

# EDUCATIONAL REVIEW ARTICLE

## Laparoscopic Hernia Repair

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### Abstract

The laparoscope was first invented in the early 20th century. The first laparoscopic hernia repair was in 1990. Despite almost 20 years of laparoscopic hernia repair experience, open hernia surgery remains the main stay of hernia surgery today. This review looks at current evidence and guidelines on the use of laparoscopic hernia repair surgery.

### Introduction

Laparoscopic surgery has become one of the most innovative aspects of general surgery. Since its invention in the early 20th century, laparoscopic surgery has replaced many open procedures and represents a continually developing speciality. Although it is difficult to determine who first used the laparoscope in a patient, Georg Kellig, a Dresden physician was the first to report experimental work in dogs.<sup>1</sup> It is generally thought that the first laparoscopic procedure in humans was performed by Hans Christian Jacobaeus of Sweden. Jacobaeus reported this in 1910 in the *Münchener Medizinische Wochenschrift* (Munich Medical Weekly) under the title "Ueber die Möglichkeit der Zystoskopie bei Untersuchung seröser Höhlungen anzuwenden."<sup>2</sup> (The feasibility of inspection of serous cavities by cystoscope). This claim was later disputed by Kellig.<sup>1</sup> In the intervening years, the laparoscope and laparoscopic surgical instruments have undergone many modifications to become a powerful diagnostic and therapeutic tool in many surgical specialities. Since 1990, laparoscopic hernia surgery has become more common but its role is still debated.

A hernia is defined as the protrusion of an organ or tissue outwith its normal body cavity, but the hernial sac takes with it all the usual linings of that cavity. Hernias of the anterolateral abdominal wall are common; the lifetime risk of developing an inguinal hernia is 27% for men and 3% for women.<sup>3</sup> The potential complications of hernias are serious and real. A retrospective study of the natural history of groin hernias estimated that 2.8% of inguinal hernias would strangulate at 3 months with this increasing to 4.5% after 2 years. In comparison, 22% of femoral hernias were found to strangulate at 3 months rising dramatically to 45% at 21 months.<sup>4</sup> Incisional hernias are also increasing in incidence, although the laparoscope has brought its own hernia, the port site hernia. Rarer types of hernias include spigelian hernias arising at the semi-lunar line of the lateral rectus abdominis, umbilical hernias, both congenital and acquired, epigastric hernias and para-stomal hernias. This review will consider the use of the laparoscope in the repair of the most common hernias of the antero-lateral abdominal wall.

### Laparoscopic Repair of Inguinal Hernia

In the United Kingdom, about 100,000 inguinal hernias are repaired every year amounting to an estimated cost of over £50 million.<sup>5</sup> Furthermore, hernia repairs approximate to over 80,000 consultation episodes, 100,000 bed days and 33,000 day cases per year in England and Wales alone.<sup>6</sup> Open repair of inguinal hernias was pioneered in the late 19th century using simple suture techniques, such as the Bassini method and the Shouldice repair. With the development of prosthetic meshes, the past decades have seen a plethora of procedures placing a variety of meshes in different anatomical planes using various methods of fixation. It was inevitable that a laparoscopic method would be pioneered and in 1990, the American surgeon Ralph Ger documented the placement of a mesh plug into an animal model of an inguinal hernia.<sup>7</sup> Currently, the two most commonly performed laparoscopic inguinal hernia repairs are the transabdominal preperitoneal repair (TAPP) and the totally extraperitoneal repair (TEP). The TAPP procedure approaches the surgical area by first entering the peritoneal cavity, whereas the TEP enters only the pre-peritoneal plane. Both procedures allow good visualisation of the whole of the groin region and thus identification of any direct, indirect or femoral hernia and indeed, obturator hernia. The aim of laparoscopic hernia surgery is the same as that for open surgery, namely reduction of the hernial sac and its contents followed by a tension free repair typically with a mesh. In laparoscopic inguinal hernia surgery, the typical mesh size is 10 by 15 cm, which will cover all the defects in the myopectineal region (this compares to the typical mesh size of 6 by 11 cm for open inguinal hernia surgery, which only covers the inguinal orifices). The mesh can then either be fixed with sutures or staples, or left to fix via granulation and tissue ingrowth into the mesh to form a scar plate.

An audit of Scottish surgeons performed between April 1998 and March 1999 found that 4% of inguinal hernia repairs were carried out with laparoscopic surgery, with the vast majority (84%) with open mesh, 11% with open non-mesh surgical procedures and 1% with the mesh placed in the pre-peritoneal space at open surgery.<sup>8,9</sup> The percentage of inguinal hernia repairs performed laparoscopically has risen little on a national scale since that study period. However, in 2006, 65% of all inguinal hernia repairs were performed laparoscopically in the Lothian region of Scotland. Furthermore, this percentage has been rising year on year. With such variation in practice both in the United Kingdom and worldwide it has become evident that the question of whether laparoscopic repair is superior to open repair should be answered. In 2001 the National Institute of Clinical Excellence (NICE) published guidelines appraising the use of laparoscopic surgery for repair of inguinal hernias.<sup>9</sup> Further revised guidelines were published in 2004.

The group responsible for the assessment report for these guidelines also published a Cochrane review in 2003 that analysed randomised controlled trials published up to 1999.<sup>10</sup> The NICE guidelines of 2004 recommend that "for the repair of primary inguinal hernia, open (mesh) should be the preferred surgical procedure" and that "laparoscopic surgery would be the preferred technique for the repair of recurrent hernias... and bilateral hernias...and should also be an option for primary repair of unilateral hernias". The 2004 NICE report summarised the results of the randomised trials between open and laparoscopic groin hernia surgery which demonstrated that the laparoscopic repair was associated with less acute pain and thus a quicker return to daily activities and work, less wound complications such as haematoma, seroma and infection and less risk of chronic pain. There was a similar recurrence rate (see below) and a similar risk of major vessel, bowel or bladder injury (except for a slightly higher risk for the TAPP repair). However, the laparoscopic repair took longer to perform and was a more expensive option. In view of the numbers of hernia repairs performed each year, the NICE report did not support primary unilateral hernia repair laparoscopically but acknowledged it was suitable as a first line operation, this recommendation being made purely as a result of the cost implication. However, for the patient and society, the price of an open operation is more acute and chronic pain, more time off work, and more wound complications! This cost-benefit analysis was elegantly examined in a systematic review of the effectiveness and economic value of laparoscopic repair funded by the Health Technology Assessment Programme, an advisory group to NICE.<sup>11</sup> This appraisal found that while unilateral hernia open flat mesh repair was the least costly option, it provided less quality-adjusted life years compared to both TAPP and TEP. Also laparoscopic repair for bilateral hernias reduces both operating time and convalescence period equating to a greater cost-effectiveness. In addition, repair of an occult hernia may also be performed enhancing the benefit of the procedure.

There are still outstanding issues which give rise to concern about the laparoscopic approach, namely the recurrence rate, and the time of surgery of laparoscopic versus open hernia surgery. These two issues will be discussed in turn.

A meta-analysis by Schmedt et al<sup>12</sup> suggested that laparoscopic repair may be associated with a higher recurrence rate but it must be considered that this meta-analysis were largely affected by a single randomised controlled trial of over two thousand patients.<sup>13</sup> The trial found a higher rate of recurrence with laparoscopic repair than after open repair of primary hernias (10.1 percent vs. 4.0 percent), but rates of recurrence after repair of recurrent hernias were similar in the two groups. Although this study recruited a large number of patients, the procedures were performed by over 100 different surgeons with different degrees of expertise. The paper itself concluded that there was no difference in recurrence rate when a 'highly-experienced' surgeon performed either laparoscopic or open repair (5.1% versus 4.1% respectively) and that the higher rates of total recurrence were accountable to the less-experienced surgeons. Furthermore, experienced surgeons performed all the analysed recurrent hernia repairs. Schmedt et al, when excluding this large trial from the other 33 randomised controlled trials found no significant difference in recurrences with laparoscopic repairs recurring at 5.5% versus 2.7% with an open repair.<sup>12</sup> A more recent randomised trial, with a median of 52 months follow up, showed no difference in the recurrence rate between open and laparoscopic mesh repair.<sup>14</sup>

Another key issue is the length of time to perform the operation. While the early trials of laparoscopic versus open hernia repair

reported a longer operating time for the laparoscopic repair<sup>10,11,12</sup> this is no longer true in experienced hands. Results from our own unit suggest that there is no difference in the time taken to perform an open repair compared to a laparoscopic repair.<sup>15</sup> This is despite the laparoscopic group having a higher percentage of bilateral and recurrent hernias which typically take longer to perform with either technique. Looking purely at a primary unilateral hernia, the operating time was 46 minutes +/- 17.4 and 53 minutes +/- 19.7 for laparoscopic and open procedures respectively. A recent randomised trial reported no operating time difference between the laparoscopic and open hernia surgery groups, with a median duration of 55 minutes in both groups.<sup>16</sup> However, the duration of operation in the laparoscopic group decreased continuously throughout the study with increasing experience of the surgeons, so that by the end of the trial period, laparoscopic repair was quicker than the open repair.

### To TAPP or to TEP?

A Cochrane collaboration published a meta-analysis in 2005 comparing TAPP and TEP repair. This collaboration reviewed published literature from 1990 to June 2003.<sup>17</sup> Only one small randomised controlled trial was identified which reported no difference in recurrence rates, duration of operation, haematoma formation, length of hospital stay or time to return to work or activity.<sup>18</sup> Eight non-randomised trials collectively suggested TAPP to be associated with higher rates of port-site hernias and visceral injuries though there was no difference in infection rates or vascular injury. In addition, there appeared to be a higher rate of conversion to open surgery in attempted TEP repair. The NICE committee in its 2004 guidelines "considered that current evidence did not suggest which of the two available laparoscopic methods should be preferred for routine surgery". With seemingly similar results and complications the choice between the two procedures should firmly be based on the surgeon's experience and preference. Revision of NICE guidelines are scheduled for 2007 but doubt remains over the adherence to such guidelines by clinicians.<sup>19</sup> This seems only natural given that the art of surgery varies greatly with operator style, experience and resources.

Are there any disadvantages to laparoscopic inguinal hernia surgery? Current laparoscopic hernia surgery requires a general anaesthetic while many open hernias can be performed under local anaesthetic (although the majority of open hernia operations are still performed under general anaesthetic in Scotland). Relative contra-indications to laparoscopic inguinal hernia surgery are previous laparoscopic repair, previous lower abdominal surgery and large inguino-scrotal hernias. The learning curve for the operation varies between 60 to 100 cases, well within the reach of modern day surgical trainees training in units who perform such surgery on a regular basis. The learning curve for a consultant surgeon teaching himself is around 250 cases, accounting for much of the delay in rolling out this type of surgery in the Western world.

### Laparoscopic Repair of Femoral Hernia

Femoral hernias possess the greatest potential for bowel incarceration and strangulation out of all the common abdominal wall hernias. Perhaps part of this problem arises as femoral hernias are often difficult to diagnose prior to incarceration.<sup>20</sup> In a large American series of 180 femoral hernia repairs, 100 (56%) of the repairs were performed as emergencies due to small bowel obstruction.<sup>21</sup> A Scottish report of 44 cases over a ten-year period documented a mortality rate

of 5% in those requiring emergency surgery.<sup>22</sup> This figure appears to be consistent with more recent data collected from the Scottish Audit of Surgical Mortality between the years of 1994 to 1997 identifying a 3.1% mortality rate. Thirty seven deaths were reported occurring in 1184 operations in women undergoing femoral hernia operations, with 59% of these operations performed as emergencies.<sup>23</sup> The largest published series of femoral hernia repairs comes from the Swedish Hernia Register, reporting 2927 repairs of which 1068 (36.5%) were repaired at an emergency operation. In this series, femoral hernia repairs accounted for 1.1% of all groin hernia operations in men and 22.4% of operations in women, a reflection of their natural higher incidence in women.<sup>24</sup>

Although laparoscopic repairs of inguinal hernias are well reported, the repair of femoral hernias by laparoscopic techniques is not. Our own unit has successfully used the TEP repair for femoral hernias including those that were clinically irreducible. Of these fifteen repairs only one recurred (7%) in the follow up period.<sup>25</sup> A larger series of 51 repairs found no recurrences at one-year follow up, although complications of haematoma, port site infection, nerve irritation and ileus were documented.<sup>26</sup> There are currently no published randomised controlled trials of laparoscopic versus open femoral hernia repair.

## Laparoscopic Repair of Incisional and Other Ventral Hernias

Incisional hernias arise following surgery through the anterolateral abdominal wall and it is estimated that 10-15% of laparotomy incisions eventually develop an incisional hernia. Wound infection complicating healing of the laparotomy wound is the main risk factor for development of an incisional hernia.<sup>27</sup>

Various open methods exist to repair incisional hernias and the majority of techniques involve the use of mesh. However, mesh does not abolish hernia recurrence. The ten-year follow-up from a randomised controlled trial of open incisional hernia repair showed that mesh halved the recurrence rate from 63% with suture repair to 32% with mesh repair.<sup>28</sup> The laparoscopic repair was first described in 1993 with placement of a mesh within the peritoneal cavity, which was fixed to the anterior wall with staples.<sup>29</sup> Laparoscopic repair is possible even with incarcerated bowel, but strangulation, especially when the colon is involved, requires conversion to an open procedure as the mesh infection rate is unacceptably high in such patients. Comparison between laparoscopic and open repair methods for incisional hernias is difficult as reported studies have grouped incisional hernias with other ventral hernias. Nevertheless, such studies have found similar findings to that of laparoscopic inguinal repair, namely, lower complication rates, shorter length of hospital stay, quicker return to work with similar recurrence rates although operative times were found to be longer in the laparoscopic group as compared to open repair.<sup>30,31</sup> More recent studies of laparoscopic ventral hernia repair have found shorter operative times compared to open repairs, perhaps reflecting increasing surgical experience within centres worldwide.<sup>32,33</sup> The most frequent complications following open repair are bowel obstruction, ileus, wound seroma and wound infections compared to laparoscopic repair where only ileus and seroma occur at a significant rate. The only published randomised controlled trial of incisional hernia repair to date confirms the findings of previous retrospective series. In this study of 170 patients randomised to laparoscopic or open repair, the laparoscopic group had a shorter operative time, a shorter period of hospital admission, fewer wound

infections and a faster return to work.<sup>33</sup> A number of randomised trials comparing open to laparoscopic incisional hernia in Europe and North America are ongoing.

The use of laparoscopic repair of incisional hernias has been shown to be cost-effective despite increased direct operative costs, mainly due to the reduced wound complications and shorter hospital stay. Indeed, laparoscopic incisional hernia repair in some patients is possible within a day-case unit, and the majority within a 23 hour unit.<sup>34,35</sup>

The main caveat to laparoscopic incisional hernia surgery is the size of the hernia. Laparoscopic incisional hernia surgery places a mesh with good overlap over the hernial defect but does not approximate the fascial edges. Thus, in patients with larger hernias, the repair patches what is present rather than restoring the original muscle alignment, so the cosmetic outcome in larger hernias may not be as good as for open surgery. At open surgery, not only can muscle re-approximation occur but also an abdominoplasty can be performed at the same time.

## Emergency Hernia Repair

Emergency hernia surgery remains a common general surgical emergency, with a relatively high morbidity and mortality rate, as compared to elective hernia surgery. Analysis of thirteen years of the Swedish Hernia Registry amounting to over 100,000 hernia repairs found that the mortality risk for any groin hernia repair was increased 7-fold in men and women when performed as an emergency operation. Furthermore, the risk of mortality was increased 20-fold if a bowel resection was undertaken.<sup>24</sup> The overall standardised mortality ratio was 1.4 for men and 4.2 for women, reflecting a greater proportion of emergency operations in women, which were largely femoral in nature. Surprisingly age did not correlate with a worse outcome.

A number of centres have reported small series of emergency laparoscopic groin hernia repairs at international hernia conferences. The data are small, but the consensus is that such surgery is possible and safe, and appears to reduce both the number of wound complications and chest infections in this high risk group. The treatment strategy is laparoscopy first with reduction of the hernial sac contents and inspection of their viability. Sometimes the hernia reduces on induction of anaesthesia and laparoscopy allows inspection of the reduced bowel to ensure viability. Any free fluid is aspirated and the abdominal cavity lavaged. If the hernial sac contents are viable, then groin hernia repair is performed either by the TAPP or TEP technique. If bowel is non viable, then surgical resection of the infarcted bowel is performed either by open or laparoscopic surgery depending on the expertise of the surgical team. The hernia is repaired two to six weeks later by a TEP approach depending on the recovery of the patient.

Emergency laparoscopic repair of incisional and other ventral hernias has also been presented but the role of this in minimising morbidity and mortality is less clear than for groin hernia.

## Conclusions

We are approaching twenty years of clinical experience and scientific research with laparoscopic surgery and much has changed in this time. Laparoscopic hernia surgery is quickly becoming more than just an 'interest' of a general surgeon but a sub-speciality within general surgery itself. Given the high success rates achievable by a skilled surgeon, and the high levels of patient satisfaction, minimally invasive surgery is likely

to become the patient's procedure of choice. However, given the resource restraints of the NHS and the level of training required, it is perhaps not surprising that laparoscopic hernia repair is not widely utilised in Scotland or indeed the UK, remaining nationally in single figures as a percentage of the total number of hernia operations. Nevertheless, with the constant technological advances in minimally invasive surgery and suitability for day-case surgery, laparoscopic repair of the majority of abdominal wall hernias will become the gold standard procedure as current general surgical trainees are trained in these procedures, widening the surgical expertise from the early laparoscopic hernia repair pioneers.

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