Chapter

Special Considerations in Pediatric Abdominal Surgeries

Arwa El Rifai and Ahmad Zaghal

Abstract

Pediatric surgery, as a specialty, pertains to the diagnosis, treatment and operative management of pediatric patients with congenital as well as acquired pathologies. The physiology and functional reserve of children is different than adults and this necessitates special considerations when dealing with this subgroup of patients. This includes careful anesthesia planning, perioperative care, as well as in-depth knowledge and appreciation of anatomic variations and operative techniques.

Keywords: Pediatrics, abdominal surgery, laparoscopy

1. Introduction

A pearl of wisdom "Children are not small adults" [1].

Pediatric surgery is a discipline that gradually came to light after the efforts of pioneering surgeons who dedicated their practice and refined their skills for the care of children. This sequentially provided the setting stones to establish organized training and scholarly platforms to share scientific knowledge and evidence-based practice [2].

In this chapter, we aim to highlight the peculiarities of abdominal open and minimally invasive surgery in the pediatric population with emphasis on perioperative preparation, types of incisions and wound considerations.

2. Special physiologic considerations in the pediatric patient

2.1 Anesthesia

Anesthesia in the pediatric population poses its challenges from airway management to medication prescription, however generally speaking it is well tolerated. During laparoscopy, some physiologic changes require careful management especially due to the particular patient positions as well as the pneumoperitoneum. These effects span the cardiovascular system and can manifest as bradycardia, decreased venous return, reduced cardiac output and rarely venous gas embolism. To minimize these consequences a lower insufflation pressure is recommended at 6 mmHg for infants and not above 10-12 mmHg for older children [3]. The respiratory system is also affected by the reduced diaphragmatic motion as well as the reduced lung compliance [3]. The central nervous system, the gastrointestinal system as well as coagulation can be affected as well. All these changes vary depending on patient

characteristics as well as the nature and duration of the operation together with the patient position [3]. Laparoscopy, be it intraperitoneal or extraperitoneal, can have hemodynamic as well as cardiovascular effects on pediatric patients [4].

For some pathologies, such as tracheoesophageal fistula (TEF), diaphragmatic hernia and abdominal wall defects early surgical intervention might be necessary. This should not come at the expense of thorough screening of other associated anomalies that may be associated with these entities. As such, meticulous physical examination, careful cardiac evaluation with echocardiography and ultrasound examination to screen for associated congenital anomalies is key. For example, associated anomalies in TEF occur in around 50% of the patients. Therefore, the conditions within the VACTREL association should be looked for, including vertebral, anal, cardiac, renal as well as limb malformations [5]. Similarly, diaphragmatic hernia is associated with other anomalies in 40% of cases and can present with respiratory distress at birth; therefore, they require optimization of their cardiopulmonary status as well as control of pulmonary hypertension before embarking on surgical repair [6]. Lastly, congenital abdominal wall defects particularly omphalocele is associated with chromosomal, cardiac, and renal malformations [7]. In view of the possible associated anomalies and the limited physiologic reserve that pediatric patients have, some require preoperative optimization prior to the surgical intervention. For instance, evaluation and pre-operative correction of electrolytes and fluid status is crucial in cases of pyloric stenosis to avoid peri-operative ventilatory and circulatory complications [8].

Pediatric patients include neonates and infants and span up to adolescence and often the cutoff is set at 21 years of age [9]. Despite this seemingly wide continuum, the smaller the size of the patient the more restricted is the working space during surgery including laparoscopy [10]. Additionally, due to the high surface area to body mass ratio in the younger patients it is imperative to regulate intraoperative temperature to avoid the sequel of hypothermia [11].

2.2 Abdominal wall

Surgery in the pediatric age group poses a challenge due to physiologic reasons inherent to this age group. Abdominal wall elasticity is higher in this age group and can compensate for the smaller space available to operate. This is significant mainly in laparoscopic procedures whereby pneumoperitoneum is imperative for generating the space. Even though, pediatric patients have higher abdominal wall elasticity which is advantageous in laparoscopy, this is limited by the non-linearity of the relationship with intra-abdominal pressure [12]. Therefore, a balance between the added space and the optimal intra-abdominal pressure is key. Moreover, it is also important to note that the decreased thickness of the abdominal wall can pose challenges for trocar secure placement. Most laparoscopic instruments are also available in small calibers including 2-, 3- and 5-mm sizes [10].

2.3 Urethral-catheter and nasogastric tube decompression

In children, the abdominal cavity provides restricted space for operation; therefore, urinary bladder (Foley catheter) and naso-gastric decompression can deflate the bladder and stomach respectively. Moreover, depending on the surgical procedure required such as pelvic operations a urinary catheter may be required to avoid inadvertent injury [10]. As an alternative to urinary catheter insertion, in case of short operation time, some surgeons might opt for Crede's maneuver to empty the bladder [13]. This maneuver entails applying suprapubic pressure onto the bladder to decompress the bladder without instrumentation [14].

2.4 Skin preparation

An important part of preparing the patient for surgery is skin preparation with the aim of decreasing the risk of wound complications. Several solutions are available including povidone-iodine, chlorhexidine and alcohol-based solutions. In adults several studies including randomized control studies showed the superiority of using chlorhexidine-alcohol solution as compared to povidone-iodine solution with respect to prevention of wound infection [15]. In the pediatric age group, the common practice is using povidone-iodine solutions despite ample evidence on the risk especially in the neonates and premature [16]. One study assessed the transcutaneous absorption of Iodine in infants younger than 3-months and showed significant increase is plasma levels of iodine [17]. Another study demonstrated an increase in urinary excretion of iodine in infants exposed to povidone-iodine in the first months of life, this was coupled with a rise in thyrotropin as well as a decrease in thyroxine when compared to the group receiving chlorhexidine solutions [18] Comparably, the use of chlorhexidine in neonates for PICC-line care was associated with skin compromise and dermatitis [19] and some studies showed transdermal absorption [20]. There is discrepancy in evidence and the guidelines aren't clear on which type of antiseptic agent to be used [21].

2.5 Use of electrosurgical energy

The advent of electrosurgical devices was a great achievement in surgery. It allowed for precise dissection as well as hemostasis. For the neonatal and pediatric surgeons alike, it is imperative to use the lowest possible setting to get the desired effect. For monopolar devices, this includes the utilization of low-voltage continuous or blended waveforms to cut or coagulate effectively. Bipolar devices, which are considered a safer option than monopolar, use low voltage with good vessel sealing effects with minimal collateral tissue damage [22].

3. Open surgery in the pediatric patient

When evaluating an infant or a child, timely diagnosis and treatment are essential in view of the limited physiologic reserve these patients have. The most common abdominal emergencies in pediatrics are acute appendicitis, symptomatic hernia, intussusception as well as congenital anomalies such as atresia and malrotation [23].

3.1 Access for open surgery

Whenever planning an operation, special considerations need to be entertained for choosing the type of incision. This often takes into account the surgical pathology, the contamination status as well as the patient's anatomy, the most commonly used incision in the pediatric age group is the transverse laparotomy incision.

3.2 Access for redo surgery

Reoperations, planned or unplanned, can pose significant morbidity in adults as well as in children. Several indications for reoperation arise in the pediatric age group, these include wound complications, bleeding as well as intra-abdominal infections [24]. One of the important considerations in reoperations is incision planning since adhesions are likely to form and bowel loops might adhere to the

wound site. This may constitute an increased risk of iatrogenic injuries while trying to gain access to the abdominal cavity [25]. One way to avoid this is choosing a virgin area for the incision.

3.3 Laparotomy incisions

In infants, unlike adults, a supraumbilical transverse incision provides exposure to the whole abdomen. On the other hand, the midline laparotomy incision is less commonly used in children as compared to adults. It is found to be associated with higher risk of dehiscence in comparison to the transverse laparotomy incision [26]. Depending on the surgical pathology other incision types can be used.

3.4 Subcostal incisions

A subcostal incision, also known as Kocher incision can be performed when access to the right and left upper quadrants is needed. As such a left subcostal incision can provide access to the spleen, diaphragm and esophagus. A right subcostal incision can provide access of the biliary tree in major hepatobiliary operations. The incision is generally started in the midline at the subxiphoid area and extended laterally parallel to the costal margin. The incision can be extended to gain better exposure bilaterally as a rooftop modification. Another modification that can be used in liver transplant surgery is the Mercedes-Benz modification. It entails fashioning the subcostal incisions lower than the standard unilateral subcostal incision with an extension in the midline towards the xyphoid process [27].

3.5 Trans-umbilical incision

Another less invasive access to the peritoneal cavity in children utilizes the trans-umbilical route and utilizes the advantageous abdominal wall elasticity to have a large operating field. It is performed by incising circumferentially around the umbilicus completely or partially and then incising the fascia in the midline and accessing the peritoneum guided by the site of the pathology [28]. The circum-umbilical access in children was first utilized to perform a pyloromyotomy in 1986 [29] and since then it has been used for several operations such as hypertrophic pyloric stenosis and intestinal atresia repair [28] This access technique is gaining popularity in older children for operations such as Meckel's diverticulum and ovarian cysts with comparable operative time and good cosmesis [30]. A wound protector can be utilized to stretch the wound further and allow exteriorization of the specimen as needed. Moreover, the incision can be extended to form an "Omega sign" and gain wider access if deemed necessary. Also, a variation to the incision can be done by performing it at the outer umbilical fold [30]. As compared to the traditional transverse incision one study by Suri et al. reported comparable operative times, use of narcotics as well as length of hospital stay and wound infection rate. However, they noted a higher hernia rate than the transverse incision group but not requiring operative intervention for resolution [31]. During umbilical access in the neonates, it is necessary to carefully ligate any urachal remnant, umbilical vessels or vitelline duct remnants [32].

3.6 Other incisions

Despite the decreased popularity of the open approach for acute appendicitis, it is still used in certain cases of complicated appendicitis, lack of laparoscopic equipment and expertise. The open approach using a McBurney/Gridiron incision which

is an oblique right lower quadrant incision or a more transverse Lanz incision in the same quadrant [33].

Another common incision used in pediatric surgery is the Pfannenstiel incision. It provides a wide surgical field and good cosmetic result. It has been used for repair of inguinal hernia in emergency setting [34] as well as in urologic operations [35]. Another lower abdominal incision, the concealed arch incision, has been used in pediatric urologic surgery. It involves an incision, mainly in females, fashioned on the inner aspect of the labia majora bilaterally with care taken to avoid the clitoris. This incision was shown to provide similar exposure as the traditional Pfannesntiel incision [36].

Another commonly used incisions are those needed to access the gastrointestinal tract either for decompression or for diversion of fecal stream. In children most commonly a sigmoid or transverse colostomy are most commonly used. Stomas are fashioned away from the laparotomy incision (if any) and are brought through the rectus muscle.

Depending on the segment of bowel chosen a right or left lower quadrant incision is used or an upper quadrant site for a transverse colostomy [37].

4. Laparoscopic surgery in the pediatric patient

Laparoscopic surgery has gained popularity ever since it was first described by Kelling in 1923 [38]. It includes working in the peritoneal cavity as well as the retroperitoneal space covering a myriad of procedures such as gastrointestinal and urologic procedures. However, the abdominal cavity in children and neonates is much smaller posing some technical challenges as well as a steep learning curve for most pediatric laparoscopic procedures [10]. The most common procedures performed for children are cholecystectomy, appendectomy and fundoplication. Some of the complications associated with these surgeries include wound infection, abscess formation as well as obstruction. These complications are noted to occur at a lower rate when compared to open surgery [39].

4.1 Access for laparoscopy

Several techniques are available to gain access to the peritoneal cavity for the purpose of performing a laparoscopic or a robotic procedure. Open access method is one technique of gaining entry to the peritoneal cavity, it entails making an incision usually for the camera port and then incising the peritoneum under direct vision. This is a very safe method and reduces the risk of inadvertent injury to the abdominal viscera during entry. Another method of entry to the abdominal cavity and establishing pneumoperitoneum is via the Veress needle. It utilizes a special needle that penetrates through the abdominal wall and alerts the surgeon by transmitting two haptic pops indicating successful entry. Moreover, correct placement can be tested by aspiration using a syringe with no blood or enteric fluid return. Lastly, direct access can be used, in this technique a transparent trocar is placed directly over the incision and using the scope penetration of the abdominal wall layers is done under vision. Regardless of the access method, the risk of inadvertent injury decreases with operator experience [10].

4.2 Single-incision

As part of the thrive for minimally invasive approaches to surgery, the advent of single-incision operations came about. By definition, it is surgery performed using

one incision through which access to the abdomen, chest or retroperitoneum will be provided. The first pediatric single-incision operation was an appendectomy done in 1998 [40]. Since then, several operations have been attempted using this approach. Besides the most commonly performed appendectomy, Inguinal hernia repairs were second in frequency followed by cholecystectomy and varicocelectomy [41]. For single-port operation in children, the umbilicus is of small caliber and thus restricts instrumentation and specimen exteriorization. The Benz incision, an inverted Y-shaped incision, through the umbilicus has been reported as a means to overcome this [42].

4.3 Robotic surgery

Some of the challenges faced in laparoscopic surgery can be overcome by using the robotic platforms. Robotic surgery allows higher precision and ease of instrumentation with 360-degree hand movements while providing a three-dimensional view [10].

5. Closure techniques and use of drains

Abdominal closure techniques encompass mass or layered closure with variable use of absorbable versus non-absorbable suture material, monofilament versus polyfilament and continuous versus interrupted patterns [43]. The literature is scarce on comparing each technique of closure in the pediatric age group. A Cochrane review that looked at studies in adults and children regarding wound closure concluded absorbable suture material resulted in less risk of fistulization. Moreover, it showed no superiority of interrupted versus continuous closure techniques with respect to hernia formation. Lastly, the use of monofilament sutures was associated with reduced hernia risk [44]. Evidence regarding the long-term effect of abdominal wall closure technique is scarce and stems from literature with prolonged follow up until adulthood in patients undergoing surgery for congenital abdominal wall defects in infancy. One study reported on the need for reoperation later in life in up to 22% of the patients due to occurrence of hernias or sequelae of atresia [45]. Another study reported that adult patients who had congenital abdominal wall defects repaired in childhood showed comparable quality of life as the general population [46]. The common practice nowadays is to use absorbable sutures to close abdominal wall defects as well as surgical incisions including laparotomies [44]. These sutures will dissolve before a significant abdominal wall growth is noted and hence unlikely to affect or retard growth.

5.1 Use of drains

Drain insertion after surgery is debatable with the theoretical benefit of clearance of residual infection, debris and as a window to hemostasis. One of the most common operations where drains are used is perforated appendicitis. In these cases, a Jackson-Pratt (JP) drain is commonly used which utilizes a negative pressure closed system to clear fluid. However, evidence against the use of JP drains is accumulating with evidence showing increased postoperative complications including abscess formation, and small bowel obstruction [47]. Another study failed to show decrease in intra-abdominal abscess formation with the use of Blake drains in perforated appendicitis [48]. If a drain was placed after perforated appendicitis, the timing of removal is dictated by the output volume and character. It is generally considered optimal to remove drains once output is clear and less than 20 ml/day [49]. Another

classic indication for drain insertion is after Roux-en-Y hepatojejunostomy in choledochal cyst operations, However, with the advent of laparoscopy the use of drains after this operation is reserved for a particular subset of patients with significant inflammation at the operative field, perforated biliary peritonitis and a cyst that is majorly embedded within the pancreatic parenchyma [50].

Yet there remains a role for drains in certain clinical scenarios. This includes placement of Penrose drain in a subcutaneous abscess cavity after adequate drainage and debridement of infected wounds and abscesses. Often these drains are removed once the drainage from the cavity is minimal and surrounding soft tissue infection has resolved [51]. Moreover, there is a potential role for peritoneal drainage as a definitive measure in necrotizing enterocolitis (NEC) with perforation with or without laparotomy as clinically indicated in the course of follow up [52].

6. Wound considerations

Wound complications can pose a serious postoperative morbidity on surgical patients including children. The incidence ranges from 0.4 [26] to 1.2% [53] however it has a high mortality rate that can range from 8% [26] up to 34% in cases of evisceration [54]. Several risk factors have been reported including vertical incisions namely in children younger than one year of age [26]. Other independent risk factors included age less than one-year with an odds ratio of 9.5, wound infection OR 3.7, median incision OR 2.9 and emergency surgery 2.8 [55].

7. Conclusion

Despite the similarities in surgical principles between adult and pediatric surgery it is imperative to appreciate the differences that remain. With this in mind, surgical pathologies in the pediatric age group remain the most diverse and intriguing yet challenging cases.

Conflict of interest

The authors declare no conflict of interest.

Author details

Arwa El Rifai and Ahmad Zaghal*
Department of Surgery, American University of Beirut Medical Center, Beirut, Lebanon

*Address all correspondence to: az22@aub.edu.lb

References

[1] Gillis J, Loughlan P. Not just small adults: the metaphors of paediatrics. Arch Dis Child. 2007: 92(11):946-947. DOI: 10.1136/adc.2007.121087

[2] Ziegler M, Azizkhan R, Allmen D, Weber T. Chapter 1: History of Pediatric Surgery. Operative Pediatric Surgery, 2nd ed, McGraw-Hill; 2014

[3] Gupta R, Singh S. Challenges in Paediatric Laparoscopic Surgeries. Indian J Anaesth. 2009: 53(5):560-566. PMCID: PMC2900088, PMID: 20640106

[4] Halachmi S, El-Ghoneimi A, Bissonnette B. Hemodynamic and Respiratory Effect of Pediatric Urological Laparoscopic Surgery: A Retrospective Study. The Journal of Urology. 2003:170:1651-1654. DOI: 10.1097/01.ju.0000084146.25552.9c

[5] De Jong E, Felix J, De Klein A, Tibboel D. Etiology of Esophageal Atresia and Tracheoesophageal Fistula: "Mind the Gap". Curr Gastroenterol Rep (2010) 12:215-222 DOI: 10.1007/s11894-010-0108-1

[6] Wynn J, Yu L, Chung W. Genetic causes of congenital diaphragmatic hernia. Semin Fetal Neonatal Med. 2014 December; 19(6): 324-330. DOI:10.1016/j.siny.2014.09.003

[7] Mann S, Blinman T, Wilson R. Prenatal and postnatal management of omphalocele. Prenat Diagn 2008; 28: 626-632. DOI: 10.1002/pd.2008

[8] Kamata M, Cartabuke R, Tobias J. Perioperative care of infants with pyloric stenosis. doi:10.1111/pan.12792. DOI:10.1111/pan.12792

[9] Hardin A, Hackell J. Age Limit of Pediatrics. Pediatrics. 2017: 140(3): e20172151. DOI: 10.1542/peds.2017-2151

[10] Tomaszewski J, Casella D. Pediatric Laparoscopic and Robot-Assisted Laparoscopic Surgery: Technical Considerations. Journal of Endourology. 2012: 26(6):602-613. DOI: https://doi.org/10.1089/end.2011.0252

[11] Bindu B, Bindra A, Rath G. Temperature management under general anesthesia: Compulsion or option. J Anaesthesiol Clin Pharmacol. 2017: 33(3):306-316. DOI: 10.4103/joacp.JOACP_334_16

[12] Zhou R, Cao H, Gao Q. Abdominal Wall Elasticity of Children during Pneumoperitoneum. Journal of Pediatric Surgery. 2020:55(4):742-746. DOI: 10.1016/j.jpedsurg.2019.05.025

[13] Lobe T. Chapter 36: Pediatric Laparoscopy: General Considerations. Page 387. C. E. H. Scott-Conner (ed.), The SAGES Manual Society of American Gastrointestinal Endoscopic Surgeons 1999

[14] Barbalia G, Klauber G, Blaivas J. Critical Evaluation Of The Crede Maneuver: A Urodynamic Study Of 207 Patients. The Journal of Urology. Volume 130, Issue 4, October 1983, Pages 720-723. https://doi.org/10.1016/S0022-5347(17)51423-8

[15] Darouiche R, Wall M, Itani K. Chlorhexidine-Alcohol versus Povidone-Iodine for Surgical-Site Antisepsis. N Engl J Med. 2010: 362(1):18-26. DOI: 10.1056/NEJMoa0810988

[16] Ng A, Jackson C, Kazmierski M. Evaluation of Antiseptic Use in Pediatric Surgical Units in the United Kingdom—Where Is the Evidence Base?. European Journal of Pediatric Surgery. 2016 Aug;26(4):309-315. DOI: 10.1055/s-0035-1559883

[17] Mitchell I, Pollock J, Jamieson M, Fitzpatrick K, Logan R. Transcutaneous

iodine absorption in infants undergoing cardiac operation. Ann Thorac Surg. 1991: 52(5):1138-1140. DOI: 10.1016/0003-4975(91)91295-7

[18] Smerdely P, Lim A, Boyages S. Topical iodine-containing antiseptics and neonatal hypothyroidism in very-low-birthweight infants. Lancet. 1989: 2(8664):661-664. DOI: 10.1016/s0140-6736(89)90903-3

[19] Visscher M, deCastro M, Combs L. Effect of chlorhexidine gluconate on the skin integrity at PICC line sites. J Perinatol. 2009: 29(12):802-807. DOI: 10.1038/jp.2009.116

[20] Owen J, Ellis SH, McAinsh J. Absorption of chlorhexidine from the intact skin of newborn infants. Arch Dis Child. 1979: 54(5):379-383. DOI: 10.1136/adc.54.5.379

[21] Loveday H, Wilson J, Pratt R. epic3: National Evidence-Based Guidelines for Preventing Healthcare-Associated Infections in NHS Hospitals in England. J Hosp Infect. 2014 Jan; 86: S1–S70. DOI: 10.1016/S0195-6701(13)60012-2

[22] Sinha S, Dhua A. Energy Sources in Neonatal Surgery: Principles and Practice. Journal of Neonatal Surgery 2014;3(2):17. PMCID: PMC4420325. PMID: 26023488

[23] Firomsa T, Teferra M, Tadesse A. Trends and Outcomes of Emergency Pediatric Surgical Admissions from a Tertiary Hospital in Ethiopia. Ethiop J Health Sci. 2018:28 (3):251-258. DOI: 10.4314/ejhs.v28i3.2

[24] Li A, Zhu H, Zhou H, Liu J, Deng Y, Liu Q, Guo C. Unplanned surgical reoperations as a quality indicator in pediatric tertiary general surgical specialties: Associated risk factors and hospitalization, a retrospective case–control analysis. Medicine 2020;99:19 (e19982). http://dx.doi.org/10.1097/MD.0000000000019982

[25] Coleman M, Mclain A, Moran B. Impact of Previous Surgery on Time Taken for Incision and Division of Adhesions During Laparotomy. Dis Colon Rectum 2000;43:1297-1299. DOI: 10.1007/BF02237441

[26] Waldhausen J, Davies L. Pediatric Postoperative Abdominal Wound Dehiscence: Transverse Versus Vertical Incisions. J Am Coll Surg. 2000 Jun;190(6):688-691. DOI: 10.1016/s1072-7515(00)00284-2

[27] Bradnock Tm Carachi R. 2013) A10 Subcostal and Rooftop Incisions. In: Carachi R., Agarwala S., Bradnock T.J., Lim Tan H., Cascio S. (eds) Basic Techniques in Pediatric Surgery. Springer, Berlin, Heidelberg. https://doi.org/10.1007/978-3-642-20641-2_10

[28] Elhalaby E, Hassan H, Hashish M, Hashish A. The versatility of the transumbilical approach for laparotomy in infants. Annals of Pediatric Surgery. 2015:11(1):1-6. DOI: 10.1097/01.XPS.0000459975.88923.a6

[29] Tan K, Bianchi A. Circumumbilical incision for pyloromyotom. Br J Surg. 1986:73(5):399. DOI: 10.1002/bjs.1800730529

[30] Tsuji Y, Maeda K, Ono S, Yanagisawa S. A new paradigm of scarless abdominal surgery in children: Transumbilical minimal incision surgery. Journal of Pediatric Surgery. 2014:49:1605-1609. DOI: 10.1016/j.jpedsurg.2014.06.009

[31] Suri M, Langer J. A comparison of circumumbilical and transverse abdominal incisions for neonatal abdominal surgery. Journal of Pediatric Surgery. 2011: 46(6):1076-1080. DOI: 10.1016/j.jpedsurg.2011.03.032

[32] Hegazy A. Anatomy and embryology of umbilicus in newborns:

a review and clinical correlations. Frontiers of Medicine. 2016:10(3):271-277. DOI: 10.1007/s11684-016-0457-8

[33] Khirallah M, Eldesouki N, Elzanaty A, Ismail K, Arafa M. Laparoscopic versus open appendectomy in children with complicated appendicitis. Ann Pediatr Surg 13:17-20. DOI: 10.1097/01.XPS.0000496987.42542.dd

[34] Koga H, Yamataka A, Ohshiro K, Okada Y. Pfannenstiel Incision for Incarcerated Inguinal Hernia in Neonates. Journal of Pediatric Surgery volume 38:8, E16E18. DOI:https://doi.org/10.1016/S0022-3468(03)00293-8

[35] Kim C, Docimo S. Use of Laparoscopy in Pediatric Urology. Rev Urol. 2005;7(4):215-223

[36] Snow B. Journal of Pediatric Urology (2015) xx, 1e2, Journal of Pediatric Urology (2015) xx, 1e2. http://dx.doi.org/10.1016/j.jpurol.2015.05.021

[37] Minkes R, Grewal H. Stomas of the Small and Large Intestine in Children Treatment & Management [Internet]. 2019. Available from: https://emedicine.medscape.com/article/939455-treatment#d1 [Accessed: 2021-01-22]

[38] Litynski G. Laparoscopy - The Early Attempts: Spotlighting Georg Kelling and Hans Christian Jacobaeus. JSLS. 1997:1(1):83-85. PMID: 9876654, PMCID: PMC3015224

[39] Billingham M, Basterfield S. Pediatric Surgical Technique: Laparoscopic or Open Approach? A systematic Review and Meta-Analysis. Eur J Pediatr Surg. 2010:20(2):73-77. DOI: 10.1055/s-0029-1241871

[40] Esposito C. One-trocar appendectomy in pediatric surgery. Surg Endosc. 1998:12(2):177-178. DOI: 10.1007/s004649900624

[41] Saldana L, Targarona E. Single-Incision Pediatric Endosurgery: A Systematic Review. Journal of Laparoendoscopic & Advanced Surgical Techniques. 2013 May;23(5):467-480. DOI: 10.1089/lap.2012.0467

[42] Amano H, Uchinda H, Kawashima H. The Umbilical Benz Incision for Reduced Port Surgery in Pediatric Patients. JSLS. 2015;19(1):e2014.00238. DOI: 10.4293/JSLS.2014.00238

[43] Khan S, Saleem M, Talat N. Wound dehiscence with continuous versus interrupted mass closure of transverse incisions in children with absorbable suture: a randomized controlled trial. World Jnl Ped Surgery. 2019;2:e000016. DOI:10.1136/wjps-2018-000016

[44] Patel S, Paskar D, Nelson R. Closure methods for laparotomy incisions for preventing incisional hernias and other wound complications. Cochrane Database of Systematic Reviews. 2017 Nov; 2017(11): CD005661. DOI: 10.1002/14651858.CD005661.pub2

[45] Tunell W, Puffinbarger N, Tuggle D, Taylor D, Mantor P. Abdominal Wall Defects in Infants Survival and Implications for Adult Life. Ann Surg. 1995 May; 221(5): 525-530. DOI: 10.1097/00000658-199505000-00010

[46] Koivusalo A, Lindahl H, Rintala R. Morbidity and quality of life in adult patients with a congenital abdominal wall defect: a questionnaire survey. J Pediatr Surg. 2002 Nov;37(11):1594-1601. doi: 10.1053/jpsu.2002.36191

[47] Song R, Jung K. Drain insertion after appendectomy in children with perforated appendicitis based on a single-center experience. Ann Surg Treat Res 2015;88(6):341-344. http://dx.doi.org/10.4174/astr.2015.88.6.341

[48] Ferguson D, Anderson K, Arshad S, et al., Prophylactic intraabdominal

drains do not confer benefit in pediatric perforated appendicitis: Results from a quality improvement initiative. Journal of Pediatric Surgery, In Press. https://doi.org/10.1016/j.jpedsurg.2020.06.031.

[49] Eysenbach L, Caty M, Christison-Lagay E, Cowles R. Outcomes following adoption of a standardized protocol for abscess drain management in pediatric appendicitis. Journal of Pediatric Surgery 56 (2021) 43-46. https://doi.org/10.1016/j.jpedsurg.2020.09.050

[50] Diao M, Li L, Cheng W. To drain or not to drain in Roux-en-Y hepatojejunostomy for children with choledochal cysts in the laparoscopic era: a prospective randomized study. Journal of Pediatric Surgery (2012) 47, 1485-1489. DOI:10.1016/j.jpedsurg.2011.10.066

[51] Ladd A, Levy M, Quilty J. Minimally invasive technique in treatment of complex, subcutaneous abscesses in children. Journal of Pediatric Surgery (2010) 45, 1562-1566. DOI:10.1016/j.jpedsurg.2010.03.025

[52] Downward C, Renaud E, Peter S, Abdullah F. Treatment of necrotizing enterocolitis: an American Pediatric Surgical Association Outcomes and Clinical Trials Committee systematic review. Journal of Pediatric Surgery (2012) 47, 2111-2122. http://dx.doi.org/10.1016/j.jpedsurg.2012.08.011)

[53] Gruessner R, Pistor G, Kotei DN. Relaparotomie im Kindesalter [Relaparotomy in childhood], Langenbecks Arch Chir, 1986: 367(3):167-180. DOI: 10.1007/BF01258935

[54] Cığdem M, Onen A, Otcu S, Duran H. Postoperative abdominal evisceration in children: possible risk factors. Pediatr Surg Int (2006) 22:677-680 DOI 10.1007/s00383-006-1722-8

[55] Ramshorst G, Salu N, Bax N. Risk Factors for Abdominal Wound Dehiscence in Children: A Case-Control Study. World J Surg. 2009 Jul;33(7):1509-1513. DOI: 10.1007/s00268-009-0058-7