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Surgery for Tracheal Stenoses

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ABSTRACT : On the basis of an analysis in the outcome of tracheal surgery, it proved useful for the relief of respiratory distress. As a result, we are confident that surgical management should be mandatory for tracheal stenoses, provided that the patient's general condition is satisfactory with preoperatively meticulous cares. The incidence of occurring the risks of postoperative complications was relatively high in patients with malignant lesion. It seemed preferable to select a wide resection as far from the visible margin of the tumor as possible, in particular, in case of adenoid cystic carcinoma.

INTRODUCTION

Pathologies of the tracheal stenoses are limited in rare occasion. Stenoses of the trachea are mainly based on extrinsic compression, primary or secondary tumors on the tracheal wall and inflammatory or traumatic episodes resulting in scarring which makes the trachea narrow in the lumen.

It is well accepted that when mean diameter of the trachea is reduced to less than half, dyspnea will be expected. The minimum diameter of 4mm is thought to be necessary to preserve life. Fifty percent of primary tumors of the trachea are squamous cell carcinomas, whereas 35% are adenoid cystic carcinoma which are often invasive to a greater or lesser extent.

In many occasions, patients with tracheal stenosis hitherto had undergone emergency operation due to the danger of imminent asphyxia. However, laser surgery is now available for preoperatively reducing tracheal stenosis. Patients with tracheal stenosis, therefore, benefit by laser surgery to avoid the need for an emergency operation.

The experimental and clinical studies performed by Grillo and colleagues made a fundamental contribution to the development of modern surgery of the trachea^{1) 4)}.

In this study, clinical experiences with surgery for tracheal stenosis were reviewed to clarify an indication of surgical treatment on the basis of surgical outcome for tracheal stenosis.

PATIENTS

During the period 1981 to 1991, 30 patients with tracheal stenosis were surgically treated in the First Department of Surgery, Nagasaki University School of Medicine.

The causes of tracheal stenoses in patients who underwent surgery listed in **Table 1**. Stenoses by malignancy included 19 patients (63.3%). Of them, primary tumors were in seven, secondary lesions invaded from thyroid and esophageal cancers consisted in 11 patients. Next, inflammatory lesions were seen in seven patients. The stenoses affected by scarring following trauma were observed in three patients. Other causes were congenital web stenosis and radiation injury in one, respectively. The

Table 1. Tracheoplasty : Causes of tracheal stenosis

Causes	No. of patients	Ages (mean)
Thyroid cancer	9	48-77 (64)
Primary tracheal tumor	7	23-74 (47)
Post-tracheostomy	4	22-74 (55)
Trauma	3	19-44 (30)
Esophageal cancer	3	53-66 (58)
Inflammation	3	27-64 (46)
Congenital malformation	1	60
Radiation	1	43
Total	30	19-77

Table 2. Combined procedures used

Combined Procedures	No. of Patients
Thyroidectomy	9 (Total Subtotal 7, Hemi 2)
Laryngectomy	6
Esophagectomy	6 (Reconstruction 5)
Lobectomy/Pneumonectomy	2
Others**	3

** : submandibular gland 1, neck vessels 1, thoracic vertebra 1

Table 3. Resected tracheal lengths and postoperative complications

	resected length (number of rings)			incidence of complication
	2~4 (N=8)	5~9 (N=7)	10~13 (N=3)	
thyroid cancer	recurrent nerve paralysis 1	anastomosis insufficiency 1 pneumonia 1	stenosis 1	4/7 57.1%
primary tracheal tumor		stenosis 2	anastomosis insufficiency 1	4/5 80.0%
esophageal cancer		anastomosis insufficiency 1	pneumonia 1	0/1 0
posttracheostomy	stenosis 2			2/3 66.7%
congenital				0/1 0
postirradiation	branchiocephalic vein fistula 1			1/1 100%
incidence of postop. complication	4/8 (50.0%)	5/7 (71.4%)	3/3 (100%)	

Table 4. Resection of tracheal bifurcation and plasty cases

	resected tracheal length			
	1	2	3	4
resected length of contralateral bronchus	1 ○○○ ○	2 ○ ○○ ○	3 ○	4 ○

majority of patients were based on the stenosis affected by intraluminal growth of carcinoma and extrinsic compression. Carcinomas arising from the thyroid gland are common to clinically cause tracheal stenosis in this series.

The ages of patients ranged from 19 to 77.

The operative procedures commonly used were circumferential resection for affected segment of the trachea and end to end anastomo-

sis. However, feasibility of end to end anastomosis is limited to a resection within 10 rings of the trachea (4 to 5cm long).

Combined procedures were thyroidectomy in nine, laryngectomy in six, esophagectomy in six, pulmonary lobectomy and/or pneumonectomy in two including the resection of submandibular gland, neck vessels and thoracic vertebra in one, respectively as indicated in **Table 2**.

The operative procedures of thyroidectomy and laryngectomy were commonly used in reflection of tracheal stenosis by thyroid cancer.

The fact that six patients undergo esophagectomy explains the membranous portion of the trachea is susceptible to cancer invasion from the esophagus because of void of the serosa in the esophagus.

Postoperative complications were encountered

in 21 patients. Six (28.6%) out of those in whom complications occurred were directly related to the operative death. Most were catastrophic accidents including anastomotic dehiscence in two.

In addition, postoperative complications were closely associated with resected length of the trachea as shown in **Table 3**.

The more the trachea is extensively resected, the more postoperative complications are frequently seen. According to primary lesions, the lesion originated by tracheal tumors showed the highest incidence of postoperative complications. It seems reasonable to be due to extensive resection. The maximum length of the trachea resected was 13 rings of the trachea in this series.

On the other hand, **Table 4** showed the relationship in a resection of tracheal carina between the tracheal and bronchial length. It was feasible to resect two rings of the trachea with three rings of the bronchus and/or four rings of the trachea with two rings of the bronchus, respectively.

Difficulty in performance of tracheal reconstruction is how to manage to intraoperatively respiratory support and how to prevent postoperative stenosis at anastomosis.

Development of high frequency ventilation made surgery for the trachea far advanced and safety. In addition, development of absorbable suture material also help prevent postoperative complications by granulation tissues at anastomosis.

The wide spread application of bronchial sleeve resection has made surgeons more familiar with anastomosis of the trachea including carinal resection.

Needless to say, postoperative complications were more frequently encountered in case of tracheal surgery rather than bronchial one. When postoperative complications occurred in tracheal surgery, these were grave and fatal as compared with bronchial surgery.

Rapid and proper management for complication is required for salvage of postoperative complication.

Indication for surgical resection must be correct. Preoperatively endoscopic assessment of the lesion should be accurate, evaluating

mucosal ulcer, hemorrhagic spot and direct vision of cancer infiltration on the surface of the mucosa.

The length of the lesion is limited to 10 to 12 rings of the trachea and 4 to 5 rings including the tracheal bifurcation. It is well known that the lesion of adenoid cystic carcinoma extensively extends beneath the mucosa in spite of healthy appearance of the mucosa^{5) 6)}.

Intraoperatively histologic examination is needed for precise determination of the resected margin and suture must be performed on healthy tissues, excluding stenotic and diseased tissues.

On the basis of a result of this study, surgeons should be paid an attention to frequent complications for malignant diseases. It is generally accepted that oncological radicality is ensured by extensive resection. However, ensurement of oncologic radicality increases the incidence of postoperative complications. Application of complementary radiotherapy should be taken into consideration for a valid palliation. It should only prove necessary to determine the extent of the resection in which it is possible to directly suture by the addition of tracheal mobilization as far as possible. Needless to say, clinical use of artificial trachea is not available so far without exception⁷⁾. When tension is added to anastomotic sites, surgical technique must be extremely precise. Omental wrapping is recommended for promotion of wound healing at anastomosis and for early development of neovascularity.

Recently, the surgical outcome of the trachea has been improved with an aid of meticulous cares such as the application of laser surgery and the insertion of stent tube.

In conclusion, it is worth stressing that successful treatment at initial stage yields satisfactory outcome of surgery.

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