

# Inguinal Hernia and Hydrocele

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## ■ BRIEF BACKGROUND, EPIDEMIOLOGY, AND INTRODUCTION

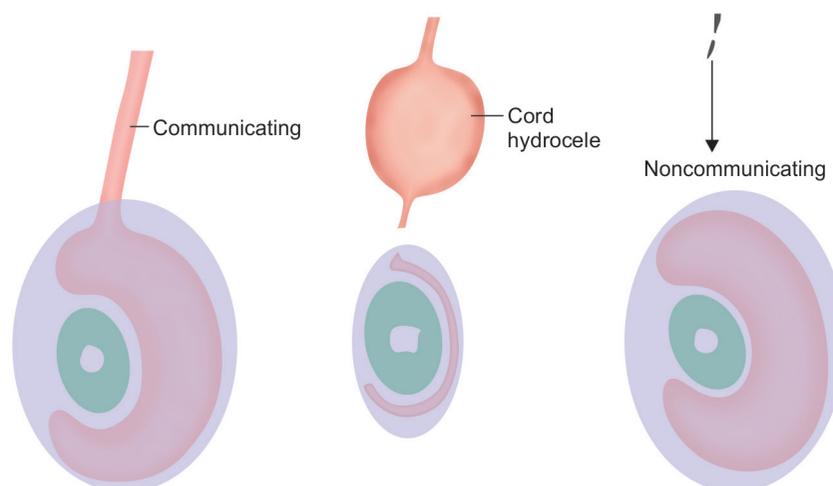
Inguinal hernia and hydrocele are two of the most common urological surgical conditions that require invasive repair; inguinal hernias occur in 1–4% of all infants, with a higher incidence among premature infants.<sup>1</sup> Mostly seen in males, with a male to female ratio of 6:1.<sup>2</sup> On the other hand, communicating hydroceles are common in newborn males, with an incidence of 2–5%; 90% of these resolve during the 1st year of life as a result of spontaneous closure.<sup>3</sup> Prematurity and low birth weight are risk factors for inguinal hernia and the incidence can reach up to 30% of patients.<sup>4</sup>

Hydrocele could be defined as a collection of fluid between the parietal and visceral layers of the tunica vaginalis formed when the processus vaginalis (PV) fails to obliterate forming either an inguinal hernia or hydrocele. If the lumen is too small to admit bowel, peritoneal fluid

can collect in the tunica vaginalis and form a hydrocele. In females, incomplete obliteration of the PV is named the canal of Nuck.<sup>5</sup> Hydroceles can be classified in communicating, noncommunicating, and cord hydrocele (**Fig. 1**). If the lumen is wide enough, abdominal contents may be extruded into it and form an inguinal hernia.<sup>6</sup>

Indirect inguinal hernia can be formed from a wider PV opening, large internal and external inguinal rings, and a lack of obliquity of the inguinal canal, permitting the passage of fat or small intestines through the inguinal canal. This is a condition mostly seen in infants. Direct inguinal hernias are mostly seen in adults caused by connective tissue degeneration of the abdominal muscles permitting intestines to slide into the groin<sup>6</sup> and are very uncommon in pediatric population.

Both pathologies can be diagnosed by physical examination and confirmed without the strict use of images; the presence of a reducible asymptomatic firm bulge in the groin or scrotum in males or a mass in the



**Fig. 1:** Patent processus vaginalis with different types of hydrocele.

labia majora in girls is suspicious of an inguinal hernia. Incarceration of the hernia sac should be suspected in a patient who presents with severe, sudden onset of pain and a hard, tender, fixed mass in the groin. If it is not reduced manually, surgical reduction should follow.<sup>7</sup>

If physical examination is not confirmative, inguinal ultrasound (US) is the image of choice for patients with suspected inguinal abnormalities<sup>8</sup> especially when clinical diagnosis is unsure. Keep in mind that results of this study are not all standardized, depending on operator skills and cooperation from the patient (stillness and Valsalva maneuver). This technique is a low cost and noninvasive fast method for diagnostic assessment. During the examination, patient is in a supine position, the Valsalva maneuver should be performed to identify transient hernias; standing up evaluation can be done if supine position fails. The hernia contents can be hyperechoic because of omental fat, anechoic because of fluid, or of mixed echogenicity with reverberations caused by air in the bowel loops.<sup>9</sup> US more than diagnostic also helps in surgical reconstruction decisions by evaluating the extent of reducibility of the hernial content. Contralateral patent PV can be seen in 40% of children with unilateral inguinal hernia.<sup>10</sup> Patent processus vaginalis (PPV) or hydrocele can be visualized by US during straining as inflow of intra-abdominal fluid into the PV or as an expanded PV owing to the protrusion of a viscus.<sup>11</sup>

Differential diagnosis for inguinal lesions is challenging because of similarities during the physical examination such as tender palpable masses; under these findings we should have in mind the following diagnosis: inguinal hernia, spermatic cord hydrocele, undescended testis, hematoma, inflammation, abscess, benign or malignant tumors, metastatic or benign lymph node enlargement, round ligament varicosities or mesothelial cyst, and herniated ovary.

## ■ INDICATIONS AND PREREQUISITES FOR SURGERY

Before surgery after correct diagnosis is made throughout physical examination and image assistance, elective repair can be programmed. During in office visits, manual reduction of a nonstrangulated hernia should always be easy to obtain. If reduction maneuver is painful, it can be done under sedation, these needs to be booked for surgery sooner than later.

Indications for surgery in hydrocele are mostly age dependent with some exceptions like a noncommunicating cysts with volume greater than 10 mL with high tension.<sup>12</sup> Discussion of when to operate in patients without complications is under debate with some surgeons that prefer to close the PV before the age of 2 years<sup>13</sup> and others believe there is a chance for PV to obliterate before the age of 4 years maintaining an observational behavior.<sup>14,15</sup> Our suggestion is to wait between 18 months and 24 months to resolve by itself, before suggesting surgery.

Different management is seen in asymptomatic inguinal hernia, these can be programmed for surgery as soon as possible. One study with a population of 2,030 neonatal patients revealed that less than 10% of patients with inguinal hernia developed incarceration while surgery was being delayed<sup>16</sup> for repair. On the other hand, indications for urgent inguinal hernia repair include patients that are symptomatic because of strangulation of bowel. Strangulation incidence is 35% among infants that are programmed for elective surgery.<sup>17</sup> Same result percentage is seen in other studies.<sup>18</sup>

With this information, parents should be educated and advised to assist to the nearest emergency department if incarceration manifests while waiting for elective repair.

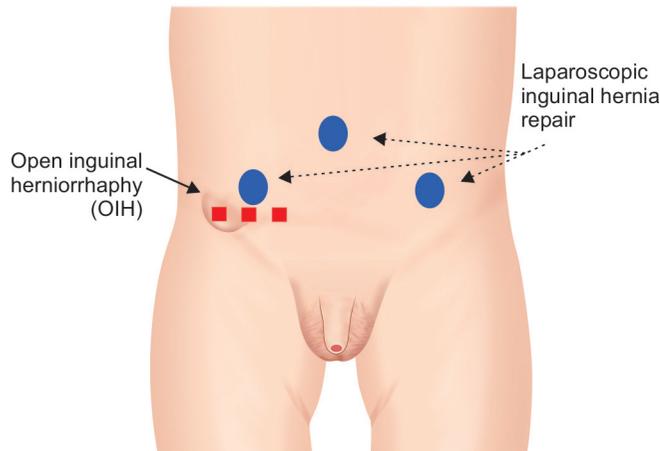
## ■ PREOPERATIVE TECHNIQUE

For hydrocele and inguinal hernias, surgical principles and techniques are very similar. However, for inguinal hernias, these could be done either by an open inguinal herniorrhaphy (OIH) or a laparoscopic inguinal hernia repair (LIHR) (Fig. 2).

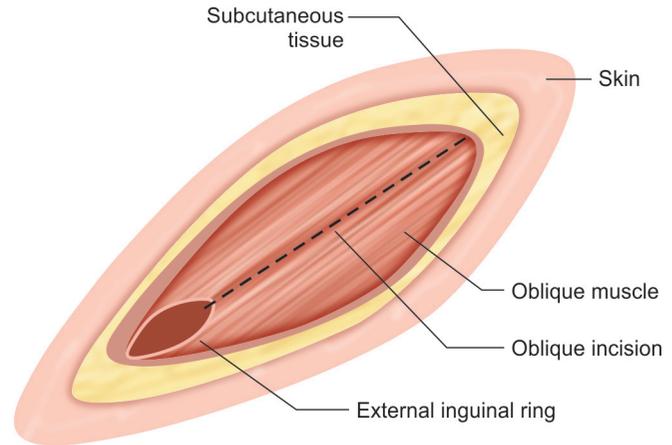
The important components of the procedure involve: ensuring the hernia sac is emptied and entirely closed after surgery, preserving the integrity of vas deferens, testicular vessels, and ilioinguinal nerve and at the end, the testis should be located at the floor of the scrotum when procedure is complete.<sup>19</sup> In girl's special round ligament fixation should be obtained, this will avoid uterine damage preventing future dyspareunia.

## Open Surgical Technique Description<sup>20</sup>

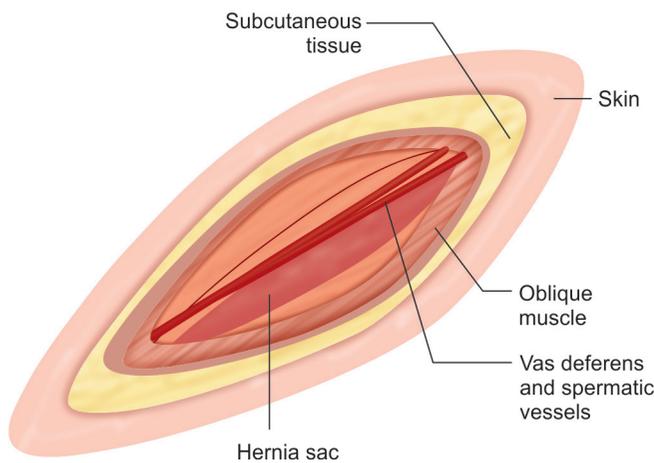
After anesthesia induction, antiseptic skin preparation, and draping of the child in a supine position, a transverse incision is made in the above the external inguinal ring, identifying the epigastric vein to avoid bleeding. Scarpa's fascia is incised and the external oblique fascia is exposed



**Fig. 2:** Surgical approach for open and laparoscopic technique.



**Fig. 3:** After the external inguinal ring is identified, the external oblique fascia is opened with a superiorly oblique incision following its fibers, perpendicular to the ring.



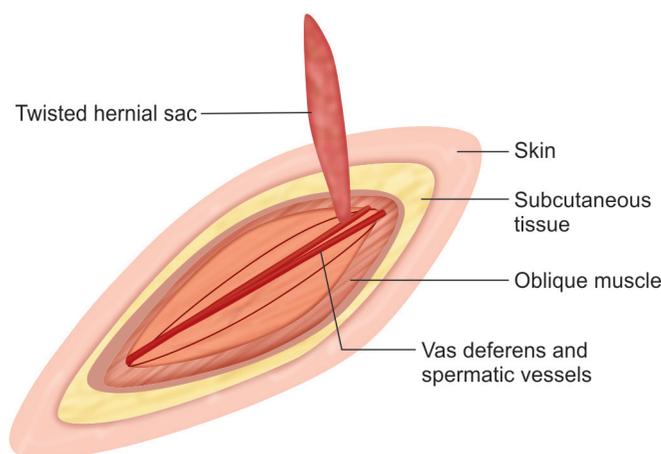
**Fig. 4:** Always keep the vas deferens in sight it should never be grasped directly to avoid injury, identification and careful dissection of the spermatic vessels is crucial, before proceeding to dissect the hernial sac, it should always be divided anteromedially. The limit for superior dissection is identified by the presence of retroperitoneal fat at the neck of the sac.

and traced laterally to the inguinal ligament. Once the superficial inguinal ring is identified, the external oblique fascia is opened superiorly in the long axis of its fibers (**Fig. 3**); the ilioinguinal nerve should be identified to avoid injury. The undersurface of the superior leaflet of the external oblique is gently dissected free from the internal oblique and abdomen's transverse muscle. The inferior leaflet is mobilized down to the inguinal ligament. During this mobilization, the iliohypogastric and ilioinguinal

nerves are located. The ilioinguinal nerve can be seen on the outer vestment of the spermatic fascia.

In boys, the cremasteric muscle is teased open by blunt dissection on the anteromedial surface of the cord and spread to expose the glistening peritoneum of the indirect hernia sac. The sac is elevated anteromedially and the spermatic vessels are identified and carefully dissected free from the diverticular structure of the inguinal hernia sac. Once the spermatic vessels are mobilized away from the sac, the vas deferens is visualized. Once the vital structures (vessels and vas deferens) (**Fig. 4**) are identified and cleared laterally, the hernia sac or the PPT of the hydrocele can be divided between clamps and the upper end dissected superiorly to the level of the internal (deep) inguinal ring. The base of the sac may be twisted to make sure that all the contents have been reduced (**Fig. 5**). The proper extent of the superior dissection is identified by the presence of retroperitoneal fat at the neck of the sac. At this point, we can see the opposite internal ring laparoscopically if we suspect a contralateral PPT. In our experience, the best way is through the inguinal sac with a 5 mm 70° scope. When a contralateral hernia is noted, a similar repair can be performed on the opposite groin during the same procedure with limited morbidity.

In girls, the closed sac, which usually contains the round ligament, then it is fixed to the base with a stitch through the oblique major fascia and redundant sac is removed; wound closure is accomplished with running absorbable 4-0 suture approximating the external oblique fascia leaflets to the external ring.



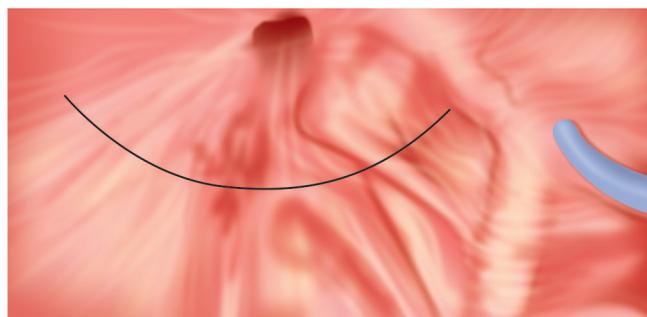
**Fig. 5:** Finally the base of the sac should be twisted to ensure that all contents are fully reduced.

The skin edges are approximated with a Dermabond dressing in infants if they are not toilet-trained. Alternatively, Mastisol and sterile skin closure strips (e.g. Steristrips<sup>®</sup>) and a semipermeable adhesive film dressing (e.g. Opsite<sup>®</sup>) are applied in older children.

### Laparoscopic Technique Description

After anesthesia induction, antiseptic skin preparation, and draping of the child in a Trendelenburg position, Hasson cannula is inserted in the umbilicus under direct vision using an open technique. A pneumoperitoneum is produced (8–10 mm Hg) and a 3 mm 0° telescope is introduced. A 3 mm needle driver and 3 mm Kelly forceps are inserted in the right and left flanks portless. The open internal ring of the inguinal hernia is closed with a purse-string or Z-type of nonabsorbable monofilament material. Complete circuit ligation of the hernia sac is important to prevent recurrence (**Fig. 6**). The Kelly elevates the peritoneum so that the stitch is applied without injuring the vas deferens and testicular vessels. The contralateral internal ring is also inspected; it may be considered patent if there is an obvious opening or if bubbles are seen on external manipulation of the scrotum and/or groin.<sup>4</sup> After identifying the PPV, if sac is present, conventional high sac ligation should be done.

Other minimally invasive techniques are available like laparoscopic needle-assisted inguinal hernia repair, MacClain L et al.<sup>21</sup> studied outcomes in a 495 children study, with a 4% rate of minor complications and 0.56%



**Fig. 6:** Patent processus vaginalis is well seen through laparoscopic approach closure should be safe, always making sure that vital structures are not compromised by the repairing suture.

recurrence rate. The hybrid single incision laparoscopic intraperitoneal ligation was studied by Li S et al.<sup>22</sup> for cosmetic outcomes and maneuverability reporting similar results to those of single-port laparoscopic technique. Comparative single incision versus multiport laparoscopic procedure performed by Kozlov et al.<sup>23</sup> reported similar functional results in treatment of inguinal hernia in babies during the first 3 months of life. The only difference was cosmetic results leaving a scarless incision in the single-incision laparoscopic surgery group.

After extensive analysis of different laparoscopic techniques, the one that promises better outcomes is the single incision laparoscopic percutaneous extracorporeal closure (SILPEC)<sup>24</sup> with no complications or early recurrences after surgery; on the other hand, the single port percutaneous hernia repair with a subcutaneous endoscopically assisted ligation (SEAL)<sup>25</sup> has the highest recurrence rate of 4.3%.

The use of LIHR started over 2 decades ago with several emerging laparoscopic surgical techniques, laparoscopic approach versus open surgery has the following advantages: low wound infection, less pain, and short hospital stay. The advantages related to the procedure are: easy-going technique, it is an outpatient procedure, the cord structures remain untouched, the type of hernia is evident, contralateral inguinal ring and clear visualization of the anatomy, and allowing also inspection of the adnexae in girls.<sup>26</sup> The disadvantages of LIHR repair in children are: costs, longer duration, general anesthesia with endotracheal intubation is necessary, increased possibility of injury to intra-abdominal organs, and longer learning curve.<sup>7</sup>

Numerous studies comparing recurrence and complications from LIHR and OIH procedures have been described; most recent reports show that LIHR has the same recurrence rate as OIH, with higher rate of complications for OIH compared with LIHR.<sup>27</sup> Similar results were obtained by Timberlake et al.<sup>28</sup>

### ■ POSTOPERATIVE CARE AND FOLLOW-UP

As this is a 1-day case surgery, postoperatively, food and drinks can be initiated after recovery from the anesthetic. Infants with bronchopulmonary dysplasia, anemia, prematurity, or those who required ventilator support at the time of birth, should be observed after operative repair for at least 24 hours, monitored for episodes of apnea and/or bradycardia. Patient should be discharged with oral analgesics.

Vigorous activity should be limited for 48 hours. Returning to normal activities as soon as the child feels capable. Baths can be initiated on the 3rd day after surgery.

Follow-up should be done 1 week after surgery for early complications continued by monthly follow-ups for minimum 6 months before discharging the patient.

### ■ OUTCOMES, COMPLICATIONS, AND MANAGEMENT

During surgery, local complications can be bleeding, injury to spermatic vessels, and vas deferens; the use of magnifying loupes during the reconstruction of intraoperative injuries will make the repair more precise, especially in newborns.

Early complications after surgery may include: local edema, hematoma, and wound infection.

Late complications are seen postsurgery during follow-up like: recurrent hydrocele or hernia, iatrogenic displacement of the testis, injury to the vas deferens resulting in a possible infertility, and testicular atrophy. To avoid postoperative hydrocele, the anterior and lateral aspects of the sac can be partially resected or the distal sac can be open completely.

Recurrence complications are higher in males that are operated before the 1st year of age and those managed by laparoscopic approach;<sup>29</sup> recurrence reduces significantly when the procedure is operated by a skilled experienced pediatric surgeon or pediatric urologist, or the procedure is

programed and not done under emergency circumstances. Recurrent inguinal hernia in children may include: (1) a missed hernial sac or unrecognized peritoneal tear; (2) a broken suture ligature at the neck of the sac; (3) failure to repair (snug) a large internal inguinal ring; (4) unrecognized defect of the floor of the inguinal canal (direct inguinal hernia); (5) infection; (6) increased intra-abdominal pressure (patients with ventricular-peritoneal shunts or continuous ambulatory peritoneal dialysis); (7) in patients with cystic fibrosis and chronic cough; and (8) connective tissue disorders (i.e. Ehlers-Danlos syndrome).<sup>22</sup>

### ■ FUTURE ADVANCES AND DIRECTIONS

Inspection of the contralateral PV in the asymptomatic hydrocele or herniated patients is under discussion because of the risk of metachronous hernia or the risk of recurrent PV patency. Pierrri O et al. found that bilateral exploration is unnecessary in 90% of patients.<sup>30</sup> Diminishing the risk for seminal tract obstruction or damage to the spermatic cord and vessel for those asymptomatic explored patients. Our advise is that exploration of the contralateral side should be determined by additional findings; this means that if there are no physical findings of PPV and parents understand the recurrence rate, contralateral exploration can be avoided, unless parents prefer to explore despite the encountered evidence. The US may be useful to provide evidence for the contralateral exploration.

Tendency toward extracorporeal suturing and knotting technique with a single port access for inguinal hernia repair is increasing.<sup>31</sup>

The tendency for minimally invasive procedures is growing; in the future, a more expectant less invasive attitude can be acquired, extending follow-up until spontaneously PV obliteration is obtained specially in communicating hydroceles. General anesthesia is used for invasive procedures and increasing complications are been described before, after, and during surgery, especially in low-weight preterm infants.<sup>32</sup> Regional anesthesia is a promising option for preterm infants undergoing herniorrhaphy,<sup>33</sup> reducing the risk of postoperative apneas. As the increase in low-birth weight premature infants is an ongoing challenge, trying to achieve minimal complications of inguinal hernia repair. Thus, further analysis should be expected in the future under this topic.

## ■ CONCLUSION

Patent processus vaginalis leads to hydrocele and hernia. Palpable mass in the groin should be evaluated for possible PPV-associated conditions. Ongoing controversies on the management of hernia and hydrocele are still being expressed specially when it comes to surgical technique of choice based on recurrence and complication rates, aiming for minimally invasive procedures with better outcomes, also laparoscopic exploration of the contralateral asymptomatic side, and its repair during the same surgery is a constant debatable topic.

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