Circumferential cricotracheal resection with end to end anastomosis versus cricoid collar technique for the management of severe laryngotracheal stenosis: A comparative study

Thesis

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Abstract

This is a prospective study which compares the efficacy of cricotracheal resection (CTR) with end-to-end anastomosis and cricoid collar technique in severe laryngotracheal stenosis. 23 patients were selected and arranged into 2 groups from 2007 to 2010. All patients were Cotton's grade 3 or 4 and McCaffrey stage III. Group I (17 patients) underwent CTR while group II (6 patients) were operated with the collar technique. All patients underwent laryngeal release procedures. 15 patients (88.2%) were successfully decannulated in group I whereas only one patient (16.7%) was decannulated in group II. Postoperative cord paralysis was noted in 3 patients of group I and in one patient of group II. CTR is the procedure of choice for severe laryngotracheal stenosis rather than cricoid collar owing to its high decannulation rate and fewer complications.

Key words: laryngotracheal stenosis – resection anastomosis – collar technique

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Abbreviation

SGS	subglottic stenosis
PGS	posterior glottis stenosis
IPSS	Idiopathic progressive subglottic stenosis
ILS	idiopathic laryngeal stenosis
PDT	percutaneous dilatational tracheotomy
ACF	arytenoids cartilage fixation
RLNP	recurrent laryngeal nerve paralysis
LTP	Laryngotracheoplasty
LTR	Laryngotracheal reconstruction
PDS	polydioxanone suture
Nd-YAG	neodymium:yttrium-aluminum-garnet
LTF	larynotracheal fistula
CTR	partial cricotracheal resection
GERD	Gastroesophageal reflux disease

Introduction

The laryngotracheal stenosis is a major sequel that affects the cricoid cartilage and the trachea due to many causes, the most frequently encountered is the prolonged intubation. The stenosis of this narrow area of the airway manifests rapidly as stridor that affects the patient's quality of life.

There are many classifications designed to determine the degree and the extent of the stenosis. They also consider the associated medical illness of patients and the outcome of surgery for breathing and voice production.

Surgery to this particular problem remains challenging which attract the attention of many ENT and cardiothoracic surgeons.

Some surgeons advocate the open reconstructive procedures as the treatment of choice to preserve the airway. While others suggest that the closed endoscopic approaches are still successful with minimal surgery especially since the introduction of laser in endoscopic laryngeal surgery. However both procedures could not achieve the high success rate among all patients especially the group of advanced larygotracheal stenosis.

Cricotracheal resection is a challenging procedure that completely eradicates the problem of stenosis with least morbidity. There is an ongoing high success rate of it in different age groups of patients. Surgeons become more familiar with this technique which gradually substitutes other reconstructive procedures.

Cricoid collar is a recent technique that combines the benefits of reconstruction with protection of the recurrent laryngeal nerve and the complete resection of stenosis.

The aim of this study is to evaluate and compare the success rate of decannulation and postoperative complications of the patient between cricotracheal resection and cricoid collar technique.

Chapter I

BASIC CONSIDERATION

The larynx is commonly referred to as the “voice box”. The larynx is responsible for three basic functions; protection of the trachea and the lungs from food and fluids as well as permitting the passage of air into the respiratory system and vital structure in the production of sound. Nine various cartilages create the structure of the larynx. Three of them are large and unpaired while the remaining are small and paired. The anterior thyroid cartilage is the largest of the framework. The “Adam’s apple” is a prominent point of this structure, created by the vertical anterior ridges of the laryngeal cartilage. This particular cartilage is affected by the hormones of the male and tends to become more prominent in males than in females ***(Sasaki and Isaacson, 1988)***.

The larynx begins to develop around the fourth week of development. It begins as an outgrowth from the ventral portion of the primitive pharynx called the laryngotracheal groove, also known as the foregut. The laryngotracheal groove also helps to form the primitive opening of the larynx, or aditus. The aditus is composed of 3 structures; the hypobranchial eminence which is the most cephalic part and develops into the epiglottis and the lateral 2 eminences that develop into the arytenoid cartilages ***(O'Rahilly and Boyden, 1973).***

Epithelialization causes the laryngeal lumen to obliterate; the lumen recanalizes later by the 10th week of gestation and forms the laryngeal ventricles and both true and false vocal cords. Failure of complete recanalization results in laryngeal web or subglottic stenosis. The diameter of subglottic region in full-term newborn is more than 4 mm ***(Verwoerd-Verfoef et al., 1997)***.

It is suggested that the lateral growth centers may be of significance only during embryonic development. There have been recent studies in the rabbit model demonstrating that a transection of the lateral cricoid cartilage does not impair growth of the cricoid cartilage in a multidirectional manner ***(Ward and Triglia, 2000).***

The cricoid cartilage is the only complete cartilaginous ring present in air passages. It is composed of a deep broad quadrilateral lamina posteriorly, and a narrow arch anteriorly. Near the junction of the arch and lamina an articular facet is present for inferior cornu of thyroid cartilage. The lamina has slopping shoulders which carry articular facets for the arytenoids. These joints are synovial with capsular ligaments. Rotation of the cricoid cartilage on thyroid cartilage can take place about an axis passing transversely through joints. A vertical ridge in the midline of the posterior lamina gives attachment to the longitudinal muscles of the oesophagus and produces a shallow concavity on each side for the origin of posterior cricoarytenoid muscle ***(Stell et al., 1980).***

The entire surface of cricoid is covered with mucous membrane. The lower part of laryngeal cavity is called the subglottis and extends from lower border of the vocal folds to lower border of the cricoid cartilage. Its upper part is elliptical in form, but its lower part widens and become circular in shape and continuous with the trachea ***(Eckel et al, 1999)***.

The trachea is a cartilaginous and membranous tube about 10-11 cm in length. There are 16-20 incomplete cartilaginous rings. Cross section is D-shaped. The rings are deficient posteriorly and completed by a fibrous membrane. It extends from the lower border of the cricoid cartilage at level of the sixth cervical vertebra to the bifurcation at the

upper border of the fifth thoracic vertebra or second costal cartilage or manubriosternal angle. Bifurcation moves upwards during swallowing and downwards and forwards during inspiration to the level of sixth thoracic vertebra. The trachea lies in the midline although the bifurcation is slightly to the right. The diameter increases during inspiration and decreases during expiration. In children the trachea is smaller deeply placed and more mobile than in adults. The bifurcation is higher in children than adults until the age of 10-12 years ***(Vanpeperstraete, 1973)***.

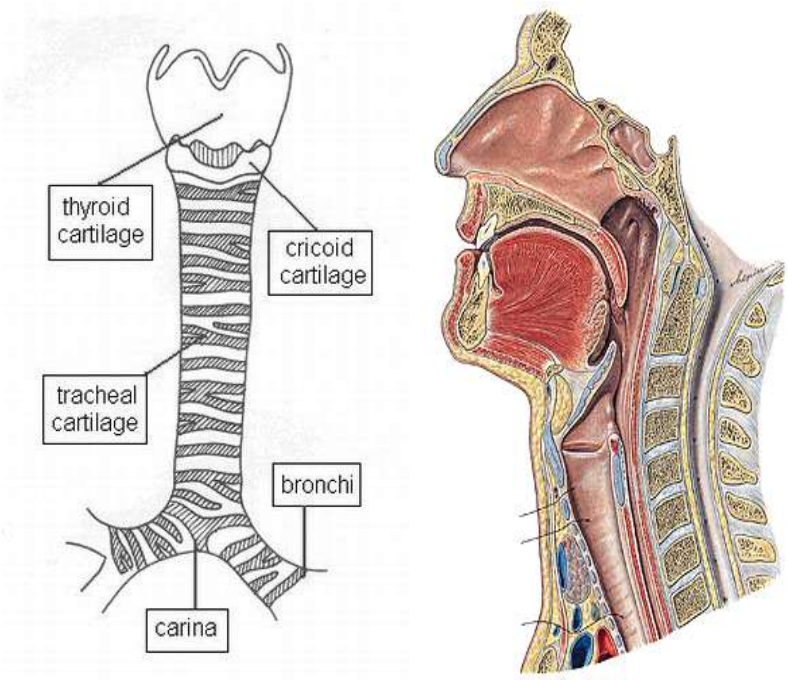

Fig 1: Anatomy of the larynx and trachea

The fibrous membrane covering the trachea is the continuation of perichondrium surrounding the cartilage. These fibers cross each other diagonally allowing changes in the diameter of the airway. A non-striated muscle is present within the fibrous membrane, mostly transverse called "trachealis" which allows alteration of cross-sectional area of the trachea and bronchi ***(Neil Weir, 1997)***.

Minnich and Mathisen (2007) demonstrated relation of the trachea to the surrounding where the central part of the trachea is covered

anteriorly by skin, superficial and deep fascia, sternohyoid and sternothyroid muscles. The isthmus of the thyroid gland usually covers the second to the fourth rings. In the lower part of neck, it is crossed by a communicating band between anterior jugular veins, as well as inferior thyroid veins and thyroid ima artery – if present – which ascends from arch of aorta or brachiocephalic artery.The right and left lobes of thyroid gland which descend to level of fifth or sixth tracheal cartilages lie on either side of the trachea, as does the carotid sheath enclosing the common carotid artery, internal jugular vein, and vagus nerve. The inferior thyroid artery lays anterolaterally.

The oesophagus lies behind trachea with recurrent laryngeal nerve lying in a groove between them. The recurrent laryngeal nerve on the right side leaves the vagus nerve as it crosses right subclavian artery. It then loops under the artery and ascends to the larynx in a groove between the oesophagus and trachea. On the left side, nerve originates from the vagus as it crosses the arch of aorta. It then passes under the arch and ligamentum arteriosum to reach groove between oesophagus and trachea. In the neck, both nerves follow the same course and pass upwards accompanied by the laryngeal branch of inferior thyroid artery, deep to the lower border of inferior constrictor. It enters the larynx behind the cricothyroid joint. The nerve then divides into motor and sensory branches. The motor branch has fibers derived from cranial accessory nerve with cell bodies in the nucleus ambigus; these supply all intrinsic muscles of larynx except the cricothyroid muscle. The sensory branch supplies mucous membrane below the vocal folds and also carries afferent fibers from stretch receptors in the larynx. As it ascends in the neck, it gives branches – which are numerous on right than left – to mucous membrane and muscular coat of oesophagus ***(Neil Weir, 1997)***.