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

Essay
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بسم الله الرحمن الرحيم

وقُلِ اعْمَلُوا فَسَيَرَى اللَّهُ عَمَلَكُمْ
ورَسُولُهُ والْمُؤْمِنُونَ

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Wessam El-Said Mohamed Metwally

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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	:	Cardiopumonary bypass
CT	:	Computed topography
dmnX	:	Dorsal motor nucleus of vagus
EA	:	Esophageal atresia
ECG	:	Electrocardiohraphy
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 inspied 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 ambigus
Nd:YAG	:	Neodymium-Yttrium-Aluminum-Garnet
NMB	:	Neuromuscular blockade
NO	:	Nitric oxide
nTS	:	Nucleus tractus solitarius
O2	:	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

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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).**

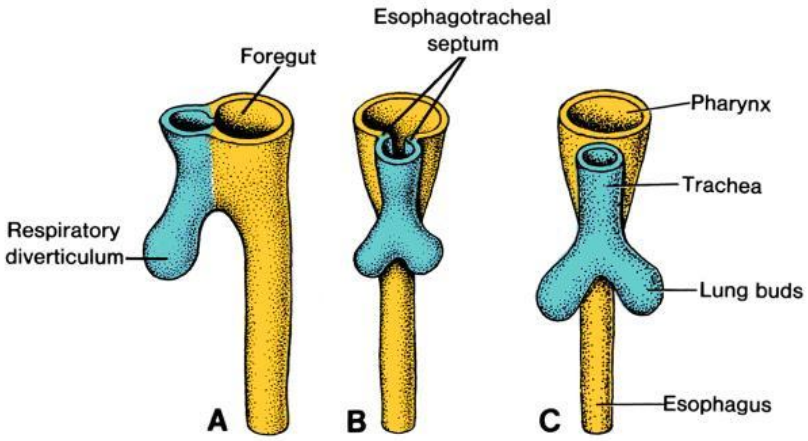

Figure (1) Successive stages in the development of the respiratory diverticulum from the primitive foregut. **A:** At the end of the 3rd week. **B and C:** During the 4th week **(Phipps *et al.*, 2006).**

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 4^{th} 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 laryngeotracheal groove during the 6^{th} gestational week will result in different degree of clefts and tracheo-esophageal fistulae. Disturbances during the 8^{th} and 10^{th} 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