

Strategies In Surgery

Minimally Invasive Surgery: A Key Part of the Pediatric Surgery Routine

- Inguinal Hernia
- Pyloric Stenosis
- Appendicitis
- Pectus Excavatum
- Pneumonia and Empyema

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The field of pediatric surgery continues to rapidly advance as we implement new methods of minimally invasive surgery (MIS). OU Children's Physicians pediatric surgeons utilize **dedicated laparoscopic operating rooms** in the new surgery center of The Children's Hospital at OU Medical Center.

With **advances in laparoscopic surgery and development of child-friendly instruments**, many traditional open procedures are performed in a minimally invasive fashion. Often minimally invasive surgery (MIS) is considered a high-tech field for more advanced cases, but the pediatric surgeons at OU Children's Physicians are utilizing MIS more often than not on a daily basis to improve outcomes and simplify routine procedures. Even if not using a laparoscope or thoracoscope to perform the procedure, incision size is often reduced for a more cosmetically acceptable result. Following are examples of procedures now frequently performed by OU Children's Physicians pediatric surgeons with MIS techniques:

INGUINAL HERNIA

The most common presentation of an inguinal hernia in infants is a bulge in the groin or the scrotal sac in males. This bulge is seen more easily during straining or crying. Hernias in children are rarely due to a weakness in the muscles or tissues in the groin as would be typical in adults. Approximately three to five percent of term infants may be born with a clinically apparent inguinal hernia, while preterm infants have a considerably higher incidence (nine to 11 percent). In infants of less than 28 weeks' gestation, the incidence is higher, closer to 35 percent.

The most common complication of inguinal hernia is incarceration. In most instances, inguinal hernia repair in infants and children can be done as outpatient surgery. The incision for hernia repair is made in a natural skin crease on the side of the hernia. The hernia sac is then closed with sutures. Prosthetic mesh or plugs commonly used in adult hernia repairs are not needed in childhood hernia repairs, but occasionally in older teenagers. Although laparoscopic hernia repair has become a popular alternative in adults, there is a limited role for this minimally invasive technique in infants and young children.

However, we still have found laparoscopy to play a valuable role. There is considerable

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controversy as to whether children with a hernia on one side should have the opposite side explored during surgery. Development of scopes less than two millimeters in diameter allows us to **routinely explore the contralateral side in infants less than one to two years of age, without the risk of injuring the spermatic cord that one would encounter during open groin exploration.** Because the hernia sac communicates with the peritoneal cavity, it can be used to insufflate the abdomen such that the scope can be safely placed. Figure 1 demonstrates a contralateral inguinal hernia as seen through the two millimeter scope.

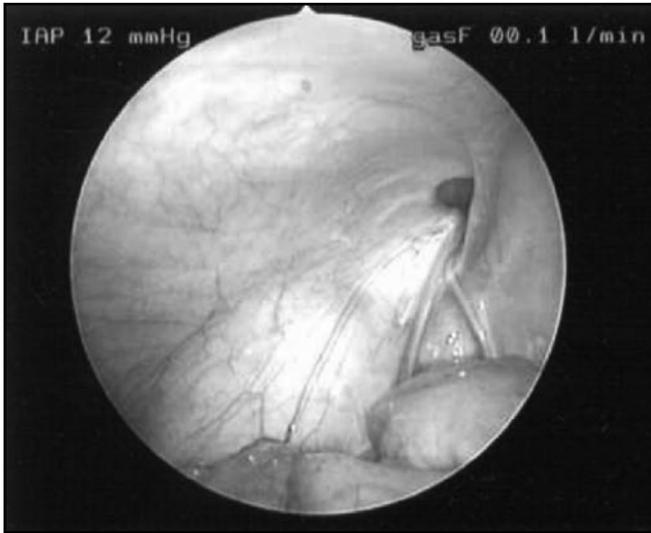


Figure 1

PYLORIC STENOSIS

Pyloric stenosis is a condition in which the pyloric muscle becomes thickened. The most typical symptom is the forceful vomiting of formula or milk. Symptoms usually begin when children are between three and five weeks old. Repeated vomiting that persists for several days may irritate the stomach and lead to mild stomach bleeding.

Before surgery, care is aimed at correcting the dehydration and possible electrolyte abnormalities with intravenous fluids. Then, surgery can be performed on most infants within a day after admission to the hospital. The procedure can be done through a variety of incisions. Originally, it was performed through a somewhat large incision in the right upper abdomen. We presently use a **more cosmetically acceptable incision around the belly button.**

In addition, we are **using laparoscopy with three very small incisions to lessen the risk of wound infection and potential for adhesions.** Regardless of the approach used, the thickened pyloric muscle around the outside of the

pylorus is cut to relieve the blockage, while the inside lining of the pylorus remains intact. The usual post-operative course is to initiate feedings shortly after surgery with a goal of discharge within 12 to 24 hours after initial feeds. Figure 2 shows a completed laparoscopic pyloromyotomy.

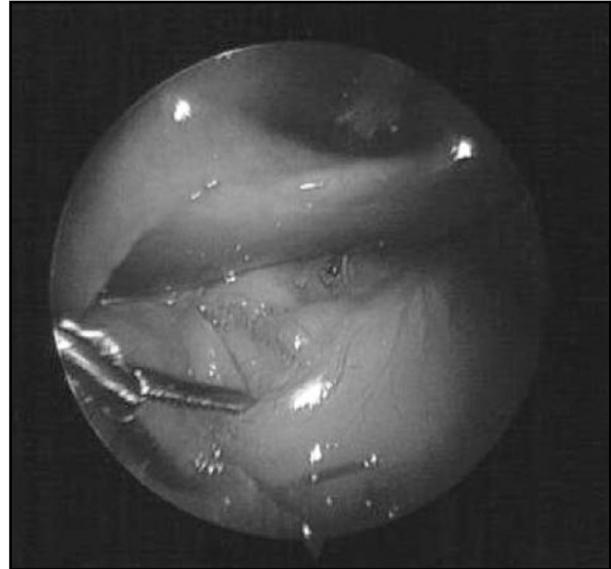


Figure 2

APPENDICITIS

Acute appendicitis is one of the most common causes of abdominal pain in childhood. This diagnosis must be considered in all age groups but is more common in children between ages four and 15 years old. In most patients, the appendix is located in the right lower area of the abdomen. However, it may be in various other locations in the right upper area of the abdomen under the gallbladder, in the pelvis across the top of the bladder, or behind the large intestine.

In instances of early appendicitis, a child should receive intravenous fluids, antibiotics and medication for pain relief. Once antibiotics are administered, there is often a reduction in pain and tenderness in many children. In most instances, antibiotics and pain medications should not be given until the diagnosis of appendicitis has been made.

We presently **perform most pediatric appendectomies via a laparoscopic approach.** The cost of laparoscopic surgery, while sometimes higher than traditional surgery, is typically offset by savings due to shorter hospital stays, quicker recovery and parents' ability to return to work sooner. A laparoscopic operation can be performed in the same time required to perform an open appendectomy, and if the

appendix is ectopically located, it is often easier than the open approach. In addition to a smaller incision with the laparoscopic approach, surgeons can completely see other abdominal structures should the appendix appear normal.

When an appendix has ruptured, a patient should undergo fluid resuscitation, and antibiotics should be given to treat infection. Then, a patient may be taken to the operating room for appendectomy. However, in many cases of ruptured appendices, the approach of interval appendectomy is applied: Patients are first treated with antibiotics to allow the infection to go away. Abscesses are drained with CT guidance, and antibiotics are continued until an infection is gone. A peripherally-inserted central catheter (PICC) may be placed into a vein. Then, a patient is sent home on intravenous (IV) antibiotics once able to eat and pain controlled through oral medication. Some six to eight weeks later, appendectomy is performed. The complications appear to be less with this approach of waiting before performing the appendectomy when the appendix has ruptured.

PECTUS EXCAVATUM

Pectus excavatum, or funnel chest, is a congenital malformation of the anterior chest, characterized by a prominent depression of the body of the sternum, usually involving its lower half to two-thirds. The lower rib cartilages bend posterior to form a depression. The first and second ribs and the upper sternum are essentially normal. Asymmetric deformities are common, with the depression being deeper on the right with the sternum being rotated posterior to that side. In most instances, however, the depression involves the lower half of the sternum and is symmetrical with a decrease in the depth of the chest cavity.

Symptoms are infrequent during early childhood except for an unwillingness to expose the chest while swimming or taking part in other social or athletic activities. Decreased stamina and endurance often become apparent during early adolescence when children may become involved in competitive sports.

When the deformity is moderate to severe, the heart is considerably displaced into the left side of the chest, and lung expansion during inhaling is limited, resulting in a “restrictive defect” on pulmonary function tests. Many patients with this condition are thin with poor posture and a protuberant abdomen.

The standard surgical repair involves general anesthesia with a transverse chest incision made over the depressed sternum. The chest muscle is elevated to expose the sternum, and ribs

and the lower deformed rib cartilages are removed on both sides of the sternum. The outer bony edge of the sternum is cut above the sunken portion to create a hinge that can be used to elevate the lower sternum. A stainless steel bar is placed behind the sternum and sewn to the adjacent ribs to maintain the new position of the sternum. The bar is generally removed six months to one year later through a lateral chest incision done in an outpatient setting.

Recently, a **new minimally invasive method of pectus excavatum repair** was devised by Don Nuss, M.D., a pediatric surgeon in Norfolk, VA. In his method, a titanium bar is used to elevate the sternum without removal of the rib cartilages. A curved, titanium bar is placed under the sternum through two, lateral chest incisions often with the use of a thoracoscope to guide its passage. The bar must remain in place for two years to allow for permanent remodeling of the rib cartilages. Studies indicate the two methods of repair are comparable in length of hospital stay, pain medicine requirements and patient satisfaction. The Nuss repair is demonstrated in Figure 3.

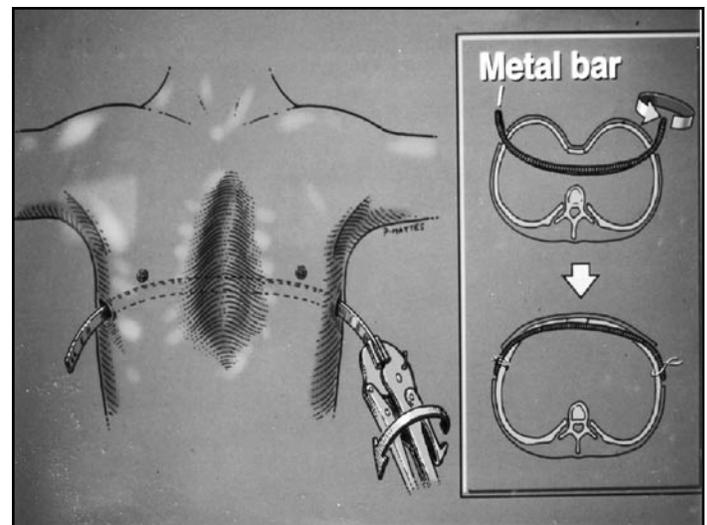


Figure 3

PNEUMONIA AND EMPYEMA

Empyema is a chest infection that occupies the thoracic space between the lung and the chest wall. In children, empyema is usually a complication of pneumonia. Inflammatory reaction to pneumonia produces fluid in the pleural space. If the infection from the pneumonia spreads to this fluid, pus may accumulate, resulting in empyema. Fluid that does not flow freely may be trapped or may represent the thicker, gel-like material characteristic of empyema.

Removal of such material from the chest with a chest tube is usually not possible, and a different plan of therapy must be selected. Options include medical therapy with or without placement of a chest tube or by combined medical and surgical intervention. A child with a small empyema used to be treated with intravenous antibiotics for 10 to 14 days, sometimes with a chest tube as well. Additional antibiotics were given by mouth for one to three weeks thereafter. If a patient responded to the antibiotics, no further intervention was indicated. If not, surgical intervention, in the form of a thoracotomy, was often indicated.

Studies have shown that early evacuation of a significant empyema reduces hospital stay and hastens the child's return to normal activities. Open thoracotomy and evacuation of the empyema is effective but requires a large incision in the chest wall.

Recent application of **video-assisted, minimal access techniques (VATS) allows evacuation of the empyema to be accomplished with a more rapid recovery and less patient discomfort.** For the video-assisted operation, two small incisions are made in the chest wall. The lung is partially deflated, and a telescope is inserted into the pleural space so that the surgeon can see. Through the additional small incision,

a variety of instruments are used to evacuate as much fluid, pus and debris as possible, from the pleural cavity. Care is taken to avoid injury to the lung, although the pneumonia may have already broken through the surface of the lung. Chest tubes are usually left through the incisions to promote further drainage of the infection. Once drainage stops, and there is no air leak from the lung, the chest tubes are removed, which usually occurs within two to three days.

Some surgeons instill medication through the chest tube to help break up the adhesions that may form after the VATS operation. Early diagnosis of effusion associated with pneumonia and prompt intervention reduces the complications associated with the disease. **Minimally invasive surgical intervention for advanced empyema speeds recovery and reduces the hospital stay.**

Minimally invasive surgery has now become a part of the daily pediatric surgical protocol. It is routinely offered now where its benefits are clearly documented. Here at The Children's Hospital at OU Medical Center as well as nationally, even common congenital defects such as esophageal atresias with tracheoesophageal fistula and congenital cystic adenomatoid malformation are being treated with minimally invasive approaches.

Additional reading:

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