

Philippe Monnier
Editor

Pediatric Airway Surgery

Management of
Laryngotracheal
Stenosis in Infants
and Children

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To all of the children who have endured the nightmare of living with a tracheostomy cannula and to the family members who have gone through frightening experiences while caring for them at home.

To my wife Dominique whose constant support and encouragement allowed me to complete this project and prosper in academic medicine.

To my teacher and mentor, the late Professor Marcel Savary, who taught me the art of precise observation, documentation, and synthesis

Preface

Paediatric Airway Surgery is the fruit of experience gained over many years to improve the surgical outcome for children suffering from a variety of compromised airways. It focuses on the technical aspects of diagnosis and treatment to provide the reader not only with well-established treatment modalities, but also with new concepts of paediatric airway management. Some ideas may not be shared by all, but should stimulate new thoughts in search of better solutions in the future.

This endeavour was induced by numerous foreign colleagues who visited the Lausanne ENT Department to study endoscopic and open surgical airway techniques, particularly cricotracheal resection and its variants.

This book is also intended to provide insights into controversial issues pertaining to the most difficult airway reconstructions. The author does not claim to present definite solutions to the challenging problem of the compromised paediatric airway. Nonetheless his modest goal, based on the experience of pioneers, is to add a stone to the pyramid of knowledge in this field of research. With inputs from different horizons, it is hoped that this will one day lead to the full rehabilitation of most tracheostomized children suffering from various forms of laryngotracheal stenosis.

Contributors to this book have all been directly implicated in the management of these children and they write from their vast experience.

The lead author wishes for this book to reflect the necessary commitment that a paediatric airway surgeon must possess to acquire the stepwise knowledge of subtle diagnostic and therapeutic skills for providing the best possible care for his or her young patients.

January 2010
Lausanne, Switzerland

Philippe Monnier

Acknowledgments

I am thankful to the many colleagues who encouraged me to undertake the project of writing this book on the management of paediatric airway problems. My interest in this field matured with the pioneering work of my mentor, the late Professor Marcel Savary, who performed the first paediatric partial cricotracheal resection in 1978. I am deeply grateful to him for his open mind and his thoughtful and innovative work in endoscopy and head and neck surgery. Thanks to him, I had the opportunity to meet and exchange ideas with F. Griffith Pearson of Toronto, who has been very supportive of the Lausanne group over the years. It is a pleasure and honor to know such a keen and thoughtful thoracic surgeon, and I am greatly indebted to him for his valuable guidance.

This book reflects the commitment of a group of colleagues who deal with paediatric airway problems as a team. Madeleine Chollet-Rivier deserves special recognition for being such a knowledgeable and skilled anaesthetist. She makes the management of difficult and compromised airways in infants and children both safe and easy. Marc-André Bernath takes over the skillful part of anaesthesia for most airway reconstructions, and Jacques Cotting and Marie-Hélène Perez the postoperative care in the paediatric Intensive Care Unit. They all deserve recognition for their efficient and professional work. Mercy George from Vellore, India, played a special role as an independent reviewer of the surgical results of paediatric partial cricotracheal resections performed in Lausanne, focusing on different aspects of the problem. She also made thoughtful remarks about the manuscript that she read as a first editor, and deserves special acknowledgement.

Finally, this project would never have been possible without the commitment of Kapka Batchvaroff, my secretary, who, with dedication and patience, and commitment performed the difficult tasks of word and reference processing. She must be congratulated for her hard work.

No text dedicated to endoscopic and surgical techniques is self-explanatory without high-quality illustrations. Marion Brun-Baud and Anthony Guinchard have lent their master command of computer programs and their understanding of anatomical details to meticulously create the beautiful medical art work throughout the book. I am grateful for their contribution.

Last but not least, I must express special thanks to my colleagues who ran the ENT department while I was working on *Paediatric Airway Surgery*.

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Abbreviations

ACCG	Anterior costal cartilage graft
ACS	Anterior cricoid split
AE	Aryepiglottic (folds)
ARDS	Acute respiratory distress syndrome
ArF	Argon fluoride (laser)
ARS	Airway reconstruction surgery
ASA	American Society of Anesthesiology
A-SGS	Acquired subglottic stenosis
BAL	Broncho-alveolar lavage
BiPAP	Bi-level positive airway pressure
BVCP	Bilateral vocal cord paralysis
CA	Cricoarytenoid
CAA	Cricoarytenoid ankylosis
CCG	Costal cartilage graft
CNS	Central nervous system
CO ₂	Carbon dioxide
CPAP	Continuous positive airway pressure
CS	Corticosteroids
C-SGS	Congenital subglottic stenosis
CT	Computerised tomography
CTR	Cricotracheal resection
CTS	Cricotracheal stenosis
CW	Continuous working (laser)
D	Digital
DNA	Desoxyribonucleic acid
DS	Double-stage
DS-LTR	Double-stage laryngotracheal reconstruction
DS-PCTR	Double-stage partial cricotracheal resection
I-3C	Indol-3 carbinol
ECMO	Extracorporeal membrane oxygenation
ENT	Ear-nose-throat
EO	Eosinophilic oesophagitis
EPP	Epiglottic petiole prolapse
ET	Endotracheal
ET-CO ₂	End-tidal carbon dioxide
ETT	Endotracheal tube
EXIT	Ex-utero intrapartum treatment

Extended PCTR	Partial cricotracheal resection combined with an additional open airway procedure
FEES	Functional endoscopic evaluation of swallowing
GOR	Gastro-oesophageal reflux
GORD	Gastro-oesophageal reflux disease
He-Ne	Helium neon (laser)
HPV	Human papilloma virus
Hz	Hertz
ICU	Intensive care unit
ILCSI	Intra-lesional corticosteroid injection
JORRP	Juvenile-onset recurrent respiratory papillomatosis
KTP	Potassium-titanyl phosphate (laser)
LASER	Light amplification by stimulated emission of radiations
LC	Laryngeal cleft
LM	Laryngomalacia
LSCTS	Long-segment congenital tracheal stenosis
LT	Laryngotracheal
LTOC	Laryngotracheo-oesophageal cleft
LTP	Laryngotracheoplasty
LTR	Laryngotracheal reconstruction
LTS	Laryngotracheal stenosis
MMC	Mitomycin C
MRI	Magnetic resonance imaging
MRSA	Methicillin-resistant staphylococcus aureus
Nd-YAG	Neodymium: yttrium-aluminum-garnet (laser)
NIBP	Non-invasive blood pressure
NIV	Non-invasive ventilation
NPO	Nil per oral
OA	Oesophageal atresia
OH	Obstructive hypopnea
OSA	Obstructive sleep apnoea
OSAS	Obstructive sleep apnoea syndrome
PCC	Posterior costal cartilage
PCCG	Posterior costal cartilage graft
PCTR	Partial cricotracheal resection
PEEP	Positive end expiratory pressure
PEG	Percutaneous endoscopic gastrostomy
PGS	Posterior glottic stenosis
PICU	Paediatric intensive care unit
PPI	Proton pump inhibitors
RAE	Ring-Adair-Elwin (tubes)
RDA	Recommended dietary allowances
RDS	Respiratory distress syndrome
RLN	Recurrent laryngeal nerve
RRP	Recurrent respiratory papillomatosis
RSV	Respiratory syncytial virus
SAL	Secondary airway lesion
SEMAS	Self-expandable metallic airway stent
SG	Subglottis, subglottic

SGH	Subglottic haemangioma
SGS	Subglottic stenosis
SGSa	Isolated subglottic stenosis
SGSb	Isolated subglottic stenosis with comorbidities
SGSc	Subglottic stenosis combined with glottic involvement
SGSd	Subglottic stenosis combined with glottic involvement and comorbidities
SLN	Superior laryngeal nerve
SML	Suspension microlaryngoscopy
SpO ₂	Saturation in pulse-oxymetry
SS	Single-stage
SS-LTR	Single-stage laryngotracheal reconstruction
SS-PCTR	Single-stage partial cricotracheal reconstruction
TC-CO ₂	Transcutaneous carbon dioxide
TCI	Target controlled infusion
TIVA	Total intravenous anaesthesia
TNFL	Transnasal fibre-optic laryngoscopy
TOF	Tracheo-oesophageal fistula
UAR	Upper airway resistance
UVCP	Unilateral vocal cord paralysis
VC	Vocal cord
VCP	Vocal cord paralysis
W	Watt