Chapter 13
Hydrocele and Hernia

David Chalmers and Emily Serrell

Name of Procedure

Hydrocelectomy or herniorrhaphy.

Lay Description

A hydrocele is a fluid-filled sac that accumulates around the testicle. It may be an enclosed pocket (noncommunicating) or along a patent path through the inguinal canal into the abdomen (communicating). If contents from the abdomen are able to enter the tract, it is called an indirect inguinal hernia.

A hydrocelectomy involves a small scrotal incision to remove the fluid around the testicle. Stitches may be used to reinforce or close any communication between the abdomen and scrotum.

A hernia repair involves a small groin incision to locate and close the opening between the abdomen and scrotum. Sometimes this procedure is done laparoscopically with a small camera and thin instruments inserted through small abdominal incisions to view and close the opening between the abdomen and scrotum.

D. Chalmers, MD
Pediatric Urology, Maine Medical Center and Barbara Bush Children's Hospital, Portland, Maine, USA
e-mail: dchalmers@mmc.org

E. Serrell
Tufts University School of Medicine, Boston, MA, USA

Intended Benefit

Simple hydroceles are a benign condition that are rarely symptomatic and do not negatively affect the testicle or future fertility. The majority resolve spontaneously by 2 years of age. Persistent simple or communicating hydroceles may be repaired in order to reduce parental anxiety, decrease the size of the hemi-scrotum, and avoid enlargement or progression to an inguinal hernia. The latter occurs in <5 % of hydroceles [1].

Communicating hydroceles share a common etiology with the indirect inguinal hernia due to a persistent patency of the processus vaginalis, which typically closes after the testis passes through. Inguinal hernias should be repaired in order to avoid complications of incarceration (non-reducible) or strangulation (vascular compromise) of bowel and intraabdominal contents. Incarceration occurs in a minority of hernias, most commonly in infants [1], but the incidence increases with duration of time [2]. In very rare cases, incarceration can lead to ischemic bowel necessitating resection or in compression of spermatic cord contents resulting in gonadal atrophy or infarction [3].

Technique

Hydrocelectomy is typically performed under general anesthesia, although spinal anesthesia may be considered in special circumstances. The patient is placed in the supine position. For a simple hydrocele, a small scrotal skin-incision is used to access the hydrocele sac and testicle. The sac is incised, drained and then may be either plicated with sutures or partially excised and reapproximated. The former approach has the benefit of less dissection, intra-operative bleeding, and need for electro-cautery hemostasis, though the complication rates are similar [4]. The testis is replaced into the subdartos tissue, and the scrotal skin is closed with absorbable sutures.

The communicating hydrocele and indirect inguinal hernia may be repaired either as an open or laparoscopic approach. Communicating hydroceles may be repaired via a scrotal approach, and the patent processus vaginalis is ligated as cranially as possible towards the internal ring. This is particularly appropriate for children >12 years of age [5]. In an open inguinal hernia repair, an inguinal crease incision is made to mobilize and then separate the hernia sac from the surrounding cord structures. The sac is then ligated high in the inguinal canal. Laparoscopic repair can be accomplished with the patient in supine or slight Trendelenburg position. Recent studies have examined the efficacy of one, two, or three-port laparoscopy. The typical transperitoneal approach involves placement of camera and trocars beyond the peritoneum, and the internal ring is closed with either absorbable or non-absorbable suture, traditionally in a purse string fashion. Percutaneous approaches have also been described in an attempt to minimize additional trocar incisions. This involves placement of an endoscope at the umbilicus to visualize a suture passing extracorporeally, around the internal ring, and then passed extracorporally so the ring is closed. The, peritoneum then fascia are

reapproximated with running, absorbable sutures, by some authors. Skin is closed in a subcuticular fashion and then either sealed with tissue adhesive, skin strips, or gauze and transparent film.

Postoperative Expected Course

Hydrocelectomy and hernia repair surgeries are minimally invasive and relatively low risk. The majority of procedures are performed on either an outpatient or day-surgery basis with patients discharged the same day as surgery. Overnight stay is rare and indicated only for complications or inguinal hernia repair in premature or very young infants. Parents should be educated on post-operative expectations for recovery. For example, some discomfort, redness, crusting, bruising, and swelling is normal, but worsening of these features or fever >101.3 °F requires follow-up with the surgeon or other healthcare provider. Scrotal swelling may persist for several weeks.

The use of perioperative antibiotics is controversial. The trans-scrotal, laparoscopic and open inguinal approaches are all classified as class II, clean-contaminated surgeries with <10 % risk of infection due to the risk of exposure from the genito-urinary or gastrointestinal systems [6]. In addition, post-operative pediatric wounds may be exposed to colonic flora in the environment of the diaper. As such, perioperative antibiotic prophylaxis to prevent infection with *S. aureus* and enteric gram-negative bacilli contamination is optional.

Full recovery to normal activity is expected within a few days to weeks, and children will self-regulate their activity according to pain and energy. Typical recommendations include limiting rigorous activity and straddle activities for 2 weeks. Pain management is initiated before surgery is complete with injection of local anesthetic at the surgical incisions. Most children's pain will be managed well by alternating Acetaminophen (Tylenol) and Ibuprofen (Motrin) for the first 24–48 h. Narcotic medication such as liquid codeine or oxycodone may be appropriate for older children.

Diet following surgery should be normal as tolerated. Post-anesthetic nausea and vomiting occurs in 6 % of pediatric patients and should be controlled with serotonin receptor blockers such as ondansetron [7]. Sutures are absorbable and gauze bandage may be used over the incision sites for inguinal hernia repair or laparoscopic incisions. Children should avoid full water submersion for at least 48 h but then have no restriction on bathing or showering.

Follow Up

Follow-up timing, and even necessity, should be per surgeon's discretion. If there are signs of infection as described above within 2 weeks of surgery, the patient should be seen in the office as soon as possible. If it will provide reassurance to the

family, follow up in 2–4 weeks. Otherwise, office staff may call for updates on patient recovery and well-healing wounds.

Risks and Complications

The complications following hydrocelectomy or herniorrhaphy can be classified as early—iatrogenic injury, scrotal edema, hematoma, wound infections, sensory impairment—or as late—hydrocele or hernia recurrence, testicular atrophy, chronic pain, and testicular ascent. It should be noted that the rates of these complications may be underreported, as late complications may present after the patient has aged out of follow-up of hernia or hydrocele surgery and go unrecognized by study authors.

Early

Infection: <1 %

Infection following hydrocelectomy or herniorrhaphy can be expected to be <1 % due to the classification of both surgeries as clean-contaminated [8]. Because of this, many surgeons opt to avoid perioperative antibiotics. In general, wound infection is higher in open than laporoscopic approach. Three meta-analyses reviewing 70 studies report infection rates of 0–2 % with the majority of cases reporting close to zero infections [9–11].

Bleeding and Hematoma: ≤1 %

Bleeding is a risk of any procedure that breaks the dermal barrier of the skin. Following hydrodcelectomy or herniorrhaphy bleeding may occur due to inadequate hemostasis of the superficial fascia, damage to the pampiniform plexus, or from the edges of the excised distal hernia sac. In the later scenario, blood can travel via the processus vaginalis and result in scrotal hematoma. The incidence of reported hematoma as a complication is <1 %, and these resolved spontaneously over the course of several weeks. A study in the Netherlands reported 0.9–1.6 % incidence of hematoma or seroma as well as 0.1–0.5 % incidence of bleeding necessitating reoperation [12]. There appears to be little effect of the surgical approach on subsequent hemorrhage or hematoma.

Scrotal Edema: 5 %

Scrotal edema and induration, as defined by postoperative swelling without indication of recurrent hydrocele or hernia, is a common complication of surgery. Up to 5 % of patients may experience significant scrotal swelling, particularly following scrotal hernia repair. However, in all cases this subsided spontaneously within 2 weeks [13].

Iatrogenic Injury: ≤1 %

The highest incidence of iatrogenic injury is damage to the seminal pathway structures during hydrocele or inguinal hernia repair. In addition, the hernia sac may contain abdominal viscera, intestine, bladder, ovary, or uterus. Gentle mobilization will aid in protecting sac contents, though unintentional cystectomy has been reported as a complication of routine herniorrhaphy [14].

Damage to the testicle is possible in the transcrotal hydrocele approach. Injury of the vas deferens or epididymis can occur with excessive electrocautery use or excision of the hernia sac or hydrocele, particularly at the tail of the epididymis [15]. The inguinal sac may contain embryonal cells of the spermatic cord contents as well as outright portions of the vas deferens and epididymis. In samples analyzed by pathology, true vas deferens and epididymis were identified in 0.33 % [16]. A similar pathologic analysis identified either vas or epididymis remnants in 0.53 % of hernia sac samples [17]. Damage to either of these structures along the spermatic pathway may affect future fertility either through direct obstruction or by damage-induced sperm-agglutinating antibodies [15, 18].

Sensory Change: 2–5 %

The genitofemoral nerve passes through the internal ring and travels with the spermatic cord, and the ilioinguinal nerve passes lateral to the internal ring. These nerves are at particular risk during laparoscopic and open hernia repairs, respectively. Trauma can occur during inguinal ring dissection, via heat-transfer from electro-cautery, or due to compression due to postoperative swelling or scarring and produce sensory neuropathy. Traditional pelvic nerve distribution attributes sensation from the genitofemoral nerve over the femoral triangle, ilioinguinal nerve over the groin, and anterior femoral cutaneous nerve over the anterior thigh. However, this is highly variable. Absence of the cremasteric reflex may be another indicator of sensorineural damage, particularly the genitofemoral nerve. Following laparoscopic surgery, 2–5 % of children may report numbness in the thigh or groin that presents zero to 10 days following surgery and resolves in 92 % of cases by 8 months [19]. Chronic pain following hydrocele or hernia repair is infrequently reported but may occur >3 months in 2 % of patients [12]. A small 50-year follow-up survey of adult patients who had undergone childhood inguinal hernia repair found that 3 % of adults reported chronic groin pain [20].

Late

Reactive Hydrocele: ≤1 %

Postoperative hydrocele should be differentiated from scrotal edema, though the entities may be confused. Following hydrocele or hernia repair, the distal sac will continue to produce fluid. In the case of very large hernias, this fluid may be

produced faster than it may be resorbed and accumulate as a postoperative hydrocele. In Ein's series of 6,361 patients, only 2 persisted [21]. Incidence is increased in infants <3 kg, with one small study reporting ipsilateral hydrocele in 11 % of herniotomies [22].

Testicular Atrophy: ≤0.5 %

Testicular atrophy (necrosis) is an exceedingly rare but potentially devastating outcome of inguinal surgery. Laparoscopic repair of inguinal hernia in and of itself does not impair gonadal perfusion or size [23]. However, ligation of the testicular artery results in testicular atrophy in 20–40 % of cases. The 60–80 % of persistent testes have adequate collateral blood flow from the deferential and cremasteric arteries [24]. The majority of reviewed studies report zero incidence of testicular atrophy in simple hydrocele or hernia repairs [3, 25]. In two case series of 6,361 and 1,565 patients, there were reported rates of 0.3 % and 0 % atrophic testes respectively [21, 26]. The risk of testicular atrophy increases in premature infants [22] and in children with incarcerated inguinal hernias [27]. This is likely due to compression of gonadal vessels by intra-abdominal contents in the inguinal canal.

Testicular Ascent/Iatrogenic Cryporchidism: ≤1 %

Testicular ascent, or iatrogenic undescended testis, is a rare complication. It can result from either mechanical tethering of the testis or post-operate scarring that prevents the spermatic cord's growth with the rest of the body. Studies vary in incidence, with most series reporting no cases; indeed, two meta-analyses of 29 studies did not mention this as a complication [10, 11]. An assessment of 11,272 inguinal hernia repairs in China reported five cases of tethered high testis [28]. The incidence of iatrogenic cryptorchidism does increase to up to in premature infants [29]. This risk may be decreased by confirming proper testis positioning in the scrotum and, if necessary, anchoring the testis in the scrotum prior to closure [30].

Recurrence: <5 %

Recurrence of hydrocele or hernia is the most common long-term consequence of surgery. Recurrence rates are approximately 0.5–1 % in uncomplicated open repairs, 2 % in premature infants, and 3–6 % following repair of an incarcerated hernia [24]. Esposito et al. performed a 20 case meta-analysis reflecting a 0–5.5% rate of recurrence, with most studies trending toward the lower end of that spectrum [9]. This rate reflects a number of other retrospective and prospective studies [21, 31, 32]. The long-term recurrence risk into adulthood is not well-described, although one small study reports a rate of up to 8.4 % repeat groin surgery [20].

The likelihood of recurrence depends on a variety of surgical and patient factors. A meta-analysis of ten studies comparing open and laparoscopic inguinal repair demonstrated recurrence of hernia in 2–4 % of laparoscopic cases and 0–2 % of open cases [33]. A similar meta-analysis of seven studies reflected no statistically significant difference in the rate of recurrence based on surgical approach [11].

When recurrences did occur, they were more likely right-sided (75 %), direct, and discovered at 6 months (50 %) to 5 years (96 %) of age [31]. Recurrent hernias were more likely to occur with patient presenting with incarceration, prematurity, postoperative complications [34] as well as comorbidities like growth failure/malnutrition, increased intraabdominal pressure, genitourinary tract abnormalities. Surgical associations with recurrence included low ligation of the hernia sac, damage to the floor, peritoneal inclusion with spermatic cord, missed direct hernia, and less surgical experience [31, 34, 35].

Though few well-powered studies have been published regarding trans-scrotal approach for hydrocelectomy or herniotomy, the reported recurrence rate is low (0–2 %) [13, 32, 36, 37]. It should also be noted that rare cases of late abscess following primary repair, most likely to occur with non-absorbable silk suture, may be mistaken for recurrence and should be considered on the differential [38].

Contralateral Hernia: 7 %

The presence of metachronous contralateral hernias following unilateral hernia repairs is well-recognized, with an estimated incidence of 7 % by meta-analysis of over 15,000 patients with a variety of surgical approaches [39]. It is unclear whether the contralateral hernias were not identified at time of initial surgery, if surgery affected development, or whether the hernias developed independent of surgery. However, even following negative laparoscopic evaluation during surgery, metachronous inguinal hernias presented in 1.3 % of patients. These new hernias were more likely to be right-sided and associated with laparoscopic inguinal approach vs. periumbilical, small angle laparoscope, and high pneumoperitoneum pressure [40, 41]. As such, parents should be educated that the natural history of the inguinal ring is unpredictable and unilateral inguinal hernia repair will not prevent contralateral hernia.

References

1. Hall N, Ron O, Eaton S, Pierro A. Surgery for hydrocele in children – an avoidable excess? J Pediatr Surg. 2011;46(12):2401–24054.
2. Chen LE, Zamakhshary M, Foglia RP, et al. Impact of wait time on outcome for inguinal hernia repair in infants. Pediatr Surg Int. 2009;25:223–7.
3. Fasching G, Hollwarth ME. Risk of testicular lesions following incarcerated inguinal hernia in infants. Pediatr Surg Int. 1989;4(4):265–8.

4. Gahukamble DB, Khamage AS. Prospective randomized controlled study of excision versus distal splitting of hernial sac and processus vaginalis in the repair of inguinal hernias and communicating hydroceles. J Pediatr Surg. 1995;130(4):624–5.

5. Wilson JM, Aaronson DS, Schrader R, et al. Hydrocele in the pediatric patient: inguinal or scrotal approach? J Urol. 2008;180:1724–7.

6. Kiddoo DA, Wollin TA, Mador DR. A population based assessment of complications following outpatient hydrocelectomy and spermatocelectomy. J Urol. 2004;171(2 pt 1):746–8.

7. Murat I, Constant I, Maud'huy H. Perioperative anaesthetic morbidity in children: a database of 24 165 anaesthetics over a 30-month period. Pediatr Anesth. 2004;14(2):158–66.

8. Cruse PJ, Foord R. The epidemiology of wound infection. A 10-year prospective study of 62,939 wounds. Surg Clin North Am. 1980;60:27–40.

9. Esposito C, St. Peter SD, Escolino M, Juang D, Settimi A, Holcomb G. Laparoscopic versus open inguinal hernia repair in pediatric patients: a systematic review. J Laparoendosc Adv Surg Tech. 2014;24(11):811–8.

10. Bharathi R, Arora M, Baskaran V. Minimal access surgery of pediatric inguinal hernias: a review. Surg Endosc. 2008;22:1751–62.

11. Yang C, Zhang H, Pu J, et al. Laparoscopic vs open herniorrhaphy in the management of pediatric inguinal hernia: a systemic review and meta-analysis. J Pediatr Surg. 2011;46:1824–183.

12. De Lange DH, Kreeft M, Van Ramshorst GH, Aufenacker TJ, Rauwerda JA, Simons MP. Inguinal hernia surgery in the Netherlands: are patients treated according to the guidelines? Hernia. 2010;14:143–8.

13. Alp B, Irkilata H, Kibar Y, Zorba U. Comparison of the inguinal and scrotal approaches for the treatment of communicating hydrocele in children. Kaohsiung J Med Sci. 2014;30(4):200–5.

14. Redman J, Jacks D, O'Donnell P. Cystectomy: a catastrophic complication of herniorrhaphy. J Urol. 1985;133:97–8.

15. Zahalsky MP, Berman AJ, Nagler HM. Evaluating the risk of epididymal injury during hydrocelectomy and spermatocelectomy. J Urol. 2004;171(6 Pt 1):2291–2.

16. Popek EJ. Embryonal remnants in inguinal hernia sacs. Hum Pathol. 1990;21(3):339–49.

17. Steigman CK, Sotelo-Avila C, Weber TR. The incidence of spermatic cord structures in inguinal hernia sacs from male children. Am J Surg Pathol. 1999;23:880–5.

18. Friberg J, Fritjofsson A. Inguinal herniorrhaphy and sperm-agglutinating antibodies in infertile men. Arch Androl. 1979;2(4):317–22.

19. Chrouser K, Vandersteen D, Crocker J, Reinberg Y. Nerve injury after laparoscopic varicolectomy. J Urol. 2004;172:691–3.

20. Zendejas B, Zarroug A, Erben Y, Holley C, Farley D. Impact of childhood inguinal hernia repair in adulthood: 50 years of follow-up. J Am Coll Surg. 2010;211(6):762.

21. Ein SH, Njere I, Ein A. Six thousand three hundred sixty-one pediatric inguinal hernias: a 35-year review. J Pediatr Surg. 2006;41:980–6.

22. Davies B, Fraser N, Najmaldin A, Squire B, Crabbe D, Stringer M. Prospective study of neonatal inguinal herniotomy: the problem of the postoperative hydrocele. Pediatr Surg Int. 2003;19:68–70.

23. Parelkar SV, Oak S, Gupta R, et al. Laparoscopic inguinal hernia repair in the pediatric age group–experience with 437 children. Pediatr Surg. 2010;45:789–92.

24. Palmer L, Palmer J. Management of abnormalities of the external genitalia in boys. In: Wein A, editors. Campbell-Walsh urology. Elsevier Health Sciences, Cambridge, MA, 9th ed. 2011;146:3368–98.

25. Orth RC, Towbin AJ. Acute testicular ischemia caused by incarcerated inguinal hernia. Pediatr Radiol. 2012;42(2):196–200.

26. Endo M, Watanabe T, Nakano M, et al. Laparoscopic completely extraperitoneal repair of inguinal hernia in children: a single-institute experience with 1,257 repairs compared with cutdown herniorrhaphy. Surg Endosc. 2009;23:1706–1.

27. Nah SA, Giacomello L, Eaton S, de Coppi P, Curry JI, Drake DP, Kiely EM, Pierro A. Surgical repair of incarcerated inguinal hernia in children: laparoscopic or open? Eur J Pediatr Surg. 2011;21(1):8–11. doi:10.1055/s-0030-1262793. Epub 2010 Oct 11.
28. Zhang JZ, Li XZ. Inguinal hernia in infants and children in China. Pediatr Surg Int. 1993;8:458.
29. Esposito C, Turial S, Escolino M, Giurin I, Alicchio F, Enders J, Krause K, Settimi A, Schier F. Laparoscopic inguinal hernia repair in premature babies weighing 3 kg or less. Pediatr Surg Int. 2012;28:989–92.
30. Kaplan GW. Iatrogenic cryptorchidism resulting from hernia repair. Surg Gynecol Obstet. 1976;142:671.
31. Grosfeld J, Minnick K, Shedd F, West K, Rescorla F, Vane D. Inguinal hernia in children: factors affecting recurrence in 62 cases. J Pediatr Surg. 1991;26(3):283–7.
32. Gokcora I, Yagmurlu A. A longitudinal follow-up using the high trans-scrotal approach for inguinal and scrotal abnormalities in boys. Hernia. 2003;7(4):181–4.
33. Alzahem A. Laparoscopic versus open inguinal herniotomy in infants and children: a meta-analysis. Pediatr Surg Int. 2011;27(6):605.
34. Steinau G, Treutner KH, Feeken G, Schumpelick V. Recurrent inguinal hernias in infants and children. World J Surg. 1995;19(2):303.
35. Vogels HDE, Bruijnen CJP, Beasley SW. Predictors of recurrence after inguinal herniotomy in boys. Pediatr Surg Int. 2009;25:235–8.
36. Iyer K, Kumar V, Huddart S, Bianchi A. The scrotal approach. Pediatr Surg Int. 1995;10:58–60.
37. Lais A, Ferro F. Trans-scrotal approach for surgical correction of cryptorchidism and congenital anomalies of the processus vaginalis. Eur Urol. 1996;29:235.
38. Calkins CM, St. Peter SD, Balcom A, Murphy PJ. Late abscess formation following indirect hernia repair utilizing silk suture. Pediatr Surg Int. 2007;23(4):349–52.
39. Miltenburg DM, Nuchtern JG, Jaksic T, et al. Meta-analysis of the risk of metachronous hernia in infants and children. Am J Surg. 1997;174:741–4.
40. Hoshino M, Sugito K, Kawashima H, Goto S, Furuya K. Prediction of contralateral inguinal hernias in children: a prospective study of 357 unilateral inguinal hernias. Hernia. 2014;18(3):333–7.
41. Zhong H, Wang F. Contralateral metachronous hernia following negative laparoscopic evaluation for contralateral patent processus vaginalis: a meta-analysis. J Laparoendosc Adv Surg Tech. 2014;24(2):111–6.