

# Operative Dictations in Pediatric Surgery

Dominic J. Papandria  
Gail E. Besner  
R. Lawrence Moss  
Karen A. Diefenbach  
*Editors*

---

# Operative Dictations in Pediatric Surgery

---

Dominic J. Papandria  
Gail E. Besner • R. Lawrence Moss  
Karen A. Diefenbach  
Editors

# Operative Dictations in Pediatric Surgery

 Springer

*Editors*

Dominic J. Papandria  
Department of Surgery  
Emory University  
Atlanta, GA  
USA

Gail E. Besner  
Department of Pediatric Surgery  
Nationwide Children's Hospital  
Columbus, OH  
USA

R. Lawrence Moss  
Nemours Children's Health System  
Jacksonville, FL  
USA

Karen A. Diefenbach  
Nationwide Children's Hospital  
Columbus, OH  
USA

ISBN 978-3-030-24211-4      ISBN 978-3-030-24212-1 (eBook)  
<https://doi.org/10.1007/978-3-030-24212-1>

© Springer Nature Switzerland AG 2019

This work is subject to copyright. All rights are reserved by the Publisher, whether the whole or part of the material is concerned, specifically the rights of translation, reprinting, reuse of illustrations, recitation, broadcasting, reproduction on microfilms or in any other physical way, and transmission or information storage and retrieval, electronic adaptation, computer software, or by similar or dissimilar methodology now known or hereafter developed.

The use of general descriptive names, registered names, trademarks, service marks, etc. in this publication does not imply, even in the absence of a specific statement, that such names are exempt from the relevant protective laws and regulations and therefore free for general use.

The publisher, the authors, and the editors are safe to assume that the advice and information in this book are believed to be true and accurate at the date of publication. Neither the publisher nor the authors or the editors give a warranty, expressed or implied, with respect to the material contained herein or for any errors or omissions that may have been made. The publisher remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

This Springer imprint is published by the registered company Springer Nature Switzerland AG  
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

*To Smedley, Kinch, and Chumley – my one love and my two epic sidekicks – you followed where the path led and offered up the best parts of yourselves to add delight to the journey. I am a better man every day despite myself and because of you all.*

Dominic J. Papandria

*To my mother who instilled in me the desire to become a surgeon-scientist before the term was even invented; to my son, Matthew, and daughter, Nicole, who never fail to amaze me; to my husband, David, who has always supported me; and to the many patients who have entrusted their care to me.*

Gail E. Besner

*To my greatest teachers: the many children and families for whom I have had the great privilege to care. To the many students and residents who have left me confident that surgery has an exciting future and is in the best of hands. To my wife Kris and my three children Jackson, Krissy, and Ruby who mean more than the world to me.*

R. Lawrence Moss

*To my parents who gave me the courage to pursue my dream; to my sister, my biggest cheerleader; and to my husband for his love and unfailing support, I would not be here without you.*

Karen A. Diefenbach

---

## Preface

In the tradition of the adult text, *Operative Dictations in Pediatric Surgery*, this new volume is designed as a concise guide to the pediatric surgical trainee and practicing surgeon alike. The surgical care of children is inherently multidisciplinary, and we are excited to share this work with our community of surgeons, urologists, gynecologists, head and neck surgeons, and allied health providers. We greatly appreciate the support and enthusiasm on the part of Springer Publishing in coordinating the efforts of our fantastic team of authors to produce this inaugural edition. The book provides summary information across a great variety of surgical and endoscopic procedures, together with template operative dictations to orient learners to the pertinent details and technical variations of the operation. Each chapter also includes procedure-specific indications and risks that are relevant to the consent process.

Our collaborating authors – 81 in all – represent 8 distinct surgical subspecialties and are drawn from 18 institutions throughout North America. We are delighted to offer their collective expertise and perspective to our colleagues and trainees who care for children across the surgical spectrum. In preparing this volume, we have attempted to provide appropriate emphasis on minimally invasive approaches and to portray contemporary practice whenever possible. The result reflects the authors' experiences while still addressing common technical variations to ensure that each chapter is broadly reflective of clinical practice. We do recognize that individual practice is informed by surgeon experience, resource constraints, and other factors, and thus adaptation of the materials included is expected to suit each clinical situation.

As the pediatric surgical community continues to advance the science and technical sophistication of the care of this fragile population, we embrace new challenges and strive to invest in the future of this most rewarding discipline. If we can help to perpetuate the continued success of our peers and the understanding of those who will someday follow in the footsteps, that will be our ultimate satisfaction in this endeavor.

Atlanta, GA, USA  
Columbus, OH, USA  
Jacksonville, FL, USA  
Columbus, OH, USA

Dominic J. Papandria  
Gail E. Besner  
R. Lawrence Moss  
Karen A. Diefenbach

---

# Contents

<b>1 Rigid and Flexible Esophagoscopy for Foreign Body Removal</b> .....	1
William B. Rothstein and Laura A. Boomer	
<b>2 Flexible Esophagoscopy and Fluoroscopically Guided Dilation</b> .....	5
William B. Rothstein and Laura A. Boomer	
<b>3 Repair of Esophageal Atresia with Tracheoesophageal Fistula (Open and MIS Approaches)</b> .....	9
Dominic J. Papandria and Karen A. Diefenbach	
<b>4 Esophageal Replacement</b> .....	13
Michaela Kollisch-Singule and Jennifer Stanger	
<b>5 Esophagomyotomy (Open and MIS Approaches)</b> .....	17
Kate Savoie and Karen A. Diefenbach	
<b>6 Esophagogastric Fundoplication (Open and MIS Approaches)</b> .....	21
Dani O. Gonzalez and Payam Saadai	
<b>7 Hiatal and Paraesophageal Hernia (Open and MIS Approaches)</b> .....	25
Kate Savoie and Karen A. Diefenbach	
<b>8 Esophagogastroduodenoscopy and Percutaneous Endoscopic Gastrostomy</b> .....	29
Justin T. Huntington and Karen A. Diefenbach	
<b>9 Gastrostomy Placement (Open and Laparoscopic Approach)</b> .....	33
Justin T. Huntington and Karen A. Diefenbach	
<b>10 Pyloromyotomy (Open and Laparoscopic Approach)</b> .....	37
Justin T. Huntington and Karen A. Diefenbach	
<b>11 Exploratory Laparotomy for Complications of Peptic Ulcer Disease</b> .....	41
Justin T. Huntington and Karen A. Diefenbach	

<b>12</b>	<b>Placement of Gastric Electrical Stimulator</b> .....	45
	Dominic J. Papandria and Karen A. Diefenbach	
<b>13</b>	<b>Removal of Bezoars and Other Ingested Foreign Bodies (Open and MIS Approaches)</b> .....	51
	Frances C. Okolo and Stefan Scholz	
<b>14</b>	<b>Sugiura Procedure (Esophagogastric Devascularization)</b> .....	55
	Andrew Yeh and Stefan Scholz	
<b>15</b>	<b>Laparoscopic Sleeve Gastrectomy</b> .....	59
	Astrid R. Soares-Medina, Marc P. Michalsky, and Bradley J. Needleman	
<b>16</b>	<b>Laparoscopic Roux-En-Y Gastric Bypass</b> .....	63
	Astrid R. Soares-Medina, Marc P. Michalsky, and Bradley J. Needleman	
<b>17</b>	<b>Jejunostomy Placement, Open and MIS Approaches</b> .....	69
	Frances C. Okolo, Paul K. Waltz, and Stefan Scholz	
<b>18</b>	<b>Laparotomy for Midgut Volvulus</b> .....	75
	Lorraine I. Kelley-Quon	
<b>19</b>	<b>Ladd's Procedure</b> .....	77
	Courtney Pisano and Gail E. Besner	
<b>20</b>	<b>Repair of Duodenal Atresia (Open and MIS Approaches)</b> .....	81
	Afif Kulaylat and Karen A. Diefenbach	
<b>21</b>	<b>Open Repair of Jejunioleal Atresia</b> .....	85
	Dominic J. Papandria and Karen A. Diefenbach	
<b>22</b>	<b>Resection of Meckel's Diverticulum</b> .....	89
	Courtney Pisano and Gail E. Besner	
<b>23</b>	<b>Resection of Omphalomesenteric Duct Remnant</b> .....	93
	Lorraine I. Kelley-Quon	
<b>24</b>	<b>Reduction of Intussusception</b> .....	95
	Courtney Pisano and Gail E. Besner	
<b>25</b>	<b>Resection of Enteric Duplication or Mesenteric Cyst</b> .....	99
	Mitchell R. Ladd and Daniel Rhee	
<b>26</b>	<b>Serial Transverse Enteroplasty (STEP)</b> .....	103
	Afif Kulaylat and Karen A. Diefenbach	
<b>27</b>	<b>Stricturoplasty and Small-Bowel Stricture Bypass (Open and MIS Approaches)</b> .....	105
	Lea Wehrli and Stefan Scholz	
<b>28</b>	<b>Ileostomy Creation (Open and MIS Approaches)</b> .....	111
	Justin T. Huntington and Karen A. Diefenbach	
<b>29</b>	<b>Appendectomy</b> .....	115
	Melissa Vanover and Payam Saadai	



<b>30</b>	<b>Cecal Volvulus</b> . . . . .	121
	Andrew Yeh and Stefan Scholz	
<b>31</b>	<b>Percutaneous Peritoneal Drain Placement for Necrotizing Enterocolitis</b> . . . . .	125
	William B. Rothstein and Laura A. Boomer	
<b>32</b>	<b>Laparotomy for Necrotizing Enterocolitis</b> . . . . .	127
	William B. Rothstein and Laura A. Boomer	
<b>33</b>	<b>Malone Continent Appendicostomy</b> . . . . .	131
	Devin R. Halleran, Richard J. Wood, and Marc A. Levitt	
<b>34</b>	<b>Total Abdominal Colectomy with End-Ileostomy</b> . . . . .	135
	Benedict C. Nwomeh, Jeremy G. Fisher, and Jason Zakko	
<b>35</b>	<b>Completion Proctectomy and Ileal Pouch-Anal Anastomosis, Diverting Loop Ileostomy</b> . . . . .	139
	Benedict C. Nwomeh, Jeremy G. Fisher, and Jason Zakko	
<b>36</b>	<b>Swenson-Like Transanal Pull-Through</b> . . . . .	145
	Devin R. Halleran, Richard J. Wood, and Marc A. Levitt	
<b>37</b>	<b>Duhamel Procedure</b> . . . . .	149
	Kate Savoie and Brian D. Kenney	
<b>38</b>	<b>Soave-Like Transanal Endorectal Pull-Through</b> . . . . .	153
	Devin R. Halleran, Richard J. Wood, and Marc A. Levitt	
<b>39</b>	<b>Laparoscopic Colonic Mapping</b> . . . . .	157
	David Coyle and Karen A. Diefenbach	
<b>40</b>	<b>Laparoscopic Leveling Colostomy for Colonic Aganglionosis</b> . . . . .	161
	David Coyle and Karen A. Diefenbach	
<b>41</b>	<b>Posterior Sagittal Anorectoplasty: Male</b> . . . . .	165
	Rebecca M. Rentea, Richard J. Wood, and Marc A. Levitt	
<b>42</b>	<b>Posterior Sagittal Anorectoplasty: Female</b> . . . . .	169
	Rebecca M. Rentea, Richard J. Wood, and Marc A. Levitt	
<b>43</b>	<b>Cloacal Reconstruction with Total Urogenital Mobilization</b> . . .	173
	Rebecca M. Rentea, Richard J. Wood, and Marc A. Levitt	
<b>44</b>	<b>Anal Stricturoplasty</b> . . . . .	177
	Devin R. Halleran, Richard J. Wood, and Marc A. Levitt	
<b>45</b>	<b>Vaginoplasty and Vaginal Replacement</b> . . . . .	179
	Alejandra Vilanova-Sánchez, Geri D. Hewitt, and Marc A. Levitt	
<b>46</b>	<b>Augmentation Enterocystoplasty</b> . . . . .	183
	Christina B. Ching	
<b>47</b>	<b>Urinary Conduit</b> . . . . .	187
	Molly E. Fuchs and Daniel G. Dajusta	

<b>48</b>	<b>Appendicovesicostomy/Mitrofanoff</b> . . . . .	191
	Molly E. Fuchs and Daniel G. Dajusta	
<b>49</b>	<b>Circumcision</b> . . . . .	197
	Nicholas Beecroft and Daryl J. McLeod	
<b>50</b>	<b>Orchiopexy (Open and MIS Approaches)</b> . . . . .	201
	Christopher Jaeger and Seth A. Alpert	
<b>51</b>	<b>Fowler-Stephens Procedure</b> . . . . .	207
	Kyle J. Van Arendonk and Dai H. Chung	
<b>52</b>	<b>Radical/Simple Orchiectomy</b> . . . . .	213
	Laura Rausch and Harold N. Lovvorn III	
<b>53</b>	<b>Incision and Drainage of Bartholin Gland Duct Cyst or Abscess with Word Catheter Placement; Marsupialization of Bartholin Gland Duct Cyst or Abscess</b> . . . . .	217
	Alejandra Vilanova-Sánchez and Kate A. McCracken	
<b>54</b>	<b>Management of Ovarian, Isolated Fallopian Tube, or Adnexal Torsion (Open and MIS Approaches)</b> . . . . .	219
	Alejandra Vilanova-Sánchez and Kate A. McCracken	
<b>55</b>	<b>Staging Laparotomy and Oophorectomy for Malignancy</b> . . . . .	225
	Sara A. Mansfield and Kate A. McCracken	
<b>56</b>	<b>Ovarian Cystectomy for Benign Ovarian Masses (Open and MIS Approaches)</b> . . . . .	227
	Alejandra Vilanova-Sánchez and Kate A. McCracken	
<b>57</b>	<b>Hymenectomy</b> . . . . .	231
	Alejandra Vilanova-Sánchez and Kate A. McCracken	
<b>58</b>	<b>Drainage of Tubo-Ovarian Abscess</b> . . . . .	233
	Kate A. McCracken	
<b>59</b>	<b>Surgical Management of an Ectopic Pregnancy Via Laparoscopic Salpingectomy or Laparoscopic Salpingostomy</b> . . . . .	237
	Kate A. McCracken	
<b>60</b>	<b>Nephrectomy</b> . . . . .	241
	Margaret E. Gallagher and Harold N. Lovvorn III	
<b>61</b>	<b>Cholecystectomy</b> . . . . .	247
	Courtney Pisano and Gail E. Besner	
<b>62</b>	<b>Kasai Portoenterostomy (Open and MIS Approaches)</b> . . . . .	255
	Stefan Scholz and Lea Wehrli	
<b>63</b>	<b>Resection of Choledochal Cyst</b> . . . . .	263
	Amy E. Lawrence and Katherine J. Deans	

<b>64</b>	<b>Hepatic Resection (Right/Left Hepatectomy; Extended Right/Left Hepatectomy; Wedge Resection)</b> .....	267
	Justin T. Huntington and Jennifer H. Aldrink	
<b>65</b>	<b>Inguinal Hernia Repair</b> .....	271
	Melissa Vanover and Payam Saadai	
<b>66</b>	<b>Ventral/Incisional Hernia Repair (Open and MIS Approaches)</b> .....	275
	Michaela Kollisch-Singule and Jennifer Stanger	
<b>67</b>	<b>Umbilical Hernia Repair</b> .....	279
	Katherine Culbreath and Daniel Rhee	
<b>68</b>	<b>Silo Placement for Gastroschisis</b> .....	283
	Jamie E. Anderson and Payam Saadai	
<b>69</b>	<b>Operative Repair of Gastroschisis</b> .....	287
	Jamie E. Anderson and Payam Saadai	
<b>70</b>	<b>Sutureless Repair of Gastroschisis</b> .....	289
	Jamie E. Anderson and Payam Saadai	
<b>71</b>	<b>Repair of Omphalocele</b> .....	293
	A. Francois Trappey III and Payam Saadai	
<b>72</b>	<b>Interval Laparotomy with Placement of Temporary Closure</b> .....	295
	Carolyn Gosztyla and Howard I. Pryor II	
<b>73</b>	<b>Flexible Bronchoscopy</b> .....	299
	Carlos Andrés de la Torre Ramos	
<b>74</b>	<b>Rigid Bronchoscopy and Foreign Body Removal</b> .....	303
	Carlos Andrés de la Torre Ramos	
<b>75</b>	<b>Tube Thoracostomy</b> .....	305
	Carlos Andrés de la Torre Ramos	
<b>76</b>	<b>Pulmonary Bleb Resection and Pleurodesis (Open and MIS Approaches)</b> .....	307
	Ekene A. Onwuka and Christopher K. Breuer	
<b>77</b>	<b>Pectus Excavatum Repair (Open and MIS Approaches)</b> .....	311
	Kate Savoie and Brian D. Kenney	
<b>78</b>	<b>Ravitch Procedure (Open Approach for Chest Wall Deformities)</b> .....	315
	Carlos Andrés de la Torre Ramos	
<b>79</b>	<b>Repair of Pectus Carinatum</b> .....	319
	Kate Savoie and Brian D. Kenney	
<b>80</b>	<b>Transabdominal Repair of Congenital Diaphragmatic Hernia (Open and MIS Approaches)</b> .....	321
	Dominic J. Papandria and Karen A. Diefenbach	

<b>81 Thoracic Repair of Congenital Diaphragmatic Hernia (Open and MIS Approaches)</b> .....	325
Dominic J. Papandria and Karen A. Diefenbach	
<b>82 Lobar Resection of Congenital Pulmonary Malformations (Open and MIS Approaches)</b> .....	329
Rita D. Shelby, Dominic J. Papandria, and Karen A. Diefenbach	
<b>83 Extralobar Resection of Congenital Pulmonary Malformations (Open and MIS Approaches)</b> .....	333
Kate Savoie, Dominic J. Papandria, and Karen A. Diefenbach	
<b>84 Thymectomy and Aortopexy</b> .....	337
Joseph Adam Sujka and Shawn D. St. Peter	
<b>85 Ligation of Patent Ductus Arteriosus</b> .....	341
Mitchell R. Ladd and Alejandro V. Garcia	
<b>86 Thymectomy (Open and MIS Approaches)</b> .....	345
Stefan Scholz and Alejandro V. Garcia	
<b>87 Pulmonary Decortication (Open and MIS Approaches)</b> .....	349
Ekene A. Onwuka and Christopher K. Breuer	
<b>88 Exploratory Laparotomy, Right/Left Nephrectomy, Paraaortic/Paracaval Lymph Node Dissection</b> .....	353
Sara A. Mansfield and Jennifer H. Aldrink	
<b>89 Abdominal Resection of Neuroblastoma</b> .....	357
Sara A. Mansfield and Jennifer H. Aldrink	
<b>90 Right/Left Thoracotomy/Thoracoscopy, Resection of Paraspinal Thoracic Neuroblastoma</b> .....	359
Sara A. Mansfield and Jennifer H. Aldrink	
<b>91 Right/Left Thoracoscopy/Thoracotomy, Resection of Pulmonary Nodule(s)</b> .....	361
Sara A. Mansfield and Jennifer H. Aldrink	
<b>92 Adrenalectomy (Open and MIS Approaches)</b> .....	363
Sara A. Mansfield and Jennifer H. Aldrink	
<b>93 Wide Local Excision of Malignant Melanoma With or Without Sentinel Lymph Node Biopsy</b> .....	369
Jennifer H. Aldrink	
<b>94 Right/Left Thyroid Lobectomy/Total</b> .....	371
Sara A. Mansfield and Jennifer H. Aldrink	
<b>95 Open and Percutaneous Dilation Tracheostomy</b> .....	375
Joseph R. Esparaz and Charles J. Arahamian	
<b>96 Cervical Lymph Node Biopsy</b> .....	379
Michaela Kollisch-Singule and Jennifer Stanger	

<b>97</b>	<b>Excision of Thyroglossal Duct Cyst</b> . . . . .	381
	Carolyn Gosztyla and Howard I. Pryor II	
<b>98</b>	<b>Excision of Branchial Cleft Cyst/Sinus</b> . . . . .	385
	Lorraine I. Kelley-Quon	
<b>99</b>	<b>Parathyroidectomy</b> . . . . .	387
	Sara A. Mansfield and Jennifer H. Aldrink	
<b>100</b>	<b>Excision of Benign Soft Tissue Lesions</b> . . . . .	391
	Anthony J. Munaco	
<b>101</b>	<b>Incision and Drainage</b> . . . . .	393
	Melissa Vanover and Payam Saadai	
<b>102</b>	<b>Excisional Biopsy of Benign Breast Mass</b> . . . . .	395
	Young Chun and Isam Nasr	
<b>103</b>	<b>Aspiration/Drainage of Breast Abscess</b> . . . . .	399
	David Coyle	
<b>104</b>	<b>Excisional Lymph Node Biopsy</b> . . . . .	403
	Morgan Johnson, Courtney Pisano, and Gail E. Besner	
<b>105</b>	<b>Torticollis</b> . . . . .	405
	Lea Wehrli and Stefan Scholz	
<b>106</b>	<b>Resection of Postaxial Supernumerary Digits</b> . . . . .	409
	Greg Grenier and Julie Balch Samora	
<b>107</b>	<b>Two-Incision Four-Compartment Lower Extremity Fasciotomy</b> . . . . .	417
	Carolyn Gosztyla and Eric Jelin	
<b>108</b>	<b>Splenectomy (Open and MIS Approach)</b> . . . . .	421
	Lorraine I. Kelley-Quon	
<b>109</b>	<b>Splenorrhaphy</b> . . . . .	425
	Paul K. Waltz and Stefan Scholz	
<b>110</b>	<b>Subtotal Splenectomy or Splenic Cyst Excision</b> . . . . .	429
	Seth Goldstein and Daniel Rhee	
<b>111</b>	<b>Placement of Central Venous Catheter</b> . . . . .	433
	Carolyn Gosztyla and Howard I. Pryor II	
<b>112</b>	<b>Placement of Catheters for Hemodialysis/Pheresis (HD) Utilizing Ultrasound (US) and Fluoroscopy</b> . . . . .	437
	Rebecca M. Rentea and Richard J. Hendrickson	
<b>113</b>	<b>Extracorporeal Membrane Oxygenation (Venovenous) Cannulation</b> . . . . .	441
	Laura A. Galganski and Payam Saadai	
<b>114</b>	<b>Extracorporeal Membrane Oxygenation (Arteriovenous) Cannulation</b> . . . . .	445
	Payam Saadai and Laura A. Galganski	

---

**115 Extracorporeal Membrane Oxygenation Decannulation . . . . . 449**  
Payam Saadai and Laura A. Galganski

**116 Creation of Distal Splenorenal Shunt . . . . . 451**  
Jamie R. Robinson, James A. O’Neill,  
and Harold N. Lovvorn III

**117 Temporal Artery Biopsy . . . . . 455**  
Justin A. Sobrino and Jason D. Fraser

**118 Supraclavicular Right/Left First Rib Resection. . . . . 457**  
Justin A. Sobrino, Pablo Aguayo, and David Juang

**119 Debridement of Burn Wounds . . . . . 461**  
Rita D. Shelby and Renata B. Fabia

**120 Thoracic and Abdominal Escharotomy . . . . . 463**  
Rita D. Shelby and Renata B. Fabia

**121 Upper Extremity Escharotomy and Fasciotomy . . . . . 465**  
Rita D. Shelby, Rajan K. Thakkar, and Kim A. Bjorklund

**122 Lower Extremity Escharotomy and Fasciotomy . . . . . 469**  
Rita D. Shelby and Rajan K. Thakkar

**123 Excision and Autografting of Burn Wound . . . . . 473**  
Rita D. Shelby and Renata B. Fabia

**124 Burn Contracture Release . . . . . 475**  
Rita D. Shelby and Renata B. Fabia

**125 Placement of Peritoneal Dialysis Catheters . . . . . 479**  
Rebecca M. Rentea and Richard J. Hendrickson

**Index . . . . . 483**

---

## Contributors

**Pablo Aguayo, MD, FACS, FAAP** Department of Surgery, Children's Mercy Hospital and Clinics/University of Missouri - Kansas City, Kansas City, MO, USA

**Jennifer H. Aldrink, MD** Nationwide Children's Hospital, The Ohio State University College of Medicine, Division of Pediatric Surgery, Department of Surgery, Columbus, OH, USA

**Seth A. Alpert, MD** Nationwide Children's Hospital and The Ohio State University Wexner Medical Center, Section of Urology, Columbus, OH, USA

**Jamie E. Anderson, MD** University of California, Davis, Department of Pediatric General, Thoracic and Fetal Surgery, Sacramento, CA, USA

**Charles J. Aprahamian, MD** OSF Children's Hospital of Illinois, Division of Pediatric Surgery, Department of Surgery, Peoria, IL, USA

**Nicholas Beecroft, BS** The Ohio State University College of Medicine, School of Medicine, Columbus, OH, USA

**Gail E. Besner, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Kim A. Bjorklund, MD, MEd** Nationwide Children's Hospital, Department of Plastic, Reconstructive and Hand Surgery, Columbus, OH, USA

**Laura A. Boomer, MD** Children's Hospital of Richmond, Virginia Commonwealth University, Department of Pediatric Surgery, Richmond, VA, USA

**Christopher K. Breuer, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Christina B. Ching, MD** Nationwide Children's Hospital, Department of Pediatric Urology, Columbus, OH, USA

**Dai H. Chung, MD** Children's Medical Center Dallas, Department of Surgery, Dallas, TX, USA

**Young Chun, MD** Johns Hopkins University, Department of Pediatric Surgery, Baltimore, MD, USA

**David Coyle, MD, MB BCh BAO** Nationwide Children's Hospital, Division of Pediatric Surgery, Columbus, OH, USA

**Katherine Culbreath, BS** Johns Hopkins Hospital, Department of Surgery, Baltimore, MD, USA

**Daniel G. Dajusta, MD** Nationwide Children's Hospital, Department of Pediatric Urology, Columbus, OH, USA

**Carlos Andrés de la Torre Ramos, MD** University Hospital La Paz, Pediatric Surgery, Madrid, Spain

**Katherine J. Deans, MD, MHSc** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Karen A. Diefenbach, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Joseph R. Esparaz, MD** University of Illinois College of Medicine at Peoria; OSF Children's Hospital of Illinois, Department of Surgery, Peoria, IL, USA

**Renata B. Fabia, MD** Nationwide Children's Hospital, Pediatric General Surgery, Columbus, OH, USA

**Jeremy G. Fisher, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Jason D. Fraser, MD** Department of Surgery, Children's Mercy Hospital and Clinics/University of Missouri - Kansas City, Kansas City, MO, USA

**Molly E. Fuchs, MD** Nationwide Children's Hospital, Department of Pediatric Urology, Columbus, OH, USA

**Laura A. Galganski, MD** University of California, Davis, Department of Pediatric General, Thoracic and Fetal Surgery, Sacramento, CA, USA

**Margaret E. Gallagher, MD** Monroe Carell Jr. Children's Hospital at Vanderbilt, Department of Pediatric Surgery, Nashville, TN, USA

**Alejandro V. Garcia, MD** Johns Hopkins University, Department of Pediatric Surgery, Baltimore, MD, USA

**Seth Goldstein, MD, MPH** Ann & Robert H Lurie Children's Hospital of Chicago, Chicago, IL, USA

**Dani O. Gonzalez, MD** Icahn School of Medicine at Mount Sinai, Department of Surgery, New York, NY, USA

**Carolyn Gosztyla, MD** Walter Reed National Military Medical Center, Department of General Surgery, Bethesda, MD, USA

**Greg Grenier, MD** Ohio University/Doctors Hospital, Department of Orthopedic Surgery, Columbus, OH, USA



**Devin R. Halleran, MD** Nationwide Children's Hospital, Center for Colorectal and Pelvic Reconstruction, Columbus, OH, USA

**Richard J. Hendrickson, MD** Children's Mercy, University of Missouri - Kansas City, Department of Pediatric Surgery, Kansas City, MO, USA

**Geri D. Hewitt, MD** Nationwide Children's Hospital, Department of Surgery, Columbus, OH, USA

**Justin T. Huntington, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Christopher Jaeger, MD** The Ohio State University Wexner Medical Center, Department of Urology, Columbus, OH, USA

**Eric Jelin, MD** Johns Hopkins, Department of Surgery, Bloomberg Children's Center, Baltimore, MD, USA

**Morgan Johnson, MS** The Ohio State University, College of Medicine, Columbus, OH, USA

**David Juang, MD, FACS, FAAP** Department of Surgery, Children's Mercy Hospital and Clinics/University of Missouri - Kansas City, Kansas City, MO, USA

**Lorraine I. Kelley-Quon, MD, MS** Children's Hospital Los Angeles, Division of Pediatric Surgery, Department of Surgery, Keck School of Medicine of University of Southern California, Los Angeles, CA, USA

**Brian D. Kenney, MD, MPH** Pediatric Intensive Care Unit, Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Michaela Kollisch-Singule, MD** SUNY Upstate Medical University, Department of General Surgery, Syracuse, NY, USA

**Aff Kulaylat, MD** Nationwide Children's Hospital, Department of Surgery, Columbus, OH, USA

**Mitchell R. Ladd, MD, PhD** Johns Hopkins Hospital, Department of General Surgery, Baltimore, MD, USA

**Amy E. Lawrence, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Marc A. Levitt, MD** Nationwide Children's Hospital, Center for Colorectal and Pelvic Reconstruction, Columbus, OH, USA

**Harold N. Lovvorn III, MD** Monroe Carell Jr. Children's Hospital at Vanderbilt, Department of Pediatric Surgery, Nashville, TN, USA

**Sara A. Mansfield, MD, MS** The Ohio State University Wexner Medical Center, Department of General Surgery, Columbus, OH, USA

**Kate A. McCracken, MD** Nationwide Children's Hospital, Department of Pediatric & Adolescent Gynecology, Columbus, OH, USA

**Daryl J. McLeod, MD, MPH** Nationwide Children's Hospital, Department of Surgery, Section of Urology, Columbus, OH, USA

**Marc P. Michalsky, MD** Professor of Clinical Surgery and Pediatrics, The Ohio State University College of Medicine, Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**R. Lawrence Moss, MD** Nemours Children's Health System, Jacksonville, FL, USA

**Anthony J. Munaco, MD** OSF Healthcare Children's Hospital of Illinois, University of Illinois College of Medicine at Peoria, Department of Pediatric Surgery, Peoria, IL, USA

**Isam Nasr, MD** Johns Hopkins Hospital, Department of Pediatric Surgery, Johns Hopkins Children's Center, Baltimore, MD, USA

**Bradley J. Needleman, MD** The Edwin H. and E. Christopher Ellison Professor of Surgery, The Ohio State University College of Medicine, Wexner Medical Center, Department of Surgery, Columbus, OH, USA

**Benedict C. Nwomeh, MD** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**James A. O'Neill, MD** Vanderbilt University Medical Center, Department of Pediatric Surgery, Vanderbilt Children's Hospital, Nashville, TN, USA

**Frances C. Okolo, MD** University of Pittsburgh Medical Center, Department of General Surgery, Pittsburgh, PA, USA

**Ekene A. Onwuka, MD, MS** The Ohio State University Wexner Medical Center, Department of General Surgery, Columbus, OH, USA

**Dominic J. Papandria, MD** Department of Surgery, Emory University, Atlanta, GA, USA

**Courtney Pisano, DO, MS** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Howard I. Pryor III, MD** Division of Pediatric Surgery, Walter Reed National Military Medical Center, Department of Surgery, Bethesda, MD, USA

**Laura Rausch, BS, MA, MD** Vanderbilt University Medical Center, Department of General Surgery, Nashville, TN, USA

**Rebecca M. Rentea, MD** Children's Mercy, University of Missouri -Kansas City, Department of Pediatric Surgery, Kansas City, MO, USA

**Daniel Rhee, MD, MPH** Johns Hopkins School of Medicine, Department of Surgery, Baltimore, MD, USA

**Jamie R. Robinson, MD, MS** Vanderbilt University Medical Center, Department of General Surgery, Nashville, TN, USA

**William B. Rothstein, MD** Virginia Commonwealth University Health System, Department of Surgery, Richmond, VA, USA

**Payam Saadai, MD** UC Davis Medical Center/Shriners Hospital for Children, Division of Pediatric Surgery, Sacramento, CA, USA

**Julie Balch Samora, MD, PhD, MPH** Nationwide Childrens Hospital, Department of Orthopaedics, Columbus, OH, USA

**Kate Savoie, MD, MS** Nationwide Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA

**Stefan Scholz, MD** University of Pittsburgh School of Medicine, Children's Hospital of Pittsburgh, Department of Pediatric Surgery, Pittsburgh, PA, USA

**Rita D. Shelby, MD** Nationwide Children's Hospital, Ohio State University Wexner Medical Center, Department of Pediatric Surgery, Columbus, OH, USA

**Astrid R. Soares-Medina, MD, FEBPS** Assistant Professor of Clinical Surgery and Pediatrics, Ponce Health Sciences University School of Medicine, Mayagüez Medical Center, Department of Pediatric Surgery, Mayagüez, PR, USA

**Justin A. Sobrino** Department of Surgery, Children's Mercy Hospital and Clinics/University of Missouri - Kansas City, Kansas City, MO, USA

**Shawn D. St. Peter, MD** Children's Mercy Hospital, Department of Pediatric Surgery, Kansas City, MO, USA

**Jennifer Stanger, MD** SUNY Upstate Medical University, Department of Pediatric Surgery, Syracuse, NY, USA

**Joseph Adam Sujka, MD** Children's Mercy Hospital, Department of Pediatric Surgery, Kansas City, MO, USA

**Rajan K. Thakkar, MD** Nationwide Children's Hospital, Pediatric General Surgery, Columbus, OH, USA

**A. Francois Trappey III, MD** University of California, Davis, Department of Pediatric General, Thoracic and Fetal Surgery, Sacramento, CA, USA

**Kyle J. Van Arendonk, MD, PhD** Children's Hospital of Wisconsin, Department of Surgery, Milwaukee, WI, USA

**Melissa Vanover, MD** University of California, Davis, Department of Pediatric General, Thoracic and Fetal Surgery, Sacramento, CA, USA

**Alejandra Vilanova-Sánchez, MD** Hospital La Paz, Department of Pediatric Surgery, Madrid, Spain

**Paul K. Waltz, MD** University of Pittsburgh Medical Center, Department of General Surgery, Pittsburgh, PA, USA

**Lea Wehrli, MD** Children's Hospital of Pittsburgh of UPMC, Department of Pediatric Surgery, Pittsburgh, PA, USA

**Richard J. Wood, MBChB, FCPS(SA)** Nationwide Children's Hospital, Center for Colorectal and Pelvic Reconstruction, Columbus, OH, USA

**Andrew Yeh, MD** University of Pittsburgh, Department of Surgery,  
Pittsburgh, PA, USA

**Jason Zakko, MD** Ohio State University Medical Center/Nationwide  
Children's Hospital, Department of Pediatric Surgery, Columbus, OH, USA



# Rigid and Flexible Esophagoscopy for Foreign Body Removal

# 1

William B. Rothstein and Laura A. Boomer

## Indications and Benefits

- Metallic or radiopaque foreign body confirmed radiographically
- Suspected foreign body by history, or impacted organic material
- Benefits: Direct visualization of the foreign material, confirmation of removal, evaluation of the esophageal mucosa

## Risks and Alternatives

- Standard risks (bleeding, infection, need for additional procedures, risks of anesthesia)
- Injury to adjacent structures (teeth, pharynx, esophagus)
- Aspiration
- Perforation or laceration of the pharynx or esophagus
- Alternatives: Long laryngoscope with Magill forceps, fluoroscopically guided balloon, or catheter removal

W. B. Rothstein  
Virginia Commonwealth University Health System,  
Department of Surgery, Richmond, VA, USA

L. A. Boomer (✉)  
Children's Hospital of Richmond, Virginia  
Commonwealth University, Department of  
Pediatric Surgery, Richmond, VA, USA  
e-mail: [Laura.boomer@vcuhealth.org](mailto:Laura.boomer@vcuhealth.org)

## Essential Steps

### Rigid Esophagoscopy with Foreign Body Removal

1. Place the patient supine with a shoulder roll to facilitate neck extension similar to endotracheal intubation – the “sniffing position.” A tooth guard is recommended to avoid dental injury.
2. Select the largest suitable rigid endoscope.
3. Ensure the camera and light source are appropriately set up prior to beginning the procedure, and that all equipment is the appropriate length for the endoscope.
4. Sit or stand at the patient's head.
5. Retract the tongue and protect the teeth with the non-dominant hand, and carefully guard the endotracheal tube, so as to avoid dislodging the tube during the procedure.
6. Insert scope into oral cavity with the lip of the bevel up. Balance it using the thumb and index finger of non-dominant hand as a fulcrum.
7. Under direct visualization, advance scope along posterior pharyngeal wall.
8. Elevate the cricoid with the tip of the scope and advance into the cervical esophagus.
9. Only advance scope when lumen is visualized.
10. Clear secretions with suction while inspecting for foreign body. Inspect for

pathology that may be associated with a retained foreign body (esophageal webs, strictures).

11. Use long grasping forceps to remove foreign body. This can be done piecemeal through the lumen of the scope with soft objects. Large solid objects may be grasped tightly to the end of the scope and removed by retracting the scope and grasper together.
12. After removal, reinsert the endoscope to complete the exam by inspecting the lumen at the site of the foreign body to evaluate for damage, and distal to the foreign body to ensure no further obstruction.

### Flexible Esophagoscopy with Foreign Body Removal

1. Place patient in the supine position with the neck extended. (Alternatively, the patient may be placed in lateral decubitus position.)
2. Stand at the head of on the right side of the Table.
3. A bite block facilitates easy passage of the scope.
4. Insert an 8–9-mm flexible endoscope over the tongue and advance along the posterior pharynx under direct visualization. In smaller children, a 6-mm pediatric endoscope may be required; however, the working channels of smaller endoscopes will accommodate a smaller range of instruments.
5. Apply gentle insufflation and pressure against the upper esophageal sphincter to advance into cervical esophagus.
6. Clear secretions with suction to adequately visualize the foreign body.
7. Foreign bodies can be grasped with various snares and graspers through the working port of the scope and removed piecemeal or retracted along with the scope.
8. After removal, reinsert the endoscope to complete the exam by inspecting the lumen at the site of the foreign body to evaluate for damage, and distal to the foreign body to ensure no further obstruction.

**Table 1.1** Recommended endoscopy sizes

Age	Rigid	Flexible
Premature infant	4	≤6 mm (pediatric gastroscopie)
Term infant (0–3 months)	4–5	≤6 mm (pediatric gastroscopie)
3–12 months	5–6	≤6 mm (pediatric gastroscopie)
1–2 years	6	6–8 mm
2–5 years	6–7	8 mm (adult gastroscopie)
5–10 years	7	8 mm (adult gastroscopie)
>10 years	8	8 mm (adult gastroscopie)

### Note These Variations

- The oral cavity can also be navigated by passing the scope along the floor of the mouth, to the right of the tongue, and following the right pyriformis fossa.
- Recommended endoscopy sizes based on patient size listed in Table 1.1.

### Template Operative Dictation (Rigid)

**Preoperative Diagnosis** Esophageal foreign body

**Postoperative Diagnosis** Esophageal foreign body

#### Findings

1. Esophageal foreign body at the level of *cricopharyngeus/mid-esophagus/gastroesophageal junction*
2. No evidence of intraluminal injury
3. Normal cervical esophageal anatomy

**Procedure(s) Performed** Rigid esophagoscopy with foreign body removal

**Anesthesia** *General endotracheal anesthesia/Procedural sedation*

**Specimen** *Coin/foreign object/none*

**Estimated Blood Loss** None

**Indications** This is a/an \_\_\_-day/week/month/year-old *male/female* with a/an \_\_\_-day/hour/week history of drooling and dysphagia after a choking event. A suspected esophageal foreign body was confirmed radiographically. *He/she* was deemed to be a suitable candidate for rigid esophagoscopy with removal of foreign body.

**Procedure in Detail** The patient was placed in supine position and appropriately padded after a smooth induction of general anesthesia. A shoulder roll was placed and the neck gently extended. Timeouts were performed using both pre-induction and pre-incision safety checklists with participation of all present in the operative suite. These confirmed the correct patient, procedure, operative site, and additional critical information prior to the start of the procedure. A size \_\_\_ rigid endoscope was introduced to the oral cavity and advanced through the upper esophageal sphincter under direct visualization. The foreign body was visualized at the level of the \_\_\_. At this point, an optical long grasping forceps was introduced through the lumen of the endoscope and the foreign body was grasped. The foreign body was retracted against the orifice of the endoscope and the endoscope and foreign body were retracted out through the oral cavity. The endoscope was then reinserted past the level of the previous foreign body and slowly withdrawn. The esophageal mucosa appeared intact and undamaged, with no anatomical abnormalities noted. The endoscope was then removed and the procedure terminated.

Upon completion of the procedure, a debriefing checklist was completed to share information critical to the postoperative care of the patient. The patient tolerated the procedure well, was extubated in the operating room, and was transported to the post-anesthesia care unit in stable condition.

## Template Operative Dictation (Flexible)

**Preoperative Diagnosis** Esophageal foreign body

**Postoperative Diagnosis** Esophageal foreign body

### Findings

1. Esophageal foreign body at the level of *cricopharyngeus/mid-esophagus/gastroesophageal junction*
2. No evidence of intraluminal injury
3. Normal cervical esophageal anatomy

**Procedure(s) Performed** Flexible esophagoscopy with foreign body removal

**Anesthesia** *General endotracheal anesthesia/Procedural sedation*

**Specimen** *Coin/foreign object/none*

**Estimated Blood Loss** None

**Indications** This is a/an \_\_\_-day/week/month/year-old *male/female* with a/an \_\_\_-day/hour/week history of drooling and dysphagia after a choking event. A suspected esophageal foreign body was confirmed radiographically. *He/she* was deemed to be a suitable candidate for flexible esophagoscopy with removal of foreign body.

**Procedure in Detail** The patient was placed in *supine position/lateral decubitus position* and appropriately padded after a smooth induction of general anesthesia. Timeouts were performed using both pre-induction and pre-incision safety checklists with participation of all present in the operative suite. These confirmed the correct patient, procedure, operative site, and additional critical information prior to the start of the procedure. A bite block was placed in the mouth. A size \_\_\_ flexible endoscope was introduced to the oral cavity and advanced through the

upper esophagus, maintaining direct vision of the lumen throughout. The foreign body was visualized at the level of the \_\_\_\_\_. At this point, a grasping forceps was introduced through the working channel of the endoscope and advanced through until the tip could be visualized. The foreign body was grasped and pulled up against the endoscopy channel. The endoscope and foreign body were retracted out through the oral cavity. The endoscope was then reinserted past the level of the previous foreign body and slowly with-

drawn. The esophageal mucosa appeared intact and undamaged, with no anatomical abnormalities noted. The endoscope was then removed and the procedure terminated.

Upon completion of the procedure, a debriefing checklist was completed to share information critical to the postoperative care of the patient. The patient tolerated the procedure well, was extubated in the operating room, and was transported to the post-anesthesia care unit in stable condition.





# Flexible Esophagoscopy and Fluoroscopically Guided Dilation

# 2

William B. Rothstein and Laura A. Boomer

## Indications and Benefits

- Symptomatic strictures related to anastomotic strictures (after esophageal atresia repair), caustic ingestion, or other cause
- Benefits: Direct visualization of stricture, confirmation of dilation, evaluation of the esophageal mucosa

## Risks and Alternatives

- Standard risks (bleeding, infection, need for additional procedures, risks of anesthesia)
- Injury to adjacent structures (teeth, pharynx, esophagus)
- Aspiration
- Perforation of the pharynx or esophagus
- Alternatives: Enteric feeding tube placement, fluoroscopically guided balloon dilation, esophageal resection

W. B. Rothstein  
Virginia Commonwealth University Health System,  
Department of Surgery, Richmond, VA, USA

L. A. Boomer (✉)  
Children's Hospital of Richmond, Virginia  
Commonwealth University, Department of  
Pediatric Surgery, Richmond, VA, USA  
e-mail: [Laura.boomer@vcuhealth.org](mailto:Laura.boomer@vcuhealth.org)

## Essential Steps

### Flexible Esophagoscopy with Balloon Dilation of Stricture

1. Place patient in left lateral decubitus or supine position with neck extended.
2. A bite block facilitates easy passage of the scope.
3. Insert a flexible endoscope over the tongue and advance along the posterior pharynx under direct visualization. For sufficiently tight strictures, a bronchoscope may be necessary.
4. Apply gentle insufflation and pressure against the upper esophageal sphincter to advance into cervical esophagus.
5. Advance to the point of stricture. Carefully inspect the mucosa for signs of perforation. If visual findings are inconsistent with pre-procedure diagnosis, consider tissue sample.
6. A wire can be passed through the stricture under fluoroscopic guidance.
7. Pass the balloon dilator through the scope and over the wire.
8. Real-time fluoroscopy may be used to confirm placement of the balloon across the stricture. Balloon should sit with equal portions above and below the point of stricture.
9. Dilation diameter should be selected based on pre-procedure radiographic findings.

10. Fill the balloon dilator with water or contrast and maintain for 30 seconds to 1 minute at each chosen dilator diameter.
11. Watch the balloon fill under fluoroscopy to ensure balloon does not slip above or below stricture, as well as directly with the endoscope.
12. Repeat or serial dilations may be necessary depending on the etiology of the stricture.
13. Remove the balloon dilator and again inspect mucosa for bleeding or perforation.
14. It may be possible to traverse the stricture with the flexible endoscope following dilation.

---

### Note These Variations

- Push dilators or bougies may be used in place of a balloon dilator. After passage of a guidewire through the stricture, the bougie is passed over the wire and guided into the stomach by fluoroscopy. Additionally, some bougies do not have the ability to be passed over a wire. These may be inserted directly into the esophagus, but passage should be visualized with fluoroscopy. This method is associated with a greater risk of bleeding and perforation due to the shear stress of the dilator.

---

### Template Operative Dictation

**Preoperative Diagnosis** Esophageal stricture

**Postoperative Diagnosis** Esophageal stricture

#### Findings

1. \_\_\_-cm long, circumferential radial stricture in *cervical esophagus/mid-esophagus/distal esophagus*
2. No evidence of esophageal perforation pre- or post-procedure

#### Procedure(s) Performed

1. Flexible endoscopy with balloon dilation of esophageal stricture
2. Intraoperative fluoroscopy with surgeon interpretation

**Anesthesia** *General/procedural sedation*

**Specimen** {Specimen}

**Estimated Blood Loss** \_\_\_ ml

**Indications** This is a/an \_\_\_ *day/week/month/year-old male/female* with a history of *esophageal atresia with tracheoesophageal fistula/caustic ingestion/{other primary cause}*. Patient symptoms were concerning for stricture, which was confirmed by *upper GI study/endoscopy*. *He/she* was deemed to be a suitable candidate for flexible endoscopy with balloon dilation of esophageal stricture.

**Procedure in Detail** After a smooth induction of anesthesia, the patient was placed in *left lateral decubitus position/supine position* and appropriately padded. Timeouts were performed using both pre-induction and pre-incision safety checklists with participation of all present in the operative suite. These confirmed the correct patient, procedure, operative site, and additional critical information prior to the start of the procedure. A flexible endoscope was introduced to the oral cavity and advanced through the upper esophageal sphincter under direct visualization. A symmetrical, circumferential stricture was visualized in the \_\_\_. At this point, a guidewire was inserted through the accessory port of the endoscope and across the stricture under direct fluoroscopy. A \_\_\_-mm balloon dilator was introduced through the accessory port of the endoscope over the wire. A small amount of contrast was introduced into the balloon and placement confirmed by fluoroscopy. Once the

balloon dilator was able to be passed through the stricture, and its position confirmed on fluoroscopy, the wire was removed. The balloon was then inflated with contrast for 60 seconds to the designated pressure. The balloon was then completely deflated. A second dilation was performed in a similar fashion with a \_\_\_-mm balloon. The balloon was again deflated and then withdrawn. After the procedure, the mucosa was inspected carefully with the endoscope.

There was a small amount of bleeding, but no other sign of mucosal damage. Upon completion of the procedure, a debriefing checklist was completed to share information critical to the postoperative care of the patient. The patient tolerated the procedure well, was extubated in the operating room, and was transported to the post-anesthesia care unit in stable condition. A post-procedure chest radiograph was obtained in the recovery room.



# Repair of Esophageal Atresia with Tracheoesophageal Fistula (Open and MIS Approaches)

# 3

Dominic J. Papandria and Karen A. Diefenbach

## Indications and Benefits

- Esophageal atresia, with or without tracheoesophageal fistula
- Benefits: Restoration of esophageal continuity, protection of the airway from aspiration when fistula present

## Risks and Alternatives

- Standard risks (bleeding, infection, need for additional procedures, risks of anesthesia)
- Injury to adjacent structures (trachea, esophagus, azygous vein, lung, vagus nerve, recurrent laryngeal nerves)
- Chest wall deformity, scoliosis (associated with open approach)
- Anastomotic leak, anastomotic stricture, or recurrence of fistula
- Alternatives: Temporary occlusion/ligation of fistula

D. J. Papandria  
Department of Surgery, Emory University,  
Atlanta, GA, USA

K. A. Diefenbach (✉)  
Nationwide Children's Hospital,  
Columbus, OH, USA  
e-mail: [Karen.Diefenbach@nationwidechildrens.org](mailto:Karen.Diefenbach@nationwidechildrens.org)

## Essential Steps

### Thoracoscopic Repair

1. Rigid bronchoscopy with patient in supine position and occlusion of the fistula with Fogarty catheter
2. Position patient in left lateral decubitus position (left side down) and pad and secure patient to operative table
3. Prep and drape
4. Port placement
5. Identification, isolation, and ligation of the tracheoesophageal fistula
6. Identification and mobilization of the upper esophageal pouch
7. Division of the fistula and resection of the tip of the proximal segment of the esophagus
8. Anastomosis of the proximal and distal esophageal segments
9. Injection of local anesthetic to perform intercostal rib blocks for regional anesthetic effect
10. Placement of thoracic drain near the anastomosis
11. Closure of the remaining incisions

### Repair by Thoracotomy

1. Rigid bronchoscopy and placement of Fogarty catheter to occlude the fistula

2. Position patient in left lateral decubitus position (left side down) and pad and secure patient to operative table
3. Prep and drape
4. Muscle-sparing thoracotomy incision and placement of retractors
5. Identification, isolation, and ligation of the tracheoesophageal fistula
6. Identification and mobilization of the upper esophageal pouch
7. Division of the fistula and resection of the tip of the proximal segment of the esophagus
8. Anastomosis of the proximal and distal esophageal segments
9. Placement of thoracic drain near the anastomosis
10. Closure of the thoracotomy

---

### Note These Variations

- Bronchoscopy is not performed by all surgeons; it is included as many surgeons do it routinely to evaluate tracheal anatomy, identify the location of the distal fistula, rule out a proximal fistula, evaluate for significant tracheomalacia, and optimally place the endotracheal tube.
- At the time of the bronchoscopy, a Fogarty catheter may be used to occlude the fistula to facilitate ventilation and allow general anesthesia including paralytics to be given prior to entrance into the chest and ligation of the fistula.
- Preoperative echocardiogram is performed on all of these patients to evaluate for congenital cardiac anomalies which are frequently associated with TEF/EA and to evaluate the location of the aortic arch. Some surgeons will change their approach from the right to the left if there is a right-sided aortic arch.

---

### Template Operative Dictation (Thoracoscopic)

**Preoperative Diagnosis** *Esophageal atresial esophageal atresia with tracheoesophageal fistula*

**Postoperative Diagnosis** Same as preoperative diagnosis

**Findings** Same as postoperative diagnosis

**Procedure(s) Performed** Thoracoscopic repair of esophageal atresia *with tracheoesophageal fistula*

**Anesthesia** General

**Specimen** None

**Drains** *None/\_\_\_FR chest tube/\_\_\_FR drain*

**Implants** None

**Estimated Blood Loss** \_\_\_mL

**Indications** This is a/an \_\_\_-day/week/month/year-old *male/female* with esophageal atresia and tracheoesophageal fistula. *He/she* was deemed to be a suitable candidate for thoracoscopic repair of the same.

**Procedure in Detail** Timeouts were performed using both pre-induction and pre-incision safety checklists with participation of all present in the operative suite. These confirmed the correct patient, procedure, operative site, and additional critical information prior to the start of the procedure. General anesthesia was induced and patient remained spontaneously breathing. *A rigid bronchoscopy was performed which noted normal tracheal anatomy, mild/moderate/severe tracheomalacia, and a tracheoesophageal fistula at approximately \_\_\_cm proximal to the carina. A 3/4/5 FR Fogarty catheter was passed through the fistula and the balloon inflated to occlude the fistula. The endotracheal tube was then placed in a midtrachea position.* The patient was placed in left lateral decubitus position and appropriately padded and secured. The right chest and axilla were then prepped and draped in the usual sterile fashion. A \_\_\_-mm port was placed in the anterior axillary line at the level of the \_\_\_ intercostal space. After verifying the position of the port in the chest, the chest was insufflated to a pressure of 4/6 mmHg. Two additional ports were placed under direct

vision, one in the anterior axillary line at the \_\_\_ intercostal space under direct vision and one in the posterior axillary line in the \_\_\_ intercostal space.

**[Choose One:]**

**If tracheoesophageal fistula:** Inspection of the chest revealed the azygous vein and blunt dissection revealed the distal esophagus below the vein. Following the distal esophagus superiorly, the fistula was identified where it inserted on the posterior wall of the membranous trachea. *To facilitate safe ligation of the fistula, the azygous vein was ligated and divided using electrocautery/a bipolar sealing device/endoclips.* The fistula was then ligated using a \_\_\_-0 Vicryl suture ligature/an endoclip. The fistula was divided and the distal portion of the esophagus was mobilized to minimize tension on the anastomosis.

**If pure atresia:** {Continue dictation}

Inspection of the chest near the esophageal hiatus revealed a short distal segment of distal esophagus. This was mobilized circumferentially using blunt dissection being careful to avoid injury to any vagal fibers. A bipolar sealing device was used for hemostasis.

{Continue dictation}

Dissection was then performed to expose and mobilize the proximal esophageal pouch using blunt dissection and bipolar sealing device for hemostasis. Gentle pressure on the orogastric tube facilitated this process. Care was taken to dissect closely along the esophagus to avoid injury to the membranous trachea and the recurrent laryngeal nerves. Any vagal fibers were preserved when possible.

Once both the proximal and distal segments of the esophagus were mobilized, the end of the proximal esophageal segment was *excised/incised* to expose the mucosa. The anastomosis was then performed using interrupted \_\_\_-0 Vicryl/PDS suture starting at the far corner of the posterior wall of the anastomosis and completing the back wall. The OG tube was then passed under direct vision into the distal esophagus and the anterior wall of the anastomosis was then completed starting from the farthest corner. A total of \_\_\_ sutures were placed. The transanastomotic tube was *removed/passed into the stomach and secured by anesthesia.*

*Intercostal rib blocks were performed under direct visualization using \_\_\_% Marcaine with epinephrine. A \_\_\_FR chest tube/ \_\_\_ drain was placed adjacent to the anastomosis and secured as it exited the chest at the inferior, anterior incision using \_\_\_-0 Silk/Neuroton/Nylon suture.*

The remaining ports were removed and the incisions closed at the level of the fascia using a \_\_\_-0 Vicryl suture and a \_\_\_-0 Monocryl suture. Dressings were applied to the incisions *and the drain site.*

Upon completion of the procedure, a debriefing checklist was completed to share information critical to the postoperative care of the patient. The patient tolerated the procedure well. *He/she remained intubated and was transported to the NICU unit in stable condition thereafter.*

---

## Template Operative Dictation (Open)

**Preoperative Diagnosis** *Esophageal atresial Esophageal atresia with tracheoesophageal fistula.*

**Postoperative Diagnosis** Same as preoperative diagnosis

**Findings** Same as postoperative diagnosis

**Procedure(s) Performed** Repair of esophageal atresia with tracheoesophageal fistula

**Anesthesia** General

**Specimen** None

**Drains** None/\_\_\_FR chest tube/\_\_\_FR drain

**Implants** None

**Estimated Blood Loss** \_\_\_ mL

**Indications** This is a/an \_\_\_-day/week/month/year-old male/female with esophageal atresia and tracheoesophageal fistula. He/she was deemed to be a suitable candidate for repair of the same by thoracotomy.

**Procedure: in Detail** Timeouts were performed using both pre-induction and pre-incision safety checklists with participation of all present in the operative suite. These confirmed the correct patient, procedure, operative site, and additional critical information prior to the start of the procedure. General anesthesia was induced and patient remained spontaneously breathing. *A rigid bronchoscopy was performed which noted normal tracheal anatomy, mild/moderate/severe tracheomalacia, and a tracheoesophageal fistula at approximately \_\_\_ cm proximal to the carina. A 3/4/5 FR Fogarty catheter was passed through the fistula and the balloon inflated to occlude the fistula. The endotracheal tube was then placed in a mid-trachea position.* The patient was placed in left lateral decubitus position and appropriately padded and secured. The right chest and axilla were then prepped and draped in the usual sterile fashion. A muscle-sparing incision was made at the level of the fourth intercostal space extending from the anterior axillary line posteriorly for a length of \_\_\_ cm. The latissimus dorsi muscle was mobilized and retracted without dividing and the serratus anterior muscle was mobilized from its posterior insertion to expose the ribs and intercostal muscles. The chest was entered at the fourth intercostal space just superior to the fifth rib. *Care was taken to preserve the parietal pleura.* The Finochietto retractor was used to spread the ribs. Blunt dissection was used to separate the parietal pleura from the chest wall posteriorly until the distal esophagus was identified.

**[Choose One:]**

***If tracheoesophageal fistula:*** Following the distal esophagus superiorly, the fistula was identified where it inserted on the posterior wall of the membranous trachea. *To facilitate safe ligation of the fistula, the azygous vein was ligated and divided using electrocautery/suture ligation.* The fistula was then ligated and divided using a \_\_\_-0 Vicryl suture ligature/interrupted \_\_\_-0 \_\_\_ sutures. The distal portion of the esophagus was mobilized to minimize tension on the anastomosis.

***If pure atresia:*** The distal esophagus was mobilized circumferentially to minimize tension

on the anastomosis using blunt dissection being careful to avoid injury to any vagal fibers. A bipolar sealing device was used for hemostasis.

{Continue dictation}

Dissection was then performed to expose and mobilize the proximal esophageal pouch using blunt dissection and bipolar sealing device for hemostasis. Gentle pressure on the orogastric tube facilitated this process. Care was taken to dissect closely along the esophagus to avoid injury to the membranous trachea and the recurrent laryngeal nerves. Any vagal fibers were preserved when possible.

Once both the proximal and distal segments of the esophagus were mobilized, the end of the proximal esophageal segment was *excised/incised* to expose the mucosa. The anastomosis was then performed using interrupted \_\_\_-0 Vicryl/PDS suture starting at the far corner of the posterior wall of the anastomosis and completing the back wall. The OG tube was then passed under direct vision into the distal esophagus and the anterior wall of the anastomosis was then completed starting from the farthest corner. A total of \_\_\_ sutures were placed. The transanastomotic tube was *removed/passed into the stomach and secured by anesthesia.*

*A \_\_\_FR chest tube/ \_\_\_ drain was placed adjacent to the anastomosis and secured as it exited the chest at the anterior and inferior to the incision using \_\_\_-0 Silk/Neuroton/Nylon suture.*

The incision was closed in layers. Interrupted \_\_\_-0 Vicryl sutures were used to approximate the ribs being careful to not obliterate the intercostal space. The serratus anterior muscle was reapproximated to its posterior insertion using interrupted \_\_\_-0 Vicryl sutures. The subcutaneous tissue was closed using a running \_\_\_-0 Vicryl suture and the skin was closed using a running \_\_\_-0 Monocryl suture. Dressings were applied to the incisions *and the drain site.*

Upon completion of the procedure, a debriefing checklist was completed to share information critical to the postoperative care of the patient. The patient tolerated the procedure well. *He/she remained intubated and was transported to the NICU unit in stable condition thereafter.*





# Esophageal Replacement

# 4

Michaela Kollisch-Singule and Jennifer Stanger

---

## Indications and Benefits

- Esophageal stricture (from caustic injury, reflux esophagitis, anastomotic scarring after esophageal atresia repair, achalasia)
- Congenital esophageal stenosis (if not amenable to resection with end-to-end anastomosis)
- Long-gap esophageal atresia
- Benefits: Continuity of gastrointestinal tract to optimize enteral nutrition

---

## Risks and Alternatives

- Standard risks (bleeding, infection, need for additional procedures, risks of anesthesia)
- Injury to adjacent structures (azygous vein, vagus nerve, posterior membranous trachea)
- Vascular insufficiency with necrosis
- Anastomotic stricture/leak/ulcer
- Delayed gastric emptying, disordered peristalsis, ulcers

- Long term: Dilation and dysmotility of the conduit
- Alternatives: Serial dilations of strictures, delayed repair of atresia/stenosis, gastric/jejunal feeding tubes for enteral nutrition

---

## Essential Steps

1. Abdominal incision
2. Mobilization of esophagus
3. Mediastinal dissection of esophagus
4. Neck dissection of esophagus
5. *If {Colon interposition}*
  - (a) Division of gastrocolic ligament
  - (b) Mobilization of ascending and descending colon
  - (c) Conduit assessment for perfusion
  - (d) Ligation of left branch of the middle colic artery and the marginal artery (with preservation of the ascending branch of the left colic artery)
  - (e) Transection of transverse colon
  - (f) Mobilization of colon up mediastinum
  - (g) Division of descending colon
  - (h) Transection of stomach distal to gastroesophageal junction
  - (i) Withdrawal of esophagogastric specimen from mediastinum through neck
  - (j) Creation of colono-gastric anastomosis
  - (k) Creation of colo-colonic anastomosis

---

M. Kollisch-Singule (✉)  
SUNY Upstate Medical University, Department  
of General Surgery, Syracuse, NY, USA  
e-mail: [KolliscM@upstate.edu](mailto:KolliscM@upstate.edu)

J. Stanger  
SUNY Upstate Medical University, Department  
of Pediatric Surgery, Syracuse, NY, USA



## 6. *If {Gastric tube}*

- (a) Gastrohepatic ligament divided down to pylorus
  - (b) Mobilization of greater curvature of stomach
  - (c) Ligation of left gastric artery
  - (d) {Pyloroplasty}
  - (e) Creation of gastric tube with sequential staple loads
  - (f) Withdrawal of esophagogastric specimen from mediastinum through neck
7. Transection of cervical esophagus
  8. Anastomosis between cervical esophagus and colon/gastric conduit
  9. Penrose drain into neck
  10. {Jejunostomy feeding tube}
  11. Closure

---

### Note These Variations

- Open, laparoscopic, robotic approach
- Conduit choice: Colonic interposition, gastric tube, gastric transposition, jejunal substitution
- Stapled/handsewn anastomoses
- Suture choices
- Placement of jejunostomy feeding tube

---

### Template Operative Dictation (Open)

**Preoperative Diagnosis** Esophageal *stricture/stenosis/atresia*

**Postoperative Diagnosis** Same as preoperative diagnosis

**Findings** Same as postoperative diagnosis

**Procedure(s) Performed** Esophageal replacement

**Anesthesia** *General*

**Specimen** *Esophagus/esophagogastrectomy*

**Drains** Penrose in neck

**Implants** None

**Estimated Blood Loss** \_\_\_ mL

**Indications** This is a/an \_\_\_-day/week/month/year-old *male/female* with esophageal *stricture/stenosis/atresia*, which was causing *dysphagia/odynophagia/inability to maintain oral nutrition*. *He/she* was deemed to be a suitable candidate for esophageal replacement with a *colon transposition/gastric tube*.

**Procedure in Detail** Following satisfactory induction of anesthesia, the patient was placed in a supine position and appropriately padded. {A Foley catheter and nasogastric tube were placed.} Timeouts were performed using both pre-induction and pre-incision safety checklists with participation of all present in the operative suite. These confirmed the correct patient, procedure, operative site, and additional critical information prior to the start of the procedure. The abdomen and left neck were then prepped and draped in the usual sterile fashion. Prophylactic antibiotics were given.

*An upper midline/transverse/subcostal incision was made into the abdomen and the peritoneal cavity entered. The pars flaccida was incised and dissected to the right crus of the diaphragm. The crural dissection was continued by coming across the anterior arch of the diaphragm. The left crus was similarly dissected as much as possible, which required ligation of the short gastric arteries, until the anterior aspect of the gastro-esophageal junction was visualized. The esophagus was retracted laterally to expose the decussation of the crural fibers, and a retroesophageal window was developed until the esophagus was circumferentially mobilized. The esophageal hiatus was widened by incising it anteriorly. The phrenic vein was ligated in order to adequately expose the mediastinum.*

The mediastinum was entered and the loose areolar tissue was bluntly dissected around the distal esophagus separating it from the surrounding mediastinal attachments and mobilization carried proximally toward the neck.

Attention was turned to the left neck. Just anterior to the sternocleidomastoid muscle and extending to just above the sternum, a small neck

incision was made and carried down along the medial aspect of the sternocleidomastoid muscle. The omohyoid and sternohyoid muscles were divided. The dissection was carried deeper until the vertebral bodies were palpable posteriorly. The esophagus was bluntly dissected free of the posterior membranous trachea anteriorly, and from the vertebral bodies posteriorly. The cervical esophagus was encircled with a/an \_\_\_-inch Penrose drain and retracted gently caudally allowing for blunt dissection inferiorly toward the previous mediastinal dissection from the transhiatal approach.

**[Choose one:]**

**If {colon interposition}:** {The patient preoperatively received a colonic *mechanical/antibiotic* prep.} The gastrocolic ligament was incised, separating the transverse colon from the greater curvature of the stomach. The splenic and hepatic flexures were taken down. In a lateral-to-medial approach, the mobilization of the left colon was continued from the splenic flexure down the white line of Toldt, mobilizing the descending colon off the retroperitoneum to the level of the sigmoid colon. In a similar fashion, the ascending colon was mobilized to the level of the cecum dissecting down from the hepatic flexure sweeping the colon off the hepatorenal fossa and retroperitoneum, while protecting the ureter, duodenum, and kidney. The colon was grasped and elevated to identify the tenting of the mesentery to indicate the regions of the middle and left colic vascular pedicles. {Transillumination was used to identify the arteries.} The peritoneum was incised on either side of these vessels in order to isolate them. {The length of colon required for the conduit was estimated by measuring the distance from the angle of the mandible to the xiphoid process.} The conduit was assessed for adequate perfusion and viability by placing small bulldog clamps on the arteries to be ligated and reassessing for graft viability. After several minutes, the bowel appeared *healthy/dusky* {and flow was confirmed with fluorescein dye injection/mesenteric Doppler flow/inspected for venous congestion}. After demonstrating adequate perfusion, the left branch of the middle colic artery was

ligated at its origin and the marginal artery was ligated. The remaining mesentery between the right colic artery and the right branch of the middle colic artery was divided, being cautious to leave the ascending branch of the left colic artery and arcades intact. Using the previously noted required length for guidance, the transverse colon was divided and brought up through the mediastinum and through the cervical neck incision in an isoperistaltic fashion, verifying that there were no twists in the mesentery. The distal colon was divided, verifying adequate conduit length to reach the stomach. An anastomosis was fashioned with a *handsewn/stapled* anastomosis to re-establish continuity of the colon. The stomach was stapled just distal to the gastroesophageal junction. A colono-gastric anastomosis was created with a *handsewn anastomosis/linear cutting staples* verifying no redundancy of the colon within the mediastinum.

**If {gastric tube}:** The division of the gastrohepatic ligament was continued along the lesser curvature of the stomach to the duodenum, exposing the lesser sac. {No accessory/replaced left hepatic artery was noted.} Attention was then directed to mobilizing the greater curvature of the stomach. The gastrocolic ligament was divided while the right gastroepiploic artery and arcade were carefully preserved. Retrogastric adhesions to the retroperitoneum and pancreas were taken down. Once the lesser sac was completely mobilized, the left gastric pedicle was ligated with a \_\_\_\_\_ before completely freeing the stomach. {A pyloroplasty was performed.} The nasogastric tube was withdrawn. The gastric conduit was created in an *isoperistaltic/retroperistaltic fashion* over a \_\_\_\_\_ French chest tube, using a stapler along the greater curvature of the stomach. The left gastroepiploic arcade was identified and preserved throughout this process. Sequential staple loads were used until adequate length of the tube was obtained to reach the cervical incision. {The suture line was oversewn with \_\_\_\_\_ suture.} The gastric conduit was withdrawn into the cervical neck wound and visualized directly from the abdomen to verify that the staple line remained lateral and the specimen did not twist.

The cervical esophagus was transected sharply and the esophagus and *colon/gastric*

conduit were lifted out of the mediastinum via the neck incision. The *colon/gastric* conduit was opened and a heel stitch secured between the cervical esophagus and *gastric/colonic* conduit. A *cutting stapler/handsewn anastomosis* was used to create a *side-to-side/end-to-end* anastomosis between the cervical esophagus and the conduit. The remaining defect was then closed with *interrupted \_\_ sutures/TA stapler* and a nasogastric tube was then passed distally into the neo-esophagus. After completing the anastomosis, the conduit was grasped and pulled down into the abdomen until the cervical anastomosis seated down into the neck, ensuring a straight conduit. Hemostasis was verified. The nasogastric tube was secured at \_\_cm at the

level of the nares. {A jejunostomy feeding tube was placed.}

The abdomen was irrigated and hemostasis verified. The abdominal fascia was closed with \_\_ suture. The wound was irrigated and closed with \_\_\_\_. A Penrose drain was placed in the cervical neck incision and secured. The neck incision was closed with interrupted \_ suture and the skin was reapproximated with \_\_ and dressed.

Upon completion of the procedure, a debriefing checklist was completed to share information critical to the postoperative care of the patient. The patient tolerated the procedure well, *was extubated in the operating room*, and was transported to the post-anesthesia care unit in stable condition thereafter.