

E-ISSN: 2709-9369
P-ISSN: 2709-9350
www.multisubjectjournal.com
IJMT 2021; 3(2): 172-178
Received: 10-05-2021
Accepted: 20-06-2021

Iqbal Aziz
Professor, Department of
Ilmul Jarahat, AKTCH
(AMU), Uttar Pradesh, India

Matiur Rehman
Assistant Professor, Sanskriti
University, Mathura, Uttar
Pradesh, India

Nishat Afroz
PG Scholar, Department of
Moalajat, AKTCH (AMU),
Uttar Pradesh, India

Corresponding Author:
Iqbal Aziz
Professor, Department of
Ilmul Jarahat, AKTCH
(AMU), Uttar Pradesh, India

Understanding *Fataq* (Hernia) and their management: An appraisal

Iqbal Aziz, Matiur Rehman and Nishat Afroz

Abstract

“*Fataq*” is an umbrella term that is used for different types of hernia, and it is described under the caption of ‘*Tafarruqe Ittesal*’, that tearing and inflammation occur in the membrane due to *Ghaleez Wa Fasid Ghiza, Ehtebas Ghair Tabayi*. Hippocrates, Galen, *Zakaria Rhazi, Ali Ibn Abbas Majoosi, Ibn Sina, Ismail Jorjani, and Ibn Hubal Baghdadi* are among the most famous Unani thinkers who are mentioned by Various *Zimad* (ingredients; *Mom, Mazoo, Zuft Baloot, Post Anar, Maida Lakri, Sib Samage Arabi* etc.) about the pathophysiology of *Fataq*, and also their method of treatment, which acts “*Qabiz-e-Urooque*”. Although the majority of them have been scientifically established to be astringent and promote membrane and muscular strength, many are reluctant to employ herbal preparations for hernia care due to their sluggish action. International recommendations based on high-level evidence have addressed procedure selection. Only in unusual circumstances and for particular reasons may surgeons vary from their recommendations. Hernia surgeons must be skilled in both open and endoscopic/laparoscopic methods in order to follow the guidelines.

Keywords: *Fataq*, Hernia, repair, laparoscopic, mesh

Introduction

Early historical descriptions of *Fataq* (hernia) may be found, and various ancient physicians, including Hippocrates and Praxagoras of Kos, studied their treatment as subject experts ^[1]. An inguinal hernia is an opening of the oblique and transversal muscles in the myofascial plain that can herniate intraabdominal or extraperitoneal organs and occur in the groin with a lump that goes away at low pressure or when the patient lies down ^[2]. Reparation of the inguinal hernia is an extremely common operation carried out by surgeons ^[3]. Over 800,000 repairs are performed each year ^[4]. Inguinal hernias represent 75 per cent of all hernias in the abdominal wall ^[5]. The occurrence of inguinal hernias is distributed bimodally, with peaks around age 5 and after age 70 ^[6]. Two-thirds of these hernias are indirect, making the most common groin hernia in both males and females an indirect hernia ^[7]. Males account for about 90% of all inguinal hernias and females about 10% ^[8]. Just 3 percent of all inguinal hernias are femoral hernias which are most frequently seen in women with females accounting for around 70 percent of all femoral hernia ^[9]. An inguinal hernia will affect nearly 25% of men and less than 2% of women over their lifetime. A more common indirect hernia occurs on the right ^[10]. These groin hernias may be divided into location-based, indirect, direct, and femoral ^[11]. Most patients with a groin bulge or pain ^[12]. Healthcare experts are suggesting that all symptomatic hernias be treated to prevent complications ^[13]. The open or laparoscopic technique may be used with the intention of closing defects and repairing them without stress ^[14]. Typically a mesh is used for tension-free reparation. Primary suture repair may be done when the mesh is contraindicated ^[15]. Inguinal hernias are considered to be congenital as well as to have acquired components. Most adult hernias are deemed to have been acquired. There is evidence, however, to suggest that genetics play a role too ^[16]. Patients with a common history of a hernia are at least four times more likely than patients with no known family history to have an inguinal hernia ^[17]. Research has also shown that other conditions such as chronic obstructive pulmonary disease (COPD), Ehlers-Danlos syndrome, and Marfan syndrome lead to a greater occurrence of an inguinal hernia ^[18]. It is also suspected that increased intra-abdominal pressure, as seen in obesity, chronic cough, heavy lifting, and constipation strain, also contributes to the development of an inguinal hernia ^[19]. Male sex and rising age are the principal risk factors for inguinal hernia. Inguinal hernia complications include strangulation, bowel obstruction, and infarction. Recurrence can occur following surgery ^[20]. Inguinal hernias are at risk of irreducibility or incarceration, which may lead to strangulation and obstruction; however, strangulation is uncommon as with femoral hernia.

National England statistics identified that 5 percent of primary inguinal hernia repairs in 1998-9 were emergency operations [21]. Older age and longer hernia and irreducibility cycles are risk factors for acute complications. Gallegos and colleagues researched a "functional treatment of strangulation" to identify inguinal hernias [22].

A hernia is reducible if it occurs intermittently and can be forced back into the abdominal cavity, and is irreducible if it stays outside the abdominal cavity indefinitely [23]. A reducible hernia is typically a chronic condition, and on the basis of standard symptoms and signs, a clinical diagnosis is made. The disorder may be one-sided or bilateral and can recur following treatment [24].

The treatment of choice is surgery, ranging from a nylon darn, Shouldice coated, Lichtenstein mesh to a laparoscopic fix. Open mesh repair is reproducible by non-specialist surgeons and is, therefore, the preferred repair technique for primary inguinal hernia (96% of UK surgeons, 99% of Japanese surgeons, 95% of Danish surgeons, and 86% of US surgeons) [25]. Systematic studies and meta-analysis of randomized clinical trials showed that laparoscopic hernia surgery is associated with longer operating times but less serious postoperative pain, fewer complications, and a quicker return to normal activities compared with open repair [26].

Recently, the National Institute for Health and Clinical Excellence (NICE) recommended laparoscopic surgery as a treatment choice for inguinal hernia and confirmed that patients should be fully informed about the risks and benefits of open and laparoscopic surgery to enable them to choose between procedures [27].

However, several countries do use hernia repair with general or regional anesthesia, with a few using local anesthesia [28]. A recent, Swedish, multicenter trial randomized patients to receive local anesthesia for infiltration, regional anesthesia, or general anesthesia for inguinal hernia repair in non-specialist centers [29]. The study showed a major benefit of local anesthesia due to absorption, which was associated of shorter hospital stay, less intense postoperative pain, and fewer micturition issues [30].

The mortality rate for elective hernia repair is lower than or equivalent to the standardized mortality rate for the population [31]. Bay-Nielsen and colleagues have published results of 26,304 hernia repairs from the prospective Danish hernia database. Four percent of all repairs to groin hernias were emergencies [32]. After elective surgery, a 30-day mortality rate of 0.02 percent was reported in patients under 60 years of age and 0.48 percent in those over 60 years of age [33].

Acute surgery had a mortality rate of 7 percent, similar to the rate on the Swedish hernia register; data from the Scottish Audit of Surgical Mortality give an overall mortality rate of 0.2 percent for inguinal hernia repair, with most deaths in the elderly population with a grade of three and above ASA (American Association of Anaesthesiologists) [35].

Bruising and hematoma are common after hernia repair, and rates of infection with wounds vary from 1% to 7% [35]. Recent meta-analyses from a Cochrane review and from another study show that prophylactic antibiotics do not reduce the risk of infections in surgical sites [36].

Large cohort studies from specialist centers find very low rates of recurrence after open mesh repair, and a meta-analysis of randomized clinical trials with mesh repair found

lower rates of recurrence [37]. Butters and colleagues recently published a long-term follow-up of a study in a single German institution comparing three techniques (the Shouldice, Lichtenstein, and transabdominal pre-peritoneal techniques) [38].

Recurrence rates were higher for the study's Shouldice arm, with equally low rates for the other two sides. Population-based studies often support decreased mesh repair recurrences; however, these studies use reoperation levels as proxy measures for recurrence and thus can underestimate true recurrence [39]. Thirty to fifty percent of patients with a recurrent hernia are either unaware of a recurrence or do not want another repair [40]. Chronic pain is pain that persists or occurs following normal tissue healing and can reasonably be defined as pain that persists three months after an inguinal hernia has been repaired [41]. Approximately 30 percent of patients report long-term pain or discomfort at the hernia repair site when asked or when completing a confidential questionnaire [42]. Chronic pain is the most extreme long-term hernia repair complication, which can last for many years. The cause of the pain is poorly understood and is more likely in younger patients who were initially in severe pain from their hernia [43].

Regression analysis from population-based studies identified four factors as independent predictors of chronic pain: preoperatively high pain levels; age; an anterior surgical approach; and a postoperative complication [44].

Patients are better handled by referral to a pain clinic where they can instigate a multidisciplinary approach [45]. Surgical review with excision of the nerve and removal of the mesh is reserved for those of whom medical care fails [46].

The frequency of infertility after reconstruction of the inguinal hernia is greater than in the general population [47]. During the time of surgery, damage to the vas deferens is estimated to be 0.3 percent for adults and 0.8-2.0 percent for infants. Testis injury that contributes to atrophy can occur in 0.5 percent of primary hernia repairs, with a 10-fold increase in recurrent repairs. It can minimize testicular failure and infertility by minimizing recurrences using mesh repair [48].

Epidemiology of Hernia

The incidence of inguinal hernia in the population varies between 2% and 4%, increasing with age up to 20%. In 95% of cases, hernias are external, and in 5% they are internal [49]. Of all hernias, 75% are inguinal (two-thirds indirect and one-third direct); 10% are incisional, and 5-7% are umbilical, femoral, or in other, rare locations. Whereas about 80-90% of inguinal hernias occur in males, 75% of all femoral hernias are found in females. With over 750,000 inguinal hernia operations per year in the USA, inguinal hernia repair is the most common operation for general surgeons [50].

Causes and risk factors

Two factors that increase the risk of hernias are weak abdominal muscles and weak connective tissue. Some people are born with weak connective tissue, whereas in others it becomes weaker in older age. Illnesses or surgery can also weaken tissue and muscles [51]. Being very overweight increases the pressure in your abdomen. But this only increases the risk of incisional and umbilical hernias. It doesn't affect the risk of inguinal hernias. Tumors or a build-up of fluid in the abdomen can increase the pressure

on the abdominal wall too ^[52]. Abdominal wall hernias are also more common in pregnant women. Smoking and illnesses like diabetes can make it more difficult for wounds to heal properly after surgery, which makes incisional hernias more likely ^[53]. Lifting heavy objects, coughing and straining can make existing hernias grow in size. Whether these things can also cause hernias in the first place probably depends on the type of hernia. It isn't clear whether this is the case with inguinal hernias, for example ^[54].

Pathogenesis

The pathogenesis of hernias is multifactorial. Congenital hernias are performed hernial openings caused by incomplete closure of the abdominal wall (e.g., persistent processes vaginalis), while, in acquired hernias, the cause is increasing dehiscence of fascial structure with accompanying loss of abdominal wall strength ^[55]. The develop typically in locations where larger blood vessels or the spermatic cord lie, or where previous incisions were made ^[56].

Different etiological factors, such as increased intra-abdominal pressure (in pregnancy, intra-abdominal tumors, chronic obstructive lung disease, ascites, chronic intestinal obstruction, and adiposity), or pathological changes in the connective tissue of the abdominal wall, is blamed, without conclusive significance ^[57]. New material for understanding the pathogenesis has been provided by recent studies on collagen metabolism disorder, in which an increase of collagen III was proven in patients with hernia ^[58].

Diagnosis of Hernia

History, local examination with inspection and palpation of the hernial opening, auscultation, and diaphanoscopia are employed for hernia diagnosis. In case of uncertain clinical findings, sonography is the best means for confirming the hernial opening and content ^[59]. Radiographic diagnosis of hernias is rarely required. The imaging techniques that can be used are plain abdominal film, upper gastrointestinal series and/or contrast enema, intravenous pyelography and cystography, herniography, and CT-scan or MRT. Differential diagnosis includes lymphadenitis, lipoma, varicose nodules of the saphenous vein, hydrocele, tumors, abscesses, cysts, endometriosis, and inguinal testis ^[60].

Classification of Inguinal Hernias

There are several classifications for inguinal hernias. Currently, there is no universal classification system for inguinal hernias. One simple and widely used classification is the Nyhus classification which categorizes hernia defects by size, location, and type ^[61].

Nyhus Classification System for Hernia

Type I: An indirect hernia; normal size internal ring; typically, in infants, children, and small adults ^[62]. Type II: An indirect hernia; enlarged internal ring without impingement on the floor of the inguinal canal; does not extend to the scrotum. Type IIIA: A direct hernia; size not taken into account. Type IIIB: An indirect hernia that has grown enough to infringe upon the posterior inguinal wall; indirect sliding or scrotal hernias are regularly assigned to this category because they are often associated with the extension to direct space. This type also includes pantaloon hernias ^[63]. Type IIIC: A femoral hernia ^[63], and Type IV: A

recurrent hernia; modifiers A to D are sometimes added that correspond with direct, indirect, femoral or mixed respectively ^[63].

Symptoms and Complications of Hernia

To what extent a hernia represents a disease entity rarely depends on the fact of the hernia itself, but rather on the fate of hernial contents. Giant hernias may cause significant bodily discomfort by weight alone; Hernias may cause complaints from the restriction of physical activity develop surface ulceration, or be displeasing on aesthetic and cosmetic grounds alone. But changes in the contents lead more commonly to the hernia's becoming a true disease entity ^[64]. These include nutritional (perfusion) problems of the mesentery, bowel, and omentum or/and interference in propulsion and incarceration of intestinal contents (partial or complete intestinal obstruction) ^[65].

Prevention

Whether and how hernias can be prevented depends on the type of hernia. To prevent incisional hernias, it's a good idea to avoid strain due to things like carrying heavy objects following surgery at first. If the risk of recurrence is very high, a synthetic mesh can be used as a preventive measure ^[66]. Losing weight can lower the risk of incisional and umbilical hernias ("after surgery" and "belly button" hernias). But weight loss won't lower the risk of inguinal (groin) hernias. It's not clear whether carrying heavy objects makes inguinal hernias more likely. Stopping smoking can help surgical wounds heal better, which probably lowers the risk of incisional hernias. It is also important to make sure that medical conditions like diabetes and anemia are treated properly because they can affect how well wounds heal too ^[67].

Treatment of Hernia

Surgery is the only treatment option for hernias. It involves pushing the hernia sac back into the abdomen or removing it, and closing the gap in the abdominal wall with stitches. A fine synthetic mesh is usually placed on the affected area too, to strengthen the abdominal wall and prevent the hernia from coming back ^[68]. In open surgery, the operation is carried out through a larger cut where the hernia is. In minimally invasive surgery (also called laparoscopic or keyhole surgery), several smaller cuts are made. The abdomen or abdominal wall is operated on by inserting surgical instruments and a fine tube with a camera attached to it (laparoscope) through the cuts. The camera enables the surgeon to see the inside of the abdomen on a screen. The surgery options will depend on things like the type and size of the hernia ^[69]. Hernias don't always have to be operated on. If they aren't causing any problems and the risk of complications is low, surgery isn't needed. This is also true in people who are very old, weak, or seriously ill and have a hernia that doesn't pose an acute risk. People who have an inguinal hernia, on the other hand, are usually advised to have surgery ^[70].

Hernia supports or hernia belts (tight, belt-like bandages) were often used in the past to try to stop hernias from bulging out of the abdomen. This is not recommended nowadays, though, because they don't make the hernia go away and can have side effects such as pressure ulcers (bedsores) ^[71]. Inguinal hernia in the adult is the most common type of hernia (75%) and occurs mainly in males.

Indirect herniation occurs through a persistent processus vaginalis (60–70%) and direct herniation through the fossa inguinalis medialis (30–40%). In up to 15% of patients, they occur bilaterally [72].

Inguinal hernia is the most common surgical disease in children, with an incidence of 1–2%. Hernias occur five times more often in boys than in girls. Sixty percent of cases occur on the right side, and 10% bilaterally. In almost every case, inguinal hernias in children result from an abnormally persistent processus vaginalis, that remains open in 80–90% of neonates and is still present in 50% at the end of the first year. This persistence does not imply the presence of a hernia but means simply a potential for hernia formation. Because of a high risk of incarceration, especially testis or ovary, particularly at a premature age or under 3 months (14–30%), an operation should not be delayed [73].

The main management procedure is high ligation of the hernial sac. In girls, the hernial sac should be sutured under the obliquus internus muscle for fixation of the rotundum ligament [74].

Surgical Repair

Surgical repair is the definitive treatment for an inguinal hernia. As a general rule, all symptomatic inguinal hernias should be repaired when possible. In some asymptomatic or minimally bothersome hernias, watchful waiting can be an option. There is a multitude of different techniques for hernia repair with different complications and recurrence profiles [75].

Open Approach

Tissue repairs

Tissue repairs are repairs where the native tissue is used to close the hernia defect with suture, and no mesh is used. These repairs are used when the operative field is contaminated or in emergency surgery where the viability of the hernia contents is in question [76]. The 3 main primary tissue repairs are the Bassini, Shouldice, and McVay. The Shouldice has the lowest recurrence rate when experienced surgeons perform tissue repairs. McVay is the only technique that can be used in femoral hernia repair. All surgeons should have a good grasp of the technical aspects of these repairs, as a primary repair will likely be the only option in a contaminated case. Prosthetic repairs are preferred over native tissue repair due to lower incidence of recurrence [77].

Prosthetic repairs

The prosthetic repairs are tension-free repairs, and thus, these have a lower hernia recurrence rate as compared to tissue repairs [78]. The prosthetic repairs are the Lichtenstein tension-free repair, plug and patch, and Prolene Hernia System (PHS). Lichtenstein repair is the most popular and used most around the world. The Prolene Hernia System repair is the only one of the 3 that places a mesh in the preperitoneal space with an open repair. Mesh repairs are contraindicated in a contaminated field due to the high rate of infection [79].

Laparoscopic Repairs

Transabdominal preperitoneal procedure (TAPP)

The transabdominal preperitoneal procedure TAPP is a technique where a hernia is repaired through an intraperitoneal approach. TAPP can be useful for bilateral

hernia repair, large hernia defects, and recurrence after open repair [90]. A large mesh can be placed with this approach covering the direct, indirect, and femoral spaces. The disadvantage to this approach is a complication to other intraperitoneal viscera and structures. A patient must be able to tolerate pneumoperitoneum for laparoscopic approaches [91].

Total extraperitoneal procedure (TEP)

The laparoscopic extraperitoneal procedure is a technique where the hernia repair is completed without intraperitoneal infiltration. This minimizes the risks of injury to intraperitoneal viscera and structures when compared to a TAPP repair [91]. The TEP procedure also avoids intraperitoneal adhesions from prior surgery making the dissection quicker and easier. The disadvantage to the TEP procedure is that the surgeon is constrained to limited space while dissecting. Visualization of the surrounding anatomy is limited as compared to TAPP repair. If the peritoneum is violated during the procedure, then conversion to TAPP may be warranted [92].

Laparoscopic repairs compared to open repairs have equivalent recurrence rates. The laparoscopic approach has been shown to improve postoperative pain and patients may resume normal activities sooner as compared to open repair. However, laparoscopic repair is associated with higher operative costs, and technical proficiency can be difficult to achieve. Some studies suggest it takes as many as 250 laparoscopic hernia repairs for a surgeon to reach optimal proficiency [93-96].

Conclusion

Nowadays, 11 percent of patients with primary inguinal hernia repair experience recurrence, and 10–12% experience persistent pain. The international hernia societies have developed evidence-based guidelines for the standardization of care to enhance the result of inguinal hernia repair. When bowel resection is required for emergency inguinal repair or there is contamination, there are several options depending on the situation: closing only the hernia sac and repairing the hernia later, tissue repair in the Shouldice technique, and Lichtenstein technique with biologic or biosynthetic mesh.

References

1. Norman Williams S, Christopher Bulstrode JK, Ranan Connell PO, Bailey. *Loves Short practice of surgery*, 25th Edition, UK, Edward Arnold Publisher Ltd, 2008.
2. Decker E, Currie A, Baig MK. Prolene hernia system versus Lichtenstein repair for inguinal hernia: a meta-analysis. *Hernia*. 2019 Jun;23(3):541-546.
3. Muschaweck U, Koch A. [Sportsmen's groin]: Definition, differential diagnosis and treatment]. *Radiologe*. 2019 Mar;59(3):224-233.
4. Sun L, Shen YM, Chen J. Laparoscopic *versus* Lichtenstein hernioplasty for inguinal hernias: a systematic review and Meta-analysis of randomized controlled trials. *Minim Invasive Ther Allied Technol*. 2020 Feb;29(1):20-27.
5. Li J, Gong W, Liu Q. Intraoperative adjunctive techniques to reduce seroma formation in laparoscopic inguinal hernioplasty: a systematic review. *Hernia*. 2019 Aug;23(4):723-731.
6. Fernando H, Garcia C, Hossack T, Ahmadi N, Thanigasalam R, Gillatt D, *et al*. Incidence, Predictive

- Factors and Preventive Measures for Inguinal Hernia following Robotic and Laparoscopic Radical Prostatectomy: A Systematic Review. *J Urol*. 2019 Jun;201(6):1072-1079.
7. Schmitz R, Willeke F, Barr J, Scheidt M, Saelzer H, Darwich I, Zani S, *et al.* Robotic Inguinal Hernia Repair (TAPP) First Experience with the New Senhance Robotic System. *Surg Technol Int*. 2019 May 15;34:243-249.
 8. Tam V, Rogers DE, Al-Abbas A, Borrebach J, Dunn SA, Zureikat AH, *et al.* Robotic Inguinal Hernia Repair: A Large Health System's Experience With the First 300 Cases and Review of the Literature. *J. Surg. Res.* 2019 Mar;235:98-104.
 9. Payiziwula J, Zhao PJ, Aierken A, Yao G, Apaer S, Li T, *et al.* Laparoscopy Versus Open Incarcerated Inguinal Hernia Repair in Octogenarians: Single-Center Experience With World Review. *Surg Laparosc Endosc Percutan Tech*. 2019 Apr;29(2):138-140.
 10. Clelland AD, Varsou O. A qualitative literature review exploring the role of the inguinal ligament in the context of inguinal disruption management. *Surg Radiol Anat*. 2019 Mar;41(3):265-274.
 11. Nedelcu M, Verhaeghe P, Skalli M, Champault G, Barrat C, Sebbag H, *et al.* Multicenter prospective randomized study comparing the technique of using a bovine pericardium biological prosthesis reinforcement in parietal herniorrhaphy (Tutomech TUTOGEN) with simple parietal herniorrhaphy, in a potentially contaminated setting. *Wound Repair Regen*. 2016 Mar;24(2):427-33.
 12. Vu JV, Gunaseelan V, Dimick JB, Englesbe MJ, Campbell DA, Telem DA. Mechanisms of age and race differences in receiving minimally invasive inguinal hernia repair. *Surg Endosc*. 2019 Dec;33(12):4032-4037.
 13. Mellert LT, Cheung ME, Zografakis JG, Dan AG. Laparoscopic Inguinal Hernia Repair Using ProGrip Self-Fixating Mesh: Technical Learning Curve and Mid-Term Outcomes. *Surg Technol Int*. 2019 May 15;34:235-240.
 14. Kingsnorth A, LeBlanc K. Hernias: inguinal and incisional. *Lancet* 2003;362:1561-71.
 15. Devlin HB. Trends in hernia surgery in the land of Astley Cooper. In: Soper NJ, ed. *Problems in general surgery*. Philadelphia, PA: Lippincott-Raven, 1995;12:85-92.
 16. Chow A, Purkayastha S, Athanasiou T, Tekkis P, Darzi A. Inguinal hernia. *BMJ Clin Evid* 2007;4:1-20.
 17. Page B, Paterson C, Young D, O'Dwyer PJ. Pain from primary inguinal hernia and the effect of repair on pain. *Br J Surg* 2002;89:1315-8.
 18. Gallegos NC, Dawson J, Jarvis M, Hobsley M. Risk of strangulation in groin hernias. *Br J Surg* 1991;78:1171-3.
 19. Fitzgibbons Jr RJ, Jonasson O, Gibbs J, Dunlop DD, Henderson W, Reda D, *et al.* The development of a clinical trial to determine if watchful waiting is an acceptable alternative to routine herniorrhaphy for patients with minimal or no hernia symptoms. *J Am Coll Surg*. 2003;196:737-42.
 20. Hernia Trialists Collaboration EU. Repair of groin hernia with synthetic mesh, meta-analysis of randomized controlled trials. *Ann Surg* 2002;235:322-32.
 21. Bisgaard T, Bay-Nielsen M, Christensen IJ, Kehlet H. Risk of recurrence 5 years or more after primary Lichtenstein mesh and sutured inguinal hernia repair. *Br J Surg* 2007;94:1038-40.
 22. Kingsnorth A. Controversial topics in surgery: the case for open repair. *Ann R Coll Surg Engl* 2005;87:59-60.
 23. EU Hernia Trialists Collaboration. Laparoscopic compared with open methods of groin hernia repair: systematic review of randomised controlled trials. *Br J Surg* 2000;37:860-7.
 24. Memon MA, Cooper NJ, Memon B, Memon MI, Abrams KR. Meta-analysis of randomised clinical trials comparing open and laparoscopic inguinal hernia repair. *Br J Surg* 2003;90:1479-2.
 25. Neumayer L, Giobbie-Hurder A, Jonasson O, Fitzgibbons R Jr, Dunlop D, Gibbs J, *et al.* Open versus laparoscopic mesh repair of inguinal hernia. *N Engl J Med* 2004;350:1819-27.
 26. Grant AM, Scott NW, O'Dwyer PJ, for the MRC Laparoscopic Hernia Trial Group. Pain and numbness after laparoscopic and open repair of a groin hernia: five year follow-up of a randomized trial. *Br J Surg* 2005;91:1570-4.
 27. National Institute for Health and Clinical Excellence. Laparoscopic surgery for inguinal hernia repair. 2004.
 28. Nordin P, Zetterstrom H, Gunnarsson U, Nilsson E. Local, regional or general anaesthesia in groin hernia repair: multicentre randomised trial. *Lancet*. 2003;362:853-8.
 29. Nordin P, Zetterstrom H, Carlsson P, Nilsson E. Cost-effectiveness analysis of local, regional and general anaesthesia for inguinal hernia repair using data from a randomised trial. *Br J Surg* 2007;94:500-5.
 30. O'Dwyer PJ, Serpell MG, Millar K, Paterson C, Young D, Hair A, *et al.* Local or General anaesthesia for open hernia repair: a randomized trial. *Annals of Surgery*. 2003;237:574-9.
 31. Kehlet H, Bay-Nielsen M. Anaesthetic practice for groin hernia repair—a nation-wide study in Denmark 1998-2003. *Acta Anaesthesiol Scand*. 2005;49:143-6.
 32. Fitzgibbons RJ, Giobbie-Hurder A, Gibbs JO, Dunlop DD, Reda DJ, McCarthy M Jr, *et al.* Watchful waiting vs repair of inguinal hernia in minimally symptomatic men: a randomised clinical trial. *JAMA* 2006;295:285-92.
 33. O'Dwyer PJ, Norrie J, Alani A, Walker A, Duffy F, Horgan P. Observation or operation for patients with an asymptomatic inguinal hernia. *Ann Surg*. 2006;244:167-73.
 34. Bay-Nielsen M, Thomsen H, Heidemann Andersen F, Bendix JH, Sørensen OK, Skovgaard N, *et al.* Convalescence after inguinal herniorrhaphy. *Br J Surg*. 2004;91:362-7.
 35. Bay-Nielsen M, Kehlet H, Strand L, Malmstrøm J, Andersen FH, Wara P, *et al.* Quality assessment of 26 304 herniorrhaphies in Denmark: a prospective nationwide study. *Lancet*. 2001;358:1124-8.
 36. Haapaniemi S, Sandblom G, Nilsson E. Mortality after elective and emergency surgery for inguinal and femoral hernia. *Hernia*. 1999;4:205-8.
 37. McGugan E, Burton H, Nixon SJ, Thompson AM. Deaths following hernia surgery: room for improvement. *J R Coll Surg Edinb*. 2000;45:183-6.

38. Sanchez-Manuel FJ, Seco-Gil JL. Antibiotic prophylaxis for hernia repair. *Cochrane Database Syst Rev* 2004;(4):CD003769.
39. Aufenacker TJ, Koelemay MJW, Gouma DJ, Simons MP. Systematic review and meta-analysis of the effectiveness of antibiotic prophylaxis in prevention of wound infection after mesh repair of abdominal wall hernia. *Br J Surg* 2006;93:5-10.
40. Butters M, Redecke J, Koninger J. Long-term results of a randomised clinical trial of Shouldice, Lichtenstein and transabdominal preperitoneal repairs. *Br J Surg*. 2007;94:562-5.
41. Berndsen FH, Peterson V, Arvidsson D, Leijonmarck C-E, Rudberg C, Smedberg S, *et al.* Discomfort five years after laparoscopic and Shouldice inguinal hernia repair: a report from the SMIL Study Group. *Hernia*. 2007;11:307-13.
42. Franneby U, Sandblom G, Nordin P, Nyren O, Gunnarsson U. Risk factors for long-term pain after hernia surgery. *Ann Surg*. 2006;244:212-9.
43. Bay-Nielsen M, Perkins FM, Kehlet H. Pain and functional impairment 1 year after inguinal herniorrhaphy: a nationwide questionnaire study. *Ann Surg*. 2001;233:1-7.
44. Fitzgibbons Jr RJ. Can we be sure that polypropylene mesh causes infertility? *Ann Surg*. 2005;241:559-61.
45. Primates P, Goldacre MJ. Inguinal hernia repair: incidence of elective and emergency surgery, readmission and mortality. *Int J Epidemiol*. 1996;25:835-9. 10.1093/ije/25.4.835
46. 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. 10.1016/j.jpedsurg.2005.11.073
47. Nilsson H, Stylianidis G, Haapamaki M, Nilsson E, Nordin P. Mortality after groin hernia surgery. *Ann Surg*. 2007;245:656. 60.10.1097/01.sla.0000251364.32698.4b
48. Burcharth J, Pommegaard HC, Bisgaard T, Rosenberg J. Patient-related risk factors for recurrence after inguinal hernia repair: a systematic review and meta-analysis of observational studies. *Surg Innov*. 2015;22:303-17. 10.1177/1553350614552731.
49. Kureshi A, Vaiude P, Nazhat SN, Petrie A, Brown RA. Matrix mechanical properties of transversalis fascia in inguinal herniation as a model for tissue expansion. *J Biomech*. 2008;41:3462. 8.10.1016/j.jbiomech.2008.08.018
50. Pascual G, Corrales C, Gomez-Gil V, Bujan J, Bellon JM. TGF-beta1 overexpression in the transversalis fascia of patients with direct inguinal hernia. *Eur J Clin Invest*. 2007;37:516-21. 10.1111/j.1365-2362.2007.01816.x
51. Kayaoglu HA, Hazinedaroglu SM, Bulent Erkek A, Kocaturk PA, Kavas GO, Aribal D. Comparison of the plasma and hernia sac tissue copper levels in direct and indirect inguinal hernia patients. *Biol Trace Elem Res*. 2005;108:53-9. 10.1385/BTER:108:1-3:053
52. Pascual G, Rodriguez M, Gomez-Gil V, Trejo C, Bujan J, Bellon JM. Active matrix metalloproteinase-2 upregulation in the abdominal skin of patients with direct inguinal hernia. *Eur J Clin Invest*. 2010;40:1113-21. 10.1111/j.1365-2362.2010.02364.x
53. Burcharth J, Pommegaard HC, Rosenberg J. The inheritance of groin hernia: a systematic review. *Hernia*. 2013;17:183-9. 10.1007/s10029-013-1060-4
54. Zoller B, Ji J, Sundquist J, Sundquist K. Shared and nonshared familial susceptibility to surgically treated inguinal hernia, femoral hernia, incisional hernia, epigastric hernia, and umbilical hernia. *J Am Coll Surg*. 2013;217:289-99. e1.10.1016/j.jamcollsurg.2013.04.020
55. Burcharth J, Pedersen M, Bisgaard T, Pedersen CB, Rosenberg J. Familial clustering and risk of groin hernia in children. *BJS Open*. 2017;1:46-9. 10.1002/bjs.5.8
56. Mihailov E, Nikopentis T, Reigo A, Nikkolo C, Kals M, Aruaas K, *et al.* Whole-exome sequencing identifies a potential TTN mutation in a multiplex family with inguinal hernia. *Hernia* 2017;21:95-100. 10.1007/s10029-016-1491-9
57. Zhang Y, Han Q, Li C, Li W, Fan H, Xing Q, *et al.* Genetic analysis of the TBX1 gene promoter in indirect inguinal hernia. *Gene*. 2014;535:290-3. 10.1016/j.gene.2013.11.012
58. Qiao Y, Zhang Z, Huang W, Pang S, Xing Q, Yan B. Two functional sequence variants of the GATA6 gene promoter in patients with indirect inguinal hernia. *Gene*. 2014;547:86-90. 10.1016/j.gene.2014.06.030
59. Zhao Z, Tian W, Wang L, Wang H, Qin X, Xing Q, *et al.* Genetic and functional analysis of the TBX3 gene promoter in indirect inguinal hernia. *Gene*. 2015;554:101-4. 10.1016/j.gene.2014.10.031
60. Sezer S, Simsek N, Celik HT, Erden G, Ozturk G, Duzgun AP, *et al.* Association of collagen type I alpha 1 gene polymorphism with inguinal hernia. *Hernia*. 2014;18:507-12. 10.1007/s10029-013-1147-y
61. Jorgenson E, Makki N, Shen L, Chen DC, Tian C, Eckalbar WL, *et al.* A genome-wide association study identifies four novel susceptibility loci underlying inguinal hernia. *Nat Commun*. 2015;6:10130. 10.1038/ncomms10130
62. Poobalan AS, Bruce J, Smith WC, King PM, Krukowski ZH, Chambers WA. A review of chronic pain after inguinal herniorrhaphy. *Clin J Pain*. 2003;19:48-54. 10.1097/00002508-200301000-00006
63. Aasvang E, Kehlet H. Chronic postoperative pain: the case of inguinal herniorrhaphy. *Br J Anaesth*. 2005;95:69-76. 10.1093/bja/aei019
64. Scheuermann U, Niebisch S, Lyros O, Jansen-Winkeln B, Gockel I. Transabdominal preperitoneal (TAPP) versus Lichtenstein operation for primary inguinal hernia repair – a systematic review and meta-analysis of randomized controlled trials. *BMC Surg*. 2017;10(17):55. 10.1186/s12893-017-0253-7
65. Simons MP, Aufenacker T, Bay-Nielsen M, Bouillot JL, Campanelli G, Conze J, *et al.* European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2009;13:343-403. 10.1007/s10029-009-0529-7
66. Miserez M, Peeters E, Aufenacker T, Bouillot JL, Campanelli G, Conze J, *et al.* Update with level 1 studies of the European Hernia Society guidelines on the treatment of inguinal hernia in adult patients. *Hernia*. 2014;18:151-63. 10.1007/s10029-014-1236-6
67. Schleidgen S, Klingler C, Bertram T, Rogowski WH, Marckmann G. What is personalized medicine:

- sharpening a vague term based on a systematic literature review. *BMC Med Ethics*. 2013;21(14):55. 10.1186/1472-6939-14-55
68. Öberg S, Andresen K, Rosenberg J. Absorbable meshes in inguinal hernia surgery: a systematic review and meta-analysis. *Surg Innov*. 2017;24:289-98. 10.1177/1553350617697849
 69. Fang Z, Ren F, Zhou J, Tian J. Biologic mesh versus synthetic mesh in open inguinal hernia repair: system review and meta-analysis. *ANZ J Surg*. 2015;85:910-6. 10.1111/ans.13234
 70. Rosenberg J, Bisgaard T, Kehlet H, Wara P, Asmussen T, Juul P, *et al.* Danish Hernia Database recommendations for the management of inguinal and femoral hernia in adults. *Dan Med Bull*. 2011;58:C4243.
 71. Bay-Nielsen M, Perkins FM, Kehlet H. Pain and functional impairment 1 year after inguinal herniorrhaphy: a nationwide questionnaire study. *Ann Surg*. 2001;233:1-7. 10.1097/0000658-200101000-00001
 72. Langeveld HR, Klitsie P, Smedinga H, Eker H, Van't Riet M, Weidema W, *et al.* Prognostic value of age for chronic postoperative inguinal pain. *Hernia*. 2015;19:549-55. 10.1007/s10029-014-1282-0
 73. Haastrup E, Andresen K, Rosenberg J. Low reoperation rates in young males after sutured repair of indirect inguinal hernia: arguments for a tailored approach. *Am J Surg*. Forthcoming, 2017, 10.1016/j.amjsurg.2017.02.015
 74. Klinger A, Kawata M, Villalobos M, Jones RB, Pike S, Wu N, *et al.* Living scaffolds: surgical repair using scaffolds seeded with human adipose-derived stem cells. *Hernia*. 2016;20:161-70. 10.1007/s10029-015-1415-0
 75. Iyyanki TS, Dunne LW, Zhang Q, Hubenak J, Turza KC, Butler CE. Adipose-derived stem-cell-seeded non-cross-linked porcine acellular dermal matrix increases cellular infiltration, vascular infiltration, and mechanical strength of ventral hernia repairs. *Tissue Eng Part A*. 2015;21:475-85. 10.1089/ten.TEA.2014.0235
 76. Zheng R, Altieri MS, Yang J, Chen H, Pryor AD, Bates A, *et al.* Long-term incidence of contralateral primary hernia repair following unilateral inguinal hernia repair in a cohort of 32,834 patients. *Surg Endosc*. 2017;31:817-22. 10.1007/s00464-016-5037-0
 77. Sharma RK, Murari K, Kumar V, Jain VK. Inguinoscrotal extraperitoneal herniation of a ureter. *Can J Surg*. 2009 Apr;52(2):E29-30.
 78. Jiang ZP, Yang B, Wen LQ, Zhang YC, Lai DM, Li YR, *et al.* The etiology of indirect inguinal hernia in adults: congenital or acquired? *Hernia*. 2015 Oct;19(5):697-701.
 79. Mouravas V, Sfoungaris D. The etiology of indirect inguinal hernia in adults: congenital, acquired or both? *Hernia*. 2015 Dec;19(6):1037-8.
 80. Eilber KS, Freedland SJ, Rajfer J. Obstructive uropathy secondary to ureteroinguinal herniation. *Rev Urol*. 2001 Fall;3(4):207-8.
 81. Yahya Z, Al-Habbal Y, Hassen S. Ureteral inguinal hernia: an uncommon trap for general surgeons. *BMJ Case Rep*. 2017 Mar 08;2017
 82. Pollack HM, Popky GL, Blumberg ML. Hernias of the ureter. An anatomic-roentgenographic study. *Radiology*. 1975 Nov;117(2):275-81.
 83. Lu A, Burstein J. Paraperitoneal inguinal hernia of ureter. *J Radiol Case Rep*. 2012 Aug;6(8):22-6.
 84. McKay JP, Organ M, Bagnell S, Gallant C, French C. Inguinoscrotal hernias involving urologic organs: A case series. *Can Urol Assoc J*. 2014 May;8(5-6):E429-32.
 85. Bittner R, Montgomery MA, Arregui E, *et al.* Update of guidelines on laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal hernia (International Endohernia Society) *Surg Endosc*. 2015;29:289-321.
 86. Bittner R, Arregui ME, Bisgaard T, *et al.* Guidelines for laparoscopic (TAPP) and endoscopic (TEP) treatment of inguinal Hernia (International Endohernia Society (IEHS)) *Surg Endosc*. 2011;25:2773-2843.
 87. Trevisonno M, Kaneva P, Watanabe Y, *et al.* A survey of general surgeons regarding laparoscopic inguinal hernia repair: practice patterns, barriers, and educational needs. *Hernia*. 2015;19:719-724.
 88. O'Reilly EA, Burke JP, O'Connell PR. A meta-analysis of surgical morbidity and recurrence after laparoscopic and open repair of primary unilateral inguinal hernia. *Ann Surg*. 2012;255:846-853.
 89. Eklund AS, Montgomery AK, Rasmussen IC, Sandbue RP, Bergkvist LA, Rudberg CR. Low recurrence rate after laparoscopic (TEP) and open (Lichtenstein) inguinal hernia repair: a randomized, multicenter trial with 5-year follow-up. *Ann Surg*. 2009;249:33-38.
 90. Saleh F, Okrainec A, D'Souza N, Kwong J, Jackson TD. Safety of laparoscopic and open approaches for repair of the unilateral primary inguinal hernia: an analysis of short-term outcomes. *Am J Surg*. 2014;208:195-201.
 91. Burcharth J, Andresen K, Pommergaard HC, Bisgaard T, Rosenberg J. Direct inguinal hernias and anterior surgical approach are risk factors for female inguinal hernia recurrences. *Langenbecks Arch Surg*. 2014;399:71-76.
 92. Sevonius D, Gunnarsson U, Nordin P, Nilsson E, Sandblom G. Recurrent groin hernia surgery. *Br J Surg*. 2011;98:1489-1494.
 93. Klosterhalfen B, Klinge U. Retrieval study at 623 human mesh explants made of polypropylene - impact of mesh class and indication for mesh removal on tissue reaction. *J Biomed Mater Res B Appl Biomater*. 2013;101:1393-1398.
 94. Kuehnert N, Kraemer NA, Otto J, *et al.* In vivo MRI visualization of mesh shrinkage using surgical implants loaded with superparamagnetic iron oxides. *Surg Endosc*. 2012;26:1468-1475.
 95. Sajid MS, Leaver C, Baig MK, Sains P. Systematic review and meta-analysis of the use of lightweight versus heavyweight mesh in open inguinal hernia repair. *Br J Surg*. 2012;99:29-37.
 96. Köckerling F, Simons MP. Current Concepts of Inguinal Hernia Repair. *Visc Med*. 2018 Apr;34(2):145-150. doi: 10.1159/000487278.