

Perioperative Anesthetic Considerations for Surgical and Non Surgical Management of Tracheal Stenosis

Essay

*Submitted for Partial Fulfillment of the Master Degree in
Anesthesiology*

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2015**

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

وَقُلْ اَعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ
وَرَسُولُهُ وَالْمُؤْمِنُونَ

صدق الله العظيم

سورة التوبة آية (105)

Acknowledgements

First, thanks are all due to Allah for Blessing this work until it has reached its end, as a part of his generous help throughout our life.

My profound thanks and deep appreciation to Dr. Ayman Mokhtar Kamaly, Professor of Anesthesiology, Intensive Care and Algology, Faculty of Medicine, Ain Shams University for his great support and advice, his valuable remarks that gave me the confidence and encouragement to fulfill this work.

I am deeply grateful to Dr. Ayman Ahmed Abdellatif, Assistant Professor of Anesthesiology, Intensive Care & Algology, Faculty of Medicine, Ain Shams University for adding a lot to this work by his experience and for his keen supervision.

I am also thankful to Dr. Hany Victor Zaki, Lecturer of Anesthesiology, Intensive Care and Algology, Faculty of Medicine, Ain Shams University for his valuable supervision, co-operation and direction that extended throughout this work.



Wessam El-Said Mohamed Metwally

List of Contents

	Page
List of Abbreviations	i
List of Figures	iii
List of Tables	v
Introduction	1
Aim of the Work	3
Chapter 1: Anatomy and Physiology of the Trachea:	
A) Embryology of the trachea	4
B) Anatomy of the trachea	5
I. Anatomy of the trachea	5
II. Relations of the trachea	9
III. Histology of the tracheobronchial tree	10
IV. Blood supply & lymphatic drainage	12
V. Nerve supply of the trachea	14
C) Physiology of the tracheobronchial tree	16
D) Physics of airflow	17
I. Types of airflow	17
II. Tracheobronchial airflow dynamics & resistance..	20
Chapter 2: Epidemiology & Pathophysiology of Tracheal Stenosis:	
A) Incidence of tracheal stenosis	22
B) Etiology of tracheal stenosis	22
I. Etiology of pediatric tracheal stenosis	23
II. Etiology of adult tracheal stenosis	29
C) Pathophysiology of tracheal stenosis	31
D) Classifications of tracheal stenosis	34
Chapter 3: Non Surgical Management of Tracheal Stenosis:	
A) Diagnosis of tracheal stenosis	39
I. Clinical picture	39
II. Physical examination	40

III. Investigations	40
B) Management of tracheal stenosis	49
I. Initial stabilization	49
II. Conservative management	49
III. Airway intervention	50
• Non surgical management of tracheal stenosis ..	
I. Patient selection for non surgical management of tracheal stenosis	51
II. Different approaches for non surgical management of tracheal stenosis	52
III. Anesthetic considerations for bronchoscopy	60
Chapter 4: Surgical Management of Tracheal Stenosis:	
A) Different approaches for surgical management of tracheal stenosis	67
B) Anesthetic considerations for tracheal resection & reconstruction	68
I. Patient selection and preoperative assessment...	68
II. Monitoring and equipment	70
III. Surgical approaches & patient positioning.....	71
IV. Premedication	71
V. Induction of anesthesia	72
VI. Intraoperative management & Ventilation Methods	73
VII. Emergence and extubation	82
Chapter 5: Postoperative Follow up & Complications:	
A) Postoperative considerations	85
I. Postoperative care	85
II. Postoperative airway management	86
III. Postoperative pain management	86
IV. Postoperative follow-up	87
B) Complications.....	87
C) Future of tracheal stenosis management.....	91
Summary in English	95
References	97
Summary in Arabic	

List of Abbreviations

2-D	: Two-dimensional
3-D	: Three-dimensional
ABG	: Arterial blood gas
APC	: Argon plasma coagulation
ASA	: American society of anesthesiologists
CAO	: Central airway obstruction
COPD	: Chronic obstructive pulmonary disease
CPAP	: Continuous positive airway pressure
CPB	: Cardiopulmonary bypass
CT	: Computed topography
dmnX	: Dorsal motor nucleus of vagus
EA	: Esophageal atresia
ECG	: Electrocardiography
ECO2	: End tidal carbon dioxide
EES	: Everolimus
ETT	: Endotracheal tube
EXIT	: Ex-utero Intrapartum Treatment
FEF	: Forced expiratory flow
FEV1	: Forced expiratory volume 1st second
FIF	: Forced inspiratory flow
Fio2	: Fraction of inspired oxygen
FVC	: Forced vital capacity
HFJV	: High frequency jet ventilation
HFOV	: High frequency oscillation ventilation
HFPPV	: High frequency positive pressure ventilation
HFV	: High frequency ventilation
ICU	: Intensive care unit
IPPV	: Intermittent positive pressure ventilation
LMAs	: Laryngeal mask airways

List of Abbreviations (Cont.)

LTS	: Laryngeotracheal stenosis
MRI	: Magnetic resonance imaging
mTOR	: Mammalian target of rapamycin
nA	: Nucleus ambiguus
Nd:YAG	: Neodymium-Yttrium-Aluminum-Garnet
NMB	: Neuromuscular blockade
NO	: Nitric oxide
nTS	: Nucleus tractus solitarius
O ₂	: Oxygen
PEEP	: Positive end expiratory pressure
PES	: Paclitaxel
RD	: Respiratory diverticulum
SES	: Sirolimus
TCI	: Target control infusion
TIVA	: Total intravenous anesthesia
V/Q	: Ventilation/perfusion
VB	: Virtual bronchoscopy
VIP	: Vasoactive intestinal peptide
VT	: Tidal volume
ZES	: Zotarolimus

List of Figures

Fig.	Title	Page
1	Successive stages in the development of the respiratory diverticulum from the primitive foregut.	4
2	The trachea and mainstem, lobar, and segmental bronchi.	8
3	Transverse section of the trachea.	11
4	Blood supply of the larynx and cervical trachea.	12
5	Schematic view of the tracheal microscopical blood supply.	13
6	Diagram of the airway generations in the human adult lung.	17
7	Flow types: The three basic types of flow are laminar, turbulent and transitional.	18
8	Diagram showing relationship between crosssectional area and generation of the airway.	21
9	Classification of congenital tracheal stenosis.	25
10	The anomalous left pulmonary artery (LPA) is seen arising from the right pulmonary artery (RPA) and coursing between the esophagus and the trachea.	29
11	Ulceration and necrosis of the tracheal wall.	32
12	Schematic representations of the basic types of stenosis.	37
13	Clinical examples of the degrees of stenosis.	38
14	A 14 year-old male patient with tracheal stenosis.	43
15	Improved detection of focal tracheal stenosis using 3-D external rendering of CT data.	43
16	Efer-Dumon rigid bronchoscope with external port for ventilation, free moving telescope with an attached c-mount for video and external side port for suction catheter and laser fiber.	45

List of Figures (Cont.)

Fig.	Title	Page
17	Flow-volume loops.	46
18	Effect of dynamic extrathoracic airway obstruction.	48
19	Effects of dynamic intrathoracic airway obstruction.	48
20	Algorithm for multidisciplinary approach for management of tracheal stenosis	50
21	Flexible bronchoscopic ballon dilatation	53
22	Different types of silicone air way stents	56
23	Bronchoscopic picture, immediately after stent insertion (Dumon silicone stent)	57
24	Juvenile papillomatosis of the glottic and subglottic region in a 16-year-old boy is seen before (left panel) and after (right panel) treatment with argon plasma coagulation	58
25	High frequency jet ventilation	64
26	Procedure for resection of high tracheal lesion	74
27	Procedure for resection of lower tracheal lesions	76
28	Procedure for resection of carinal lesions	76
29	The airway management of a lower tracheal resection	77
30	Sentinel stitch between the chin and sternon	83
31	Sentinel stitch can be avoided using this or thesis (orthopedic corset individually designed and custom made) for cervical flexion	83
32	(a): Plain X-ray showing a stent place (b) CT scan showing the stent in place	87
33	Stepwise approach for a bioengineered airway to replace a defective bronchus	94

List of Tables

Table	Title	Page
1	Dimensions of the growing trachea related to age. Tracheal length is from vocal cords to carina.	7
2	Classification of congenital tracheal stenosis according to clinical status and endoscopic findings.	26
3	Myer-Cotton grading system for laryngeotracheal stenosis.	35
4	Types of airway stenosis.	36
5	Numerical assignment of degree of airway stenosis.	37
6	Scoring system according to the location.	37
7	Complications of HFJV.	80

Introduction

Tracheal stenosis is a potentially life-threatening condition. Tracheostomy and endotracheal intubation remain the commonest causes of benign stenosis, despite improvements in design and management of tubes. Post-tracheostomy stenosis is more frequently encountered due to earlier performance of tracheostomy in the intensive care units, while the incidence of post-intubation stenosis has decreased with application of high-volume, low-pressure cuffs (*Tsakiridis et al., 2012*).

Tracheal stenosis can present very insidiously or as a catastrophic near death episode requiring cardiopulmonary resuscitation. In many cases the condition is precipitated by an acute respiratory infection. Worsening of dysnea following recumbency may also result, dysnea on exertion appears when 50% of the airway is stenosed, dysnea at rest occurs when 75% of the airway is stenosed. Typically, in adults, exertional dysnea occurs when the airway diameter is reduced to about 8mm, resting dysnea occurs at a diameter of 5mm, at which stridor also occurs (*Wong et al., 2010*).

Therapeutic options for tracheal stenosis include tracheal resection and reconstruction, laser reconstruction, electrocautery excision of the tissue, tracheal dilatation and stenting. Tracheal dilatation and stenting is a relatively new procedure for the treatment of tracheal stenosis. Currently, stents are only licensed for malignant conditions, because the incidence of stent erosion or malfunction is probably a function of time (*Juvekar et al., 2003*).

Anesthesia for tracheal resection is one of the most challenging aspects of anesthesia practice because of the unique conditions associated with narrowed airway diameter and the problem of maintaining ventilation during induction,



bronchoscopy, and the period of tracheal resection and reconstruction (*Lee et al., 2006*).

Tracheal stenosis is a demanding task for both patient and doctors, it is not without complications, which may be immediate like inflammatory edema at the site of anastomosis, respiratory distress by laryngeal paralysis, surgical and mediastinal emphysema, early like swallowing disorder and late complications like restenosis (*Abbasidezfouli et al., 2007*).



Aim of the Work

This study was conducted to study tracheal stenosis with all its causes and types, and to review and analyze anesthetic considerations for the different methods of management, as well as to review postoperative care.

Chapter (1)

Anatomy and Physiology of the Trachea

A) Embryology of the trachea:

The development of the trachea begins between the 3rd and 4th gestational weeks. The respiratory system forms as a ventral diverticulum, called respiratory diverticulum (RD), from the caudal part of the foregut. A tracheoesophageal septum develops at the site where the longitudinal tracheoesophageal folds fuse together. This septum divides the foregut into a ventral portion “the laryngotracheal tube” and a dorsal portion “the esophagus” (**Fig.1**). The laryngotracheal tube and surrounding splanchnic mesenchyme give origin to the larynx, the trachea, the bronchi, and the lungs. The proximal end of the laryngotracheal tube opens into the pharynx near the level of the last pharyngeal arch forming the glottis, the midportion will develop into the trachea whereas the distal end will bifurcate to form the lung buds (**Phipps et al., 2006**).

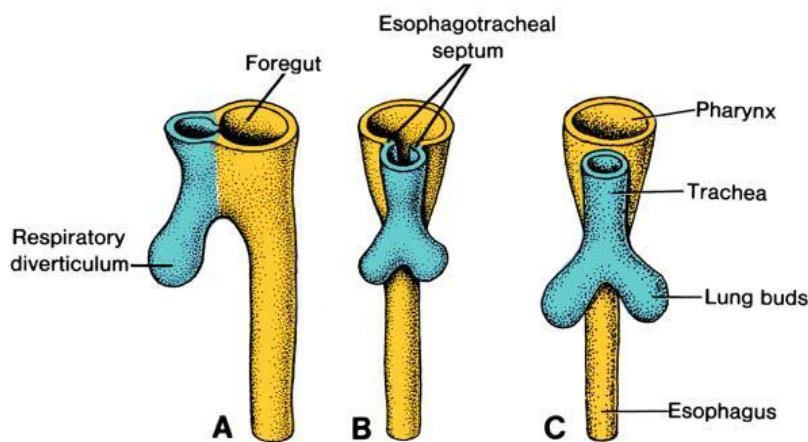


Figure (1) Successive stages in the development of the respiratory diverticulum from the primitive foregut. **A:** At the end of the 3rd week. **B and C:** During the 4th week (**Phipps et al., 2006**).

The endoderm of the pouch will develop into the tracheal epithelium whereas the surrounding splanchnic mesenchyme starts to form the cartilaginous rings between weeks 8 and 10. Cartilage growth occurs by remodeling and proceeds cranio caudally so that the trachea is initially funnel-shaped being wider at the laryngeal level (**Carlson, 1996**).

Different tracheal anomalies can be traced along specific timelines. Abnormalities in the 4th gestational week would affect the initial separation of the foregut and lung buds. This would result in severe anomalies associated with cardiac and skeletal malformations. Failure of formation of the laryngotracheal groove during the 6th gestational week will result in different degree of clefts and tracheo-esophageal fistulae. Disturbances during the 8th and 10th weeks will result in abnormalities in tracheal cartilage development resulting in various degrees of stenosis and complete rings but with fewer associated anomalies (**Phipps et al., 2006**).

B) Anatomy of the trachea:

I. Anatomy of the trachea

The Trachea is flexible yet rigid tube which has the difficult task moving, twisting and bending without any possibility of narrowing or occlusion. It travels through different tissues and external pressures and yet has to have a smooth humid lining with effective protective mechanisms. It is fixed at both extremities and has to comply with neck movement, chest pressures and posterior changes induced by esophageal motions or moving boluses. It has protective mechanisms in case its main protector, the larynx, fails (**Allen, 2003**).

The trachea starts in the neck at the cricotracheal ligament at the level of C6 or the intervertebral disc C6-C7 in adults. It ends in the chest. The carina is usually at the level of