Practical Pediatric Gastrointestinal Endoscopy
Practical Pediatric Gastrointestinal Endoscopy

Third Edition

Edited by

George Gershman
Professor of Pediatrics, David Geffen School of Medicine
Chief, Division of Pediatrics Gastroenterology, Hepatology and Nutrition
Harbor-UCLA Medical Center
Torrance, California, USA

Mike Thomson
Professor of Paediatric Gastroenterology and Interventional Endoscopy
Director of the International Academy for Paediatric Endoscopy Training
Centre for Paediatric Gastroenterology, Nutrition and Haematology
Sheffield Children's Hospital NHS Foundation Trust
Sheffield, UK;
Portland Hospital for Women and Children
London, UK
# Contents

## Personal statements  ix
## Contributors  xvii
## About the Companion Website  xxiii

### Part One  Pediatric Endoscopy Setting  1

1 **Introduction**  
George Gershman and Mike Thomson

2 **History of pediatric gastrointestinal endoscopy**  
Samy Cadranel, Jean-François Mougenot, and Douglas S. Fishman

3 **The endoscopy unit**  
Harpreet Pall

4 **Pediatric procedural sedation and general anesthesia for gastrointestinal endoscopy**  
Tom Kallay, Rok Orel, and Jernej Brecelj

5 **Pediatric endoscopy training and ongoing assessment**  
Catharine M. Walsh, Looi Ee, Mike Thomson, and Jenifer R. Lightdale

6 **Recertification and revalidation as concepts in pediatric endoscopy**  
Priya Narula and Mike Thomson

7 **The role of the Global Rating Scale in pediatric endoscopy**  
Priya Narula and Mike Thomson

8 **Quality indicators as a critical part of pediatric endoscopy provision**  
Priya Narula and Mike Thomson

9 **e-learning in pediatric endoscopy**  
Claudio Romano and Mike Thomson
<table>
<thead>
<tr>
<th>Section</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Part Two  Diagnostic Pediatric Endoscopy</td>
<td>43</td>
</tr>
<tr>
<td>10  Indications for gastrointestinal endoscopy in childhood</td>
<td>45</td>
</tr>
<tr>
<td>Dalia Belsha, Jerome Viala, George Gershman, and Mike Thomson</td>
<td></td>
</tr>
<tr>
<td>11  Diagnostic upper gastrointestinal endoscopy</td>
<td>53</td>
</tr>
<tr>
<td>George Gershman and Mike Thomson</td>
<td></td>
</tr>
<tr>
<td>12  Pediatric ileocolonoscopy</td>
<td>77</td>
</tr>
<tr>
<td>George Gershman and Mike Thomson</td>
<td></td>
</tr>
<tr>
<td>13  Handling of specimens and orientation of biopsies</td>
<td>113</td>
</tr>
<tr>
<td>Marta C. Cohen and Paul Arnold</td>
<td></td>
</tr>
<tr>
<td>14  Enteroscopy</td>
<td>117</td>
</tr>
<tr>
<td>Mike Thomson and Arun Urs</td>
<td></td>
</tr>
<tr>
<td>15  Wireless capsule endoscopy</td>
<td>129</td>
</tr>
<tr>
<td>Mike Thomson</td>
<td></td>
</tr>
<tr>
<td>16  Endoscopic ultrasonography</td>
<td>141</td>
</tr>
<tr>
<td>Simona Faraci, Luigi Dall’Oglio, Paola de Angelis, and Douglas S. Fishman</td>
<td></td>
</tr>
<tr>
<td>17  Chromoendoscopy</td>
<td>157</td>
</tr>
<tr>
<td>Mike Thomson and Paul Hurlstone</td>
<td></td>
</tr>
<tr>
<td>18  Confocal laser endomicroscopy in the diagnosis of pediatric gastrointestinal disorders</td>
<td>167</td>
</tr>
<tr>
<td>Mike Thomson and Krishnappa Venkatesh</td>
<td></td>
</tr>
<tr>
<td>19  High-risk pediatric endoscopy</td>
<td>175</td>
</tr>
<tr>
<td>Jenifer R. Lightdale, Mike Thomson, and Douglas S. Fishman</td>
<td></td>
</tr>
<tr>
<td>Part Three  Pediatric GI Pathologies and the Role of Endoscopy in Their Management</td>
<td>183</td>
</tr>
<tr>
<td>20  Esophagitis</td>
<td>185</td>
</tr>
<tr>
<td>Mário C. Vieira, Luciana B. Mendez Ribeiro, and Sabine Krüger Truppel</td>
<td></td>
</tr>
<tr>
<td>21  Eosinophilic esophagitis</td>
<td>195</td>
</tr>
<tr>
<td>Calies Menard-Katcher, Glenn T. Furuta, and Robert E. Kramer</td>
<td></td>
</tr>
<tr>
<td>22  Gastritis and gastropathy</td>
<td>201</td>
</tr>
<tr>
<td>Shishu Sharma and Mike Thomson</td>
<td></td>
</tr>
</tbody>
</table>
Contents

23 Celiac disease 207
Alina Popp, Vasile Daniel Balaba, and Markku Mäki

24 Role of endoscopy in inflammatory bowel disease including scoring systems 213
Salvatore Oliva, Mike Thomson, David Wilson, and Dan Turner

Part Four Therapeutic Pediatric Endoscopy 221

25 Endoscopic management of esophageal strictures 223
Michael Manfredi, Frederick Gottrand, Luigi Dall’Oglio, Mike Thomson, George Gershman, Antonio Quiros, and Thierry Lamireau

26 Endoscopic management of caustic ingestion 235
Erasmo Miele and Samy Cadranel

27 Pneumatic balloon dilation and peroral endoscopic myotomy for achalasia 241
Valerio Balassone, Mike Thomson, and George Gershman

28 Endoscopic approaches to the treatment of gastroesophageal reflux disease 249
Mike Thomson and Chris Fraser

29 Foreign body ingestion 261
Raoul Furlano, George Gershman, and Jenifer R. Lightdale

30 Non-variceal endoscopic hemostasis 269
George Gershman, Jorge H. Vargas, and Mike Thomson

31 Variceal endoscopic hemostasis 279
Patrick McKiernan, Lauren Johanson, and Mike Thomson

32 Endoscopic approach to obscure gastrointestinal bleeding lesions 287
Natalia Nedelkopoulou, Sara Isoldi, Dalia Belsha, and Mike Thomson

33 Percutaneous endoscopic gastrostomy 295
Natalie Bhesania, Mike Thomson, and Marsha Kay

34 Single-stage percutaneous endoscopic gastrostomy 305
Andreia Nita, Jorge Amil-Dias, Arun Urs, Mike Thomson, and Prithviraj Rao

35 Pediatric laparoscopic-assisted direct percutaneous jejunostomy 317
Mike Thomson, Jonathan Goring, Richard Lindley, and Sean Marven

36 Naso-jejunal and Gastro-jejunal tube placement 323
George Gershman
37 **Endoscopic retrograde cholangiopancreatography** 325
*Douglas S. Fishman, Paola de Angelis, Luigi Dall’Oglio, and Victor Fox*

38 **Endoscopic drainage of pancreatic pseudocysts** 343
*Mike Thomson*

39 **Duodenal web division by endoscopy** 347
*Mike Thomson, Shishu Sharma, Filippo Torroni, and Jonathan Goring*

40 **Polypectomy** 351
*George Gershman, Mike Thomson, and Gabor Veres*

41 **Endomucosal resection** 361
*Mike Thomson and Paul Hurlstone*

42 **Endoscopic management of polyposis syndromes** 371
*Warren Hyer, Mike Thomson, and Thomas Attard*

43 **Transnasal gastrointestinal endoscopy** 377
*Sara Koo, Kristina Leinwand, Simon Panter, and Joel A. Friedlander*

44 **Endoscopic bariatric approaches** 387
*Mike Thomson and Matjaz Homan*

45 **Over-the-scope clip and full-thickness resection device** 393
*Mike Thomson*

46 **Endoscopic treatment of gastrointestinal bezoars** 397
*Andreia Nita and Mike Thomson*

47 **Natural orifice transendoluminal surgery** 401
*Mike Thomson*

Index 403
George Gershman

To the new generations of pediatric gastroenterologists and endoscopy enthusiasts: a letter to the future.

Once upon a time, there was a young fellow in Moscow, Russia, who was a resident working in one of the oldest hospitals in Moscow, named after Yevgeny Botkin, court physician to Tsar Nicholas II (who was murdered along with the entire Tsarust family by Bolsheviks in 1918).

The training was all about patient care. The diagnostic tools were limited to a stethoscope, basic laboratory support, and X-rays. The time felt almost frozen.

One day, I heard a rumor that one of the attending physician named Eduard Rokhlin was performing unique procedures, and out of curiosity I asked for permission to watch.

To my surprise, I was allowed not only to observe the study but look inside the endoscope. I still remember that moment of excitement and disbelieve that I was looking inside the stomach of a live person in real time. It was the moment which changed my life. I was fortunate to witness the fast progression of flexible endoscopy from a primitive stage of large-caliber fiberscopes with an eyepiece resembling that of old microscopes to modern high-definition, slim and ultra-slim video endoscopes, single- and double-balloon enteroscopes, endoscopic capsules, and many other innovations which have opened unlimited diagnostic and therapeutic possibilities in the field of pediatric gastroenterology.

You, my young colleague, who have opened a new page of your life, step into a fascinating journey of new discoveries in pediatric gastroenterology.

I express my deep gratitude to Dr Eduard Rokhlin, who was my endoscopy mentor and dear friend; Professor Samy Cadranel and Jean-François Mougenot: two remarkable physicians and endoscopists who opened the door for me to enter the world of European community of pediatric gastroenterology; Professor Jon A. Vanderhoof, who gave me the opportunity to share my endoscopy skills and scientific data with my American colleagues at the Annual Meeting of North American Society of Pediatric Gastroenterology and Hepatology in 1989; and Professor Marvin E. Ament, one of the pioneers of pediatric GI endoscopy, who invited me to work with him at UCLA in Los Angeles. Finally, this book would not be possible without love and support of Irina, my amazing wife and healer and my daughter Zhenya, a talented artist, educated and art historian and my granddaughter Nikka, a truly gifted musician and composer.
**Mike Thomson**

**Why Pediatric Endoscopy?**

Please forgive this indulgence, but as you may divine from this, I am clearly a little too focussed, and some may say ‘sad and obsessed’, with this area of medicine!

Like most things in life, and particularly in the serendipitous, chaotic and mal-designed world of medical careers, I ‘fell’ in to endoscopy in children. Which does sound a little ‘messy’!

I am very grateful to George my co-Editor and massive contributor for the opportunity to join him in this venture - we did it together for the Second Edition 10 years ago, and this version has massively surpassed that one. Marvin Ament should not be forgotten as an integral part of the first and second Editions - a real progenitor of paediatric endoscopy. We hope that this Third Edition has kept pace with this fast-changing field.

I was first exposed to endoscopy in children in 1986 in a large teaching hospital in the North of England where it was ‘hold them down, minimally sedate, and get on with it.’ Things have changed a bit since then! However, to be fair, at that point, I did not ‘get the bug’ for pediatric endoscopy. It was really still in its infancy, having been championed in the late 1970s and early 1980s by such giants of the field as Sami Cadranel (so sadly, recently left us), Marvin Ament and Jean-Francois-Mougenot. Sami, Jean-Francois and I were (much) later get to know each other and become friends. They and many others set the scene for the undertaking of children’s endoscopy by children’s specialists in GI – a cause I have always believed in and tried to implement. Who wants an adult surgeon doing a quick sigmoidoscopy on your child with suspected Crohn’s and taking no biopsies? Never mind not getting to the ileum!

Hobby horse time – I always call the lower GI procedure an ileo-colonoscopy not simply a colonoscopy. Why, for instance, would you be happy with having a bronchoscopy where the bronchoscopist only examined the trachea and main left and right bronchi without going further? Or even just the left lung and not the right?!

My first inspirational moment came when I took up the position of GI/Hepatology Fellow in the Royal Brisbane Children’s Hospital in Australia in 1989 - a perfect equation of work hard/play hard. My mentor Prof Ross Shepherd was, and is, one of the most astute clinicians I have had the good fortune to learn from - and luckily he was a great teacher of endoscopy as well. Prof Geoff Cleghorn and Dr Mark Patrick deserve mention here as well and imparted knowledge and skill tips that I have not forgotten. Australia at this point were streets ahead of Europe in this area and in the 5 years I was there I had an accelerated endoscopy training, which, like many things in medicine, was down to good luck rather than good management. Also undertook my MD Doctorate on CF here.

Quick story - on our research staff we had a vet called Ristan Greer and I had a patient who had recurrent H pylori type bug called then Gastrospirillum hominis (now Helicobacter heilmanii) only usually previously seen in cats and dogs – we agreed to scope the cats and dogs at their farm with Ristan anesthetising them and using an old scope that was to be thrown out we identified the micro-organism in the cats, gave eradication to the girl and the cats simultaneously, and she was ‘cured’. Cue a paper in The Lancet.

Watersheds occur in life, and I chose, for family reasons, to return to the UK in 1994. Birmingham and Dame Professor Deirdre Kelly CBE and her world-leading liver unit awaited. Gulp. Without doubt one of the most inspirational women and doctors in the UK, to this day. When I first arrived, I met Sue the amazing PA to Deirdre, and after she had shown me my office – in a Portacabin! – I asked her ‘Are you doing that accent for a joke?’ It took a while for me to get back in to her good books! It was easy transferring skills but not so easy adapting back to a West Midlands climate. I loved my time there but the only things that the two cities have in common is the letter ‘B’.
No beach or surf in Brummie. Made some great life-long friends there though. I clearly remember getting a phone call, possibly ‘tongue in cheek’, from the head histopathologist in Birmingham Children’s Hospital two weeks after I had started. I had performed a scope on a post-transplant girl and sent the biopsies off. He said I had mislabelled the samples because I had put ‘terminal ileum’ on one, and they hadn’t seen that label for years, so was I sure! And so to another mentor, the extraordinary Deirdre Kelly, from whom I learnt many things - but not much endoscopy. But another good friend which the journey of medicine has allowed me to make. She was instrumental in my application to then become a Consultant with the incomparable Prof John Walker-Smith, one of the fathers of our discipline, at the Royal Free Hospital in London. Got lost, nearly missed the interview, swore I would never work and live in London - got the job and moved to London.

The next ten years were eye-opening. The ‘dream-team’ of JAWS (which acronym I know he dislikes), Simon Murch, Alan Phillips, me and latterly Rob Heuschkel were as close to a medical family as is possible. We should remember here our friend Dave Casson who sadly passed away from gastric cancer. Importantly I was privileged to learn at John’s feet but almost, if not more, significant for me, I was able to hone my apprentice-type ileo-colonoscopy skills with the greatest of them all, Prof Christopher Williams. A unique character is a fair way to describe him, but he is acknowledged as having been the best of the best when it came to ileo-colonoscopy training. Simon Murch, John Fell and I learnt a great deal. We were in the mid-nineties, however, still iv drug users! Eric Hassall, the famous North American paediatric gastroenterologist and a good and wise friend, once wrote a paper ‘Why paediatric endoscopists should not be iv drug users.’ Referring to the dual role of performing a procedure and also administering the iv sedation. Holding down a child should never be part of an endoscopy, nor should respiratory rescue. ‘Let the anaesthetists do what they want to keep the child still, unknowing and amnesic and don’t get involved’ has always been my mantra. Cost and availability of anaesthetists is the only reason why it still happens in the bad old way.

So I had a vision - please forgive me for sounding like a prima donna! The John Walker-Smith Unit had been running a brilliant Paeds Gastro Course in December in London for at least 12 years. As the young guy and the endoscopy enthusiast I thought ‘why not add on a live endoscopy day?’ John was very receptive and the first one was a real experiment but it worked. I still owe Simon an apology for training the room camera on him as he was scoping and videoing his ‘gurnying’ (facial movements as if in pain), during a live ileo-colonoscopy, to 150 people in the main auditorium! Fortunately, he has a great and forgiving sense of humour. It was probably the first ever successful live paediatric endoscopy meeting. The close interaction with scientists such as Alan Phillips also came out in this Course with biopsy orientation and handling adding another dimension. The Meeting seemed, apparently, to work smoothly - but a bit like a swan gliding serenely over the lake’s surface, meanwhile its legs swimming frenetically beneath, we were frantically trying to get all the pieces of the jigsaw to fit together and at the appropriate time. It was amazing and a real privilege to be able to invite the great and good from the world of paediatric endoscopy over to London to teach over the next 10 years - Victor Fox, Luigi Dall’Oglio, Jean-Francois Mougenot, Jean-Pierre Olives, Sami Cadranel, Yvan Vandenplas, Ernie Seidman, Harland Winter, Athos Bousvaros, Raoul Furlano and of course Eric Hassall. Other giants of the field I was to meet later.

Over the next ten years we worked closely with the adult GI Unit and Prof Owen Epstein and I produced a DVD with over 400 endoscopy videos and stills, which is still available and remains for me a great resource for Powerpoint presentations etc. This textbook has many other videos on the accompanying webpage if you are
Personal statements

interested. The Paediatric Endoscopy Unit evolved and we started pioneering therapeutic techniques with close clinical governance, and always learning from meetings such as the BSG, ESGE, UEGW, and DDW which showcased new and exciting techniques in endotherapy. The Unit did however produce a non-endoscopy virtue - a wife and our first daughter - Kay was a part of our team at middle grade level for a while which is how we met (Mills and Boon or not!) and I remain so grateful that she threw her towel in with me!

Eventually the ‘pull to the North’ became overwhelming for me - back to where I grew up - and in 2004 I took the difficult and painful decision to leave John, Alan, Simon and Rob and move to the relative peds GI virgin territory of Sheffield Children’s Hospital. Back to ‘God’s Own County’, Yorkshire. Thanks to Kay, my incredible and long-suffering partner for agreeing and sacrificing her promising career in ‘Pharma’ to which she had made a transfer and a name for herself in a short time. I appreciate it more than you can know.

So, now a blank canvas - almost. Prof Chris Taylor was the only paeds GI there when I arrived on, fittingly, April the 1st 2005. I remember that in the very first list I broke their only colonoscope! Oops! Time to get some more then….…..

Chris was a very generous host and indulged my ambitions. He was even kind enough as we became friends to ask me to be his best man and I was delighted - only embarrassing him slightly.

In 2005 we carried on with the Royal Free Course but then transferred it to Sheffield the year after and converted it to a Hands-On small group ileo-colonoscopy Course over 2-3 days. This was to be the template for the nest 15 years and has increased in frequency driven by demand to about 6–8 a year.

Meanwhile we began to build the Unit and with my colleagues and friends we have now over 50 staff. Prof Chris Taylor and Prof Stuart Tanner (hepatology) retired (Chris only recently) and I was joined by consultant colleagues Sally Connolly (now also retired), David Campbell, Prithviraj Rao, Priya Narula, (temporarily Dalia Belsha, Franco Torrente and Camilla Salvestrini), Arun Urs, Natalia Nedelkopoulos, Shishu Sharma, Zuzana Lontd, Intan Yeop and Akshay Kapoor. Amazing team who all bring something different to the table. The Gastro Nurses are so important to us led very ably by Valda Forbes. Dietitians also brilliant led by Lynn Hagin, SALT by Jane Shaw, and psychology by Charlotte Merriman are also hugely important and fantastic. Prof Marta Cohen, head of histopathology and I have collaborated on research over the years and she is always energetic and a great colleague to have.

The people of Sheffield and the region are, contrary to popular belief of a Yorkshireman being a ‘Scotsman robbed of his generosity’, incredibly generous. The Sheffield Children’s Hospital Charity (led by my friend David Vernon-Edwards) were, and have been, pivotal in financial help to make the Unit the most fantastic place to work - the Endoscopy Unit of the Future, the double balloon enteroscopy set up, the wireless capsule endoscopy service and the new magnetic-controlled capsule technology, and most recently the Symbionix virtual endoscopy training simulator, are amongst a few of the things that they have kindly and generously funded for us, allowing us to stay at the cutting edge of training and diagnostic and endo-therapeutic capability.

An area that I am particularly happy with is the ESPGHAN Council’s open-minded approach to the Endoscopy Special Interest Group initiatives in terms of Training. Hands-On Courses are spreading, the Endoscopy Learning Zone at the Annual Meeting has been fantastic and is going from strength to strength under the guidance now of Prof Raoul Furlano, and the first ever live endoscopy session occurred in 2019 in Glasgow at the Annual ESPGHAN Meeting and was very well received. There is nothing like performing live endoscopy to 500 people to get the cardiovascular system energised! Thank you to the recent Presidents of ESPGHAN Raanan Shamir and
the ever-enthusiastic Sanja Kolacek. Sanja has pushed for, and obtained funding for, the ESPGHAN Pediatric Endoscopy Fellowships which are starting in early 2021, which will be amazing - thank you!

My endoscopic ‘raison d’etre’ is to attempt to put the paediatric surgeons out of work! Hence pushing the boundaries in such areas as are covered in this Textbook. Nevertheless, I think it is critical that we work hand in hand with our surgical colleagues, many of who perform endoscopy, in order to blur the interface between our approaches. I am extremely fortunate to work with some fantastic and enlightened individuals in the surgical team and we are almost a joint Unit nowadays – as can be seen by our innovations with laparoscopic assisted endoscopic percutaneous jejuno-stomy and duodenal web division, amongst many others. Maybe I am a frustrated surgeon after all! Hopefully the web page is educational to those that access it with many videos etc. I am particularly indebted to the open-minded attitude and team-spirited nature of Mr Sean Marven, Mr Richard Lindley, Prof Ross Fisher, Mr Suresh Murthi, Prof Prasad Godbole, Ms Emma Parkinson, and more recently Ms Liz Gavens and Ms Caroline McDonald. Sparring with Jenny Walker was always fun and we are now good friends. Rang Shawis and Julian Roberts should not be missed out here.

Endoscopy in the modern world in children could not occur - especially endo-therapeutic - without the excellence of our anaesthetists - my stars are Dr David Turnbull, Dr Liz Allison, Dr Kate Wilson, Dr Rob Hearn, Dr George Colley at the Royal Free, and most importantly of all, the best paediatric anaesthetist of them all, Dr Adrian Lloyd-Thomas (AL-T). A quick story - the modern practice of topical application of Mitomycin C after esophageal dilation came from a chance conversation with AL-T, who told me that the ENT guys used Mitomycin C post-laryngeal reconstruction to prevent circumferential stenosis - we tried it and it worked in the esophagus of a girl requiring multiple frequent esophageal dilation. Cue a paper in The Lancet. Perhaps we should have more cross-specialty conversations?

We should remember that this is the only truly ‘procedure-specific’ paediatric specialty and stick to our guns with respect of the importance of endoscopy in our training. The Guidelines and Position Papers, some joint with ESGE and NASPGHN have been extremely well received and, in addition, have helped in raising the JPGN Impact Factor to its new dizzying height of nearly 3.

Medicine is a vocation amongst us of course, and training the next generation has been one of my major aims. In this I am particularly grateful to Prof Sanja Kolacek in her unswerving support and application of her considerable energy in moving forward the recent amazing ESPGHAN Endoscopy Fellowship Program - worth mentioning again!

We should, in my view, never compromise on the quality of training or care delivery afforded by paediatric endoscopy by those of us fortunate enough to have benefitted by it in our careers. Adult GI endoscopists should be involved only if we cannot avoid it - that comes down to our learning the correct skills and techniques and making their involvement redundant. We still have plenty to learn from them though, I will acknowledge.

Recently we have created a global community for Pediatric Endoscopy - adult GI, European, North American, South American, Asian, Australasian Peds GI - and Joint Endoscopy Guidelines have emerged – this is fantastic and I am sure that this fruitful collaboration will continue. Special mention should go to the drivers of these collaborative efforts and the contributors - Catharine Walsh, Doug Fishman, Jenifer Lightdale, Jorge Amildias, Andrea Tringali, Mario Vieira, Raoul Furlano, Victor Fox, Looi Ee, Patrick Bontems, Matijaz Homan, Rok Orel, Frederick Gottrand, Alexandra Papadopoulou, Salvatore Oliva, Erasmo Miele, Claudio Romano, Luigi Dall’Oglio, Rob Kramer, Mike Manfredi, Diana Lerner, Marsha Kay, Tom Attard, Warren Hyer, Joel Freidlander, ‘The Richards’ Hansen and
Russell, David Wilson, Dan Turner, Pete Gillett, Pat McKiernan, Stephen Murphy, Christos Tzivinikos, Ari Silbermintz, Rupert Hinds, Marta Tavares, Bruno Hauser, Yvan Vandenplas, Ron Bremner, Pete Lewindon, Petar Mamula, Orin Ledder, Merit Tabbers, Ilse Broekaert, Cesare Hassan, Marc Benninga, Alessandro Zambelli, Nikhil Thapar, Iva Hojsak, Stefan Husby, Ilektra Athiana, Andrea Nita, Sara Isoldi, Paola DeAngelis, Lissy De Ridder, the incomparable Samy Cadranel, all in the Sheffield Team and many many more - apologies if I have missed you out!

Thank you to the numerous members of the endoscopy Companies that have been so helpful over the years with Courses etc etc. You will know who you are but to numerous to mention here.

Kevin and Kat in ESPGHAN Head Office have always been very receptive to any Qs needed and I am grateful to them.

There is no ceiling to what we can achieve in pediatric endoscopy. Attending ‘adult’ GI and endoscopy meetings is illuminating e.g. ‘ESGE Days’. We are no longer the Cinderella part of pediatric GI but we still need to achieve parity with the adult Societies - a place at the ‘top table’ i.e. Societal Councils – as occurs in all adult GI Societies.

I would like to thank all the trainees from so many countries and backgrounds for their personal commitment and sacrifice over the last 25 years in coming to train with us - it never ceases to amaze me how mothers and fathers and spouses can leave their loved ones for months, on occasions a year or more, in order to train in this fantastic compelling area. Their ability to do so has been facilitated by my amazing Endoscopy Fellow and Course Coordinator, without whom it would have been truly impossible to run such a successful training program - Sam Goult. Thankyou Sam.

And then, if you have got this far then ‘well done’. It is so important to me to hold up my hand and say that, in all honesty, I could have not done all that I have done (admittedly a microcosm in the great scheme of things) without the forbearance and tolerance of my wife Kay and my exceptional and talented and kind daughters Ella, Jess and Flo. Incredible people and my driving force. I am sorry to you all for being away so much giving lectures and all that stuff when you were growing up and when you, Kay, were managing them so amazingly, almost single-handedly. I would have done things differently if I had had the time again and know what I know now. Medicine as a job is not necessarily life, although some times it is difficult to see beyond the vocation.

Lastly, I want to say a special thankyou to all the families and children that it has been my pleasure and privilege to help over the last 35 years.

As a small post-script it would be remiss of me to not thank all the authors who have been extremely patient over the last 4 years and I hope that you will be happy with the labour of love that has produced this book with your extraordinary help. Nearly all of you are good friends – some are friends yet to make – some are friends during this process that have sadly passed. Gábor (Veres) was a great and a good man and I never saw him be anything but kind and intelligent and helpful and energetic. A particularly sad event occurred recently – Prof Samy Cadranel lost his battle against cancer. He trained and touched so many in our discipline from the late 1970s to the modern day. He was a real giant in the field of pediatric endoscopy – he produced the first bespoke pediatric endoscope in 1978, led the field in diagnostics and then in therapeutic endoscopy. He trained a generation across the world leaders in the field such as Carlo di Lorenzo, Luigi Dall’Oglio and many many others. I was asked by him to lecture on advances in endoscopy at his Festschrift in Brussels some 15 years ago – he may have retired but he maintained a phenomenally active role in ESGPHAN. Most recently he taught on our Endoscopy Learning Zone at the Annual ESPGHAN Meeting and was always there for me if I needed a bit of guidance or advice. What he did not know about pediatric endoscopy is not worth knowing.
A polymath and a multi-linguist, but above all a really nice man and a wise and good doctor. We will miss both of these guys greatly in the future.

Please enjoy this text if you can, and believe me when I say that this is the distillation of a life’s work, but not just mine - it is a distillation of all that I have been taught and that George has been taught - it is therefore the ‘handing down of knowledge’ which is key to keeping a discipline moving forwards.

YOU! – the next generation – continue to push paediatric endoscopy forwards – training, research, Courses, expansion of the ELZ, further collaboration with our friends all over the world and push for live endoscopy at all the annual meetings – but please remember that, like our counterparts in adult GI endoscopy, we should be recognized and have a say on the Councils of our respective Societies.

Can I just mention some amazing people that deserve it who have been mentioned and some who have not? Andrei Nita; Jorge Amil-Dias; Alexandra Papadopoulos; Marc Benninga; Nikhil Thapar; Pete Lewindon; Tom Attard; Warren Hyer; Muftah Eltumi; Paul Hurlstone; Mark Donnelly; Mark McAlindon; Stuart Riley; Deb Salvin (of the world-famous ‘Salvin procedure’); Dom Hughes; Helen Wigmore; Ben Roebuck, Jamie Shepherd; Dave Turnbull; Liz Allison; and of course all the extremely patient authors of all the Chapters.

Our work would not have been possible without the trust and cooperation of all the children and families, so much heartfelt gratitude goes to these – tens of thousands!

My working life has been orchestrated by two amazing PAs without whom I would never have found the time to do all of this. Sam – thank you! Kate – thank you! You are both incredible.

Thank you to the amazing team at the publishing house – Anupama Sreekanth and editing team all along the gestation and birth i.e. April 2021, including lastly Holly Regan-Jones, who was amazing during ‘labour’. Lastly the production to completion expertly orchestrated by Hari Sridharan – thanks for your patience!

Undoubtedly there will be mistakes somewhere in all these pages, and if there are then, we’ll get it right next time (please let us know) - but it has been a labour of love and thank you to everyone – absolutely everyone – that has contributed, in even the smallest way.

The FatBoys Fell Running Club of Hathersage deserve a special mention for keeping me sane and balancing my life – to whom I lost my virginity (in fell racing terms!) – ‘a drinking club with a running problem’!

Lastly a big hug and love to my dear long-suffering wife Kay – thank you for putting up with me. And my fab daughters Ella, Jess and Flo, of whom I am immensely proud – sorry for the holiday time taken up with writing etc!!!

And as Sir Steve Redgrave, the most famous Olympic rower, said, on winning his last gold medal ‘If you ever see me in a boat again, shoot me!’ - and that goes for textbooks for me as well.
Contributors

Jorge Amil-Dias
Department of Pediatric Gastroenterology, Centro Hospitalar de São João, Porto, Portugal

Paul Arnold
Histopathology Department, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Thomas Attard
Department of Gastroenterology, Children’s Mercy Hospital, Kansas, MO, USA

Vasile Daniel Balaban
“Dr. Carol Davila” Central Military Emergency University Hospital and “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

Valerio Balassone
UOC di Chirurgia ed Endoscopia Digestiva, Ospedale de Bambino Gesù, Rome, Italy

Dalia Belsha
Centre for Paediatric Gastroenterology and International Academy of Paediatric Endoscopy Training, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Natalie Bhesania
Department of Pediatric Gastroenterology, Hepatology and Nutrition, The Cleveland Clinic, Cleveland, OH, USA

Jernej Brecelj
Department of Gastroenterology, Hepatology and Nutrition, University Children’s Hospital, University Medical Centre Ljubljana, and Department of Pediatrics, Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia

Samy Cadranel
Queen Fabiola Children’s Hospital, Free University of Brussels, Brussels, Belgium

Marta C. Cohen
Department of Paediatric Histopathology, Sheffield Children’s Hospital NHS Foundation Trust; Honorary Senior Lecturer, University of Sheffield, Sheffield, UK

Luigi Dall’Oglio
UOC di Chirurgia ed Endoscopia Digestiva, Bambino Gesù, Rome, Italy

Paola de Angelis
UOC di Chirurgia ed Endoscopia Digestiva, Bambino Gesù, Rome, Italy

Looi Ee
Department of Gastroenterology, Hepatology and Liver Transplant, Lady Cilento Children’s Hospital, Brisbane, Australia

Simona Faraci
Department of Surgery, Ospedale de Bambino Gesù, Rome, Italy
Victor Fox  
Department of Gastroenterology, Boston Children’s Hospital, Boston, MA, USA

Douglas S. Fishman  
Department of Gastrointestinal Endoscopy and Therapeutic Endoscopy, Texas Children’s Hospital, Houston, TX, USA

Chris Fraser  
Department of Gastroenterology, Edinburgh Royal Infirmary, Edinburgh, Scotland, UK

Joel A. Friedlander  
Children’s Hospital Colorado/Digestive Health Institute, University of Colorado School of Medicine, Aurora, CO, USA

Raoul Furlano  
Department of Pediatric Gastroenterology and Nutrition, University Children’s Hospital, Basel, Switzerland

Glenn T. Furuta  
Digestive Health Institute, Section of Pediatric Gastroenterology, Hepatology and Nutrition, Children’s Hospital Colorado, Gastrointestinal Eosinophilic Diseases Program, Department of Pediatrics, Mucosal Inflammation Program, University of Colorado School of Medicine, Aurora, CO, USA

George Gershman  
Harbor-UCLA Medical Center, David Geffen School of Medicine, UCLA, Torrance, CA USA

Jonathan Goring  
Paediatric Surgical Unit, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Frederick Gottrand  
Pediatric Gastroenterology, Hepatology and Nutrition Department, CHU Lille, University of Lille, Lille, France

Matjaz Homan  
Department of Gastroenterology, Hepatology and Nutrition, University Children’s Hospital, University of Ljubljana, Ljubljana, Slovenia

Paul Hurlstone  
Department of Endoscopy, Doncaster and Bassetlaw Hospitals NHS Foundation Trust, Doncaster, UK

Warren Hyer  
Department of Gastroenterology, St Mark’s Hospital, London, UK

Sara Isoldi  
Department of Digestive Endoscopy, “Sapienza” University, Sant’Andrea Hospital, Rome, Italy

Lauren Johanson  
Pittsburgh Liver Research Center, Children’s Hospital of Pittsburgh, Pittsburgh, PA, USA

Tom Kalley  
Harbor-UCLA Medical Center, David Geffen School of Medicine, UCLA, Los Angeles, CA USA

Marsha Kay  
Department of Pediatric Gastroenterology, Hepatology and Nutrition, The Cleveland Clinic, Cleveland, OH, USA

Sara Koo  
Pediatric Neurogastroenterology and Motility Program, Anschutz Medical Campus, Denver, CO, USA

Robert E. Kramer  
Digestive Health Institute, Section of Pediatric Gastroenterology, Hepatology and Nutrition, Children’s Hospital Colorado, Gastrointestinal Eosinophilic Diseases Program, Department of Pediatrics, Mucosal Inflammation Program, University of Colorado School of Medicine, Aurora, CO, USA
Thierry Lamireau
Centre of Pediatric Gastroenterology,
University of Bordeaux, Chu de Bordeaux,
Hopitaux de Bordeaux, Bordeaux, France

Kristina Leinwand
Pediatric Neurogastroenterology and Motility
Program, Anschutz Medical Campus, Denver,
CO, USA

Jennifer R. Lightdale
Division of Pediatric Gastroenterology,
UMass Memorial Children's Medical Center,
Department of Pediatrics, University of
Massachusetts, Worcester, MA, USA

Richard Lindley
Paediatric Surgical Unit, Sheffield Children's
Hospital NHS Foundation Trust, Sheffield,
UK

Markku Mäki
Faculty of Medicine and Health Technology,
Tampere University, Tampere, Finland

Michael Manfredi
Division of Gastroenterology, Hepatology
and Nutrition, Boston Children's Hospital,
Boston, MA, USA

Sean Marven
Sheffield Children’s Hospital NHS Foundation
Trust, Sheffield, UK

Patrick McKiernan
Pittsburgh Liver Research Center, Children’s
Hospital of Pittsburgh, Pittsburgh, PA, USA

Calies Menard-Katcher
Digestive Health Institute, Section of Pediatric
Gastroenterology, Hepatology and Nutrition,
Children's Hospital Colorado, Gastrointestinal
Eosinophilic Diseases Program, Department
of Pediatrics, Mucosal Inflammation Program,
University of Colorado School of Medicine,
Aurora, CO, USA

Erasmo Miele
Department of Digestive Endoscopy,
“Sapienza” University, Sant’Andrea Hospital,
Rome, Italy

Jean-François Mougenot
Médecin des Hôpitaux de Paris Honoraire,
Hôpital Robert Debré et Hôpital Necker-Enfants Malades, Paris, France

Priya Narula
Centre for Paediatric Gastroenterology
and International Academy of Paediatric
Endoscopy Training, Sheffield Children’s
Hospital NHS Foundation Trust, Sheffield,
UK

Natalia Nedelkopoulou
Centre for Paediatric Gastroenterology
and International Academy of Paediatric
Endoscopy Training, Sheffield Children’s
Hospital NHS Foundation Trust, Sheffield,
UK

Andreia Nita
Centre for Paediatric Gastroenterology
and International Academy of Paediatric
Endoscopy Training, Sheffield Children’s
Hospital NHS Foundation Trust, Sheffield,
UK

Salvatore Oliva
Maternal and Child Health Department,
Pediatric Gastroenterology and Liver Unit,
Sapienza – University of Rome, Rome, Italy

Rok Orel
Department of Gastroenterology, Hepatology
and Nutrition, University Children's Hospital,
University of Ljubljana, Ljubljana, Slovenia

Harpreet Pall
Section of Gastroenterology, Hepatology,
and Nutrition, St Christopher’s Hospital for
Children; Drexel University College of
Medicine, Philadelphia, PA, USA
Contributors

Simon Panter
Department of Gastroenterology, South Tyneside and Sunderland NHS Foundation Trust, Sunderland, UK

Alina Popp
“Alessandrescu-Rusescu” National Institute for Mother and Child Care and “Carol Davila” University of Medicine and Pharmacy, Bucharest, Romania

Antonio Quiros
Department of Pediatric Gastroenterology, Valley Health System, Paramus, NJ, USA

Prithviraj Rao
Centre for Paediatric Gastroenterology and International Academy of Paediatric Endoscopy Training, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Luciana B. Mendez Ribeiro
Center for Pediatric Gastroenterology, Hospital Pequeno Príncipe, Curitiba, Brazil

Claudio Romano
Department of Human Pathology and Pediatrics, University of Messina, Messina, Italy

Shishu Sharma
Centre for Paediatric Gastroenterology and International Academy of Paediatric Endoscopy Training, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Mike Thomson
Centre for Paediatric Gastroenterology and International Academy of Paediatric Endoscopy Training, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Filippo Torroni
UOC di Chirurgia ed Endoscopia Digestiva, Bambino Gesù, Rome, Italy

Sabine Krüger Truppel
Center for Pediatric Gastroenterology, Hospital Pequeno Príncipe, Curitiba, Brazil

Dan Turner
Juliet Keidan Institute of Paediatric Gastroenterology and Nutrition, Shaare Zedek Medical Centre, Jerusalem, Israel; Faculty of Medicine, Hebrew University of Jerusalem, Israel

Arun Urs
Centre for Paediatric Gastroenterology and International Academy of Paediatric Endoscopy Training, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Jorge H. Vargas
Ronald Reagan UCLA Medical Center, UCLA Mattel Children’s Hospital, UCLA Medical Center, Santa Monica, CA, USA

Krishnappa Venkatesh
Centre for Paediatric Gastroenterology and International Academy of Paediatric Endoscopy Training, Sheffield Children’s Hospital NHS Foundation Trust, Sheffield, UK

Gabor Veres
Deceased. Formerly Department of Paediatric Gastroenterology, University of Budapest, Budapest, Hungary

Jerome Viala
Department of Pediatric Gastroenterology, Robert-Debré Hospital, Paris, France

Mario Vieira
Center for Pediatric Gastroenterology, Hospital Pequeno Príncipe, Curitiba, Brazil

Catharine M. Walsh
Division of Gastroenterology, Hepatology and Nutrition and the Research and Learning
Institutes, Hospital for Sick Children, Department of Paediatrics, and Wilson Centre, University of Toronto, Toronto, Canada

David Wilson
Department of Child Health, University of Edinburgh, Edinburgh, Scotland, UK
About the Companion Website

This book is accompanied by a website

www.wiley.com/go/gershman3e

- All figures from the book available to download in PowerPoint
- Videos chosen to show key components discussed in the chapters

Scan this QR code to visit the companion website
Part One

Pediatric Endoscopy Setting
1

Introduction
George Gershman and Mike Thomson

In the late 1960s, flexible gastrointestinal endoscopy emerged as a novel diagnostic tool but was not employed routinely in children until the mid-1970s when pediatric flexible esophagogastroduodenoscopes became commercially available. In the decade that followed, there was a significant expansion and application of this modality in children. As the result, many discoveries and improvements in diagnosis and treatment of various pediatric GI disorders have been made despite the limitations associated with light and image transmission through the fiberoptic cables – the technology which only allowed the operator to look down the scope through the eyepiece.

The advent of the microchip with a video camera sited at the tip of the endoscope has advanced the optical imagery significantly. The days of an operator’s watery eye “glued” to the endoscope head and poor-quality images due to fiber breakage within the optic cables and condensation of water under the lenses at the tip of the instrument are long gone. The only “advantage” of fiberscopes was that no one else knew what you were looking at and there was a propensity for claims such as ‘Oh yes, I got to the terminal ileum!’ Nowadays, everyone can see where you are in the GI tract on the screens so there is no hiding . . .

Modern endoscopes include high-definition images, high magnification, confocal endomicroscopy with up to 1000× magnification, narrow-band imaging with focus on various light spectra to allow identification of dysplasia and polyp pit pattern, autofluorescence and other diagnostic modalities. Furthermore, the therapeutic capabilities of the modern endoscope are phenomenal and include up to 3.8 mm working channels and even scopes with two working channels to allow more sophisticated work. Very narrow (4.5 mm) scopes are now available to allow endoscopy in the smallest of infants/neonates and these are now applicable in older children for outpatient transnasal endoscopy without sedation. Three-dimensional imaging techniques are standard in most colonoscopes which enables identification of loops during ileocolonoscopy, speeding up the process and making it safer and less uncomfortable when it is done without general anesthesia. These concepts are now aided by the use of insufflation using carbon dioxide which is much more quickly absorbed than air.

In addition, endoscopic accessories have developed miraculously and allow many therapeutic procedures to occur which had previously been the domain of surgical options only.
These include endoscopic fundoplication, per-oral endoscopic myotomy for achalasia, percutaneous jejunostomy, duodenal stenosis treatment, fundal variceal ablation, pancreatic pseudocyst drainage and many others discussed in the corresponding chapters of the book.

In parallel with the advances in equipment, we have seen an enormous upskilling of the operators mainly due to the focus on training – this has been made possible by the greater availability of virtual models, hands-on animal training and more investment in one-to-one fellowships and short focused therapeutic endoscopic courses over the last 10–20 years. Online portfolios and direct observer procedure skill assessments are the cornerstones of these advances. Virtually every large GI meeting now has a hands-on endoscopy component and often a live endoscopy segment as well.

Virtually every year, a new endoscopic application is developed and many of the recent advances are included in this textbook – such as the over-the-scope clip for perforation closure, Hemospray® for diffuse GI bleeding, Stretta radioablation of the distal esophagus for reflux treatment, and then the concept of natural orifice transendoluminal surgery (NOTES) needs a mention as the newest kid on the block. This latter exciting technology is in some ways a modality looking for an appropriate application, especially in children, and is discussed at the end of the book.

We have tried to make this text the definitive one for pediatric endoscopy and we hope you enjoy reading it. No doubt more advances in technology will have been developed by the time this book hits the shelves but this is to be applauded. If the velocity of advances continues at the present pace, there is no barrier or horizon that is safe from endoscopy. It is reasonable to say that the gastrointestinal endoscopist should have the aim to make the GI pediatric surgeon virtually redundant. However, it has to be said that increasingly, the two disciplines are working more closely together and pediatric surgeons use endoscopy more and more themselves.

We hope that this book will enthuse the younger generation of trainees to follow the path of minimally invasive solutions to every problem that the GI tract produces in children. We may learn a lot from our adult colleagues but conversely, with our exposure to congenital abnormalities, we may be able to take a lead in these areas also. Imagination is our only barrier.

We would like to thank our colleagues who have kindly given up their valuable time to contribute some really fantastic chapters and images. We hope you really enjoy reading the book and that you gain a lot from it. The images and videos and webpage will allow knowledge to be disseminated widely. Most, if not all, of the world experts in pediatric endoscopy have contributed and we are truly grateful. We would like to thank the publishers, without whose guidance and help this would have been impossible.

This journey would not have been possible without the love and support of our families.

**MIKE:** thanks to Kay, my wife, and Ella, Jess and Flo, my wondrous daughters who put up with their old dad – especially editing the chapters when on holiday!

**GEORGE:** many thanks to Irina, my beloved wife and muse, and my two precious artists: my daughter Zhenya and granddaughter Nikka who continue to bring beauty to the world.

Thank you and hopefully those of you who are training now will be contributors in future editions and we will pass on the baton to you in due course. Remember – do no harm and have fun. It is the best specialty you can imagine.

Mike and George