

Tracheomalacia after reoperation for an adenomatous goiter located in a unique position

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Abstract Tracheomalacia after thyroidectomy is a life-threatening situation. However, it is difficult to predict postoperative tracheal obstruction with certainty. A case of a 74-year-old woman with a long-standing adenomatous goiter (98 g) is reported. She had undergone partial right lobe thyroidectomy 54 years earlier. After total thyroidectomy, she was reintubated and required a tracheostomy because of tracheomalacia. The right residual thyroid tumor weighed only 5 g, but it extended to the retrotracheal space. Because the right lobe had stretched the membranous wall of the trachea over a long period of time, the tracheal lumen was thought to have collapsed because of loss of the foundation of the tracheal cartilage (the residual right lobe) along with the supportive surrounding tissue (the left lobe) after surgery. The present case suggests that the occurrence of tracheomalacia could be attributed to reoperation and retrotracheal extension. Thus far, six preoperative predictive factors for the development of severe postoperative respiratory obstruction have been reported: goiter for more than 5 years, preoperative recurrent

laryngeal nerve palsy, significant tracheal narrowing and/or deviation, retrosternal extension, difficult endotracheal intubation, and thyroid cancer. Two more factors, reoperation and retrotracheal extension of tumor, may also be risks for airway obstruction after thyroidectomy.

Keywords Adenomatous goiter · Membranous wall of the trachea · Postoperative airway obstruction

Introduction

Tracheomalacia after thyroidectomy results in a fatal outcome without optimal management [1, 2]. In a prospective study of 964 thyroidectomy patients, 59 patients required tracheostomy (6%). The incidence rate of tracheomalacia was 1.6% ($n = 16$) [3]. In a retrospective study of 505 thyroid surgery procedures for benign disease, tracheomalacia was noted in 4 patients (0.8%) [4]. Almost all reported cases of tracheal collapse after thyroidectomy were caused by large goiter, thyrotoxicosis, or thyroid cancer [4–7]. Tracheomalacia after resection of a small, nontoxic, benign thyroid tumor is extremely rare [2]. Here, the case of a 74-year-old woman with a benign thyroid tumor (98 g), who developed acute airway obstruction after total thyroidectomy and required tracheostomy, is presented.

Case report

A 74-year-old woman (height 143 cm, weight 39 kg) was scheduled for total thyroidectomy. The thyroid tumor was 5×8 cm in size and had been diagnosed as adenomatous goiter 14 years earlier. Although she had undergone partial right lobe thyroidectomy 54 years earlier, details of the

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operation were unconfirmed. Routine preoperative blood tests and electrocardiogram were normal except for mild anemia (Hb, 9.7 g/dl). Thyroid function tests revealed a euthyroid state. Her chest was clear on auscultation. A preoperative chest X-ray showed tracheal stenosis and rightward deviation. On chest and cervical computed tomography (CT) scan, the trachea was crescent shaped at the cricoid cartilage level (Fig. 1). The tracheal diameter was 4.62 mm at the narrowest part, and the length of the stricture was about 10 mm. Bronchial fiberoptic examination revealed that the tracheal inner wall was soft and smooth (Fig. 2a). A 5-mm-diameter fiberoptic passed the narrowed part easily. The left lobe of the thyroid gland was $12 \times 5 \times 3.5$ cm in size and pushed the trachea to the right side. The residual right lobe was $3 \times 3 \times 1.5$ cm in size and was located in the back of the membranous wall of the trachea.

The patient received no premedication. Nasotracheal intubation with a microlaryngeal tube (MLT; Mallinckrodt

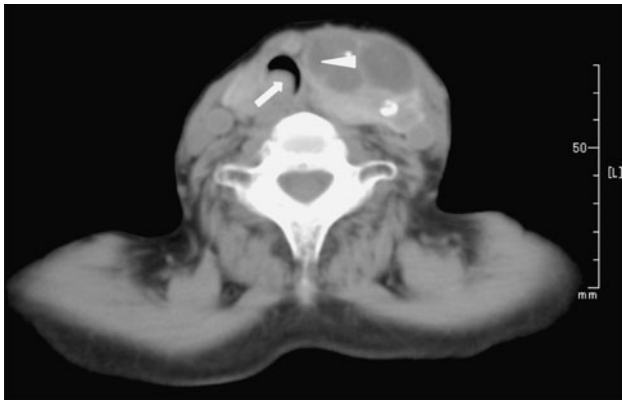
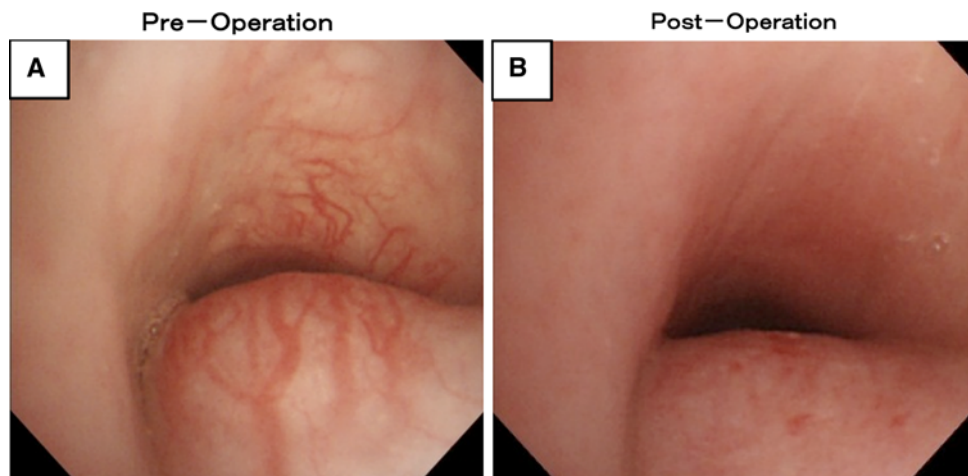


Fig. 1 Cervical computed tomography (CT) scan at the level of the cricoid cartilage. The trachea is compressed to the right side by the enlarged left lobe of the thyroid gland (*white arrowhead*) and has become crescent shaped. The residual right lobe is located in the back of the membranous wall of the trachea (*white arrow*)

Fig. 2 a Bronchoscopic findings before surgery show crescent shape: posterior and right lower walls protrude into the bronchial lumen.
b Bronchoscopic findings after surgery (at 16th day) indicate persistent tracheal stenosis



Medical, Athlone, Ireland) (ID, 6.0 mm) was performed under bronchial fiberoptic guidance after intravenous fentanyl 50 μ g and midazolam 2 mg were given with 2% sevoflurane and 100% oxygen 6 l/min inhalation with spontaneous breathing. After confirming tracheal intubation, rocuronium was given. Anesthesia was maintained uneventfully with sevoflurane in oxygen and remifentanyl (0.2–0.3 μ g/kg/min). The thyroid gland was removed completely, and both recurrent laryngeal nerves were identified and preserved. The excised thyroid gland was 98 g in weight (left and pyramidal lobes, 93 g; right lobe, 5 g). Estimated surgical blood loss was 20 ml. After confirming hemostasis, extubation was performed with the patient awake. However, the patient complained of dyspnea with stridor after extubation. After 15 min, she was reintubated with inhalation of sevoflurane in oxygen. A tracheostomy was performed following fiberoptic observation. The tracheal lumen was not edematous, but it was collapsed as a result of the deformity of the tracheal cartilage. Glottic or subglottic edema, vocal cord paralysis, and hematoma were not detected. No images were obtained during inspiration and expiration, but a surgeon noted that the tracheal lumen could be deformed by gentle pressure between the thumb and fingers. On the basis of the surgeon's palpation and clinical observations, the patient was diagnosed as having tracheomalacia. Because the membranous wall of the trachea had been stretched by the residual right lobe of the thyroid gland for a long time, the tracheal cartilages of the stenotic part were not able to support the tracheal lumen. After adequate spontaneous respiration and awareness were restored, the patient was returned to the ward.

There were no neurological complications after the operation. Histological study confirmed an adenomatous goiter without malignant tissue. Decannulation was not successful for a long time because of her fear of asphyxia and repeated laryngeal infections. However, her

tracheostomy was eventually closed on the 103rd post-operative day, and she was discharged home.

Discussion

The characteristics of this case are that the trachea was lifted by the residual right tumor and was semirotated to the left side. Therefore, the tracheal cartilage appears to have been able to maintain a semicircular shape in the CT image, not the saber sheath shape, despite compression by the enlarged left lobe. However, this CT image did not indicate that the cartilage was intact. The cartilage of the narrowed part had probably been softened for a long time. After the tracheostomy, it became obvious that the tracheal cartilage was soft and its lumen collapsed without support by the surgeon's fingers. Thus, the present case was likely a membranous (crescent) type morphologically (Fig. 2b) and a combined (weakness of the cartilage and loosening of the membranous wall) type histologically in Murgu and Colt's classification [8]. The right residual thyroid tumor in this case had the following four characteristics: long-standing, small, retrotracheal extension, and reoperated goiter.

Agarwal et al. [9] analyzed 900 thyroidectomies in their retrospective study and concluded that patients with long-standing goiter, even when benign, are more prone to develop tracheomalacia (3.1%). Abdel Rahim et al. [7] investigated 103 patients with a large goiter prospectively. They also reported that a long-standing goiter of more than 5 years is one of the risk factors for the development of serious postoperative respiratory obstruction. Because our case had a long history, 54 years, postoperative tracheomalacia could be anticipated.

Unilateral and bilateral thyroid enlargement have been defined as an excised thyroid lobe weighing 40 g or more and as an entire thyroid gland weighing 80 g or more, respectively [10]. These definitions are based on the following two facts. The weight of a normal lobe of the thyroid gland varies from 5 to 10 g. Goiter was defined as a thyroid enlarged more than 4–5 times by Perez et al. [11] in 1958. They further classified goiter into three groups (group 1, palpable goiters; group 2, visible goiters; group 3, large goiters). However, they did not present weight criteria for each group. In epidemiological studies, a precise weight definition did not appear necessary. Therefore, we could not regard our case as a large goiter despite the severe symptoms. To the best of our knowledge, the smallest goiter that induced airway obstruction after thyroidectomy was 80 g, and it was a malignant tumor [9]. This case shows that a patient with even a small benign thyroid tumor has the potential to develop airway obstruction after thyroidectomy.

With respect to the factors leading to the airway obstruction and the long-term tracheostomy in the present case, the position of the tumor was probably important. According to Marangos [2], airway obstruction is caused by extensive softening of the tracheal ring and loss of the surrounding hard and inelastic goiter tissue. In addition to this mechanism, the membranous wall of the trachea had probably been stretched by the tumor and was no longer present to act as a foundation for the tracheal cartilage after the thyroidectomy. Under ordinary circumstances, thyroid tissue is not located in the dorsal area of the trachea. After the previous thyroid surgery, the trachea might have been compressed to the ventral side and rotated slightly by the disproportionate enlargement of the right and left lobes. As a result of this displacement of the trachea and ventral side scar tissues of the previous operation, the residual right lobe might have been located in the dorsal area of the trachea. Esophageal cancer is a typical disease that causes tracheal obstruction by compression from the dorsal side [12, 13]. However, other diseases also compress the trachea from behind [14, 15]. To prevent unexpected airway obstruction after surgery, it is important to check for evidence of compression of the trachea from the dorsal side during preoperative imaging diagnosis.

Kadhim et al. [4] reported that five patients with benign thyroid disease had presented with life-threatening acute airway obstruction. Two of the five patients had undergone previous thyroid surgery (20 and 35 years earlier, respectively). The previous operation induced tissue adhesions and further complicated the anatomy. The incidence of tracheomalacia might be increased with reoperation, because the tissue adhesions or anatomic problems might lead to serious thinning or deforming of the tracheal wall. Six preoperative predictive factors for the development of serious postoperative respiratory obstruction have been previously reported: goiter for more than 5 years, preoperative recurrent laryngeal nerve palsy, significant tracheal narrowing and/or deviation, retrosternal extension, difficult endotracheal intubation, and thyroid cancer [7]. The present case suggests that the occurrence of tracheomalacia may have been attributed to reoperation and retrotracheal extension.

Finally, tracheomalacia has been classically defined as a reduction in airway cross-sectional area greater than 50% on expiratory images in the radiology literature [16–18]. In the present case, the diagnosis of tracheomalacia was not established on the basis of the gold standard. However, histopathological or surgical definitions have been also reported [7, 9, 19, 20]. The condition of the present case was in agreement with diagnostic criteria described by Abdel Rahim et al. [7]. Because other airway obstruction factors (edema, secretions, recurrent nerve paralysis, hematoma, etc.) were excluded by the fiberoptic examination, the

diagnosis of tracheomalacia appears to have been applicable to the present case.

In conclusion, a 74-year-old woman with an adenomatous goiter (98 g) underwent a second thyroidectomy, and she developed tracheomalacia and acute airway obstruction that necessitated reintubation and tracheostomy. Her tracheomalacia was probably induced by extensive softening of the tracheal ring, loss of the surrounding supportive tissue, and loosening of the membranous wall of the trachea, which was induced by resection of the residual right lobe located in the back of the trachea. The present case suggests that both reoperation and retrotracheal extension of goiter may be risk factors for airway obstruction after thyroidectomy.

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