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Classic diseases revisited

Compression syndromes caused by substernal goitres

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Summary
Enlargement of the thyroid is common, especially in areas of endemic iodine deficiency. Substernal enlargement of a goitre can cause compression of several mediastinal structures. As a consequence of tracheal compression and tracheomalacia, syndromes of chronic respiratory distress occur and intercurrent upper respiratory infections may lead to acute respiratory failure. Superior vena cava syndrome secondary to compression by a substernal goitre may be complicated by venous thrombosis. Although dysphagia is the most frequent oesophageal symptom of a substernal goitre, upper gastrointestinal bleeding from 'downhill' oesophageal varices may be an initial presentation. Arterial compression or thyrocervical steal syndrome by large substernal goitres occasionally cause cerebral hypoperfusion and stroke. Recurrent and phrenic nerve palsies, as well as Horner's syndrome, occur secondary to non-malignant mediastinal goitres and may resolve after surgery. Substernal goitres rarely cause therapy-resistant pleural effusions, chylothorax and pericardial effusion. In conclusion, although cervical goitres are easily recognised, the initial presentation of mainly substernal goitres may be unusual.

Keywords: goitre; superior vena cava syndrome; compression syndromes; dysphagia; thyrocervical steal

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Enlargement of the thyroid gland is very common in areas of endemic iodine deficiency. Substernal goitres account for 13.7% of mediastinal tumours admitted for surgery and 5–20% of patients selected for thyroid surgery.[1 2] The thyroid gland is bound posteriorly by vertebral bodies, anteriorly by cervical fasciae or muscles, and superiorly by laryngeal cartilages. No anatomical structure prevents the thyroid from growing into the thoracic inlet following the negative intrathoracic pressure during swallowing and breathing. Therefore substernal thyroidal growth leads to dislocation of adjacent anatomical structures. The present review focuses on the variety and pathophysiology of compression-related symptoms and clinical signs of substernal goitres (box).

Veins

Major displacement of the superior vena cava is not possible, since substantial parts are embedded in the pericardium. Additionally, the thin-walled vena cava and innominate vein are less resistant to external pressure than the aortic arch or the carotid arteries. Therefore, head, neck, and upper extremity congestion due to stenosis, occlusion or thrombosis of mediastinal veins are a common complication of mediastinal tumours.[3] Although infiltrating malignant diseases cause up to 97% of superior vena cava syndromes, they can be secondary to a variety of benign causes.[4] Fast-growing malignant tumours such as small cell carcinoma of the lung usually result in acute or subacute occlusion of the superior caval vein.[5] Thrombus formation is common.[3] Benign causes, such as iatrogenic superior vena cava thrombosis secondary to venous catheterisation or pacemaker implantation, may also result in sudden onset of symptoms.[6] On the contrary, a slowly growing substernal thyroid can be asymptomatic due to venous collateral formation (figure 1).[5] Congestion of the face, cyanosis and distress while elevating both arms (Pemberton's sign) can indicate an increased thoracic inlet pressure by a substernal mass.[7–9] While keeping the arms elevated, venous blood flow from the arms contributes to congestion of neck and head during transient obstruction of the superior caval vein and collaterals. It has therefore been suggested that the Pemberton manoeuvre may be useful in patients with a suspected substernal goitre.[10] However, continuous thyroid growth can result in symptomatic vena cava syndrome secondary to compression or thrombosis-related occlusion of central or collateral veins.[11 12] The most common symptoms are dyspnoea, facial congestion, venous distension of the chest wall, arm swelling, and facial plethora.[4]

Trachea

Apart from a growing cervical mass, respiratory symptoms due to continuous irritation of the upper airway are by far the most common presentation of a substernal goitre.[2] Either cough, hoarseness or shortness of breath are noted by approximately 90% of patients selected for surgical treatment.[13] Progression of tracheal narrowing may result in breathlessness on exertion, stridor or right-sided congestive heart failure secondary to persistent hypoxia.[14] Mild symptoms may deteriorate to acute respiratory failure during respiratory tract infections or fever.[14] Respiratory distress may also result from acute enlargement of the thyroid gland due to intrathyroid haemorrhage.[15] Symptomatic relief of upper airway obstruction in patients not eligible for surgery can be provided by insertion of a tracheal endoprosthesis.[16] However, dyspnoea in patients with mediastinal goitre may not always be secondary to tracheal dislocation. Other rare causes include decompensated right-sided congestive heart failure, pleural effusion, and pulmonary hypoperfusion due to compression of pulmonary arteries.[14 17 18]

Compression syndromes due to substernal goitres

Veins
- superior vena cava syndrome
- venous thrombosis
- portal hypertension

Trachea
- compression-related cough
- asphyxia
- tracheomalacia
- hypoxia-related right-sided congestive heart failure

Oesophagus
- compression-related dysphagia
- downhill varices (haemorrhage)

Cerebrovascular
- cerebral ischaemia
- (sinus thrombosis)

Nerves
- recurrent nerve palsy
- phrenic nerve palsy
- Horner's syndrome

Chylous
- chylothorax

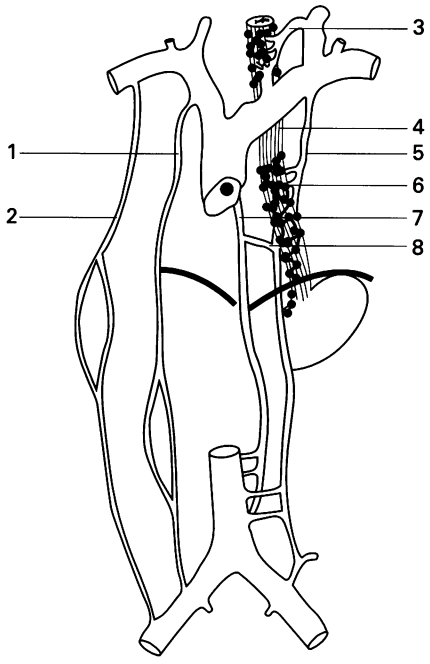

Figure 1 Important collateral pathways in superior vena cava syndrome. 1 = internal mammary vein, 2 = thoraco-epigastric vein, 3 = inferior thyroid vein, 4 = oesophagus, 5 = axillary hemi-azygos vein, 6 = mediastinal oesophageal veins, 7 = azygos vein, 8 = hemi-azygos vein

Oesophagus

Oesophageal involvement secondary to substernal thyroid tissue most commonly presents as dysphagia. The prevalence of dysphagia at the time of surgery has been reported to be about 30%.[2] An air oesophagogram on a plain film was seen in 15% of patients as a sign of intermittent aerophagy due to continuous irritation of neck structures by the enlarged thyroid.[19] A barium swallow can visualise oesophageal displacement and stenosis. In a study of 1051 cases with cervical and substernal goitre, 3% of patients developed 'downhill' oesophageal varices.[20] The prevalence was related to the size of the thyroid and was 0% in small and 12% in large cervical goitres. Compression of the superior caval vein results in congestion of the inferior thyroid vein and other branches which drain blood from the cranial third of the oesophageal vein (figure 1). Vena cava compression between right atrium and azygos vein may even result in varices of the entire oesophagus, since venous congestion can be transmitted via the hemi-azygos vein to mediastinal oesophageal veins. Gastrointestinal haemorrhage may therefore be the initial presentation of a substernal goitre.[21-23] The same haemodynamic consequences may occasionally cause otherwise unexplained portal hypertension.[24]

Cerebrovascular

Several patients with large substernal goitres and otherwise unexplained cerebral ischaemia have been reported. Recurrent hemiplegia and aphasia during extension of the neck, reported in one case, were most likely caused by direct compression of the carotids by a mediastinal mass.[25] However, recurrent transient ischaemic attacks have been reported without arterial compression. Thyrocervical steal by an increased thyroid blood flow accounted for the cerebral ischaemia in this case, since all symptoms resolved after thyroid surgery.[26] Large substernal goitres may also associated with superior sagittal sinus thrombosis. Since this syndrome has only been reported in patients with goitrous Graves' disease, the underlying mechanism (either immune-mediated hypercoagulability or stasis of venous blood flow) remains speculative.[27]

Nerves

Several nerves cross the thoracic inlet and are exposed to damage by mediastinal pathologies (figure 2). The left recurrent laryngeal nerve is most frequently affected as it passes the upper mediastinum around the aortic arch. Although vocal cord palsy is traditionally considered to be a late sign of infiltrative malignant disorders such as thyroid carcinoma, it may occasionally be secondary to compression of benign mediastinal pathologies such as substernal goitres or left atrial enlargement (Ortner's syndrome). The pre-operative prevalence of vocal cord palsy was 3% in a large German study of benign thyroid goitre,[20] and 1% in a British study of 2321 patients, 89% of whom regained vocal cord movement after surgery.[28] Horner's syndrome has occasionally been related to benign thyroid pathologies. However, Horner's syndrome is seldom the single manifestation of substernal goitres. Reversibility after thyroidectomy has been reported.[29] Although the phrenic nerves cross the thyroid gland at the thoracic inlet, phrenic nerve palsy is a rare complication of thyroidal enlargement.[30] Unilateral diaphragmatic paralysis is commonly asymptomatic and may only be accidentally detected on a chest X-ray. Bilateral phrenic nerve palsy secondary to a benign substernal goitre may present as acute respiratory failure requiring intubation or tracheostomy.[30]

Chylothorax

Massive unilateral chylothorax did not resolve after drainage but did resolve after surgical removal of a large multinodular substernal goitre in some patients. Compression of the brachiocephalic vein and the thoracic duct were assumed to cause this rare complication of thyroid enlargement. However, these patients were in their seventies and had signs of concomitant cardiac disease.[31]

Conclusions

Although cervical goitres are easily recognised, the initial presentation of mainly substernal goitres may be unusual, due to compression of mediastinal structures. The most common symptoms are dyspnoea, dysphagia, and unproductive cough. Symptoms secondary to recurrent nerve palsy and superior vena cava syndrome are occasionally seen. Unusual compression-related symptoms

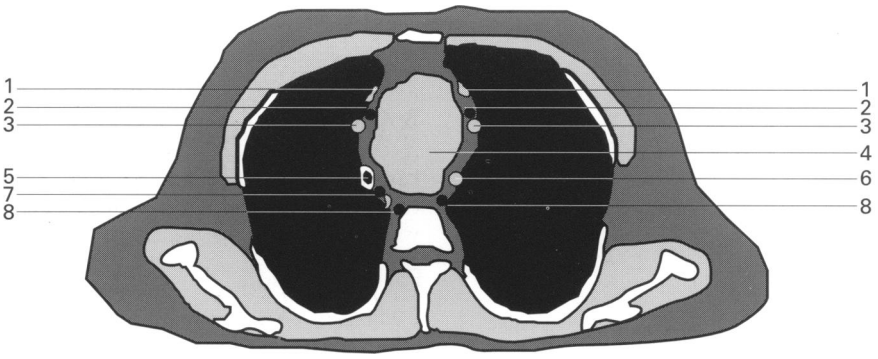

Figure 2 Dislocation of mediastinal structures by a substernal goitre. 1 = brachiocephalic vein, 2 = phrenic nerve, 3 = common carotid artery, 4 = goitre, 5 = trachea, 6 = subclavian artery, 7 = recurrent nerve, 8 = cervical sympathetic ganglion

include bleeding from downhill oesophageal varices, transient ischaemic attacks, chylothorax, Horner's syndrome, phrenic nerve palsies, and stroke. Although most of these symptoms are frequently related to mediastinal malignancies, benign intrathoracic masses should also be considered, since almost all substernal goitres can be treated by conventional cervical thyroid surgery.

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