Practical Considerations in Pediatric Surgery

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Abstract

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The care of pediatric patients requires special considerations that are often not addressed in the literature. Relatively straightforward tasks such as clinical evaluation, antibiotic use, splinting, wound closure, and care of simple burns become complicated in the pediatric population for several reasons. The authors seek to demystify some of these topics using the senior author's years of clinical experience treating pediatric patients by giving practical advice and general considerations when treating children.

The adage “children are not just little adults” is strikingly apparent to any physician caring for the pediatric patient. Many simple and straightforward tasks employed in the care of an adult patient often require extra thought to accommodate the pediatric patient. Unfortunately, a paucity of information exists in the literature addressing many of these common, day-to-day issues. We address a few of these matters and offer useful advice for providers caring for children. We discuss general principles regarding clinical evaluation of a pediatric patient and management of burns in those patients, as well as practical considerations regarding choice of antibiotic therapy, splinting, and suture material.

Clinical Evaluation

Although pediatric wound closure necessitates many of the same techniques and principles as those of adult wounds, some special considerations must be made and appropriate accommodations must be employed to optimize clinical outcomes while simultaneously providing a comfortable wound repair setting for the child. Clinical evaluation of the pediatric patient can be very challenging. A child presenting to the emergency room with an open wound has not only experienced a physically painful event, but also a mentally traumatizing one. Both the child and parents can be quite distraught, and the physician plays an integral role in the provision of emotional support.

Aside from the administration of pain medications, distraction techniques using toys can divert the child's focus away from the injury. A physician's communication skills are greatly undervalued qualities that can vastly affect confidence in the surgeon. Addressing the child directly at eye level and conversing with the child about a topic of interest are effective comforting mechanisms. Although providing the parents with a detailed explanation of the child's condition and treatment plan is a vital aspect of the patient encounter, surgeons often fail to address the child, instead speaking around them to address only the caretakers. Using the child's name should be a routine part of any interaction, rather than simply stating “your son” or “your daughter.” Parents are fond of their child's name and greatly appreciate its use.

The efficient use of time is another critical aspect of the patient encounter and can be optimized by avoiding aspects of the physical examination that may upset the child until the end of the clinic visit. In many cases, if the exam upsets the child or causes additional pain, subsequent crying becomes a barrier to communication with the caretakers and can cause major delays in obtaining the necessary information. An uncooperative child may need to be physically restrained by the parents to perform some aspects of the physical exam. Placing the child in the caretaker's lap and employing his or her help in restraining the child can greatly aid in this regard. Successful utilization of available resources and rapid

adaptation to challenging scenarios are often overlooked skills that can greatly simplify the patient encounter.

Antibiotics

The indications for antibiotic administration in the pediatric surgery patient are vast; a thorough review is beyond the scope of any single article. Here, we discuss common indications for antibiotic therapy, prophylaxis for surgical site infections (SSIs), as well as present practical suggestions to facilitate administration.

Surgical site infections are one of the most common complications of surgery, affecting 2.3 to 5.4% of the pediatric surgical population.^{1,2} In the pediatric population, generally accepted risk factors for developing an SSI include anatomical location, bacterial contamination of the wound as described by the Centers for Disease Control wound classification grade³ (►Table 1), and the procedure duration.⁴ Procedures involving implants, procedures below the waist, and prior skin irradiation increase the risk of complications for plastic surgery operations.⁵

By convention, the microbial contamination producing a SSI occurs at the time of operation; in the majority of cases, it originates from either endogenous skin flora or exposed hollow viscus.⁴ The most common pathogens causing a SSI after a plastic surgery procedure include *Staphylococcus aureus*, other staphylococci, and streptococci. Gram-negative organisms (i.e., *Pseudomonas aeruginosa*, *Serratia marcescens*, or Enterobacteriaceae like *Escherichia coli*) are more frequently encountered after procedures below the waist, procedures involving macerated, moist environments, and in patients with diabetes mellitus.⁵

Multiple studies have demonstrated prophylactic antibiotics as efficacious in reducing the SSI rate when administered in the appropriate clinical settings.^{1,2} However, there is a relative paucity of adequately powered studies that elucidate the appropriate clinical settings warranting antibiotic prophylaxis in pediatric surgery. Notably, antibiotic prophylaxis does not decrease the risk of infection for most clean plastic surgery procedures,⁵ and in the vast majority of elective surgeries in children, antibiotics are not necessary, but still routinely prescribed.

Antimicrobial prophylaxis is not recommended for most clean plastic surgery procedures in patients without additional

risk factors for postoperative infection (i.e., poor nutritional status, obesity, diabetes mellitus, altered immune response, corticosteroid therapy). Antimicrobial prophylaxis is recommended for clean-contaminated procedures and for clean procedures performed on patients with the aforementioned risk factors.⁵ In general, first- or second-generation cephalosporins⁴ or ampicillin-sulbactam⁵ are appropriate first-line agents, but antibiotic selection should be tailored to the pathogens one expects to encounter in a given operation.⁴

Once the need for antimicrobial prophylaxis has been established, a few general principles must be kept in mind. Bactericidal levels of the antibiotic should be established prior to skin incision. A landmark study⁶ identified the optimal timing to be within 2 hours of skin incision; however, multiple recent reports^{1,2} cite 1 hour as the standard. Postoperative prophylaxis should be limited to 24 to 48 hours,^{4,5} regardless of the presence of indwelling catheters or drains,⁵ as prolonged therapy may facilitate the development of resistant organisms and/or expose the patient to unnecessary morbidity (i.e., *Clostridium difficile* colitis). In the senior author's opinion, a great medication for postoperative prophylaxis or treatment is clindamycin. Typically, clindamycin is prescribed at 10 mg/kg per dose twice per day.

More practical issues arise when oral antibiotic therapy is indicated. No child likes taking medication. The caretaker should be questioned as to whether the child tolerates pills. In most cases, it is best to prescribe the antibiotic in the form of a liquid. As these medications often have an undesirable taste, asking the pharmacist to flavor the liquid is advisable. Moreover, the most concentrated form of the liquid should be chosen to minimize the volume of ingestion. Because it is often difficult to have a child swallow a medication, the frequency of antibiotic use should be minimized. The fewer times a family has to administer medication the better.

Splints

Splints present a unique challenge in the youngest of children for many reasons. In infants and younger children, the splint serves primarily to protect the hand or arm from accidental secondary trauma. Unfortunately, children have an uncanny ability slip out of the splint. Although casting a child is always a tempting option, cutting the child out of the cast is traumatic for both the patient and the surgeon.

Table 1 Centers for Disease Control (CDC) surgical wound classification³

Class I/clean	Operative wound without inflammation or violation of the respiratory, alimentary, genital, or urinary tract
Class II/clean-contaminated	Operative wound with controlled violation of the respiratory, alimentary, genital, or urinary tract without unusual contamination
Class III/contaminated	Fresh traumatic wounds or operative wounds with either major breaks in sterile technique or gross spillage from the gastrointestinal tract
Class IV/dirty	Old traumatic wounds with devitalized tissue and operative wounds involving existing clinical infections or perforated viscera (suggesting that organisms causing postoperative infections were present in the field before the operation)

Compared to casts, splints decrease pain and bleeding while preventing possible further soft tissue, vascular, and neurologic compromise due to postoperative or postinjury swelling with casts. Consequently, a splint is usually preferred. Basic principles of splinting include, but are not limited to, the following: controlling pain, immobilizing the joint proximal and distal to the involved location, and properly protecting wounds or operative sites.

After trial and error, the most successful splint has proven to be a sugar tong splint with several key modifications. First, the splint has to be above the elbow. Splints below the elbow in young children are at the highest risk for removal by the child. It is also helpful to keep the elbow flexed at greater than 90 degrees in the splint to maximize the chance of retention.

To begin, a dressing is placed over the appropriate surgical area or wound and Mastisol (Ferndale Laboratories, Inc.) is applied to the forearm and upper arm. Webril (Kendall Medical) should be placed to provide padding for the interdigital space and antecubital fossa, taking great care to not place too much padding in the antecubital fossa. One must be careful while flexing the elbow to greater than 90 degrees, as this can cause compression on the forearm structures and impede blood flow. Following the Webril application, plaster material is measured such that it wraps from the fingertips, up the forearm, around the elbow, and back up to the fingers. The plaster material is placed in warm water, the excess water is drained, and the material is then placed in sugar tong fashion. The plaster material should touch immediately distal to the antecubital fossa. A Coban (3M, Inc.) or an ACE (3M, Inc.) wrap should then be placed loosely over the plaster. Lastly, Elastoplast tape (Beiersdorf AG) is wrapped over the ACE wrap and stapled at many of the points of intersection of tape with the wrap.

A critical aspect of this dressing is the application of Mastisol, which allows the Webril to stick to the arm, and in turn allows the plaster to stick to the Webril and to itself at its point of contact with the opposing length of plaster. The circumferential wrap over the plaster has a tendency to come undone or unravel, but the tape and staples should prevent this from occurring. This has been a very successful form of dressing when splints are needed.

Wound Closure and Suture Material

In many cases, the use of suture material for skin closure is preferred over tissue adhesives. Tissue adhesives, such as Dermabond (Ethicon, Inc.), are typically only acceptable for the closure of straightforward lacerations that are under no tension. If applied incorrectly or if adhesive gets in the wound, a severe inflammatory reaction can potentially occur causing wound breakdown. With that said, many families view the use of these glues as suboptimal when compared with sutures.

Choosing the appropriate suture material can greatly influence the final appearance of the wound. Multiple factors must be taken into consideration when making this decision. This includes evaluation of the suture's construction (i.e., monofilament vs. braided), permanence (i.e., absorbable vs. nonabsorbable), tensile strength, and tissue reactivity. Char-

acteristics of the wound itself must also be taken into account. This includes the location and the depth of the injury and the tensile forces acting on the skin edges.

In the adult patient, the use of a nonabsorbable suture is often the preferred material for skin closure; however, in the case of the pediatric patient the suture removal process can be painful and often difficult to execute due to the child's lack of cooperation. Often, the removal of sutures is more traumatic for the child and family than the original placement. By using absorbable sutures, suture removal is avoided thereby simplifying the postoperative care of the child. Absorbable sutures progressively lose their tensile strength and eventually resorb completely; therefore, they should never be used when prolonged approximation of tissue is required.

Gut sutures are very useful in the pediatric population. For simple facial lacerations in a child, 5-0 or 6-0 fast-absorbing gut sutures are very effective as long as deep dermal sutures of Monocryl (Ethicon, Inc.) or Vicryl (Ethicon, Inc.) have been used. Although these sutures have moderate tissue reactivity, the dissolution of this material is fast enough that suture marks are rarely seen. The lips and perioral area are two regions that may require permanent suture such as nylon due to constant motion and saliva.

Steri-Strips (3M, Inc.) can also be a great adjunct to suture placement. These latex-free hypoallergenic paper tapes are often used over a closed incision to offload tension and minimize shear forces on wound edges. It is very important to apply Mastisol and allow this to dry prior to placing Steri-Strips.

Burns

Our discussion here applies only to small burns in children. Burns meeting burn center referral criteria (►Table 2) are beyond the scope of this discussion and should be handled by experts according to burn protocols. In addition, hand and foot burns should be treated very cautiously; the clinician should have a low threshold for referral to a burn center. Total body surface area involved can be easily assessed using the Lund and Browder chart and burn depth can be assessed by clinical judgment.⁷

The most common causes of pediatric burns requiring admission are scald (42%), flame (29%), and contact burns (10%).⁸ Contact burns are most frequently seen with curling irons and treadmills. They are typically small, located on the hand, and full-thickness in nature. Burns from water are usually partial-thickness and much easier to manage. In children who have scalds on the bilateral buttocks, child abuse should be strongly considered. In pediatric patients who have been in house fires, carbon monoxide poisoning should always be suspected even in the absence of burn lesions. Children have a tendency to hide in enclosed spaces during these situations, which predisposes them to carbon monoxide poisoning.⁹

Initially, the clinician should focus on resuscitation if indicated. Focus should then be directed toward other injuries that may require more immediate attention. Clothing and

Table 2 American Burn Association criteria for referral to a burn center

1. Partial-thickness burns greater than 10% of total body surface area
2. Burns that involve the face, hands, feet, genitalia, perineum, or major joints
3. Third-degree burns in any age group
4. Electrical burns, including lightening injury
5. Chemical burns
6. Inhalation injury
7. Burn injury in patients with pre-existing medical disorders that could complicate management, prolong recovery, or affect mortality
8. Any patient with burns and concomitant trauma (such as fractures) in which the burn injury poses the greatest risk for morbidity or mortality. In such cases, if the trauma poses the greater immediate risk, the patient may be stabilized initially in a trauma center before being transferred to a burn unit. Physician judgment will be necessary in such situations and should be in concert with the regional medical control plan and triage protocols.
9. Burned children in hospitals without qualified personnel or equipment for the care of children
10. Burn injury in patients who require special social, emotional, or rehabilitative intervention

Source: Advanced Burn Life Support Provider Manual. Chicago, IL: American Burn Association; 2011: 25–27. Copyright © American Burn Association.

debris should be removed. It is often prudent to provide pain management preceding exposure, inspection, and cleansing of the burn, especially in the pediatric population. Once these issues have been addressed, the etiology of the burn injury should be ascertained along with the approximate temperature of the object and the time of skin contact. The burn may be cleansed gently with soap and water. Tetanus prophylaxis is indicated.¹⁰ Following this, the burn should be appropriately dressed. This can be accomplished with a nonadherent gauze, such as Xeroform (Kendall/Covidien), then covered with dry gauze and a Kerlix (Covidien) roll. Fingers and toes should be wrapped individually to avoid undesirable healing and skin maceration.

One critical aspect of managing burns is minimizing the number of dressing changes that the family has to perform. Many times, physicians instruct family members to perform dressing changes two to three times daily. This can be remarkably difficult with young children. Typically, one good dressing change daily is sufficient. The family should be told to do this at bath time and should be encouraged to wash the area with warm water. Topical treatment should be restricted to bacitracin, Neosporin (Johnson & Johnson), or Bactroban (GlaxoSmithKline). Silver sulfadiazine is difficult to remove at the time of dressing changes and tends to accumulate on the burn over time. Moreover, it should be avoided in infants younger than 2 months and periocularly. Following washing and the application of ointment, a nonstick gauze followed by a bulky wrap should be placed. With burns on the hand, the entire hand should be bandaged—almost like a boxing glove. Selectively covering small areas of the hand is not effective for young children.

Conclusion

The treatment of pediatric patients requires special considerations that are often overlooked in the literature. Thoughtful approaches to the clinical examination of

pediatric patients lead to a timely diagnosis and treatment and minimize the distress experienced by a child. Preoperative antibiotics should be given judiciously to minimize unnecessary exposure. Splinting requires more forethought in the pediatric population, with special focus directed at ensuring the splint stays in place. Wound closure and suture selection should follow the basic principles we have detailed here in addition to best clinical judgment. When managing pediatric burns, one must have a low threshold for transfer to a burn center and remember the unique issues to be addressed in dressing the child's burn.

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