

# Diagnostic and Interventional Ultrasound in Pediatrics and Pediatric Surgery

Stefan Scholz  
Marcus D. Jarboe  
*Editors*

 Springer

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## Preface

Ultrasound (US) has become the radiographic diagnostic method of choice to aid in the diagnosis of medical problems in children, one of the most profound changes in pediatric practice in the past few decades. This is especially true in the realm of pediatric surgical diseases.

Radiation exposure is a recognized problem and a significant concern in the medical community and with the public at large. Many recent studies have highlighted the dangers of radiation exposure in regards to malignancy, especially in children and young adults. Concern among parents has grown to ensure that radiation needed for diagnostic requirements in children is kept at a minimal level.

This concern has been the impetus for change in the world of pediatric imaging, the foremost of which has been increased use of magnetic resonance imaging (MRI) and ultrasound (US). There has been evidence suggesting negative implications of anesthesia on the developing brain. US rarely requires sedation or anesthesia as opposed to other radiation-free techniques such as the MRI. Sonography is a child-friendly nonintimidating imaging technique thriving on the absence of fat with pictures of exquisite clarity, rendering it much more suited to abdominal examinations in children.

The general trend in surgery over the past decades has been toward minimizing the invasiveness of surgical interventions. US used for real-time guidance of needle and catheter placement has resulted in less invasive, safer, and more accurate interventions. The pediatric population is well suited for US with its small body size and, generally, low body fat resulting in tremendous image quality. Given all of these advantages, there is a large impetus to maximize US use to diagnose pediatric surgical diseases. Furthermore, US is often regarded as the modern day equivalent to the stethoscope extending one's physical exam.

Despite these advantages, there are hurdles to overcome to apply US technology successfully. Despite its well-recognized value, education and practice remain the major obstacles in developing expertise in the use of preoperative and intraoperative US limiting its widespread use.

The quality of information gained with US depends largely on the skill and expertise of those scanning the patient and interpreting the dynamic images. Sonography is highly examiner dependent.

In many medical centers, which primarily treat adults, even the radiologists are not comfortable using US in pediatric disease processes. Although the literature has clearly shown that using US for venous access is much

safer, US-guided line placement is not the norm. Even though US is not a new technology, there are very few ways outside a radiology residency that you can learn how to use US effectively as a physician or surgeon. In addition, there are very few resources to read with regards to pediatric surgical US.

Because of this, there is a national push to widely implement US in pediatric practice. The American College of Surgery (ACS) offered the very first US course in the USA targeted to pediatric surgeons in fall 2013. This course was so well received by the pediatric surgical community that we were inspired to create a resource and guide for US in pediatric surgical problems to familiarize pediatric practitioners with its possibilities and limitations.

In health care, there is a strong emphasis on safety and quality, and US makes procedures safer and more dependable. There is a demand for less invasive techniques and US provides new minimally invasive options. There is clearly a drive for less cost, and US is relatively inexpensive. There is a push for less radiation and US has none.

Pediatric surgeons and other pediatric subspecialties understand this and are looking for ways to get trained.

Currently, there are no other books dedicated to sonographic applications for pediatric surgical diseases in the English language. Pediatric surgeons and specialists dealing with pediatric surgical disease need a book to read and reference to help them bring US to their practice and use it effectively.

This textbook is designed to present a state-of-the-art guide and review of US applications for children and infants with surgical problems.

The text is meant as a single source to provide information about sonographic application, interpretation, and technique for a diversity of pediatric surgical care providers. The textbook can be a useful tool for the US novice as well as the more advanced ultrasonographer. Initial obstacles faced by a physician starting with US are addressed, such as the scanning techniques, underlying anatomy and normal sonographic findings. The initial chapter provides an introduction and basic overview about US theory and techniques. Subsequent chapters focus on specific body parts and systems and their disease processes as it pertains to pediatric and neonatal patients. The textbook includes a chapter dedicated to abdominal trauma and its evaluation with the focused abdominal sonography for trauma (FAST) exam.

For clarity, the textbook is divided into two separate parts. The first part focuses on US as a tool for diagnosis and monitoring of pediatric surgical and urological problems. The second part will outline interventional procedures routinely performed under US guidance in children. All chapters are written by experts and include the most up to date scientific and clinical information.

For practical purposes, specific details of those chapters include preparation of the patient and technical tips and tricks for safe and effective procedures. Interventional techniques for US-guided vascular access, diagnostic, and therapeutic drainage procedures, core biopsy of masses and solid organs, fine-needle aspiration (FNA) of the thyroid gland, sclerotherapy for vascular malformations, regional blocks for postoperative pain control and intraoperative applications of sonography will be presented. Every chapter is accompanied with extensive illustrations. A brief review of the existing literature of

the particular topic follows each chapter.

We hope that this textbook will improve understanding and interpretation of sonographic pictures and reports and serve as a practical guide for a growing number of US users, surgeons, and pediatricians, alike. It is meant to bolster the comfort level for interpretation and performing US themselves for pediatricians, pediatric surgeons, and pediatric radiologists. The aim is to provide the sonographer with a framework to use in diagnosis, so that the maximum amount of information can be gained from the US examination.

As a first edition, the reader may forgive typical “birthing problems” of a newly conceptualized project. We hope that this text will serve as a natural link between pediatrics, pediatric surgery, and pediatric radiology in a truly collaborative fashion. We are convinced that for US use in pediatric surgical problems, the best is yet to come!

*Our book is dedicated to all the sick infants and children and their pediatric practitioners who examine and treat them with the utmost skill and gentility.*

Practical tips for performing US:

1. Take a course—US is a valuable tool for diagnosis, management, and therapy. To incorporate it into your toolbox, learning the basics is invaluable: how it works, how to optimize your image, and getting comfortable with all the knobs and buttons of the machine. Many societies and associations are now offering courses, which you should definitely consider as an excellent beginning step.
2. Stay in practice—US is a tool that you should try to use as much as possible. The best use would be to incorporate it in as many cases as possible to develop familiarity and comfort. While you are unlikely to have abdominal and retroperitoneal masses present every day, using US for common cases such as central line insertion is an ideal way of keeping in practice.
3. Learn from experts—Even if you have taken a course, you can always learn from others. Your US technologist and radiologists are great resources. Get into the habit of reviewing all of the images from US that you order and then read the report afterwards—this is a quick way of “testing” yourself to make sure you have seen everything that the experts have. You may even find subtle findings that were not initially identified.
4. Partner with experts—If you are a novice in the use of US, arrange for your radiologist or US technician to be available to help you during your cases. For some of the more difficult cases as described in this chapter, having another set of eyes to interpret, and other hands to adjust images will be invaluable. Additionally, in general, the quality of the US machines from radiology are superior to the smaller mobile ones used in the operating room (OR)—which usually are intended for line insertions and guidance of blocks.
5. Share expenses—The major cost impact of US is the acquisition of probes. Unless you are in a situation where cost is not a concern, and few of us are, you will need to carefully consider which probes you want to purchase. Think about what procedures you want to do now, and in the next 10 years

(about the time that technology will improve). For some probes, such as laparoscopic probes, which you may only use occasionally, it may be best to share the expense with another hospital or borrow their probe on the rare occasion that you will need it. Just be careful about the selection of companies for your US machines and probes, as there are no universal connectors.

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Our careers in pediatric surgery have been inspired by many teachers and mentors at varying institutions over the years, in Germany and the USA, who served as our role models in the challenging but gratifying care of children.

This book is the result of a team effort and we would like to highlight the hard work and dedication of the pediatric specialists, especially pediatric surgeons, and pediatric radiologists, who have contributed chapters to this text. More importantly, all of them continue their devotion to a career of taking care of infants and children who need our help and who ultimately make it all worthwhile.

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On a special note, we would like to thank our wives, *Elizabeth and Sarah*, without their support this book would have not been possible. Our wonderful children, *Mischa, Nicholas, and Gavin* as well as *Colin, Liam, and Katherine*, are the reason we get up early every morning.

I would also like to thank my mother, Birgit Scholz, for her continued support and enthusiasm for my ongoing professional endeavors despite the hurtful distance to another continent.

Stefan Scholz  
Marcus D. Jarboe

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**Part I**  
**Diagnostic Ultrasound**