

## Unilateral phrenic nerve paralysis: a rare complication after total thyroidectomy for a large cervico-mediastinal goitre

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**SUMMARY:** Unilateral phrenic nerve paralysis: a rare complication after total thyroidectomy for a large cervico-mediastinal goitre.

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*Unilateral phrenic nerve paralysis is a rare complication of cervico-mediastinal goitre. It occurs when adhesions grow between the intrathoracic part of the thyroid and the nerve, specially where the goitre enters the mediastinum behind the first rib. The damage may be caused by strain of the nerve due to the descent of the goitre into the chest or may be caused by the surgical manoeuvres during thyroidectomy performed by cervical approach.*

*Two patients operated on for large cervico-mediastinal goitre are reported: a 70-year-old male with a large intrathoracic growth of the left thyroid lobe and a 54-year-old male with a large intrathoracic growth to the right lobe. A few days after total thyroidectomy they showed signs of exertional dyspnoea. The exams performed showed hemidiaphragm relaxatio due to phrenic nerve paralysis, with resulting reduction of respiratory space.*

*Phrenic nerve paralysis may follow total thyroidectomy for large cervico-mediastinal goitres; is not due to the operative technique, but rather to the particular anatomic conditions which may be found.*

**RIASSUNTO:** Paralisi monolaterale del nervo frenico: una rara complicanza dopo tiroidectomia totale per voluminoso gozzo cervico-mediastinico.

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*La paralisi monolaterale del nervo frenico è una rara complicanza del gozzo cervico-mediastinico. Si verifica quando si sviluppano aderenze tra la parte intratoracica della tiroide ed il nervo, soprattutto dove il gozzo entra nel mediastino, dietro la prima costa. Il danno può essere causato dalla trazione del nervo dovuta alla discesa del gozzo nel torace o può essere causato dalle manovre chirurgiche durante la tiroidectomia eseguita con approccio cervicale.*

*Vengono esaminati due pazienti operati per voluminoso gozzo cervico-mediastinico: un uomo di 70 anni con un voluminoso ingrandimento intratoracico del lobo sinistro della tiroide e un uomo di 54 anni con un voluminoso ingrandimento intratoracico del lobo destro. Alcuni giorni dopo la tiroidectomia totale, entrambi hanno manifestato segni di dispnea da sforzo. Gli esami eseguiti hanno dimostrato una relaxatio di un emidiaframma, dovuta alla paralisi del nervo frenico, con una risultante riduzione dello spazio respiratorio.*

*La paralisi del nervo frenico può essere conseguenza della tiroidectomia totale per voluminosi gozzi cervico-mediastinici: non è dovuta alla tecnica operatoria ma piuttosto alle particolari condizioni anatomiche che si possono determinare in questi casi.*

KEY WORDS: Cervico-mediastinal goitre - Thyroidectomy - Complications - Phrenic nerve paralysis.  
Gozzo cervico-mediastinico - Tiroidectomia - Complicanze - Paralisi del nervo frenico.

### Introduction

Unilateral phrenic nerve paralysis following total thyroidectomy for cervico-mediastinal goitre rarely hap-

pens. The phrenic nerve may become involved in the anatomical changes which occur in a large cervico-mediastinal goitre. The nerve adhering firmly to the thyroid gland may consequently suffer strain both during the progressive descent of the goitre into the mediastinum and during thyroidectomy by cervical approach.

In thyroid surgery the risk of phrenic nerve paralysis occurs especially where the nerve enters the mediastinum, through the thoracic outlet, behind the first rib. In fact it is here, between the capsule of the intrathoracic goitre and the nerve, that significant adhesions may form more often (1).

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## Personal series

### Case 1

Diabetic 70-year-old male, with chronic bronchitis, suffering from a large multinodular cervico-mediastinal toxic goitre with displaced trachea to the right, being treated with 5 mg of methimazole. The chest X-ray before surgery showed a marked signs of chronic bronchitis (Fig. 1).

*Surgical procedure* - Total extracapsular excision of the intrathoracic goitre, plunged into the right side of the mediastinum for about 6 cm and into the left side for about 10 cm. Recurrent laryngeal nerves and parathyroids are preserved.

The patient was discharged on the third day after surgery without dysphonia, nor dysphagia, nor dyspnea and with asymptomatic hypocalcaemia (8.8 mg%) treated with calcium and vitamin D. When he resumed normal activity exertional dyspnea appeared. The chest CT, two months later, showed a raised left hemi-diaphragmatic for relaxation, with respiratory symptoms (Fig. 2). The patient showed only slight improvement from physiotherapy.

### Case 2

Overweight 50-year-old male, affected by chronic bronchitis, with large multinodular cervico-mediastinal goitre and autonomous functioning nodule in the right lobe with tracheal deviation, under treatment with 5 mg of methimazole. Chest X-ray showed a larger intrathoracic goitre and confirmed a heavy chronic bronchitis.

*Surgical procedure* - Total extracapsular thyroidectomy of the goitre plunging in the mediastinum for about 6 cm to the right and for about 10 cm to the left, in retrovascular position. Recurrent laryngeal nerves and parathyroids are preserved.

The patients was discharged on the third day after surgery, normocalcemic, without disphonia nor disfagia nor dyspnea. On taking up normal activity a slight exertional dyspnoea appeared. Chest X-ray, carried out three months later following a bout of flu with persistent coughing and exertional dyspnea, showed a rise of the diaphragmatic right hemi-cupule for relaxio with symptoms of respiratory distress (Fig. 3). A pleural scan, carried out about three months later, showed marked hypo-mobility of the right hemi-diaphragm for relaxatio. The patient showed only slight improvement with physiotherapy.

## Discussion

The section of the phrenic nerve, the consequent paralysis of the hemi-diaphragm, with ascent of the thoracic base and consequent lung immobilization, was the therapy used for years in pulmonary tuberculosis.

Iatrogenous surgical paralysis of the phrenic nerve happens relatively frequently in cardiothoracic surgery and in oncology surgery of the cervical and mediastinal area, when radical lymphadenectomy is carried out (3-5). In indwelling manoeuvres of a central vein catheter for chemotherapy (8) or hemodialytic treatment (9) the phrenic nerve lesion is less frequent but well documented.



Fig. 1 - Case 1: chest X-ray before surgery.



Fig. 2 - Case 1: chest CT scan following surgery.



Fig. 3 - Case 2: chest X-ray following surgery.

Cervico-mediastinal goitre may be associated with paralysis of the phrenic nerve not necessarily as a consequence of thyroidectomy. In fact there is evidence of paralysis from strain of the nerve, due both to intrathoracic growth of the goitre and thyroidectomy through a transcervical approach.

The pathogenesis of the cervico-mediastinal goitre and the anatomy and topographic relationship of the phrenic nerve clearly explain this clinical condition. The thyroid, growing, increases in weight therefore slowly descends into the chest. Of course, some factors favour its descent such as a short, thickset neck, greater width and flatness of the thoracic outlet, increase of the size of the lower part of the thyroid lobes, elasticity of the upper vascular peduncles. The negative thoracic pressure and the movement of the prethyroid muscles promote further descent of goitre into the mediastinum.

The trachea is often affected by the compression of the goitre. The same can be said for the brachycephalic venous trunks and for the esophagus (10). The lower parathyroid glands may be considerably displaced downwards and their retrieval may become complex. Particular emphasis should be placed on the relationship between the goitre and the recurrent laryngeal nerves for the displacement as a result of the descent of the gland into the mediastinum.

The main trunk of the phrenic nerve, about 1.5 mm in diameter, runs from the top surface of the anterior scalenus muscle and, positioned between the subclavian artery and the vein, enters the chest and settles on the pleuric cupule descending into the anterior mediastinum. On the right it follows the side of the superior vein cava, runs along the pericardium and finally reaches the diaphragm. On the left side, the nerve descends laterally to the aortic arch on the side wall of the pericardium and reaches the diaphragm just behind the top of the heart.

If adherences occur between the thyroid gland and the phrenic nerve in case of cervico-mediastinal goitre, immediately beyond the upper thoracic outlet, it is possible to damage the nerve during surgery. The phrenic nerve, in that region, is not under direct visual control, neither is there a way of identifying and preserving it as is out of the surgical area and the removal of the intrathoracic portion of the goitre, through the

cervicotomy, can damage it.

The most frequent surgical technique for cervico-mediastinal goitre is through a cervical incision by which it is generally possible to remove the gland. The surgical procedure which we usually use is cervicotomy opening the prethyroid muscles out, except for those cases in which, due to the considerable size of the goitre, it is necessary to cut them.

When the thyroidectomy is difficult we prefer to begin the operation from the smallest lobe. When the loboistmectomy on that side is carried out, we proceed to the ligation of the upper vascular pedicle of the most deep intrathoracic lobe, paying attention not to injure the external branches of the upper laryngeal nerve. Having identified the recurrent nerve, we perform gentle traction of the thyroid gland holding the detached portion and freeing the part in the mediastinum. Having freed the goitre from the mediastinum and safeguarded the parathyroids with their vascular branches, we finally proceed to the complete removal of the gland from the laryngotracheal axis.

We do not agree and therefore we do not use the technique of the threads of traction, nor the so-called 'morcellement', nor the use of a Foley catheter (2).

## **Conclusion**

Whenever relaxation of the hemi-diaphragm with the appearance of exertional dyspnea appears, following thyroidectomy for cervico-mediastinal goitre, phrenic nerve paralysis should be suspected. This condition, caused by the rise of the diaphragm, may determine a reduction in the respiratory space due to compression of the pulmonary paraenchaema and a restrictive syndrome with a slight hypoxia, especially in patients with associated chronic respiratory pathologies.

The surgical technique used for the cervico-mediastinal thyroidectomy is not responsible for phrenic nerve paralysis, which is due, in fact, to the particular anatomic conditions (adhesions) which may be caused by the descent into the mediastinum of the goitre.

Early respiratory physiotherapy remains the most effective and realistically the only therapeutic treatment of this condition.

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