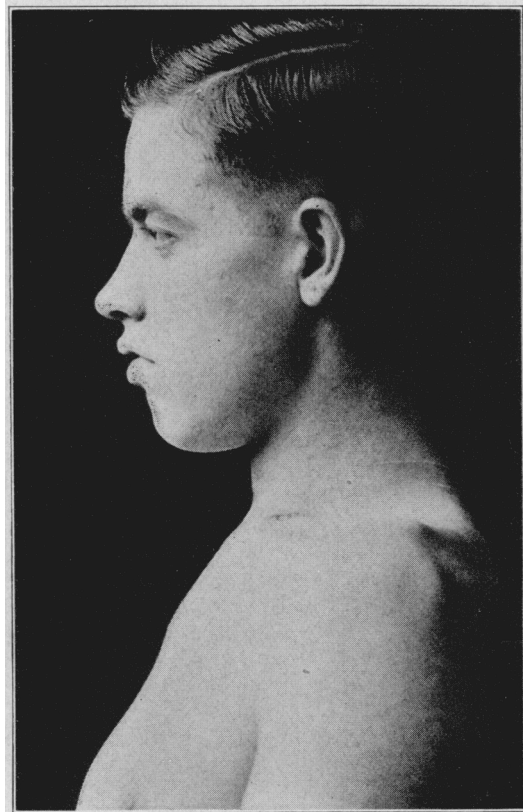


Fig. 5 (Case 297878).—Patient shown in Figure 2, after operation.

of splitting the sternum if necessary. The gland was ruptured to reduce its volume before bringing it out of the chest cavity. Tissue amounting to one fourth of a normal sized lobe was preserved on the left side of the trachea.

The patient's postoperative convalescence was normal (Figs. 5 and 6). The metabolic rate, Dec. 24, 1919, was +9. December 30, the blood pressure was 116 systolic, and 74 diastolic; the pulse rate was 78.

The more snugly the tumor is wedged into the thoracic aperture, the more pronounced are the symptoms. The retrosternal tumor lies

in close relation to the trachea, esophagus, common carotid artery, internal jugular vein, pneumogastric, sympathetic, phrenic, and recurrent laryngeal nerves, and as it descends, it is in close relation to the innominate and subclavian vessels, the thoracic duct, lungs, bronchi, the arch of the aorta, and the pericardium (Fig. 7). On account of the capaciousness of the thoracic cavity and the relative movability of its contents, the completely intrathoracic goiter may be without symptoms, since all the structures can be displaced without being

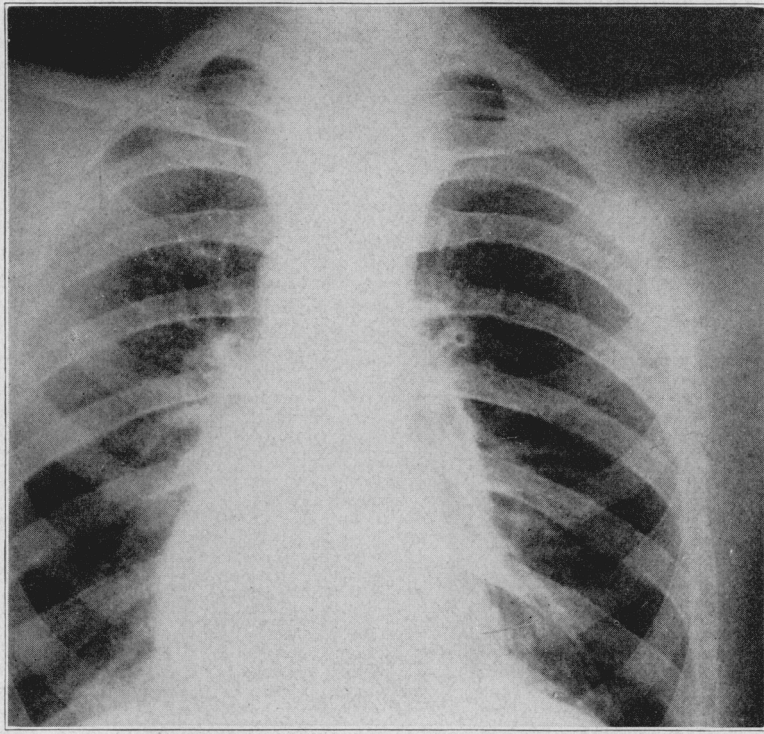


Fig. 6 (Case 297878).—Anteroposterior view of chest of patient shown in Figures 3 and 4, after operation.

actually compressed. The recurrent laryngeal nerve is an exception, as displacement of the large arterial trunks may exert traction resulting in its partial or total paralysis. However, any structure that passes through the upper thoracic aperture may be compressed by the goiter, with resulting symptoms. Pain is practically never present unless the tumor is malignant, but a sense of pressure or fulness is very frequent. Symptoms arising from pressure on the trachea, the recurrent laryngeal and the internal jugular vein are the most frequent.

Definite tracheal deformity was noted in 163 patients (30 per cent.) of the series. The tumor may lie anterior, posterior, or to the side of the trachea, and the symptoms, if any, are varying degrees of dyspnea, such as rasping breathing with inspiratory stridor, and choking and coughing spells. Sudden muscular exertion or extension or flexion of the head may cause the tumor to become wedged in the inlet, resulting in spells of obstructive breathing, with choking and coughing. Dilated veins in the neck and on the chest wall were noted in fifty-eight patients (10.7 per cent.), (Figs. 8, 9 and 10). Laryngeal

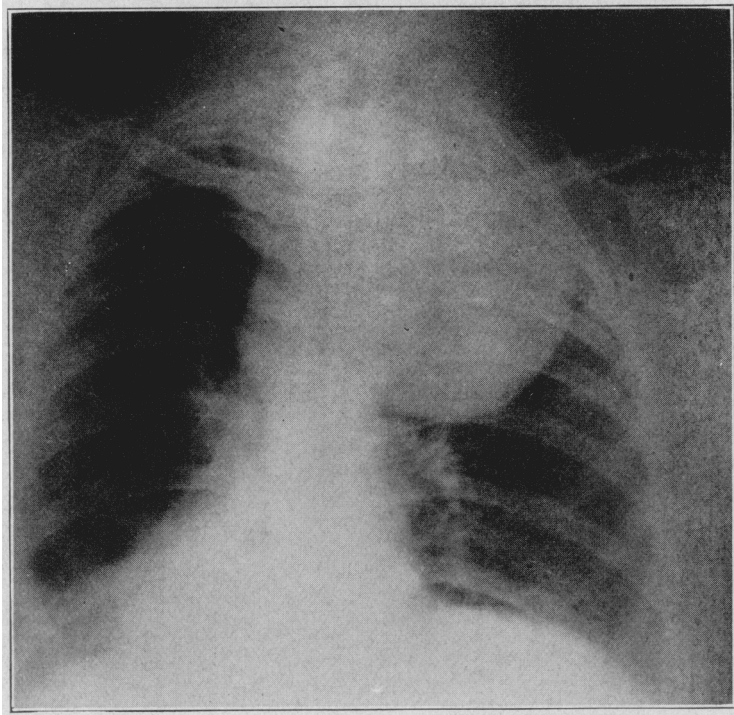


Fig. 7 (Case 333997).—Huge intrathoracic goiter filling the right upper portion of the chest.

examinations were recorded for 452 patients, and in forty-five (10 per cent.) a partial or complete paralysis of one or both cords was noted, although hoarseness was recorded in only twenty-nine patients.

#### DIAGNOSIS

In the presence of a cervical enlargement, a substernal or intrathoracic goiter can frequently be diagnosed by palpation. In most cervical goiters, the inferior pole of the lobe is well outlined when

the patient swallows or coughs. If the limit of the lower pole cannot be palpated, a substernal projection is suspected. If the neck is not enlarged, often a tumor may be felt or seen above the clavicle or sternum when the patient swallows or coughs. With the larger growths, percussion may reveal dulness. Many have emphasized the importance of the sudden disappearance of a cervical goiter with or without the appearance of marked obstructive symp-

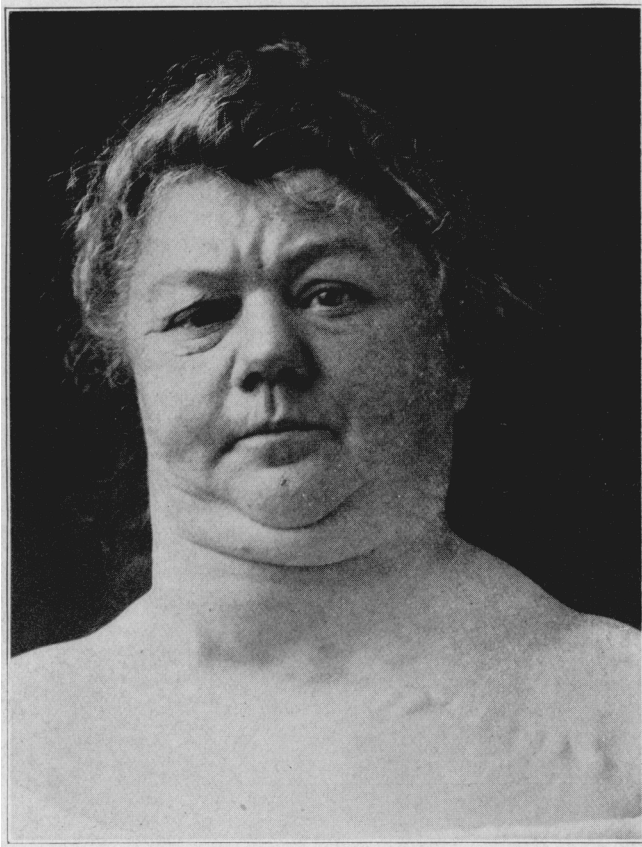


Fig. 8 (Case 320327).—Huge intrathoracic goiter producing marked obstruction and dilatation of veins over neck and chest.

toms. In only seven patients in this group was an appreciable diminution in the size of the goiter noted, and in three of these the history was indefinite. Only one patient gave a definite history of disappearance of the gland, with the production of obstructive respiratory symptoms. As the shadow of a small, retrosternal goiter may not be discerned in the roentgenogram the final preoperative diagnosis rests on the fluoroscopic examination.

## OPERATIVE TECHNIC

In patients with large substernal goiters, or in those who have any obstructive dyspnea, local anesthesia should be employed. Not infrequently when the patient is under the influence of a general anesthetic serious respiratory obstruction is encountered, either during the elevation of the tumor or even before the incision in the skin has been made. In many of these patients, the pressure of the goiter on the trachea has so embarrassed breathing that the accessory muscles of respiration have been brought into play, especially the sternomas-

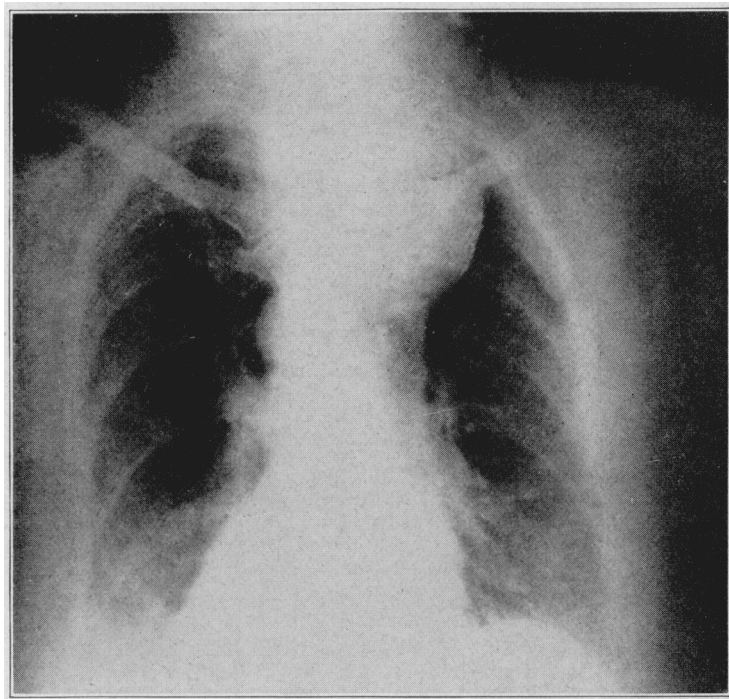


Fig. 9 (Case 320327).—Goiter shown in Figure 8.

toids, trapezius, pectoralis major and minor, rhomboideus major and minor, and the erector spinae. Under a general anesthetic the assistance of these muscles is lost, and respiratory movement may be extremely difficult or impossible. In such cases the operator must either hastily elevate the tumor, or perform a tracheotomy. If possible both procedures should be avoided. When the goiter is raised hastily, frequently the thyroid veins, and sometimes the inferior thyroid artery, are torn. Attempts to clamp these may result in the injury of important neighboring structures, such as the internal jugular vein



and the recurrent laryngeal nerve. The technic of the operation was recently described by Judd.<sup>5</sup>

The thyroid is approached through the usual low transverse incision, reflecting upward a flap of skin and the platysma muscle. It is essential that all the bleeding vessels are caught and tied before the goiter is approached; otherwise the field of operation may be partially obstructed by the presence of hemostats. The goiter is exposed by dividing the fascia in the midline between the two sterno-



Fig. 10 (Case 320327).—Patient shown in Figure 8, after operation.

hyoids. These muscles are divided between clamps, including a part of the sternocleidomastoid if necessary for better exposure.

As tracheal obstruction may be encountered at any stage of the operation, the surgeon should at once locate the trachea; its position may be greatly changed from the normal, owing to the pressure of the tumor. The first step in removing the intrathoracic goiter is free-

5. Judd, E. S.: Intrathoracic Goiter, *Internat. Clin.* **1**:149, 1920.

ing the superior pole by dividing the superior thyroid vessels between double clamps (Fig. 11). These vessels are tied immediately, in order to rid the operative field of the presence of the forceps, which, if left, might be pulled off during the course of the operation, resulting in troublesome bleeding.

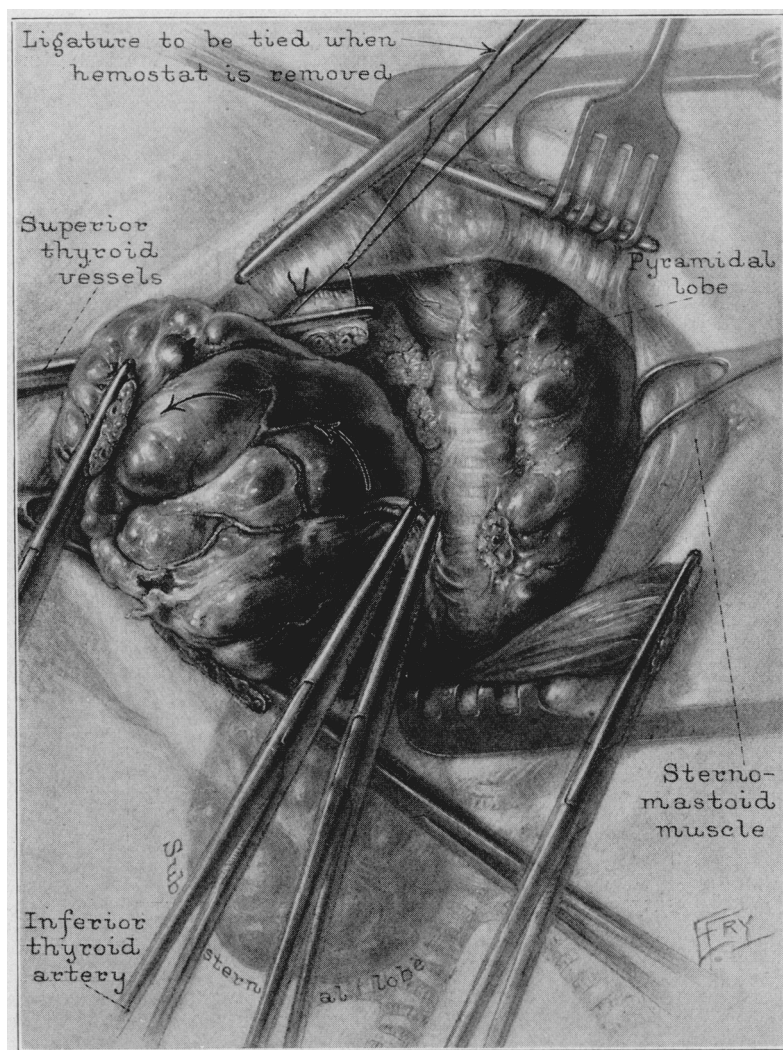


Fig. 11.—Right superior pole of gland free and isthmus divided. Mesial branch of inferior thyroid artery before it is divided.

The middle thyroid vein, which drains a rich plexus of veins beneath the capsule, emerges from the lateral surface of the gland

and enters directly into the internal jugular. This is divided and tied immediately.

The isthmus is then divided and the lobe freed from its attachment to the trachea. By traction on the tumor in a forward and slightly downward direction, the goiter may be resected from above

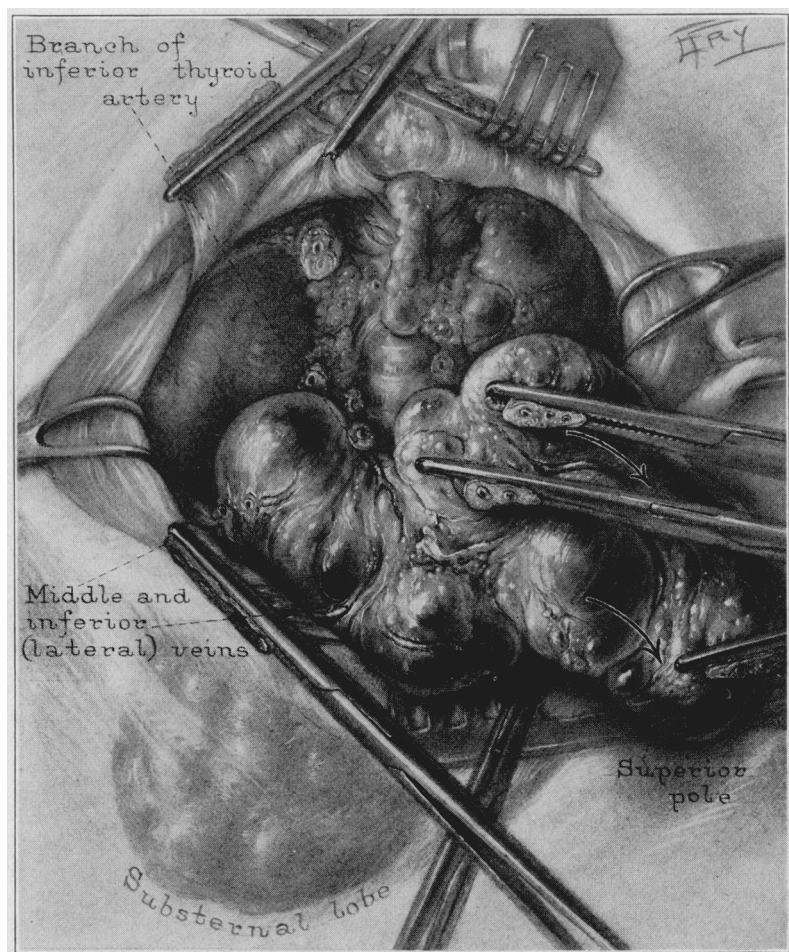


Fig. 12.—Superior thyroid pole drawn downward and inward. Both branches of the inferior thyroid artery have been divided and ligated before the substernal tumor is elevated.

downward, leaving the posterior capsule. As the inferior thyroid artery enters the gland near the middle of the lobe and remains partly in the neck in practically all substernal goiters, its branches can be clamped and severed before the substernal projection is raised

(Fig. 12). If an attempt is made to pry up the intrathoracic portion before dividing the inferior thyroid artery, there is always danger of tearing this vessel.

The only unclamped vessels remaining are the inferior thyroid veins (often two) which leave the gland at its inferior pole. These will usually be found entirely within the thorax. By traction on the cervi-

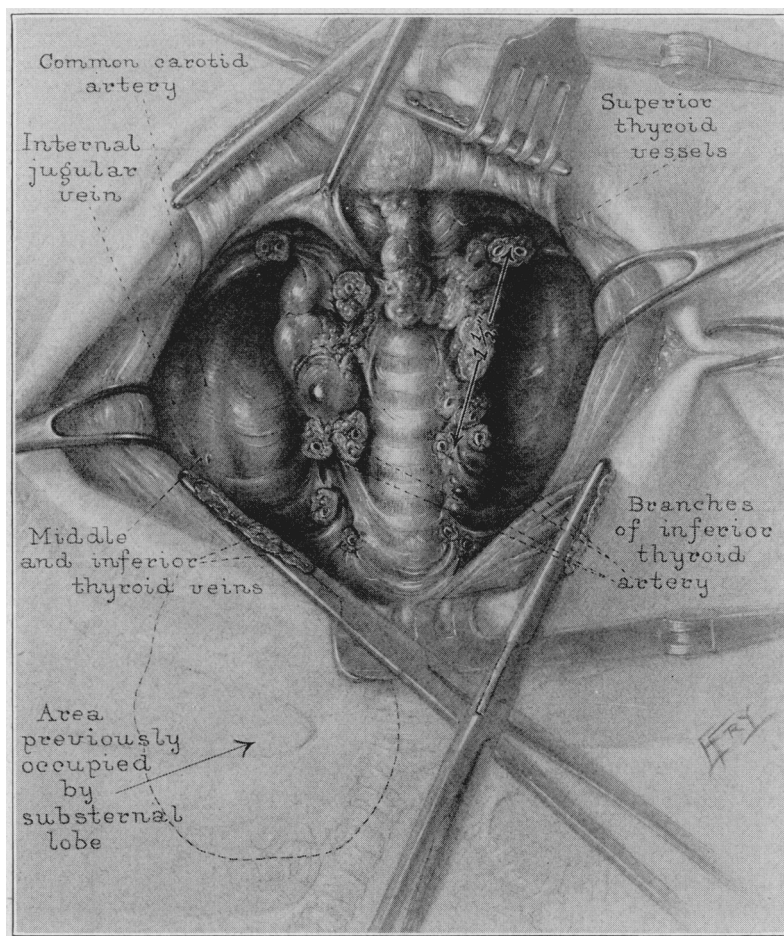


Fig. 13.—Operation completed except suture of divided muscles and closure of skin incision.

cal portion of the goiter, the intrathoracic projection can be elevated and the inferior thyroid veins clamped as they come into view (Fig. 13).

Difficulty may be experienced in elevating the tumor from the thorax. If it cannot be elevated easily, one of two procedures may

be followed, namely, removal by morcellation or longitudinal division of the sternum in order to increase the diameter of the thoracic aperture, as suggested by Lilienthal.<sup>6</sup> If the inferior thyroid artery can be secured first, removal by morcellation may be accomplished with safety. However, if the entire thyroid gland is within the thorax and the inferior thyroid artery cannot be secured, it is probable that division of the sternum may be necessary for the removal of the tumor, although this procedure will be undertaken with definite additional risk.

If a large cervical tumor is also present on the side opposite the intrathoracic projection, it is often well to resect this tumor first as better exposure will be obtained for attacking the substernal tumor.

In every thyroidectomy, an examination of both lobes should be made as a matter of routine, since often very large tumors may be concealed behind the sternomastoid, possibly behind the trachea or beneath the sternum. In our experience the "recurrences" of simple adenomatous growths have been due to failure to remove all adenomatous tissue at the first operation. In this series there were seventeen patients who had had previous operations for the removal of a portion of the gland. Three of these had had two operations. In 448 patients, the goiter involved both lobes, and bilateral resections were required; in thirty-five patients, the right lobe and isthmus were removed, and in fifty-eight patients, the left lobe and isthmus.

The intrathoracic tumor, unless malignant, is definitely encased within the capsule of the thyroid. It is separated from the intrathoracic organs by an additional layer of fascia to which the tumor is usually attached only lightly, and offers no increased difficulties in the removal of the entire capsule. The malignant tumors infiltrate into the surrounding tissues and are inoperable. Occasionally the capsule of a benign tumor is so firmly adherent and in such a relatively inaccessible position, closely associated with the large arterial and venous trunks, that its separation is attended with added risk. In such cases, after the removal of the cervical portion of the goiter, the contents of the intrathoracic capsule may be enucleated entirely by dissecting with the finger without much loss of blood. The edges of the capsule are steadied by forceps, the finger of the left hand is placed laterally and posterior to the capsule to control the inferior thyroid artery by compression. With the index finger of the right hand the capsule is ruptured and its adenomatous content is shelled out. The sac is then packed with gauze, which is removed in four or five days.

6. Lilienthal, H.: A Case of Mediastinal Thyroid Removed by Trans-sternal Mediastinotomy, Surg., Gynec. & Obst. **20**:589-593, 1915.

## COMPLICATIONS

Tracheal obstruction may be encountered either during the operation or several hours later. The collapse of the trachea during the course of the operation is frequently due to pressure obstruction from the goiter or from the forceps; it occurs most frequently during the elevation of a large growth on one side, or immediately after, and is usually the result of an adenoma, possibly unsuspected, lying behind the trachea or below the sternum on the opposite side. The obstruction is relieved by the elevation of the second growth. A tracheotomy may have been necessary before the elevation of the second growth; usually the opening in the trachea can be closed at the completion of the operation. In this series it was not necessary to do a tracheotomy during the course of the operation. Marked tracheal deformities, such as the scabbard trachea, due to bilateral pressure resulting in softening of the cartilaginous rings of the trachea, are not infrequently seen, and are often associated with obstructive breathing, at times requiring the opening of the trachea. However, the indication for tracheotomy in these cases does not usually appear for from twenty-four to forty-eight hours after the operation. A tracheotomy may also be necessary for the dyspnea associated with cord paralysis incident to the operation. The dyspnea of patients with profound hyperthyroidism may be confused with the obstructive dyspnea; but I wish to emphasize the importance of opening the trachea in all cases if any doubt exists, for thus a life will occasionally be saved. In performing a tracheotomy in a thyroidectomized patient, the mediastinal space should always be well walled off by a pack before the trachea is opened to prevent a possible fatal mediastinitis. Eight postoperative tracheotomies were performed in this series, five for obstructive dyspnea and three for toxic dyspnea. All patients in the former group survived and all in the latter died. Obstructive breathing necessitated a tracheotomy in twenty-four hours after operation in three patients, in thirty-two hours in one, and in forty-eight hours in one.

*Hemorrhage.*—Postoperative hemorrhage is not an infrequent complication following a thyroidectomy. It occurs usually within the first six hours, and is easily diagnosed by the increasing obstructive breathing, choking spells, cyanosis, and a tense swelling in the neck. The wound should be reopened immediately, the clot evacuated, and the open vessel clamped and tied. There were three cases of secondary bleeding in this series. The frequency of secondary hemorrhage is due, first, to the fact that the remaining portion of the thyroid gland is movable, and, following the movements of the trachea, a ligature may become loosened; and, second, that veins are often broken during

the dislocation of a lobe from its bed without the knowledge of the operator. Traction may temporarily occlude the opening in the vein and a clot may form, which will be forced out a few hours later by the patient's straining. To prevent secondary bleeding demands more than the exercise of care in primary hemostasis. The patient should be induced to strain or cough while on the operating table, when the "secondary hemorrhage" can be controlled.

*Paralysis of the Vocal Cords.*—Preoperative and postoperative examination of the larynx should be a routine in all cases. Injury to the recurrent laryngeal nerve may be either direct or indirect. The direct causes may be stretching or severing the nerve, or crushing or compressing by forceps or suture (Fig. 14). The indirect causes may

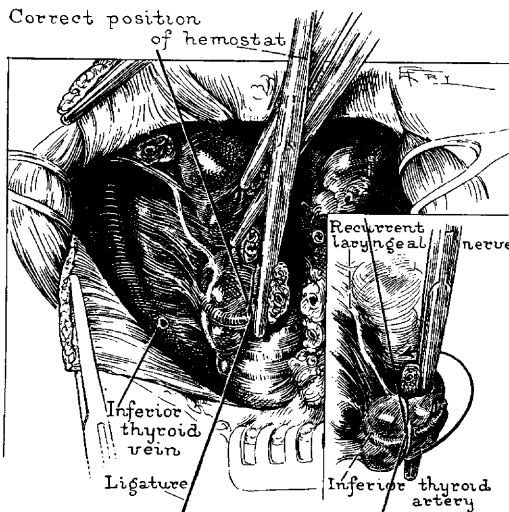


Fig. 14.—Manner in which the recurrent laryngeal nerve may be caught in the ligature by twisting the forceps.

be the traction incident to the swelling in the neighboring tissues, or to edema of the nerve itself, or the nerve may be compressed in scar tissue. In this series a postoperative examination of the larynx was not recorded in ninety-two patients. A positive finding from two to four weeks after the operation, varying from edema, lagging, slight abductor or adductor paresis to a recurrent paralysis, was reported in 170 patients. The right cord was afflicted in sixty-seven, the left in seventy, and both in thirty-three. There was aphonia in two of these, in one of whom the gland had been extirpated for cancer. In the greater number of these patients no change in the voice could be noted, or only a slight huskiness similar to that of many of the patients with negative laryngeal findings. A direct injury to the nerve during the

course of the operation may often be detected immediately by the sudden change in breathing, such as rasping, with inspiratory stridor. Cutting the offending suture may be followed shortly by the return to normal.

*Tetany.*—Removal of the parathyroids or damage to their blood supply, evidenced by the development of a permanent tetany, is extremely rare following thyroidectomy. Even in cancer of the thyroid, when an attempt is made to remove the entire gland, serious injury to the parathyroids is uncommon. In this series, postoperative tetany occurred in six patients. In all it was temporary; in five it was evidenced by slight cramping of the fingers and toes, and occurred from twelve to forty hours after operation, lasting from twenty-four to forty-eight hours. One patient had convulsive seizures.

*Air Embolus.*—The danger of extensive air embolism in operations near the root of the neck often is not appreciated. In the removal of large substernal goiters associated with numerous dilated veins the recognition of this complication is of especial importance. The thyroid veins run directly into the larger venous channels, the internal jugular and the innominate. If thyroid veins are torn accidentally and the opening is not recognized, an opportunity is afforded for the aspiration of a large quantity of air into the vein. The accident may occur during the course of the operation or shortly afterward, during straining or coughing. Cyanosis and dyspnea develop, rapidly becoming more intense. The pulse is little affected until the last. Necropsy reveals the right side of the heart filled with frothy blood. There was no incidence of air embolism in this series.

#### RESULTS

The results of the operation for the removal of substernal and intrathoracic goiters are very satisfactory. The patients are almost immediately relieved of most distressing symptoms, and they are most grateful. The mortality is low. There were sixteen deaths in this series of 542 operations (2.9 per cent.). Two may be classified as due to faulty technic, one of these to the loss of blood after a thoracotomy for the exploration of a huge intrathoracic cancer, and the other to septicemia, probably originating from the wound. Three patients died from pneumonia. Eleven (68 per cent.) died from acute hyperthyroidism seventy-two hours following operation. The average preoperative basal metabolic rate was +43. These patients were recognized as bad surgical risks; most of them had been treated medically before the operation.