

Trachea Necrosis after Thyroidectomy ; Case Report and Review

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갑상선절제술 후 발생한 기도 괴사 ; 증례보고

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= 국문초록 =

갑상선절제술은 내분비 외과의사가 하는 수술 중 가장 안전한 수술이지만 수술 중 기도나 식도가 손상 받을 수 있으므로 각별한 주의를 기울여야 한다. 특히 기도 괴사와 같이 생명에 위협을 주는 합병증이 있음을 유념해야 한다. 본 논문은 갑상선 전 절제술과 승모관 치환술을 함께 받은 72세 여성환자가 수술 후 3일만에 기도 괴사가 발생한 케이스이다. 3개의 기관류에 걸쳐 괴사가 발생되어 있었다. 괴사된 조직을 제거하고, 이후 지속적인 괴사조직에 대한 제거와 치료와 적으로 기관개창술을 시행하고, 자연폐쇄를 유도하여 성공적으로 치료되었다. 비슷한 여러 논문들을 살펴본 결과 기도 괴사를 유발하는 요인으로는 조절되지 않는 기침, 여성, 갑상샘중독 결절, 기도 삽관 시 발생하는 손상, 삽관튜브 커프의 과팽창으로 기도가 장시간 높은 압력으로 압박되었을 때, 적절하지 않은 커프 크기, 삽관튜브 커프의 공기를 빼지 않고 무리하게 움직였을 때, 출혈이 많을 때, 과도한 전기소작으로 인한 손상, 기도로 가는 혈관손상으로 인한 혈액공급의 차단, 감염 등으로 보고 있다. 치료는 기도의 괴사와 감염의 정도에 따라 달라질 수 있다. 일차 봉합술, 일시적 스토마 형성, 일시적 기관조루술, 단단연결술, 기도 스텐트 설치술, 근육피판 재건술, 보존적 치료 등을 시행할 수 있다. 기도 괴사에 대한 위험인자와 치료에 대해서는 아직 확실히 적립되지 않은 상태이다. 드문 합병증이지만 생명을 위협할 수 있는 이러한 합병증에 대해 항상 염두 해 두고 수술 시 신중을 기하고 문제 발생시 신속한 대응을 해야겠다.

중심 단어 : 갑상선 암 · 갑상선 절제술 · 기관괴사.

Introduction

Thyroidectomy is the most commonly performed procedure in the field of endocrine surgery, and complications after thyroidectomy are rare if it is performed by an experienced surgeon. Complication rate reaches 4.3%, such as vocal cord

paralysis, hypoparathyroidism, hematoma, and wound infection.³⁾ Moreover, tracheal injury after thyroidectomy is even rare, as there are less than 10 case reports published about the complication so far. According to the previous reports, tracheal injury manifests ten to fourteen days after thyroidectomy. We presented a patient with tracheal necrosis and reviewed the previous reported articles to find out possible causes and appropriate treatments.

Case Report

A 72-year-old woman suffered from weight loss and voice change for three months before she was diagnosed with thy-

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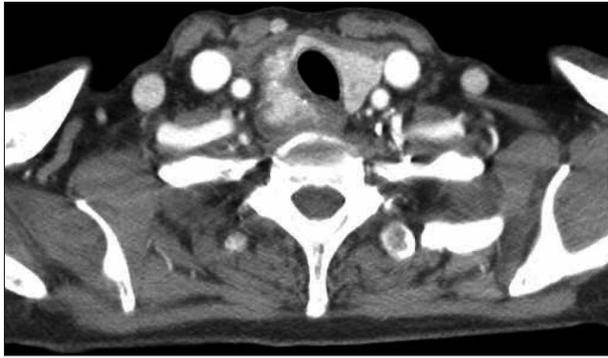


Fig. 1. Neck computed tomography section before thyroidectomy (pre-op evaluation).

roid cancer during ultrasonography-guided fine needle aspiration. She underwent a total thyroidectomy with central compartment lymph node dissection. She had a past history of asthma(30 years) but had not used steroids or had an attack in the past year. She occasionally took pain-killers due to hip and shoulder pain. Preoperative ultrasonography and computed tomography of the neck(Fig. 1) showed thyroid cancer of the right lobe with a suspicious capsular invasion, right recurrent laryngeal nerve invasion, and esophageal invasion. For further evaluation of the esophagus, esophageal ultrasonography(EUS) was also performed but it did not show any specific findings other than extrinsic compression. For general anesthesia, the patient was performed preoperative systemic evaluation and an echocardiogram showed an ejection fraction of 63%, normal wall motion abnormality, and mitral valve prolapse with severe MR grade IV. Therefore a combined operation of thyroidectomy and valve replacement was planned with a cardiovascular surgeon.

On the day of operation, the cardiovascular-surgeon started the mitral valvuloplasty and mitral annuloplasty first. The valve replacement operational time was 220 minutes and there was 100cc of blood loss. Following the open-heart surgery, the thyroidectomy was performed. Anticoagulant was not used intraoperatively, and amount of bleeding was equivocal to usual thyroidectomy. Adhesion between tumor and trachea was easily dissected with Mosquitos, without usage of coagulation devices. Recurrent laryngeal nerve was resected due to invasion. And the direct invasion of thyroid cancer to the esophagus was noticed. The outer serosa and submucosa layer were resected with layer by layer dissection, leaving the mucosal layer intact. The total operational time for thyroidectomy with central compartment dissection and esophageal shaving procedure was 190 minutes. After operation the patient was stay in an intensive care unit and extubated on post-operative day 3. Seven hours after extubation, the patient had dyspnea with upper chest emphysema, and swelling of the face

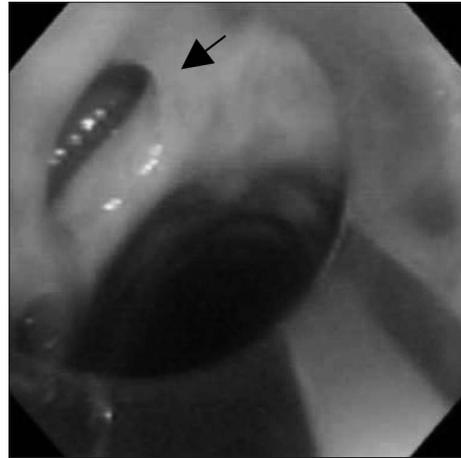


Fig. 2. Bronchoscopy immediately after perforation demonstrates a small defect above the left vocal cord(10 o'clock direction).

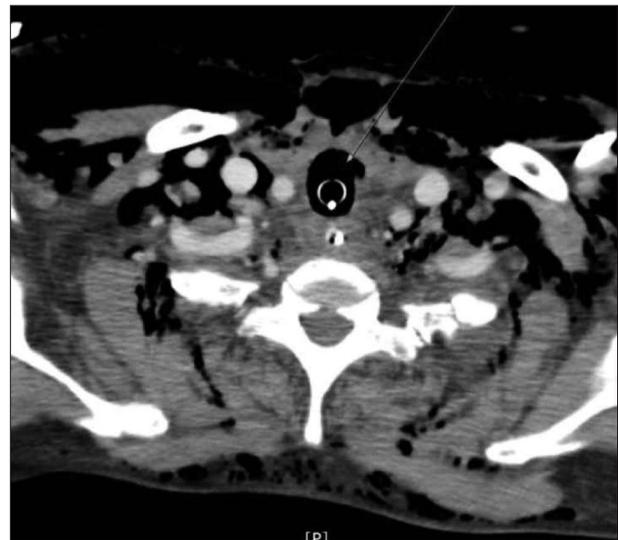


Fig. 3. Neck computed tomography section, demonstrating extensive subcutaneous emphysema of the neck(arrow).

and neck. The patient was reintubated and was confirmed a tracheal perforation by bronchoscopy(Fig. 2). Right above the left vocal cord, an oval-shaped hole was found, which we suspected was a perforation. The subsequent computed tomography scan definitely showed perforation and necrosis of the surrounding tissue(Fig. 3). During an emergency operation, the perforation of the trachea was found due to wide-range necrosis, which included tracheal rings III, IV, and V. Tracheal rings I and VI were also necrotized partially(Fig 4A). The surrounding soft tissue infected(Fig. 4B). The location of the invasion was different from where we identified with bronchoscopy. And perforation was not definitely present but tissue thinning was in process leading to perforation. The tracheal defect and the surrounding infectious necrotic tissue were removed in a rectangular bloc of 1×2 cm size(Fig. 4C). In case circumferential invasion of the trachea had occurred, resection and end-to end anastomosis is the treatment of choice.

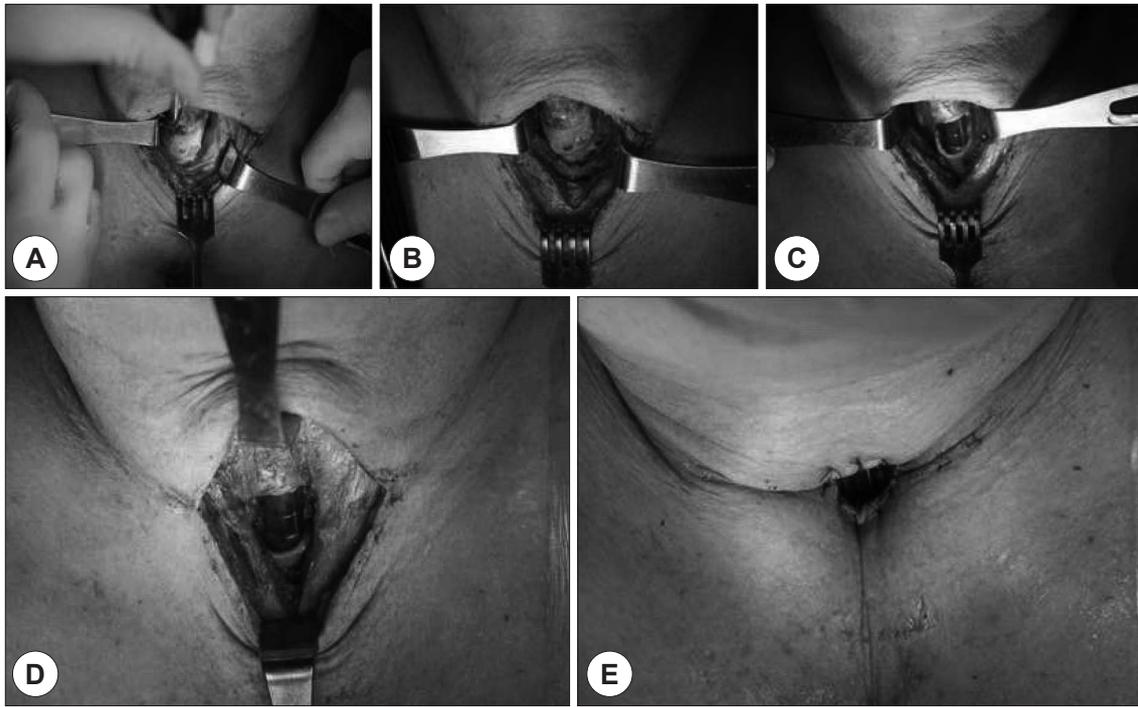


Fig. 4. During an emergency operation, the perforation of the trachea was found due to wide-range necrosis, which included tracheal rings III, IV, and V. Tracheal rings I and VI were also necrotized(A). The surrounding soft tissue also infected(B). The tracheal defect and the surrounding infectious necrotic tissue were removed in a rectangular bloc of 1 × 2 cm size(C). The lateral margin of trachea was sutured to the sternohyoid muscle while the upper and lower margins were sutured to the skin. Finally, we performed a penetrated tracheal stoma to induce spontaneous closing(D and E).

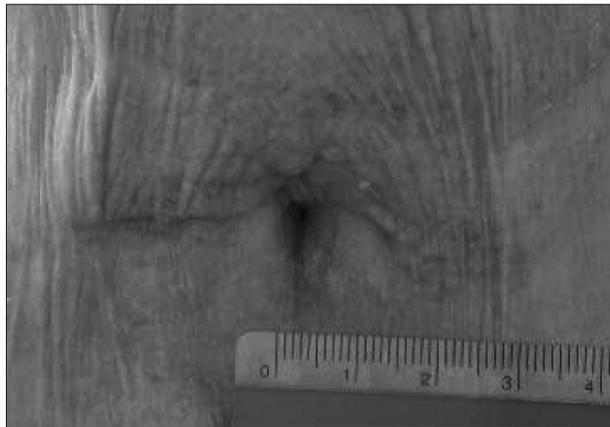


Fig. 5. Wound picture on discharge day.

However, in cases where less than half of the trachea is involved, conservative management, such as sternocleidomastoid periosteal flap or fenestration with staged closure is feasible. Primary closure is preferred to delayed closure when the injury site is clear without infection. An end-to-end anastomosis reconstruction needs further cervicomediastinal dissection, and requires a lengthy surgery. In this case, we considered patient factors including that less than half of the trachea was involved, the trachea injury was associated with severe necrosis, and she was an older woman who had recently underwent heart surgery before we decided on our course of action. Therefore, we decided that conservative surgery

was feasible, and the lateral margin of trachea was sutured to the sternohyoid muscle while the upper and lower margins were sutured to the skin(Fig. 4D and 4E). Finally, we performed a penetrated tracheal stoma to induce spontaneous closing.

Discussion

Tracheal injury as a complication after thyroid surgery is extremely uncommon. The rate of tracheal injury after thyroidectomy was 0–0.6%.³⁾ Gosnell et al. reported that only 0.06% of 11,917 patients in 45 years had tracheal injuries following thyroidectomies.¹⁾ In the case presented in the Gosnell paper, the damages were caused by a traction injury or surgical instruments found during the operation, not during the postoperative period as in our case. Tracheal perforation has two potential causes, one from acute rupture of trachea without necrosis and the other from necrosis, leading to necrotic perforation. Direct tracheal injuries during operations can lead to weakened areas, which could be ruptured with increased pressure when the patient coughs. Other causes of perforation include ischemia and necrosis. Similar cases were found and eight published papers were examined thoroughly(Table 1). The patients' ages ranged from 17 to 65, and patients' characteristics, such as gender and underlying disease, varied. The site of perforation and level of damaged tracheal ring were all

Table 1. Tracheal necrosis case review

Age/ Sex	Past history	Re-operation date(post- operative date)	Defect site	Treatment	Reference
30/F	Hyperthyroidism	POD #8	Right side 2 nd -4 th ring necrosis(+)	11 Montgomery T-tube (3 months)	<i>Alexander Golger et al. Can J surg, Vol. 45, No. 6, December 2002⁸⁾</i>
17/F	Grave's disease	POD #9 (sneeze)	Anterior 2 nd -4 th ring 2.5cm linear necrosis	Primary absorbable suture	<i>HagigMazeh et al. Endocrine practice Vol. 18 No. 4 July/August 2012¹⁰⁾</i>
53/F	Grave's disease	POD #8	Posterolateral 1 st -3 rd ring 1 st : necrosis 3 rd : perforation	Circumferential excision and anastomosis	<i>Sebastien Jacqmin et al. Journal of Anesthesia 2005⁹⁾</i>
45/M	Non-invasive thyroid cancer	POD #4 (cough)	Rt. antero-lateral 4 th ring 6mm longitudinal elliptic laceration local infection(+)	Not primary suture Thyroid muscle flap	<i>Luca Bertolaccini et al. European Association for cardio-thoracic surgery 2012⁴⁾</i>
56/F	Thyroid vesicular adenocarcinoma, Obesity(BMI : 43) HTN Ovary ca. s/p ovariectomy CTx. postop ARDS, Lt. recurrent laryngeal nerve paralysis(cough, fever)	POD #6	anterior side 2 nd -5 th ring : necrosis(+) 3 rd -4 th ring : perforation(+)	Large defect Muscle flap reconstruction montgomery t-tube (3 month)	<i>Gregory Philippe et al. Critical care research and practice 2012¹¹⁾</i>
20/F	Grave's disease	POD #7	Lt. anterior 1 st tracheal ring 1×2 mm	Primary suture by 3-0 vicryl	<i>Edward J.Damorose and John F.Damorose AurisNasus Larynx 2009⁷⁾</i>
65/M	Medullary carcinoma (T4aN1bM1), liver metastasis	POD #7	2 nd tracheal ring 5 mm hole necrosis(+)	Penetrated stoma	<i>A Chauhan et al. Journal of postgraduate medicine, 2009⁵⁾</i>
65/M	Adenoma	POD #15	Rt. Anterolateral above carina 4.5 cm 1.5×1.5 mm	Conservative care	<i>Conzo G et al. AnnaliItaliani di Chirurgia 2012⁶⁾</i>

different from each others. The numbers of cases classified with damaged areas were as follows : four anterior, three anterolateral, and one posterolateral. The risk factors of tracheal complication are : persistent uncontrolled cough, female gender,¹⁾ thyrotoxic goiter, direct intubation injury, prolonged intubation with high cuff pressure,²⁾ inadequate tube size, traumatic maneuvers during tube insertion or mobilization of a tracheal tube prior to insufficient tube cuff deflation, diathermy, excessive cauterization, disruption of blood supply, hematoma, and infection. Such causes could be classified into three types : patient characteristics, intra-operative problems, and intubation-related problems. On one hand, tracheal perforations caused by intubation usually occur on the posterior wall of the trachea. On the other hand, tracheal necrosis fol-

lowing thyroidectomy has been recorded mostly on the anterior wall of the trachea. Excessive cauterization is the most important cause of tracheal perforation.^{8,12)} In our case, the patient's trachea was almost not cauterized. Her postoperative course may have been influenced by several factors. First, she had a longer period of intubation as she underwent a combined thyroidectomy and open-heart surgery, requiring intensive care. Second, the blood supply of trachea could have been blocked when the cancer-involved right lateral border of the trachea was dissected because the tracheal blood supply runs to the lateral side of the inferior thyroid artery,¹⁷⁾ forming an anastomosis at the lateral border of trachea. Third, the right thyroid had a larger lesion, which could have recruited more blood supply than the left side. Thus, the remaining blood sup-

ply from the left trachea may not have been sufficient to cover the blood requirement, causing ischemic necrosis.

The treatments of tracheal injury depend on the individual conditions of the patient, such as the degree of inflammation and the extent of damage. First, a small defect and minimal inflammation perforation of the trachea can simply be primarily sutured as part of intra-operative perforation management.^{7,10} Additional vacuumed dressing may be applied with minimal inflammation. Second, in cases involving more than half the circumferential, tracheal resection and primary reconstruction may be warranted.⁹ The tracheal length that can be reconstructed must be sufficiently secured. Careful mobilization of the entire trachea in eight cadavers allowed for anastomosis with one pound of tension, after a 4–6 cm resection, with an additional 2.5 to 5 cm obtained by division of the left main bronchus.¹³ Full mobilization of the trachea must be performed carefully because the tracheal supply vessels run along the anterior and the lateral tracheal walls,¹⁴ and the patient's age and prior cervical radiation history may restrict tracheal resection without undue tension due to a loss of resiliency. Third, if the defect cannot be closed primarily due to severe inflammation in spite of small size, a penetrated stoma or temporary tracheostomy can be created, leading to spontaneous healing. As with our patient, in some cases, these methods worked to successfully resolve the tracheal issue.^{8,12} Fourth, localized severe inflammation or tracheomalacia, in which a lengthy non-circumferential defect is repaired by use of a reinforced around muscle flap such as the pectoralis muscle and strap muscles can be performed.^{4,15} Also, a combination with a temporary endotracheal silicone stent insertion may be performed to protect the tracheal stenosis.¹¹ Fifth, it may be resolved using conservative care without surgery.⁶ If the defect is minimal, will not proceed further, and is localized near a surrounding structure, it is possible to see spontaneous healing. If the patient's vital signs and physical condition are stable, then it is possible to treat the patient with only the appropriate antibiotics.¹⁶

In our case, the patient was performed a penetrated stoma. Although our patient had high risk of mediastinitis and mortality because of cervical wound infection near to combined cardiac operation site. However, she recovered without additional critical problems, and the stoma closed spontaneously without additional operations (Fig. 5). When the patient visited our outpatient clinic 90 days after her initial surgery, she had fully recovered without further complications.

In conclusion, thyroidectomy is usually performed without morbidity, but tracheal necrosis is a critical complication. Even if there had been no specific intraoperative event, tracheal

necrosis must be considered as a possible complication in patients with multiple risk factors. If early detection and rapid response were possible, a good outcome could be expected.

References

- 1) Gosnell JE, Campbell P, Sidhu S, Sywak M, Reeve TS, Delbridge LW. *Inadvertent tracheal perforation during thyroidectomy. Br J Surg.* 2006;93(1):55-56.
- 2) Abbey NC, Green DE, Cicale MJ. *Massive tracheal necrosis complicating endotracheal intubation. Chest.* 1989;95(2):459-460.
- 3) Anegg U, Lindenmann J, Matzi V, Smolle J, Maier A, Smolle-Juttner F. *Efficiency of fleece-bound sealing (TachoSil) of air leaks in lung surgery: a prospective randomised trial. Eur J Cardiothorac Surg.* 2007;31(2):198-202.
- 4) Bertolaccini L, Lauro C, Priotto R, Terzi A. *It sometimes happens: late tracheal rupture after total thyroidectomy. Interact Cardiovasc Thorac Surg.* 2012;14(4):500-501.
- 5) Chauhan A, Ganguly M, Saidha N, Gulia P. *Tracheal necrosis with surgical emphysema following thyroidectomy. J Postgrad Med.* 2009;55(3):193-195.
- 6) Conzo G, Fiorelli A, Palazzo A, Stanzone F, Della Pietra C, Santini M. *An unpredicted case of tracheal necrosis following thyroidectomy. Ann Ital Chir.* 2012;83(1):55-58.
- 7) Damrose EJ, Damrose JF. *Delayed tracheal rupture following thyroidectomy. Auris Nasus Larynx.* 2009;36(1):113-115.
- 8) Golger A, Rice LL, Jackson BS, Young JE. *Tracheal necrosis after thyroidectomy. Can J Surg.* 2002;45(6):463-464.
- 9) Jacqmin S, Lentschener C, Demirev M, Gueroult S, Herman P, Ozier Y. *Postoperative necrosis of the anterior part of the cervical trachea following thyroidectomy. J Anesth.* 2005;19(4):347-348.
- 10) Mazeh H, Suwanabol PA, Schneider DF, Sippel RS. *Late manifestation of tracheal rupture after thyroidectomy: case report and literature review. Endocr Pract.* 2012;18(4):e73-e76.
- 11) Sandu K, Monnier Y, Hurni M, Bernath MA, Monnier P, Wang Y, et al. *Repair of tracheomalacia with inflammatory defect and mediastinitis. Ann Thorac Surg.* 2011;91(1):e14-e16.
- 12) To EW, Tsang WM, Williams MD, Lai EC, Chan M. *Tracheal necrosis and surgical emphysema: a rare complication of thyroidectomy. Ear Nose Throat J.* 2002;81(10):738-741.
- 13) Michelson E, Solomon R, Maun L, Ramirez J. *Experiments in tracheal reconstruction. J Thorac Cardiovasc Surg.* 1961;41:748-759.
- 14) Salassa JR, Pearson BW, Payne WS. *Gross and microscopical blood supply of the trachea. Ann Thorac Surg.* 1977;24(2):100-107.
- 15) Philippe G, Pichon N, Lerat J, Amiel JB, Clavel M, Mathonnet M. *Successful treatment of anterior tracheal necrosis after total thyroidectomy using vacuum-assisted closure therapy. Crit Care Res Pract.* 2012;2012:252719.
- 16) Koletsis E, Prokakis C, Baltayiannis N, Apostolakis E, Chatzimi-

chalis A, Dougenis D. *Surgical decision making in tracheobronchial injuries on the basis of clinical evidences and the injury's anatomical setting: a retrospective analysis. Injury. 2012;43(9):*

1437-1441.

17) Grillo HC. *Surgery of the Trachea. Arch Surg. 1977;112(12):1508-1509.*