Reoperative Pediatric Surgery

Edited by

Steven Teich, MD

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Humana Press

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Cover illustration: The picture on the front cover depicts the two authors performing surgery together. We wish to thank Dr. Jon Groner for his photographic expertise.

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We are inspired by our patients and their families, who place their trust in our surgical expertise and wisdom. During our training in pediatric surgery we were fortunate to have witnessed commitment to long term patient care by our esteemed teachers, Drs. H. William Clatworthy, Jr., E. Thomas Boles, Jr., and Marc I. Rowe.

We dedicate this book to our respective parents, Pauline and Abraham Teich and Mary and James Caniano, who taught us that we could accomplish anything through hard work and perseverance.

We also dedicate this book to our respective spouses, Esther Chipps and Richard Flores, who are our closest friends, wisest advisors, and sources of daily strength.

Steven Teich, MD
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Preface

"Good judgment comes from experience, and
often experience comes from poor judgment."

Rita Mae Brown

Reoperative surgery is a challenge that is confronted by every surgeon. Although a particular operation may be initially performed with technical skill and followed by appropriate postoperative care, functional and/or anatomic problems may require further surgical attention.

The unique circumstances of pediatric patients may predispose them to a greater likelihood of requiring reoperation after a major procedure.

- A bowel resection in a neonate may develop a stricture if the anastamosis does not grow at the same rate as the adjacent bowel. The reoperative anastamotic technique is critical, as is the decision whether to resect or taper dilated bowel.
- The cancer survival rate has increased dramatically for many pediatric tumors. These patients often require reoperation for treatment of recurrences, as well as for treatment of complications of chemotherapy, such as second malignancies.
- Pediatric surgical patients often require lifelong follow-up that is obviously much longer than for adults. This increases the chances of requiring reoperation for many conditions, including gastroesophageal reflux disease and inguinal hernia.
- Even a "simple" gastrostomy may develop complications related to growth. With linear growth, the skin of the abdominal wall often migrates towards the chest wall. Therefore, the gastrostomy becomes angulated with leakage of gastric contents onto the abdominal wall, necessitating repositioning of the gastrostomy away from the costal margin.
- Pediatric patients with congenital diseases, such as cystic fibrosis, often require multiple reoperations for complications related to their underlying condition.

It is important to mention that not every pediatric surgery reoperative problem has a wealth of contemporary literature. Often reoperative surgery requires seldom used and more complex operative techniques. Frequently, these techniques are too new or too specialized to be found in current pediatric surgery textbooks. For this reason, we have enlisted a group of authors who are recognized experts for their respective topics to provide the most up-to-date information on reoperations for their pediatric surgical colleagues.

The pediatric surgery literature on reoperations is fragmented and sketchy. The need for a pediatric surgery textbook that critically analyzes and consolidates all the available literature on reoperations is obvious. For this reason, we have compiled a detailed source of information on reoperations for all areas of the body, all parts of the gastrointestinal tract, all types of pediatric solid tumors, and many common but perplexing problems that we co-manage with other pediatric specialists.

This book has been a labor of love. Now, we hope that it will become a valuable reference for pediatric surgeons, pediatric anesthesiologists, general surgeons performing pediatric surgery, and all pediatric physicians.

We wish to thank our secretaries, Cathy Rings and Teresa Rodich, for their invaluable assistance in the preparation of this book.

Steven Teich, *MD*
Donna A. Caniano, *MD*

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1 Radiology of the Postoperative Patient

Diagnosis and Intervention

William E. Shiels, II, DO, *D. Gregory Bates,* MD, *and Mark J. Hogan,* MD

CONTENTS

INTRODUCTION

The integrated and effective use of radiological diagnostic modalities and interventional techniques and therapies provides the surgeon with the opportunity to make accurate diagnoses of reoperative issues and complications and to provide timely intervention. A close functional relationship between surgeons and radiologists allows the surgeon the full advantage of surgical therapies or radiological interventional techniques and therapies, as best suits the individual patient needs. Interventional radiology offers a multimodality image-guided and minimally invasive management approach to a multitude of reoperative issues and complications. Consultation between

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the primary surgeon and the radiology team provides discussion of techniques, interventional therapeutic options, expected outcomes, and contingency plans. The surgeon must have a clear understanding of the contrast media used, anatomic approaches of interventional procedures, and associated potential complications, should operative intervention be required following radiological diagnosis and/or intervention.

ABSCESS OF THE CHEST AND ABDOMEN

Abdominal abscesses are the most common indication for image-guided drainage, and appendicitis is the most common etiology *(1–5)*. Appendicitis is more common in children than adults, and children are more likely to have perforated appendicitis and abscesses *(1–3,5–7)*. Percutaneous drainage combined with antibiotics may allow for delayed less-invasive surgery (laparoscopic or small right lower quadrant [RLQ] incision) in children who present with rupture and abscess *(7–14)*. Alternatively, the drainage of postoperative abscesses can eliminate a second surgery *(2–7)*. Other causes of intraabdominal abscesses are less common, but include infected cerebrospinal fluid (CSF) and pancreatic pseudocysts, necrotizing enterocolitis (NEC), Crohn's disease, and postoperative abscesses of any cause.

The imaging techniques are dependent on the suspected site of abscess. Although CT scanning is most commonly used for abdominal sepsis (Fig. 1), magnetic resonance imaging (MRI) or ultrasound may be more useful in the musculoskeletal system or with superficial lesions (Fig. 2).

After obtaining appropriate history, physical examination, laboratory tests, and abdominal plain radiographs, abdominal computed tomography (CT) scan has become the gold standard for the diagnosis of abdominal abscess *(1,3,4)*. If the patient's

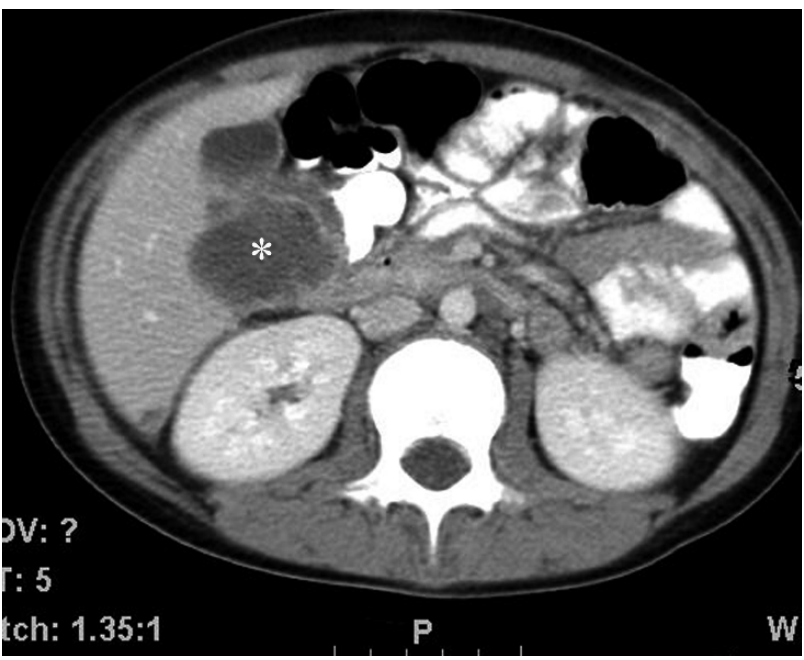

Fig. 1. CT scan of a febrile patient after surgery for ruptured appendicitis shows an abscess (*) near the gallbladder fossa.

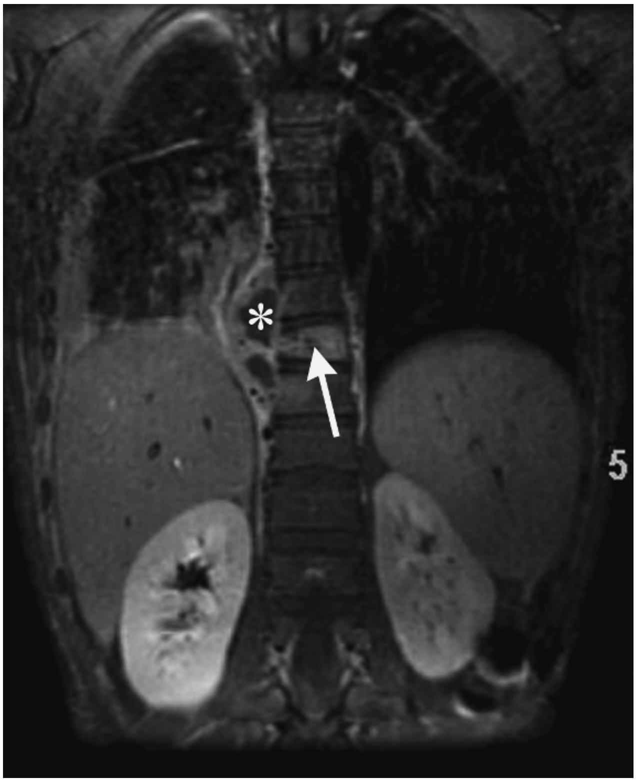

Fig. 2. Coronal image from an MRI shows osteomyelitis of a thoracic vertebral body (arrow), and an adjacent paraspinal abscess (*), drained with ultrasound guidance.

symptoms last longer than 48 hours or if the surgeon has a high clinical suspicion of abdominal abscess, a CT scan with both oral and IV contrast should be performed. The oral contrast improves the recognition of abscesses, as children have less intraabdominal fat than adults and oral contrast differentiates intestinal loops from abscess (Fig. 3). Although CT scanning for abdominal pain has proliferated rapidly, this increased utilization coincides with new information regarding radiation risks in children. Standardized CT dosing techniques are available to decrease exposure as much as possible. Ultrasound can sometimes substitute for CT. This is particularly true in infants with NEC.

Musculoskeletal abscesses are usually diagnosed either with MRI or ultrasound (Fig. 2). MRI is the best imaging tool to evaluate for abscesses related to osteomyelitis. Ultrasound can identify fluid collections within areas of cellulitis.

Neck infections are typically first imaged with CT (Fig. 4A,B). However, after an area of necrosis is identified, ultrasound is more reliable in determining if the lesion is fluid-filled and drainable (*15*). Chest abscesses are best imaged with CT, and will be discussed in the section on pulmonary infections (*16,17*).

Ultrasound guidance is ideal in children *(1)*. Children are usually smaller, which may allow sonographic visualization of abscesses. Ultrasound is portable, multiplanar, and provides real-time imaging without the deleterious effects of ionizing radiation. Freehand techniques allow the maximum flexibility during the procedure and increase

Fig. 3. Patient is postappendectomy for perforated appendix. Oral contrast on the CT allows for differentiation between the bowel loops and the abscess (*).

the access site choices. High-quality ultrasound equipment is required with multiple transducers ranging from high-frequency probes for excellent near-field visualization to larger lower frequency probes for deeper abscesses. Endocavitary probes are also needed for selective drainage procedures. CT and CT fluoroscopy are often the preferred guidance modalities in adults. These techniques are also useful in children when ultrasound cannot visualize the abscess because of overlying gas or bone; however, the radiation exposure must be minimized *(18)*.

Most abdominal abscesses are accessible from a transabdominal approach with ultrasonographic guidance (Fig. 5A,B), although deep pelvic abscesses may require transrectal or transgluteal techniques *(8,9,12–14,19,20)*. Transrectal drainage is guided with ultrasound, using either a transabdominal transducer and imaging through the bladder, or an endocavitary probe in the rectum (Figs. 6 and 7). Transgluteal drainage is usually performed with CT guidance *(14,20)*, although transgluteal ultrasound guidance has been described *(13)*. Transgluteal drainage has a reported higher complication rate because of vascular injury and is considered more painful; however, even with the smaller sciatic notch in children, some have excellent success with this technique *(14, 20)*. Abscesses in other sites are accessed through the most direct approach, avoiding vascular and other important structures.

Needles, wires, and catheters are similar to those used in adults. Because of sedation concerns and the lack of cooperation in most children, we choose equipment that provides the greatest procedural efficiency. Ultrasound guidance allows the use of larger needles in smaller patients as the advancement is performed in real time, and the best access window is chosen. This decreases the number of steps and simplifies the procedure. If the access window is small, or if CT guidance is necessary, smaller access sets are available. Standard drainage catheters are available from multiple manufacturers, with most patients receiving 8–12 Fr drains, although that is dependent on the thickness of the fluid. Smaller catheters (5 or 6 Fr) are often helpful in neck or

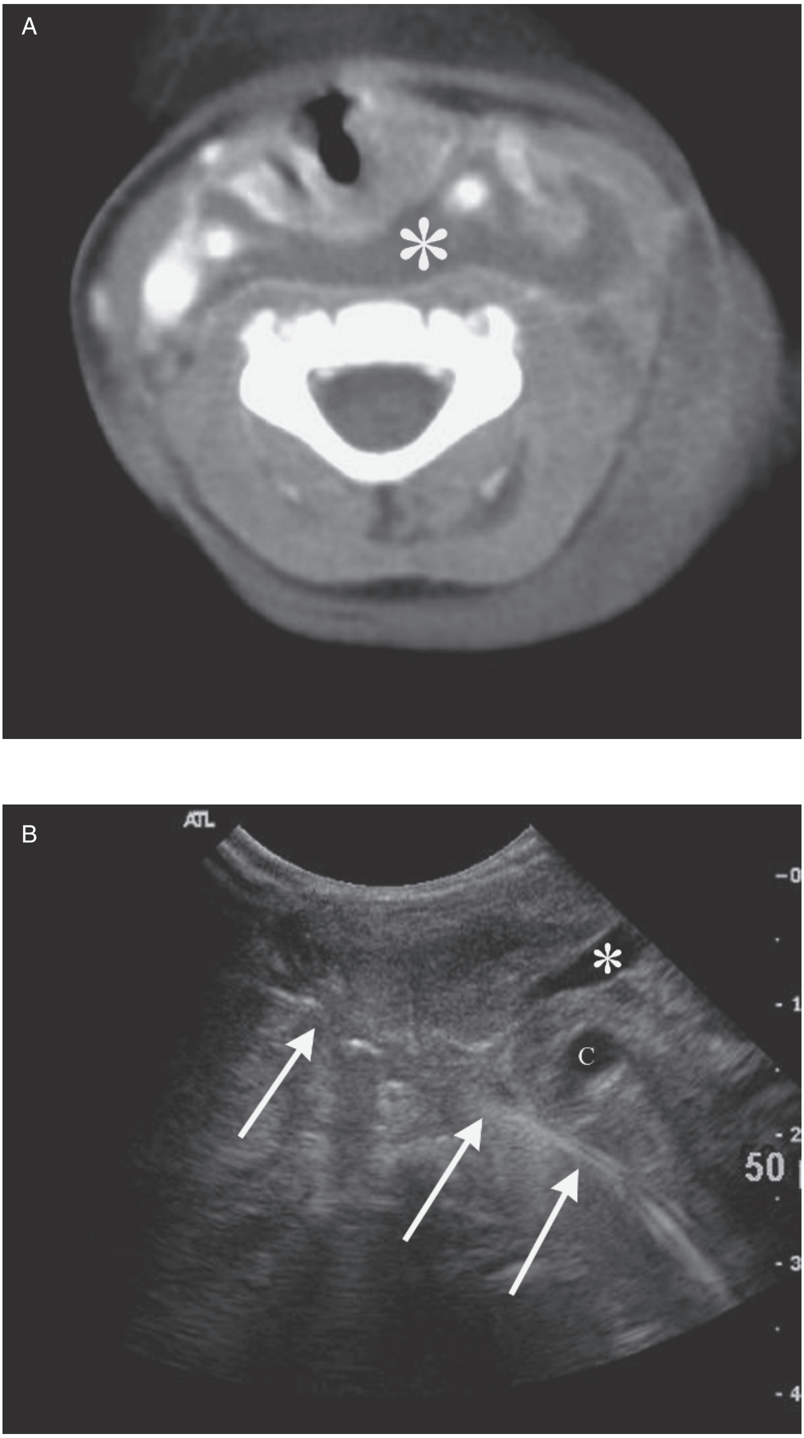

Fig. 4. Patient with fever after tonsillectomy. **(A)** There is a retropharyngeal abscess (*). **(B)** Demonstates ultrasound guidance to place a drainage tube (arrows) into the abscess avoiding the carotid artery **(C)** and the jugular vein (*).

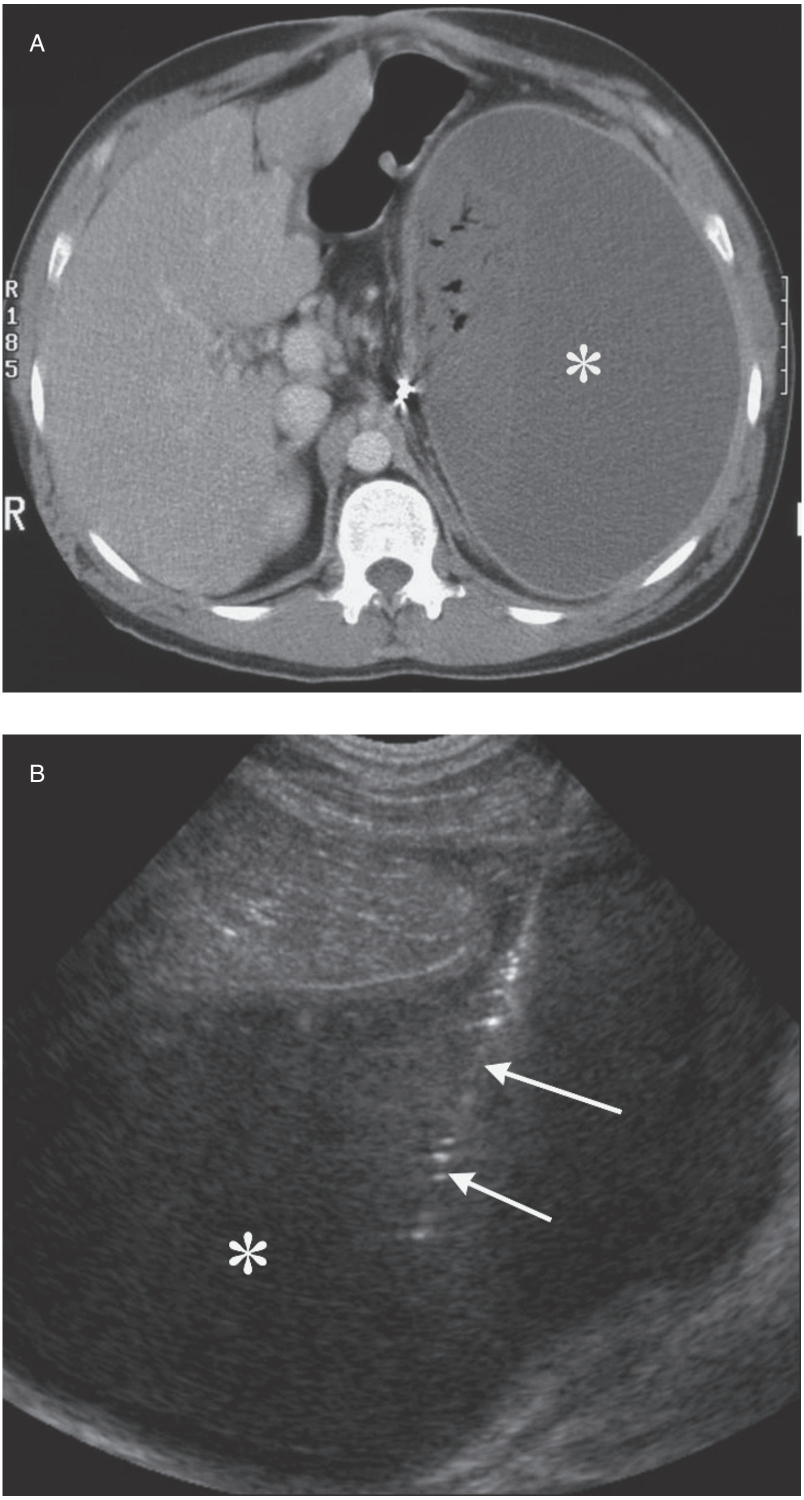

Fig. 5. Splenic abscess. **(A)** CT shows a large abscess (*) in the splenic bed after splenectomy. **(B)** Needle (arrows) placement into the abscess (*) with ultrasound guidance.

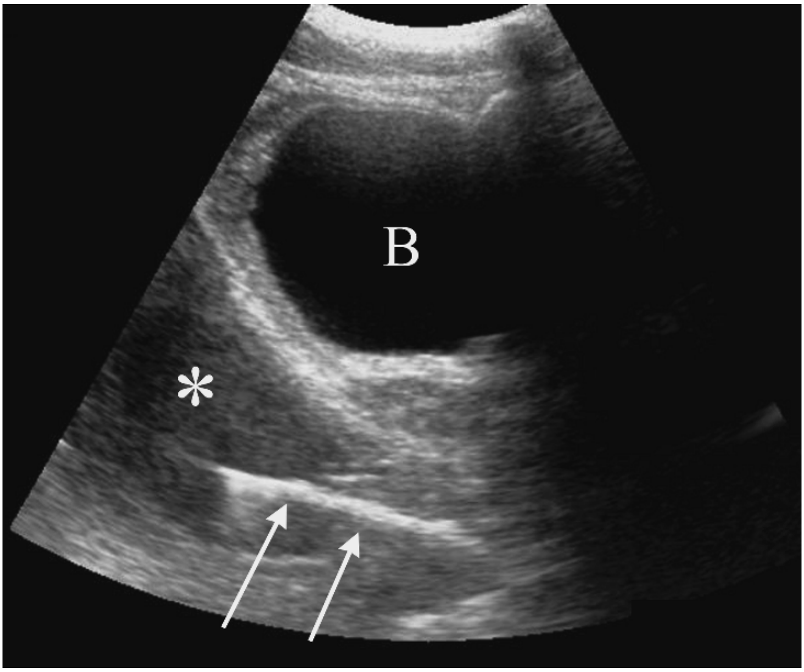

Fig. 6. Pelvic abscess (*) is seen behind the bladder **(B)**. The drain (arrows) is advanced with ultrasound guidance into the abscess.

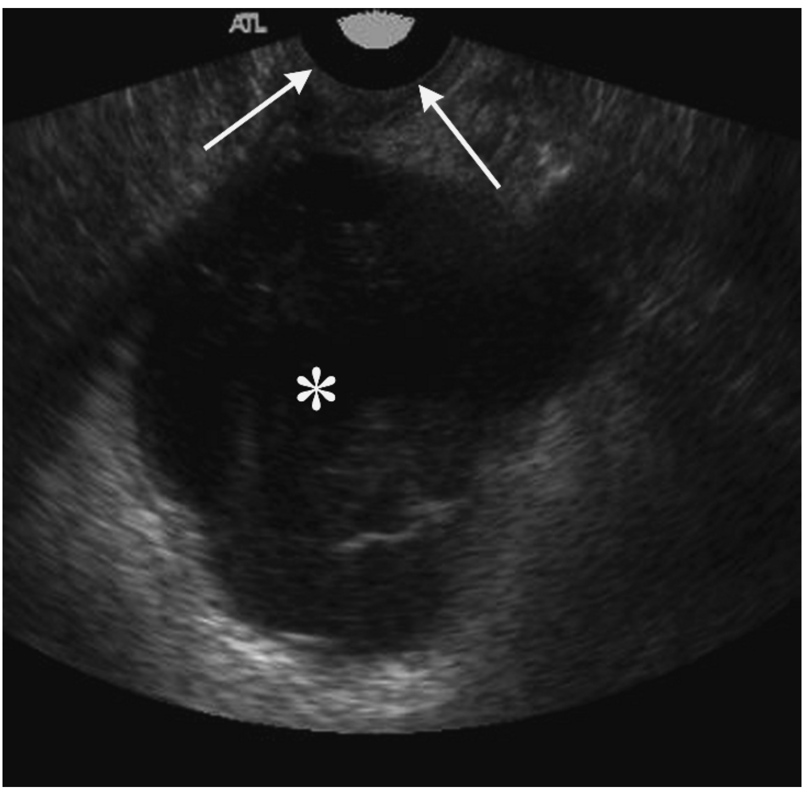

Fig. 7. Transrectal abscess drainage. The ultrasound probe (arrows) will guide placement of a drain into the pelvic abscess (*).

superficial abscesses; however, most abdominal abscesses require larger tubes because of increased fluid viscosity. For abscesses from NEC, 18–20 G intravenous catheters can be used for aspiration with ultrasound guidance (Fig. 8). This is often done portably with the premature infant remaining in an incubator.

The abscess is evacuated as much as possible immediately, and lab samples are sent. Currently, all catheters are placed to bulb suction, as the patients are not compliant with keeping the bag dependent for gravity drainage. The catheter is secured with an adhesive device unless the patient is too small to allow adequate fixation, in which case the catheter should be sutured to the skin. Saline flush with 10 cc is performed every shift. This amount should be subtracted from the tube output, although this is a common charting error.

Assessment is performed at least daily. The patient usually becomes afebrile with drainage less than 10 mL/day within 2 days, and almost always within 4 days; after which time the drain is removed. If tube output continues after 48 hours, we perform a tube injection to evaluate for a fistula.

Image-guided drainage procedures in both pre- and postoperative appendiceal abscesses are successful in 81–100% of patients *(7,8,10–13,20)*. Complications from abscess drainage are uncommon, occurring in up to 11% *(9–11)*, with catheter migration the most common *(8,11)*. Bloody pus is almost universal, but significant hemorrhage

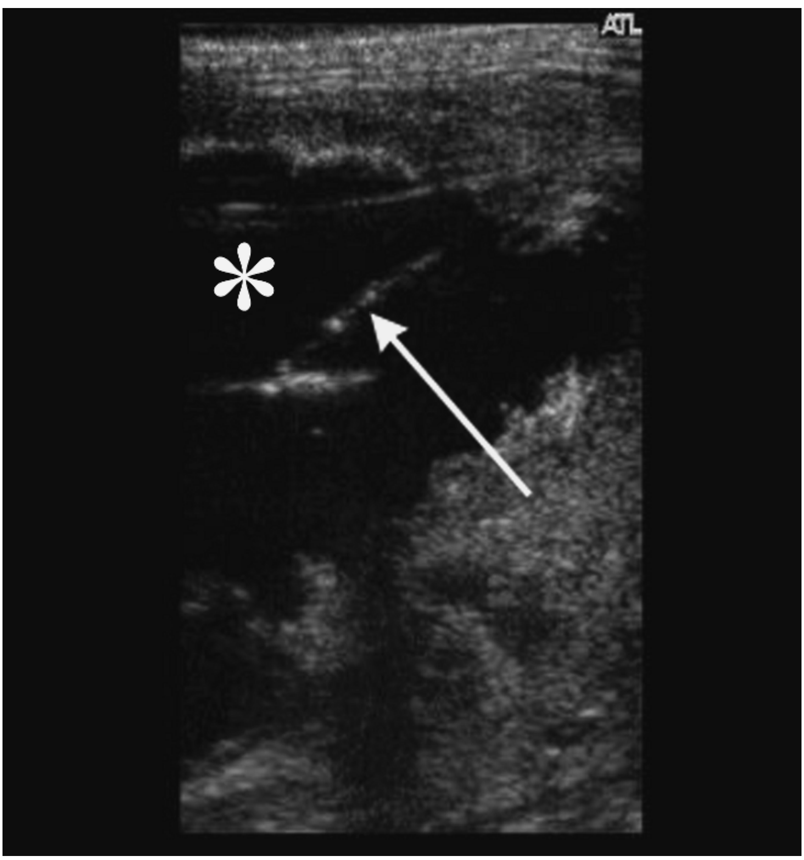

Fig. 8. An IV cannula (arrow) is advanced into abscess (*) after surgery for NEC.