PART 2

Specific Aspects of Groin Hernia Management

16. Groin Hernias in Women
17. Femoral Hernias
18. Complications – Prevention and Treatment
19. Pain – Prevention and Treatment
20. Recurrent Inguinal Hernias
21. Emergency Groin Hernia Treatment

Chapter 16  Groin Hernias in Women

N. Schouten, H. Eker, K. Bury and F. Muysoms

Introduction

Groin hernia repairs are 8 to 10 times more common in men compared with women\(^1,2\). Inguinal hernias (IHs) occur 9 to 12 times more commonly in men whereas femoral hernias occur approximately 4 times more commonly in women\(^3\). These differences may be explained by the greater distance between the pubic tubercle and the internal ring and the wider rectus abdominus muscle in females\(^4\).

No systematic reviews or randomized controlled trials (RCTs) specifically address groin hernia repair in women. Data are collected mainly from subgroup analyses of epidemiological studies from national databases noting that reoperation rates after anterior hernia repairs in women are higher when compared with men. In roughly 40% of reoperations in women, femoral hernia recurrences are found, suggesting that these “recurrences” might represent hernias overlooked during primary operations\(^5\)–\(^11\). Therefore, the European Hernia Society (EHS) guidelines on groin hernia treatment recommends laparoscopic repair in women covering both the inguinal and femoral orifices\(^12\).

Key Questions

KQ16.a In women with a groin lump, what is the best diagnostic modality and is a preoperative diagnosis necessary?

KQ16.b What is the optimal treatment for women with groin hernias?

KQ16.c What is the risk of incarceration/strangulation in women with groin hernias? What is the incidence of emergent inguinal/femoral hernia repair in women? What are the outcomes?
Statements and Recommendations

<table>
<thead>
<tr>
<th>Statement</th>
<th>No clinical or diagnostic tests can reliably distinguish inguinal from femoral hernias.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement</td>
<td>Femoral hernias occur more often in women.</td>
</tr>
<tr>
<td>Statement</td>
<td>Femoral hernias are more likely than inguinal hernias to incarcerate and strangulate.</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Provided that expertise is available, women with groin hernias are recommended to undergo laparoscopic repair with preperitoneal mesh implantation.</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Timely hernia repair is recommended in women with groin hernias.</td>
</tr>
<tr>
<td>Recommendation</td>
<td>Physicians should consider femoral hernia in the differential diagnosis of groin swelling in women.</td>
</tr>
</tbody>
</table>

Evidence in Literature

When an overt groin hernia is present, the diagnosis can often be confirmed by physical examination. Textbooks state that a femoral hernia produces swelling inferolateral to the pubic tubercle and an inguinal hernia causes superomedial swelling; however, this subtle distinction is often difficult to discern, particularly in obese women.

A meta-analysis of ultrasound as an initial diagnostic imaging modality for groin hernias showed a high sensitivity and positive predictive value in cases confounded by diagnostic uncertainty. The study cited low expense and minimal risk as advantages over other radiologic methods. However, ultrasound and clinical examination are “operator dependent” and may be unable to distinguish an inguinal from a femoral hernia. Both may also miss femoral hernias entirely.

The literature confirms that femoral hernias are frequently found in women undergoing groin hernia repair but that a correct preoperative diagnosis of these hernias is uncommon.

In a few large epidemiological studies from national databases, reoperation rates after open anterior groin hernia repairs in females are higher when compared with reoperation rates in males. In approximately 40% of reoperations after anterior mesh or non-mesh repairs, a femoral hernia...
“recurrence” is found, representing a nearly tenfold risk of this finding in women. The explanation for this phenomenon may be that femoral hernias are overlooked during initial operations since an open anterior repair does not involve opening of the transversalis fascia nor preperitoneal space exploration. Subgroup analysis from the same studies supports this contention by noting that reoperation rates after laparoscopic approaches (TEP, TAPP) are lower when compared to Lichtenstein or other open anterior approaches.

Two small cohort studies focused on hernia repair in women also suggest that an open anterior repair is associated with a relatively high postoperative complication rate and a higher incidence of postoperative pain compared with women undergoing TEP hernia repair.

The high frequency of femoral hernias in women and the high risk of femoral recurrence mentioned above highlight the need for preperitoneal exploration and repair in all women with groin hernias. A laparoscopic preperitoneal repair offers a thorough view of the entire myopectineal orifice and creates easy access to, and coverage of, both inguinal and femoral defects. This also obviates the need for a correct preoperative diagnosis. Anatomically and with regard to mesh application, there is little difference between the laparoscopic and open preperitoneal approach, but laparoscopic repair techniques have a long learning curve. In experienced hands though, laparoscopic hernia repair seems to be associated with a slightly lower reoperation risk than open preperitoneal repair.

Femoral hernias carry a higher risk of strangulation when compared with IHs. In the Swedish and Danish hernia registries, 36% to 39% of femoral hernias were emergently repaired versus 5% of IHs. About 17% of women with groin hernias require emergent repair versus about 5% of men with groin hernias. Furthermore, patients with femoral hernias have a greater risk of undergoing bowel resection (23% of patients undergoing emergent femoral hernia repair compared with approximately 5% of patients undergoing emergent IH repair). Bowel resection occurred in 17% of women undergoing emergent groin hernia repair. There are no specific data about bowel resection after femoral hernia repair.

A woman’s risk of death in the 30 days after elective femoral hernia repair is comparable to the risk of dying in an age- and gender-matched population (< 0.1%). However, 3.8% of women die in the 30 days following emergent femoral hernia repair.

The higher incidence of femoral hernias in women and the associated strangulation risk argues strongly against a watchful waiting strategy in women with groin hernias. Timely hernia repair is recommended.

**Discussion**

There are no systematic reviews or RCTs specifically addressing groin hernias in women but several subgroup analyses from large epidemiological studies of national databases provide information about groin hernias and groin hernia repairs in women. It is abundantly clear that femoral hernias are more common in women. This argues for the use of a preperitoneal approach.
laparoscopic approach in women with groin hernias. Additionally, since strangulation risk is unacceptably high, timely elective repair of groin hernias in women is strongly advised.

Key Question

KQ16.d How is a groin lump in a pregnant female diagnosed and treated?

Statements and Recommendation

<table>
<thead>
<tr>
<th>Statement</th>
<th>Groin hernia formation is uncommon during pregnancy.</th>
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<tbody>
<tr>
<td>Evidence</td>
<td>☐☐☐ ☐☐☐ ☐☐☐ ☐☐☐</td>
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</table>

<table>
<thead>
<tr>
<th>Statement</th>
<th>The most likely diagnosis in a woman with the onset of a groin lump during pregnancy is round ligament varicosity.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence</td>
<td>☐☐☐ ☐☐☐</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Watchful waiting is suggested in pregnant females with groin swelling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Evidence</td>
<td>Weak</td>
</tr>
</tbody>
</table>

Evidence in Literature

IH formation during pregnancy is rare with a prevalence estimated as 1:2,000\(^{23}\). A watchful waiting strategy is recommended for those who develop IHs during pregnancy\(^{24}\).

Although mainly described in small case series and case reports, the onset of a groin lump in pregnancy is often a round ligament varicosity rather than a hernia\(^{25}\). A round ligament varicocele arises from the veins draining the round ligament and the inguinal canal. It is a rare entity associated with pregnancy, presents with a groin lump typically early in the third trimester, progressively enlarges during pregnancy and regresses soon after delivery\(^{25}\). The diagnosis can be easily confirmed by color Doppler sonography. If, in fact, a groin lump consisting of varicose veins occurs, symptoms will spontaneously abate after delivery and expectant management can be used. Varicocele resection might be necessary only in cases with severe pain.

Discussion

There are several case reports and case series, but only one small prospective cohort study describing the onset of a groin lump in pregnancy associated with varicose veins of the round ligament rather than a groin hernia. All conclude that a watchful waiting strategy is safe and preferred. It seems prudent to confirm the diagnosis with color Doppler sonography. The true prevalence of groin hernia formation during pregnancy is unknown, difficult to determine, and only mentioned—but not investigated—in two small cohort studies. The level of evidence supporting the statements in this section is low because of limited medical literature on the subject.

Key Question

KQ16.e Should the round ligament be preserved in women who undergo groin hernia repair?
Statement and Recommendation

<table>
<thead>
<tr>
<th>Statement</th>
<th>Division of the genital branch of the genitofemoral nerve carries a small risk of deafferentation, hypersensitivity, and ipsilateral labial numbness.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>It is suggested to avoid division of the round ligament in open repair. If division of the round ligament is done in laparoscopic repair, it should preferentially be performed proximal to the genital branch meeting at the fusion with the peritoneum.</td>
</tr>
</tbody>
</table>

Evidence in Literature

One unaddressed issue in the management of groin hernia repair in women is whether the round ligament should be divided or spared during surgery. Although there is no evidence in literature to support this, there are some anatomy-based considerations to take into account, mainly based on extrapolation from extended experience with anterior and retroperitoneal neurectomy.

The round ligament is attached to the uterus through the broad ligament of the uterus, enters the inguinal canal and finally terminates in the digital process of fat of the labia majora. The genital branch of the genitofemoral nerve mostly meets the round ligament at the internal ring, but sometimes it may join earlier. Division of the round ligament in open repair inherently implies simultaneous division of the genital nerve and likely division of the ilioinguinal nerve. Sacrifice typically has minimal morbidity or consequence but carries a small risk of deafferentation hypersensitivity and ipsilateral labial numbness that may contribute to complaints of sexual dysfunction. It is therefore advised to avoid division of the round ligament in open (anterior) hernia repair. If the ligament is divided nonetheless, care should be taken to properly address any incidentally ligated nerves.

Division of the round ligament in laparoscopic hernia repair is optional and might facilitate optimal mesh placement. The round ligament is enveloped by the peritoneum and may lead to lower folding of the mesh or peritoneum sliding beneath. For this reason, many surgeons choose to divide it in laparoscopic repair. There are fewer implications of division in the pre-peritoneal space as the nerves are not adherent to the ligament until it enters the internal ring. Division of the round ligament should therefore be performed proximal to the genital branch meeting, which is typically best performed at the fusion with the peritoneum where division has no functional implication.

Discussion
There is no literature that addresses the sparing or division of the round ligament in groin hernia repair in women. The statements are based on anatomical considerations and thorough discussion with experts in anterior and retroperitoneal neurectomy.

Chapter 17  Femoral Hernias
H. Eker, N. Schouten, K. Bury and F. Muysoms

Introduction
Elective and emergent femoral hernia repairs constitute roughly 2% to 4% of all groin hernia repairs. However, the true femoral hernia incidence is likely lower than 2% to 4% since this estimate is skewed by the high percentage of surgically-treated femoral hernias compared to IHs. Medical literature focused on femoral hernias is scant and studies lack sufficient power to draw firm conclusions. However, large systematic reviews on IHs provide data that can inform decision-making about femoral hernia management.26,27

Some topics in this chapter (e.g. suture and mesh choice, prevention and treatment of complications) were assumed to be comparable to IH repair and were not evaluated separately.

Key Questions
KQ17.a Is there a recurrence rate difference between suture and mesh open femoral hernia repairs?

KQ17.b Following femoral hernia repair are there differences in recurrence rates, complications or the incidence of chronic pain between open anterior mesh repair and open posterior mesh repair?

KQ17.c Following open and endoscopic femoral hernia repairs are there differences in recurrence rates, postoperative pain and complications?

KQ17.d Should asymptomatic femoral hernias always be treated surgically?

Statements and Recommendations

<table>
<thead>
<tr>
<th>Statement</th>
<th>Preperitoneal mesh repair results in significantly fewer recurrences and less postoperative pain and foreign body sensation.</th>
<th>☒☒☐☐</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement</td>
<td>Laparo-endoscopic repair of femoral hernias results in significantly fewer recurrences and less postoperative pain.</td>
<td>☒☒☐☐</td>
</tr>
<tr>
<td>Statement</td>
<td>Laparo-endoscopic repair offers the opportunity to establish correct diagnoses in cases where preoperative diagnoses were incorrect.</td>
<td>☒☒☐☐</td>
</tr>
</tbody>
</table>
Recommendation: Mesh should be used in elective femoral hernia repairs. 

Strong *Upgraded

Recommendation: Providing expertise is available, a laparo-endoscopic procedure is recommended for elective femoral hernia repair. 

Strong *Upgraded

Recommendation: Timely elective repair is recommended for all patients with femoral hernias. 

Strong *Upgraded

Two systematic reviews (SRs) were identified that focused on IH repair but included data and recommendations on femoral hernias. KQ 25.d, concerning whether an asymptomatic femoral hernia should be electively repaired, received the strongest consensus recommendation. Watchful waiting is discouraged since the risks of serious and potentially lethal complications such as strangulation and bowel resection are unacceptably high. Several clinically significant differences were found in outcomes following elective and emergent femoral hernia repair. When compared to elective repair, emergent femoral hernia repair is associated with a greater risk of small bowel resection and a longer length of hospital stay.

In contrast to IH repair, primary suture repair of femoral hernia is still an accepted technique in elective and emergency settings. A cohort study from a specialized hernia center concluded that there were no significant differences regarding recurrence rate between tissue-based and mesh repair of femoral hernias. However, studies from the Danish Hernia Database and the Swedish Hernia Registry all concluded that recurrence and reoperation rates after mesh repair were significantly lower.

Which mesh or plug should be used in open femoral hernia repair was investigated in two RCT’s and a large national database study. Significantly better results concerning recurrence, postoperative pain and foreign body sensation were found in the RCT for preperitoneal mesh repair compared to plug repair. No differences in hernia recurrence were found in a retrospective study. The large database study showed no differences in postoperative pain between different mesh types and anatomical locations for the mesh devices.

The medical literature strongly supports the advantages of elective laparoscopic femoral hernia repair. Three cohort studies from specialized hernia centers found that endoscopic repairs provide the opportunity to unerringly diagnose conditions which may have been obscure preoperatively. Several other cohort studies of various sizes found significantly fewer recurrences after elective endoscopic femoral hernia repairs. The aforementioned arguments strongly support a laparo-endoscopic approach for femoral hernia repair.
Chapter 18  Complications – Prevention and Treatment
S. Smedberg, W. Reinpol, A, Wijsmuller and R. Fitzgibbons

Introduction

Common primary outcome measures in IH surgery studies include: recurrence, chronic postoperative pain, and wound infection. Usually reported as secondary outcomes are: urinary and sexual dysfunction, hematoma, seroma, infrequent visceral and vascular injuries, late postoperative complications, and mortality. These secondary measures are indispensable when considering the success and value of different types of IH repairs.

Urinary retention

Key Questions

KQ18.a Is early postoperative pain associated with increased urinary retention risk?
KQ18.b Is there an age-associated postoperative urinary retention risk?
KQ18.c Does intraoperative parenteral fluid restriction reduce urinary retention risk?
KQ18.d Is there an increased risk of postoperative urinary retention with open anterior repair?
KQ18.e When is prophylactic urinary bladder catheterization indicated before hernia operation?
KQ18.f Is there effective prophylactic medication to decrease urinary retention?

Statements

<table>
<thead>
<tr>
<th>Statement</th>
<th>There is only indirect evidence that pain results in increased urinary retention rates based upon the experience with painful tack fixation vs non-fixation techniques. LOE = weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement</td>
<td>Urinary retention after inguinal hernia repair increases with age.</td>
</tr>
<tr>
<td>Statement</td>
<td>Minimizing the amount of parenteral fluids given to patients undergoing inguinal herniorrhaphy may result in a lower incidence of urinary retention.</td>
</tr>
<tr>
<td>Statement</td>
<td>Open anterior repair performed under local anesthesia has a decreased incidence of urinary retention compared to endoscopic repair.</td>
</tr>
</tbody>
</table>
There is no difference in the incidence of urinary retention between open repair and endoscopic repair when performed under general anesthesia.

There is no evidence that routine use of a urinary catheter is necessary for either conventional or laparoscopic inguinal herniorrhaphy. Therefore, its use should be discouraged in favor of immediate voiding prior to operation. A history of a prostatectomy or previous urinary emptying problems is a relative indication for urinary catheterization.

Prazosin, phenoxybenzamine hydrochloride or tamsulosin may be effective in preventing urinary retention.

Evidence in Literature

The incidence of urinary retention following IH repair varies widely in published series ranging from less than 1% to greater than 20%[36,37]. The most common predisposing factor for postoperative urinary retention (POUR) after an IH repair is the use of general or regional anesthesia[38-42]. Most authorities feel that regional anesthesia (spinal or epidural) is worse than general. However, in a study pooling data from 70 nonrandomized and two randomized studies, the incidence of urinary retention with local anesthesia was 0.37% (33 in 8,991 patients), with regional anesthesia 2.42% (150 in 6,191 patients), and with general anesthesia 3% (344 in 11,471 patients). The need for general anesthesia for most laparoscopic IH repairs (LIH) almost certainly accounts for the higher incidence of POUR after LIH repair which has been reported to be as high as 22%[37]. Other factors which have been inconsistently incriminated for POUR, (i.e. some studies reporting statistically significant differences after LIH while others do not) include: over-hydration with intravenous fluid during surgery[37], bilateral hernia repairs[43], increased BMI[43], use of opioid analgesics[44], older age[44,45], prostatic symptoms[45] and prolonged operative time[43,45]. In a meta-analysis performed by Tam et al the incidence of POUR was found to be higher in patients with tack fixation presumably because of increased pain (3.1% vs >1.0%) but this difference did not reach statistical significance[46]. Other meta-analyses have not demonstrated a difference in urinary retention when comparing tack fixation with glue[47]. Meta-analyses of RCTs comparing various hernia techniques have not shown a difference in urinary retention rates among the various laparoscopic and open techniques[48,49]. Many surgeons routinely place urinary catheters for inguinal herniorrhaphy especially when done laparoscopically[43,45]. This seems to be more a surgical tradition, not an evidence-based practice. A year study looked at patients in two time periods, an earlier one when urinary catheters were used routinely and a later one when they were not. A marked improvement in urinary complications (cystitis, urinary retention and hematuria) occurred when the practice of routine urinary catheterization was abandoned[50]. One of the largest laparoscopic TAPP series also showed that the procedure can be safely conducted without the use of a urinary catheter[51]. Urinary retention can be treated by either intermittent catheterization or temporary placement of an indwelling urinary catheter. Prophylactic use of alpha-1 receptors
antagonists such as prazosin, phenoxybenzamine hydrochloride or tamsulosin have been shown in some studies to be an effective strategy to prevent postoperative urinary retention\textsuperscript{49–51}. Overall urinary function as measured by the American Urological Association Symptom Score is improved by hernia repair providing a Foley catheter was not used at the time of the index operation\textsuperscript{52}.

**Sexual dysfunction**

Sexual problems after hernia operations are probably under-reported, patients often being unwilling to discuss their sexual concerns. The heading “sexual dysfunction” includes several interacting factors, making the topic’s bounds difficult to delineate. For that reason, it is also difficult to measure the incidence of sexual dysfunction.

**Key Questions**

**KQ18.g** What defines “sexual dysfunction” after IH surgery?
**KQ18.h** What is the incidence of sexual dysfunction after IH surgery?
**KQ18.i** Are ischemic orchiditis causes known; and can this complication be prevented?
**KQ18.j** Does hernia repair with heavyweight mesh cause more testicular pain than hernia repair with lightweight mesh?
**KQ18.k** Are methods of repair or bilateral operation related to risks of impaired spermatogenesis and hormone production?
**KQ18.l** Can sexual dysfunction following hernia repair be treated surgically?

**Statements**

<table>
<thead>
<tr>
<th>Statement</th>
<th>The incidence of sexual dysfunction causing moderate-to-severe symptoms is around 5-7%. Impairment of testicular function and fertility occurs in less than 1%.</th>
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<tbody>
<tr>
<td></td>
<td>There is a risk of damage to the spermatic artery and/or vein causing testicular ischemia and orchitis when dissecting the spermatic cord in both open and laparoscopic techniques.</td>
</tr>
<tr>
<td></td>
<td>There is no significantly increased long-term risk of impaired spermatogenesis and hormone production related to methods of repair or bilateral surgical procedures.</td>
</tr>
<tr>
<td></td>
<td>Painful conditions interfering with sexual function can be improved by operative techniques used for treatment of neuropathic pain, release of the spermatic cord and mesh removal.</td>
</tr>
</tbody>
</table>

**Evidence in Literature and Discussion**
There is no generally accepted definition of sexual dysfunction after hernia operations. Publications can roughly be divided into those reporting on pain having a negative effect on sexual function such as neuropathic pain in the groin, pubalgia and orchialgia (discussed in Chapter 18 on pain, briefly mentioned in this text), those focusing on negative effects of hernia operations on fertility and testicular gonadal function and those evaluating complications having an influence on both symptoms and function, i.e. dysejaculation and ischemic orchitis.

Groin or genital pain interfering with sexual activity was assessed in two follow-up questionnaire studies from the Danish Hernia Database. In the first, consisting mainly of open repairs, 28% admitted to some pain while the second study of exclusively laparoscopic repairs reported 11% some pain\textsuperscript{53,54} with 2.8% of the mainly open and 2.4% of the laparoscopic group reporting that pain moderately to severely impaired their sexual activity.

The incidence of dysejaculation\textsuperscript{55} and felt to be caused by spermatic duct trauma and/or a mesh-related inflammatory reaction along the duct typically causing pain at the superficial inguinal ring) was 7.6% and 3.1% respectively\textsuperscript{56}.

Ischemic orchitis is caused by damage to the arterial and/or venous structures in the spermatic cord. An early clinical review suggested the condition was related to venous thrombosis caused by the operative trauma\textsuperscript{57}. In a subsequent study, when distal indirect sacs were left in situ and recurrent hernias were operated upon with preperitoneal technique, the risk of ischemic orchitis was reduced from 0.65% to 0.03% and from 2.25% to 0.97%, respectively\textsuperscript{58}. In most cases the acute condition subsides postoperatively, but may result in testicular atrophy\textsuperscript{59}. In atrophic testicles after ischemic orchitis seminiferous tubes are usually absent. Leydig cells producing testosterone and supporting Sertoli cells are, however, usually still present and have a normal appearance\textsuperscript{57}. In a meta-analysis of randomized studies of lightweight mesh vs heavyweight mesh, the incidence of testicular atrophy was reported as 0.8% irrespective of repair method\textsuperscript{60}.

Testicular function is related to testicular perfusion\textsuperscript{59}. Animal studies have shown considerable structural changes in the cord and testicle after hernia repair, more pronounced after the use of mesh\textsuperscript{59,61,62}. In clinical studies, mesh repairs have negative effects on testicular perfusion and testicular volume, and reduce testosterone levels and sperm motility during the early postoperative period\textsuperscript{59,63}. However, long-term follow-up has not shown statistically significant differences in testicular perfusion or spermatogenesis compared to preoperative values\textsuperscript{64,65}. Further studies are in progress\textsuperscript{66}.

Apart from above mentioned complications, infertility may be caused by operative injury to the vas deferens by division, ligation, clipping, stapling, electro cauterization and scarification. Damage to the vas is estimated to occur in 0.3% of adults and 0.8-2.0% of children\textsuperscript{67}. The inflammatory response to mesh can be so severe that vas obstruction results\textsuperscript{68}. One of the major arguments for the routine use of mesh in IH surgery however, is to preserve fertility. The theory is that by decreasing the generally accepted recurrence rate in the general population from 10% to 15% seen with Bassini and its variants to less than 5% with the mesh tension-free approach,
reoperative surgery, with its heavy toll of testicular loss, is avoided. The development of sperm antibodies as a result of extravasation of sperm from an injured duct is of particular concern because the argument is challenged that the patient is protected by the opposite testicle when a unilateral inguinal herniorrhaphy is done.

There was no increased risk of male infertility after bilateral hernia surgery with or without mesh when compared to the general population in a prospective questionnaire study within the Swedish Hernia Register. In a retrospective register study of bilateral hernia operations, a significantly higher incidence of infertility was found in a subgroup receiving mesh on both sides compared to sutured repairs. However, the risk was very low, and both studies concluded that there is no increased infertility risk after hernia repairs using mesh.

A recent publication on surgical treatment of chronic inguinodynia with tailored neurectomy, funicular release and/or mesh removal confirmed beneficial effects on dysejaculation with significant reduction of VAS scores in 20 patients from 55 to 21 (p<0.001). Sexual life normalized in two-thirds of the patients. Vasovasal anastomosis to correct infertility after hernia surgery is most often reported after hernia operations performed when the patient was a child. In adult patients with previous polypropylene mesh repairs and infertility caused by vasal obstruction, reconstruction and eventual fertility restoration is possible in only a minority of patients.

**Hematoma and perioperative vascular incidents**

The EHS guidelines on IH treatment in adults report a significantly lower incidence of hematoma formation occurs following endoscopic versus open repairs.

**Key Questions**

**KQ18.m** Is hematoma formation related to hernia repair method or mesh use?

**KQ18.n** Are intraoperative bleeding and postoperative hematoma formation related to a surgeon’s level of experience?

**Statements**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Hematoma incidence is reduced after endoscopic IH repair compared with open repair.</th>
<th>☐ ☐ ☐ ☐</th>
<th>Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Statement</td>
<td>There is inadequate medical evidence to link hematoma formation risk to a surgeon’s level of experience.</td>
<td>☐ ☐ ☐ ☐</td>
<td></td>
</tr>
</tbody>
</table>
Evidence in Literature

Nine reviews and meta-analyses (Table 1) have compared open with endoscopic IH procedures; however not all report on hematoma formation76–84.

Several of the studies that did investigate the incidence of hematoma formation report a reduction in hematoma incidence after endoscopic versus open hernia repair but do not cite exact differences76,77.

A 2003 meta-analysis, which included the mean incidence of hematoma formation from 33 trials (Table 1), reported a significantly lower incidence after endoscopic versus open techniques82. This difference was attributed mainly to the TEP procedure which is associated with significantly less hematoma formation than are open repairs. No significant difference in hematoma formation incidence was found when TAPP and open repairs were compared. When Shouldice versus endoscopic and Lichtenstein versus endoscopic repairs were compared, a significantly lower incidence of hematoma formation was seen after endoscopic repairs80–83.

Another meta-analysis which included 3,410 patients, compared Shouldice repair to open mesh repairs and to other open non-mesh repairs and reported no significant difference in the incidence of hematoma formation between Shouldice repairs versus either open mesh repair or non-mesh repair85.

A different meta-analysis compared open preperitoneal mesh repair with Lichtenstein repair and found no difference in hematoma incidence86.

Three other meta-analyses reported no difference in hematoma incidence amongst different types of open mesh repairs87–89.

One RCT and three cohort studies have examined the influence of the endoscopic IH repair learning curve on postoperative complications including hematoma formation20,90–92. The RCT compared endoscopically-operated patients with open-repair patients and investigated the effect of surgical residents’ postgraduate level. Besides a difference in the incidence of hernia recurrence, no difference was found in overall complication rate90.

A retrospective cohort study investigated the learning curve influence on morbidity in laparoscopic IH repair (TAPP)92. No inter-group morbidity differences were noted between those operated upon by young trainees under supervision and those operated upon by experienced surgeons92. However, it is possible that some hematomas were missed owing to the study’s retrospective design.

A prospective cohort study also investigated the impact of surgeons’ experience in TEP endoscopic hernia repair patients. Significantly more complications were noted in surgeons’ first 100 cases compared with those of more experienced surgeons91.

This finding is mirrored by another prospective cohort study that reported a significant decrease in postoperative complication rates with enhanced learning curve experience with the TEP.
procedure (see also chapter 22). However, a direct comparison of hematoma formation incidence was not made.

Discussion

The clinical relevance of hematoma formation following IH repair is unclear since there is no hematoma severity classification and hematoma-related interventions are usually not reported. Two cohort studies do report significant decreases in overall complications associated with progress along the TEP repair learning curve. However, this information is too indirect to allow conclusions about hematoma formation and surgeons’ level of experience. Additionally, other outcome measures must be weighed when considering which repair type to undertake.

Anticoagulants

Anticoagulants and platelet aggregation inhibitors lower the incidence of thromboembolic events perioperatively and postoperatively and may also affect the incidence of hematoma formation after open or endoscopic IH repair.

Key Question

KQ18.0 Which patients undergoing anticoagulant or antiplatelet therapy are at risk of significant hematoma formation following hernia repair?

Statement and recommendation

<table>
<thead>
<tr>
<th>Statement</th>
<th>Perioperative management of patients on anticoagulant or antiplatelet therapy should be governed by local or institutional protocol.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>Endoscopically a highly cautious approach should be taken when operating on patients undergoing anticoagulant or antiplatelet therapy even after bridging with LMWH. The development of local protocols is suggested to guide management of these patients.</td>
</tr>
</tbody>
</table>

Evidence in Literature

Eight studies have examined anticoagulated hernia repair patients, five RCTs and three retrospective cohort studies. Two of the RCTs were excluded from our analysis because their results did not directly answer the KQs posed above. One retrospective cohort study has investigated the influence of platelet aggregation inhibitors on the incidence of hematoma formation.

A 1981 study randomized otherwise healthy male adults undergoing open hernia repair to either prophylactic heparin (5,000U one hour before surgery and every 12 hours thereafter for 4 days) or placebo. One hematoma occurred in the 30 study patients. There were no thromboembolic
complications. The study authors concluded that there were no significant inter-group differences.

A 1986 study randomized unilateral hernia patients to either prophylactic heparin (5,000U heparin one hour before surgery and every 12 hours for four days) or placebo. All patients were discharged on postoperative day five and a variety of hernia repair techniques were employed. Significantly more hematomas were seen in the heparin group.

Another study involving the Bassini-Lotheisen repair, randomized to heparin at 5,000U two hours preoperatively and every eight hours for five days and placebo. Significantly more hematomas occurred in the heparin group. No thromboembolic complications occurred. The study authors concluded that heparin should be administered only to those with an increased thromboembolic risk. Notably, the heparin dose used was higher than that used in other comparable studies.

A 2000 retrospective study reviewed 465 patients undergoing Shouldice repair. Healthy patients did not receive anticoagulation. Prophylactic heparin was given to those with risk factors for thromboembolism or for a longer operation. A higher incidence of hematoma formation and surgical re-intervention was seen in the heparin group.

A case-matched retrospective cohort study from 2008 examined patients who developed hematomas after open IH repair and reported warfarin use as the only significant predictor of postoperative bleeding.

Another 2008 study, done retrospectively, compared patients on warfarin with INRs in the 2 to 3 range with those in the 3 to 4 range and reported that an INR of 3 to 4 was associated with an increased risk of postoperative hematoma formation (p=0.03). The study authors concluded that IH repair can safely be done in patients on warfarin with an INR < 3.

A 2014 retrospective review of 1,839 patients, including 40 who continued warfarin perioperatively, reported no significant difference in hematoma formation between these patients and those who had discontinued warfarin or a case-matched control group.

One 2011 study investigated clopidogrel effects in 46 patients undergoing open or endoscopic hernia repair. Patients were divided into those who had received clopidogrel < 7 days before operation and those who had received clopidogrel ≥ 7 days before operation. No significant differences in bleeding complications were reported.

Discussion
Most anticoagulant-related studies on hernia patients are dated and were performed before day surgery was common and during an era when patients spent several days postoperatively in hospital. Also, patient activity levels between those admitted and those discharged are unclear. Stasis is a known risk factor for thromboembolic complications and patient mobilization levels are poorly described in most studies. Additionally, operative techniques have changed over time. Therefore, the available study results generally do not apply to the patient groups of interest in the modern era.
Seroma
Seroma assessment in IH repair studies is hampered by the lack of standardized definitions for this condition\(^{103}\). No trials include seroma as a primary outcome. If studies are planned that include seroma formation, it is our groups’ opinion that only symptomatic seromas should be considered a postoperative complication.

Key Questions

KQ18.p What are the risk factors for postoperative seroma formation?

KQ18.q Is there an association between open anterior repair method and postoperative seroma formation?

KQ18.r Do certain endoscopic or open preperitoneal techniques increase the risk of postoperative seroma formation?

KQ18.s Can the risk of postoperative seroma formation be reduced surgically?

KQ18.t Does drain usage reduce the risk of postoperative seroma formation?

KQ18.u Is there an association between hernia sac treatment modality and seroma/hematoma formation?

KQ18.v Does the use of abdominal binders or comparable wound compression devices prevent seroma/hematoma formation?

Statements

<table>
<thead>
<tr>
<th>Statement</th>
<th>The risk factors for postoperative seroma formation include: scrotal hernia, coagulopathy and congestive liver failure.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evidence in Literature</td>
<td>The reported incidence of seroma formation after IH repair varies between 0.5 and 12.2%. Seroma formation risk factors are: coagulopathy, congestive liver diseases and cardiac insufficiency(^{103,104}). Several meta-analyses report that seroma formation incidence is significantly higher following endoscopic and laparoscopic (TAPP/TEP) versus open hernia repair(^{82–84,105}). A 2013 RCT confirmed this finding; although its clinical relevance is uncertain. Another meta-analysis of mesh versus non-mesh open techniques across 13 RCTs found no significant difference in seroma formation incidence(^{106}). Neither did a meta-analysis of 8 RCTs with 2,919 patients comparing Lichtenstein with mesh-plug repair(^{89}). Another study found that seromas were the most frequent complication after TAPP repair of scrotal hernias(^{107}). An RCT</td>
</tr>
</tbody>
</table>
comparing TAPP repair with titanized lightweight mesh versus TAPP repair with heavyweight mesh found significantly fewer seromas in the lightweight group\textsuperscript{108}. Two recent RCTs reported significantly more seromas following TEP versus TAPP repair\textsuperscript{109,110}.

Two studies found that seroma and hematoma formation incidence is lessened after TAPP and TEP repair of large direct defects by inverting the lax fascia transversalis and closing the defect\textsuperscript{111,112}. A recent meta-analysis of laparoscopic IH repair comparing mesh fixation with tissue glue versus tack fixation reported no difference in seroma formation\textsuperscript{113}. Another meta-analysis found a lower seroma incidence after glue mesh fixation compared with suture mesh fixation in open IH repair\textsuperscript{47}.

Two studies found that drain insertion may prevent seroma formation especially in complicated and large scrotal hernias\textsuperscript{114,115}. Two other studies demonstrated that drain insertion after TEP repair may also reduce the incidence of seroma formation\textsuperscript{116,117}.

Most seroma resolve spontaneously over six to eight weeks. Since infections following seroma aspiration are regularly described, it is our groups’ firm opinion that only symptomatic seromas be treated.

Studies of drain usage to prevent seroma formation provide conflicting results. One study of 100 patients found no benefit following open repair. However, another study involving 301 patients found fewer seromas after a 24-hour drainage period\textsuperscript{105,114}.

Since clinically significant seroma formation following IH repair is uncommon, our group recommends against routine drain insertion after primary uncomplicated repair.

There is no evidence that binders and other compression devices prevent hematoma and seroma formation.

**Infrequent complications**

**Key Questions**

**KQ18.w** How common are serious complications during hernia surgery?

**KQ18.x** Are serious complications more common during endoscopic hernia surgery in patients with a history of previous abdominal surgery?

**KQ18.y** Is mesh migration—with the attendant risk of pain and severe complications—related to: mesh type, mesh shape, repair method, wound infection, or hernia type?

**Statements**

<table>
<thead>
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<th>Statement</th>
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<tbody>
<tr>
<td>Serious complications—bowel, bladder and vascular injuries—rarely occur during hernia surgery although they are more common during laparo-endoscopic versus open hernia repair.</td>
</tr>
</tbody>
</table>
Patients with a history of lower abdominal surgery have an increased risk of visceral damage during laparo-endoscopic hernia repair.

Evidence in Literature

One meta-analysis comparing endoscopic to Lichtenstein and other open mesh techniques reported 13 incidents in 3,640 operations (0.4%) of potentially serious operative complications (defined as bowel, bladder and vascular injuries)\(^83\).

Another meta-analysis comparing endoscopic to Shouldice and other non-mesh techniques reported 4 incidents in 5,900 operations (0.1%) of potentially serious operative complications\(^84\).

A systematic review and meta-analysis of TEP versus Lichtenstein reported no inter-group differences in severe adverse events from the patient’s perspective although 1,068 events—including chronic pain and recurrences—occurred in 5,397 patients. We calculated that, were chronic pain and recurrences excluded, 78 (1.4%) severe events occurred\(^76\).

In one study, infrequent serious intraoperative complications were reported to occur more frequently in endoscopic versus IH surgeries although there was no overall morbidity difference\(^83\).

A Cochrane review of laparoscopic versus open techniques found that operative complications were uncommon, but more frequent, in the laparoscopic group\(^82\). Another Cochrane review found an increased incidence of operative complications with the TAPP over the TEP approach\(^118\). The principle reported serious events were bowel perforation, urinary bladder damage and vascular injuries\(^82\)–\(^84\),\(^118\).

First trocar introduction during hernia operations has the potential to cause bowel and vascular injury. A variety of techniques including: use of blunt-tipped trocars, optical access trocars and needlescopic 3-5 mm instruments have been studied, and are shown to reduce complications and improve safety\(^119\)–\(^121\).

One study has shown that patients with a history of lower abdominal surgery are at increased risk for visceral injury during laparoscopic hernia operation\(^122\).

Vascular injuries at dissection and mesh fixation or suturing in the preperitoneal space typically involve the epigastric vessels or the aberrant obturator vessels crossing the Cooper ligament, the so-called *corona mortis*\(^123\).

Subcutaneous carbon dioxide emphysema can occur during TEP repair. This rare but serious condition affects the respiratory and/or cardiovascular system\(^124\),\(^125\).

Infrequent serious late complications related to mesh, mesh fixation, port-site hernia formation, and intra-abdominal adhesions have all been reported\(^12\),\(^118\),\(^126\),\(^127\).
Port-site hernias occur mostly after TAPP operations with a frequency of 0% to 3.7% according to a Cochrane review and up to 8% after TAPP operations of recurrences after previous preperitoneal—mainly TAPP—repairs of primary hernias. Closure of port sites ≥ one cm is recommended.

The risk of intestinal obstruction after hernia surgery was calculated in a study based on data from the Swedish Hernia Register. Ninety patients—representing 0.3% of 33,275 operations on primary hernias—had intestinal obstruction considered to be related to the hernia operation. TAPP was the only operative technique associated with an increased relative risk of obstruction.

Mesh complications (see chapter 10 on meshes)—excluding pain and problems related to the mesh itself or its fixation—are rare and can take years to develop. These generally are not mentioned in RCTs and only occasionally in meta-analyses. Clinical observations of these complications are most often published as case reports. Late mesh-related complications are associated most often with polypropylene meshes. Sometimes deep infections, including abscesses, develop around mesh. Erosion into hollow organs including the bowel or bladder and ingrowth and obstruction of the spermatic duct has been reported. Mesh migration into the abdominal cavity, the bowel or bladder, or into the scrotum and mainly associated with mesh plugs in open techniques and preperitoneal meshes placed laparoscopically. Mesh exposed to the abdominal cavity through peritoneal defects (e.g. after hernia sac resections and peritoneal tears) may cause bowel adhesions resulting in bowel obstruction. Adhesions and obstruction caused by tacks has been reported.

In a register study of postoperative complications and recurrence risks spanning 150,514 operations, those with complications such as hematoma and severe pain documented in the medical record at 30-day follow-up had a significantly increased relative risk (RR 1.23 and RR 1.84, respectively) of reoperation for recurrent hernia.

Discussion

Serious complications related to hernia operations are rare. When they do occur, their details and descriptions are often published as secondary outcomes. Reviews of complications are often based on collections of individual cases in RCTs, retrospective follow-up cohorts and case reports. Prospective registration of specific complications in a national registry is difficult, hampered by practical limitations on reporting of details and by compliance issues when reported. Secondary outcomes are frequently ill defined making comparisons difficult and potentially unreliable. These confounders should be considered when interpreting reviews on severe and/or rare complications.

Mortality
The mortality rate associated with elective hernia surgery is no higher than the mortality rate in the general population when compared to Cause-of-Death registers calculating expected deaths considering age and gender of the population, and often somewhat lower given patient selection criteria for operation\textsuperscript{135}, with high risk patients being excluded from elective hernia repairs. This is not the case for emergent hernia repair. It is important to know the risk factors for incarceration and strangulation and patient characteristics such as medical history, age and physical condition that place patients at increased risk of death.

**Key Question**

**KQ18.z** What is the 30-day mortality rate following groin hernia repair? What are the causes of this mortality?

**Statements**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Death in the 30 days following inguinal hernia repair is very rare and mainly associated with emergent repair.</th>
<th>☒ ☒ ☒ ☒</th>
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<tbody>
<tr>
<td>Statement</td>
<td>Femoral hernias are associated with an increased likelihood of emergent repair.</td>
<td>☒ ☒ ☒ ☒</td>
</tr>
<tr>
<td>Statement</td>
<td>Mortality in the 30 days following elective hernia repair is mainly related to medical comorbidities.</td>
<td>☒ ☒ ☒ ☒</td>
</tr>
</tbody>
</table>

**Evidence in Literature**

A 2011 systematic review summarized mortality rates following elective and emergent IH repairs. The review encompassed 85,585 operations reported in 14 publications over a 50-year period. The average reported mortality was 0.5% (range 0 to 2%) representing 470 patients\textsuperscript{136}.

An average mortality rate of 5.8% was found for emergent IH repair. Of 7,404 emergent hernia operations reported in 18 publications during the same study period, 22% were performed for femoral hernias and bowel resections were done in 14% of the emergent hernia operations. Factors associated with a statistically significant increase in morbidity and mortality included: age over 49 years, delayed presentation to hospital, presence of a femoral hernia, nonviable bowel, and ASA class above two\textsuperscript{136}.

The INCA Trialists’ Collaboration published a meta-analysis in 2011 on which approach—operation or observation—would be best for asymptomatic or mildly symptomatic male IH patients. A literature review and a Markov model of relevant parameters like mortality associated with elective or emergent hernia repair was incorporated into the meta-analysis. The mortality associated with elective IH was 0.2% (596 of 242,207 patients). The mortality associated with emergent IH repair (excluding femoral hernias) was 4% (715 of 18,092 patients)\textsuperscript{137}. 
A 1996 study analyzed data from 30,675 IH operations performed on patients of all ages, during the period 1976 to 1986 in a geographically defined population. The study included data on the nine percent of patients who underwent an emergent operation. Of note, emergent operations were much more common in patients over 50 years of age. On average, emergent operation patients were older than elective operation patients and had a significantly greater postoperative mortality rate. No deaths were reported in day surgery patients\textsuperscript{138}.

Another study on elective hernia repair in the elderly found a tenfold increase in mortality for nonagenarians versus octogenarians (3\% versus 0.3\%, respectively)\textsuperscript{139}.

A Scottish audit of mortality following hernia surgery reported 91 fatalities (18 elective) in 28,760 inguinal and femoral hernia operations on a surgical ward or within 30 days of surgery during the period 1994 to 1997. Mortality was 0.8\% following IH repair, and 3.1\% following femoral hernia repair. Cardiopulmonary and neurological diseases were the principle comorbidities in the patient population\textsuperscript{140}.

A cost-utility analysis of treatment options for IH done at Massachusetts General Hospital and Harvard Medical School analyzed data from over 1.5 million adult patients. Data from national databases and 51 RCTs were analyzed. A mathematical model derived from the data predicted that surgical mortality increased 8.7\% per one year age increase. As an example, the calculated mortality risk for a 25 year-old male operated on for primary IH was 0.0065\% and was postulated to be 125 times higher (0.81\%) for a 65 year-old male undergoing operation for a recurrent IH with obstruction. These calculations were found to be in agreement with outcomes seen in national hernia registries\textsuperscript{141}.

From 1992 to 2005, data on 107,838 groin hernias were entered in the Swedish Hernia Register\textsuperscript{32}. Five thousand two hundred and eighty of 104,911 (5.1\%) IHs were treated emergently compared with 1,068 of 2,927 (36.5\%) femoral hernias. Twenty-two percent of the operations in women were for femoral hernia versus 1\% in men. In both men and women, operation for femoral hernia (including emergent operation) was associated with a seven-fold mortality increase. Mortality for elective hernia repair was not higher than the background mortality recorded in the national Cause-of-Death register, but increased seven-fold after emergent operations and 20-fold with bowel resection. Seventeen percent of women and 5.1\% of men underwent emergent surgery. The overall standardized mortality ratio (observed/expected death in the population) within 30 days following hernia repair was 1.4 in men and 4.2 in women. In elective surgery this ratio was lower, 0.67 and 0.85 respectively. Cardiovascular disease accounted for 59\% of the observed mortality in elective cases\textsuperscript{32}.

Another Swedish Hernia Register study looked at 3,980 patients operated on for femoral hernia. Women were at increased risk for emergent operation, 40.6\% versus 28.1\% in men. Emergent femoral hernia operation was associated with a ten-fold increase in mortality. The mortality risk of elective femoral hernia operation did not exceed that of the general population\textsuperscript{22}.
A registry study of patients who died within 30 days of surgery examined causes of treatment delay and death\textsuperscript{135}. In 37\% of patients with signs of bowel obstruction, documentation was missing on physical examination of the groin. These patients had an increased time-to-surgery when compared with patients with a palpable lump. Women and those with femoral hernias were significantly less likely to have a groin examination done.

A cohort study from the Danish Hernia Database of 29,033 elective groin hernia repairs analyzed: 30-day postoperative morbidity, prolonged length of stay, and death. Morbidity increased with age. Regional anesthesia was associated with an increased risk of complications. Thirty-day mortality following elective hernia repair was 0.12\%\textsuperscript{142}. Another Danish multicenter study of 57,709 day surgery procedures reported no day-surgery-related deaths\textsuperscript{143}.

**Discussion**

Mortality risk calculations and cause-of-death analyses require large data sets. Prospective registration of operations facilitates these calculations and reduces selection bias thereby making the results more representative of the overall hernia surgery population. National registers are useful when calculating mortality risks since the results can be verified and compared with national Cause-of-Death registers.

Emergent hernia surgery is associated with considerably increased mortality. Symptom duration before diagnosis and treatment delays are factors that contribute to this increased mortality.

In elective hernia repair, medical comorbidities are the primary contributor to cause of death and must be considered when planning operations, especially in the elderly.

**Chapter 19  Pain – Prevention and Treatment**

A. Wijsmuller, D. Chen, L. Liem, M. Loos, W. Reinpold and S. Smedberg

**Pain prevention**

*Definition of chronic postoperative inguinal pain (CPIP)*

Chronic pain is a frequent long-term complication following nearly all surgical procedures. However, there are no consensus definitions of exactly what constitutes chronic pain after specific operations. With IH repair, pain patterns may differ depending on structures and organs involved and the type of repair performed. While certain predisposing neuroanatomic and technical factors can be avoided, chronic postoperative inguinal pain (CPIP) remains a complex challenge with several psychological, social, genetic and behavioral influences.

**Key Questions**

**KQ19P.a** How is chronic pain defined? What is its prevalence after IH repair?
Statement and Recommendation

<table>
<thead>
<tr>
<th>Statement</th>
<th>Ten to 12% of inguinal hernia repair patients experience at least a level of moderate pain that impacts daily activities.</th>
</tr>
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<tbody>
<tr>
<td>Recommendation</td>
<td>Chronic pain should be defined as ≥ bothersome moderate pain impacting daily activities lasting ≥ three months postoperatively.</td>
</tr>
</tbody>
</table>

Key Question

KQ19P.b What are the risk factors for CPIP?

Statement

<table>
<thead>
<tr>
<th>Statement</th>
<th>CPIP risk factors include: young age, female gender, high preoperative pain, early high postoperative pain, recurrent hernia and open hernia repair.</th>
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</thead>
</table>

Evidence in Literature

Definition of chronic pain

In 1986 the International Association for the Study of Pain defined chronic pain as pain lasting more than three months. This definition was considered valid in epidemiological studies and was used in randomized studies on hernia surgery, even if pain related to surgery was not part of the objectives when the definition was formulated.

However, with mesh hernia repairs, the inflammatory healing process may last longer than this defined 3-month interval due to tissue reaction to the mesh. Therefore, some systematic review authors have used pain lasting six months or more as a criterion for inclusion in their reviews.

In spite of these varied interpretations of chronic pain, we recommend that the widely-accepted ≥ three-month time period be used to define CPIP. We also recommend that the definition of CPIP include a level of discomfort rated by the patient as ≥ moderate and impacting daily activities.

Prevalence of chronic pain

As noted in various guidelines, CPIP incidences vary from 0.7 to >75%. The reported incidence of pain varies greatly due in part to the pain definition used in the guideline.

One RCT looking at Kugel versus Lichtenstein repair, considered any visual analog score (VAS) of pain > 0 at three months to be chronic pain, and reported incidences of 20.7% and 40.5% respectively. Another prospective follow-up study of hernia repairs performed during 1992-93 (pre-mesh) used different definitions. Mild pain was defined as occasional pain/discomfort, not limiting activity, with return to pre-hernia lifestyle. Moderate pain was defined as pain preventing
return to preoperative activities. Severe pain was defined as pain incapacitating the patient frequently or interfering with daily activities.\textsuperscript{149}

Follow-up data in this study and reporting on any groin/inguinal pain within the last month, found a 62.9\% incidence at one year and a 53.6\% incidence at two years. The incidence of moderate-to-severe pain was 11.9\% at one year and 10.6\% at two years.

A Danish Hernia Database one-year questionnaire follow-up study found that 28.7\% of patients reported hernia-area pain in the last month, 11\% reported work- or leisure-activity impairment, and 4.5\% had received medical treatment for pain.\textsuperscript{150}

Follow-up interval is an important metric since pain tends to decrease over time. In the same Danish Hernia Database group, those with pain after one year were followed up after six years. After six years, less pain was reported by 75.8\% of patients, the same pain by 16.7\% and increased pain by 7.5\%.\textsuperscript{53}

In a meta-analysis of open preperitoneal versus Lichtenstein repair, chronic postoperative pain of greater than 6 months duration was found in 7.1\% and 12.3\% respectively.\textsuperscript{86} In another meta-analysis of TEP versus Lichtenstein, chronic postoperative pain of greater than 3 months duration was reported in 12.5\% and 16.8\% respectively.\textsuperscript{76}

Meta-analyses and guidelines on surgical technique find that chronic pain occurs less frequently after endoscopic versus open procedures.\textsuperscript{83,84} Mesh use reduces the risk of chronic pain and surgical “fine tuning” on mesh choice and fixation method (or no fixation) may help to decrease its incidence (see chapters 12 & 13).

Overall, the incidence of clinically significant CPIP is in the 10 to 12\% range.\textsuperscript{147,151} Debilitating CPIP affecting normal daily activities or work ranges from 0.5 to 6\%.\textsuperscript{147}

Systematic reviews published within the last decade have generally found similar predictors for CPIP development.\textsuperscript{104,146,151,152} The International Endohermia Society guidelines summarized from the literature: young age, female gender, preoperative pain level and postoperative pain intensity as risk factors for chronic postoperative pain.\textsuperscript{104} One author has summarized risk factors for post-herniorrhaphy inguinal pain (Table).\textsuperscript{152}

**Table** Risk factors for chronic post-herniorrhaphy inguinal pain

<table>
<thead>
<tr>
<th>Preoperative:</th>
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<tbody>
<tr>
<td>Young age, female gender, high pain intensity level (inguinal/elsewhere), lower preoperative optimism, impairment of everyday activities, operation for a recurrent hernia, genetic predisposition (DQB1*03:02 HLA haplotype).</td>
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</tbody>
</table>

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<tr>
<th>Experimentally-induced pain:</th>
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<tr>
<td>High pain intensity to tonic heat stimulation can identify patients at risk for chronic pain.</td>
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</table>

<table>
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<tr>
<th>Perioperative:</th>
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<tbody>
<tr>
<td>Less experienced surgeon/not dedicated hernia center, open repair technique, mesh type:</td>
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</table>
heavyweight, mesh fixation: suture, staple, ilio-inguinal nerve neurolysis in Lichtenstein repair.

**Postoperative:**
Postoperative complications (hematoma, infection), high early postoperative pain intensity, lower perceived control over pain, sensory dysfunction in the groin.

Population-based studies from the Swedish Hernia Register on long-term pain after hernia repair are in accord with the systematic reviews cited above. Pain interfering with daily activity occurred in 98 of 2,421 (6%) patients followed one to six years after the operation. Pain risk factors included: age below median, female gender, direct hernia, open technique, postoperative complications noted in patient files at 30 day review, recurrent hernia repair, and chronic pain of other origin in the three years prior to operation. Similar results were found in another register study of 2,456 patients followed for two to three years.

Another author, in a more holistic review, confirmed the same risk factors and added the significance of mental state, anxiety and patient expectations.

A prospective cohort study investigated psychological models for prediction of chronic postoperative pain after hernia surgery. These models are useful for predicting acute pain and in non-surgical contexts, for predicting transition from acute to chronic pain. A finding of higher pain intensity one-week postoperatively predicted higher pain intensity at four months. Lower preoperative optimism was an independent risk factor for chronic pain occurrence.

A systematic review of predictive experimental pain studies of quantitative sensory testing investigated mechanical, thermal and electrical stimuli. The review found that preoperative pain tests may predict 4 to 54% of the variance in postoperative pain occurrence. However, the review concluded that there is no simple reliable prognostic assessment method for postoperative pain.

**Discussion**

A consensus on the definition of CPIP does not exist, although a time threshold has been suggested. Most IH literature uses a three-month duration to define chronic pain. As discussed, for mesh-based repairs, a six-month time frame may be more appropriate.

In a similar manner, discomfort severity that seems clinically meaningful has been set at a level of “bothersome moderate pain impacting daily activities.” Using this cut-off, roughly 10 to 12% of patients experience this chronically after IH surgery.

Pain etiology does not enter into the definition of pain itself. However, etiology, treatment, prognosis and, above all, prevention, is of utmost importance for the research into pain following IH surgery.

**Inguinal nerve anatomy**

**Introduction**
CPIP is thought to be primarily of a neuropathic origin. Therefore, knowledge of the most common inguinal nerve distribution patterns and variants is paramount in its prevention and treatment.

Key Question

KQ19P.c What is the most common inguinal nerve distribution pattern and how common is it?

No Statement

Evidence in Literature

Several anatomic studies have been performed to elucidate the course of one or more of the inguinal nerves\textsuperscript{157–170}. Anesthesiology-based studies have been done to improve nerve block success\textsuperscript{157–159}. Surgical anatomical studies have been done in the hopes of preventing nerve injury during different approaches in this area\textsuperscript{157,160–168}. These anesthesiology-based and surgical anatomical studies report data on retroperitoneal and/or anterior nerve distribution patterns.

This section focuses on the most common course of the ilioinguinal (IIN), iliohypogastric (IHN), and the genitofemoral (GFN) nerves retroperitoneally over the quadratus lumborum and psoas muscles and anteriorly after they pierce the transverse abdominal muscle (TAM) and enter into the inguinal canal.

Pooled results of anatomical studies indicate that the IHN was present in 864 of 879 inguinal dissections (98%, range 60 to 100%)\textsuperscript{157,159–166,168}. The IIN was present in 1217 of 1443 dissections (84%, range 56 to 100%)\textsuperscript{157–169}. The genital branch (GB) of the GFN was present in 256 of 258 dissections (99%)\textsuperscript{160,165,166,170} (see Table 1).

In 68% (578 of 844) of dissections, the IIN and IHN emerged separately lateral to the psoas muscle instead of emerging as a single trunk\textsuperscript{157–161,163,168}. (see Table 2) Thereafter the IHN runs anteriorly over the quadratus lumborum muscle to pierce the TAM usually just cranial to the iliac crest, and runs shortly between the TAM and the internal oblique muscle (IOM) to pierce the IOM and run dorsally to the external oblique muscle (EOM). The IIN does the same, except that in most cases a part of its course is caudal to the iliac crest, anterior to the iliac muscle\textsuperscript{160}.

The GFN emerges through the psoas muscle as a single branch in the majority of patients (58%) and divides into femoral and genital branches anterior to the psoas muscle\textsuperscript{165}.

In most patients, the IHN innervates the hypogastric region, after a course just cranial to the spermatic cord. Cutaneous innervation of the medial thigh, pubic and scrotal/labial area and inguinal crease is provided jointly by the IIN and GB. The same applies to the motor innervation of the cremasteric muscle. When present, the IIN usually runs anteriorly and parallel to the spermatic cord. The course of the genital branch is usually laterocaudal at the level of the internal inguinal ring\textsuperscript{166}.

The dorsal nerve branch of the pudendal nerve which originates from S2 to S4, innervates the posterior scrotum/labia\textsuperscript{162}. Data from a chronic pain patient series in which treatment consisted of triple neurectomy—that was extended to nerve tissue surrounding the vas deferens in some
patients—suggest that the testicles are viscerally innervated by autonomic nerve fibers located with the lamina propria of the vas deferens originating from the deep pelvis plexus and referred to as paravasal nerves \(^{171,172}\).

Variations in the distribution pattern of inguinal nerves exist on several levels in the course of each nerve. Because of this logarithmic increase in different types of distribution patterns, a classic distribution pattern and its incidence cannot be determined.

**Key Question**

**KQ19P.d** What are the most common variations in anterior inguinal nerve distribution patterns?

**No Statement**

**Evidence in Literature**

Common variations in inguinal nerve distribution patterns include a proximal common trunk for the IHN and IIN, an emergence of the GFN through the psoas muscle as two separate branches and variation in cutaneous innervation by the IIN and GB of the medial thigh, pubic and scrotal/labial area and inguinal crease.

In 266 of 844 dissections (32%, range 9-50 %) there is a single trunk for the IHN and IIN emerging laterally from behind the psoas muscle after which it usually divides somewhere after passing the quadratus lumbarum muscle before piercing the IOM\(^{157-161,163,168}\) (table 2). Notably in one study, in 44 of 256 dissections (17%) with a common IHN/IIN trunk, the trunk divided beyond the anterior superior iliac spine (ASIS). In a subgroup, this trunk would divide after perforating through the aponeurosis of the EOM\(^{168}\). This pattern may have been misinterpreted in other studies as an absent IIN, leading to an underestimation of the IIN’s true prevalence. One study describes that the GFN emerges through the psoas muscle as separate femoral and genital branches in 27 of 64 dissections (42%)\(^{165}\).

Several studies describe a variation with an absent IIN (range 7 to 44%)\(^{158,165-167}\). In this case, sensory innervation of the medial thigh, pubic and scrotal area and inguinal crease is mostly provided by the GB\(^{158,165-167}\). A high-quality anatomic study suggests that in these cases the sensory component of the IIN follows the course of the GB after interconnections between the IIN and GB proximally at the height of the internal ring or at the lumbar level\(^{165}\).

Interconnections between all inguinal nerves have been described. Some studies note the absence of cutaneous innervation by the GB\(^{165}\). One study found the GB in all dissections, but in 18 of 64 of those dissections (28%) it did not contain sensory fibers for cutaneous innervation\(^{165}\).

**Nerve management during open inguinal hernia repair**

**Introduction**

Surgeons can either recognize or ignore the courses of the inguinal nerves during open IH repair. The IHN and IIN can be seen directly. The GB, running adjacent to the cremasteric vessels in the majority of cases, can be indirectly determined by the course of those vessels.
Key Question

KQ19P.e Does a “nerve-recognition” approach reduce the incidence of acute and chronic pain following open inguinal hernia repair?

Recommendation

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Nerve anatomy awareness and recognition during surgery is recommended to reduce the incidence of chronic post-herniorrhaphy pain.</th>
<th>Strong</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>*upgrade</td>
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</tbody>
</table>

Evidence in Literature

A literature search was done for studies comparing only nerve-recognizing (N-R) with nerve-ignoring (N-I) approaches. Several studies that lacked a group in which nerves were ignored were excluded. One review was found that included data from two cohort studies investigating the influence of a N-R versus N-I approach.

A high-quality prospective multicentre cohort study compared the influence of preservation versus division of the IIN, IHN and GB during open mesh herniorrhaphy. At six months postoperatively, the incidence of moderate-to-severe pain was 4.7% in 189 N-I (no nerves identified) patients and 0% in 310 patients in whom all nerves were identified and preserved (p=0.02).

An older study compared chronic pain in N-I versus N-R McVay-repair patients. A four-point scale was used for symptom reporting (1 = no pain, 2 = minor, 3 = major, 4 = persistent or disabling) with a follow-up of > five years. Symptoms graded as 3 or 4 occurred in 3.7% of 297 N-I patients and 1.6% of 614 patients in whom all nerves were identified (p<0.001).

The conclusion from both studies was that N-R (all three nerves) results in a significantly lower incidence of chronic pain.

Discussion

Both cited studies were observational and therefore “low” grade. Additionally, in the McVay-repair study, only one surgeon performed all operations possibly resulting in a systematic bias and therefore a “very low” grade. The multicenter center study quality was “high.” Overall, the evidence quality on the subject is “low.”

The GRADE system also assesses benefit-to-harm ratio. An N-R approach presumably improves operative outcomes by avoiding iatrogenic nerve injury, suture entrapment of nerves and mesh-stimulated scarring with resultant nerve damage. Chronic pain leads to disability, repeated clinical encounters, consultations with anesthesiologists and other specialists, additional imaging studies, and extra costs in various ways. Although there is only a “low” level of medical evidence to support it, a strong recommendation for an N-R/nerve preservation approach seems justified since this is associated with less chronic pain. To be clear, N-R/preservation in this context does...
NOT involve formal surgical dissection and identification, but rather simple recognition of nerves and their course as they are encountered.

**Prophylactic nerve resection**

**Introduction**

Medical literature describes different nerve handling techniques: nerve preservation, prophylactic neurectomy (resection, removal of a segment of the nerve along the inguinal canal), and pragmatic neurectomy (in cases of nerve injury or if mesh/nerve interference occurs). A search was conducted for studies investigating the influence of prophylactic inguinal neurectomy on chronic pain. A separate search was conducted for studies involving the IIN, the IHN and the GB of the GFN.

**Key Questions**

KQ19P.f Does prophylactic IIN resection reduce pain incidence?

KQ19P.g Does prophylactic IHN resection reduce pain incidence?

KQ19P.h Does prophylactic resection of the GB of the GFN reduce pain incidence?

**Recommendations**

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>During open surgery, planned prophylactic IIN resection is not suggested since it does not reduce chronic pain incidence and it increases the incidence of postoperative sensory loss.</th>
<th>☐ ☐ ☐ ☐ weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>A planned prophylactic IHN resection is not suggested.</td>
<td>☐ ☐ ☐ ☐ weak</td>
</tr>
<tr>
<td>Recommendation</td>
<td>There is no evidence on the subject of planned neurectomy of the GB of the GFN.</td>
<td>☐ ☐ ☐ ☐ weak</td>
</tr>
</tbody>
</table>

**Ilioinguinal nerve**

**Evidence in Literature**

Three meta-analyses and seven RCTs have investigated the influence of IIN resection during open IH mesh repair. Studies investigating a pragmatic approach to perioperative inguinal nerve handling were excluded since they did not compare a group in which the IIN was prophylactically neurectomized with a group in which it was preserved.

A 2012 meta-analysis covers all prior RCTs except two. One of these two was published after the 2012 meta-analysis. We have excluded it from our discussion.
due to a systematic bias resulting from inadequate study design. The other was also excluded from the meta-analysis and from our discussion because of selection bias\textsuperscript{185}. This meta-analysis reported no intergroup differences in chronic pain scores and numbness at six and 12 months postoperatively\textsuperscript{180}. However, increased sensory loss was reported at six and 12 months postoperatively following IIN resection.

These chronic pain outcomes were confirmed by another 2007 meta-analysis\textsuperscript{177} (MA-07). A 2011 meta-analysis (MA-11) of fewer studies than reference MA-12 reported a lower chronic pain incidence after IIN resection on the basis of fewer studies than were analysed by reference MA-11\textsuperscript{181}. References MA-12 and MA-11 reported a moderate-to-high degree of heterogeneity with respect to chronic pain as an outcome measure and questioned the suitability of pooling results. This heterogeneity is present in several RCTs on the subject as well.

**Discussion**

The data from the meta-analyses were graded as moderate since the included RCTs are moderately to highly heterogeneous. Evidence from several of the RCTs was also graded as moderate due to high loss-to-follow-up rates\textsuperscript{182}, small sample size\textsuperscript{188}, and possible selection bias\textsuperscript{183}.

The GRADE system also assesses the benefit-to-harm ratio and treatment effect magnitude. Clear benefits of prophylactic IIN division/resection have not been reported. Possible harm might result from a higher rate of sensory loss but the clinical consequence of this loss is unclear. Therefore the treatment effect magnitude is low, leaving us unable to make a strong recommendation. Finally, since study follow-up durations are 12 months maximum and delayed long-term painful conditions may occur following neurectomy (i.e. neuroma, deafferentation hypersensitivity), some of these adverse outcomes may have been missed in presently available series.

**Iliohypogastric nerve**

**Evidence in Literature**

Two RCTs\textsuperscript{184,191} and three cohort studies\textsuperscript{174,192,193}—but no reviews—were found comparing IHN neurectomy with IHN preservation.

One RCT\textsuperscript{191} and one cohort study\textsuperscript{193} were eliminated from this critical appraisal, the RCT because of systematic bias due to comparison of two adjustments of the surgical technique. The cohort study was eliminated because of imprecision due to small sample size and possible selection bias.

Another RCT compared chronic pain incidence after tension-free self-gripping mesh repair with sutured Lichtenstein repair and recorded the type of nerve management\textsuperscript{174}. It too was omitted from our critical appraisal since it did not report on the incidence of chronic pain after pure prophylactic IHN. Therefore, we deemed the evidence to justify prophylactic IHN neurectomy too indirect.

One RCT\textsuperscript{184} and one cohort study\textsuperscript{192} were critically appraised. Both reported no significant differences in the incidence of chronic pain or sensory loss one year postoperatively.
Discussion

Although the included RCT was well conducted, only one study of its type exists. Therefore we considered the evidence quality to be moderate. The GRADE system assesses the benefit-to-harm ratio as well as the treatment effect magnitude and no benefit of prophylactic IHN resection has been reported. Furthermore, the development of a painful neuroma may have been missed as adverse outcome in the presently available series. In short, no positive treatment effect has been shown, making a strong recommendation for IHN resection unsupportable.

Genital branch of the genitofemoral nerve

Evidence in Literature

No studies were found comparing prophylactic resection of the genital branch of the GFN with preservation of this nerve

Pragmatic neurectomy

Introduction

Pragmatic neurectomy refers to nerve resection or removal of a segment of a nerve that is “at risk.” An “at risk” nerve in turn, is one that has been damaged during surgery, is in danger of being traumatized due to interference with mesh position, or is likely to be included in the fibrotic process around mesh. Our search on this topic encompassed studies reporting on pain incidence following pragmatic resection of inguinal nerves.

Key Question

KQ19P.1 Does pragmatic resection of inguinal nerves reduce pain incidence?

Recommendation

| Recommendation | Pragmatic resection of the IIN and/or the IHN is suggested if iatrogenic nerve injury occurs or if the nerve(s) interfere(s) with mesh position. | weak |

Evidence in Literature

Our search found one cohort study comparing pragmatic neurectomy of “at risk” nerves with a routine nerve preservation approach. Three other cohort studies involving only pragmatic neurectomy (without a nerve-preservation control group) were identified, but excluded from analysis.

The analyzed cohort study involved 364 Lichtenstein hernia repair patients who underwent neurectomies for “at risk” nerves (traumatized, stretched or interfered with by mesh). In a different group of 161 Lichtenstein patients, no recommendations were given for nerve handling and a nerve-preservation routine was employed. There were no significant inter-group differences.
in the number of identified nerves. In the larger group, significantly more IHN resections were done (40% versus 12% respectively). No inter-group differences existed for IIN and GB resections. At three months postoperatively there was significantly less pain in the nerves-at-risk resection group. It was concluded that, in Lichtenstein hernia repair patients, a pragmatic approach of at-risk neurectomy produced less chronic postoperative pain\textsuperscript{173}.

Three other cohort studies were excluded from analysis\textsuperscript{178,189,194}. These studies investigated the influence of a pragmatic approach of “at risk” nerves but did not compare this group to a group in which all nerves were preserved. For example, one study prospectively investigated a cohort of patients in which the influence of a pragmatic approach was investigated in all 172 patients: preservation of inguinal nerves unless it was felt that they would hinder the placement of the mesh or would become entrapped by the mesh or suture material, in which case, they were divided cleanly at the edge of the wound\textsuperscript{194}. They reported no differences in mean VAS score between the groups in which the IIN or IHN or GB was divided compared to the group in which all three nerves were preserved. Another study prospectively recorded type of nerve management in 973 primary IH patients undergoing elective Lichtenstein or Trabucco repair\textsuperscript{178}. No recommendations were made regarding identification or preservation of inguinal nerves. They reported no significant difference in moderate-to-severe pain at six months and one year between a group of 310 patients in which all nerves were identified and preserved and a group of 60 patients in which one or two nerves were divided and a group of 10 patients in which all nerves were divided. Furthermore, the third study prospectively recorded type of nerve management in 781 Lichtenstein and Shouldice repairs\textsuperscript{189}. They reported 12 patients with relevant chronic pain (VAS>3) at five years. In 11 of these 12, IIN neurolysis had been performed during a Lichtenstein repair. The conclusion of this study was that mesh contact with a nerve removed from its natural bed should be avoided; supporting the notion that nerve resection is a better alternative to leaving an intact mobilized nerve in situ allowing mesh/nerve contact to occur.

Discussion

Overall, the strength of evidence on this topic is low. Only one cohort study exclusively compared a pragmatic resection of nerves ‘at risk’ approach with a general routine of preservation, supporting pragmatic ‘at risk’ neurectomy\textsuperscript{173}. One other cohort study indirectly supports the view that nerves should be pragmatically resected in case of iatrogenic damage or interference with the position of the mesh\textsuperscript{178}. Two other cohort studies report no downside to pragmatic neurectomy. The level of evidence is low since only cohort studies were conducted.

When considering the benefit-to-harm ratio, IIN or IHN division does not influence the incidence of chronic pain\textsuperscript{180}. Sensory loss has been reported to increase following IIN neurectomy\textsuperscript{180}. Pragmatic resection of at-risk nerves seems justified and provides a better alternative to nerve preservation of an injured nerve or a nerve that interferes with mesh position.

\textit{Hernia sac resection in indirect hernia}

Introduction
Hernia sac excision and ligation in indirect hernia management has been standard treatment for as long as radical hernia operations have been performed. The hernia sac—part of the parietal peritoneum—is well innervated. Early postoperative pain reduction might be achieved if the sac was resected or invaginated, but not ligated.

**Key Question**

**KQ19P.j** Does hernia sac resection and ligation increase the incidence of acute and/or chronic pain?

**Statements**

<table>
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<th>Statement</th>
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<tbody>
<tr>
<td>In indirect hernia management, sac invagination, without ligation, is associated with a reduction in the incidence of acute postoperative pain but an increased incidence of recurrence.</td>
<td>☒</td>
<td>☐</td>
</tr>
<tr>
<td>A possible increase in pain incidence should be weighed against a possible increase in recurrence incidence when considering indirect hernia sac ligation.</td>
<td>☒</td>
<td>☐</td>
</tr>
</tbody>
</table>

**Evidence in Literature**

Until the 1970s, high ligation of the indirect hernia sac was generally considered a crucial part of the hernia repair in preventing recurrence. The 1978 edition of Hernia discussed this approach. A 1977 randomized study found no support for suturing of the peritoneum at abdominal wound closure.

In the anterior abdominal wall the peritoneum is innervated by parietal nerves also innervating the skin and muscles as opposed to the visceral and posterior peritoneum having a visceral innervation through the paravertebral ganglia and the vagal nerve. A prospective randomized study of hernia sac ligation of 110 indirect hernias in 105 male patients found that sac resection without ligation did not result in increased recurrences at one to three year follow-up. There was however, a significant decrease in severe postoperative pain at two-week and in moderate pain at six-week follow-up in the non-ligated group. Increased pain after hernia sac ligation was attributed to peritoneal ischemia. A 2007 study randomized 477 Lichtenstein repair patients to ligated or non-ligated hernia sac groups. Significantly fewer non-ligated subjects had postoperative pain during a 30-day follow-up period and pain levels were significantly higher in the ligated group. Another study from 2014 randomized 167 Lichtenstein indirect hernia repair patients to one of three groups: sac dissected, not opened and inverted into the peritoneal cavity; sac excised without resection; and sac resected and transfixed at the neck. Postoperative pain scores were 3.04, 3.98 and 4.06 respectively, significantly higher in the ligation group. Chronic pain and recurrence were not significantly different amongst the groups at 80-month follow-up.

A Swedish Hernia Registry study of 48,433 open anterior indirect IH repairs examined hernia sac management. Hernia sac excision and ligation occurred in 49.5%, invagination in 37.6%, and
division (the distal sac left in situ) in 12.9%. Reoperations for recurrence occurred in 1.7%, 2.7%, and 1.7% respectively. However, within the subgroups of sutured repairs including a total of 6,217 repairs, invagination of the sac did not increase the recurrence rate significantly.

Discussion

Three RCTs have reached similar conclusions regarding postoperative pain. Indirect hernia sac invagination or resection without ligation results in less local pain in the immediate postoperative months and does not confer a long-term recurrence risk. There is a high level of evidence for this finding. However, a large register study with a five-year follow-up term found that reoperation rates for recurrence were worse in invagination or resection without ligation patients. Therefore, our final recommendation received only a weak grade.

Public pain and orchialgia

Introduction

The periosteum is highly innervated and if violated by fixation sutures or tacks, pain—intense and long-lasting—is likely to occur. The resultant pain is somatic in nature but, if intense, may be misinterpreted as neuropathic.

Key Question

KQ19P.k Does mesh fixation to the pubic bone increase the incidence of acute and/or chronic pain?

Recommendation

| Recommendation | Mesh fixation to the pubic bone is not recommended since this leads to an increased incidence of chronic pain. | Strong | *upgraded |

Evidence in Literature

While no studies focus specifically on periosteal pain, this entity is recognized as one of a number of causative factors in post-herniorrhaphy pain syndromes\textsuperscript{149,202–205}.

One study found at two-year follow-up that non-neuropathic pain is the most common cause of chronic pain. Tenderness over the medial insertion of the inguinal ligament is the most common clinical finding. Therefore, authorities recommend against placing sutures in the area of the pubic bone\textsuperscript{149}. Another study mentions the issue of pain related to periosteal sutures but does not cite an incidence\textsuperscript{202}.

A third study found that 18 of 40 patients with non-neuropathic pain had periosteal pain probably caused by sutures. The 18 patients represented 12% of the total group of those with chronic post-
herniorrhaphy pain. Eight of these received an injection with lidocaine and corticosteroids resulting in pain reduction of more than 50% in their VAS scores. From a group of 237 Swedish Hernia Register patients operated on for persistent pain after groin hernia operations, 111 completed a questionnaire. Fourteen of these patients (13%) had undergone pubic tubercle suture removal. Total or partial mesh removals were done at the same time and the results of suture removal alone were not calculated. The results within this subgroup did not significantly differ from the results in the whole study group of 111 patients answering the questionnaire, improvement being reported by 62% of the patients. In those with chronic post-herniorrhaphy pain, (10 - 12% of IH repair patients) approximately 12 - 13% will have pain probably caused by tubercle mesh fixation, representing about 1% of chronic pain cases.

Discussion

Despite this being an uncommon problem and the subject of a limited number of publications, pain due to pubic bone periosteal interference is an important issue with a significant impact on patient wellbeing. Our recommendation on the subject is therefore ungraded to strong.

In open anterior mesh repairs, the mesh overlapping the medial pubic tubercle is, in fact, an “onlay” mesh part, meaning that local preparation for mesh placement is important. Overlap should compensate for mesh shrinkage. Deeply positioned sutures for medial mesh fixation should be avoided, and if local treatment with anesthetics and corticosteroids fail, surgical suture removal must be considered.

The sensitive pubic bone area is also reachable via the preperitoneal route. The pectineal ligament along the pubic bone’s superior ramus is commonly used for suture fixation. This ligament thins medially and sutures or tacks in that area may reach periosteum. However, no publications specifically address this issue.

Orchialgia

Introduction

Few CPIP patients develop testicular pain. If it develops however it can be debilitating and adversely affect sexual function and quality of life.

Key Question

KQ19P.1 What percentage of CPIP patients have orchialgia?

Recommendation

| Recommendation | Minimizing surgical trauma to the spermatic cord is recommended to reduce orchialgia incidence. | Strong |

Evidence in Literature

Orchialgia results from damage to the testicle’s visceral innervation. These nerves run along the spermatic vessels and are derived from paravertebral ganglia mainly at the kidney level. It is known that ipsilateral orchialgia occurs in 6-44% of kidney donors. Laparoscopic standard procedure involves an en bloc dissection of the ureter and gonadal vein divided at the level of the iliac vessels’ crossing. Orchialgia does not occur if a gonadal-vein-sparing approach is used (so as not to disturb the vessel below the point of ligation at the renal vein). A study of genitofemoral neurectomy in 23 patients found that three of six patients with persistent neuralgia had significant orchialgia. None of the patients who had significant pain relief after neurectomy had preoperative testicular pain. Another study found that orchialgia was not affected by laparoscopic triple neurectomy in refractory neuropathic inguinodynia because the testes have a separate innervation.

Testicular pain occurs after open and laparoscopic hernia operations. Etiologies include: spermatic cord trauma, inflammation and fibrosis due to mesh ingrowth, and cord strangulation at the passage through a cut slit in the mesh.

Note that publications on testicular problems that do not cite patient numbers are excluded from our discussion.

A meta-analysis on endoscopic versus open mesh and non-mesh techniques found testicular atrophy or “problems” in 51 of 7,622 operations (0.7%) with no statistical significant inter-group differences in articles reporting on this issue. Chronic postoperative pain was reported in 598 of 8,524 operations (7%), endoscopic 5% and open 9%. Orchialgia and testicular problems represented 10% of the chronic groin pain cases. A systematic review found the incidence of testicular pain to be 1-6%. In another article reporting on those with severe or very severe groin pain, 22 of 120 (18%) had testicular pain and 2.6-4.5% had testicular atrophy. A meta-analysis of open preperitoneal versus Lichtenstein repair that included 2,860 patients found testicular problems in 1.3% and 1.9% respectively, chronic pain in 7.1% and 12.3% respectively, for a total of 1.6% incidence of testicular problems and a 9.8% incidence of chronic pain. In four meta-analyses on lightweight versus heavyweight mesh in open hernia surgery published from 2011 to 2013, testicular problems were all reported in the same four publications. There were no significant differences in testicular problems between groups. One of the meta-analyses reported testicular atrophy in 0.8% of patients and chronic pain in 11.2%. Irrespective of surgical technique, the incidence of orchialgia is about the same, roughly 10% of the incidence of CPIP.

New directions in acute/chronic pain prevention.

Introduction

Preoperative and intraoperative methods (various medications, psychological treatments and preparation, educational programs) have been used in attempts to prevent chronic pain. Many of the techniques hinge on surveying psychological risk factors for chronic pain after hernia operations. A few psychologically-based studies examining counseling or education have been published that related to hernia surgery.
Key Question

KQ19P.m Can preoperative and perioperative topical and systemic medications reduce the incidence of chronic pain?

Statement

| Statement | Topical and/or oral medical therapy given preoperatively or intraoperatively has not been shown to reduce the incidence of chronic pain following hernia surgery. | weak |

KQ19P.n Can chronic postoperative pain be prevented or reduced by preoperative information and psychological preparation?

Perioperative prevention of chronic pain

Evidence in Literature

A review on persistent post-surgical pain concluded that nerve injury is the major factor causing chronic pain. It further surmised that preempting neuropathic pain requires a different approach from that needed for preventing inflammatory pain\(^{211}\). Preemptive analgesia attempts to reduce sensory input from the surgical trauma causing sensitization and an increased risk of chronic postoperative pain. Analgesia timing is considered to be crucial\(^{212}\).

A systematic review and meta-analysis including 11 clinical trials on perioperative administration of gabapentin or pregabalin found that they were effective in reducing the incidence of chronic post-surgical pain\(^{213}\). Of eight gabapentin trials, four (one of which was a hernia repair study\(^{211}\)) reported lower incidence of pain and/or lower analgesic requirement > 2 months after surgery. So did all three pregabalin trials.

One systematic review on preemptive analgesia concluded that it can reduce acute postoperative pain. It also commented on the need for additional studies on gabapentin and pregabalin before recommending their use in chronic pain prophylaxis\(^{214}\). However, the review summarized, the cause of chronic pain being multifactorial, that a combination of intraoperative and postoperative pain therapy is needed to minimize the risk of developing chronic pain\(^{214}\).

Another systematic review found no evidence to support preemptive analgesia use in chronic post-surgical pain prevention\(^{215}\).

A Cochrane review on high-dose topical capsaicin on intact skin for chronic neuropathic pain from post-herpetic neuralgia and HIV neuropathy found a significant benefit during a 12-week study period\(^{216}\). One study of wound instillation of capsaicin showed superior analgesia versus placebo in the three to four days following IH repair\(^{217}\). Follow-up at 2.5 years revealed that five
of 20 patients in the capsaicin group had hyperalgesia compared to one of 16 in the placebo group. This trend did not rise to the level of statistical significance\textsuperscript{218}.

Etanercept—a tumor necrosis factor-alpha inhibitor—has the potential to inhibit neuropathic pain. When this agent was used to treat post-amputation pain, five of six soldiers in whom it was employed reported improvement\textsuperscript{219}. In a subsequent multicenter randomized study, etanercept was given 90 minutes before IH surgery and reduced post-operative pain by some measures. However, the effect was small, transient, and not statistically significant\textsuperscript{220}.

\textbf{Preoperative education and psychological preparation}

\textbf{Evidence in Literature}

In a systematic review of experimental pain studies investigating quantitative sensory testing, the variance in postoperative pain could be predicted in 4-54\% of patients. Preoperative psychometric evaluations of vulnerability, anxiety, depression and pain catastrophizing were less predictive\textsuperscript{156}. Numerous studies from a variety of disciplines have identified psychological risk factors for chronic pain\textsuperscript{155,214,221–224}. Few studies exist on preoperative preparation and education of patients to reduce chronic post-operative pain. A prospective randomized study did evaluate the influence of a preoperative informative video before hernia surgery on postoperative quality of life. A benefit was noted at three-month follow-up but no difference was detectable at six months\textsuperscript{225}. The effect of music and music combined with therapeutic suggestions was studied in a prospective randomized manner in day case varicose vein and IH surgery. Either intervention demonstrated a modest effect on patients’ pain in the immediate postoperative period. Long-term effects were not studied\textsuperscript{226}. The effect of postoperative education after hernia surgery was studied in a prospective randomized fashion. No difference in postoperative pain or return-to-work interval was found but a small statistically significant benefit on pain-when-moving was found on post-operative day #7. However, the study authors found no reason to recommend a change in standard practice regarding postoperative counseling\textsuperscript{227}.

\textbf{Discussion}

The perioperative use of medications to prevent chronic pain has focused mainly on blocking central sensitization and the development of neuropathic pain. Gabapentin is the best studied and has a documented short-term benefit. Generally, these benefits fade after one to six months. Pregabalin, though less well studied, has a similar effect. Capsaicin and etanercept have no proven long-term effect on chronic pain. So-called “preventive analgesia” through multimodal approaches is predicated on the assumption that the only way to prevent central sensitization is to completely block any painful input from the surgical wound from time-of-incision to final wound healing\textsuperscript{211,212}.

Preoperative psychological predispositions toward the development of chronic pain have been investigated in several surgical disciplines. This field remains poorly studied. The limited data available suggest only minor short-term effects on postoperative pain and no benefit in chronic pain prevention.
Pain treatment

Chronic postoperative pain treatment after inguinal hernia repair

Introduction
Chronic pain is a significant complication after IH surgery leading to disability, dissatisfaction, and impaired productivity and quality of life. Despite a wide array of general pain treatment options, management of this burdensome condition remains challenging. Due to a paucity of evidence-based data of the subject and heterogeneous patient populations and pathologies, expert opinion plays a vital role in decision making. For this reason, nearly all statements in the section below are only weakly supported but do represent a blend of an exhaustive literature review and expert opinion. The recommendations reflect current state-of-the-art and are important for clinicians and patients dealing with chronic pain.

Key Question

KQ19T.a How should inguinal hernia repair patients with immediate, severe, postoperative pain be treated?

Recommendation

Immediate severe/excruciating postoperative pain raises the possibility of vascular or nerve injury. Early re-operation is suggested to either exclude or manage these complications.

Evidence in Literature

There is clear evidence that acute postoperative pain is a risk factor for chronic pain development. Early adequate pain management is vital to reduce the risk of conversion to chronic pain. Existing guidelines of prevention and chronic pain management after IH repair address the issue of whether immediate re-operation is necessary.

No studies exist on the appropriate treatment of acute severe pain after IH repair. In particular, no studies address whether early re-operation with neurectomy prevents chronic pain. From a purely pragmatic perspective however, patients with immediate severe neuropathic pain postoperatively may be offered re-operation with neurectomy if appropriate.

Key Question

KQ19T.b What should the initial approach be to IH repair patients with chronic postoperative pain (pain still present > three months after surgery)? (see treatment algorithm)

Recommendation
A multidisciplinary team is suggested to manage chronic pain patients.

Recommendation

Pharmacologic and interventional measures—including diagnostic and therapeutic nerve blocks—should continue for a minimum of three months (minimum of six months after hernia surgery).

Evidence in Literature

Our search identified seven reviews describing different treatment options for chronic pain patients. A 1988 landmark paper presented a treatment algorithm for chronic pain after IH repair. The study authors concluded that pain persisting for two to three months required further investigation and treatment, starting with an IIN block at the ASIS. If this reduced pain to some extent, a repeat nerve block could be done since repeated injections may interrupt the pain cycle. If an IIN block is ineffective, an anesthesiologist may be asked to perform a paravertebral block of the genitofemoral nerve. If transient pain reduction is achieved, a repeat block or neurectomy of the IIN or GB of the GFN is the next recommended step. If a block does not result in pain reduction, a course of pharmacological and non-pharmacological therapy (i.e. psychotherapy, hypnosis, behavioral therapy, biofeedback, acupuncture) is advocated.

A systematic review of CPIP management was done in 2005. It concluded that neurectomy relieved chronic pain but that studies demonstrating this finding suffered from methodological flaws. In particular, a clear pre-, intra-, and post-operative assessment was deemed necessary to provide a better understanding of therapeutic options.

Another study group emphasized that there is a broad differential diagnosis for chronic inguinal pain following IH repair. Examination with ultrasonography or magnetic resonance imaging may provide useful information and may detect recurrence, meshoma, or non-hernia-related causes of pain. This group suggested an initial trial of conservative modalities and pharmacological options (e.g. TCAs, SSRIs, gabapentin, pregabalin). Then, nerve blocks and peripheral nerve stimulation were advocated as necessary. However, they acknowledged that these modalities are often ineffective and that surgical neurectomy provides the best results. Although the study group did not research the issue, the question then becomes which patients are suitable for neurectomy? They proposed a conservative treatment period of at least six months before neurectomy is done.

In 2011, the international guidelines for the prevention and treatment of CPIP were published, providing consensus statements on best-available clinical recommendations. The guidelines advised a one-year expectant period before remedial surgical treatment to allow the mesh/tissue interface inflammatory response to diminish. The guidelines further recommended a triple neurectomy if neurectomy was done. After endoscopic repair, a transabdominal or retroperitoneal approach was urged to remove the proximal parts of the nerves. They also concluded that the intramuscular part of the IHN should be resected during an open triple neurectomy.
More recently, others have proposed an algorithm for CPIP using the Delphi consensus method. They urge an expectant phase and—after recurrence has been excluded by imaging—referral to a multidisciplinary pain management team. If this approach fails, triple neurectomy and/or mesh explantation by an expert hernia surgeon is advocated.

In 2014, two CPIP reviews were published. One emphasized the complexity of, and the need for individualization in, treatment schemes making definitive broadly-applicable treatment algorithms difficult to compose. The other concluded that while neurectomy provides the best results, improved studies with long-term outcome measures should be initiated.

Most recently, data on 105 CPIP patients were published. On the basis of history, physical examination and imaging, the 105 were partitioned into neuropathic (37) and non-neuropathic (68) pain groups. Twenty-eight underwent intervention with ultrasound-guided nerve blocks. Permanent pain reduction was achieved in 18 of the 28 (62%). Implantable peripheral nerve stimulators were placed in six of the 28 who had temporary pain reduction following nerve block. Overall, this approach led to pain reduction in 24 of 28 (83%) patients.

Discussion
A step-wise multidisciplinary approach starting with minimally invasive measures like analgesics and nerve blocks is advocated in all studies. Neurectomy seems reasonable after a minimum waiting period of six months without an adequate response to other therapy. Again, a paucity of evidence in this important subject area allows only a weak grade for the recommendation.

Key Question
KQ19T.c Does non-pharmacological treatment work in CPIP?

Statement

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<tr>
<th>Statement</th>
<th>No benefit has been shown for lidocaine and capsaicin patch treatment of CPIP.</th>
</tr>
</thead>
</table>

Evidence in Literature

No studies exist on non-pharmacological treatments (e.g. physical therapy, acupuncture, mind-body therapy) for CPIP although there are some general articles on chronic pain modification and improvement by cognitive and emotional means.

Remarkably, even pharmacological treatments (e.g. NSAIDs, acetaminophen/paracetamol, TCAs, SSRIs, gabapentin, pregabalin, and opioids) of CPIP have rarely been studied. Only one relevant case report describes long-term pain reduction with gabapentin. However, the general pain literature on neuropathic pain (NeuPSIG guideline, http://www.neupsig.org/) does provide a stepwise treatment scheme. (see overview in the addendum to this chapter)
Limited evidence exists for the use of lidocaine and capsaicin patches in CPIP patients. One crossover trial of 21 patients found no benefit for lidocaine patches\(^{239}\). Another study failed to show a statistically significant benefit of the capsaicin patch although there was a trend toward less pain in the capsaicin group at one month\(^{240}\). (see addendum for a table of evidence)

**Discussion**

There is little in the medical literature on non-pharmacological treatment options for CPIP. Lidocaine and capsaicin patches have not been proven to be effective for this condition.

**Key Question**

KQ19T.d What is the effect of non-surgical interventional treatment on chronic pain after IH repair?

**Statements**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is insufficient evidence of the diagnostic and therapeutic value of nerve blocks in chronic pain after inguinal hernia repair. In clinical practice however, nerve blocks can be useful in the diagnostic and therapeutic management of chronic pain after inguinal hernia repair.</td>
<td>✗ ✗ ✗ ✓</td>
</tr>
<tr>
<td>Pulsed radio frequency ablation may be an effective treatment for chronic pain after inguinal hernia repair.</td>
<td>✗ ✓ ✗ ✓</td>
</tr>
<tr>
<td>Early findings suggest that neuromodulation of the Dorsal Root Ganglia (DRG) may be an effective treatment for chronic neuropathic pain conditions in the groin region.</td>
<td>✗ ✓ ✗ ✓</td>
</tr>
</tbody>
</table>

**Evidence in Literature**

Limited evidence exists for the use of local nerve blocks for CPIP treatment. No studies have investigated whether nociceptive pain can be reliably distinguished from neuropathic pain. Only three studies have examined the effect of local anesthesia on chronic pain\(^{241–243}\).

The most notable of these is a small double-blind RCT demonstrating that ultrasound-guided IIN and IHN blocks did not produce pain relief\(^{241}\). It is not clear from the study what percentage of patients had improperly-placed nerve blocks despite ultrasound guidance.

A larger uncontrolled, retrospective study of 43 patients used local anesthetic and a corticosteroid injection with nerve stimulator or ultrasound guidance. Thirty-two percent of the patients were relieved of moderate-to-severe pain and nerve blocks, done as described, were considered to be an effective treatment modality\(^{242}\).

A case series describes CT-guided GFN block as an effective diagnostic and therapeutic option\(^{243}\).
Neuroablative techniques for chronic pain relief have been described\textsuperscript{244–253}. Cryoablation for chronic inguinal pain has been the subject of two case studies involving a total of ten patients\textsuperscript{244,249}. One of these studies reported a 77.5% mean overall pain reduction with an average follow-up period of eight months\textsuperscript{244}. Another successful cryoablation case involved a patient with chronic inguinal pain but NO prior hernia surgery\textsuperscript{249}.

The effects of peripheral nerve stimulation (PNS), dorsal root ganglion stimulation (DRGS) and spinal cord stimulation (SCS) on CPIP is new to the pain management field. Our literature search of Pubmed and Embase yielded 117 articles using the terms “inguinal pain post-herniorrhaphy.” Excluding transcutaneous electrical nerve stimulation studies left 11 articles involving 64 patients undergoing PNS, SCS or DRGS. The largest of these involved DRGS and pain relief of 76.8% ± 8.2% (n = 10) with a follow-up period of 17.4 ±5.7 weeks\textsuperscript{254}. Another small study with a follow-up period of 12 months reported pain relief of > 75% and reduced pain medication intake with SCS\textsuperscript{255}. The other articles in this subject area are case reports or small case series.

**Discussion**

Few studies exist on nerve blocks for CPIP therefore no evidence-based recommendations for preferred technique (ultrasound-guided, neuro-stimulator directed, anatomic landmark) can be made. However, multiple authorities consider that nerve blocks serve an important diagnostic function and can be effective in the treatment of CPIP.

Cryoablation has been the subject of a few case reports involving few patients and limited follow-up. Initial positive results should be viewed accordingly.

All available studies on neuromodulation for CPIP cite sustained pain relief, quality-of-life improvement and/or analgesic use reduction or cessation. However, these studies have significant limitations, such as retrospective design, case report or series design, lack of control group, short follow-up time, and no report of adverse events or complications. Presently, there is weak preliminary information in support of neuromodulation to treat CPIP.

**Key Question**

**KQ19.** Is mesh removal without intentional neurectomy an effective treatment for chronic pain after IH repair?

**Statement**

There is insufficient evidence to support mesh removal alone without neurectomy in patients with CPIP.

**Evidence in Literature**

Mesh removal can be considered if nociceptive pain due to mesh occurs. Compression of adjacent structures like the spermatic cord and surrounding inflammation is thought to be the mechanism of this pain. Often mesh is wrinkled and fibrotic causing pain in certain positions like sitting. However some patients have pain that is both nociceptive and neuropathic\textsuperscript{256}. Therefore, the effect of mesh removal without neurectomy is difficult to interpret.
After a literature search we identified 120 papers and considered nine to be suitable/eligible for inclusion in our review/discussion. In total, 278 operations for mesh removal were included. Five studies were retrospective case series. Efficacy rates in significantly reducing or eliminating pain ranged from 60-100%. Data on the effect of mesh removal alone cannot easily be extracted since the majority combined mesh removal with a tailored or triple neurectomy (82%). Iatrogenic nerve injury during mesh removal was often an indication for simultaneous neurectomy. However, Campanelli et al routinely performed a neurectomy.

**Discussion**

Given the limitations of the literature on this subject, no conclusions can be reached regarding mesh removal sans neurectomy.

**Key Question**

KQ19T.f What type of neurectomy should be performed in patients with chronic neuropathic pain (> 3 months) after IH repair?

**Statement and Recommendation**

<table>
<thead>
<tr>
<th>Statement</th>
<th>For chronic neuropathic pain after open hernia repair, both open neurectomy and endoscopic retroperitoneal neurectomy provide acceptable outcomes.</th>
<th>☐ ☐ ☐ ☐ Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>A tailored approach to neurectomy with or without mesh removal is suggested depending on the original repair method and presentation. The decision about neurectomy type - selective or triple- is best left to the surgeon’s discretion.</td>
<td>☐ ☐ ☐ ☐ Weak</td>
</tr>
</tbody>
</table>

**Evidence in Literature**

High level evidence is lacking. In total, 25 papers were identified. Most are retrospective case series. There are only two prospective studies. The first one describes detailed preoperative and postoperative characteristics using mesh removal and a selective neurectomy. The second reports on 20 cases treated by endoscopic triple neurectomy (success rate 100%). There are no studies comparing tailored and triple neurectomies. The results of endoscopic triple neurectomies were reported in seven case series/studies/trials. The remaining 18 studies reported on patients treated with a tailored neurectomy.

The reported outcomes of triple neurectomy operations range from an 85-100% pain reduction. Selective single or double neurectomy studies generally report lower success rates.
Numerous confounding factors prohibit firm conclusions regarding a preferred neurectomy technique. First of all, most of the triple neurectomy data are derived from a single institute with reports including sequentially accumulated data. Furthermore, pain scores, follow-up, questionnaire and neurologic examination techniques are inconsistent and mostly absent. Therefore the heterogeneity in patient data prohibits firm conclusions.

Discussion
The literature quality on this subject area is poor, resulting in weakly-supported recommendations. Given that mesh removal and neurectomy and the decisions around these procedures are complex, this will likely be the situation for some time. A high level of expertise and experience is required for positive outcomes. Neurectomy type is probably a secondary consideration relative to the selection of appropriate patients likely to benefit from nerve resection.

Chapter 20  Recurrent Inguinal Hernias

H. Tran, D. Weyhe and F. Berrevoet

Introduction
Recurrent inguinal hernia clearly still is a major health problem.

Key Question
KQ20.a Are recurrence rates still too high despite innovations like endoscopic repair, anterior preperitoneal repair and new mesh prosthetics?

Statement

<table>
<thead>
<tr>
<th>Statement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recurrence rates worldwide are still too high despite numerous innovations in inguinal hernia surgery.</td>
</tr>
</tbody>
</table>

Key Question
KQ20.b Is surgery necessary for all recurrence patients?

Statement

<table>
<thead>
<tr>
<th>Statement</th>
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</thead>
<tbody>
<tr>
<td>There is no evidence to support a watchful waiting management strategy for those with recurrent inguinal hernias.</td>
</tr>
</tbody>
</table>

45
Evidence in Literature

It is estimated that, worldwide, approximately 20 million primary IH operations are performed annually\(^{278}\). Recurrence rates in this same population can be as high as 15%\(^{279}\). This figure is difficult to pinpoint since recurrence rates vary with length of follow-up\(^{280}\). Regardless, vast resources are committed to this problem.

Over 35 years after the introduction of mesh and 25 years after the first laparo-endoscopic IH repair was performed, recurrence rates when compared to open repair (tissue) techniques have not consistently decreased worldwide\(^{49,281,282}\). This situation needs improvement. Reorienting our thinking such that recurrence is routinely considered a complication rather than an expectation is a necessary first step.

Since recurrence rates are difficult to know, reoperation rates are used as a proxy, with the assumption that recurrences are up to twice as common as reoperations\(^{11}\). In a 2014 long-term Danish observational study, the reoperation rate after primary Lichtenstein repair was 2.4% and 3.3% after laparoscopic repair\(^{281}\). A 2011 Swedish study found the cumulative 24-month reoperation rate to be 1.7% for primary repair and 4.6% for recurrent repair\(^{11}\). In Australia the recurrence rate following IH repair is estimated at 7.9%, and appears unchanged over two decades\(^{283}\). This is perhaps disappointing since, in Australia in 2014, 51% of IH repairs were done laparoscopically, compared with 20% in 2000\(^{284}\).

Promisingly though, in highly specialized centers, 1% long-term recurrence rates have been achieved\(^{285}\). These same investigators have found that the recurrence rate for laparoscopic recurrent IH repair after failed anterior repair approaches that of primary hernia repair. This strongly supports the notion that hernia surgery specialization may have a positive impact on outcomes, particularly recurrence rates\(^{286}\).

Current guidelines on a watchful waiting approach to patients with primary IHs remain unchanged from the 2009 EHS guidelines\(^{12}\). However, our 2016 update states that while watchful waiting is relatively safe, there is a high likelihood of crossover to surgery (23% at 2 years and 72% at 7.5 years in one study\(^{287}\) and 68% at 5 years in another\(^{288}\). These data suggest that virtually all IH patients—whether primary or recurrent—will require repair, usually because of pain or discomfort.

A 2014 cohort study of 1,032 patients undergoing IH repair in the 16 months after the adoption of watchful waiting for asymptomatic or minimally symptomatic hernia compared with 978 in the 16 months before the adoption of watchful waiting showed a higher incidence of emergency repair (5.5% vs 3.6%, 95% confidence interval: 1.03-2.47), a higher adverse events rate (18.5% vs 4.7%, adjusted OR: 3.68, 95% CI: 2.04-6.63) and higher mortality (5.4% vs 0.1%, p<0.001, Fishers’s exact test)\(^{289}\).

Currently there is no evidence on either watchful waiting or elective repair for those with recurrent IHs. Discussions about, and plans for repair, should be shared apace with recurrent IH patients.

*Open repair for recurrent inguinal hernia*
Details of prior hernia operations are important in planning for a recurrent IH repair. Regardless of the procedure chosen to repair a recurrent hernia it is highly likely to be more difficult than a primary repair.

An anterior approach for recurrence after primary anterior repair means that scarred tissues with distorted tissue planes must be entered. In our experience/judgement this increases the risk of testicular atrophy and nerve entrapment with consequent post-herniorraphy chronic groin pain. If an endoscopic repair was previously performed, then an anterior repair where tissue planes are undisturbed is recommended\(^{290}\). At least one authority has stated, given that the extra-peritoneal space has already been dissected, an open preperitoneal approach including the PHS and Kugel should be avoided\(^{291}\).

**Key Question**

**KQ20.c** Which management strategy is best for recurrence after anterior repair?

**Statement and Recommendation**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Open pre-peritoneal repair avoiding an approach through scar tissue can be an alternative surgical technique after failed anterior tissue repair or Lichtenstein repair.</th>
<th>☓ ☓ ☓ Weak</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Recommendation</strong></td>
<td>Laparo-endoscopic recurrent inguinal hernia repair is recommended after failed anterior tissue or Lichtenstein repair.</td>
<td>☓ ☓ ☓ ☓ Strong</td>
</tr>
</tbody>
</table>

If the primary repair was a tissue repair then either the anterior or posterior—either open or endoscopic—approach can be used for the recurrent hernia repair. If the primary repair was a mesh repair then the entrance point should be via a space not previously entered.

For non-endoscopic surgeons, an anterior Lichtenstein approach has been recommended after a primary tissue repair\(^{12}\). Care must be taken to prevent any potential (additional) damage to testicular vessels since this may result in testicular atrophy\(^{292}\). According to one study, incidental femoral hernias occur in up to 9% of recurrent IH patients\(^{7}\). Therefore, groin exploration must include the femoral region.

When laparo-endoscopic surgery is not an option, the open posterior approach represents an acceptable alternative\(^{293,294}\). This approach involves placing a large mesh piece posterior to the transversalis fascia via a trans-inguinal incision (Rives), or a muscle-splitting incision (Kugel and Wantz) or a lower midline incision (Stoppa)\(^{295}\). A report of 58 Stoppa operations for recurrence reported an overall re-recurrence rate of 12%\(^{296}\). Nearly two-thirds of these occurred in the first few years after the technique was introduced at the study site. Further experience with the technique halved the re-recurrence rate in the same study.

The Prolene Hernia System\(^{R}\) operation involves mesh leaflet placements anterior and posterior to the transversalis fascia\(^{297,298}\). A connector holds the leaflets together. This technique requires a preperitoneal dissection via the anterior approach, difficult if the patient has already undergone a
posterior approach either laparoscopic or open during primary repair. Additionally, any prior anterior intervention would cause scarring, resulting in distorted tissue planes and increasing risk of testicular atrophy and nerve damage.

Since the potential for complications of open recurrent IH repair—including testicular atrophy and/or nerve entrapment and damage—is higher than for primary repair, we strongly suggest that this operation be performed by an expert hernia surgeon.

**Surgical options for patients with recurrence after anterior repair**

A 2016 study provided strong evidence that endoscopic recurrent hernia repair (TEP or TAPP) after anterior repair provides optimal outcomes while reducing the incidence of chronic pain and allowing earlier return-to-work or physical activity. Once an anterior repair has been done, an endoscopic repair will generally go through nearly undisturbed tissue planes, permitting relative ease of dissection. One study has demonstrated that the rate of recurrence of primary and recurrent IHs is similar. This likely depends on local expertise in part. It has been demonstrated that endoscopic repair after an anterior repair generally takes longer than a primary repair and increases the peritoneal tear incidence.

A 2014 meta-analysis summarized findings from six RCTs and 5 other studies comparing laparoscopic to open procedures in recurrent IH repair. The analysis of 1,311 patients demonstrated that laparoscopy was associated with a lower incidence of wound infection and a shorter sick leave without an increase in operation time.

While nationwide data on recurrence rates have remained disappointing high, there is evidence to suggest that in highly specialized hernia centers re-recurrence rates of less than 2% can be achieved. For instance, a large institutional review reported a 2% re-recurrence rate after TAPP. Yet another study of over 8,000 patients found nearly identical re-recurrence rates of 1.1% for both primary and recurrent hernia repairs.

A Swedish Hernia Register study of 850 recurrent IHs showed that posterior mesh repair (PMR)—either endoscopic of open preperitoneal—had a lower second recurrence rate versus anterior mesh repair (AMR) (5.6% vs 11%, p=0.025). An increased risk [3.21 (CI 1.33-7.44) (p=0.009)] of a second recurrence was seen after anterior primary repair followed by AMR, and a decreased risk [p=0.08 (CI 0.01-0.94)] (p=0.45) after PMR followed by AMR.

**Surgical options for patients with recurrence after TEP/TAPP**

**Key Question**

**KQ20.d** What is the best operation for a recurrence after TEP/TAPP?

**Recommendation**

| Recommendation | Anterior repair is recommended after a failed posterior repair. | Strong |


After a failed TEP or TAPP repair, where the extra-peritoneal space was entered, it is strongly recommended that an AMR (Lichtenstein)—which does not involve entering the posterior space—be performed. This recommendation remains the same as the EHS recommendation in 2009.

**Surgical options for recurrence after anterior and posterior repair**

**Key Question**

**KQ20.e** What is the optimal management strategy in the case of recurrent hernia after failed anterior and posterior (laparoscopic or anterior pre-peritoneal) repair?

**Recommendation**

| Recommendation | An expert hernia surgeon should repair a recurrent IH after a failed anterior and posterior repair. The choice of technique depends on patient- and surgeon-specific factors. | ☐ ☐ ☐ ☐ | Strong |

The comparable recurrence rates after primary anterior and laparoscopic repair imply that patients are encountered presenting with re-recurrence after a laparoscopic or anterior pre-peritoneal repair and at least one anterior repair. Another anterior repair (e.g. Lichtenstein) would be expected to have a re-recurrence rate of three times that of a primary hernia repair. In addition, there would be significant risk of testicular atrophy and/or chronic groin pain. Re-laparoscopy, either with a TAPP technique or a modified intraperitoneal onlay mesh technique is feasible but this decision, and the procedure itself, should be in the hands of an experienced laparoscopic hernia surgeon.

**Surgical options for recurrence with chronic groin pain**

**Key Question**

**KQ20.f** What are the options for a recurrence with post-herniorrhaphy chronic groin pain?

**Recommendation**

| Recommendation | There are no studies to guide decision making for recurrent hernia patients with post-herniorrhaphy chronic groin pain. It is suggested that patients with this condition be management by an expert hernia surgeon. | ☐ ☐ ☐ ☐ | Weak |

Due to multiple prior interventions, anterior and/or laparoscopic, some patients with re-recurrence will develop post-herniorrhaphy chronic groin pain. A tailored approach is urged, dependent upon previous interventions and the significance of the recurrence (e.g. large incarcerated re-recurrence with small bowel obstruction risk). While an anterior approach may address the recurrence and potentially alleviate the chronic pain (if neurectomy and meshectomy are done) there are significant risks of testicular atrophy and even orchiectomy. In addition,
subsequent recurrence is highly likely. All this must be explained to, and discussed with, the patient. Given the complexity of these cases and the high risk of complications, it is strongly suggested that patients in this category be managed by expert hernia experts.

**Conclusion**

Given the factors cited above, treatment of recurrent and serially recurrent IHs remains challenging. It may be possible to minimize re-recurrence and other complications by using appropriate surgical technique, accounting for previous approaches, and calling upon expert hernia surgeons to manage these cases.

### Chapter 21 Emergency Groin Hernia Treatment

M. López-Cano, S. Morales-Conde and P. Chowbey

**Introduction**

Medical evidence is limited about the emergent treatment of groin hernias; and the quality of that evidence is very low. Future research on the subject should focus on: incarceration and strangulation risk factors, diagnostic modalities, and optimal timing for emergency repair of incarcerated/strangulated groin hernias.

This chapter addresses key questions on best surgical approach (open anterior, posterior, or laparoscopic) and repair options (e.g. mesh versus non-mesh). It is important to consider the limitations imposed by the state of the currently available literature as we search for definitive evidence-based answers to key clinical questions.

The following definitions are used throughout this chapter¹.

**Incarceration**: Inability to reduce the hernia mass into the abdomen

**Strangulation**: The blood supply to the herniated tissues is compromised

**Key Question**

**KQ21.a** Which groin hernias in adults are at increased risk for incarceration/strangulation?

**Statement**

Statement

Risk factors for hernia incarceration/strangulation include: female gender, femoral hernia presence, and a history of hospitalizations related to groin hernias.

Evidence in Literature

It has been written that “most studies concerning hernia focus on recurrence rate, acute and chronic pain, convalescence, type of anaesthesia and risk of complications, but description of results after emergency hernia is scarce”\(^{304}\). Randomized studies (RSs) addressing KQ21.a are not available. Several non-randomized studies (NRSs) with acceptable methodological quality have been published however. Most are cohort studies although population-based studies exist also.

Patients who undergo emergent IH surgery had more hospitalizations than elective patients in the year preceding hernia repair\(^ {138}\). It has been noted that groin hernias in females have increased incarceration/strangulation risk\(^ {22,305}\). Femoral hernias in particular have an increased risk of incarceration/strangulation\(^ {22,30,305–307}\) and this risk seems to be increased if the hernia is right-sided\(^ {306}\) (see also chapters 16 and 17).

In summary, an increased incarceration/strangulation risk is found for groin hernias in adults with the following features:

- Hernia-related hospitalizations in the year preceding hernia repair
- Female gender
- Femoral hernias, particularly those on the right side

Discussion

Understanding of incarceration/strangulation risks in adults with groin hernias will be improved by large-scale epidemiological studies, preferably based on national and international registries. However, the statement in KQ21.a has been upgraded to “strong” because the incarceration/strangulation risk factors are consistent across the currently available studies. Even with the acknowledged low level of evidence, the benefits of emergent or urgent surgery likely outweigh the risks.

Key Question

KQ21.b Which risk factors increase morbidity and mortality in adults with incarcerated/strangulated groin hernias?
Evidence in Literature

Morbidity and mortality are increased amongst incarcerated/strangulated adult groin hernia patients with the following risk factors.

- Age > 65 years\textsuperscript{30,138,305,306,308}, especially octogenarians\textsuperscript{309}
- Prolonged symptom duration\textsuperscript{305}
- Delay to admission, diagnosis and surgery\textsuperscript{22}
- Prolonged time from admission to start of surgery\textsuperscript{308}
- Incarceration for more than 24 hours\textsuperscript{310}
- Symptom duration of three or more days\textsuperscript{307}
- Bowel obstruction\textsuperscript{308}
- Lack of health insurance\textsuperscript{308}
- Associated midline laparotomy for exploration after incarcerated/strangulated hernia reduction\textsuperscript{311}
- Femoral hernia\textsuperscript{30,305–308}, especially right-sided\textsuperscript{306}
- Female gender\textsuperscript{138,304,305}
- ASA class III and IV, BMI > 30 and recurrent hernia\textsuperscript{30} and
- Anticoagulant use\textsuperscript{307}

One study group has proposed a classification scheme to objectively reflect the degree of clinical and morphological change in acutely incarcerated bowel. They found that acute incarceration time was the strongest predictor of bowel damage and subsequent infection. They also found that outcomes were worse in older patients, especially those with comorbidities and higher ASA scores\textsuperscript{312}.

Discussion

The KQ21.b statement is graded as low evidence because the available evidence leaves appreciable uncertainty about the magnitude of the effects of the various risks cited. More study in this area is clearly needed.

Key Question

KQ 21.c Which diagnostic method is most suitable for the detection of incarcerated/strangulated groin hernias in adults?
**Statement and Recommendation**

<table>
<thead>
<tr>
<th>Statement</th>
<th>Clinical examination alone is sufficient for the diagnosis of incarcerated/strangulated groin hernias in almost all patients. Groin ultrasound and/or abdominopelvic CT can provide additional diagnostic information and aid decision making in selected cases.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Recommendation</td>
<td>Clinical examination of the groin is recommended in all patients presenting with signs and symptoms of bowel obstruction.</td>
</tr>
</tbody>
</table>

**Evidence in Literature**

No RCTs, systematic reviews or meta-analyses were found that address the KQ21.c. Two NRSs exist on ultrasound as a means to detect incarcerated/strangulated groin hernias. In the first of these, ultrasound was found to be helpful in diagnosing those with atypical presentations (e.g. obese patients)\(^3\)\(^1\). Hernia complications such as incarceration and strangulation are usually diagnosed or strongly suspected based on a constellation of signs and symptoms occasionally supported, or augmented, by laboratory data. However, sonography is required when the clinical picture is inconclusive or when the surgeon believes he must assess the contents of an incarcerated/strangulated groin hernia sac preoperatively. Sonographic findings associated with incarcerated hernias include: free fluid in the hernia sac (accuracy 96%), bowel wall thickening within the hernia (accuracy 97%), fluid within a herniated bowel loop (accuracy 94%), or dilated intraabdominal bowel loops (accuracy 92%)\(^3\)\(^1\). This ultrasound study did not comment on strangulated hernias due to a paucity of cases\(^3\)\(^1\). In a second study, sonography was used as a guide to show the location and direction of the fascial defect when the inguinal mass was compressed with two hands\(^3\)\(^1\). This ultrasound-guided maneuver may achieve incarcerated hernia reduction—reducing the number of emergent operation—and was found to be easier than blind manual reduction. Another advantage of sonography in this setting is its ability to diagnose other inguinal conditions presenting this groin pain or mass (e.g. varicocele, hydrocele, abscess, and lymphadenopathy). Notably, both studies included small patient numbers and their results must be interpreted cautiously.

No studies have been found regarding other imaging modalities in adults with incarcerated/strangulated groin hernias.

Regarding the importance of clinical examination, in a retrospective cohort study from the Swedish Hernia Register\(^1\)\(^3\)\(^5\) the authors concluded that “In patients with bowel obstruction, physical examination of the groin may decrease the time to surgery and reduce imaging investigations in patients needing emergency surgery for groin hernia.”
Discussion

Although the KQ21.c statement is only weakly supported by evidence, the recommendation was upgraded to strong because potential benefits greatly outweigh risks. RCTs are needed on the value of imaging studies in the setting of suspected incarcerated/strangulated groin hernias.

**KQ21.d** Should adults with acutely incarcerated/strangulated IHs undergo repair emergently?

<table>
<thead>
<tr>
<th>Statement</th>
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<tbody>
<tr>
<td>Acutely incarcerated/strangulated groin hernias represent surgical emergencies mandating timely surgery, taking into account preoperative optimization and the capabilities of local surgical facilities.</td>
</tr>
</tbody>
</table>

**Evidence in Literature**

Although most would immediately and intuitively answer “yes!” to KQ21.d there is no RCT supporting this opinion. However, results from NRSs consistently support the approach. A low-quality, comparative cohort study with small numbers of adult patients with incarcerated/strangulated groin hernias analyzed time from symptom onset to surgery in two ways. The first comparison was between patients requiring bowel resection and those not requiring it. The second was between patients treated within 12 hours of symptom onset with those treated outside that window. Both analyses found a significant increase in morbidity and mortality in those with delayed surgeries. Another similar study comparing patients operated upon within 24 hours of symptom onset versus those operated on after that period found a statistically significant increase in bowel resection rates (29% vs 49%, p=0.047).

Additionally, data related to KQ21.b impacts this issue. In particular, presentation and treatment delays, incarceration duration and prolonged symptom duration are related to increased morbidity and mortality in adults with incarcerated/strangulated groin hernias.

Discussion

Although all studies in this subject area are of low quality, the KQ21.d statement is graded as strong since benefits to patients seem to clearly outweigh risks. RCTs would be difficult, if not frankly impossible, to perform; however large-scale epidemiological studies based on national or international registries might further inform surgical decision making on this crucial issue.

**KQ 21.e** What is the optimal surgical approach (open anterior vs laparoscopic) for an acutely incarcerated/strangulated groin hernia?

**KQ 21.f** What is the optimal surgical approach (open posterior vs laparoscopic) for an acutely incarcerated/strangulated groin hernia?

**KQ 21.g** What is the optimal open surgical approach (anterior vs posterior) for an acutely incarcerated/strangulated groin hernia?
**KQ 21.h** What is the optimal laparoscopic surgical approach (TAPP vs TEP) for an acutely incarcerated/strangulated groin hernia?

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>A tailored approach is suggested for adult patients with acutely incarcerated/strangulated groin hernias since there is no evidence supporting an optimal surgical approach.</th>
</tr>
</thead>
</table>

**Evidence in Literature**

No randomized studies, systematic reviews, or comparative cohort studies address the issues raised in KQ21.e and KQ21.f.

Only one low quality randomized trial compares a mesh-based open posterior approach with a mesh-based open anterior approach and found no differences except for an increased incidence of second incisions in the anterior approach group. A preperitoneal approach was judged to be as safe as an anterior Lichtenstein approach in incarcerated/strangulated groin hernia repairs. A very low quality comparative cohort study recommends a preperitoneal approach.

No randomized studies or systematic reviews focus on TAPP or TEP repair techniques in patients with incarcerated/strangulated groin hernias. Only one low-quality comparative cohort study showed that TAPP repair is useful in elective and emergent cases such as those involving strangulated hernias in selected patients (those with scrotal hernias, previous pelvic or abdominal surgery and severe cardiac or pulmonary problems were excluded).

**Discussion**

The optimal technique for acutely incarcerated/strangulated IH repair remains an open issue, unknowable from the present literature. Well-conducted RCTs and other studies are needed to provide answers to the KQs posed above.

**KQ21.i** In patients with intestinal incarceration without signs of intestinal strangulation or concurrent bowel resection (i.e. a clean surgical field) is mesh-based repair recommended?

**KQ21.j** In patients with intestinal incarceration without signs of intestinal strangulation or concurrent bowel resection (i.e. a clean surgical field), which mesh is recommended?

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Similar to clean elective hernia surgery, mesh repair is suggested in clean emergent hernia surgery.</th>
</tr>
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**Evidence in Literature**
One low-quality cohort study compared open anterior polypropylene mesh repair with open anterior repair (anatomic repair, modified Bassini) without mesh. The majority of patients had intestinal incarceration without intestinal strangulation or concurrent bowel resection (i.e. a clean surgical field). No inter-group differences were found in wound infection rates or postoperative complications. No mesh-related problems were reported.

Another low-quality cohort study compared Lichtenstein repairs in incarcerated versus elective IH patients and found no inter-group differences. Most patients had clean surgical fields and were ASA class I and II.

One low-quality randomized trial compared Lichtenstein with Bassini repairs in selected clean (no peritonitis, inflammatory hernias or bowel resections) incarcerated groin hernia patients. In this study, the Lichtenstein repair was found to be safe and effective with an acceptable low rate of postoperative complications and no recurrences.

All studies cited used polypropylene mesh. No data were found on absorbable mesh or biologic implants.

**Discussion**

In spite of low-quality medical evidence, the statement above received a strong grade since benefits outweigh risks when mesh is used in emergent clean hernia operations. This is similar to the elective surgery experience. Definitive research is needed on this subject.

**KQ21.k** In patients with intestinal strangulation and/or concurrent bowel resection (clean-contaminated surgical field) is mesh-based repair recommended?

**KQ21.l** In patients with intestinal strangulation and/or concurrent bowel resection (clean-contaminated surgical field), which mesh is recommended?

| Recommendation | Mesh-based repair is suggested in emergent groin hernia surgery with a clean or clean-contaminated surgical field. | Weak |

**Evidence in Literature**

One well-done cohort study with a prospective analysis of Lichtenstein repairs in clean-contaminated fields (bowel resection vs no bowel resection) showed that acutely incarcerated groin hernias can be safely repaired with non-absorbable mesh (monofilament polypropylene) with an acceptable wound infection and recurrence rate even when intestinal necrosis was present.

Another small low-quality cohort study found no differences in morbidity, mortality or wound- and mesh-related problems when comparing mesh repair (Lichtenstein) with Bassini in
incarcerated/strangulated hernia repairs requiring bowel resection. Polypropylene mesh (type unspecified) was used after copious saline lavage of the surgical field.

Another cohort study compared mesh (PHS system) with non-mesh repairs in a mixed clean and clean-contaminated field population and found no differences. Contaminated-dirty field patients were excluded. The study supported the idea that use of prosthetic mesh in emergent hernia repairs is not contraindicated.

A well-done cohort retrospective study compared bowel resection with no bowel resection groups and concluded that mesh repair was safe in patients not requiring bowel resection. A further conclusion was that mesh use is not contraindicated in patients requiring bowel resection so long as the field is kept clean-contaminated during surgery. (Gauze or a wound protector was used at time of bowel resection; and the area was lavaged with saline following bowel resection.)

A low-quality systematic review with meta-analysis has been published and suffers from a number of flaws but represents the only SR that examines whether mesh repair is associated with a higher surgical site infection risk when compared with non-mesh techniques. The SR’s authors recognize their review’s weaknesses and conclude, “The mesh repair technique is a good option for the treatment of strangulated IHs in adults, giving an acceptable wound infection rate and fewer recurrences than non-mesh repair. Our study does not allow us to recommend the use of mesh in cases of bowel resection. We emphasize that, except for the two RCTs, the results are predicated on patient selection by careful surgeons.”

Information to address KQ21.l is insufficiently available in the current medical literature.

Discussion

There is limited, low-quality evidence addressing the issues raised in KQ21.k and l. The statement is therefore only weakly supported. Appreciable uncertainty exists about the magnitude of benefits and risks. Definitive research is needed on this subject.

KQ21.m In stable patients with strangulated obstruction and peritonitis caused by a bowel perforation or an abscess due to necrosis of the omentum (contaminated-dirty surgical field) is mesh repair recommended?

KQ21.n In stable patients with strangulated obstruction and peritonitis caused by a bowel perforation or an abscess due to necrosis of the omentum (contaminated-dirty surgical field), which mesh is recommended?

Evidence in Literature

No medical literature addresses KQ21.m and n.

Discussion

Based on expert opinion and judgment we recommend the following.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>It is suggested not to use mesh during emergent groin hernia repair in a contaminated-dirty surgical field.</th>
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<tbody>
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<td>Strength</td>
<td>Weak</td>
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Statement

Little evidence exists comparing the implantation of mesh of various types in non-clean surgical fields. Large-pore monofilament polypropylene, biological and biodegradable meshes have unknown effects on mesh-infection risks.

Recommendation

As surgical field contamination status worsens it is recommended that mesh use be ever more conscientiously considered. If mesh is used, the risk/benefit ratio must be carefully contemplated.

KQ21.o Should adult patients with acutely incarcerated/strangulated groin hernias receive antibiotic prophylaxis or treatment?

No statements

Evidence in Literature

No medical literature directly addresses KQ21.o. However, most papers addressing other KQs related to emergent operations for incarcerated/strangulated groin hernias reference the use of intravenously antibiotics for five days postoperatively. Antibiotic choice varied across the studies.

Discussion

Based on expert opinion and judgment we strongly recommend the following.

Recommendation

Prophylactic intravenous antibiotics are suggested during and following emergent hernia surgery. They should be continued as required depending on the contamination level of the surgical field.

*upgraded

KQ21.p In adults with acutely incarcerated/strangulated groin hernias, does hernia sac laparoscopy (hernioscopy) reduce morbidity and mortality in cases with spontaneous reduction of the hernia before viability assessment?

KQ21.q In adults with acutely incarcerated/strangulated groin hernias, is laparoscopy useful to check bowel viability even when an anterior approach is done?
### Evidence in Literature

One randomized study concludes that hernia sac laparoscopy seems to be an accurate and safe procedure with the potential to prevent unnecessary laparotomies after spontaneous incarcerated IH reduction. Particularly in high-risk patients (poorly defined, ASA class IV excluded) it may decrease major morbidity. However, this study suffers from the fact that is a preliminary report with risks of bias (no fully-explained concealment allocation, no sample size calculation, major complications not fully defined, and small sample size).

A second KQ21.p-related publication is a review of “all published articles” about hernioscopy in adults and children. Data on 58 adults are included from one RCT, seven case reports and two case series. The review concluded that in adults with incarcerated groin hernias, hernioscopy is useful to assess bowel viability after spontaneous hernia reduction. Furthermore, hernioscopy lessened the need for exploratory laparoscopy. However, the conclusion must be interpreted cautiously because—in our opinion—the publication represents a narrative review based on the authors’ subjective analysis.

The current medical literature does not address the question posed in KQ21.q.

### Discussion

Although the evidence level is only moderate, the recommendation received a strong (upgraded) rating based on expert opinion and judgment.
References mendeley


44. Patel J a., Kaufman AS, Howard RS, Rodriguez CJ, Jessie EM. Risk factors for urinary


Berney CR. The Endoloop technique for the primary closure of direct inguinal hernia


123. Lau H, Lee F. A prospective endoscopic study of retropubic vascular anatomy in 121 patients undergoing endoscopic extraperitoneal inguinal hernioplasty. *Surg Endosc Other*


133. Withers L, Rogers A. A spiral tack as a lead point for volvulus. *JSLS.* 2006;10(2):247-249.


Avsar FM, Sahin M, Arikan BU, Avsar a F, Demirci S, Elhan A. The possibility of nervus ilioinguinalis and nervus iliohypogastricus injury in lower abdominal incisions and effects...


277. Kim D, Murovic J, Tiel R, Kline D. Surgical management of 33 ilioinguinal and


