Hunterian lecture

Laparoscopic transabdominal pre-peritoneal (TAPP) repair of groin hernia: one surgeon's experience of a developing technique

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Some 120,000 new cases of groin hernia are diagnosed each year in England, of which approximately 80,000 are referred to hospital for surgical repair. Around 40,000 trusses are sold annually, a number being worn by patients awaiting surgery. Bassini, one of the first to take advantage of the then modern developments of anaesthesia and asepsis, put hernia repair on a sound anatomical and scientific basis. He opened the inguinal canal, resected the hernial sac, and proceeded to complete anatomical reconstruction, particularly of the posterior wall. The results were then observed by follow-up, and recurrences recorded – the introduction to surgery of quality control and audit. In time, in the hands of experienced surgeons, the Shouldice¹ and Lichtenstein² repairs achieved excellence, and low recurrence rates. These methods all involved an anterior approach. Ger³ first reported the laparoscopic closure of a hernial sac using a clip. Subsequently, a number of laparoscopic operations were described, but most proved unsatisfactory when subjected to anatomical and scientific analysis. Today, the transabdominal pre-peritoneal (TAPP) and totally extraperitoneal (TEP) methods survive. Using a minimally invasive approach, both encompass techniques used in the extraperitoneal or pre-peritoneal open repair of groin hernias, as described by Stoppa⁴ and others. Using this approach, these workers recorded low recurrence rates for complicated hernias.

Since 1992, the author has performed some 2600 TAPP repairs on more than 1900 patients. During the first 5 years, the technique underwent many changes in response to

observed complications and advances in technology, only becoming standardised in 1997.

Methods

Under general anaesthesia, with the patient in a 15° Trendelenburg position, and arms to the side, a standard procedure is done.^{5,6} Direct and small indirect sacs are reduced, while large sacs are amputated at their neck, leaving the distal part *in situ*. Having developed a large pre-peritoneal pocket, a 15 × 10 cm mesh is inserted and placed so that the medial border is at the symphysis pubis and the inferior border 5 cm posterior to the internal ring. The meshes are fixed by stapling to Cooper's ligament, the periosteum over the symphysis pubis, the rectus abdominus muscle, and laterally anterior to the iliopubic tract. The peritoneum is then closed meticulously by stapling or suture. With bilateral hernias, a second mesh is used.

Complications

With experience, complications have diminished, and in some cases have been almost eliminated.

By trans-illuminating the abdominal wall and mapping the vessels, the placement of the lateral cannulae in avascular areas is achieved. Gross abdominal wall bruising, which occurred 7 times in the first 140 patients, is no longer encountered. By transecting large inguino-scrotal sacs at

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their necks, scrotal bruising is lessened. When present, especially in the elderly, many patients have been found to be taking prophylactic aspirin. By developing large pre-peritoneal pockets, and placing no fixation either in or posterior to the ilio-pubic tract, meralgia paraesthetica is rarely seen. Failure of the groin peritoneal closure can lead to intestinal obstruction (overall incidence 0.19%). In the last 1300 repairs, retention of urine in one patient tore the peritoneal closure and, on bladder decompression, caused intestinal obstruction.

In the young, with strong abdominal musculature, or in patients with previous abdominal surgery, where there is increased risk of visceral injury, safe entry to the peritoneal cavity can be achieved by use of an optical trocar (Visiport [Tyco] or Optiview [Ethicon Endo-surgery]).

In 1992, when re-usable cannulae with pyramidal trochars were used, the incidence of port site hernia was 7.7%. With the introduction of disposable cannulae, and subsequently dilating tip cannulae (Ethicon Endo-surgery) together with an improved closure technique, the incidence of this complication has fallen to less than 1%.

Some 11% of patients suffered sac seromas. These varied from 1.5 cm to occasionally 12 cm in size. Nearly all absorbed spontaneously within 2–3 months, aspiration only rarely being indicated.

Of patients undergoing ambulatory surgery, 1% were admitted with urinary retention. Early postoperative mobilization and encouragement to micturate diminished this problem.

Early in the series, when 6 × 5 cm mesh was used, the recurrence rate after repair was an unacceptable 9%. With improvement in surgical technique, and increase in mesh size to 11 × 6 cm, this fell to 2.9%. Since 1996, when the mesh used was 15 × 10 cm or more, the recurrence rate has been less than 1%.

Day-case surgery

Between 1992–1994, some 300 TAPP repairs were performed on in-patients. In 1994, with the opening of a dedicated day surgical unit, ambulatory surgery began. From 1994 to 2000, 769 patients were treated (Tables 1 & 2). In the first year, observing The Royal College of Surgeons of England guidelines,⁷ 54% of all patients under the author's care had day-case surgery and only 3% of patients required postoperative admission. Resulting from the success of treatment and pressure on in-patient beds, the criteria for selection were widened. Patients over 70 years were included, providing they were fit (American Society of Anesthesiologists [ASA] grading 1–2) and had suitable social conditions. In 1999–2000, 75% of all patients were treated as day cases, and 5% required postoperative admission. In those over 70 years, 13% (which equated to 3–4 patients a year) were admitted.

A total of 3–5 patients were treated in each operating session, and 3–9 repairs done. Mean operating times (skin incision to final stitch) were 25 min for a unilateral hernia (range, 15–75 min), and 38 min for bilateral hernia (range, 20–60 min). Three (0.4%) patients required conversion to open operation – 2 for irreducible inguino-scrotal hernia, and 1 for extensive pelvic adhesions. A total of 218 patients had bilateral repairs, of whom 103 had a pre-operative diagnosis, and 115 were found at operation to have an incidental defect.

Of the patients, 730 (95%) were discharged on the day of surgery, and 43% after leaving hospital took no analgesia. Of the 39 patients admitted to hospital, mainly for medical conditions or nausea, vomiting and non-specific reasons, 34 were discharged the next day. Three patients were admitted following conversion to open operation, and 1, early in the series, following a mini-laparotomy for an omental bleed, which subsequently could have been controlled laparoscopically. Five patients were re-admitted more than 48 h postoperatively – 2 with significant non-specific groin pain, which settled spontaneously, and 3 with small bowel obstruction. Two cases occurred early in the series, while the third followed acute urinary retention treated by catheterization. All were treated laparoscopically, and discharged home within 48 h.

All patients had appointments to be seen at follow-up 2 weeks after operation. Some 80% of patients had no postoperative complications. Apart from the above, the remainder were mainly minor and transient, ranging from seroma (11%), and groin or port site haematoma or bruising (5%) to transient testicular pain. Eight patients had a recurrent hernia, of whom 5 had repairs with the smaller mesh prior to 1996, and 3 with the larger mesh. Of the latter, the primary defect in 1 patient was a large inguino-scrotal hernia. Prior to 1997, some 3% of patients

Table 1 Patients submitted to day-case TAPP repair June 1994 to April 2000

Patients	769 (737 males, 32 females)
Median age (years)	53
Age range (years)	17–86
Repairs	984 (218 bilateral)

Three patients were converted to open operation.

Table 2 Types of hernia in 766 patients

Indirect	519
Direct	401
Pantaloon	43
Femoral	19
Spigelian	2
Recurrent	66
Sliding	54

had port site hernias, but, following the introduction of dilating tip disposable trochars (Ethicon Endo-surgery), the incidence of this was much reduced (< 1%).

Whether or not to repair incidental defects was questionable, as the evidence showing progression of these to a hernia was lacking. Having adopted a policy early on to repair, records were examined to establish the incidence of these defects. A prospective randomised controlled trial was then established to determine whether, if left, these would progress to a symptomatic or clinical hernia.⁸ In this series of day-case hernia repairs, 146 (22%) patients with a pre-operative diagnosis of unilateral hernia, confirmed on examination immediately pre-operatively, were found to have incidental defects; of these, 21 were not repaired. At follow-up at 1 year and 2 years, 6 (29%) and 8 (38%), respectively, had developed a clinical hernia. On these findings, it was concluded that the incidence of incidental defects in patients with a unilateral hernia was greater than 1 to 5, and that they should be repaired.

Laparoscopic repair of recurrent inguinal hernias

Between June 1992 and December 1998, 1226 patients underwent TAPP repair. Of these, 140 (11%) were for recurrent hernia, the patients being operated on as both day cases (33%) and in-patients. These were reviewed by an independent observer, 1–8 years postoperatively. Twelve patients had died from unrelated causes, and 4 were untraceable. A total of 124 questionnaires were sent, enquiring whether the patient had a bulge in the groin, whether they were satisfied with the operation, and whether they would attend out-patients for review. There were 19 non-responders, and, unbeknown, 3 further patients had died. Of the responders, 16 requested no out-patient appointment. Of 86 patients sent clinic appointments, 57 attended. Of these, 46 (81 %) had no symptoms or signs and 6 (10.5%) who had had open mesh repairs for their primary hernias had mild groin pain during activity. None had significant pain requiring analgesia or preventing activities. Three (5%) patients operated on pre-1996, when smaller meshes were used, had a recurrent inguinal hernia, and 2 (3.5%) had an asymptomatic port site hernia (operation pre-1997). To the question 'any bulge in your groin?', 44 (77%) answered 'no'. This was confirmed on examination. In those answering 'yes', there was 1 recurrent hernia; in those unsure, there were 2. The negative predictive value of a 'no' response for detecting inguinal hernia recurrence was 100%. Of the 48 questionnaire responders not seen in the clinic, 42 (88%) reported no bulge in the groin. Four patients (3.8%) said they were unhappy with the TAPP repair.

In a study by Memon *et al.*,⁹ 10–36% of patients having open repairs of recurrent hernias were reported to have

had a re-recurrence. In this series, 3 (5%) patients in whom the recurrent hernia was repaired with the smaller mesh had a re-recurrence, and this compares with other reported TAPP series. The incidence of chronic groin pain, usually neuropathic, requiring analgesia or interfering with activities after open primary hernia repair is variously reported as 3–5%. Following open repair of recurrent groin hernia, the incidence was 4-fold (> 14%).^{10,11} None of the 57 patients reviewed following TAPP repairs had chronic pain requiring analgesia or interfering with activities.

Sports hernia

Sports hernia accounts for 2% of time lost from sport, and, in particular, professional football.¹² Between 1993 and 2001, the author treated some 300 patients. The onset of symptoms was chronic and insidious in 85%. Typically, the symptoms are worse towards the end of exercise as the athlete tires. Pain situated in the lower abdomen or groin above the inguinal ligament may radiate to the contralateral side, into the scrotum, the perineum or medial aspect of the thigh. It is usually worse after exercise, and felt on coughing (75%), sneezing (64%), and turning in bed (55%). In footballers, 32% felt pain when kicking. With rest, the pain usually settled, only to return on resumption of exercise. With continuing exercise, the onset of symptoms advances, and the severity of the pain increases, causing footballers to be substituted.

On examination, the hernial orifices are normal, as, in the absence of a compensatory injury and when tested against resistance, are the adductors. Palpation of the pubic rami is normal. The direct stress examination is almost invariably positive. This is elicited by asking the athlete, when lying down, to raise both ankles simultaneously 15 cm off the couch. The groin is then palpated firmly, above and lateral to the pubic tubercle and lateral to the edge of the easily palpable rectus abdominus muscle. Pressure in a symptomatic groin produces pain and discomfort. The diagnosis of sports hernia is based on the symptoms and physical findings. Herniography, which is rarely done other than in Scandinavia, is the only reliable form of investigation. Ekberg *et al.*¹³ reported 16 out of 17 athletes with a positive X-ray cured by herniorrhaphy. Smedberg and co-workers¹⁴ X-rayed 78 athletes with 101 painful groins. Not only was there a hernia present in 84% of symptomatic groins, but also in 49% of asymptomatic groins. Gilmore¹⁵ described a tear in the aponeurosis of the external oblique and conjoint tendon, with a dehiscence between the inguinal ligament and conjoint tendon. Specifically, he excluded a hernia. Several groups^{16–18} have performed open operations for sportsman's groin and recorded cure

Table 3 Sports hernia findings

Sportsmen	287
Mean age (years)	24.4
Age range (years)	15–47
Total hernias	448
Sports hernia (direct defect)	418
Indirect sacs	16
Pantaloons defects	8
Lipomas of cord	7

Includes 1 patient with a direct defect and lipoma of cord.

rates of 87–100%. All reported a posterior wall bulge, consistent with an incipient direct hernia.

In my own series (Table 3), 287 sportsmen have undergone a standard TAPP repair, the mesh being stapled in all but 6, with the groin peritoneum in all being closed by suture. In 161 patients, the repair was bilateral, of whom 69 (24%) had a symptomatic and 89 (31%) an asymptomatic groin. In 3 patients, there was no hernia, but a lipoma of the cord. Complications were few, and most occurred early in the series. One patient required conversion to open operation because of vascular damage. Another patient had a further laparoscopy and mini-laparotomy for sepsis, no obvious cause being found. Two had open surgery for further groin pain at a local hospital. Rehabilitation began on day 5, and escalated so that, providing there were no adverse reactions, sportsmen returned to full activities and playing after 14 days. Review after treatment of 192 patients revealed that 80% were playing at 3 weeks, and 90% at 4 weeks. Of this group of patients, 22 had further groin pain. In all, the direct stress examination was negative. One patient had open surgery for symphysis pubis instability, while 18 were diagnosed as having osteitis pubis or adductor problems. These responded to treatment by rest or injection. Longer term follow-up from 3 months to 4 years postoperatively was done on 192 sportsmen by telephone interview with the sportsman or sports physiotherapist. Details were available on 176 (92%), while 11 had retired from sport, and 5, being abroad, were untraceable. Of those responding, 174 were symptom free, and 2 had minor groin pain, not preventing sport.

To date, 8 patients have required a further laparoscopic groin procedure. Recurrence, where the mesh was fixed, occurred in 2, and in 2 out of 6 patients where the mesh was not fixed. Two of the first 8 patients, when only the symptomatic groin was treated, quickly returned for operation to the contralateral groin. In 2 patients, a contralateral defect medial to the umbilical ligament was missed at the first operation. Re-assessment of patients was greatly facilitated by keeping throughout video records of all procedures done.

Discussion

During the last 100 years, there have been two Hunterian lectures on hernia repair, delivered by Wakeley and Glassow.^{1,19} Both employed an anterior approach, the former doing a modified Bassini operation, and the latter the Shouldice procedure. Wakeley, with patients staying in bed for 2 weeks postoperatively and returning to full lifting at 6 months, reported a recurrence rate of 5.4% for primary hernia repair, and a re-recurrence rate following repair of recurrent hernia of 38%. Glassow, in a personal series of more than 20,000 repairs, containing more than 2000 recurrent hernias, had a recurrence rate of < 1% for primary hernias and a re-recurrence rate of 3.1%. The posterior approach has long been described, but Stoppa and his team in Amiens⁴ were the first to describe placing prosthetic mesh between the fascia transversalis and the peritoneum. Using this method for complicated and recurrent hernias, three different authors^{4,20,21} reported recurrence rates of 1.7–2.5%. Most occurred in the first year after operation, and were related to sepsis or technical mistakes by surgeons early in their learning curve. While reporting recurrence rates, few authors have recorded other sequelae, such as long-term chronic groin pain.

Surgeons turning to minimally invasive repair in the main failed early on to learn from the Amiens experience, fully dissecting inguino-scrotal sacs with resultant scrotal bruising, inadequately developing preperitoneal pockets, and using too small a mesh. Complication and recurrence rates were unacceptably high. There was a steep learning curve, the length of which was not appreciated by all. Because of inherent risks of visceral and vascular injury, many surgeons switched from the TAPP to TEP procedure. However, with increased surgical experience and improved technology, for example the 3-chip camera, optical trocars, and dilating tip trocars, the safety of the TAPP procedure has improved so that the incidence of major complications is now negligible. The TAPP operation is easier to learn and master, and does not suffer the same risks of preperitoneal bleeding and oozing as can be seen in the TEP procedure. Furthermore, the assessment of both groins, particularly regarding incidental defects, is easier.⁸ During the time that it was policy to repair incidental defects, there being a greater than 1 in 5 incidence in patients with unilateral hernia, only two patients returned subsequently with a contralateral hernia. In one, the operation note contained the comment 'incidental defect, too small to repair'. With improved surgical skills, operations were done as quickly, if not faster, for unilateral repairs and certainly faster for repair of bilateral or recurrent hernias. In spite of the operations being done under general anaesthesia, 75% of patients were suitable for ambulatory treatment and 95% were

discharged the same day. As with other authors, there was a quick return postoperatively to full activities and low analgesia requirements.²²⁻²⁶ Postoperative complications were, in the main, minor and transient, and compared favourably with those seen after open operation and community-based studies.²⁷ No patient suffered a mesh infection or allergy. Re-recurrence rates after repair of recurrent hernias were low. While 1 in 7 patients after open operation for recurrent hernia have suffered moderate or severe long-term chronic groin pain, this has not been apparent after laparoscopic repair.

In many patients, the diagnosis of sports hernia was long delayed. With rest, the symptoms and signs settled only to return on resumption of activity. Laparoscopic appearances would suggest repetitive injury resulting from raised intra-abdominal pressure. A number of patients doing heavy jobs were referred with groin strain. In many, the diagnosis of sports hernia was made. All were cured by laparoscopic repair. The TAPP approach allows inspection of both groins, and identification of asymptomatic defects. The incidence of these mirrors the findings on herniography.¹⁴ With simultaneous repair, the likelihood of further hernia problems is minimal, a finding very different from open operation. A rapid return to full sporting activity, usually less than half the time following open operation, benefits both the athlete and the sport.

Conclusions

In 120 years, hernia repair has come a long way. Most surgeons in time have used the anterior approach, exploiting an intimate knowledge of anatomy in the true Hunterian tradition, and being meticulous with their surgical technique in re-fashioning and repairing the abdominal wall. The best have achieved recurrence rates of less than 1%.^{1,2} However, with recurrent hernia, there is a recurrence rate of 1 in 20, and long-term 1 in 7 will have moderate-to-severe chronic groin pain.^{10,11} With the posterior approach, a safety curtain is placed between the peritoneum and the muscles of the abdominal wall. Minimal access surgery with the absence of incisions and the inherent risks thereof has allowed this approach to be exploited. Knowledge of anatomy has lessened post-operative problems. With the honing of surgical skills and evolving technology, a safe, sound, lasting, and pain-free repair is possible, and is suitable for the treatment of most patients. Exceptions include patients with gross cardio-respiratory disease (ASA grade IV), previous distal colorectal surgery, and strangulated and irreducible hernias. It is ideal for the treatment of bilateral and recurrent hernias. It appears indicated for the repair of unilateral hernias, when incidental defects can be identified and repaired, thus lessening the need for further groin surgery. While

operative costs may be higher, community costs, with patients able to return to their desks after 4 days and to heavy jobs at 10 days, are lower. The remote possibility of a major complication remains, but complications are usually few, minor and transient.

Specialist surgeons continue to out-perform generalists, and surgical skills continue to advance and adapt to technical advances. For the benefit of the patient, words first expressed by Wakeley¹⁹ 60 years ago, and re-iterated some 20 years ago by Glassow,¹ remain pertinent today. He said:

That so little interest is taken in the care of a hernia is a pity. The various operations are usually regarded as of minor importance, and to be undertaken by house surgeons, being beneath the dignity of a surgeon. A surgeon can do more for the community by operating on hernia cases, and seeing that his recurrence rate is lower, than he can by operating on cases of malignant disease!

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